ORIGIN and SPREAD of MICROBLADE TECHNOLOGY in NORTHERN ASIA and NORTH AMERICA

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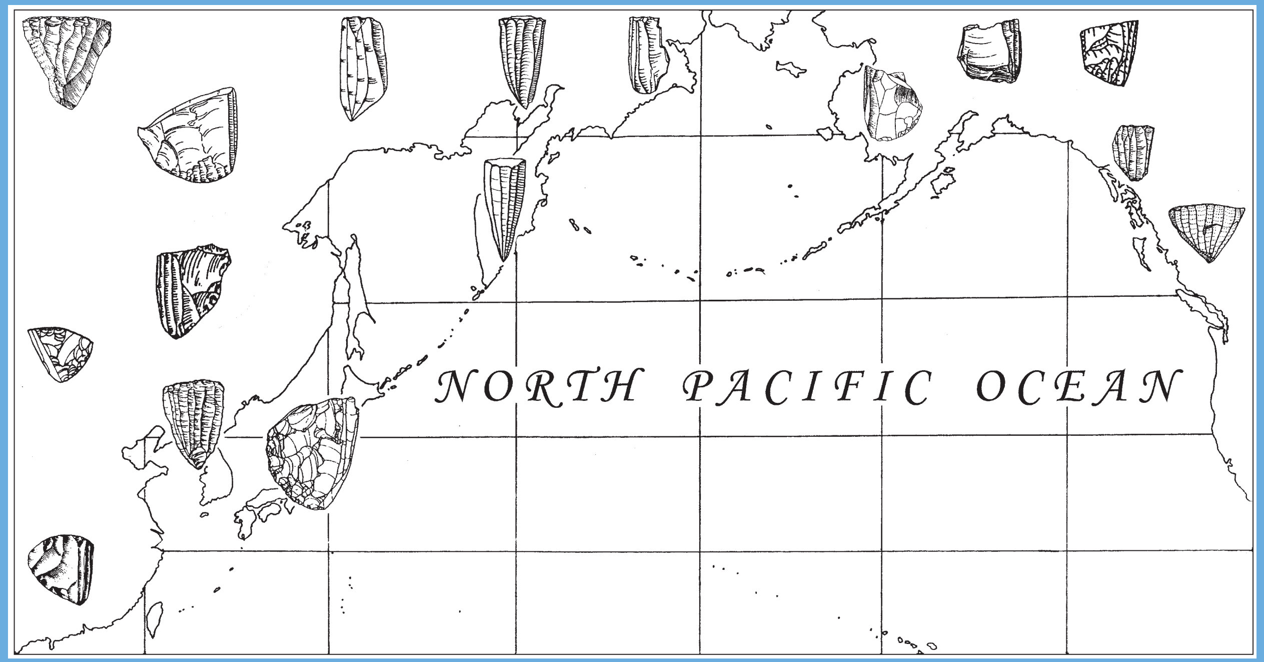

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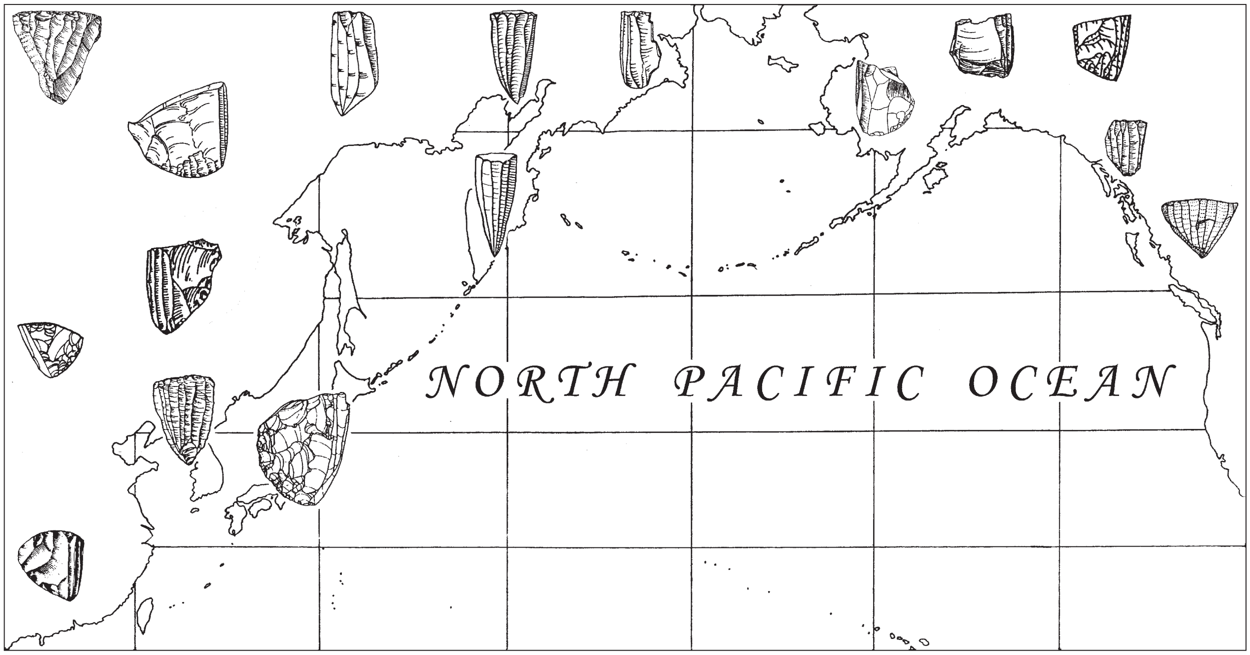

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**This Volume is
Dedicated to
Pioneering Microblade
Researcher**

Richard G. Morlan

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Radiocarbon dates are not exactly equivalent with calendar dates. Radiocarbon dates can be corrected to more closely match calendar dates using the tree-ring and marine data sets developed by Reimer et al. (2004). In this volume some authors have used calibrated dates and some have used uncalibrated dates.

In order to understand the calibrated age of uncalibrated ^{14}C dates of 21,000 BP and younger, calibrated dates rounded off to the nearest century have been presented in the Table below. All dates are given in cal BP (calendar years before the present) meaning before AD 1950. There is no reliable calibration of ^{14}C dates older than about 21,400 BP, as published before the mid-2007.

Radiocarbon Age	**Calibrated Age**	**Radiocarbon Age**	**Calibrated Age**
1000 BP	900 cal BP	11,000 BP	12,900 cal BP
2000 BP	1900 cal BP	12,000 BP	13,800 cal BP
3000 BP	3200 cal BP	13,000 BP	15,400 cal BP
4000 BP	4400 cal BP	14,000 BP	16,700 cal BP
5000 BP	5700 cal BP	15,000 BP	18,300 cal BP
6000 BP	6800 cal BP	16,000 BP	19,200 cal BP
7000 BP	7900 cal BP	17,000 BP	20,100 cal BP
8000 BP	9000 cal BP	18,000 BP	21,300 cal BP
9000 BP	10,200 cal BP	19,000 BP	22,500 cal BP
10,000 BP	11,500 cal BP	20,000 BP	23,900 cal BP
		21,000 BP	25,400 cal BP

Calibrated ages based on Reimer, P.J., M.G.L. Baillie, E. Bard, A. Bayliss, J.W. Beck, C.J.H. Bertrand, P.G. Blackwell, C.E. Buck, G.S. Burr, K.B. Cutler, P.E. Damon, R.L. Edwards, R.G. Fairbanks, M. Friedrich, T.P. Guilderson, A.G. Hogg, K.A. Hughen, B. Kromer, G. McCormac, S. Manning, C. Bronk Ramsey, R.W. Reimer, S. Remmele, J.R. Southon, M. Stuiver, S. Talamo, F.W. Taylor, J. van der Plicht, C.E. Weyhenmeyer. 2004. IntCal04 Terrestrial Radiocarbon Age Calibration, 0–26 Cal Kyr BP. *Radiocarbon* 46:1029–1058.

FOREWORD

Many years have passed and much new information has been recovered since 1952 when I first encountered microblade technology. I was part of a group of students working for the University of British Columbia under the direction of Dr. Charles E. Borden in the soon to be flooded reservoir for the Alcan power plant in the remote wilderness of Tweedsmuir Park in central British Columbia. We were excavating a house site (FaSu–19) on Natalkuz Lake and found a number of small obsidian blades that we called lamellar flakes. Upon further excavation we found a conical obsidian core in the central firepit of the house that was later radiocarbon dated to about 2400 BP. Borden, who had worked on Hamburgian sites in Germany as a high school student, and had excavated similar blades but no cores from sites near the mouth of the Fraser River, recognized these flakes and the core as products of a prepared core and blade technology now referred to universally as a microblade industry. This experience enabled me, while analyzing artifact assemblages from sites in the San Juan Islands in adjacent Washington State a year later, to recognize not only obsidian microblades, but microblades and cores of quartz crystal like those, as I learned later, are also found in the Dorset culture far away in the eastern Arctic. Microblades soon began to show up in many coastal and interior sites in British Columbia and Washington.

For many years following N.C. Nelson's 1937 initial identification of a microblade industry in Alaska and his comparison with similar artifacts from the Gobi Desert, there remained great gaps in the known occurrence of this technology. The main reason was that little archaeology had been undertaken in intermediate regions. These gaps have gradually been filled. Several years ago Yuri A. Mochanov, while showing me his field notebook, relived the great excitement he experienced when he discovered the first "Gobi" core in the Soviet Far East that eventually led to his formulation of the Dyuktai culture that occupies much of the region between the Gobi Desert and Alaska. The archaeology explosion throughout the north in both Asia and America in the 1960s and 1970s soon revealed the microblade industry as the dominant lithic technology at or near the bottom of the cultural sequence in previously glaciated regions from Norway through Siberia, Alaska, and the Canadian Arctic, and even earlier in Japan, Korea, and northern China. It was clearly part of the microlithic revolution that began in the late Palaeolithic and typifies the Mesolithic in much of the world. J. Louis Giddings' 1967 *Ancient Men of the Arctic* brought together much of the Arctic material, and in 1969 Charles Borden in *Early Population movements from Asia into western North America* worked out the time transgressive distribution of microblade technology from Healy Lake in Alaska south to the Fraser delta in British Columbia. Richard E. Morlan's studies of microblade technology in both Japan and Canada and Chester E. Chard's 1974 *Northeast Asia in Prehistory* brought the Japanese and Siberian data to the attention of North American archaeologists, and various formulations of a microblade tradition stretching from Siberia to Alaska and thence south as far as the lower Columbia River in Washington were published. Attempts at correlation with ethnic and environmental variables were also attempted of which Donald E. Dumond's suggested introduction of microblade technology into North America by the ancestors of the Na-Dene speakers remains the most widely accepted. The use of microblades as inserts in slotted bone points is well attested to in both Alaska and Siberia, and their use as knives in wooden hafts is demonstrated by Dale Croes' discoveries at the Hoko River waterlogged site on the coast of Washington. Attempts at correlation of microblade distributions with environmental variables such as temperature or ranges of certain animal species have been tried, but none have proven particularly convincing.

It is gratifying to see the continued interest in microblade technology in all its aspects by the younger generation of scholars who have authored most of the papers in this volume. Knowledge of microblade industries in both Northeast Asia and northwestern North America is brought up to date and questions regarding origins, ethnic identification, production techniques, use, and other issues of interest to the cultural historian are highlighted. Archaeology Press is very pleased to make these studies available. The decision of the volume editors to dedicate this monograph to the late Dick Morlan of the Archaeological Survey of Canada is very appropriate in view of his pioneering influential classification and study of microblade technology.

Roy L. Carlson
Professor Emeritus
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1 INTRODUCTION: MICROBLADES AND BEYOND

Yaroslav V. Kuzmin, Susan G. Keates, and Chen Shen

"EVERY LITTLE THING"

[The Beatles, *"Every Little Thing",* **from the album** *"Beatles for Sale"* **(1964)]**

The topic of this volume is primarily the origin of microblade technology in the Northern Hemisphere, based on the results of recent studies conducted in the 1990s and early 2000s. These 'little things' called microblades made human adaptation to the temperate, subarctic, and arctic environments of Siberia, East Asia, and northernmost North America very successful. As was suggested by Butzer (1991), the emergence of microblade technology in Asia was directly connected with an increase in site frequency ("site visibility") that is a function of population size. It was stated: "In northeast Siberia (mainly cave sites) and Japan (mainly buried, alluvial sites), a rapid increase in visibility was delayed until the appearance of micro-blades and pressure flaking after 14,000 BP… in any event, site visibility, as inferred from site number and assemblage size, increased with the establishment of the "developed micro-blade tradition" about 13,500 BP" (Butzer 1991:144). New data presented in this volume demonstrates that although this idea remains valid, there is one exception – the beginning of human population rise and "site visibility" in Siberia can now be dated to at least c. 35,000 BP, and it generally coincides with the earliest evidence of microblade manufacture (Kuzmin and Keates 2005:785).

Upper Palaeolithic complexes with microblades are widely distributed in Northern Asia, including the western and central parts of Siberia (e.g., Vasil'ev 1993, 2001); Northeastern Siberia and the Russian Far East, such as Yakutia (Mochanov and Fedoseeva 1984, 1996), the Kolyma and Indigirka rivers (Pitul'ko 2003; Slobodin 2001, 2006), Chukotka Peninsula (Kiryak 1996, 2005, 2006; Pitulko 2003; Slobodin 2001, 2006), Primorye Province (e.g., Vasilievsky 1996; Kuznetsov 1996), the Amur River basin (Derevianko 1996, 1998), and Sakhalin Island (Vasilevski 2003). Microblade technology is well represented in late Upper Palaeolithic assemblages of China and Korea (e.g., Chen 1984; Seong 1998), and especially of Japan (Tsutsumi 2003a, 2003b; Nakazawa *et al.* 2005). In the northernmost part of North America, microblades are common in Paleoindian and subsequent complexes of Alaska, the Yukon Territory, British Columbia, and the Northwest Territories (e.g., West 1996a; Yesner and Pearson 2002). Therefore, the problems of origin and diffusion of microblade technology are truly international and of hemispheric scale.

Only a few volumes have been published which concentrate on microblade technology and its spatial-temporal patterns. In 1993, a collection of papers, "The Origin and Dispersal of Microblade Industry in Northern Eurasia", originating from presentations at an international conference in 1992 in Sapporo (Japan), was published under the editorship of Hideaki Kimura. In 2002, a volume dealing with the microlithization of stone tools, "Thinking Small: Global Perspectives on Microlithization", put together and edited by Robert G. Elston and Steven L. Kuhn, was released. There was also an attempt to observe the typological, technological, and chronological patterns of the microblade complex on the continent-wide scale of Northern Asia (Ono *et al.* 1992:30–33). Generally speaking, the earliest firmly dated finds of microblades in Asia are thought to be as old as c. 25,000 BP. All the sources mentioned above summarize knowledge about microblade technology and its origin and spread in Eurasia and North America up to the early 1990s.

However, at that time some tentative data about much earlier microblade complexes in Siberia were released. Brief information on an assemblage with wedge-shaped cores from the Anui 2 site in the Altai Mountains (Gorny Altai) of southern Siberia was given in 1990 in a conference excursion guide (Derevianko *et al.* 1990:60), but without radiometric dates. In 1998, the first data on microblades and wedge-shaped cores from the early Upper Palaeolithic complexes in the Altai Mountains, dated to c. 35,000 BP, and perhaps even older, were published in another conference excursion guide, "Arkheologiya, Geologiya i Paleogeografiya Pleistotsena i Golotsena Gornogo Altaya" [Archaeology, Geology, and the Pleistocene and Holocene Palaeogeography of the Mountainous Altai], edited by Anatoly P. Derevianko.

A more detailed description of the Altai sites with very early microblade assemblages was published later (Derevianko *et al.* 2003). Some aspects of the origin of "tortsovoe" (narrow-face) flaking in the earliest Upper Palaeolithic complexes of the Altai Mountains, which is considered to be one of the methods for the origin of microblade reduction, were mentioned previously (Derevianko 2001; see also Derevianko and Volkov 2004). Unfortunately, these data remain poorly known outside of Russia even today; for example, the most recent English summary of the early Upper Palaeolithic of Siberia (Goebel 2004) makes no mention of these.

The discovery of very 'old' microblade complexes in southern Siberia now challenges previous models of microblade origin somewhere in East Asia, probably in northern China, and its spread to the north and east (e.g., Chen 1984:110; Tang and Gai 1986:350–353; Fagan 1996). For example, it was noted: "The long-lived microblade cultures of China and northern Asia generally appeared at least 30,000 years ago, based on a technology that produced dozens of diminutive blades from wedge-shaped, conical, and cylindrical cores. These in turn became sharp-edged barbs, arrow barbs, or scraper blades. Microblade technologies may have first evolved in northern China, where the earliest sites may occur, but they eventually spread northwards to the steppe-tundra of northeastern Asia, and even to North America. They represent a highly effective adaptation to highly mobile hunter-gatherer lifeways in open terrain." (Fagan 1996:137).

By 40,000–35,000 BP, dramatic cultural changes had occurred in North Asia, as they had elsewhere evinced by the sudden appearance of various stone tool technologies, such as blade technology, bifacial technology, and especially microblade technology (e.g., Bar-Yosef 2002; Straus *et al.* 1996; Soffer and Praslov 1993). In northern China, after about 30,000 years ago, these new technologies mixed with the indigenously developed lithic technologies (specifically the flake tool and pebble-core tool technologies), thereby forming the unique Upper Palaeolithic culture of northern China. Blade tools are known from the Shuidonggou and Youfang sites, and bifacial tools from Qingfengling, Xiachuan, and other sites, while Xiachuan, Chaisi, and Xueguan are among the numerous representative microblade sites in China (Shen *in press*).

Migrations of modern humans from the Eurasian steppe, including Siberia, probably contributed to the complexity and variability of Upper Palaeolithic lithic industries in China. The emergence of microblade technology in northern China might be the result of interactions with northern hunter-gatherer societies that are related to the event of the peopling of the Americas. While hunter-gatherers of the Eurasian steppe, who mixed with the local resident populations acquiring new cultural elements and skills, continued northeastwards to cross Beringia and thence into North America, another wave of migrating humans must have moved from Eastern Siberia southward into northern China, where they interacted and integrated with the indigenous hunter-gatherer societies (Shen *in press*). At the end of the Pleistocene, cultural manifestations in northern China, Japan, Korea, and the Russian Far East and Northeast, were part of a cultural interaction sphere that eventually reached the New World by at least 13,500–11,500 years ago.

There is no doubt that the time has now come for an updated collection of papers written by primary researchers, which reflects the up-to-date situation of the origin and spread of microblade technology in North and East Asia and North America. This is the main aim of this volume.

Besides the slow dissemination of information concerning the earliest microblades in some regions of Northern Eurasia, there are several methodological and terminological problems related to the topic of this book. If the determination of a "microblade" is more-or-less standard and generally refers to a small and narrow blade produced mostly from conical or wedge-shaped microcores (e.g., Bahn 2001; Darvill 2002), the definition of the term "microlith" is quite loose. Some scholars characterize microliths as "very small implement[s], commonly of flint, regarded as characteristic of the Mesolithic period in Europe. Typically microliths are between 10 mm and 50 mm long and shaped into either a point or a barb. They were mostly used in composite tools such as harpoons, arrows, or knives." (Darvill 2002:259–260). As was recently noted, "[t]he definition of the term microlith is notoriously slippery. In its broadest sense, it simply refers to very small tools – not a very satisfactory definition. Middle and Lower Palaeolithic assemblages from China (Gao 2000; Miller-Antonio 1992), Syria (Rust 1950), and southeastern Europe (Papaconstantinou 1989) have been called microlithic simply because the artifacts they contain are smaller than those found in contemporaneous assemblages in other places." (Kuhn and Elston 2002:2). In this volume, "microblades" are those artifacts usually found associated with wedge-shaped microcore(s), and this makes the establishment of the earliest microblade complexes more secure rather than the simple detection of small narrow blades (bladelets) which may be the result of accidental chipping.

The main focus of this volume is on both sides of the Northern Pacific as it is reflected on the book's logo (see cover). The reason is that in North and East Asia and in North America similar ways of microblade production were used. As was recently highlighted, "[i]n general, microlithic technologies in East Asia are characterized mainly by the production of microblades through elaborately developed core technologies. These were apparently used as is, as they do not often bear evidence of secondary modification until the Mesolithic and later. In contrast, more developed retouch and backing are characteristic of many late Pleistocene assemblages in Europe, western Asia, and Africa." (Kuhn and Elston 2002:2). Therefore, here we present a so-called "Asian-American microblade continuum".

The idea of putting together the latest data on microblade complexes from Northern Asia and North America was conceived in mid-2003 when several researchers from both sides of the Pacific were ready to get together, in order to share the latest knowledge and check the existing models and theories related to microblade cultural complexes. The core of this book consists of papers presented at the Symposium "Origin and Spread of Microblade Technology in Northern Asia and North America", which was part of the scientific programme at the 69th Annual Meeting of the Society for American Archaeology in Montreal, Canada, and took place on April 1, 2004, with Susan G. Keates and Yaroslav V. Kuzmin as moderators. We were fortunate to engage several scholars in this event (not supported by any source of extra funding), who have primary knowledge of the microblade complexes from regions that are not well known in the Anglophone scientific community due to language barriers, such as Chinese, Japanese, Korean, and Russian.

At the meeting in Montreal, the idea to put together a collection of papers based on the symposium's presentations was announced and well received. About three years later, we have in hand the fruit of our joint efforts. This volume consists of a general Introduction (Chapter 1), ten chapters (2 through 11) devoted to specific regions, and a Discussion (Chapter 12) of chapters 2–11. The chapters are organized geographically around the Northern Pacific, clockwise from China to western Canada.

Chapter 2 is an overview of the earlier Chinese microblade complexes, given by Chun Chen. Numerous sites with well-developed microblade technology mainly from the eastern and northeastern parts of China are described. A brief correlation with neighbouring territories, that is, Siberia, Korea, Japan, and North America is also presented. A major part of this chapter is devoted to more fundamental issues of microblade research, such as the influence of raw material, typology, and technology.

In Chapter 3, Chen Shen discusses several stone tool assemblages from the eastern part of China, Shandong Peninsula, where the Fenghuangling complex was initially considered to represent the earliest microblade tradition. Excavations and subsequent studies of lithic tool typology and technology at four key sites determined that the cultural picture of Shandong at the end of the Pleistocene is more mosaic and diverse than was thought previously.

Hiroyuki Sato and Takashi Tsutsumi present a broad characterization of Japanese microblade complexes in Chapter 4. Japan seems to be the best-studied region in the world in terms of microblade typology and technology. Recently, two volumes edited by Tsutsumi (2003a, 2003b; in total about 695 pages) with a compendium (including about 1800 catalogued sites) of microblade research in the Japanese Islands, were published in Japanese, and this chapter includes the main data from these books. The technological classification of Japanese microblade industries is fully described, with explanations of its complicated terminology. This is of great help to scholars who study microblade manufacture in Northern Asia and North America, because updated descriptions have appeared since the late 1960s (e.g., Morlan 1967, 1970, 1976). Microblade complexes of each large geographic region in Japan are presented, and a special part of the chapter is devoted to obsidian as a raw material for microblade manufacture.

In Chapter 5, Katsuhiro Sano discusses in detail various aspects of microblade complexes discovered in the central part of Honshu, the largest island of Japan. The main focus is on raw material composition and mobility of human groups in later Upper Palaeolithic times of central Honshu, dated to c. 17,000–14,000 BP. Of particular interest are first-hand data on raw materials used and distance to its sources from microblade manufacturing sites. Sano points to the transport of siliceous hard shale artifacts over a distance in excess of 200 km.

Chapter 6 is an overview of Korean microblade sites by Christopher J. Norton, Kidong Bae, Hanyong Lee, and John W.K. Harris. The main topics of this chapter are the history of microblade research on the Korean Peninsula, the chronology of microblade technology with a discussion of the problems related to the origin and diffusion of this technology, and the raw materials used to manufacture microblades. Photographs of selected microlithic artifacts enhance this chapter. In the authors' view, the earliest microblade sites are in northern China with an approximate time range of 50,000 years to c. 28,000 BP. In the region between China and South Korea, much more needs to be known about microlithic sites in North Korea as Norton and his co-authors point out in their perspectives on future research in the Korean Peninsula. This also includes the need to enlarge the sample of radiocarbon dated sites in Korea.

Chuntaek Seong in Chapter 7 presents a review of Korean microblade industries and sites. About 30 of the best-studied sites are characterized, including illustrations of artifacts and radiocarbon dates where they are available. The oldest microblade site in Korea is Sinbuk, with the earliest associated radiocarbon date of c. 25,500 BP. Seong takes issue with reconstructions of microblade development in Korea within the framework of diffusion, and proposes that research should be directed examining the ecological conditions in which hunter-gatherers lived, in particular the hypothesis of high mobility in response to very cold climates.

Both of these chapters on Korea are important contributions to North Asian studies of microblade assemblages, considering that before only some aspects have been published in English.

In Chapter 8, Yaroslav V. Kuzmin gives a general overview of chronology and environment of the earliest microblade complexes in Siberia, the Russian Far East, Mongolia, China, Korea, and Japan. Judging from the most solid chronological data of radiocarbon dates, microblade technology appeared first in southern Siberia (Altai Mountains) at c. 35,000 BP, and thereafter emerged in

Transbaikal (also southern Siberia), and in China, Korea, Japan, and the Russian Far East. The proliferation of microblades may be observable at c. 25,000–20,000 BP all over Northern Asia, including the remote northeastern part of Siberia, namely Yakutia.

Evidence of microblade technologies published over the last decade, primarily from Siberia and the Russian Far East, with a summary of the results of recent excavations in the 1990s and early 2000s, are discussed in Chapter 9 by Susan G. Keates. The sites from the Altai Mountains in southern Siberia are of particular interest considering their early radiocarbon dates, with a minimum age of about 35,000 BP. Microblade sites from other parts of Siberia, such as the Yenisei River basin, along with the earliest microblade complexes from the Russian Far East, the Amur River basin and Sakhalin Island are also described. A review of the earliest Chinese microblade sites suggests that more detailed analyses of assemblages and their chronology are necessary to obtain a clearer picture of the characteristics of microblade technology in this large region and how they relate to those of neighbouring regions.

Chapter 10 by Robert E. Ackerman is a detailed evaluation of the microblade-bearing complexes from northernmost North America, Alaska, and the Yukon Territory. Each major microblade assemblage, from the earliest Denali complex in the interior of Alaska to the Northwestern complex on the coast and the Late Tundra tradition in the continental part, is represented. Of particular interest are slotted bone and antler arrowheads, which were used for hunting with microblades inserted into grooves, dated to c. 10,400–8700 BP. Numerous illustrations help the reader to understand better the diverse microblade complexes of Alaska and the Yukon.

Chapter 11 by Martin Magne and Daryl Fedje covers the northwestern part of North America, mainly Alaska, the Yukon and Northwestern territories, and British Columbia. Besides a description of microblade sites and cultural complexes, the authors have modelled the spatial-temporal patterns of microblades in the northernmost part of North America based on radiocarbon-dated sites and how microblade technology spread across the region. The issue of possible ethnic connections between microblade-bearing humans and the Athapaskan language groups is considered.

Chapter 12 is a review of the volume, by the SAA Symposium discussant, Fumiko Ikawa-Smith. In her examination of the various chapters and particular and interrelated foci, she also gives some helpful background information, and provides suggestions for and questions to be considered in future research of microblade origins.

It is obvious that much more research is needed in order to understand the origin and spread of microblades in North and East Asia. Some regions, such as Mongolia, are still almost ‘blank’ in this respect. Critical evaluation of existing evidences is also necessary, in order to separate solid data from elements of ‘wishful thinking’. We hope that in the next decade or two most of the hotly debated issues related to microblades will be solved.

A particular challenge with this volume was the style of citing sources written in non-Latin alphabets, including Russian, Chinese, Japanese, and Korean. The aim of any bibliography is to include the original publication. In order to do so, it was decided to state the romanization of original titles and their translation in square brackets, and the romanization only of original volumes and periodicals where these publications appeared. This style was recently used by a number of periodicals dealing with oriental sources (for example, *The Journal of East Asian Archaeology; The Journal of Field Archaeology;* and *The Journal of Anthropological Archaeology).* This allows readers to find these sources in library catalogues, such as The Library of Congress of the USA.

At each stage of book production (writing of chapters, editing, polishing of text and checking the references), the contributors were quite helpful and cooperative; for example, by providing numerous translations of original Japanese sources (H. Sato and K. Sano), helping with Korean microblade sites’ names and locations (C. Seong), and sorting out quotations from journals and monographs (R.E. Ackerman and M. Magne). We appreciate their assistance which was given throughout the almost two years of volume preparation.

Finally, we would like to acknowledge several individuals who took part in the creation of this volume at different stages. We are grateful

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We would like to thank Jane Liu (Royal Ontario Museum, Toronto, Canada) for assisting with the formatting of the volume, and Anastasia V. Abdulmanova (Institute of Archaeology and Ethnography, Novosibirsk, Russia) for help with creating the volume's logo, initially designed by Y. Kuzmin. We acknowledge the financial support provided by the Royal Ontario Museum for typesetting and mailing costs. This book could not have been created without the support and assistance of Roy L. Carlson and the Archaeology Press (Simon Fraser University), who took up our suggestion to make it available for scholars and the general public. Sometimes even 'little things' make our life joyful!

2

TECHNO-TYPOLOGICAL COMPARISON OF MICROBLADE CORES FROM EAST ASIA AND NORTH AMERICA

Chun Chen

INTRODUCTION

In the last seventy years, much attention has been paid by many archaeologists in different countries, to the examination, analysis, and comparison of microblade cores, in their attempt to search for prehistoric cultural affinities through time and space. In the incipient stage of microblade research, morphological comparison was the only method for the study of the process of core preparation, reduction sequence, and rejuvenation. Since the wedge-shaped core technology called the Yubetsu technique was first reconstructed and defined by M. Yoshizaki in 1961 (see Morlan 1967:177), an increasing number of microblade techniques has been identified and defined. Techno-typological analysis has become a common approach used in microblade research. Techno-typology is the typology based on manufacturing attributes, in contrast to "morpho-typology" which is merely based on the morphological attributes of artifacts (Hayashi 1968:129). In Western archaeology, this trend of lithic analysis was also emphasized by many scholars. For example, Meltzer (1981:315) argued that archaeologists must recognize that tool morphology is determined by tool technology. Sackett (1989:51) pointed out that typology, as it is currently practiced, investigates stone tool morphology in ever more comprehensive terms, and he emphasized the need to understand the dynamics that underlie their patterning. The techno-typological approach offers a more appropriate way to distinguish the attributes of microblade cores and trace potential prehistoric affinities in time and space. As Sheets (1975:372) has put it, "technological analysis can increase the sophistication of archaeological comparison between specimens or types assessed in terms of how similar they are."

Microblade remains of a more recent period were reported widespread in provinces of North China. Most of them are surface collections with no detailed contextual or chronometric information. Many microblade remains were found either associated with pottery or ground stone tools. Locations were usually situated near dry lakes, river valleys, on sand dunes or small hills, or at the bottom of sand depressions. These remains have been generally called "microliths" in Chinese archaeology and assigned to the Neolithic age. The materials of this period are not discussed in this article.

This paper will first provide an overview of the discoveries and research of microblade remains in East Asia and North America, especially of the many new materials unearthed over the last few decades in China. The methodological consideration will focus on techno-typological approaches dealing with the attributes of raw material, core typology, core technology, edge angle, and dimensional variation. Based on the analysis of these attributes, a general comparison will be made of the similarities and differences between microblade cores found in different countries, in order to trace their development and technological change. A synthetic discussion will then outline the outcome of the comparison. Finally, a brief conclusion will explain the reasons why this technology could be adopted by so many human groups living in di-

Figure 2.1: Distribution map of microblade sites in China mentioned in the text.
1. Chaisi; 2. Xiachuan; 3. Lingjing; 4. Xueguan; 5. Hutouliang; 6. Shizitan; 7. Yaozitou; 8. Yushe; 9. Donghuishan; 10. Youfang; 11. Dabusu; 12. Angangxi; 13. Jiqitan; 14. Tingsijian; 15. Dafa; 16. Dagang; 17. Huilongwan Cave.

verse environments and distributed so widely in China proper and East Asia to northwestern North America during the Late Pleistocene and Early Holocene.

THE MAIN DISCOVERIES OF MICROBLADE REMAINS IN EAST ASIA AND NORTH AMERICA

The following microblade industries were found in the northern, eastern, and southwestern parts of China. A brief description of these discoveries is used for comparative analysis.

North China

Chaisi Locality 77.01 at the Dingcun sites

The Dingcun sites, located in Xiangfen County, Shanxi Province (35°51'N, 111°25'E), were discovered in 1954 and 11 localities were identified (Pei *et al.* 1958) (Figure 2.1). Since then, more localities with Palaeolithic materials have been found and reported in the region. In 1977, Locality 77.01 was found on the second terrace of the right bank of the Fen River near Chaisi. The upper sediment of the second terrace consists of greyish yellow sandy soil about 19 m thick. Stone artifacts, microblade remains, and mammalian fossils were unearthed from the gravel and sandy deposit, which is about 1 m thick and unconformably overlies marly clay sediment of the Lower Pleistocene.

The excavation of Locality 77.01 in 1978 yielded microblade remains, including six microcores, 86 microblades, and blades. Microcores are classified into three types, conical, wedge-shaped, and boat-shaped. Except for one wedge-shaped core of hornfels, most microcores were made of chert (Figure 2.2). Large chipping stone tools such as choppers, scrapers, and bolas were mainly made of hornfels (Wang 1986; Wang *et al.* 1994). A field survey in 1994 discovered Locality 94.01, which yielded a microblade assemblage from the second terrace of the Fen River. One microcore and four microblades were collected (Tao and Wang 1995). These two microblade localities were both dated to the Late Pleistocene. The radiocarbon date for Locality 77.01 is c. 25,000 BP (ZK-0635). Note that all ^{14}C dates in this paper are cited according to Libby's half-life of 5568 years (see The Institute of Archaeology 1991). There is no ^{14}C date for Locality 94.01, and age assessment is based on stratigraphic study.

The Xiachuan Industry

The Xiachuan sites are located in an area covering the three counties of Qinshui, Yangcheng, and Huanqu, southern Shanxi Province (Figure 2.1). Sixteen localities were found during surveys from 1970 to 1975. More than 1800 stone arti-

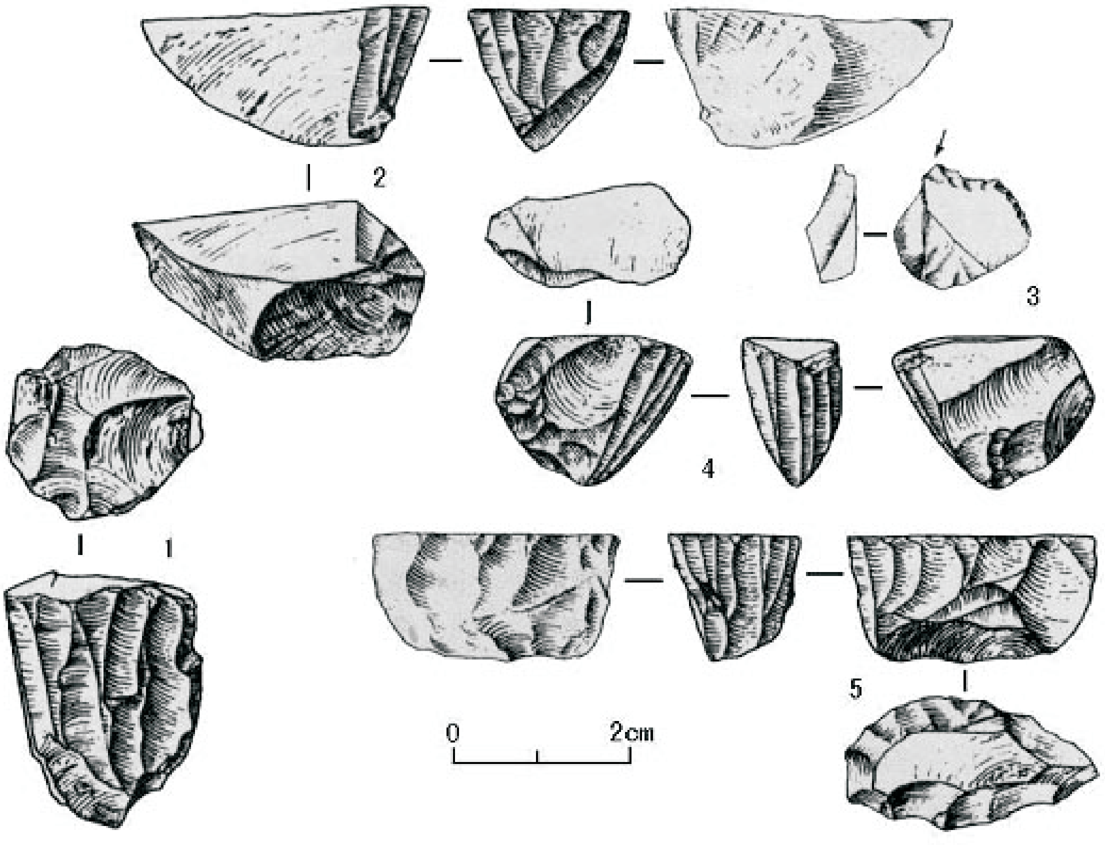

Figure 2.2: Microblade cores from Chaisi (after Wang *et al.* 1994)**.**

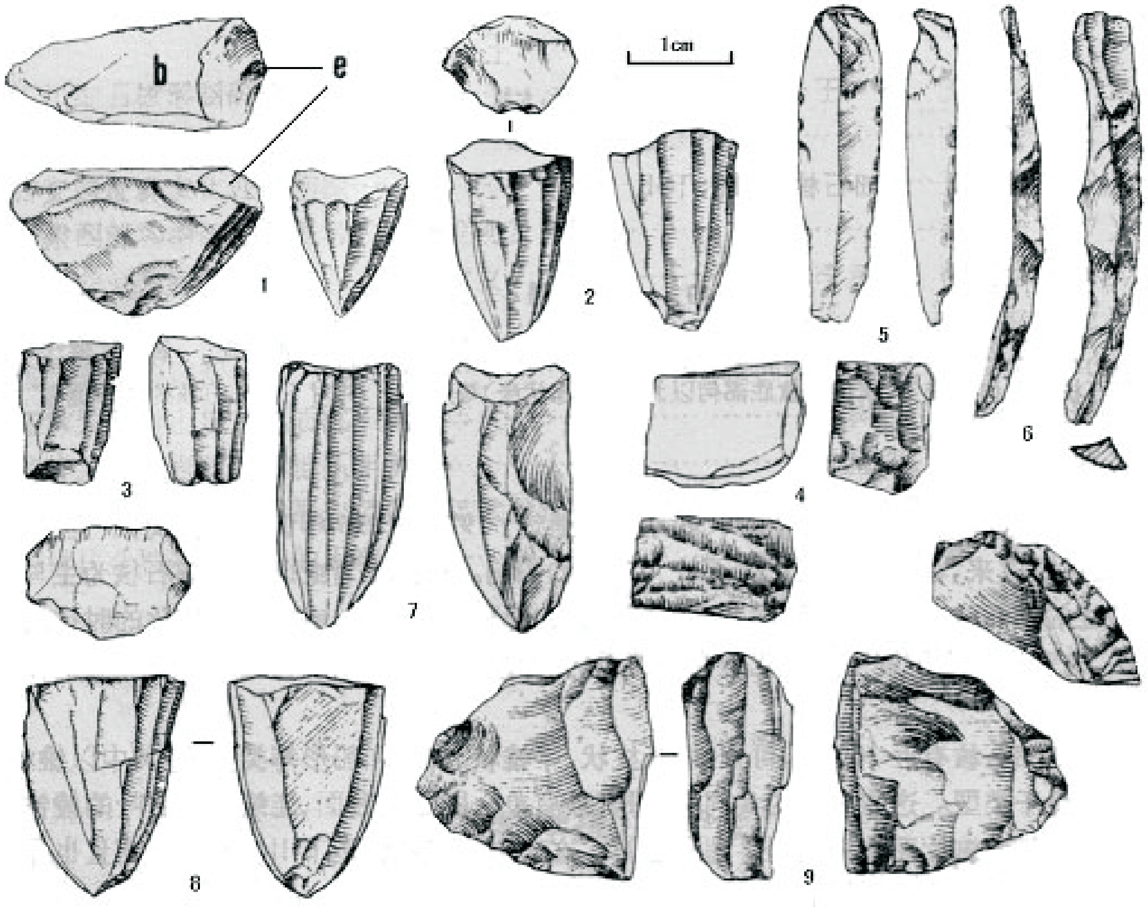

Figure 2.3: Microblade cores from Xiachuan (after Wang and Wang 1991)**.**

facts, including 219 microcores, were found in the 1973–1975 excavations (Wang *et al.* 1978). A detailed description is available in Chen and Wang (1989). From 1976 to 1978, the Committee of Cultural Relics of Shanxi Province and the Institute of Archaeology, Chinese Academy of Social Sciences, conducted excavations at the sites. The report is still pending.

Between 1990 and 1992, Chen Zheying of the Institute of Archaeology in Shanxi Province conducted three field surveys and collected 4415 stone artifacts from nine localities, including 100 microcores, 119 blades and microblades, and many microblade tools. Microcores were classified into wedge-shaped, conical, semi-conical, boat-shaped, and funnel-shaped (Figure 2.3). Other tool types include points, burins, microblade side scrapers, and other tools (Chen 1996). The chronological placement of the Xiachuan Industry is between c. 23,900 BP and c. 13,900 BP (for Lab numbers, see Kuzmin, this volume), with the latter date from the Shunwangping locality (The Institute of Archaeology 1991).

Lingjing Industry

The Lingjing site is located about 15 km to the northwest of Xuchang City, Henan Province (Figure 2.1). A lithic assemblage was collected from greyish silt and orange sand dug up during water storage construction. Therefore, the stratigraphy was disturbed and the original provenance of artifacts is unknown.

A total of 1353 stone artifacts was collected. In addition, two fragments of a human femur and some mammalian fossils were found. The fauna includes 16–17 taxa, for example, *Lamprotula* sp.,

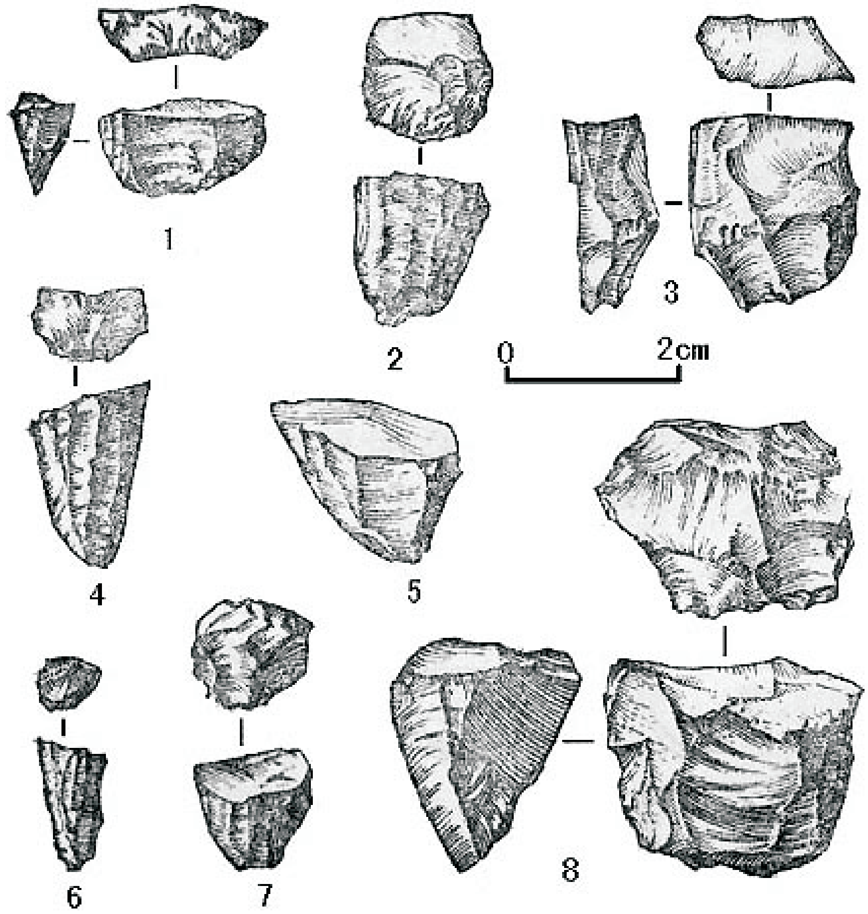

Figure 2.4: Microblade cores from Lingjing (after Zhou 1974)**.**

Ostrea sp., *Struthio anderssoni, Meles* sp., *Coelodonta antiquitatis*, *Equus przewalskyi, Sus seroba, Cervus elaphus, Ovis* sp., and *Bubalus* sp.

The raw materials are mainly quartz (69.6%), chert (20.0%), and quartzite (n=98). The stone artifacts comprise three categories, i.e., gravel tools, microblade remains, and flake tools. Only some specimens were selected for analysis, including seven microcores and 77 microblades. The microcores can be classified as wedge-shaped (n=2) and conical (n=5) (Figure 2.4). Other artifacts are, for example, flake cores, flakes, points, scrapers, burins, and choppers.

Due to the lack of stratigraphic information and absolute dating, the age of the Lingjing industry was assigned to the end of the Upper Palaeolithic or the Mesolithic period on the basis of the absence of pottery and polished stone tools (Zhou 1974).

Xueguan Industry

The Xueguan site is located in the southwestern part of Shanxi Province (Figure 2.1). A total of 4777 stone artifacts including 86 microblade cores were found in the 1979 and 1980 excavations. A single radiocarbon date gave an age of c. 13,100 BP (Wang *et al.* 1982; Chen and Wang 1989; The Institute of Archaeology 1991) (Figure 2.5).

Hutouliang Industry

The Hutouliang site is located in the Nihewan Basin, Yangyuan County, in the northwestern part of Hebei Province (Figure 2.1). More than 40,000 lithics, including 236 wedge-shaped cores were found in the 1972–1974 excavations. A single radiocarbon date gave an age of c. 11,000 BP (PV-4) (Gai and Wei 1977; Tang and Gai 1986; Chen

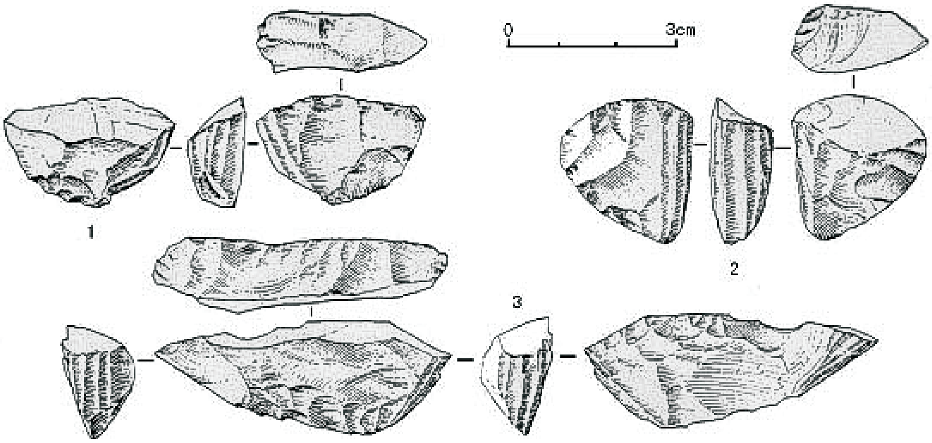

Figure 2.5: Wedge-shaped cores from Xueguan (after Chen and Wang 1989)**.**

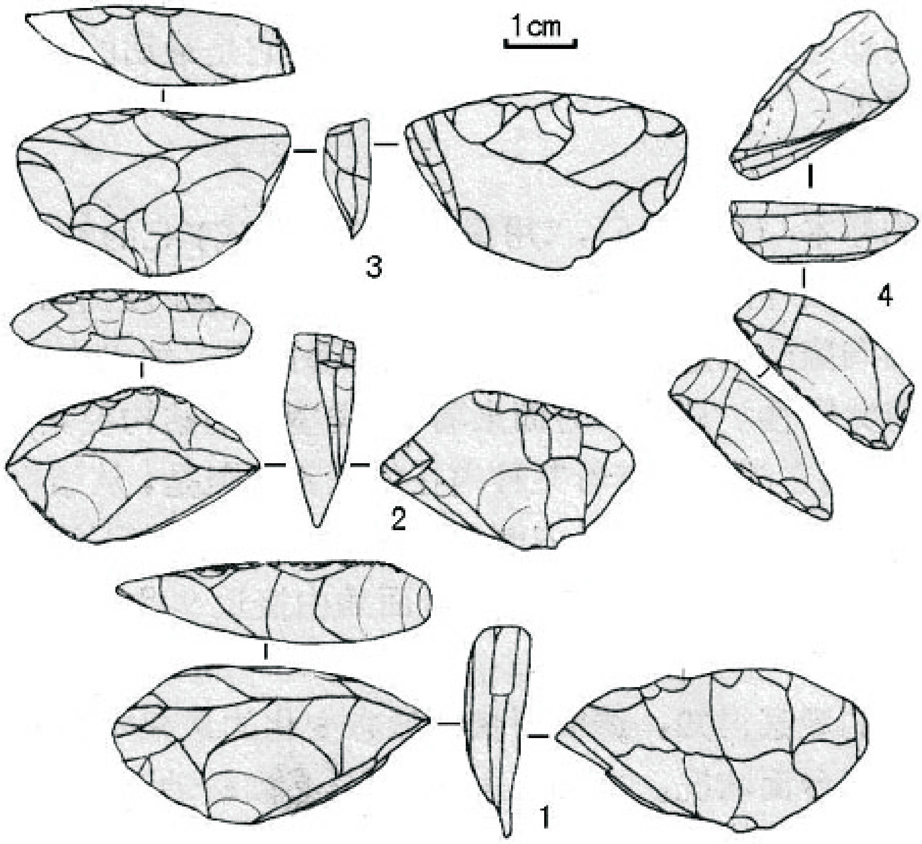

Figure 2.6: Wedge-shaped cores from Hutouliang (after Gai 1984)**.**

and Wang 1989; The Institute of Archaeology 1991) (Figure 2.6).

Shizitan Industry

The Shizitan site is located in Ji County within the southern part of the Luliang Mountains, western Shanxi Province (Figure 2.1). The excavation at Locality 1 in 1980 yielded a microblade industry from the upper cultural layers. Five layers were identified according to the geological attributes. Of these, Layers 2–5 are assigned to the upper cultural layers due to the occurrence of microblade remains with most archaeological specimens found in layers 3 and 4:

Layer 2: greyish sandy soil about 2.5 m thick with sporadic lithic artifacts;

Layer 3: greyish loess about 5.5 m thick with many microblade remains, other stone artifacts, mammalian fossils, ash, and burnt bones;

Layer 4: black loam about 1 m thick with a large amount of microblades and other stone artifacts;

Layer 5: ploughing soil about 0.4 m thick with a few microblade remains.

A total of 1807 stone artifacts were unearthed, including 208 microcores and 547 microblades. Because all microblade remains were lumped together, the numbers of microcores and microblades from the individual layers are unknown.

The raw materials used for producing microblade remains include chert of various colours, hornfels, chalcedony, and quartzite. Four types of microcores were classified, including 79 wedge-shaped, 64 boat-shaped, 35 conical, and 30 funnel-shaped cores. Wedge-shaped cores are subdivided into two styles: broad-bodied and narrow-bodied. Other implements include, for example, bifacial and unifacial points, scrapers, burins, choppers, and grinding slates (Cultural Bureau of Linfen District Administration 1989) (Figure 2.7). The age of Shizitan is based on the stratigraphy (Shi Jinming personal communication).

Yaozitou Locality

The Yaozitou locality (39°53'N, 113°00'E) is located in Huairen County, northern Shanxi Province (Figure 2.1). Microblade remains and other lithic artifacts were collected on the surface of the second terrace of the E'maokou Creek, a tributary of the Sanggan River. This locality is adjacent to the well-known E’maokou workshop. The second terrace is composed of gravel sediments in the lower portion and sandy soil sediments in the upper portion. No lithic remains were found in these deposits (Chen and Ding 1984).

Chert was the main raw material used at this locality, and some large artifacts were made of tuff. The lithic collection includes 10 microblade cores and 30 blades and microblades. Other artifacts include, for example, flakes, scrapers, a stone pestle, and a polished stone tool. The microcores were classified into three types, conical (n=2), short bodied cylindrical (n=1), and boat-shaped (n=7) (Figure 2.8).

Due to the lack of stratigraphic and faunal evidence, it is very difficult to ascertain the age of these cultural remains. It is highly likely that the E'maokou workshop was used for a long period of time during the Late Palaeolithic and the early Neolithic ages. The microblade remains may or may not be related to the workshop (Chen and Wang 1989).

Two Localities in Yushe County: Nanping and Monk Creek

In 1985, two localities were found in Yushe County, Shanxi Province (Figure 2.1). One is Nanping near Zhaowang village (37°08'56"N, 112°59'08"E), the other Monk Creek near Mengjiazhuang village (37°10'22"N, 113°02'04"E) (Figure 2.1). Both localities are located on the second terrace of a tributary of the Zhuozhang River.

The geological profile at Nanping contains six layers from top to bottom of which layer 4, a greyish gravel about 0.1–0.15 m thick, yielded a stone artifact assemblage and mammalian fossils, including *Cricetulus* sp. and *Equus* sp. A radiocarbon date on animal bones gave an age of c. 10,000 BP (The Institute of Archaeology 1991).

The geological profile at Monk Creek shows a thin loess-like sediment overlying a gravel sediment. Stone artifacts and mammalian fossils such as *Equus* sp. and *C. antiquitatis* occur in the gravel layer. A radiocarbon date on a bone fragment is c. 11,900 BP (The Institute of Archaeology 1991).

The stone artifacts of the Nanping and Monk Creek localities were analyzed together by

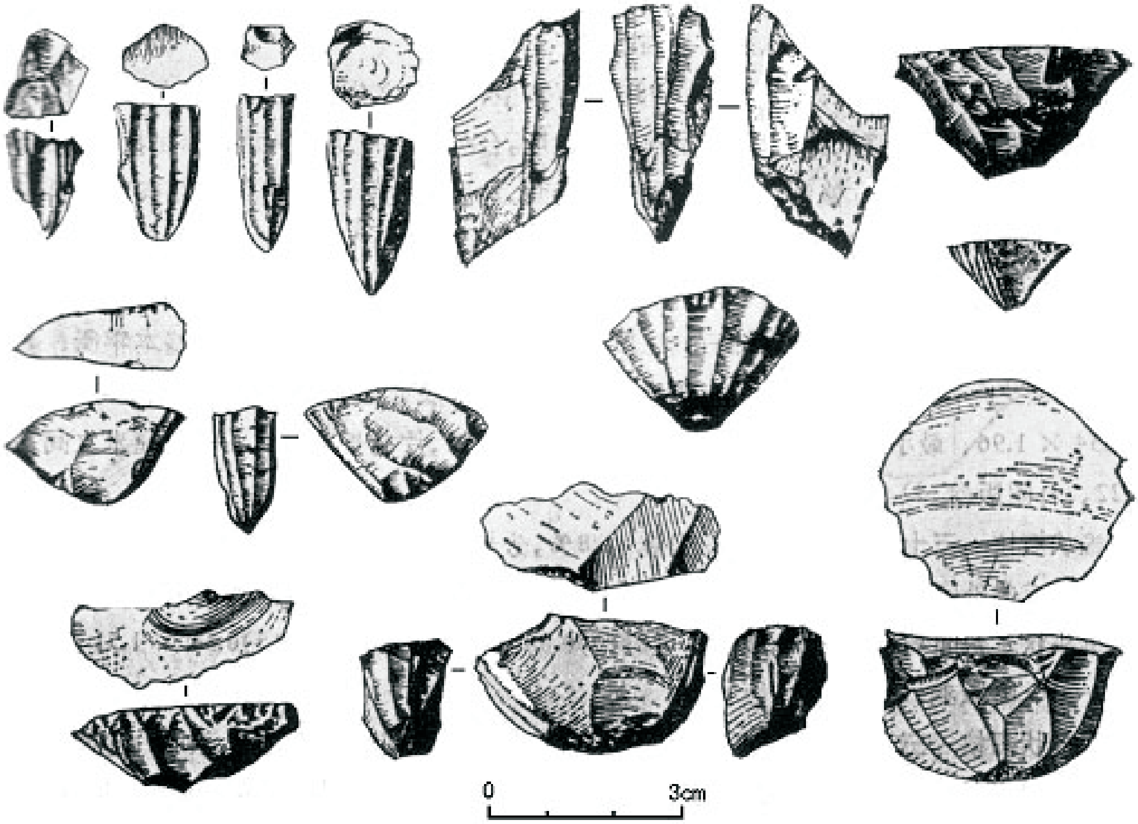

Figure 2.7: Microblade cores from Shizitan (after Cultural Bureau of Linfen District Administration 1989).

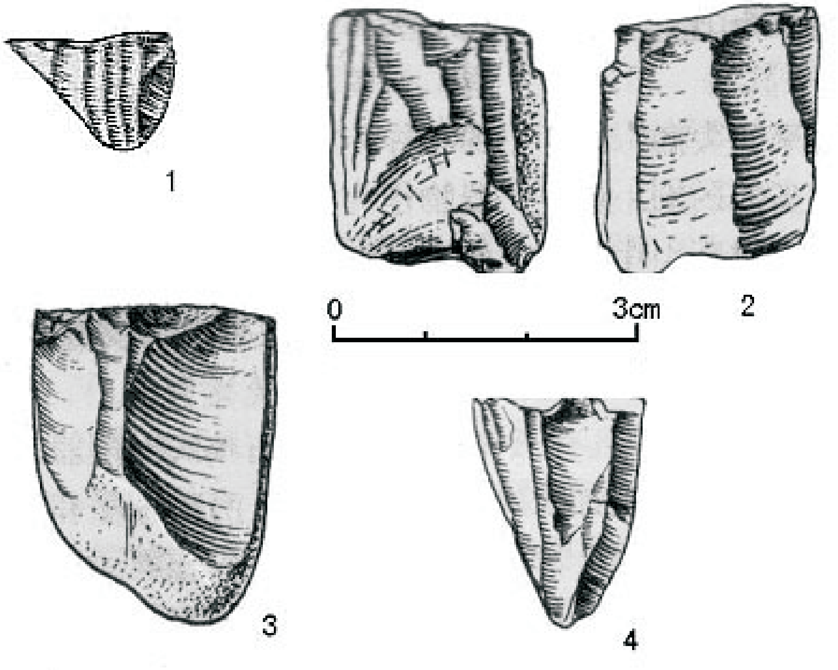

Figure 2.8: Microblade cores from Yaozitou (after Chen and Ding 1984).

Liu *et al.* (1995). The raw materials are chert (84.4%), quartzite (10.5%), and agate, quartz, and chalcedony (5.1%). Stone artifacts were classified as cores (10.55%), flakes (54.43%), retouched pieces (8.86%), and chunks and debris (13.08%). A detailed description is as follows.

A total of 25 cores (14 from Nanping and 11 from Monk Creek) were found, including 17 microcores. Nanping yielded five conical cores, one wedge-shaped core, one atypical wedge-shaped core, one atypical conical core, and three boat-shaped cores. At Monk Creek one cylindrical core, one conical core, and four boat-shaped cores were recorded. The atypical wedge-shaped core shows platform preparation similar to the Yubetzu technique, though its preform is a gravel chunk rather than a biface (Figure 2.9). Other retouched pieces were classified as 17 scrapers of various kinds, nine end scrapers, one burin, one stone point, three arrowheads, and two shell and bone ornaments (Liu *et al.* 1995).

Donghuishan Locality

The Donghuishan site (39°48'N, 118°49'E) is situated in Luanxian County, Tangshan City, Hebei Province (Figure 2.1). The lithic remains were unearthed from the second terrace of the Luan River. Seven layers were divided geologically from top to bottom: Layer 1, surface soil about 0.3 m thick; Layer 2, yellow silt clay about 2.3 m thick; Layer 3, reddish clay sandwiched with thin sandy strips about 1.4 m thick; Layer 4, greyish white sand, containing many lime nodules in the lower part, about 1.8 m thick; Layer 5, brownish

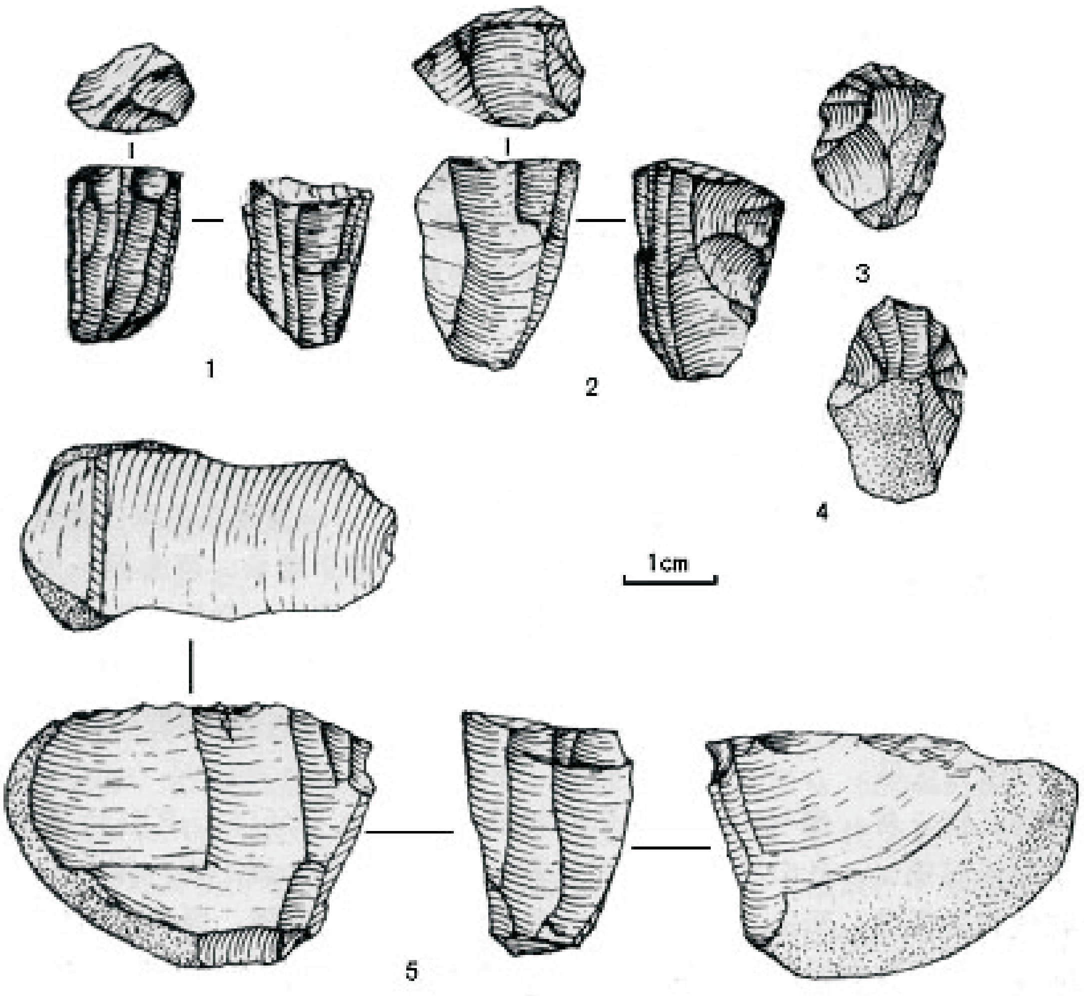

Figure 2. 9: Microblade cores from the Yushe sites (after Liu *et al.* 1995)**.**

clay about 2 m thick; Layer 6, yellow sand sandwiched with thin reddish clay about 4.2 m thick; Layer 7, dark grey clay about 3.0 m thick. Most of the lithic artifacts and fauna were recovered from Layer 4.

The raw materials are mainly chert of various colours and limestone; some quartzite and igneous rock artifacts were also found. A total of 182 lithic artifacts was collected, including three microcores and 10 microblades as well as flakes and other artifacts. The three microcores are boat-shaped and worked in chert.

No absolute dating result is available. On the basis of geological observation and cultural attributes, the age of the collection was assigned to the Upper Pleistocene or the Late Palaeolithic period (Institute of Cultural Relics 1989).

Youfang Industry

The Youfang site (40°14'N, 114°41'E) is located in the Nihewan Basin, Yangyuan County, Hebei Province and situated on the Datianwa terrace 170 m above the riverbed of the Sanggan River (Figure 2.1). The site was discovered in 1984 and excavated in 1985, yielding 697 stone artifacts and 2675 chunks or debris, some animal fossils, ash, burnt bone fragments, and burnt clay. Two natural layers were divided from top to bottom: Layer 1, plough soil about 0.3 m thick; and Layer 2, a loess sediment about 6.5 m thick with cultural remains.

The raw materials are mainly various siliceous breccia, chert, as well as rare siliceous limestone and quartzite. The lithic industry contains 13 microcores and 92 microblades. Associated artifacts are, for example, flakes, scrapers, and burins. Microcores were classified as wedge-shaped, boat-shaped, and cylindrical types. Two subtypes, broad-bodied and narrow-bodied wedge-shaped cores, were identified (Figure 2.10).

Due to the lack of dating materials, the age of the lithic industry was estimated on the basis of geological examination. As the stone assemblage was buried in the upper and middle parts of the Malan loess sediment, the authors assign its age to the late Upper Pleistocene, and possibly earlier than the age of Hutouliang (Xie and Cheng 1989).

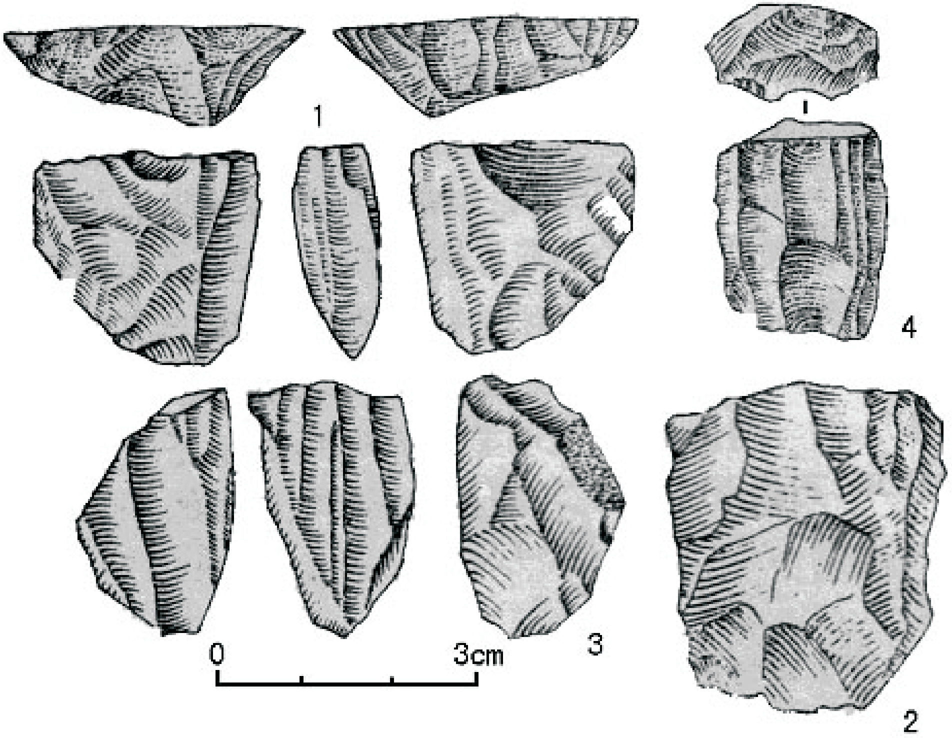

Figure 2.10: Microblade cores from Youfang (after Xie and Cheng 1989)**.**

Dabusu Locality

The Dabusu site (44°48'03"N, 123°42'42"E) is located in the Suozi township, Qian-an County, western Jilin Province (Figure 2.1). A stone assemblage was uncovered in 1985 from the second terrace on the eastern bank of the Dabusu Pond, a salty inland lake covering 56 km^2. Eight layers were identified from top to bottom in the profile of the second terrace. An ancient soil strip about 10–20 cm thick in layer 3, a brownish red ancient soil interbedded with greyish white and greyish yellow sand (about 1.5 m thick), yielded the stone assemblage which occurred within a horizontal area of about 15 m^2.

The majority of stone artifacts were made of chert; other raw materials are quartz, opal, and obsidian. A total of 486 stone artifacts were collected during the excavation, including four microcores and 121 microblades. The microcores were classified into two types: semi-conical (n=2) and wedge-shaped (n=2) (Figure 2.11). Other artifacts include, for example, scrapers and a grinding slate. Mammalian fossils were found associated.

No radiocarbon date is available. Therefore, on the basis of the geological context and lithic technology, the age of the assemblage was assigned to the Late Palaeolithic period. The locality may have been a temporary lithic workshop or a working camp near the lakeshore (Dong 1989).

The Angangxi Localities

The Angangxi (47°02'N, 123°53'E) localities are situated near Qiqiha-er City, Heilongjiang Province, well-known for their occurrence of Neolithic microblade remains (Figure 2.1). In the autumn of 1928, A.S. Lukashkin, a Russian employee of the former Zhongdong Railway Company, discovered Neolithic sites containing microblade remains near Angangxi. In 1933, Liang Siyong conducted a survey and excavation and published his discovery together with the collection he had bought from Lukashkin (Liang 1932). In 1963 and 1964, the Provincial Museum of Heilongjiang carried out surveys in this area and reported 26 localities belonging to the Neolithic period (Provincial Museum of Heilongjiang 1974).

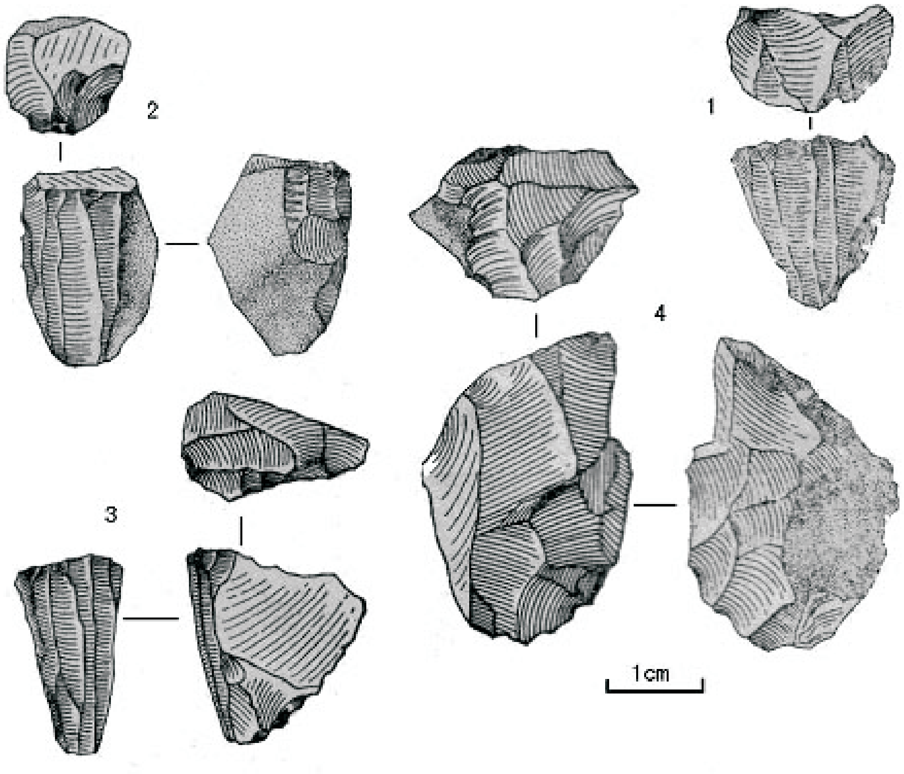

Figure 2.11: Microblade cores from Dabusu (after Dong 1989).

More lithic remains were found at the new locality of Daxingtun during field surveys in 1981 and 1982. The Daxingtun site is located 18 km southeast of Angangxi and situated on the first terrace of the Nun River about 4–6 m above the riverbed. Four layers from top to bottom were identified in the stratigraphic profile. Of these, layer 4 (overlain by loess-like sandy clay of an Upper Pleistocene fluviolacustrine deposit) is the artifactual deposit. Layer 4 contains yellow fine grain sand interbedded with green silt of the Upper Pleistocene lacustrine deposit, approximately 3.0 m thick above the ground. Stone artifacts, mammalian fossils, ash, and burnt bones were found in the upper part of this layer. The mammalian fauna contains about eight taxa, for example, *Ochotona daurica, Microtus epirattceps,* and *E. przewalskyi* (Huang *et al.* 1984). Gao (1988) also reported *Cervus* sp., *Muntiacus* sp., and other species.

The raw materials are mainly chalcedony, agate, and chert. Sixty-eight stone artifacts were reported by Huang *et al.* (1984) and 60 stone artifacts by Gao (1988), including one microcore and 17 microblades. Other artifacts include, for example, scrapers and burins. One microcore can be classified as a short bodied cylindrical core.

On the basis of the examination of the provenance of the lithic assemblage, the Daxingtun locality may have been a temporary camp during the Late Palaeolithic period. A radiocarbon date of a bone fragment gave an age of c. 11,400 BP (Huang *et al.* 1984; Gao 1988).

Jiqitan Industry

The Jiqitan site, located about 7.5 km southwest of the Hutouliang site (40°06'N, 114°26'E), is situated in the Nihewan Basin, Yangyuan County, Hebei Province (Figure 2.1). The site was discovered in 1986 and excavated from 1987 to 1989. An Upper Palaeolithic microblade industry was unearthed from the second terrace of the Sanggan River. Five geological layers were found. Cultural remains were recovered from layers 3 and 4. Layer 3 is greyish yellow sandy clay sandwiched with reddish yellow sand about 1.5 m thick, and layer 4 is a gravel about 0.5 m thick.

The cultural remains include more than 10,000 stone artifacts, charcoal, ash, and broken bones. The mammalian fauna includes, for example, *Myospalax fontanieri* and *E. przewalskyi*.

The raw materials consist mainly of quartzite and hornfels. A total of 2304 lithic artifacts was examined and analyzed, including 121 microblade cores, 452 microblades, and 51 microblade spalls (Figure 2.12). Other artifacts include, for example, projectile points and notches.

The microcores are all wedge-shaped and represent different stages of core preparation and microblade reduction. They can be subdivided into two forms: broad-bodied and narrow-bodied. They share many similarities with those from Hutouliang in typology and technology.

No radiocarbon dating result is available for the Jiqitan industry. On the basis of geological and cultural comparisons with other microbalde sites in the region, the authors assigned an age of 11,000–8000 years for Jiqitan (Institute of Cultural Relics 1993).

Tingsijian Industry

The Tingsijian site (39°44'N, 119°10'E), located in Changli County, Qinhuangdao City, Hebei Province (Figure 2.1), was discovered in 1990 and excavated in 1992 and 1993. Cultural remains were buried in the second terrace of a branch of the Yinma River. A total of 239 lithic artifacts was unearthed from the sediment of brownish yellow and brownish red sandy clay about 1.0–3.0 m below the surface.

The major raw material is chert of different colours. Eight microcores and 36 microblades were identified. Other artifacts include, for example, scrapers and burins. The microcores are all boat-shaped with the largest one measuring 20 x 15 x 11 mm and the smallest one 12 x 8 x 7 mm.

No absolute dating result is available. On the basis of geological and cultural comparison, the age of the lithic industry was assigned to the Upper Pleistocene or the Late Palaeolithic period (Wang 1997).

Dafa Locality

The Dafa site (37°40'30"N, 112°50'10"E) is located on the second terrace of the Xiao River, a main tributary of the Fen River, 15 km to the east of Yuci City, Shanxi Province (Figure 2.1). The geo-

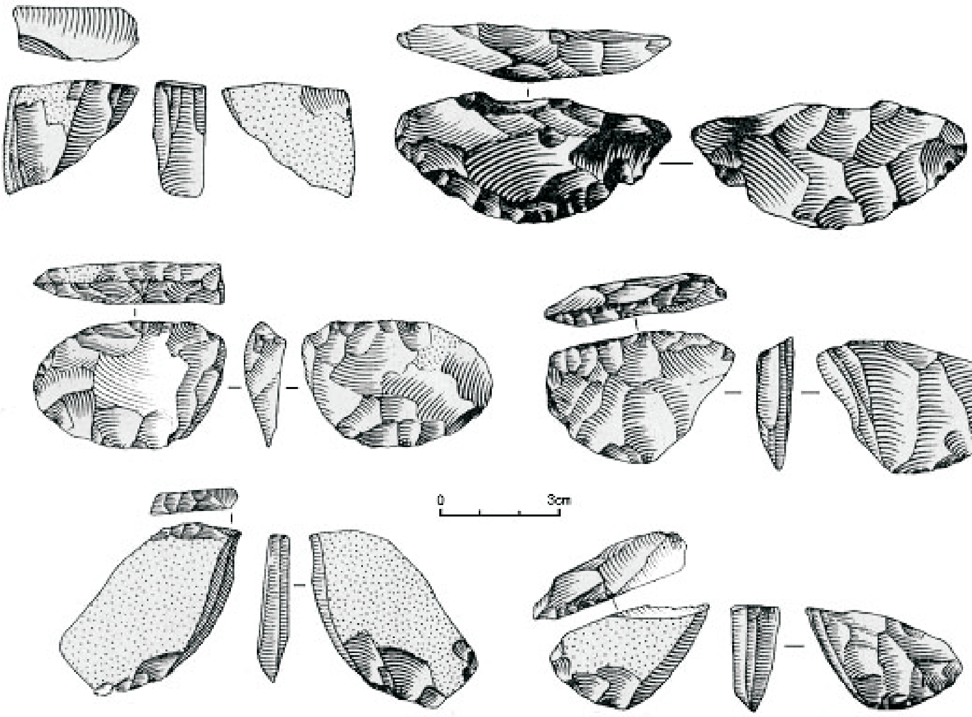

Figure 2.12: Wedge-shaped cores from Jiqitan (after Institute of Cultural Relics 1993)**.**

logical profile of the second terrace comprises six natural layers from top to bottom, of which layer 4, a greyish white sandy gravel, about 0.8–1.3 m thick, contained stone artifacts and mammalian fossils. The mammalian fauna comprises several taxa, including *Canis lupus* and *E. przewalskyi* (Gao *et al.* 1991). During the excavations in 1988 and 1990, more species were found, including *C. antiquitatis* (Li and Wang 1992).

The raw materials are mainly chert and quartzite. More than 1000 stone artifacts were found during the 1980 excavations and 289 specimens were selected for analysis. These include flake cores (n=3), bipolar cores (n=2), microcores (n=5), flakes (n=249), bipolar flakes (n=5), microblades (n=6), side scrapers (n=9), points (n=3), and burins (n=2). Microcores were subdivided into two forms, wedge-shaped (n=3) and short cylindrical (n=2) ones (Gao *et al.* 1991).

About 700 stone artifacts were uncovered during the excavations in 1988 and 1990 and 570 pieces were analyzed. These include 26 microcores and 98 microblades. Other artifacts include, for example, scrapers and points. Microcores were subdivided into four forms, conical (n=9), wedge-shaped (n=13), atypical cylindrical (n=2), and microcores with double platforms (n=2) (Li and Wang 1992).

No radiocarbon dating result is available. On the basis of geological examination and faunal analysis, the age of the Dafa assemblage was assigned to the Upper Pleistocene or the Late Palaeolithic period.

East China

Dagang Locality

The Dagang Locality (33°40'N, 113°42'E) is located in the Houji township, Wuyang County, Henan Province (Figure 2.1). Cemeteries of the Han dynasty and an Early Neolithic site belonging to the Peiligang culture were found between 1985 and 1989. During a field survey in 1989, microblade remains were unearthed from the layer below the Peiligang culture. Two excavations were conducted by the Institute of Cultural Relics of Henan Province and the Museum of Wuyang County in 1989 and 1990 to clarify the stratigraphic relationship between microblade remains and the Peiligang Culture.

The sediment of 1.28 m thickness was divided into five layers from top to bottom with layers 1–3 (0.2–0.7 m) containing Peiligang Neolithic culture artifacts and Han Dynasty potsherds. In layer 4, a brown clayey soil about 0.15–0.40 m thick, microblade remains and other lithic artifacts were discovered.

A total of 327 lithic artifacts were described and analyzed, including 19 wedge-shaped cores, nine conical cores, and 14 microblades. Other artifacts are: bipolar cores (n=22), flaked cores (n=6), flakes (n=118), bipolar flakes (n=31), various scrapers (n=30), end scrapers (n=17), points (n=10), backed flakes (n=3), flake with polished edges (n=1), and chunks and debris (n=47). Raw materials include three varieties of chert (61.5%), vein quartz (35.5%), agate (2.1%), quartzite (0.6%), and crystal (0.3%).

Wedge-shaped cores look more like boat-shaped ones, with a broad unprepared platform or slightly trimmed near the fluted edge. The largest specimen measures 32 x 11 x 13 mm. Conical cores are rather short, with an unprepared platform. The fluted surface usually covers about half of the body. The characteristics of microblade cores are similar to those from the Lingjing site which is about 40 km to the north.

Dagang may have been a temporary working camp based on the presence of chipping debris. No radiocarbon date is available. According to the cultural attributes and stratigraphic evidence, the age of microblade remains was assigned to the end of the Late Pleistocene (Zhang and Li 1996).

Southwest China

Huilongwan Cave Site

The Huilongwan Cave site is located near Panzhihua City, Sichuan Province (Figure 2.1). Three layers were identified and microblade remains were unearthed from layers 2 and 3. Cultural remains include microcores, microblades, large heavy duty stone tools, and bone and antler tools. Neither ground stone tools nor pottery were found. The microcores were classified into four types, that is, conical, wedge-shaped, funnel-shaped, and boat-shaped. The age of the site was estimated by researchers ranging between 20,000 and 12,000 years old (Li 1993).

Japan

Microblade remains occur at many sites in Japan from Kyushu to Hokkaido and comprise the most diagnostic cultural feature from the Late Pleistocene to the Early Holocene (see also Chapter 4). However, precise information concerning their stratigraphic context is not always available. Because of the unavailability of specimens from many collections for study, it is impossible to conduct a comprehensive analysis. In this article, the comparison will focus on microblade cores from a few sites, such as Yasumiba, Fukui Cave, Araya, and Shirataki. Wedge-shaped cores, microblades, and the earliest pottery at Fukui Cave are ^{14}C-dated to about 12,700 BP (Figure 2.13). Wedge-shaped cores and microblades at Araya are ^{14}C-dated to about 13,200 BP (Aikens and Akazawa 1996).

Korea

Microblade remains have been discovered at several localities in Korea, including Sokchang-ni, Saemgol, and Ch'angnae in the central part, Kogchon in the southern part, and Mandal in Pyongyang City in North Korea (see also Chapter 7). Wedge-shaped cores unearthed from the Suyanggae site in southern Korea are available for comparison (Figure 2.14). The microblade remains were assigned to the Upper Palaeolithic period based on stratigraphic considerations (Lee 1989a, 1989b).

Eastern Siberia

Microblade discoveries have long been reported from Eastern Siberia and the Russian Far East. However, detailed reports are not always available. Tabarev (1994) reported a microblade industry from Ustinovka in the Maritime Province. Since 1954, several localities have been found in the region. Subprismatic blade cores and Gobi-type (wedge-shaped) cores were collected and identified in the assemblages.

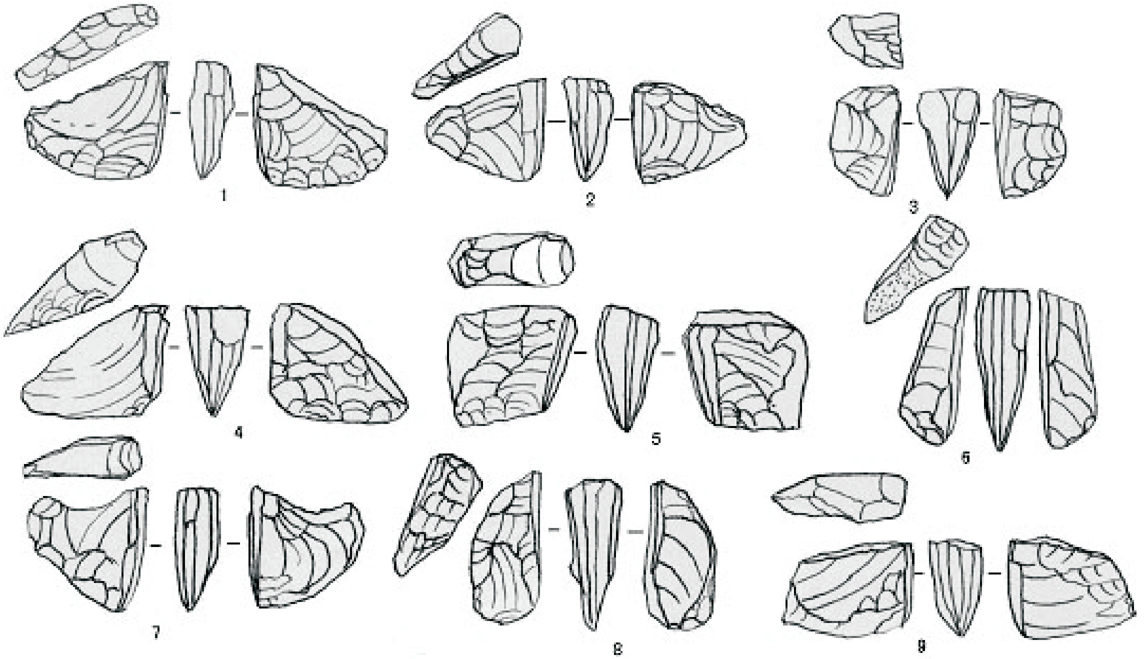

Figure 2.13: Wedge-shaped cores from Fukui Cave (after Hayashi 1968)**.** No scale given.

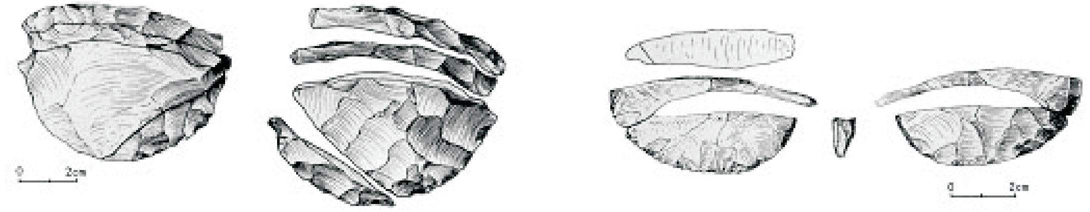

Figure 2.14: Wedge-shaped cores from Suyanggae (after Lee 1989a)**.**

The comparison of the microblade cores from this region will be mainly focused on the Dyuktai culture. According to Mochanov's definition, the Dyuktai culture represented an ethnocultural unit which covered the territory to the east of the Lena River and north of the Amur River, including Kamchatka, Sakhalin Island, and even a large part of Hokkaido, Japan. Wedge-shaped cores were considered the diagnostic element of the culture. The sites which were assigned to the culture include Layers 3–14 of the Dyuktai Cave, Ust-Dyuktai 1, Ikhine 1 and 2, Verkhne-Troitskaya, Sumnagin 1, Ust-Mil, Ezhantsy, Tumulur, Berelekh, and Maiorych. Early chronological placement of Ust-Mil and Ezhantsy was the subject of a heated debate. Layer 7b of Dyuktai Cave containing the classic type for the Dyuktai culture, such as wedge-shaped cores and bifacial knives (Figure 2.15), is ^{14}C-dated to c. 12,690 BP, c. 13,070 BP, and c. 14,000 BP. Berelekh, the most northerly Palaeolithic site in Siberia, is ^{14}C-dated to c. 12,930 BP and c. 13,220 BP. The Sumnagin culture in the Aldan Valley which was dated to about 10,500–6000 BP and Ushki Lake 1 with ^{14}C dates of c. 10,360 BP and c. 10,760 BP for layer 6 yielded microblade

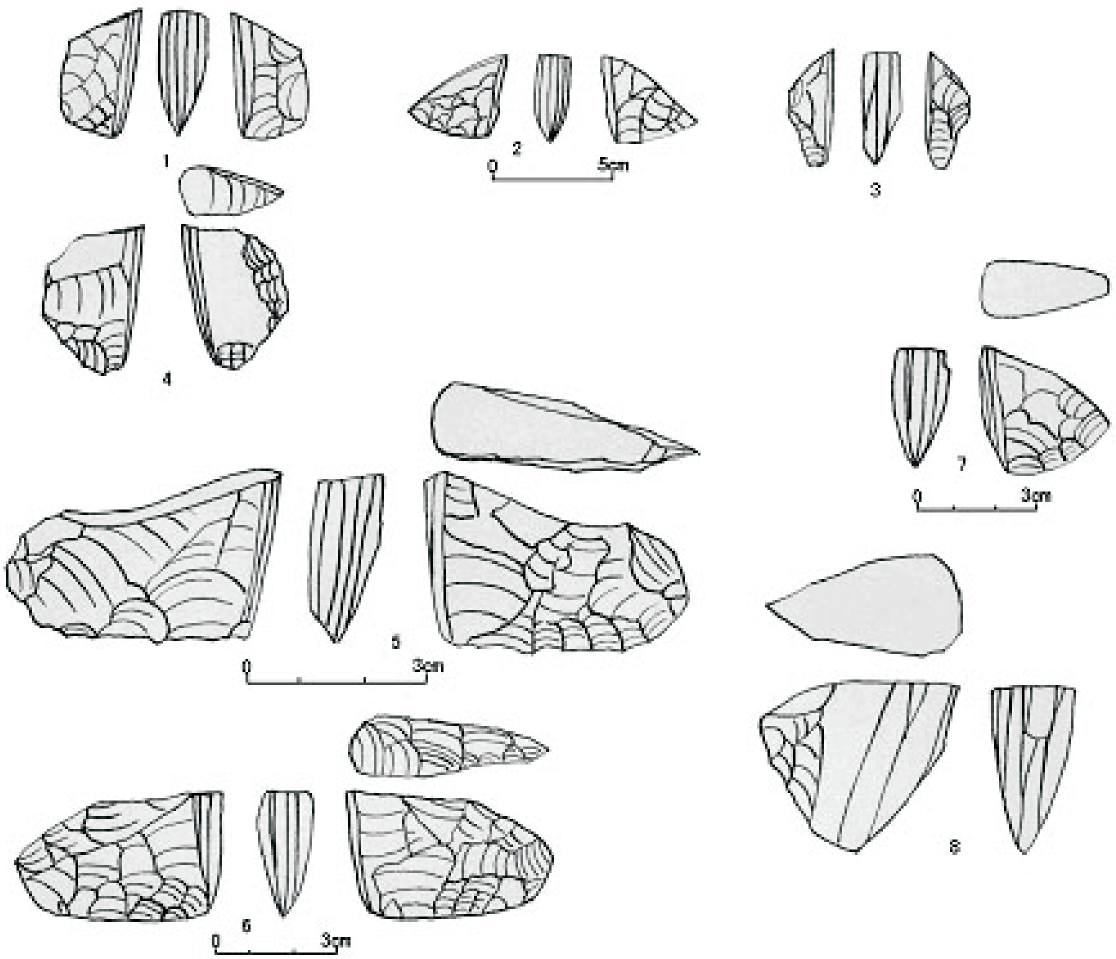

Figure 2.15: Wedge-shaped cores from the Dyuktai culture (after Mochanov 1978; Powers 1973)**.**

technology artifacts represented by conical and cylindrical prismatic cores (Mochanov 1978, 1980; Powers 1973, 1996).

North America

In North America, microblade remains occur in the Arctic and northwestern part of the continent from Alaska southward to the Columbia River and eastward to Greenland. The assemblages with relatively early dates were found in Alaska and the Pacific Northwest dating to about 12,000–11,000 BP and persisting to c. 3000 BP in Alaska. In British Columbia and Washington State, microblades were gradually abandoned by the people of the Nesikep tradition around 1500 BP. In the eastern Arctic, microblades persisted to about 900 BP along with the late Dorset culture (Dumond 1978; McGhee 1978). In this article, microblade cores from the American Paleoarctic tradition, the coastal microblade assemblages, and the Plateau Microblade tradition are analyzed and compared.

The American Paleoarctic tradition is the earliest microblade complex in the western Arctic. The microblade cores analyzed here include those from Dry Creek (Figure 2.16), Ugashik Narrows, Donnelly Ridge, the Noatak Drainage sites, Akmak, Tangle Lakes, Ground Hog Bay 2, Healy Lake, and Small sites in northern Alaska. The Campus site in Fairbanks that yielded classic wedge-shaped cores of the Amer-

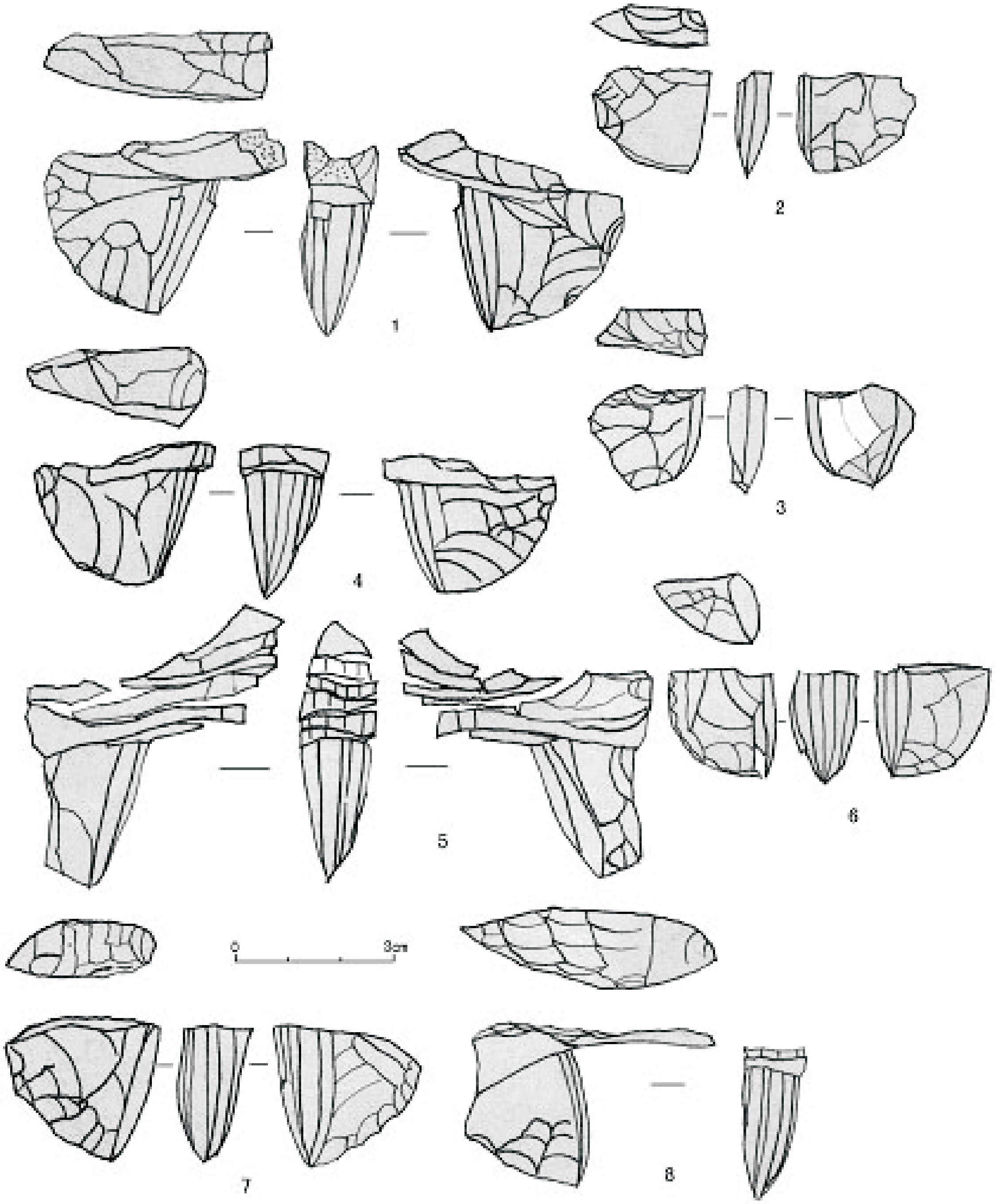

Figure 2.16: Wedge-shaped cores from Dry Creek (by courtesy of the Department of Anthropology, University of Alaska)**.**

ican Paleoarctic tradition seems too young to be a component of this tradition (Mobley 1991). However, this author includes the Campus site into this tradition based on the fact that the Campus core has been a representative of this tradition (Figure 2.17).

Several microblade assemblages along the Northwest Coast characterized by a slightly more recent chronology include Namu, Queen Charlotte Islands (or Haida Gwaii; see Magne and Fedje, this volume), Heceta Island, San Juan Islands, and Cadboro Bay. Microblade assemblages found on the Columbia Plateau were attributed by Sanger (1968a, 1969, 1970a, 1970b) to the Plateau Microblade tradition. They include Ryegrass Coulee, Drynoch Slide, Morron Lake, Windy Springs, and the Lochnore-Nesikep locality.

METHODOLOGICAL REMARKS

Comparative analysis of microblade cores involves several aspects, including raw material, typology, technology, platform edge angle variation, and core dimension. A brief discussion of these aspects is as follows.

Raw Materials

Analysis of raw material variation and spatial distribution will be helpful in assessing such important issues as technological tradition and mobility. Goodman (1944:416) pointed out that "the choice of a certain material may be purely a matter of tradition." This statement is partly true because the selection of a desirable raw material is crucial for a distinct technique or for producing specific

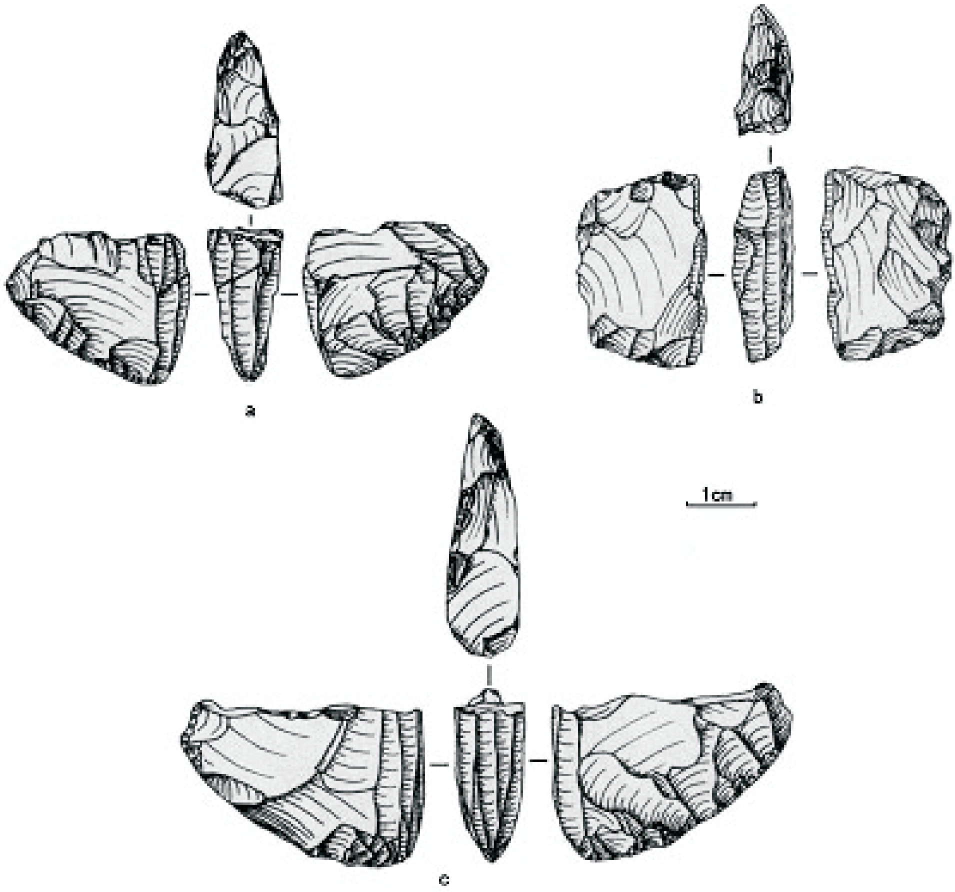

Figure 2.17: Wedge-shaped cores from the Campus site (after Mobley 1991)**.**

tool types. Therefore, a study of technology is not complete without knowing the properties of the raw materials and their influence (Crabtree 1967; Straus 1980; Torrence 1989). On the other hand, inaccessibility of certain raw materials may play a great role in technological change, since technology will be adjusted to fit the specific constraint of a particular situation. In North America, evidence indicates that change in technological tradition might have been a result of a change in lithic quality during the Paleoindian stage (Hayden 1981).

In terms of the relationship to the environment, Hayden (1989) regards lithic raw materials as similar to plant food resources. Suitable raw materials for a distinctive technology or for a specific task are not ubiquitous in the environment. The procurement of desirable raw materials is not a big problem for highly mobile groups but will greatly influence less mobile groups. For the latter, especially those in complex societies who lived in an area lacking suitable materials, long distance transportation and exchange of good quality materials may be inevitable if they want to keep using sophisticated lithic technology. Other adjustments may include the procurement of local materials of quality and economizing the use of desirable materials.

Microblade manufacture can be seen as a kind of highly curated technology. Fine-grained raw materials of good quality might have been crucial to the operation of certain specific techniques of core preparation and microblade reduction. On the basis of his wedge-shaped core reduction experiment, Tabarev (1997) made a comment on the effect played by raw material in microblade reduction and core dimension. The comparison of raw materials may give some insight into the analysis of core typology and technology and human subsistence patterns as well.

Core Typology

In my previous studies, I identified and classified six major microblade core types by examining microblade industries discovered in North China, Northeast Asia, and North America (Chen 1983, 1984). These types are the wedge-shaped, conical, cylindrical, semi-conical (tabular), boat-shaped, and funnel-shaped cores, although irregular forms and forms that fall between these categories can also be distinguished (Figure 2.18). The following is a detailed description of these six major core types.

The Wedge-Shaped Core

This core type is the first to have been identified and is the most extensively studied. There are several alternative names given to these cores, but wedge-shaped is the most widely accepted one and used by archaeologists. The wedge-shaped core is a broad typological category, which refers to the product of different manufacturing processes or techniques, that result in cores that are morphologically similar. Hayashi (1968), Morlan (1970), Sanger (1968a), and Mobley (1991) have provided detailed morphological descriptions of these cores. Here I quote Morlan's definition as an example.

> Wedge-shaped cores have elongate platforms, but the fluting chord is in the short axis of the platform and the flutes are marginally distributed. The broad faces of the specimens are irregularly flaked, and the margin opposite the fluted surface may form either a wedge or a flat surface of some kind (Morlan 1970:18).

It should be noted that the description of wedge-shaped cores given by Morlan (1970) is based mainly on specimens found in North America and Japan. An additional form of wedge-shaped core which is overlooked by Morlan contains an elongate fluted surface, a wedged keel and a short platform which I have called narrow-bodied wedge-shaped core. This form of wedge-shaped core is not the exhausted stage of microblade reduction. Many core preforms give evidence that this is a unique style of this core type.

The Conical Core

This type of microblade core normally has a circular or oval platform with flutes formed on part of the core body. In some, the core body tapers sharply downward to form a point. Thus this type of core is also called a pencil-shaped core (Jia 1978). In other specimens, the body runs parallel

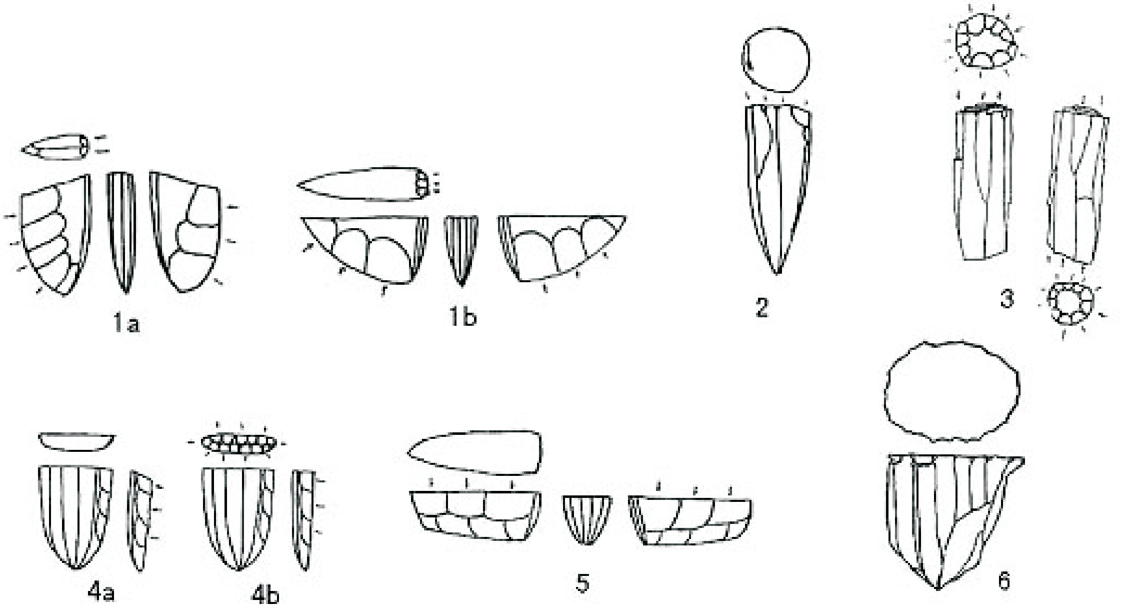

Figure 2.18: Schematic drawing of six major types of microblade cores.
1a. narrow-bodied wedge-shaped core; 1b. broad-bodied wedge-shaped core; 2. conical core; 3. cylindrical core; 4a. semi-conical core with an untrimmed platform; 4b. semi-conical core with a trimmed platform; 5. boat-shaped core; 6. funnel-shaped core. No scale given.

to the long axis and then tapers to a point near the distal end. These are sometimes called prismatic cores (Chard 1962).

The Cylindrical Core

Maringer (1950) and Morlan (1970) placed "cylindrical" and "conical" cores in the same category. In my classification, however, I propose to use the term cylindrical core to define a core type which has a platform on each end and from which microblades were removed alternatively from end to end. This may represent an attempt to rejuvenate a platform on the distal end after the failure of the original platform. However, evidence indicates that they are a distinct core type due to the fact that some core preforms from Inner Mongolia exhibit a prepared platform on each end.

The Semi-Conical Core

This core type is called "tabular core" in North America. In China, we call it semi-conical owing to the fact that this type of core usually has a flat (either an untrimmed cleavage or a trimmed plane) surface opposite to the fluting chord, somewhat like a conical core cut in half in the middle. Exhausted specimens are often thin and quite flat in the cross-section. Morlan has described it as follows:

> Tabular cores have elongate platforms on which the long axis parallels the fluting chord. The fluting chord is a straight line or plane which lies between the ends of a restricted fluting arc. In tabular cores the flutes may be said to be facially distributed in the sense that they occupy a broad face of the specimen. Adjacent smaller faces are irregularly flaked as is the broad face opposite the fluted surface (Morlan 1970:18).

The Boat-Shaped Core

This name has sometimes been used as an alternative one for wedge-shaped cores (Hayashi 1968).

I propose to restrict the term boat-shaped cores to those having a broad body and an untrimmed platform. The two side faces of the core are formed by blows struck on the platform, which consists of either a cleavage plane or a single flake scar. Thus, wedge-shaped and boat-shaped cores are technologically different. The side faces of the wedge-shaped core are mainly formed by flake scars that originate at the keel margin. Morlan (1967) named the manufacturing process for boat-shaped cores the "Horoka technique".

The Funnel-Shaped Core

This type of core has a wide round platform, which is either trimmed or untrimmed. The diameter of the platform is always longer than the height in the initial stage of microblade reduction. The manufacturing process is similar to conical cores, but they have much broader platforms than conical cores. Microblades have been removed from the edge around the perimeter of the platform. The bottom or distal end of the core is either an intact small plane or obtuse point.

Core Technology

Technological attributes are used as a second step in classifying wedge-shaped cores according to their manufacturing patterns. These patterns include preform and platform preparation and platform rejuvenation. Blank shaping and preform preparation is the first step of microblade manufacture and is directly related to the removal process. It constitutes an important element of morphological classification. The platform is one of the most important aspects of core technology. In wedge-shaped cores the patterns of platform preparation and rejuvenation are the main criteria for distinguishing different techniques of core styles.

Edge Angle and Dimensional Variation

Platform edge angle plays an important role in reflecting the technical skill of microblade makers, although the microblade cores examined here are all discarded ones and the measurements derived from these cores might not have represented the effective range of edge angles in microblade reduction. Various kinds of factors could have influenced the abandonment of cores which was not always due to the failure of its edge angle. For instance, access to raw materials must have been an important consideration before a core was discarded. As noted on many specimens, step fractures on the fluted surface may have made microblade removal impossible, despite the fact that the edge angle was still effective. Generally, the more obtuse an edge angle, the more difficult it is for a flake or blade to be removed. Interestingly, Callahan (1984) found that the edge angles of one Danish microblade core ranged from 90° to 113° and that on the basis of experiments, the practical limit of microblade removal could reach around 110°. He also pointed out "rejection will occur because either platform preparation or blade removals fail to maintain a slightly convex blade face, especially at the proximal end, regardless of the degree of obtuseness of the platform angle. However, as that angle approaches 115°, the time of maintenance, or rate of failure, will increase so rapidly that continued production may not be feasible" (Callahan 1984:95).

As far as core dimension is concerned, most examined microblade cores are discarded ones and represent different stages of microblade reduction. Therefore, dimensional comparisons between different cores might not be meaningful. However, judging from the microblade sizes produced from these cores, we can ascertain that cores of different sizes might have been specifically designed to produce the desired products. The only problem is that we are unable to compare these cores by using a uniform rule due to their different processual stages.

The size and quality of raw materials has a direct effect on the form of the finished product (Jelinek 1976). Tabarev (1994) mentioned that raw materials played an important role in the technological characteristics of microblade industries. Because of the availability of large blocks of obsidian, microblade industries in northern Japan contain larger wedge-shaped cores. Continental Far Eastern industries in Russia utilized smaller nodules of chert, flint, jasper, and flinty tuff. Therefore, the microblade cores are relatively smaller. From my examination, the relatively small size of microblade cores from the Xiachuan and the Xueguan sites in North China might not have been influenced by the size of raw materials, because there were plenty of large chunks of chert available at the sites. In this case, it seems that core dimension might have been determined by other factors such as function, technology or even cultural tradition.

COMPARISON OF RAW MATERIALS

China

The raw materials employed to make microblades in North China are mainly chert, although those from Chaisi, the earliest microblade locality so far found in China, are made of hornfels. Other siliceous rocks such as tuff, rhyolite, agate, chalcedony, crystal, obsidian, and opal, were sporadically utilized at different localities. In the Nihewan Basin, a kind of fine-grained quartzite was a main raw material used to produce microblades in the Hutouliang and the Jiqitan assemblages.

In East China, chert is the predominant raw material employed to produce microblades in the region of the Maling Mountains and the Yi-Shui rivers valley. Other raw materials include chalcedony, agate, crystal, and slate.

Japan

In Japan, obsidian is the dominant raw material used in microblade production. At Fukui Cave, high-quality obsidian was employed (Tachibana 1979:109). At the Yasumiba site, 94% of the microcores were made on obsidian. Very few were made on shale, crystal, and silicified wood (Suzuki 1979:109). Microblade remains and other stone tools in northern Hokkaido were mainly manufactured of obsidian, while those in southwestern Hokkaido and northern Honshu are of shale (Morlan 1967; Serizawa and Ikawa 1960:6).

Korea

Shale served as the main raw material for making stone artifacts at the Suyanggae site (Lee 1989b). Although the author does not mention specifically the raw material for microblade production, it seems that all products of the lithic industry were made of the same raw material.

Eastern Siberia: The Dyuktai Culture

Raw materials of the Dyuktai culture are flint, jasper, chalcedony, or some other fine-grained siliceous materials (Flenniken 1987:118). At the Ushki Lake sites, microblades were made on flint, black andesite, chalcedony, obsidian, grey siliceous slate, and grey silicified argillaceous shale (Dikov 1968:194; Powers 1973:83).

North America

Raw materials used in the assemblages of the American Paleoarctic tradition are mainly chert. Very few specimens were made on jasper, obsidian, chalcedony, argillite, and basalt.

In the assemblages of the Northwest Coast, raw materials used to produce microblades were different from place to place. At the Namu site, they include andesite, obsidian, and milky quartz. The complete microcores are all made on andesite. The presence of many obsidian microblades and microflakes led Carlson to suggest that when obsidian microcores were exhausted, they might have been used to produce microflakes by means of bipolar percussion (Carlson 1979, personal communication 1988).

On the Queen Charlotte Islands, argillaceous slate was the common material for microblade production at the Lawn Point site, while chert is the dominant one in the Kasta assemblage (Fladmark 1986:45, 53).

At the Chuck Lake site, fine-grained argillite of black, white, green, and reddish brown colours account for nearly 90% of the sample. Other less frequent materials include obsidian, vein quartz, marble, and chert (Ackerman *et al.* 1985:128).

On the San Juan Islands, raw materials selected for the production of microblades were quartz crystal and obsidian (Carlson 1960). In 1967, Sanger (1968a) found an obsidian microcore during a re-examination of the San Juan Islands collection.

Microcores found at the DcRt–15 site near Cadboro Bay were all of basalt. The presence of a considerable amount of quartz and obsidian microblades indicates that these two materials were also important in local microblade production (Sanger 1968a:105).

Microblade assemblages found on the Columbia Plateau were attributed by Sanger (1968a, 1969, 1970b) to the Plateau Microblade tradition. Basalt was the dominant material used to produce microblades at Marron Lake and the Lochnore-Nesikep locality. At Ryegrass Coulee, Drynoch Slide, the raw materials utilized for microblade production were chalcedony and chert. In central British Columbia, obsidian was the commonly used material (Sanger 1968a).

SPATIAL AND TEMPORAL CHANGES OF CORE TYPOLOGY

China

In North China, the two chronologically earliest sites in Shanxi Province, Chaisi Locality 77.01 at Dingcun and Xiachuan, contain diverse types of microcores. At Chaisi, conical, wedge-shaped, and boat-shaped cores were found. Five microcore types were identified at Xiachuan, including conical, wedge-shaped, boat-shaped, funnel-shaped, and semi-conical types. Conical cores outnumber other core types. Only two core types, wedge-shaped and boat-shaped cores, were identified at Xueguan (Shanxi Province). At Shizitan (Shanxi Province), wedge-shaped, boat-shaped, conical, and funnel-shaped cores were recorded. Microcores from Hutouliang and Jiqitan (Hebei Province) are all wedge-shaped, indicating typological specialization of microblade production. Other North Chinese sites yield a mixture of core types with wedge-shaped, boat-shaped, and conical cores being the three most prominent types.

Japan

Microcores found in layer 4 at Fukui Cave are identified as conical, semi-conical, and cylindrical. Those from Yasumiba can be included in the same category. These cores are either of a rectangular, a short equilateral triangle, or an elongated trapezoid form in cross-section (Hayashi 1968; Kobayashi 1970). I prefer to include all of them in the conical type category.

Microcores found in layers 3 and 2 at Fukui Cave are wedge-shaped (Kobayashi 1970), although some authors refer to them as boat-shaped (Hayashi 1968; Aikens and Higuchi 1982).

There are three core types so far identified in northern Honshu and Hokkaido: wedge-shaped, conical, and boat-shaped. Because of inaccessibility to original data, a comparison based on quantity is impossible here.

Eastern Siberia and the Russian Far East

The wedge-shaped core is the only type identified at the various sites of the Dyuktai culture. Then, about 10,000 years ago, wedge-shaped cores were replaced by conical and cylindrical cores of the Sumnagin culture (Powers 1973). Although no explanation is available about this replacement, the cultural change may have been caused either by a new adaptation in the Early Holocene or by the invasion of immigrants with different microblade techniques.

In the Russian Far East, microcores from the Ustinovka and Suvorovo sites are boat-shaped. These cores seem fairly large and share some similarities to the Horoka core in northern Japan (Powers 1973; Tabarev 1994).

North America

The American Paleoarctic Tradition

Microcores found in the assemblages of the American Paleoarctic tradition are all wedge-shaped forms. The majority of them are broad-bodied with the exception of a few specimens with a narrow body.

Coastal Microblade Assemblages

Microcores found in the assemblages along the Northwest Coast have generally similar attributes. No specific typological designation has been given to these cores. Morphologically, these cores most closely resemble the boat-shaped or funnel-shaped cores of East Asia.

The Plateau Microblade Tradition

Like their counterparts from coastal microblade assemblages, no typological term has been given to microcores from the Columbia Plateau. Sanger stated: “In the north use has been made of terms such as ‘wedge-shaped’ and ‘tongue-shaped’ to describe microblade cores. Although I have employed the term 'tongue-shaped' to describe microblade cores from British Columbia, I now feel it is undesirable to place the Pacific Northwest cores into name types" (Sanger 1968a:94).

TECHNOLOGICAL COMPARISON OF WEDGE-SHAPED CORES

As the wedge-shaped core is a distinctive type widespread both in East Asia and North America suggesting a cultural relationship, the comparison of microblade technology will mainly focus on this core type.

China

Several major northern Chinese sites yielding a large number of wedge-shaped cores are selected here for detailed comparison. They are Chaisi, Xiachuan, Xueguan, Hutouliang, Shizitan, and Jiqitan.

Chaisi Locality 77.01 at the Dingcun sites

Two wedge-shaped cores from Chaisi are broad-bodied forms. On one specimen, a natural triangular chunk appears to have been used as a preform to detach microblades directly. No trimming was made to prepare either the chunk or the platform. The other specimen was bifacially shaped to form a keel. The platform is a natural cleavage plane. No rejuvenation was conducted to adjust the edge angle on the platform.

Xiachuan Industry

Two processes of core preparation were used on both broad-bodied and narrow-bodied cores. The first process began with platform formation. The platform usually consisted of a single flake scar or a cleavage plane. The core body was then bifacially or unifacially worked to shape a keel. Trimming was used to adjust the edge angle. Like the two wedge-shaped cores from Chaisi, this process was somewhat similar to that used for boat-shaped cores, but there are differences that can be observed. First, the body was mainly shaped from the keel rather than from the platform; second, the platform is much more narrow than that of boat-shaped cores; and third, the platform was sometimes trimmed to adjust the edge angle.

The second process was one in which the body was formed first. Cores were bifacially or unifacially prepared, then transversal or longitudinal blows were made on the top to produce either a bevelled or a level platform. Finally, longitudinal trimming was conducted to adjust the edge angle.

Chen and Wang (1989:145) defined the Xiachuan technique based on wedge-shaped core technology at the Xiachuan site: "Small chunks or flakes were prepared unifacially or bifacially to form a keel edge. Natural planes (cleavage or flake scar) or transversely flattened surfaces were used as a platform and then trimmed from the front to adjust the edge angle." The large cores from Xiachuan are all preforms.

Xueguan Industry

Wedge-shaped cores from the Xueguan site are all broad-bodied forms produced by using the Xiachuan technique. Most specimens were bifacially prepared. Some have double fluted surfaces. Like Xiachuan, large cores from Xueguan are preforms.

Hutouliang Industry

Wedge-shaped cores from Hutouliang show diverse patterns of core preparation and platform rejuvenation. One prominent feature is that most core preforms were bifacially prepared. Several core techniques were identified and defined by Gai (1984) and Tang and Gai (1986). A detailed description of the four techniques is as follows (see Chen and Wang 1989:144):

A. The Yangyuan technique: Natural chunks or thick flakes were unifacially worked to prepare a more or less D-shaped preform. A series of blows were directed from the lateral edges to shape a flat platform, then longitudinal blows were delivered from front to back or a tablet was removed and stopped at a notch which was transversely prepared on the upper edge of the platform.

B. The Hutouliang technique: Wedge-shaped cores were unifacially prepared to make D-shaped preforms in cross-section. The platform was trimmed by transverse blows from one side and was usually bevelled. Rejuvenation of platforms was a successive process carried out in the course of microblade reduction.

C. The Hetao technique: This technique employs bifaces as core preforms. The platform was prepared by the removal of several ski-like spalls to shape a smooth plane passing through the entire lateral edge. Then microblades were detached from one end of the core without any further platform rejuvenation. This technique is similar to the Yubetsu technique in Hokkaido.

D. The Sanggan technique: Core preforms were bifacially worked to a biconvex shape. Small spalls were taken off the tip of the blank to form a narrow platform. Microblades were removed from the front of the platform. Successive rejuvenation of the platform was carried out during microblade reduction. This technique is basically identical to the Oshorokko technique in Hokkaido.

Jiqitan Industry

The technology of wedge-shaped cores of Jiqitan shows many similarities with that of Hutouliang due to their close geographic location, using the same raw materials and of similar chronological placement. Broad-bodied and narrow-bodied forms were identified and accounted for 91.3% and 8.7% of cores respectively. In addition to those prepared by the Xiachuan technique, the Yangyuan, the Hutouliang, the Hetao, and the Sanggan techniques, several broad-bodied wedge-shaped cores contain a body either bifacially or unifacially prepared, a platform consisting either of a cleavage plane or a single flake scar. No edge angle trimming or adjustment was made during the process of microblade reduction. This manufacture process is similar to the Xiachuan technique in core preparation and similar to the Hetao or the Yubetsu technique in microblade reduction.

Most narrow-bodied cores were bifacially prepared, showing a keel basically parallel to the platform and giving a tongue-shaped appearance. Their platforms are rather small and consist of a single flake scar and were never trimmed during microblade reduction.

Japan

Fukui Cave

According to Hayashi (1968:140, 149), the wedge-shaped cores from Fukui Cave were bifacially or unifacially prepared. Three patterns of platform preparation and rejuvenation were identified: (1) platform laterally retouched by multiple flaking; (2) platform formed by multiple flaking at apex; and (3) platform retouched by a longitudinal blow. He called this technique "the Fukui technique."

Another technological term for the Fukui cores is "the Saikai technique" (Akazawa *et al.* 1980; Ambiru 1979). To avoid confusion, I prefer to use the term Fukui technique.

Hokkaido

The four wedge-shaped core techniques identified in Hokkaido are Yubetsu, Togeshita, Oshorokko, and Rankoshi (see also Chapter 4). Morlan (1967:177) translated Yoshizaki's (1961) definition of the Yubetsu technique as follows:

> Beginning with a thick bifacial point, blows are struck longitudinally on the tip of the points so that long narrow flakes are removed from the edge. These flakes are rectangular in cross-section except for the first one which, of course, has a triangular cross-section since it bears the edge of the original biface. These flakes are called ski spalls since they more or less resemble skis. By the time several such ski spalls have been removed the biface has begun to look half its original size, as if it were cut in two longitudinally. The new flat blows are struck at a right angle to the long axis of the original biface. These blows cause the removal of long, thin, narrow (prismatic) flakes resembling microblades, and removal of these flakes gives the end of the biface (core) a fluted appearance.

Morlan (1976:99) outlines the Togeshita technique on the basis of Yoshizaki's (1961) description:

The ventral surface of the flake is nearly always the reverse face of the core, though it occasionally forms the obverse face, and it receives little or no facial retouch. The platform is produced by a burin blow along one long margin and spans 50–100 percent of the platform element. The obverse-reverse junction in the platform element, when it occurs, is a unifacially flaked edge on which the flaking sometimes becomes so steep that it can be described as a laterally flaked part of the platform itself. More frequently, however, the platform consists entirely of a longitudinal burin facet on the proximal end of which blows are struck to remove microblades.

Morlan (1967:188) translated Yoshizaki's (1961) description of the Oshorokko technique as follows:

> They are made on heavy bifacial points by first striking a single blow on the tip and then, using this first facet as a platform, by striking several diagonal blows in the opposite direction on the tip. The result is a burin with a single facet on one edge and multiple facets on the other.

The definition of the Rankoshi technique is as follows:

> This technique began with the preparation of a bifacial preform which was split in half along the short axis. A side blow was then delivered along part of the edge to shape the platform (Chin-Yee 1980:23; Tsurumaru 1979:33).

Korea

Wedge-shaped cores from the Suyanggae site were produced by several different techniques, resembling their counterparts in North China and Japan. However, they also contain some of their own attributes. The Hetao or the Yubetsu technique is the most prominent feature of the Suyanggae industry.

Except for those made by the Hetao or the Yubetsu technique which show very careful bifacial preform preparation, the other wedge-shaped cores were all made on large flakes prepared bifacially or unifacially. The majority of platforms consist of either a cleavage plane or a flake scar formed by a single longitudinal blow, except for one broad-bodied core which shows longitudinal rejuvenation near the fluted surface. These specimens were produced by a technology resembling the Xiachuan technique in northern China.

One narrow-bodied wedge-shaped core was unifacially prepared. The other side of the body is a cleavage plain with a few small flake scars along the keel. The platform is a cleavage plane as well. No platform rejuvenation was carried out during the process of microblade reduction. Lee (1989a) regarded this core technology as resembling the Saikai or Fukui technique in Japan. However, its platform technique differs from that of the Fukui core.

Eastern Siberia: The Dyuktai Culture

Flenniken (1987) defined the Dyuktai technique based on his technological study of the wedge-shaped cores from Dyuktai Cave, Ust-Mil, Ezhantsy, Ikhine II, and Verkhne-Troitskaya in eastern Siberia. The manufacturing process of the Dyuktai technique is summarized based on Flenniken's description (1987:118, 121):

> A biface was produced by direct freehand percussion… When preforms were finished, heat treatment was employed to some specimens to improve the flakeability of the lithic materials… With the blade core platform completedafter the removal of the ski spall, blades were then removed by pressure from the core.

Obviously, the Dyuktai technique is similar to the Hetao or the Yubetsu technique in northern China and Hokkaido.

It is noteworthy that one broad-bodied wedge-shaped core from Verkhne-Troitskaya appears to have been produced with the Xiachuan technique. Its platform was prepared by multiple transversal flaking, then trimmed by longitudinal blows from the fluted end (see illustration in Mochanov 1978:65).

No detailed description is available for wedge-shaped cores from the Ushki Lake sites, however, some general technological attributes can be observed based on the artifact illustrations (Dikov 1985, 1996; Powers 1973). The preforms of wedge-shaped cores exhibit careful bifacial or unifacial preparation. The presence of a large number of ski spalls and core tablets indicates that removal of ski spalls and tablets was the common technique utilized in platform preparation and rejuvenation.

Generally, three wedge-shaped core techniques were identified in the Dyuktai culture. They are the Dyuktai or the Hetao and the Yubetsu technique, the Xiachuan technique, and the Yangyuan or the Togeshita technique. The Dyuktai technique was the most commonly used technique in Eastern Siberia.

North America

The American Paleoarctic Tradition

Wedge-shaped cores of the American Paleoarctic tradition reveal fairly homogeneous attributes and many authors have provided detailed descriptions of their morphology and technology (Anderson 1970a, 1970b; Cook 1968; Morlan 1970, 1976; West 1967, 1981; Mobley 1991). Morlan (1970) defined the Campus technique for this type of wedge-shaped cores. The following description was provided by Henn (1978:61):

> These were most commonly fashioned by bifacially flaking a thick flake to form a keel on the end opposite where microblades were to be removed. The platform was created either by extensive retouch or by removing a large flake (core tablet) from the edge adjacent to the keel. Rejuvenation of the core for further removal of microblades was done by removing another core tablet from the platform or by extensively retouching the platform.

Based on the preceding description, we can see that the Campus technique is similar to the Yangyuan, the Fukui, and the Togeshita techniques in North China and Japan rather than to the Dyuktai technique in Eastern Siberia.

Northwest Coast and Columbia Plateau

Microblade cores from the Northwest Coast and Columbia Plateau look very similar in morphology and technology. Morlan (1970) defined the Lehman technique for these cores. The following description was provided by Sanger (1968a:114, 1970b:108):

> Microblade cores utilized a weathered surface for a striking platform which is usually modified only at the core edge. Multiple blow striking platform preparation is scarce, and core rejuvenation tablets are not known.

Morlan (1970) contends that the nature of the lithic raw material predetermined the form of the core, and that the particular sequence of element formation was not especially important.

Dimensional Comparison of Wedge-Shaped Cores

Microcores found in archaeological contexts may represent different stages of reduction. Some are preforms and some exhausted or discarded cores. Therefore, the measurements of specimens may not be comparable in terms of a dynamic perspective. However, dimensional measurements will give us a general impression of the appearance of wedge-shaped cores of different industries.

In this article, I propose to use a “dimensional index” to express core sizes. The dimensional index of a wedge-shaped core is the sum of three measurements, the maximum length, width, and height of a core. I would like to set up a subjective criterion of index 8 cm for dividing large and small cores. Large cores are those with indices 8 cm and larger, and small cores yield indices 7 cm and less. Sites selected for comparison are those yielding specimens available for measurement. In Eastern Siberia, only wedge-shaped cores from the Dyuktai culture are presented for comparison. In North America, only those from sites of the American Paleoarctic tradition are selected.

SYNTHETIC DISCUSSION

Based on comparisons of microblade technology between East Asia and North America, we suggest that microblades might have been extremely effective and efficient implements favoured by various foraging groups during the Late Pleistocene and Early Holocene in high latitude regions. Blade technology is widely regarded as having many advantages, such as the economic use of raw material. This might have been more important to foragers where raw material was at a premium due either to the scarcity of suitable stone or to limitations imposed by high residential mobility (Bar-Yosef and Kuhn 1999). Like blade technology, the spread of microblade technology may well be related to hafting and the manufacture of composite tools. Microblades are usually too small and narrow to have been hand-held tools. Although it required a greater investment of time and energy, microblade technology might have afforded users increased effectiveness in the procurement and processing of resources.

With regard to hunter-gatherer adaptations, economic risk, and tool design, Bousman (1993) listed four strategies of tool design: expedient tool, maintainable tool, reliable tool, and efficient tool. Reliable tools refer to weapons often functionally specialized and characterized by extra-sturdy construction, over-designed critical parts, high quality fitted parts, and a special repair kit. Reliable tools are used when the risk is great. Efficient tools could decrease the cost of raw material acquisition and the best example is blade technology. It could be argued that microblade technology represents a combination of reliable and efficient tools which were adopted by hunter-gatherers living in environments full of risk and a shortage of good quality raw material.

The increasing domination of wedge-shaped cores in North China, Japan, Korea, Siberia, and Alaska, may have reflected a trend towards standardization and craft specialization of microblade manufacture. Using various types of microcores at a site or at different sites may indicate a process in which individuals had multiple choices. The spatial and temporal predominance of wedge-shaped cores both in East Asia and North America may have been related to a kind of occupational differentiation and craft specialization. The advantage of using wedge-shaped core technology may also tie into other aspects such as their more economic or efficient characteristics compared to other core types with regard to raw material consumption and favouring a specific device (clamp) to hold a core without movement (e.g., Tabarev 1997). The uniformity of wedge-shaped core technology could be seen as both traditional affinity and significant technical success.

Raw Materials

Microblades in East Asia and northwestern North America were predominantly made from good quality microcrystalline silicate minerals such as chert, flint, obsidian, and chalcedony. Some kinds of softer or coarser lithic raw materials such as hornfels, shale, basalt, and argillite, were also used in certain industries.

Chert and flint are the most common raw materials encountered at many sites in China, most Dyuktai culture sites, and almost all American Paleoarctic tradition sites. A fine quality quartzite was predominantly utilized at the Hutouliang and the Jiqitan localities. Quartzite is coarser but workable like chert. In Northeast China and some other parts of China, a series of Mesozoic-Tertiary rocks and minerals such as chalcedony, argillite, agate, and jasper, were widely used.

Obsidian is the predominant raw material in Japan and also commonly encountered in some northwestern North American assemblages, especially in the regions of the Pacific coast and Columbia Plateau. Hard shale was used in Korea, southern Hokkaido, and northern Honshu.

Basalt is a young magmatic rock with rough, uneven fracture characteristics. It is a raw material commonly encountered on the Pacific coast and Columbia Plateau of North America.

Generally, the technologically most suitable raw materials for microblade production include chert, flint, chalcedony, obsidian, jasper, agate, and high quality quartzite. Microblades were also made of some relatively poor quality stones such as hornfels, shale, basalt, and argillite, and certain delicate techniques were obviously unworkable using these materials, especially very delicate platform rejuvenation. The resultant cores sometimes exhibit a rather crude appearance.

Selection of certain raw materials might reflect the adaptation and mobility of ancient microblade using groups in different regions, and utilization of certain coarse raw materials would have had an obvious impact on the performance of certain core techniques.

Core Typology

Core typology is regarded as an important factor in tracing contacts or relationships. Typological variation of microcores is thought to be stylistically significant.

In northern China, conical, boat-shaped, and wedge-shaped cores are the three most common core types in the early microblade industries such as Chaisi and Xiachuan, and the percentage of wedge-shaped cores is relatively low in comparison with the other two types. This phenomenon is, to a degree, also present in Japan. Conical and boat-shaped cores are two early core types encountered in the north of Japan. Conical cores are so far unknown in the more recent microblade assemblages of Japan and North America.

In later times, core typology exhibits a trend of specialization and differentiation. The wedge-shaped core became the predominant core type at the Xueguan, Hutouliang, and Jiqitan sites in northern China. The boat-shaped core became the predominant type at the Yaozitou, Donghuishan, and Tingsijian sites in northern China.

The exclusive use of wedge-shaped cores in the Dyuktai culture, layers 3 and 2 in Fukui Cave, and Senpukuji Cave (see Tang 1985), the Shirataki site cluster on Hokkaido, the Suyanggae site in southern Korea, and in the American Paleoarctic tradition in North America should not be seen as a coincidence with North China.

During the more recent period, wedge-shaped, conical, and semi-conical cores constitute the most frequent typological group in microblade assemblages in northern China.

No specific typological terms have been given to microcores found on the Pacific coast and the Columbia Plateau. The amorphous appearance of these cores might be related to the technological constraints imposed by a shortage of high quality raw materials, perhaps reflecting the lesser mobility or local adaptation of prehistoric hunter-gatherers in these regions.

Core Technology

Technological investigation is considered to be an important supplement to typological studies. The reconstruction of core techniques is regarded as a crucial step in identifying fundamental similarities between morphologically similar cores. The following discussion focuses on wedge-shaped cores.

Wedge-shaped cores from Chaisi, Xiachuan, and Xueguan were made with the Xiachuan technique which seems technologically simple. Those from Hutouliang and Jiqitan were made using various and more sophisticated techniques such as the Yangyuan, the Hetao, and the Hutouliang techniques. Using bifaces as the preform became very common. Various platform rejuvenation methods were employed during microblade reduction. The same phenomenon can be encountered in northern Japan, Korea, and the Dyuktai culture of Eastern Siberia. The Hetao or the Yubetsu technique was widely used.

In North America, the Campus technique and the Lehman technique have been reported. The Campus core shares many similarities with its counterparts in East Asia.

Judging from the procedure of core preparation and platform rejuvenation, I suggest that the Xiachuan, Hutouliang, Yangyuan, Fukui, Togeshita, and Campus techniques are very similar. The principle difference between these techniques is in platform rejuvenation. The Xiachuan and Hutouliang techniques rejuvenated platforms by multiple faceting whereas the Yangyuan, Fukui, Togeshita, and Campus techniques rejuvenated platforms by removing one or more tablets in addition to multiple flaking.

The technical process of the Hetao, Yubetsu, and Dyuktai techniques is identical. These techniques occurred in northern China, northern Japan, Korea, and Eastern Siberia, but are poorly represented in North America, although a few specimens found in Alaska were thought by Morlan (1976:102) to be remarkably similar to the Yubetsu core.

The Lehman technique is quite different from the wedge-shaped core techniques in East Asia and the Campus technique in Alaska. It is possible that it represents a locally developed variant of microblade technology.

It can be concluded that the Xiachuan, Hutouliang, Yangyuan, Fukui, Togeshita, and Campus techniques could be considered a homogeneous technological complex, representing the most widespread and long-lasting wedge-shaped core technology, which extended from northern China to North America, and to the Qinghai-Tibetan Plateau during the Late Pleistocene and the Early Holocene.

Core Dimension

If we use an index of 8 cm to divide large and small cores, a dimensional comparison may provide an additional insight into the relationship between different microblade industries.

The size of wedge-shaped cores from the Late Pleistocene sites such as Chaisi, Xiachuan, Xueguan, and many other localities in northern China, is generally small. The percentage of large cores increased considerably at the Hutouliang and Jiqitan sites, even though most specimens yielding large indices are preforms (Table 2.1).

The percentage of large wedge-shaped cores from Japan, Korea, and the Dyuktai culture in Eastern Siberia is very high. Those from Hokkaido are extremely large due to the availability of good quality obsidian. The wedge-shaped cores from the American Paleoarctic tradition are relatively small. They look similar to those of the Late Pleistocene industries in northern China, but are much smaller than those of the Dyuktai culture and from Hokkaido (Table 2.2).

CONCLUSION

On the basis of the faunal and palynological research so far conducted in Northern Asia and northwestern North America, we can primarily ascertain that microblades in both regions might have represented a technology or a tool kit employed by hunter-gatherers who lived in extremely diverse and severe environments. During the Late Pleistocene, with a few exceptions, the climatic conditions in most parts of northern China, the Qinghai-Tibet Plateau, Mongolia, Japan, Eastern Siberia, and northwestern North America were dry, cold, and continental. The vegetation in these regions was characterized by tundra, steppe, desert, taiga, and forest-steppe. The climate did not change or become warmer until the Holocene. Thus, we could suggest that when microblade technology was flourishing during this period, very few floral resources were available for hunter-gatherers in these regions and that microblades might have represented a technology exploiting mainly faunal resources. Animal resources were usually available year-round and easy to locate, procure, and process as opposed to plant resources in an unknown region. Microblade technology and the subsistence pattern allowed hunter-gatherers to occupy new territories or environments. They did not require new technological adjustments to continue their hunting-gathering lifeways.

Kelly and Todd (1988) pointed out that Late Pleistocene and Early Holocene climatic fluctuations and environmental changes produced periodic declines in local game populations which would impose stress on prehistoric hunting groups. These groups could have coped with periodic resource stress in two ways: switching to different resources in the same territory, or switching territories. In the northern territories, there may not have been adequate plant resources to exploit and changing the territory by migrating may have been the only choice available.

An examination of the selection of raw materials and the curation of lithic technology can help to differentiate between the mobility patterns of hunter-gatherers since recent research into their technology has indicated that mobility and scheduling are the factors that most influence the organization of technology (Koldehoff 1987). High mobility requires a portable technology which allows knappers to produce enough tools from a small amount of good raw material or to manufacture a standardized tool kit that is long lasting and multifunctional (Parry and Kelly 1987). At the same time, a standardized core technology such as microblade technology requires good quality materials.

In contrast, low mobility or sedentism poses other problems. As sedentism increases, tool mak-

Table 2.1: Dimensional comparison of wedge-shaped cores from some major sites in China.

Site	Chaisi	Xiachuan	Xueguan	Hutouliang & Jiqitan	Lingjing	Dafa	Dabusu
Index	7-5	9-4	11-4	13-4	6-4	5-4	6-4
Number	2	19	19	64	2	3	2
Big cores	0%	32%	11%	41%	0%	0%	0%

Table 2.2: Dimensional comparison of wedge-shaped cores from Japan, Korea, Eastern Siberia and North America.

	Japan		Korea	E. Siberia	North America
Site	Fukui	Hokkaido	Suyanggae	Dyuktai	Amer. Paleoarctic trad.
Index	10-5	28-7	15-5	13-6	13-4
Number	23	24	13	46	120
Big cores	57%	98%	77%	61%	10.5%

ers may face raw material depletion within their immediate living areas or face restricted access to necessary resources. Knappers have to resort to using inferior materials or alter the stone to improve its quality (Lurie 1989). On the other hand, increasing sedentism reduced the need for more costly, standardized, portable tools, and expedient tools became more common.

It is reasonable to suggest that the relative consistency of raw material selection and wedge-shaped core technology in East Asia and North America was the result of high mobility and cultural contacts which finally led to the widespread occurrence of microblade remains in these large regions. The change in raw materials and the shift to an expedient technology on the Northwest Coast and the Columbia Plateau may have been a response to decreased mobility when microblade-using groups settled in these regions.

The relative stability of techno-typological attributes of wedge-shaped cores in East Asia and North America indicates a close interaction process. The techniques of Xiachuan, Hutouliang, Yangyuan, Fukui, Togeshita, and Campus share many fundamental similarities in the manufacturing process despite raw material differences. The Hetao, Dyuktai, and Yubetsu techniques may characterize the innovation and sophistication of microblade technology.

In contrast, typological and technical specialization or variation of microcores encountered in Eastern China and on the Northwest Coast and Columbia Plateau of North America may reflect an interruption of cultural interaction or technological attenuation in a region far from the parent tradition.

Metric attributes of wedge-shaped cores, to a certain extent, can provide historically meaningful information which is helpful in verifying cultural comparisons. Four main points are noted below:

(1) Techno-typological similarities of wedge-shaped cores between the Late Pleistocene industries in northern China and the American Paleoarctic tradition are further indicated by their dimensional consistency.

(2) Although the high frequency of large cores in the Dyuktai culture, Suyanggae, Fukui Cave, and Hokkaido may have been the result of either raw material or functional factors, this phenomenon indicates to a certain extent that the Campus core in Alaska is not an exact copy of the wedge-shaped core of the Dyuktai culture. This analysis further supports the argument that the Campus

technique differs in certain respects from the Dyuktai technique in the manufacturing process (Chen and Wang 1989).

(3) Obvious differences in core techniques and dimensions between Fukui Cave and Hokkaido support the assumption that wedge-shaped core technologies in southern and northern Japan had different origins.

It is reasonable to suggest that prehistoric microblade-using groups in East Asia and North America might have adopted a highly mobile subsistence pattern to cope with the uneven distribution and seasonal fluctuation of faunal resources. Adapting to a severe environment with only faunal resources available would force these microblade-using groups to shift their territories frequently, resulting in the widespread distribution of microblade remains. Trigger (1978) has noted that among less sedentary hunting groups, such as the Eskimo, basic tool assemblages range over vast distances cross-cutting obvious cultural boundaries due to unstable band composition and frequent contact. The distribution and similarity of wedge-shaped cores might provide a good example of such a mobility and subsistence pattern.

(4) It is still too early to determine the origin of microblade technology due to incomplete archaeological evidence. Microcores unearthed from Chaisi with the earliest absolute dating result show a fairly advanced technology. Therefore, we can ascertain that the origin of microblade technology must be earlier.

Judging from the widespread distribution of microblade remains, some scholars have argued that there might have been multiple inventions or parallel developments of microblade technology in China (Sichuan Field Team of the Institute of Archaeology 1991; Duan 1989; Li 1992). Although these scholars challenge the traditional model of migrationism or diffusionism, they do not provide us with either powerful archaeological evidence or sound theoretical explanations to support their argument. Due to the complexity and sophistication of microblade technology and extremely diverse environmental habitats, the distribution of microblade remains, especially wedge-shaped cores, was most likely the result of migration. To cope with faunal resources in different environments, prehistoric hunter-gatherers could adopt different ways to pursue them. Therefore, the environmental difference will more likely cause cultural differentiation or divergence rather than analogy or convergence. For this reason, the similarities of microblade technology in East Asia and North America might have had a common origin.

Microblades must have been multifunctional artifacts. The research of these distinct remains should shift from focusing on description and comparison of their techno-typological attributes to a concern of their functions and significance to human adaptation. Usewear and *chaîne opératoire* studies are certainly helpful to solve these problems. This further exploration could finally determine why this technology was so effective, widespread, and popularly employed by hunter-gatherers during the Late Pleistocene and the Early Holocene.

3

RE-EVALUATION OF MICROBLADE INDUSTRIES AND THE FENGHUANGLING CULTURAL COMPLEX IN SHANDONG PENINSULA, NORTHERN CHINA

Chen Shen

INTRODUCTION

The significance of studying microblade technology in northern China lies in the interrelationship of Late Pleistocene hunter-gatherers in northeastern Asia and northwestern America. Microblade technology is considered to be of compelling evidence for the peopling of the New World (West 1996a; Madsen 2004). From a regional perspective, the microblade technique reveals technological innovation or diffusion that illustrates the development of human adaptation in these cultural regions. However, where exactly this particular technology of making composite hunting tools originated in northeastern Asia is still open to question. Vast data of microblade assemblages have been accumulated over the past decades in northeastern Asia. These may allow us to understand technological variability during the Late Pleistocene in these regions, but first we have to clearly demonstrate these regional variations. This study will thus focus on microblade industries from one of these cultural regions – the Shandong Peninsula of eastern China (Figure 3.1).

Microblades, as a truly compositional tool type, appeared in Chinese archaeological assemblages at the end of the Late Pleistocene, as a result of sudden technological innovation and/or adaptation. Microblade remains in China first came to light when foreign explorations in the northwestern steppe areas took place at the beginning of the last century (Andersson 1923, 1945; Boule *et al.* 1928; Teilhard de Chardin and Pei 1944; Teilhard de Chardin and Yang 1932). Microblade remains recovered from scientific excavations in the 1930s were primarily associated with Neolithic materials in northern China (Liang 1959a, 1959b). Not until the 1970s were microblade materials from Late Pleistocene deposits recognized in northern China (Jia *et al.* 1972; Gai 1985). Over the last four decades, archaeological sites with microblade assemblages were identified in most parts of China, concentrated in three macro-regions: central-northern China, the northeastern and northern steppe, and southern and southwestern China (for syntheses, see An 2000; Chen 1984; Gai 1985; Lu 1998). A general survey of some of these discoveries is offered by Chen Chun in this volume.

Research on microblade assemblages with a Late Pleistocene archaeological context did not start until the late 1970s, when the Xiachuan site of southern Shanxi Province and the Hutouliang site of Hebei Province were excavated revealing substantial microblade remains (Gai 1985; Gai and Wei 1977; Wang *et al.* 1978). An Zhimin's study of the Haila'er assemblages established for the first time a framework for the study of Chinese microblade materials, providing a foundation for understanding the temporal and spatial distribution of microblade data accumulated in the years that followed (An 1978).

During the 1980s, new approaches were taken by researches studying Chinese microblade industries. From a technological-typological approach, Tang and Gai (1986) applied the methods developed in studies of Japanese microblades to analyses of the Hutouliang assemblages from the Nihewan Basin of northern China. They identified four microblade techniques representing

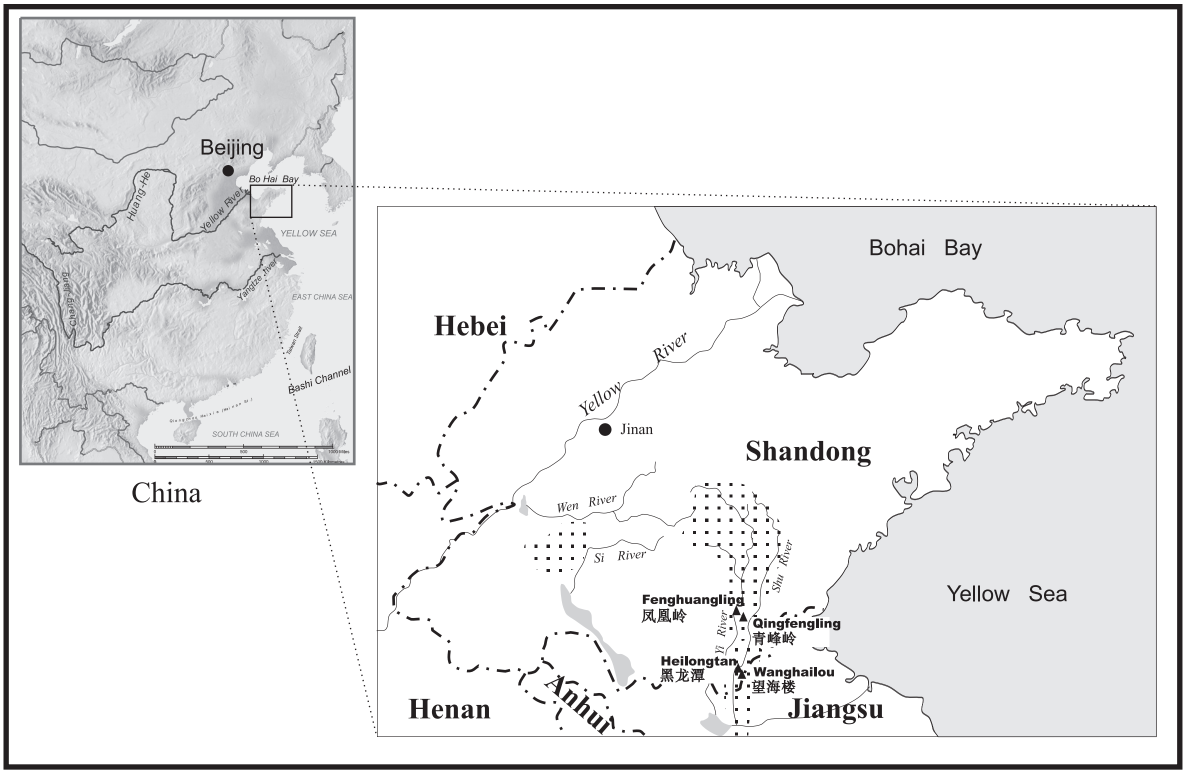

Figure 3.1: The study region showing the Shandong archaeological sites mentioned in the text.

northern Chinese industries: Yangyuan (or Togeshita), Sanggan (or Oshorokko), Hetao (or Yubetsu), and Xiachuan (or Saikai). Chen and Wang (1989) recognized technological differences in the manufacture of microblades between the Xiachuan site and the Xueguan site, suggesting that the Xiachuan industry is represented by conical microblade cores while the Xueguan microblade industry is dominated by boat-shaped and wedge-shaped cores. They further proposed that both the Xueguan and the Hutouliang techniques were developed directly from the Xiachuan technology. While Tang and Gai's (1986) study for the first time established a microblade technological link between northern China and Japan, Chen and his colleagues further examined these materials (especially from Xiachuan and Xueguan) in comparison with microblade technology from northwestern America (Chen and Wang 1989; Chen 1983, 1994, this volume).

Late in the last century, a number of important microblade sites were recovered with controlled excavations in northern China. Some important sites include Dingcun locality 77:01 (Wang 1986; Wang *et al.* 1994), Shizitan (Shanxi Sheng Linfen Xingshu Wenhuaju 1989), Youfang (Xie and Cheng 1989), and Jiqitan (Institute of Cultural Relics 1993). Among these discoveries (also see Chun Chen, this volume), a cluster of microblade assemblages were identified in the Shandong Peninsula, which are the subject of this paper. These archaeological findings provide a clear understanding of the spatial distribution of microblade technology along the middle to lower valleys of the Yellow River and its tributaries. These data, alongside limited radiocarbon dates, preliminarily established a chronology of microblade industries in northern China, although the dates of these sites need to be verified in future detailed studies. Compared to north-central China, the northern steppe and southwestern China have also yielded substantial data, but less study has been carried out in these regions. Based on these discoveries, Lu (1998) provided an updated summary of their chronological development within the above-mentioned three macro-regions in relation to Neolithic development. However, although regional traditions have been studied within the local context, microblade technology in China is still poorly understood in terms of its origins and spread throughout northeastern Asia (Shen 2004).

As far as the origins and spread of microblades in northern China are concerned, most Chinese scholars tend to favour a "north China origin" model (Jia *et al.* 1972; Gai 1985; An 2000; Xie 2000). Data from the regions clearly indicate technological similarities between northern China to those assemblages from Eastern Siberia, Japan, and Korea, and even to those from northwestern North America. Recently, Xie (2000) proposed that microblades in China originated in the middle Yellow River region (e.g., Xiachuan or Dingcun 77:01) and then spread eastward to the Korean Peninsula along a northern route and to the east coast of China along a southern route. This hypothesis has not been tested against data from each of the five microblade zones that Xie defines. However, Xie's (2000) study at least reflects the general agreement that China's east coast, especially the Shandong Peninsula, is the important geographic area for transmitting microblade technology across East Asia.

It must be noted, however, that today our best knowledge of Chinese microblades derives primarily from only a few well-known sites in the middle Yellow River, such as Xiachuan, Xueguan, and Hutouliang. These sites are among the few that have yielded microblade assemblages from scientific excavations. Evidence from other excavated sites like Shizitan, Dingcun 77:01, Youfang, and Jiqitan, has merit to challenge traditional views on microblade technological development in northern China, but unfortunately materials from these sites have not been systematically studied yet (Shen 2004). The same holds true for materials from the Shandong Peninsula. Thus, a new examination of microblade materials from Shandong is much needed.

SHANDONG MICROBLADES AND THE CONCEPT OF THE FENGHUANGLING CULTURE

Microblades first came to light in Shandong during an archaeological salvage investigation in the suburban area of Linyi City in 1982, when microblade artifacts were found in the backfill of Han Dynasty tombs. This led to the identification of the first microblade site in Shandong at a mound called Fenghuangling (literally "Phoenix Hill"). The site was subsequently excavated by archaeologists from the Institute of Archaeology, Chinese Academy of Social Sciences (CASS). Situated 5 km east of the Yi River, the site yielded hundreds of microblades from a Late Pleistocene loess deposit (Linyi Diqu Wenwu Guanli Weiyuanhui 1983). In the following year, a series of surveys was carried out in adjacent areas, focusing on the recovery of more microblade sites. As a result, 13 localities were identified as archaeological sites with microblade remains (Luan 1996:29). Two of these sites, Qingfengling in Linyi County and Heilongtan in Tancheng County, were excavated in 1984 (Han 1985a, 1985b; Linyi Diqu Wenwu Guanli Weiyuanhui 1983; Linyi Diqu Wenwu Guanli Weiyuanhui and Tancheng Xian Tushuguan 1986). The lithic artifacts which were excavated and collected from these sites clearly demonstrate a microblade context. These discoveries triggered subsequent surveys in southern Shandong, and by the early 1990s, archaeological surveys had discovered more than 100 sites or localities that were claimed to be microblade sites. Based on these discoveries, a concept, the "Fenghuangling Culture" complex, as a distinct culture of the Late Palaeolithic, was proposed to define the cultural affiliation of these newly discovered lithic assemblages in Shandong (Gao and Shao 1984; Luan 1996:29–31; Zhongguo Sehui Kexue Yuan Kaogu Yanjue Suo 1993; Xu 1999a, 1999b).

In previous studies, the proposed "Fenghuangling Culture" included almost all the archaeological sites dated to the end of the Pleistocene, regardless of whether or not they contain microblade assemblages. According to Luan (1996), these Palaeolithic sites are concentrated in three areas: the Wen and Si River valleys in central Shandong, the middle and lower courses of the Yi and Shu rivers, and the Malingshan Mountains area in southern Shandong. Recently, Xu (1999b) has suggested that the Fenghuangling complex is represented by 100 assemblages from the Yi and Shu River valleys (including the Mt. Malingshan area). Most of these sites are located on alluvial plains and in hilly areas. The lithic assemblages from Fenghuangling are represented by microblade cores, microblades, and small flake tools including scrapers, drills, and perforators, as well as utilized flakes. Large flakes and tools are rarely found. It was especially noted that, unlike other places of northern China, ground stones or pottery were not associated with microblades. The dates were estimated primarily based on the geological formation of Quaternary loess sediments pointing to Late Pleistocene deposition. Raw materials are predominantly chert and quartz, with low frequencies of agate, crystal, and sandstone. These previous studies suggest that the "Fenghuangling Culture" represents a hunting-gathering-fishing economy that existed probably at the end of the Pleistocene and the beginning of the Holocene in the region.

RESEARCH PROBLEMS

The above generalization of the Fenghuangling culture was based on very limited observations derived from archaeological surveys of site distribution. No detailed studies of cultural materials from excavated sites had been conducted. However, the materials available to date provide us with a sketchy outline of what is known and what needs to be known about lithic industries of the Palaeolithic in Shandong (Shen 2005; Shen *et al.* 2003).

First, while the overall pattern of Palaeolithic occupation in Shandong is not clear yet, results from archaeological surveys point to a sudden cultural change in the region at least during the Late Pleistocene. An increased number of archaeological sites emerged; however, the nature of these sites is not clearly defined and their spatial distribution is still poorly understood. Survey data suggests that most of the artifacts were not collected in primary context. In particular, previous studies on the Fenghuangling complex have not clearly discriminated microblade assemblages from non-microblade assemblages. Clearly, there are sites without any microblade elements within these temporal and spatial ranges, but the relationship between sites with a microblade context and those without one have not been explored yet.

Second, the dating of the Shandong microblade industries is also problematic. Like many of the other sites with microblade assemblages in northern China, none of these Shandong assemblages has been radiocarbon dated. The chronology was roughly estimated based on biostratigraphy and geological formations, which fall within a time range of the Late Pleistocene. We do not in fact know when exactly these people began to develop the microblade technique in Shandong, and under what circumstances (ecologically or culturally) microblade industries were introduced to Shandong: was it diffusion or migration?

Third, lithic artifacts from excavated sites have so far not been studied in detail. What is unfortunate is that some of the lithic artifacts may have been wrongly classified in the previous survey reports. Lithics (microblades and non-microblades) from both collected and excavated contexts at the Palaeolithic sites are abundant enough to enable us to do a thorough examination of lithic technology, but we cannot understand the specific manufacturing techniques and functions of these microblade tools until qualitative and quantitative analyses are carried out. The techniques of the Shandong microblades and the extent to which they are similar to their counterparts from surrounding regions (for example, Shanxi, Hebei, and Inner Mongolia) need to be investigated.

COLLABORATIVE RESEARCH AND 2001 FIELDWORK

These research problems justify the need for a systematic study of the Shandong Palaeolithic. It is clear that Shandong offers a great opportunity for a long-term project with promising goals of understanding microblade technology and human behaviour. In 2000, a collaborative research project was launched between the Institute of Archaeology (CASS) and the Royal Ontario Museum of Canada, with the assistance of Shandong University. This long-term research program aims to investigate the origin and development of microblade industries in Shandong. As for its initial stage, this study would focus on examining the lithic technology of microblade techniques in stratigraphic context. Our specific objectives are to investigate the nature and distribution of Palaeolithic sites by conducting archaeological surveys, especially in the middle Yi-Shu Valley and in the Wen-Si

Valley, and to understand lithic technology in general, and microblade techniques in particular, of the Palaeolithic in the study regions by conducting a detailed analysis of lithic artifacts from previously excavated materials. In addition, field investigation was carried out to obtain suitable samples for AMS ^{14}C dating and/or other archaeometric methods in order to establish the absolute chronological timeframe of the Palaeolithic in the study region (Shen *et al.* 2003).

In 2001 a small scale excavation was carried out at the Heilongtan site. This site, located 4 km east of the Shu River on a hilly slope of the west side of Malingshan Ridge on a north-south stretch, was first excavated in the fall of 1984. At the beginning of our investigation, I noticed that lithic materials from the Heilongtan site display a great deal of technological distinction from the other two excavated sites, Fenghuangling and Qingfengling, located about 50 km to the north in the middle of the Yi-Shu River valley. In addition, the site's topographic features might have caused a series of secondary deposits at the site, which would result in some complication or difficulties in defining the nature of the microblade context at this particular site. Therefore, the test excavation had two purposes: firstly, to clarify the depositional processes of the Palaeolithic remains at the site, and secondly, to obtain suitable samples for AMS radiocarbon dating.

The 2001 excavation exposed three 2 by 2 m squares, along a hilly slope. Consistent with the 1984 excavation, three depositional layers contained archaeological materials. However, sediment deposition as well as the artifact distribution observed in the three stratigraphic layers appear to indicate that only the lowest cultural layer (layer 4) is likely to be in primary context, where a large number of artifacts were densely distributed *in situ* (Figure 3.2). Artifacts from layers 2 and 3 are rare and scattered in fluvial sediments. These materials were probably eroded from upland of the site, transported, and re-deposited at the current places at a much later time in prehistory. It may indicate that the artifacts from the two layers probably belong to either the same period of the site represented by layer 4, or derive from an unknown site further upland. Therefore, this fieldwork season suggested that the three cultural layers identified during the early excavation are not indicative of chronological differences, but of secondary versus primary deposits only.

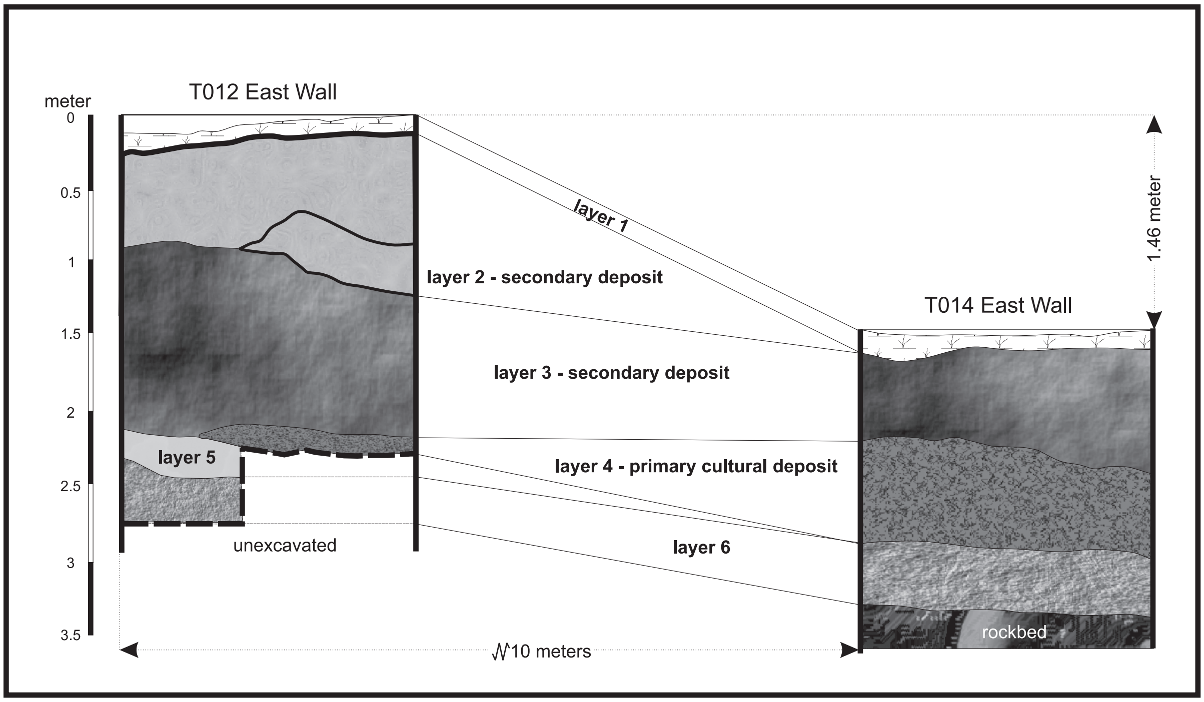

Figure 3.2: Stratigraphic profiles of the Heilongtan 2001 excavation.

Most importantly, the 2001 excavation revealed that the lithic assemblage from Heilongtan is distinct typologically and technologically, suggesting a possibly different cultural context from that represented by Fenghuangling and Qingfengling. The following section will provide more details on this matter.

The 2001 fieldwork also included a small test excavation at the Wanghailou site, which is located on a hilltop (the peak is called Wanghailou), about 1.5 km southeast of Heilongtan. This site was first identified during the 1984 survey, and more than 1000 lithic artifacts, among which are microblade cores and flake tools, were collected. The lithic assemblage is representative of a microblade context in terms of its quality and quantity; much small debitage and debris was collected as well. The stratigraphic provenience of the artifacts was unknown at the time of collection. During the 2001 excavation at Heilongtan, our field crew also conducted another survey at Wanghailou, and recovered a large number of lithic artifacts. The survey confirms that lithic artifacts, collected primarily from gullies, were eroded from loess deposits about 0.5–1 m deep on the hilltop surface. Most of these surfaces were eroded completely to the bedrock, and thus the original context of the artifacts is not well known.

However, it is fortunate that during the 2001 survey at the site, one original deposit with a Palaeolithic context on the hilltop was identified, and our team immediately carried out a test excavation at the edge of this location. This place was not eroded because of a historical structure in place since about the 7th century AD (Tang Dynasty); a shrine was built here for local ancestor worship. According to local elders, the historic structure was destroyed in the 1950s, and now the site is a crop field, where historical remains, such as Tang (AD 618–907) and Song (AD 960–1279) dynasties porcelain sherds and coins, were found. One 1 by 3 m test square revealed that the Palaeolithic deposit was located beneath a 30–50 cm thick historical deposit. A half dozen microblade cores and a few microblades were found *in situ* in the Palaeolithic deposit. As a result of this field investigation, the primary context for over 1000 lithic artifacts collected previously has been identified. Thus, analyses of the Wanghailou lithic assemblage now has the same contextual significance as that of the three other excavated sites. Therefore, in this article, I present the analysis of four lithic assemblages from these sites that have so far been excavated in Shandong.

LITHIC ASSEMBLAGES

Fenghuangling

The Fenghuangling site is the first microblade site found in Shandong, thus the site name is used for representing this new cultural manifestation – the Fenghuangling culture complex. The site is near Linyi City in the southern part of the province, on an earth mound, originally about 10–20 m high. After the 1982 excavation, the mound was removed completely because of railway construction nearby, thus the site no longer exists today.

The 1982 excavation exposed a more than 400 m^2 area. It is a multi-component site with deposits as deep as 7 m. Over 1700 lithic artifacts were recovered (Table 3.1). Among these, over half are debitage flakes, while modified or shaped tools account for 10% of the total. Products of the microblade technique, such as microblade cores, microblades, and microblade rejuvenation flakes, represent a substantial percentage of the assemblage. Wedge-shaped cores comprise one third of the microblade core component at the site. It should be noted that bifacial production was also a major reduction method, as bifacial products are also dominant, evident from the large quantity of bifacial thinning flakes present. Other tools made on flake blanks include scrapers and drills as well as modified flakes (Shen 2005:8–9; Figure 3.3).

Qingfengling

Qingfengling is located about 5.5 km north of the Fenghuangling site. It is situated on a hilly slope, at an elevation of about 65–70 m above sea level. The site was excavated in the early summer of 1984, exposing an area of 112 m^2 and yielding over 3000 lithic artifacts. The site is well preserved today as the deposit is deep (Shen 2005:9–11).

Production of microblades at this site is even more obvious than at the Fenghuangling site. Typical microblade cores and microblades are predominant (Table 3.1). One quarter of microblade cores are classified as wedge-shaped cores (Figure 3.4). Backed microblades are also found, although in

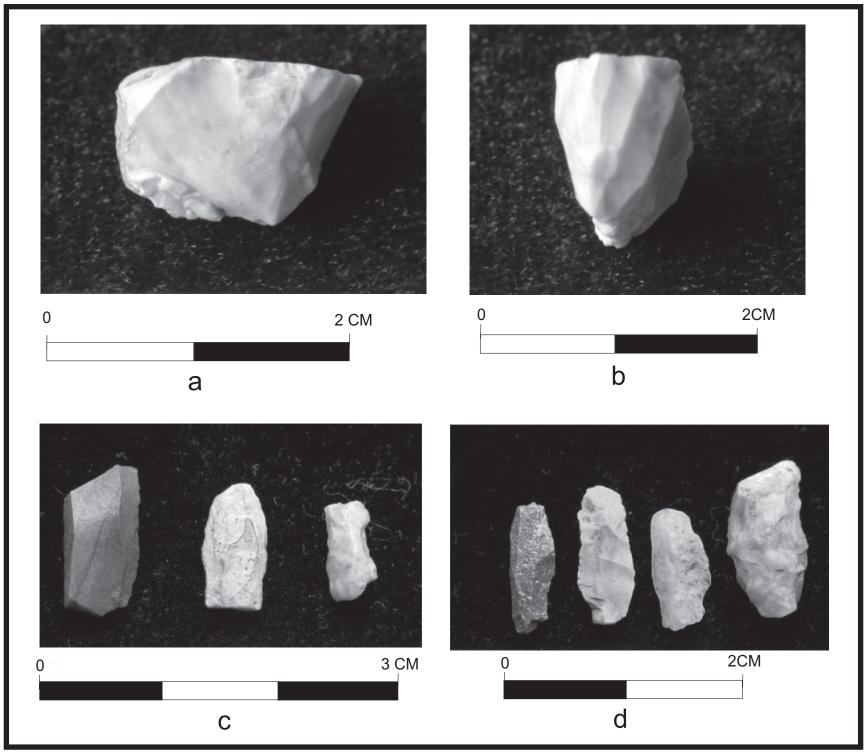

Figure 3.3: Microblade artifacts from the Fenghuangling site.
a and b: microblade cores; c and d: microblades.

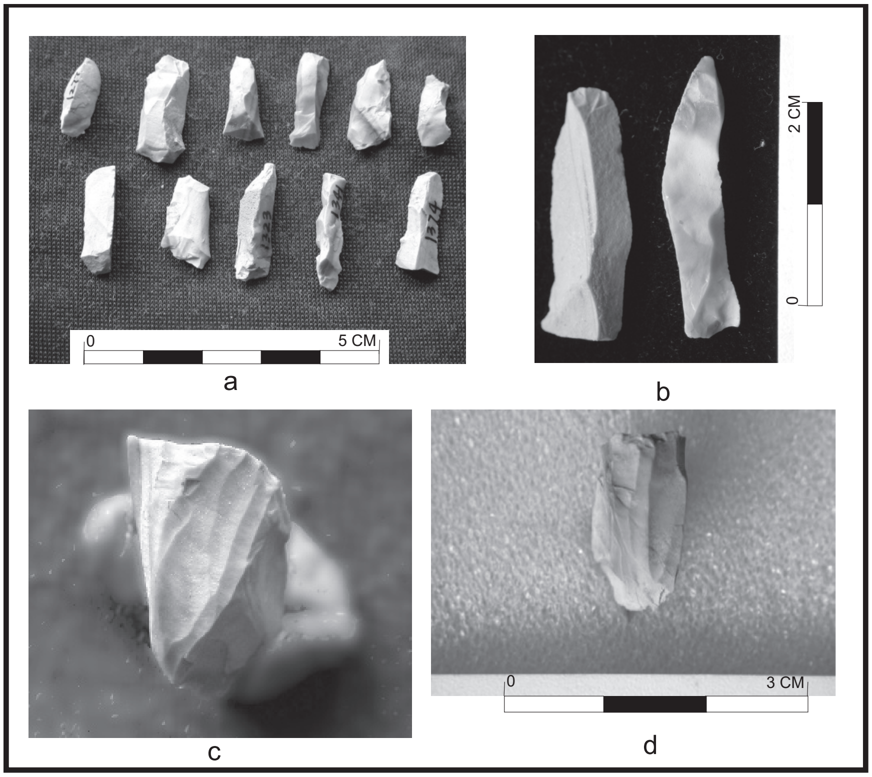

Figure 3.4: Microblade artifacts from the Qingfengling site.
a and b: microblades; c and d: microblade cores.

Table 3.1: Lithic assemblages of the Fenghuangling, Qinfengling, Wanghailou, and Heilongtan sites in Shandong.

		Fenghuangling		Qingfengling		Wanghailou		Heilongtan	
Class	**Types**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Nodule									
	Nodule	0	0.0%	0	0.0%	1	0.1%	24	1.6%
subtotal		0	0.0%	0	0.0%	1	0.1%	24	1.6%
Cores									
	Core	10	0.6%	7	0.2%	8	0.5%	73	5.0%
	Core fragment	21	1.2%	16	0.5%	32	1.9%	71	4.9%
	Microblade core	84	4.8%	152	4.8%	68	4.1%	35	2.4%
subtotal		115	6.5%	175	5.5%	108	6.5%	179	12.2%
Formal Types									
	Backed microblade	0	0.0%	2	0.1%	8	0.5%	0	0.0%
	Biface	17	1.0%	28	0.9%	40	2.4%	11	0.8%
	Biface preform	0	0.0%	0	0.0%	24	1.4%	2	0.1%
	Burin	0	0.0%	0	0.0%	2	0.1%	0	0.0%
	Chopper	0	0.0%	0	0.0%	0	0.0%	1	0.1%
	Drill	7	0.4%	1	0.0%	2	0.1%	0	0.0%
	Microblade	92	5.2%	417	13.1%	95	5.7%	7	0.5%
	Modified flake	24	1.4%	41	1.3%	74	4.4%	50	3.4%
	Notch	0	0.0%	0	0.0%	0	0.0%	1	0.1%
	Point	2	0.1%	19	0.6%	6	0.4%	4	0.3%
	Perforator	0	0.0%	0	0.0%	5	0.3%	1	0.1%
	Scraper	15	0.9%	20	0.6%	27	1.6%	16	1.1%
	Uniface	3	0.2%	2	0.1%	5	0.3%	0	0.0%
subtotal		160	9.1%	530	16.7%	288	17.2%	93	6.4%
Debitage									
	Biface split	2	0.1%	0	0.0%	6	0.4%	0	0.0%
	Blade	15	0.9%	58	1.8%	37	2.2%	7	0.5%
	Flake	279	15.9%	453	14.3%	361	21.6%	377	25.8%
	Flake, bifacial thinning	532	30.3%	644	20.3%	245	14.7%	28	1.9%
	Flake, core trimming	21	1.2%	45	1.4%	72	4.3%	1	0.1%
	Flake, microblade	6	0.3%	65	2.0%	8	0.5%	1	0.1%
	Flake, primary	23	1.3%	31	1.0%	7	0.4%	33	2.3%
subtotal		878	49.9%	1296	40.8%	736	44.1%	447	30.6%
Flaking Debris									
	Chip	336	19.1%	863	27.2%	202	12.1%	159	10.9%
	Chunk	269	15.3%	309	9.7%	335	20.1%	561	38.3%
subtotal		605	34.4%	1172	36.9%	537	32.2%	720	49.2%
Grand Total		**1758**	**100%**	**3173**	**100%**	**1670**	**100%**	**1463**	**100%**

very low numbers. Similar to the Fenghuangling site, bifacial thinning flakes are a major component of the debitage, indicative of bifacial production at the site. Other flake tools include scrapers, points, and drills, as well as modified flakes.

Wanghailou

This site is located on a hilltop of Malingshan Mountain, near the border of Shandong and Jiangsu provinces, about 67.5 km south of the Fenghuangling site. Wanghailou was first identified during the 1984 survey, and more than 1000 lithic artifacts, including a large number of microblade cores and flake tools, were collected. Our survey in 2001 identified primary Palaeolithic deposits at the site, from which we recovered a half dozen microblade cores and a few microblades *in situ*.

In all, 1670 pieces, including 143 pieces from the 2001 excavation, were catalogued. The results show

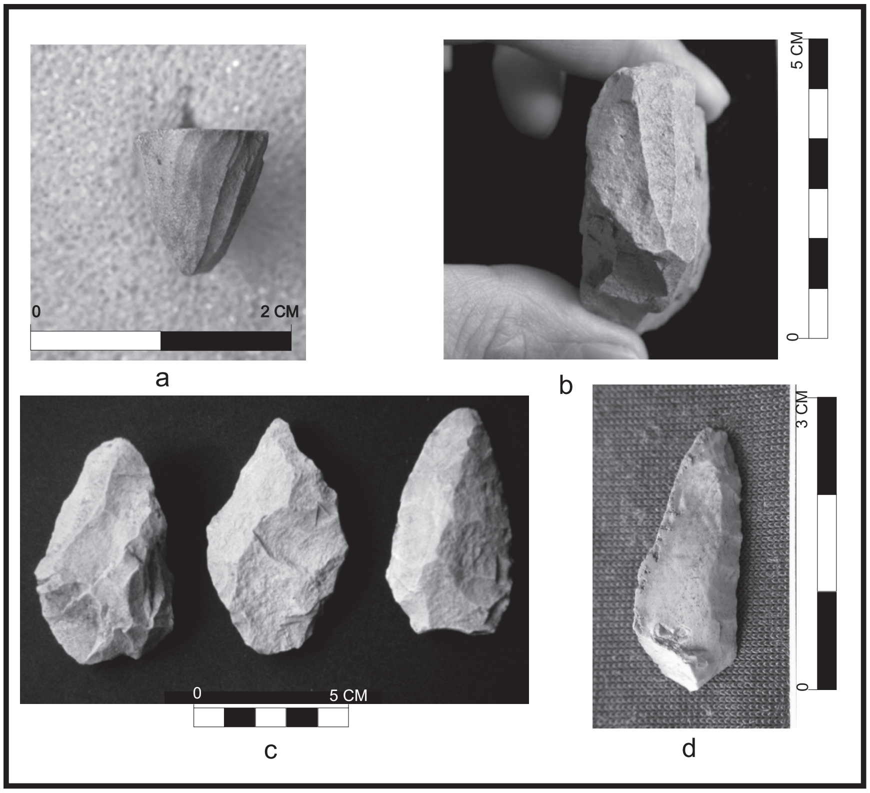

Figure 3.5: Artifacts from the Wanghailou site.
a and b: microblade cores; c: bifaces; d: point on flake.

that while microblade products are still very numerous (Table 3.1), there are also bifacial tools and by-products as well as flake tools and debitage flakes from flake-core reduction. Large bifacial tools are distinctive in terms of their manufacture and function in the region (Shen 2005:11–13; Figure 3.5).

Heilongtan

The last site examined was Heilongtan. This site was first excavated in the fall of 1984, exposing an area of 224 m^2, recovering more than 600 lithic artifacts and a large number of faunal remains. The 2001 excavation exposed three 4 m^2 pits, and an additional 735 lithic artifacts and more than 200 faunal remains were recovered. A total of 1488 artifacts were examined (Table 3.1).

The recent field investigation firmly suggests that the microblade artifacts found in the earlier excavation had probably eroded from an upland site like Wanghailou (see above). Thirty-three classified microblade cores were all surface collected in 1984, except for three from the 2001 season. Five of the seven microblades were surface collected in 1984, while the other two pieces were recovered from the layer of the 2001 excavation unit (secondary deposits). Typologically, the Heilongtan assemblage is dominated by flake core products, such as modified flakes and flake blanks (Shen 2005:13–14; Table 3.1, Figure 3.6).

TECHNOLOGICAL-TYPOLOGICAL COMPARISONS

Cores

Within the three categories of cores – flake cores, microblade cores, and core fragments, it is now clear that the microblade cores from Heilongtan appear to be of surface context. Both the Fenghuangling and Qingfengling core assemblages contain the highest frequencies of microblade cores with up to 80% (Figure 3.7). Both the Wanghailou and Heilongtan sites have a relatively high frequency of core fragments, i.e., between 30–40% of the core assemblages. It is now obvious that the Heilongtan site has the highest occurrence of flake cores (over 40%). It is worth noting

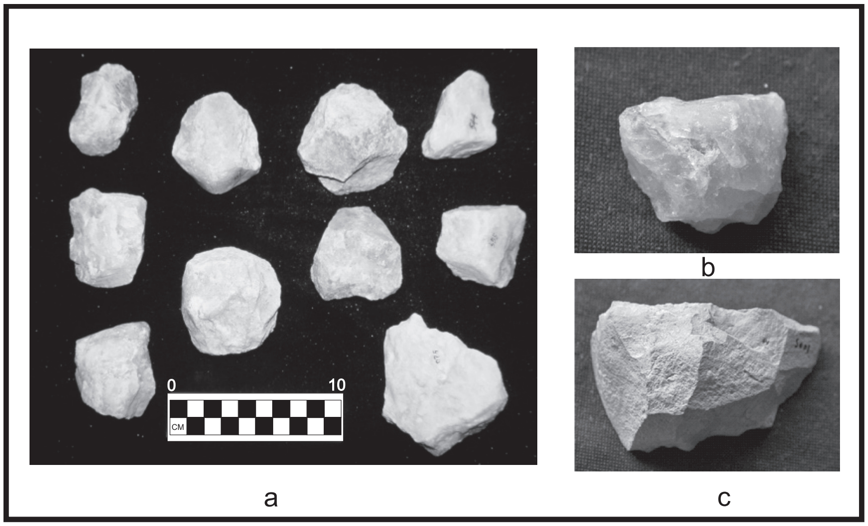

Figure 3.6: Artifacts from the Heilongtan site.
a: flake cores; b: flake; c: modified flake.

that the Wanghailou core assemblage has a good representation of flake cores as well (30%).

Formal Types

Within the formal tool type class, i.e., modified tools, typological examination also suggests that the Heilongtan site has a toolkit substantially different from the other three sites (Figure 3.8). At Heilongtan, tools are predominantly modified flakes (54%), followed by scrapers (17%) and bifaces (12%). At both Fenghuangling and Qingfengling, over half of the toolkit comprises microblades, accounting for 78% and 57%, respectively. The two sites show similar frequencies of the other types of flake tools, although the Fenghuangling assemblage displays slightly higher frequencies of bifaces and scrapers.

The distribution of tool type frequencies of the Wanghailou lithic assemblage seems to be between Heilongtan and the other two assemblages. Compared to Fenghuangling and Qingfengling, the Wanghailou assemblage contains relatively fewer microblades but still a fairly good representation (33%) of microblade products. Clearly, modified flakes have a higher frequency at Wanghailou compared to Fenghuangling and Qingfengling. In addition, Wanghailou has the highest presence of bifaces among the four assemblages, accounting for 14% of tools. It should be noted that there are substantial numbers of biface preforms (unfinished products of biface manufacture) at the Wanghailou site compared to the other three sites, suggesting a strong preference for bifacial tool production at the site, that is rarely seen at the other three sites.

It appears that there are more varieties of tool types at Wanghailou and Heilongtan than at Fenghuangling and Qingfengling (Table 3.2). Some other tool forms, although occurring in low numbers, are also indicative of a unique specialized toolkit at each of these sites. Choppers and notches are only seen at Heilongtan, although there is only a single specimen of each in the assemblage. It is also apparent that the Heilongtan toolkit is different from the others in the absence of drills and unifaces. More backed microblades were found at Wanghailou than at Qingfengling, and these do not occur in the other two assemblages. Biface preforms and perforators appear only at Wanghailou and Heilongtan. Therefore, it is clear that typological examination suggests three possible toolkit groups: 1) Fenghuangling and Qingfengling are very similar, while 2) Wanghailou is different from these and also from 3) Heilongtan. These groups are likely to represent different cultural manifestations.

Debitage and Flaking Debris

If the above observations truly indicate technological differences among these four assemblages, we should also expect to see a similar trend in debitage type variations among them. When we look at the typology of debitage products, which are likely indicative of core reduction strategies, the trend

Table 3.2: Tool types of the four lithic assemblages.

	Fenghuangling	Qingfengling	Wanghailou	Heilongtan
Chopper	No	No	No	Yes
Notch	No	No	No	Yes
Drill	Yes	Yes	Yes	No
Uniface	Yes	Yes	Yes	No
Backed microblade	No	Few	Yes	No
Biface preform	No	No	Yes	Yes
Perforator	No	No	Yes	Yes

observed suggests a similar division among the four assemblages (Figure 3.9). Both Fenghuangling and Qingfengling are similarly dominated by bifacial thinning flakes (50–60%), followed by flakes (30–40%). This may indicate bifacial production in the manufacture of wedge-shaped microblade cores. In contrast, Heilongtan has the highest flake occurrence and the lowest bifacial thinning flake frequencies, suggesting a very different lithic production system, probably hard-hammer flake core reduction. The Wanghailou debitage distribution falls in-between these two production systems, having roughly equal percentages of flakes and bifacial thinning flakes. The Wanghailou debitage assemblage is distinctive also by its relatively high percentage of blades and core trimming flakes. The presence of bifacial splits and microblade flakes at Fenghuangling, Qingfengling, and Wanghailou, strongly indicates that microblades at these sites were products of bifacial core reduction.

The flake core reduction strategy at Heilongtan is also indicated by an overwhelming presence of chunks instead of chips in the debris category (Figure 3.10). The higher frequency of chunks at Heilongtan may have resulted from the shattering process during quartz tool manufacture; quartz is the primary raw material at the site. Chips, possibly the products of pressure flaking and soft-hammer reduction, are more frequent in the other three assemblages. These clearly represent a by-product of the microblade reduction strategy.

WORKING HYPOTHESES

As the Shandong project is on-going, and detailed examination of the artifacts is still in process, the current technological-typological investigation can only suggest the following working hypotheses. First, the data suggest the possibility that two different technologies coexisted in Shandong at the end of the Pleistocene – flake-tool traditions and microblade traditions. Second, Shandong microblade industries likely consisted of different microblade techniques, but this requires further investigation. Shandong lithic industries feature more variability than we previously thought. Thus, the previous concept of a “Fenghuangling” cultural complex needs to be revised. Given the data available, I am proposing the existence of the following cultural variations in this region (Figure 3.11).

The Heilongtan assemblage does not manifest microblade technology at all. The lithic assemblages may represent a tradition that manufactured and used flake cores from flake-core reduction, a technique that was persistent in northern China during the Pleistocene. It may suggest that this lithic tradition represents a local manifestation existing in the region before microblade technology was introduced. Technologically, the Heilongtan tradition utilized local quartz raw materials for making stone tools. Their economic strategies were likely mutli-dimensional given the variety of tool types made on flake blanks.

Based on the use of raw materials, the toolkit, and core reduction, this study suggests that the Fenghuangling and Qingfengling assemblages appear to have possibly the same cultural affiliation. The variation within the Shandong microblade industry may be called the “Fenghuangling Tradition.” The technology of Fenghuangling microblades possibly resembles other microblade industries in central China, but with a greater diversity. These two sites produced extremely small microblade cores and microblades on local cherts

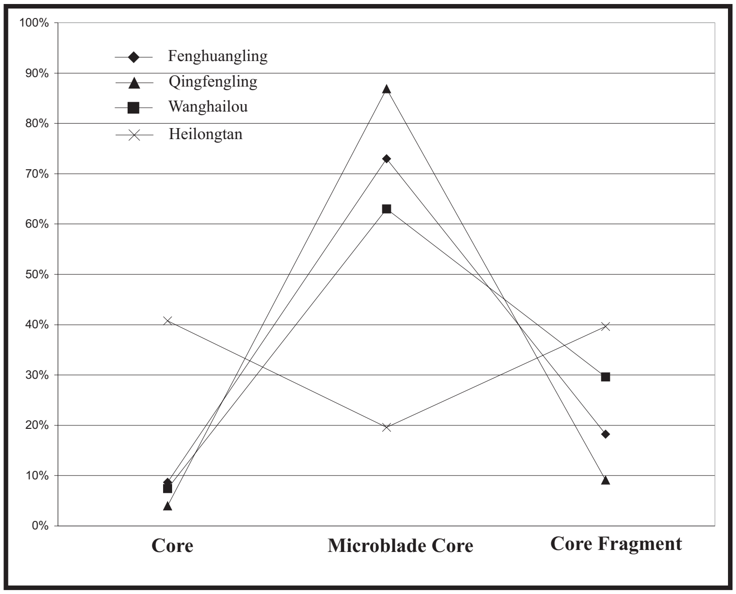

Figure 3.7: Distribution of core type frequencies.

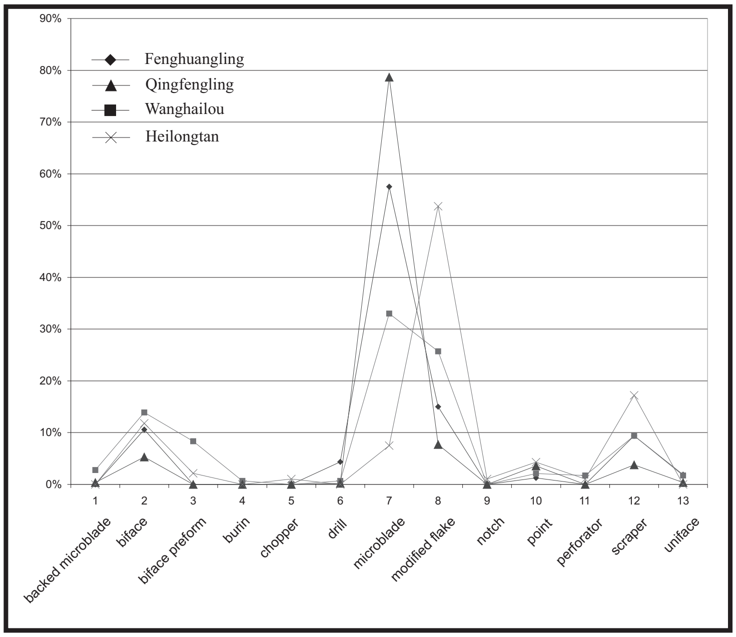

Figure 3.8: Distribution of formal type frequencies.

as well as quartz. These microblades are morphologically more similar to those found in Hebei and Shanxi provinces, but the quality of manufacture is relatively poor. This may point to cultural interactions between the Shandong and northern groups in the middle of the Yellow River valley.

It seems clear that the Wanghailou tradition represents a southern regional variation of microblade industries: the assemblage is characterized by some degree of different tool use, core reduction, and use of raw materials compared to those of the Fenghuangling tradition in the middle Yi-Shu Valley, about 50 km to the north. One important aspect of the Wanghailou tradition is the utilization of large bifacial cutting tools that were not observed in its northern counterparts.

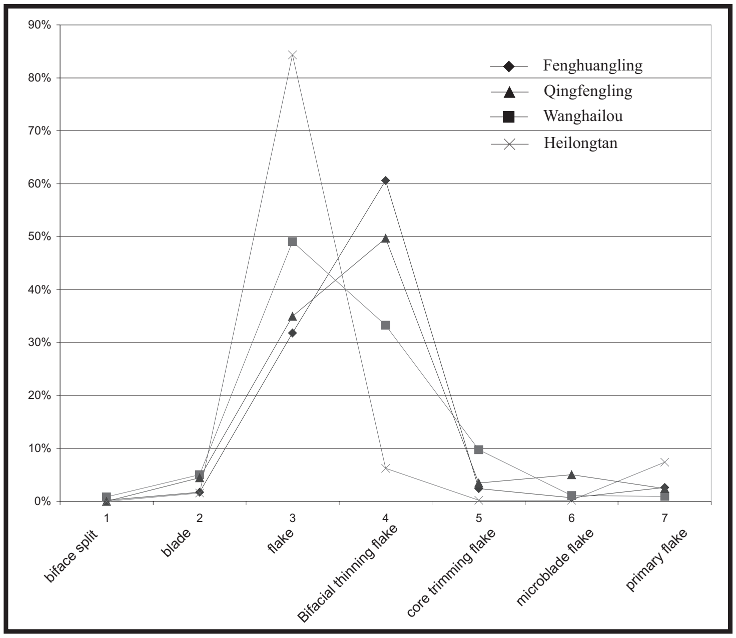

Figure 3.9: Distribution of debitage frequencies.

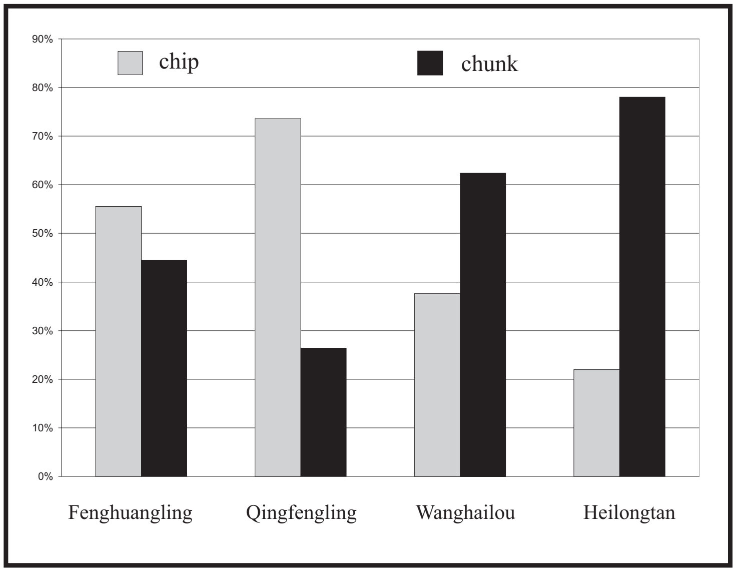

Figure 3.10: Distribution of flaking debris frequencies.

The Wanghailou assemblage probably shares close relations with assemblages found in the southern part of the Malingshan Mountains in northern Jiangsu Province (Zhang 1985, 1987; Ge and Lin 1985).

In addition, cultural materials from other surface collection sites (or localities) may also be indicative of other manifestations in the region. Lithic artifacts collected from a few dozen localities in the Wen-Si River valley appear to be non-microblade lithic industries as well (Zhonggou Sehui Kexue Yuan Kaogu Yanjue Suo 1993). These likely represent a small flake tool industry, utilizing the locally available black chert, in northern China during the Late Pleistocene. Whether or not a microblade technique similar to that found in the Yi-Shu Valley was employed in this region needs to be further investigated.

CONCLUSION

The preliminary results suggest that the late Upper Palaeolithic in Shandong at the end of the Pleistocene is more complex than we previously thought (Shen 2004, 2005). All of this evidence indicates that a variety of cultural interactions existed in this region. Although we still cannot ascertain whether the Shandong microblade industries were an indigenous development or a foreign invention, the current evidence may be in favour of a migration hypothesis, as the Shandong microblade traditions seem to indicate cultural interactions with those from both northern and southern regions. The characteristics of the production and functions of the Shandong microblade industry have to await future research. But this study suggests that the Fenghuangling concept clearly needs to be revised. In other words, the use of the "Fenghuangling Culture" to characterize the Shandong Palaeolithic industry with microblades is no longer valid in demonstrating the technological variability present during the Late Palaeolithic in this region.

ACKNOWLEDGEMENTS

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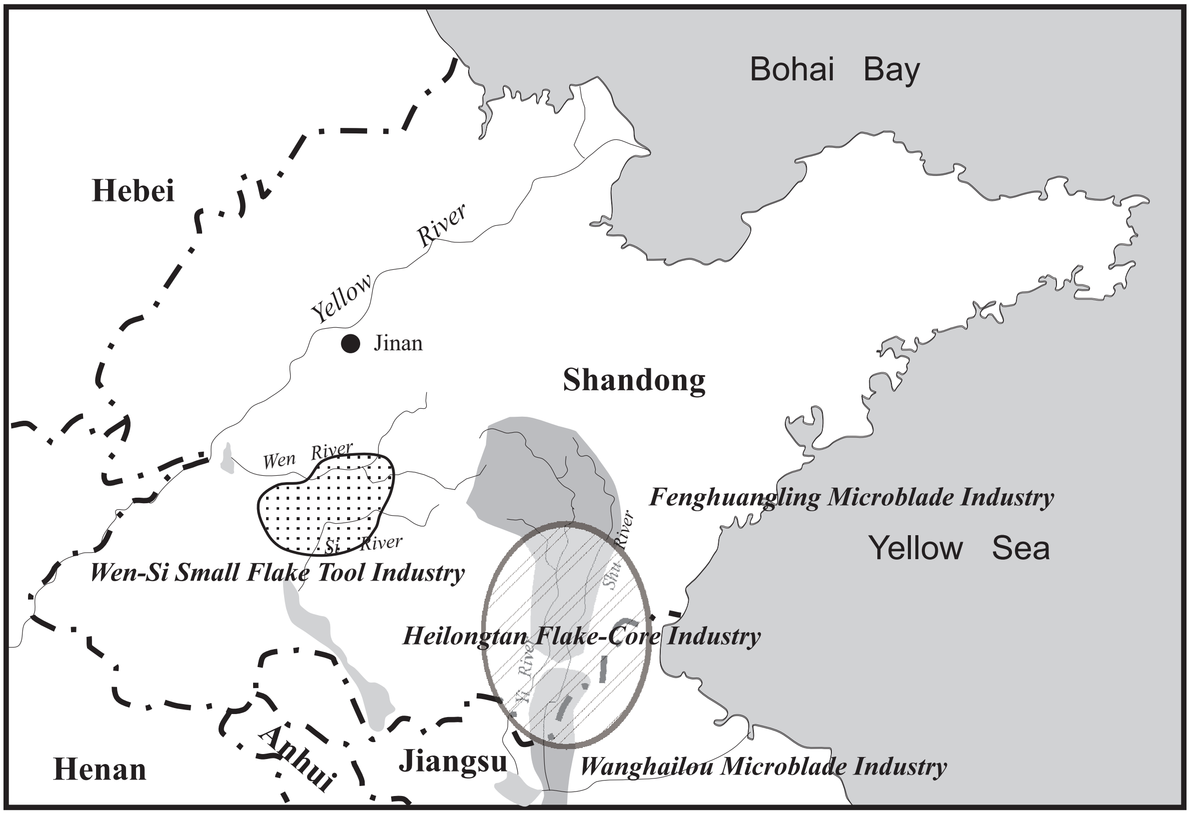


Figure 3.11: Shandong lithic industries in the Late Pleistocene.

4

THE JAPANESE MICROBLADE INDUSTRIES: TECHNOLOGY, RAW MATERIAL PROCUREMENT, AND ADAPTATIONS

Hiroyuki Sato and Takashi Tsutsumi

INTRODUCTION

Microblade Industries in the Japanese Archipelago

A microblade industry was first found in the Japanese Archipelago in 1953 at the Yadegawa site in Nagano Prefecture. There are a total of 1792 microblade sites in Japan as of 2003, 50 years after the first discovery (Tsutsumi 2003a, 2003b; Figure 4.1). These sites are distributed all over the Japanese Archipelago, except for the Ryukyu Islands, from the Toyobetsu A site at the northern end of the Soya Hills in Hokkaido in the far north to the Zenigame site on the isolated small island of Tanegashima just south of Kyushu and north of the Ryukyu Islands. Looking at the regional composition, there are 251 sites on Hokkaido, 815 sites on Honshu and Shikoku, and 726 sites on Kyushu.

Microblade sites are clustered in several regions of the archipelago, especially in eastern Hokkaido, central Honshu, and northern and southern Kyushu (Figure 4.1). At the Microblade Industry stage, these four regions appear to have been densely populated, forming a number of socio-economic territories. On the other hand, only a few small-scale sites are found in the Hokuriku, San'in, Kinki, Pacific coast of Tohoku, and Shikoku regions, which seems to indicate that they were sparsely populated. These regions could not have been the main living territories, because they lacked convenient sources of good quality lithic and other usable resources.

The 1792 microlithic sites in Japan have yielded 83,137 microblades and 8225 microcores. The total number of microblades is known for 357 sites. Of these sites, 172 (48%) yielded less than 10 microblades, 282 sites (79%) have less than 100 microblades, at 309 sites (87%) less than 200 microblades were found, and at the remaining 48 sites (13%) there are 200 or more microblades. Sites with less than 100 microblades are generally interpreted as small camp sites or transit sites, since they have scarcely any remains of habitation, but the 20% of sites with 100 or more microblades may have had a different function, such as base camps or cashes.

Of the 1792 microlithic sites, 622 have definite descriptions of the number of microcores found. At 537 sites (86%) less than 10 microcores were found, while only 55 sites (9%) yielded 10 or more microcores, at 13 sites (2.1%) 30 or more, at 10 sites (1.6%) 50 or more, and at seven sites (1.1%) 100 or more microcores were discovered. Thus, fewer than ten microcores were found at most of the sites.

The average Japanese microblade measures 2.80 cm in length, 0.55 cm in width, and 0.16 cm in thickness. There are two types of microblades: the "narrow type" , which is longer and narrower than the average, and the "wide type" , which is shorter and wider (Orikasa 1983). While the wide type microblades were mainly detached using the Yadegawa method, producing Nodake and Yasumiba type microcores, the Yubetsu and other methods resulted in narrow type microblades. Based on the results of archaeological experiments, it was determined that pressure flaking was used to manufacture Yubetsu method microblades at the Shirataki-Hattoridai site on Hokkaido (Onuma 1993). It may be presumed that microblade technology was developed on the basis of the pres-

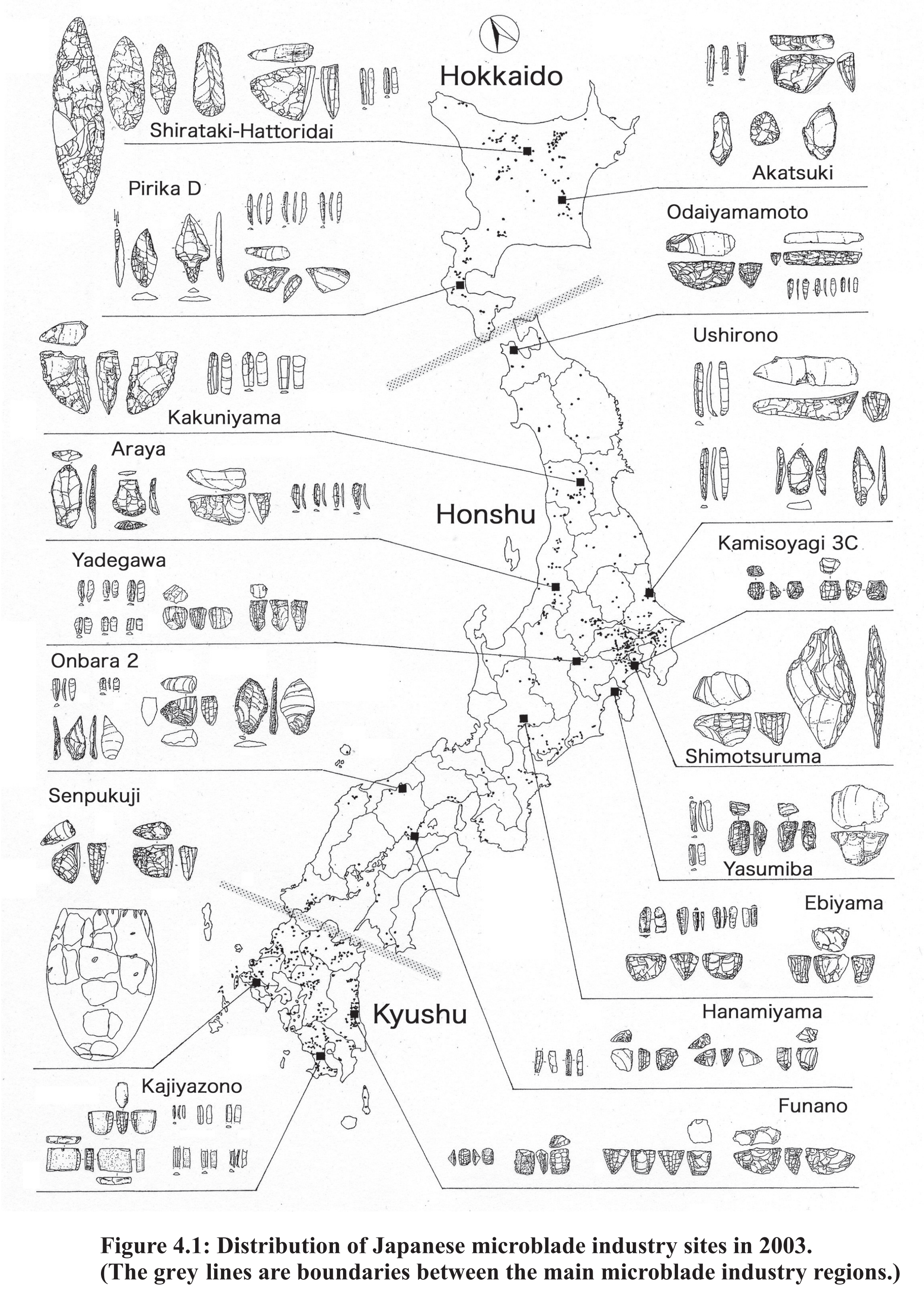


Figure 4.1: Distribution of Japanese microblade industry sites in 2003. (The grey lines are boundaries between the main microblade industry regions.)

sure flaking technique. In most cases, both ends of a microblade were removed, probably because they prevented smooth hafting. In the Japanese Archipelago, however, no examples of slotted organic tools with inserted microblades have been found to date. The unique example of Palaeolithic adhesive in Japan is a paste of animal origin, presumably hide glue, attached to microblades from the Kashiyamadate site of Iwate Prefecture in northeastern Japan (Kikuchi 1996). Ethnological evidence shows that the Ainu people in Hokkaido used hide glue, *kaputama*, made from the well-chewed skin of small size salmon.

Duration of Microblade Industries

The Yubetsu, non-Yubetsu, and Yadegawa methods belong to the early stage of microblade industries in the Japanese Archipelago. The duration of microblade industries differs among the various regions. On Honshu, uncalibrated radiocarbon dates have been obtained from several microblade sites: 14,300 ± 700 BP (Gak–604) for the Yasumiba site in Shizuoka Prefecture, 14,250 ± 105 BP (GrA–5713) for the Araya site in Niigata Prefecture, and 13,570 ± 410 BP (Gak–10545) for the Tsukimino Kamino site in Kanagawa Prefecture. In addition, the Ryusenmon (linear relief decoration) pottery, which emerged immediately after the Microblade Industry period, is radiocarbon dated to 12,000 ± 40 BP (Beta–133848) at the Seikosanso B site in Nagano Prefecture. Therefore, the duration of microblade industries on Honshu is estimated to have been approximately 3000 years, from c. 15,000 BP to c. 12,000 BP.

The oldest radiocarbon date was obtained from Hokkaido, which is adjacent to Sakhalin Island. The microblade industry of the Kashiwadai 1 site in Chitose City was AMS radiocarbon dated from 19,840 ± 70 BP (Beta–120881) to 20,790 ± 160 BP (Beta–126175). This means that the Hokkaido microblade industry emerged at approximately 20,000 BP, earlier than on Honshu by several thousand years. Since the end of the microblade industry in Hokkaido is estimated to be approximately 11,000–12,000 BP, its duration was about 10,000 years, from c. 20,000 BP to c. 11,000 BP, several times longer than on Honshu. It can be said that the late Upper Palaeolithic of Hokkaido is almost synonymous with the microblade culture. On Kyushu Island, which is adjacent to the Korean Peninsula, few radiocarbon dates have been obtained. However, since tephrochronology shows that microblade industries had appeared by c. 16,000–15,000 BP at the latest and persisted until the Incipient Jomon period, dated to c. 13,000–10,000 BP, it is certain that the microblade industries of Kyushu outlasted those of Honshu (Ono *et al.* 2002; Figure 4.2).

While the radiocarbon dates given above are all uncalibrated, the date obtained for the Araya site, c. 14,100 BP, is calibrated to 16,000–17,000 cal BP according to Serizawa and Sudo (2003). This result is only provisional, however, since the calibration curve based on dendrochronology reaches only 11,980 cal BP, even though the calibration curve of INTCAL98 (Stuiver *et al.* 1998) itself reaches 24,000 cal BP. Based on this provisional calibration curve, it is estimated that the microblade industry appeared approximately 25,000 years ago on Hokkaido, and lasted from c. 20,000–15,000 years ago on Honshu (Kudo 2003).

Taking an overview of the Japanese Archipelago, the microblade period on Hokkaido and Kyushu started earlier and lasted longer than on Honshu. While it persisted for almost 10,000 years on Hokkaido, it is highly probable that its duration was at most 3000 years on Honshu and 5000 years on Kyushu.

HOKKAIDO: MICROBLADE INDUSTRY EXPLOITING OBSIDIAN AND SHALE

Microblade industries in the Japanese Archipelago can be largely divided into two categories based on their technological features. In the Yubetsu method group, spalls were removed from a blade, flake, or bifacial blank to prepare a platform for microblade flaking, while the non-Yubetsu group lacks this process of spall removal. Each group consists of several techniques, and they show regional variation (Figure 4.2).

Technological Features of Developed Microblade Industries

In the Upper Palaeolithic of Hokkaido (c. 30,000–

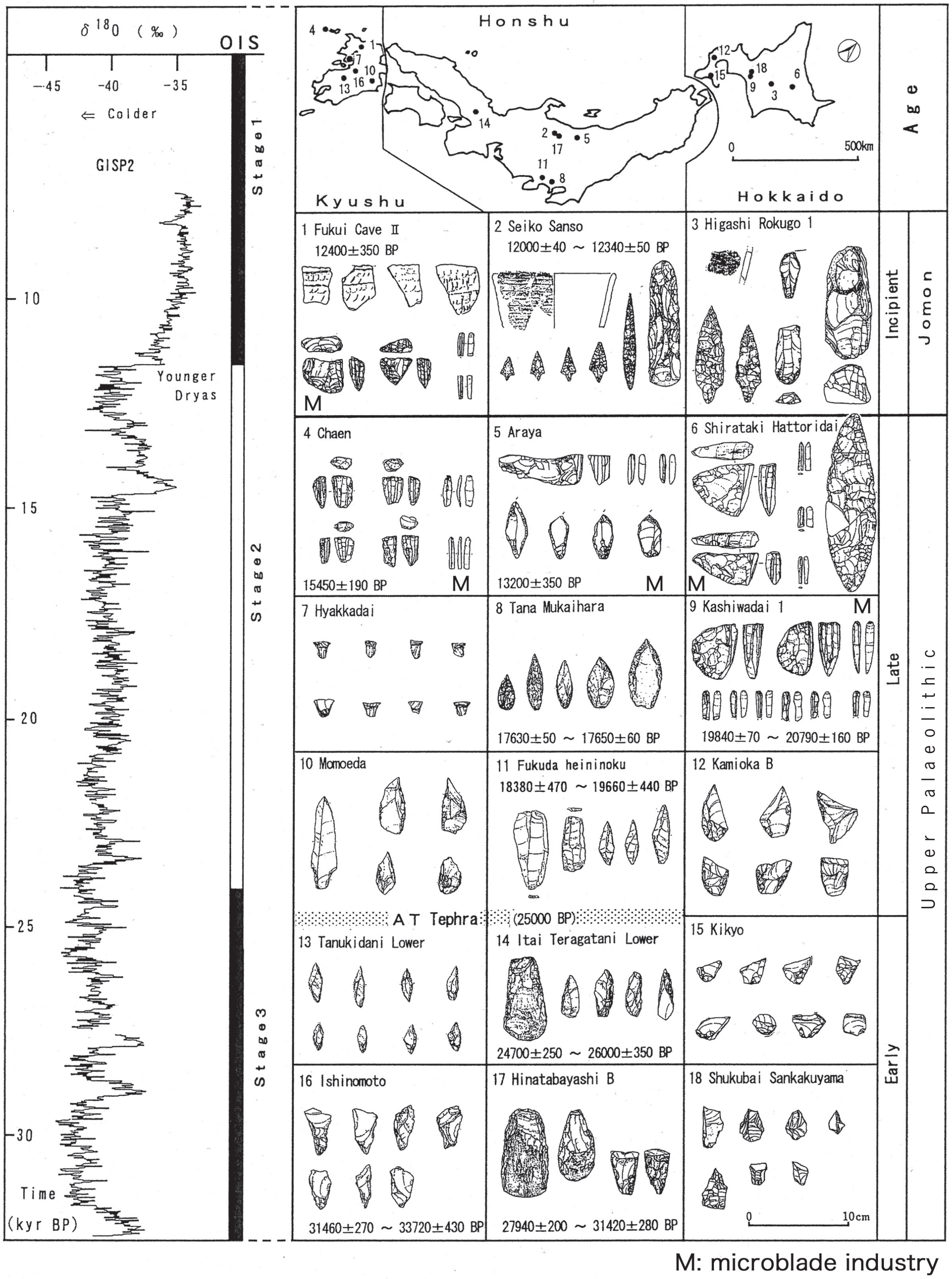


Figure 4.2: Chronology and ^{14}C dates of the Upper Palaeolithic and Incipient Jomon in Japan (after Ono *et al.* 2002).

10,000 BP), the predominant lithic raw material was obsidian from eastern and central Hokkaido and oil shale from southern Hokkaido. Obsidian represents a raw material that was transported over long distances, and was used not only on Hokkaido, but also on Sakhalin (Kuzmin *et al.* 2002). The microblade industry on Hokkaido developed a variety of detaching techniques, as described below, to adapt to the utilization of these two kinds of raw material.

The Yubetsu method group

The Yubetsu method consists of the strict Yubetsu technique, which involved forming a striking platform for detaching microblades by removing spalls from the lateral edge of a bifacial blank, and the Togeshita technique, which involved detaching spalls in the same way but choosing a blade or flake blank (Figure 4.3). The Yubetsu technique comprises various sub-techniques. While the Oshorokko sub-technique involves partial spalling on the lateral edge, in a group of some other sub-techniques the entire lateral edge was spalled. The latter group is subdivided based on the direction of spalling. In the Rankoshi sub-technique, spalls were detached along the short axis of a bifacial blank, and this is distinct from a group of techniques where spalls were removed along the long axis. The latter group is subdivided by the shape of their blanks. Boat-shaped bifacial blanks were produced with the Pirika sub-technique, whereas the strict Yubetsu technique manufactured point-shaped bifacial blanks. The strict Yubetsu technique is also subdivided according to certain attributes of microcores: while a Shirataki type microcore shows obvious traces of rubbing on the striking platform, assumed to be an anti-slip treatment for microblade flaking, a Sakkotsu type microcore lacks these traces (Figure 4.4). The relationship between these techniques is shown in Table 4.1.

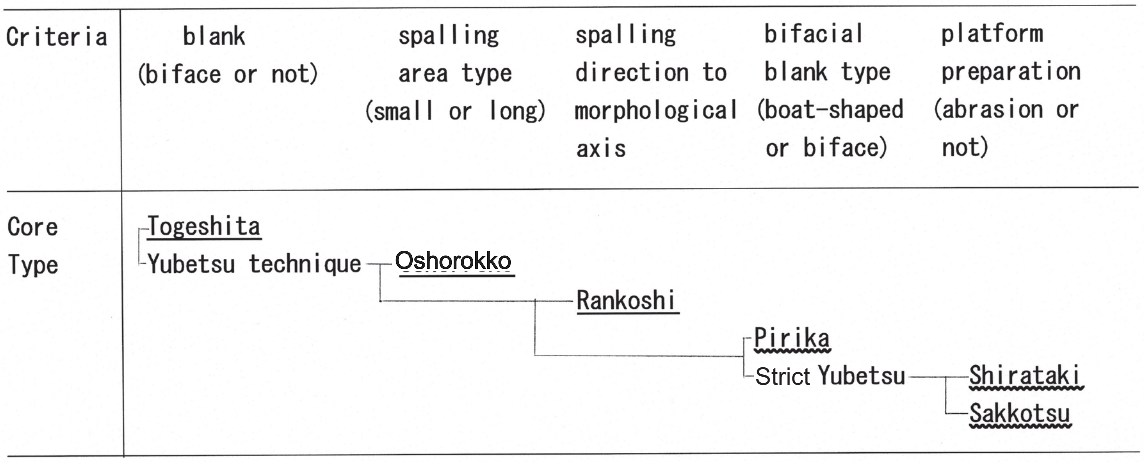
The Non-Yubetsu method group

This group is typified by (1) the Horoka technique, where a flat platform was set up and then a boat-shaped microcore prepared by retouching the edges, (2) the Hirosato technique, where microblades were detached from the end of a large blade blank as in the case of a multiple burin (Sato 2004a), and (3) the Momijiyama technique, which produced pencil-shaped and other microcores (Figure 4.4).

Raw Material Exploitation Strategy and Technological Organization

The microblade industry of Hokkaido is characterized by its long duration and the develop-

Table 4.1: Technological classification of Yubetsu method in Hokkaido*.



* Underlined core types are found near the continent (i.e., excluding Honshu).
Curve-underlined core types are from Honshu.

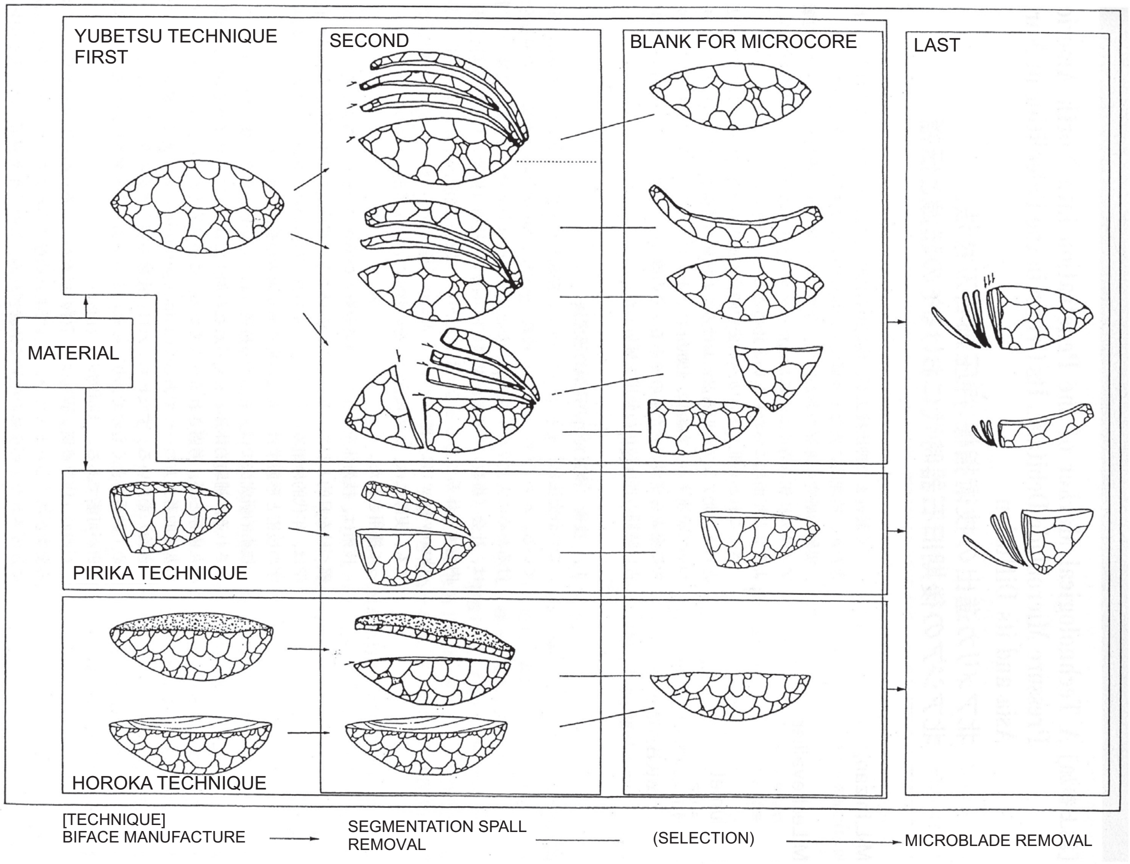


Figure 4.3: Part of the Yubetsu method including the Yubetsu technique, Pirika sub-technique, and Horoka technique (after Kimura 1993).

ment of a wide variety of microblade techniques. Microblade technology originated on the Asian continent, and became predominant in the second half of the Japanese Upper Palaeolithic (Sato 2003a). The oldest microblade industry, dated to c. 21,000–19,000 BP, was found at the Kashiwadai 1 site. It has features of the Rankoshi and Pirika sub-techniques of the Yubetsu method. The Shirataki and Sakkotsu sub-techniques, Togeshita and Horoka techniques, and other techniques and sub-techniques, appeared immediately after c. 19,000 BP. The Momijiyama technology also seems to have appeared in this time period. Microblade industries were still dominant on Hokkaido in the time period corresponding to the Incipient Jomon period (c. 13,000–10,000 BP) elsewhere in Japan. The Hirosato technique and part of the Oshorokko sub-technique are typical of the Incipient Jomon. However, details of the chronological sequence and the first and last appearance of the various microblade techniques on Hokkaido remain unclear.

Among the many obsidian sources known on Hokkaido (e.g., Hall and Kimura 2002), obsidian from the Shirataki (Kuzmin *et al.* 2002) and Oketo sources in eastern Hokkaido was transported over long distances because of its high quality and quantity. The distribution of the Shirataki and Oketo obsidian extends to Sakhalin and possibly further north to the mainland (Sato 2004b). On the other hand, the northern end of high quality and quantity oil shale sources, which are distributed along the Japan Sea coast of northeastern Honshu, extends to southern Hokkaido. It is presumed that the development of the various microblade techniques of Hokkaido was caused by the technological adaptation to exploit obsidian or oil shale. For example, at the Shirataki sites, located at the Shirataki obsidian sources, bifacial blanks were consistently produced with the Yubetsu method.

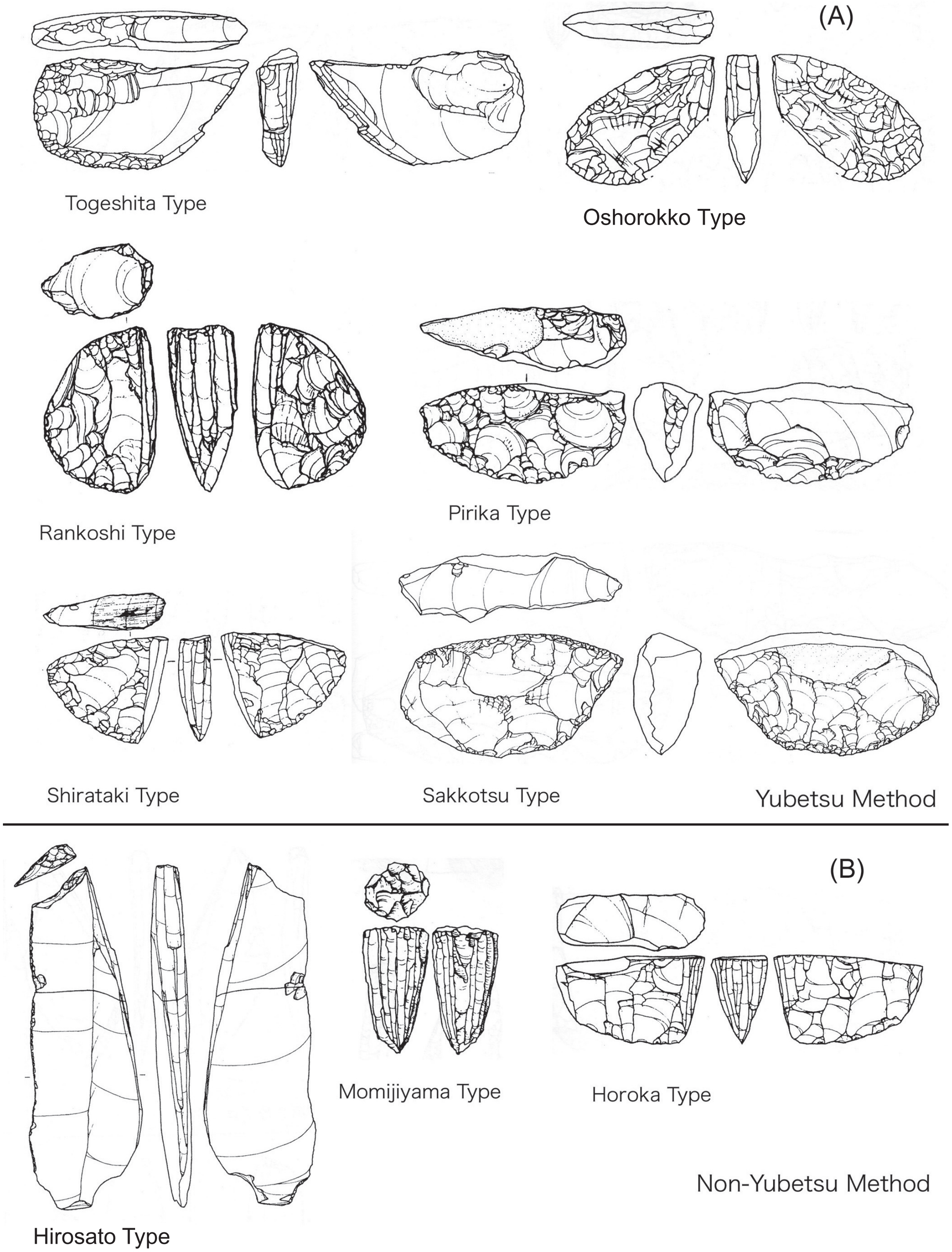


Figure 4.4: The types of microblade core from Hokkaido.

Humans adopted a behavioural strategy to carry these blanks as portable preforms to neighbouring residential base camps, where they produced microblades (Kimura 1995). As for the obsidian from the Oketo sources, the large blades often manufactured from this obsidian were used to produce microcore blanks of the Hirosato and Togeshita types. Although we believe that the Pirika sub-technique was probably specifically adopted to exploit the oil shale of southern Hokkaido, further details are needed to confirm this hypothesis.

Microblade industries on Hokkaido are always associated with a variety of abundant flake tools, such as end scrapers, side scrapers, and burins. Though this may seem to be in the natural order of things, the microblade industries of Honshu and further south show a different feature in that there are remarkably few flake stone tools in association. This phenomenon may be interpreted as follows. On Hokkaido, where, in common with the Asian continent, an organized hunting strategy of large mammals such as deer was embedded in the behavioural strategy as a main subsistence approach, people chose a technological organization less affected by the procurement of lithic raw material, which enabled them to move long distances. On the other hand, other behavioural and mobile strategies were adopted on Honshu and further south, reflecting the climatic fluctuations and different resource structure of fauna and flora.

Of the various microblade sub-techniques used on Hokkaido, the Togeshita, Oshorokko, Rankoshi, Hirosato, and Momijiyama types are not found in other parts of Japan, while similar examples are known from sites on the Asian continent. In contrast, a group of the strict Yubetsu technique, that is, the Pirika, Shirataki, and Sakkotsu sub-techniques, spread south to Honshu. Since the central Honshu site of Araya, where the Yubetsu type of microblade technique was found, is radiocarbon dated to c. 14,000 BP, it is presumed that humans using a group of the Yubetsu technique may have moved from Hokkaido to Araya. It is assumed that the group of late Microblade Industry with the Hirosato technique or the Oshorokko sub-technique ceased moving south over the Tsugaru Strait, because the Incipient Jomon period started at approximately 13,000 BP. Figure 4.5 shows the archaeological regions of Japan with characteristic microblade industries.

HONSHU: TWO DIFFERENT TRADITIONS OF THE MICROBLADE INDUSTRY

Overview

Microblade technology on Honshu can also be largely divided into two categories, the Yubetsu method group and the non-Yubetsu method group. Unlike the case of Hokkaido and Kyushu, however, the manufacturing technique is subdivided into fewer categories and these have a more limited timespan. The Yubetsu method consists of two techniques, Fukui and strict Yubetsu. The latter has three sub-techniques, Pirika, Shirataki, and Sakkotsu. The non-Yubetsu method also comprises two techniques, called Nodake-Yasumiba (Yadegawa method), and Horoka or Funano.

The geographic distribution of the Yubetsu method microblade technology is a similarly complex situation as the Horoka and Funano types. On Honshu, the Yubetsu technique is very much like the original Yubetsu on Hokkaido, and is distributed in the Tohoku region on the Pacific coast, and also extends to the San'in region in southwest Japan on the Japan Sea coast. The Sakkotsu sub-technique is found in all of these regions, but the Pirika sub-technique is known only from the northernmost part of Honshu, and the Shirataki sub-technique only in Niigata Prefecture. Because the Fukui technique – called a variation of the Yubetsu method of northern Kyushu – was brought to the Inland Sea area, it has been debated whether or not it belongs to the Yubetsu technique group known from the islands of the eastern Inland Sea and the coast of Osaka Bay.

The Yadegawa method is distributed from Kyushu to the northernmost point of Honshu. It has a sparse occurrence in northeastern Japan and a dense distribution in southwestern Japan to the west of the Chubu and Kanto regions. The Yadegawa method is the oldest microblade technology throughout the region of its geographical distribution. Though microblade technology itself is con-

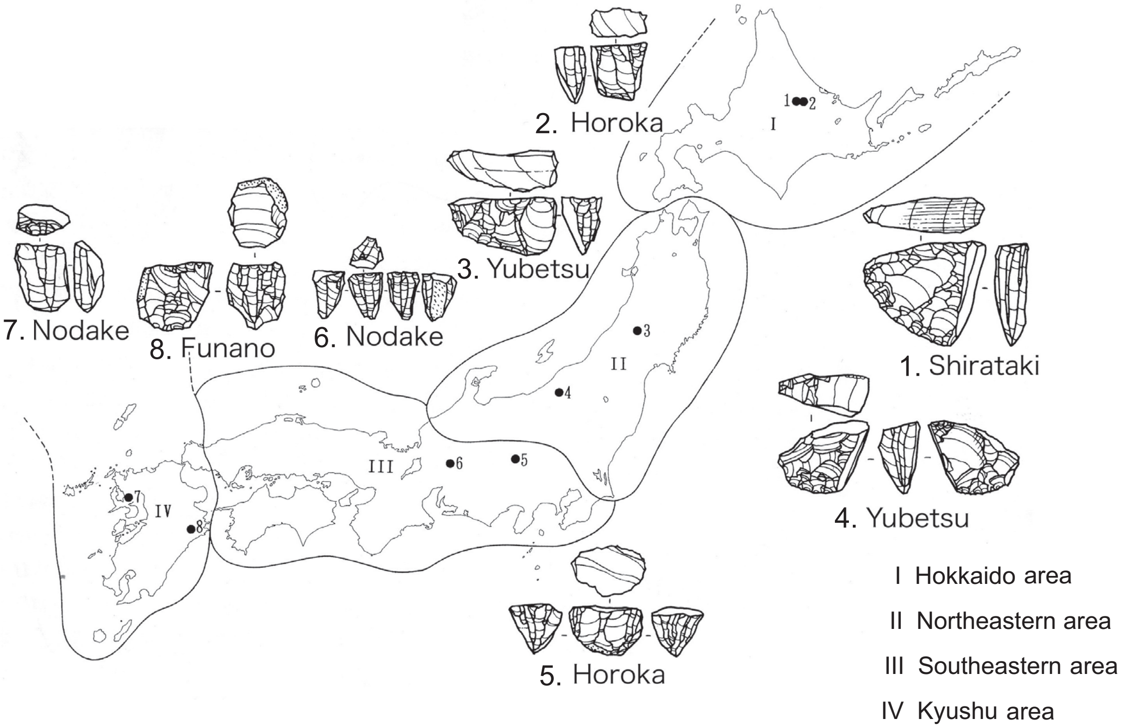


Figure 4.5: Archaeological areas of Japanese microblade industries.

sidered to have been brought from the continent, the place of origin of the Yadegawa method on the continent is unknown. Therefore, it is also possible to assume that the presence of the Yadegawa method in Japan was stimulated by information of the technical and behavioural strategies of the Microblade Industry on the continent. The Yadegawa industry is characterized by its poor stone tool assemblages. Several or dozens of microcores and few microblades are usually found, sometimes associated with tools on large flakes. There exist, therefore, various conflicting perspectives on the behavioural strategy of the group which manufactured these industries.

The Horoka and Funano techniques have an interesting feature of geographical distribution. While the Horoka technique is found most abundantly on Hokkaido, the Funano technique is prevalent on Kyushu. A reduction in the frequency of both types has been noted with increasing distance from their centre of distribution. Since they show a continuous distribution, however, it is difficult to decide on the technical affiliation of a given industry in the intermediate regions such as Kanto. Although it is possible to distinguish technologically and morphologically between the Horoka and Funano techniques at the centre of each geographical distribution, the distinction is less clear in the central part of Honshu, where both have different attributes.

Northeastern Honshu Region

Microblade sites in northeastern Honshu are represented by the Odaiyamamoto 2, Kakuniyama, Taruguchi, and Araya sites. While the Yubetsu method was predominant (Figure 4.5), the Horoka technique was also used. It is to be noted that evidence of the Yadegawa method is not found in this region, though it is widely distributed in central Honshu. Microblades are mainly made of hard shale (oil shale), but in some cases obsidian was used.

Microblade industries in northeastern Honshu typically contain transverse type burins called Araya type, along with end scrapers and drills. These flake tools are made of biface thinning flakes produced in the process of bifacial reduction to manufacture microcores and microblades (Figure 4.6). This indicates a specialized techno-

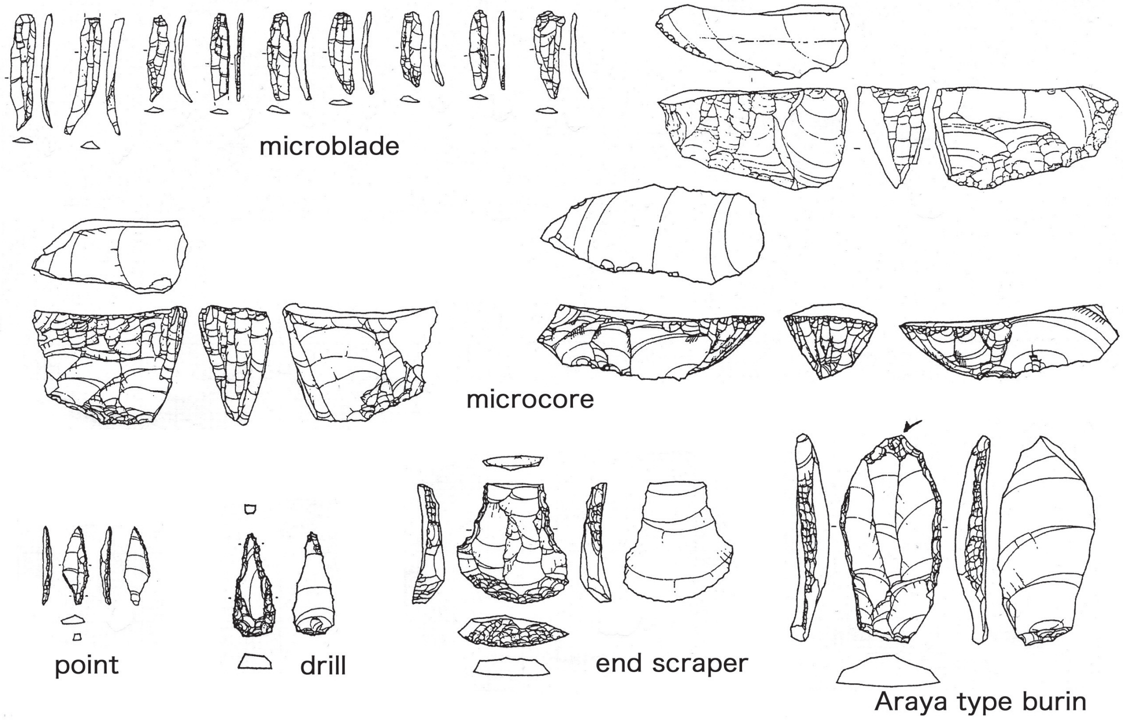


Figure 4.6: The Yubetsu method industry of Araya site in Tohoku.

logical organization of a unified lithic manufacturing strategy, which is called the mobile tool operating strategy.

The Araya type burin is a characteristic stone tool widely distributed over Northeast Asia. It has steep flaking along the edges and a facet on the left shoulder (see Figure 4.6). The reduction process of the Araya burin indicates that it was a repeatedly used "curated tool". It had been assumed that it functioned as a grooving tool, with the tip of the cutting edge used. Usewear analysis conducted by Tsutsumi (1997), however, identified no edge wear marks on the tips, while prominent gloss was found on the lateral edges. This indicates that Araya burins were employed to scrape bone or antler, using its nearly right angled lateral edge. The Araya burin may thus be characterized as a tool with "functional speciality", in contrast to a tool with "functional flexibility", the bifacial tool, for example, with various functions of cutting, scraping, and dressing hides (Tsutsumi 1997).

Microblade sites with Yubetsu method artifacts in this region are often located at the confluences of rivers, which suggests a location well-suited for fishing of salmonids and other species. Since Kato (1981) first raised the hypothesis about Late Palaeolithic fishing activity in the archipelago, it had been assumed that the exploitation of river resources, including anadromous fish, was related to the cultural dispersal of the Yubetsu industry across North Asia and northern Japan. The adoption of inland fishing of anadromous species is understood in the context of the transition process to the Jomon according to the following hypothesis: the inland fishing system worked as a releaser of the social change from the nomadic Palaeolithic society to the residential Jomon society (Sato 1992a).

The adoption of fishing in the subsistence activities of the Late Palaeolithic society in Japan is still controversial. It was necessary, however, to adopt new techniques for the exploitation of multiple food resources, because most of the large game went extinct by the end of the Pleistocene, causing a shift in the procurement system to the hunting of agile medium-sized animals. This situation probably gave rise to a focus on inland fish resources, especially salmonid species with a highly predictable and stable resource abundance, and the development of new fishing techniques. Considering this subsistence background of inland fishing, it is reasonable to suppose that the Araya type burin played an important role as a tool to make bone and antler fishing equipment.

The adaptation of microblade industries to new food resources was very different in northeastern and southwestern Japan with their own distinct environments. In contrast to possible inland fishing of salmonids in northeast Japan, in southern Kyushu, which lies at a lower latitude and has a warmer climate, nuts were heavily exploited and pitfall hunting evolved in the emerging temperate forest. It is likely that a maritime adaptation gradually developed in this region. The results of dietary analysis show that adaptation to the local environment progressed independently in each region of the archipelago at the Microblade Industry stage at the end of the Late Palaeolithic, and various types of ecology and resource subsistence in different localities began appearing in the Jomon period (Tsutsumi 2002).

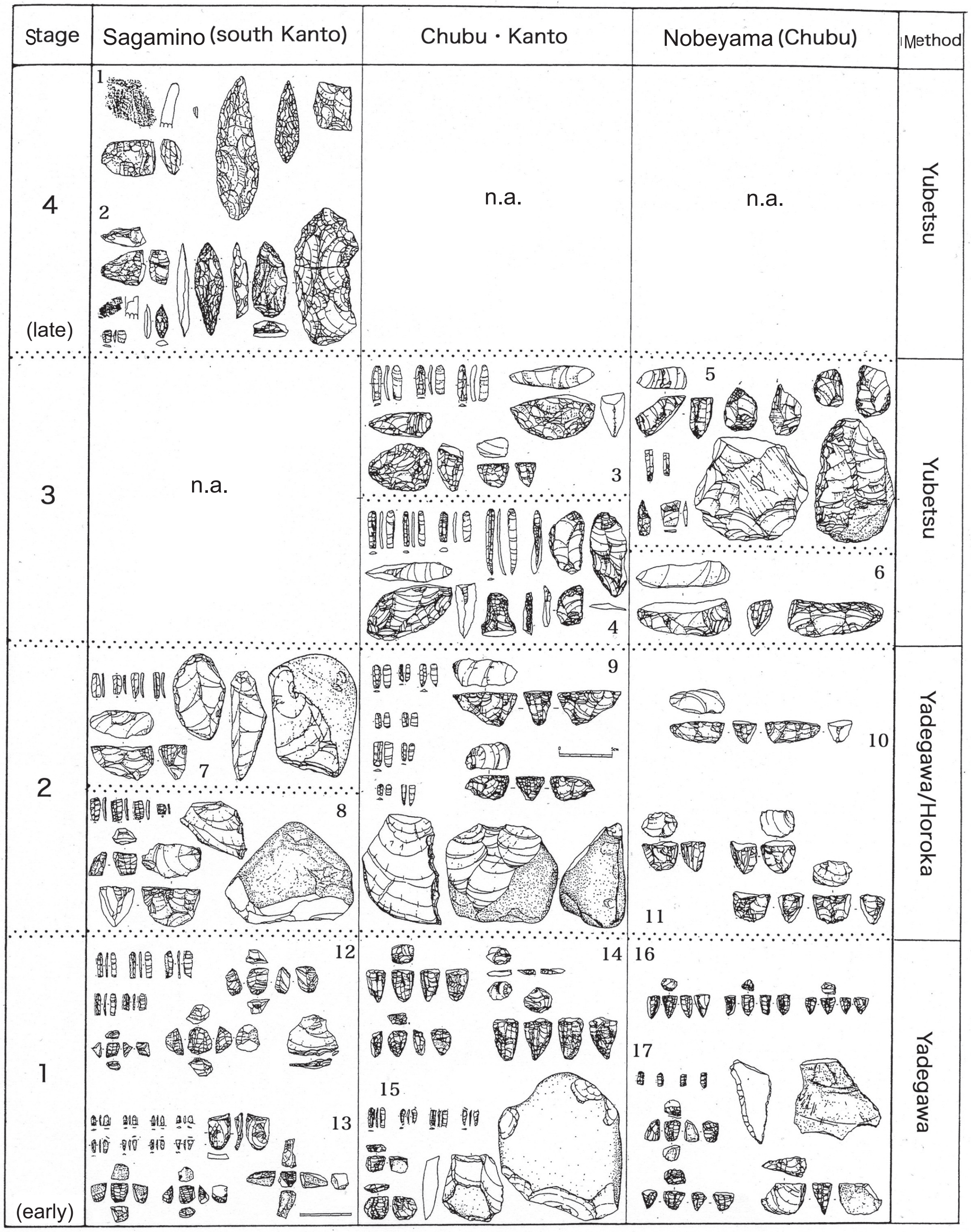
Central Honshu Region

In central Honshu, microblade sites are concentrated in several regions: Nobeyama and Wada-toge in the Central Highlands in Nagano Prefecture, northern Kanto, the Sagamino, Musashino, and Shimofusa plateaus in southern Kanto, and at the bases of the Hakone and Ashitaka mountains. The microblade industries in these regions were mainly produced with the Yadegawa and Yubetsu methods. In this section, we will discuss the microblade industries of the Sagamino Plateau and the Nobeyama region.

The Sagamino Plateau is an excellent research field for Late Palaeolithic study, blessed with thick loam sediments containing Palaeolithic finds. Based on the stratigraphy, the Sagamino microblade industries can be divided into four chronological stages. The first and second stages contain microblade industries with Yadegawa method microcores; in the third stage, Yadegawa boat-shaped microcores of the Horoka technique are characteristic; and in the fourth stage, the Yubetsu method with Sakkotsu type microcores, associated with the oldest pottery, is found (Suwama 1991; Figure 4.7). In central Honshu, we can observe a chronological order of microblade industries: the Yadegawa method in the first half and the Yubetsu method in the last stage. As for lithic exploitation, while obsidian-oriented utilization was predominant in the first half, a switch to local raw material, such as tuff, occurred in the second half. This seems to reflect some changes in the raw material procurement system, territorial system, and other behavioural aspects.

Over 40 microblade sites have been found in the Sagamino area; they contain settlements distributed along medium-sized and small rivers, working camps with pebble tools, and transit camps along migratory pathways. These sites are small, consisting of one or more spots of lithic concentration. Japanese Palaeolithic camp sites are generally categorized into three types – A: circular type settlement (clustering type), B: parallel type settlement (returning type), and C: single type settlement (small-scale type) (Figure 4.8). The circular type (A) is a home base with many households clustering around an open space, consisting of lithic concentrations in a circular arrangement. The returning type (B) is a residential camp to which humans repeatedly came back. The single type (C) is a transit camp, consisting of one or more small lithic concentrations. While most sites can be classified as settlement types A, B, or C, only the small-scale type (C) microblade sites are distributed on the Sagamino Plateau. This indicates a scattered settlement system without a home base or residential camp strategy. It is highly probable that several small groups spent a nomadic life on the plateau. This type of settlement system seems to have been a behavioural adaptation to the dispersed resources of low predictability, for example, deer hunting in a tree-covered environment. This contrasts with the settlement system in northeastern Japan, where microblade sites occupied river confluences with possible adaptation to inland fishing (see above).

In the Nobeyama region, located in the highlands 1300 m above sea level



1: Katsusaka; 2: Kamino; 3: Yanagimata A; 4: Kashiranashi; 5: Nakappara 5B; 6: Kashiwadare; 7: Shimotsuruma-nagabori 1; 8: Kamisoyagi 1; 9: Masugata; 10: Yadegawa 4; 11: Yadegawa 1; 12: Kamisoyagi 3; 13: Daikanyama; 14: Yanagimata C; 15: Ichinoseki-maeda; 16: Yadegawa 1; 17: Yadegawa 1.

Figure 4.7: Chronology of microblade industries in southern Kanto (after Suwama 1991).

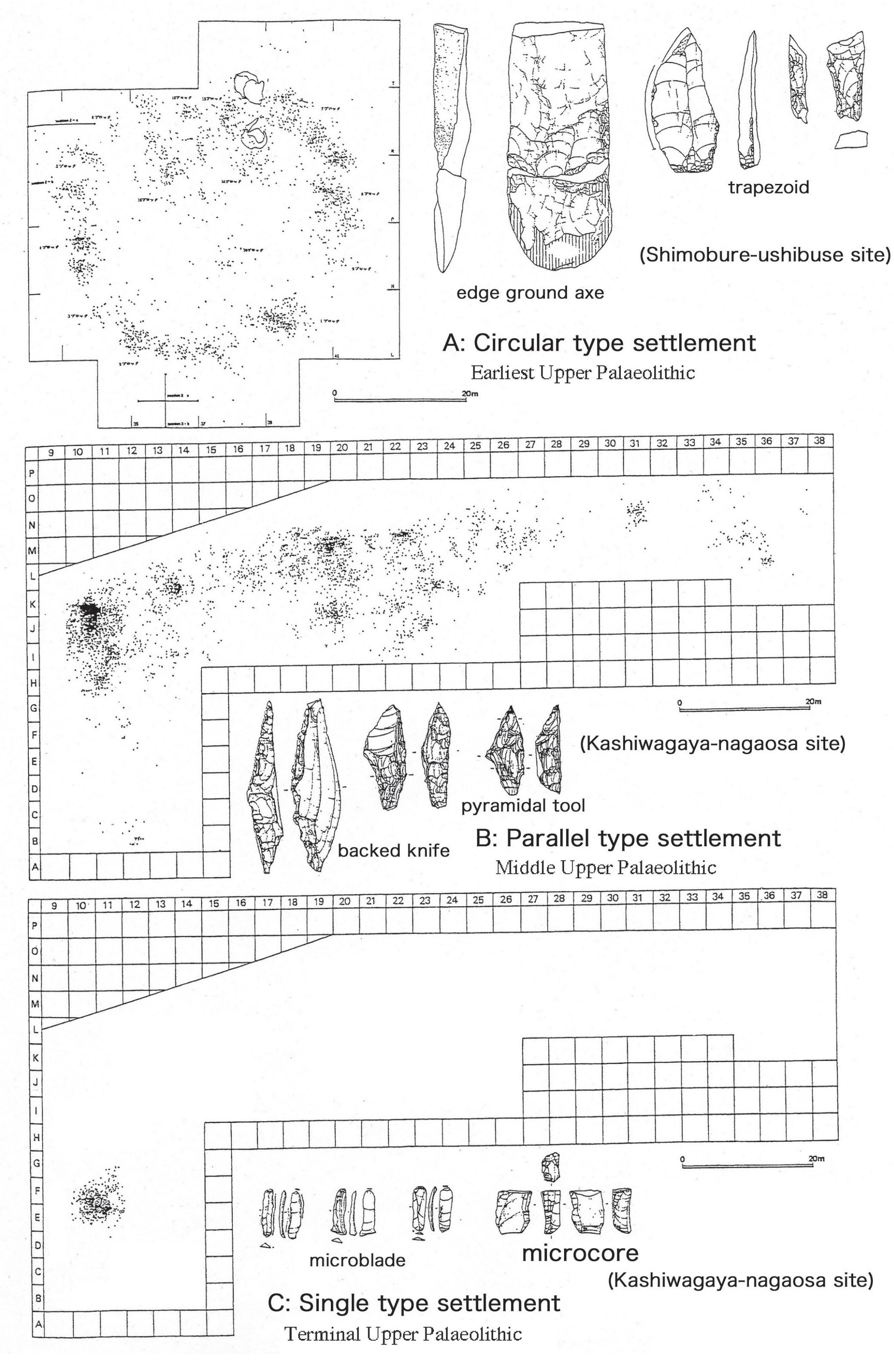


Figure 4.8: Settlement system of southern Kanto in the Upper Palaeolithic.

(asl), the Yadegawa and Yubetsu methods with Sakkotsu type microblade industries show a concentrated distribution. Discussing the geographical background of Japanese microblade industries, Suzuki (1983) pointed out that most of the microblade sites occur in low altitude areas below 200 m asl. Among the 482 sites he examined, 245 sites (51%) were less than 100 m asl and 372 sites (77%) less than 200 m asl. High altitude microblade sites over 1000 m asl were found only in the Nobeyama region; they number only 23, which is less than 5% of the total. Suzuki (1983) concluded that the living space (territory) and land utilization pattern of the Nobeyama microblade industries was a "low and flat land type = plain type" in principle (Suzuki 1983). It is to be noted that the "high and flat land type = highland type" site location in the Central Highlands is a very special case. There is no doubt that these sites were seasonal camps used except in winter, a phenomenon probably related to raw material procurement at the nearby obsidian sources.

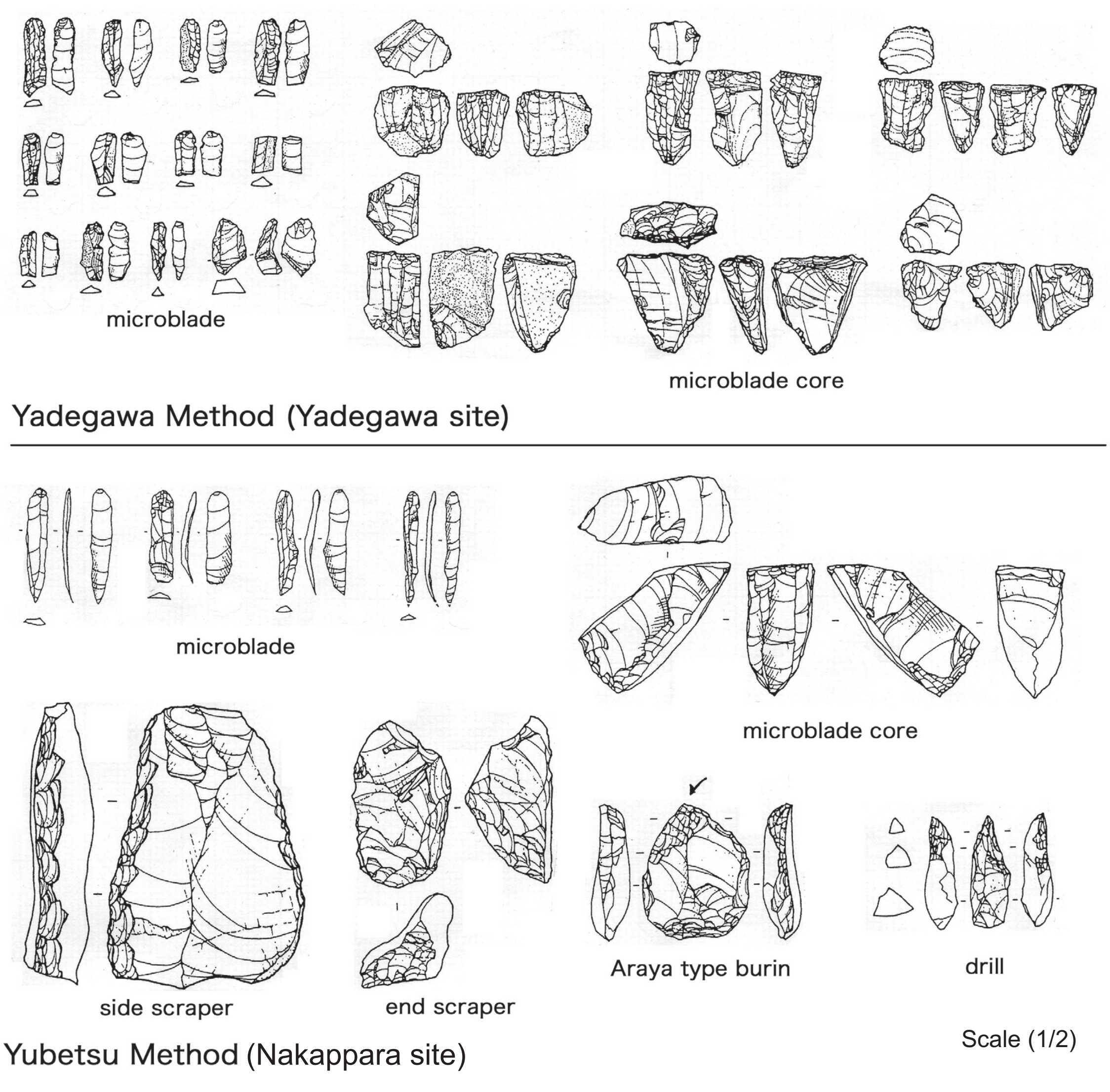


Figure 4.9: Comparison between the Yadegawa and Yubetsu method industries in central Japan.

The Yadegawa microblade industry at the Yadegawa site shows a very simple composition, containing only side scrapers and pebble tools. The Yubetsu microblade industry at the Nakappara site cluster has a strikingly different composition, containing end scrapers and burins along with microblades, side scrapers, and pebble tools (Figure 4.9). As for their chronological sequence, the Yadegawa method precedes the Yubetsu method microblade industry at the Nakappara site cluster, corresponding to the case in Sagamino.

The Yubetsu method microblade technique, utilizing oil shale, is characterized as a system in which biface thinning flakes were used to produce side scrapers, end scrapers, burins, and other tools (e.g., Otsuka 1968; Hashimoto 1988). At the Nakappara sites with Yubetsu method artifacts, however, it was pointed out that microblade and flake tool production went through separate processes (Nagatsuka 1996). These two production processes were distinct in terms of raw material selection, with obsidian used for microblades and chert for flake tools. We can observe that the retouching process of a microcore blank is simplified, compared to that of the Yubetsu method of the Araya type site (Figure 4.10); this is probably

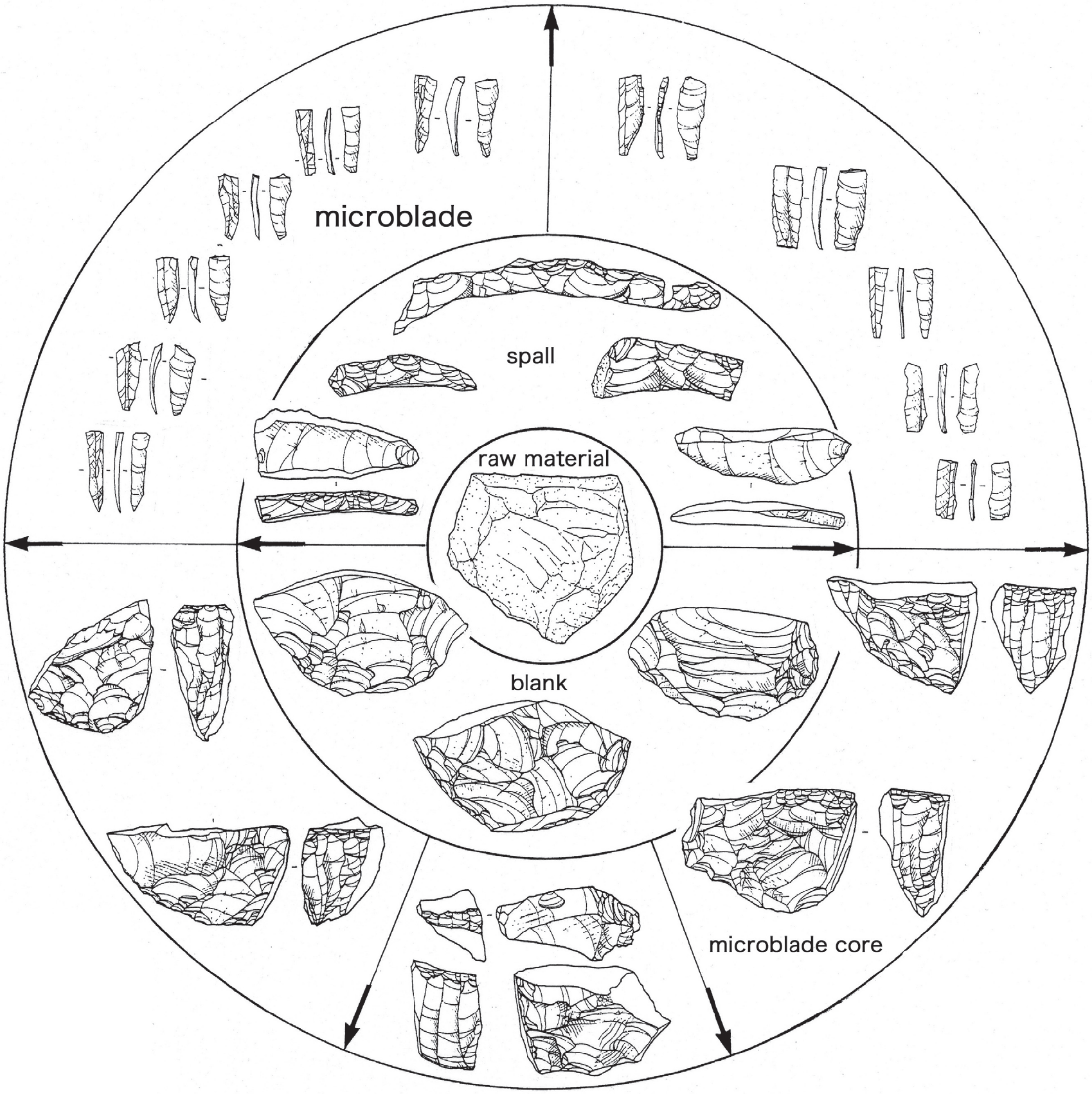


Figure 4.10: Bifacial reduction technique of the Nakappara site.

a technological response to the lack of the need to supply biface thinning flakes for flake tool production.

Biface reduction technology, a characteristic of the Yubetsu method used at the Araya site, is assumed to have been a well-established curation system advantageous to a nomadic strategy, for the following reasons: (1) a biface itself can be used as a tool, not only as a bifacial blank; (2) a well-retouched biface reduces the risk of breakage during transportation and manufacture; and (3) a rational manufacturing process and effective raw material utilization became possible as a result of the unification of microblade and flake tool production (Sato 1992a, 1995). In other words, this system is assumed to be well-suited to a highly mobile lifestyle.

The Yadegawa industry spreading over the Nobeyama region introduced a new technical system, probably as a result of contact with the Araya type industry. Flake tool and microblade production, however, went through separate processes in the indigenous Yadegawa method manufacturing system. Therefore, when the Yubetsu method was introduced to Nobeyama, the unified system of flake tool and microblade production became separated. In addition, very sharp obsidian was selected for microblade manufacture, and non-glassy and non-frangible chert was used to make flake tools such as scrapers. This kind of raw material management appears to have been a technological organization adapted to a multiple lithic environment, that is, an environment with abundant nearby lithic sources, not only obsidian but also chert and other materials.

Southwestern Honshu and Shikoku Region

In the Kinki region of southwestern Honshu, the Nijo Mountains yield glassy raw material called sanukite, a black glassy andesite. A great number of sites of the Backed Knife Industry with artifacts made mainly of sanukite are found in this region. In the Microblade Industry period, which appeared immediately after the Backed Knife Industry period, however, only few microblade sites were known in the Kinki region. It may be assumed that sanukite was not suited for delicate microblade production using pressure flaking. It is quite likely that no sites were formed in this region in the Microblade Industry period, because of its lithic environment, lacking dense and fine-grained raw material.

Microblade sites, however, are distributed in the Setouchi region to the west of Kinki, where glassy andesite sources exist. Microblade industries here were manufactured mainly with the Yadegawa method, widely distributed over western Honshu, and microblade industries with features of the Fukui technique (a variation of the Yubetsu method of northern Kyushu, see above), with a small number of Yubetsu microblade sub-techniques resembling those of northeastern Japan.

The Onbara 2 site in Okayama Prefecture has yielded the southernmost evidence of the Yubetsu method of the northeastern Japan type. At this site, Araya type burins are associated with wedge-shaped microcores (Figure 4.11). Based on the results of the Onbara 2 site excavation, Inada (1996) proposed that Palaeolithic human groups at this site may be classified broadly into two categories based on their migration style: returning-nomad groups and colonist groups. According to this hypothesis, Yubetsu method microblade sites outside the area with hard shale contain sites left by both groups. Cultural layer M at the Onbara 2 site, where mainly local lithic raw material was exploited, is assumed to have been left by a colonist group that had dispersed from northeastern Japan. Correspondingly, the assemblages from the Yanagimata, Nakappara 5B, and Nakappara 1G sites in Nagano Prefecture, also with local raw material use, are understood as assemblages left by colonist groups. On the other hand, in the Kanto region, it is assumed that the nomad groups shuttling between the Kanto and Tohoku regions manufactured microblade industries exploiting hard shale, for example, at the Ushirono, Kidoba, Shirakusa, and Kashiranashi sites (Inada 1996).

Yadegawa method microblade sites also occur on Shikoku Island.

MICROBLADE INDUSTRIES ON KYUSHU

Abundant microblade industries are found on Kyushu, an island adjacent to the Asian continent. Microblade technology on Kyushu is largely divided into two categories, the Yubetsu and the non-Yubetsu method groups (Figure 4.12).

The non-Yubetsu method group is subdivided into several techniques. The production system with Nodake-Yasumiba type microcores, which is called the Yadegawa method, involved processing a prism or cube-shaped blank by splitting the raw material and detaching microblades without preparing the striking platform. Artifacts manufactured with these techniques are distributed all over Kyushu, made on obsidian exploited from sources in various areas of the island (Figure 4.13). In contrast, the Funano technique – which is very similar to the Horoka technique – is mainly found in eastern and southern Kyushu (Figure 4.13). This technique exploited local fine-grained raw material such as rhyolite or shale, not relying on obsidian. Although in previous times it was assumed that the Funano technique was part of the early stage of the Japanese Microblade Industry, and had possibilities to be associated with the preceding Backed Knife Industry, more recently it is thought to have existed also in the transition to the Jomon period. In addition, two specialized microblade techniques show limited distribution in Kagoshima Prefecture and the southern part of Miyazaki Prefecture, both in southern Kyushu. While the Unewara technique exploited coarse-grained raw material, mainly sandstone, the Kajiyazono technique was adapted to using very thin plates of shale (Figure 4.13). Both microblade detaching techniques were technologically well adapted to the local raw materials, and are dated to the final stage of the Microblade Industry. Figure 4.14 illustrates the microblade manufacturing techniques which were used on Kyushu.

The Yubetsu method group on Kyushu is called the Fukui or Saikai technique, as the formation process of the microcore blank is different from that on Hokkaido. It is presumed that this unique Yubetsu method was brought from the Asian continent. Since the Yubetsu method in Korea contains a variety of techniques common to Hokkaido, it is quite probable that only part of these techniques were carried to Kyushu.

Outside the Japanese Archipelago, the Yadegawa method is also known from southern China (Tang 1996). Therefore, the Yadegawa method was thought to have originated from a similar microblade industry in southern China. However, since recent studies make it clear that Chinese examples are mainly from the Neolithic period (Tang 1996), southern China cannot be the place of the origin of the Yadegawa method, among the oldest microblade industries in Japan.

While the Kyushu microblade industries were based on the Fukui/Saikai technique, the complex landforms and varied climate and ecology

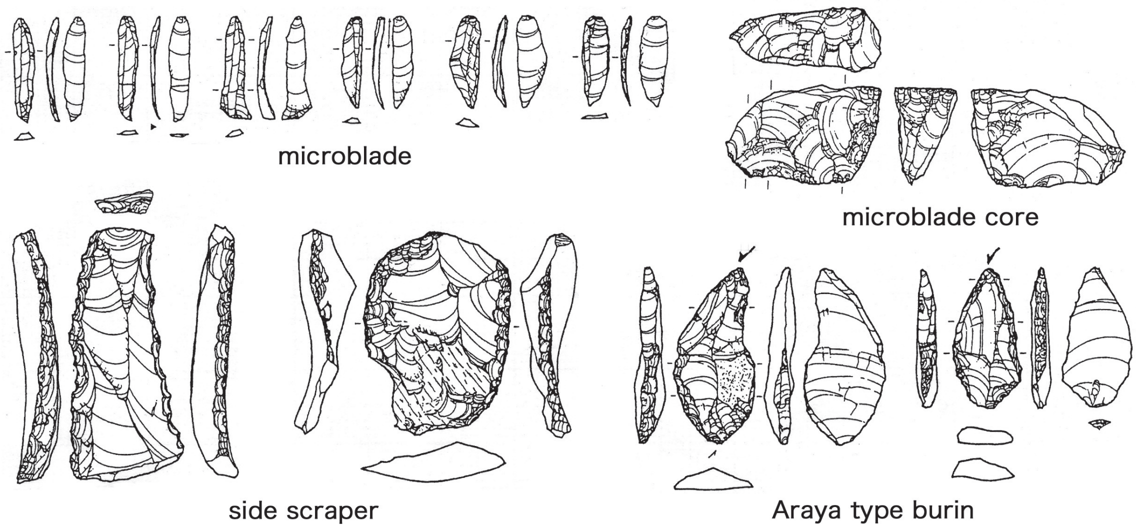


Figure 4.11: Yubetsu method industry of Onbara 2 site in southwestern Japan.

affected the manufacture of a diversity of local microcore types. The relationship between these local industries remains unclear, partly because the poor sedimentary environment has made inter-site stratigraphic comparison difficult and few results of absolute dating have been obtained.

Recently, excavations of Upper Palaeolithic sites in Korea, including microblade sites, have strikingly increased, and Korean Palaeolithic study has shown a rapid development (see Chapters 6 and 7). As a result, the following theory is gaining wide acceptance: blade points, the main stone tool category of the Korean Upper Palaeo-

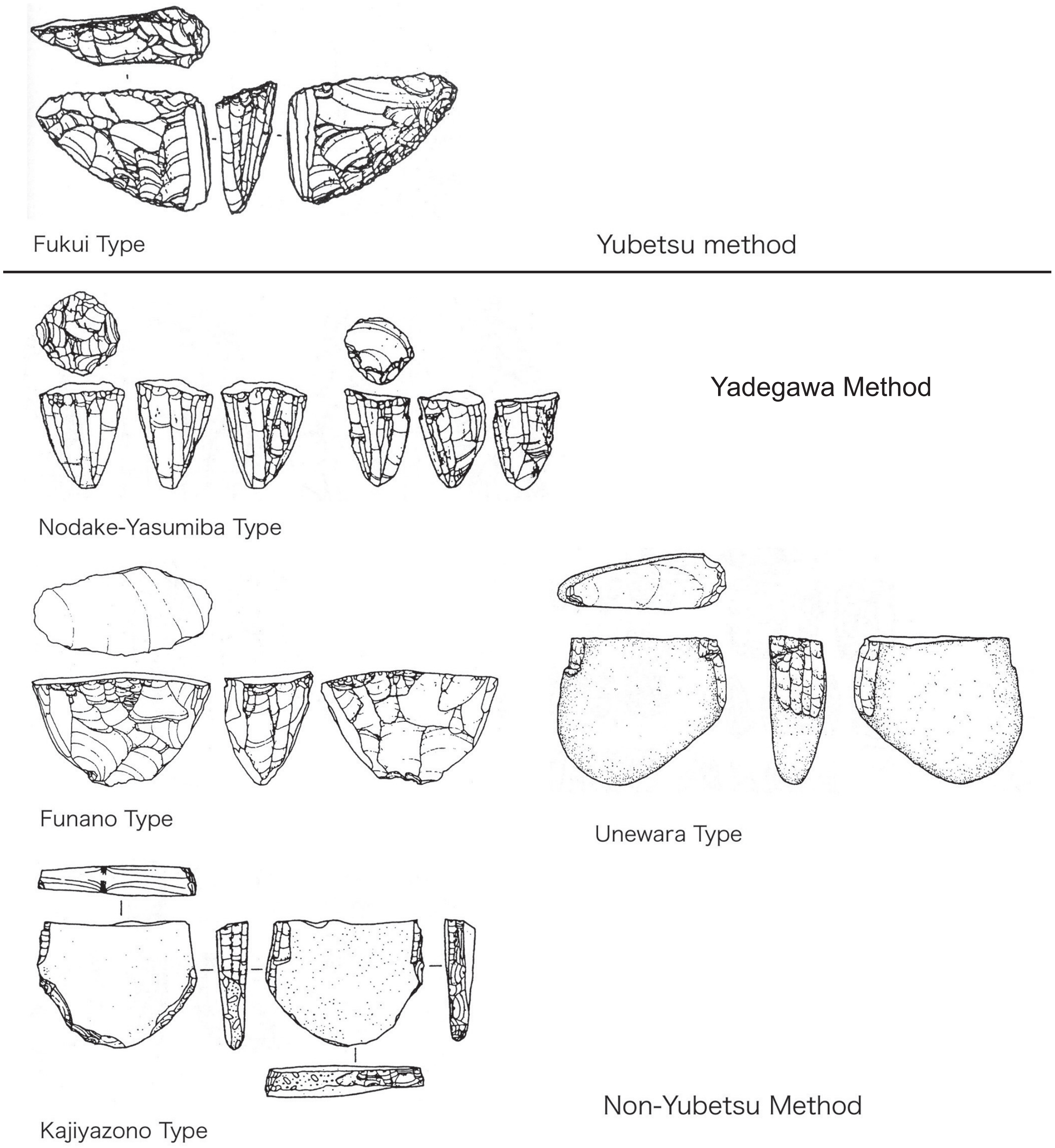


Figure 4.12: The types of microblade core of Kyushu.

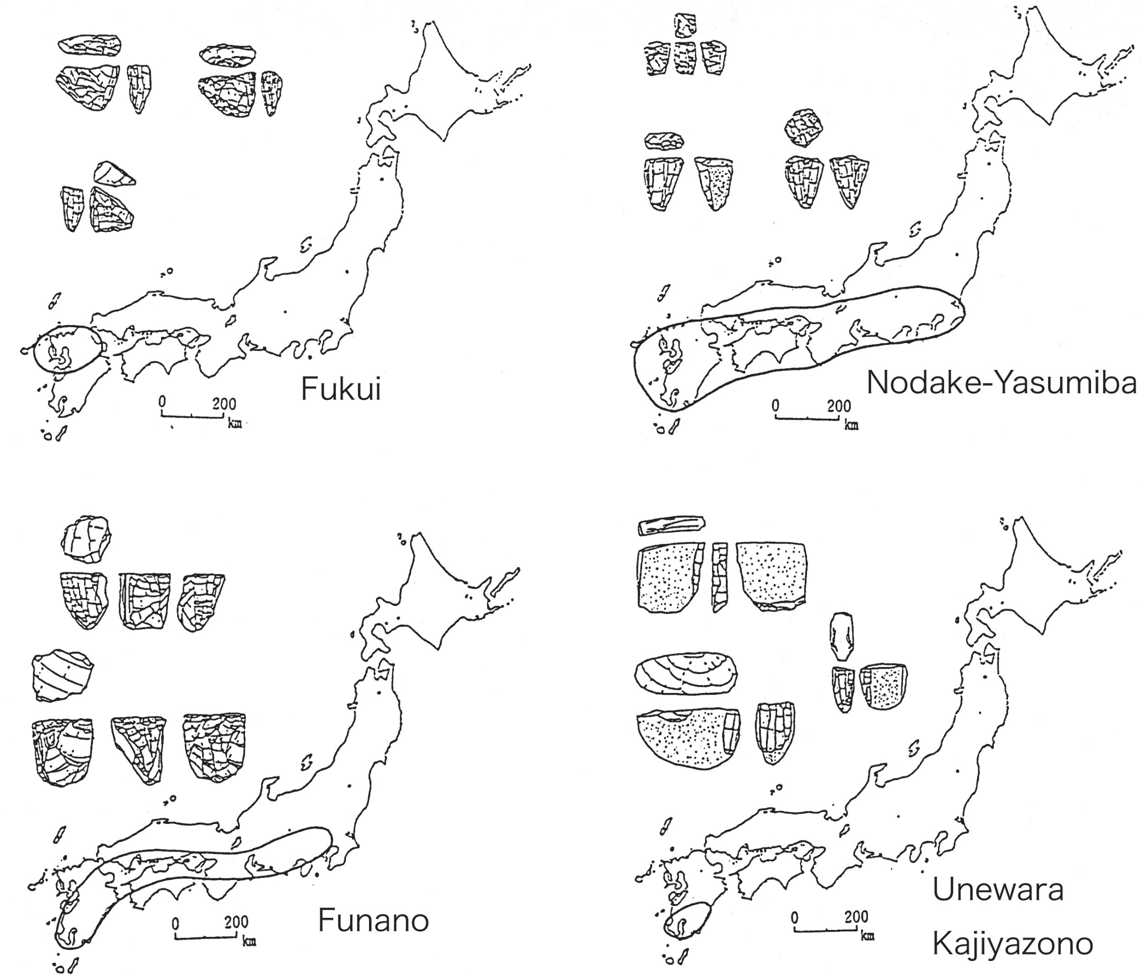


Figure 4.13: Distribution of microblade core types in southwestern Japan.

lithic, were associated with the Yubetsu method Microblade Industry since the early Upper Palaeolithic (c. 20,000 BP and earlier). On the other hand, though blade points appeared on Kyushu at the beginning of the late Upper Palaeolithic (c. 24,000–13,000 BP), they are not found associated with microblade industries. It is therefore assumed that blade points were brought to Kyushu without microblade technology. However, the examples from Korea suggest that the Yubetsu microblade technology on Kyushu is probably earlier than assumed according to the traditional view.

Microblades on Kyushu were used until the beginning of the Jomon period, which corresponds to the case on Hokkaido. On Hokkaido, humans appear to have maintained a mobile strategy even after the transition to the Jomon period on Honshu and Kyushu, especially in its southern part which was the first region of Japan to adopt a sedentary strategy. In other words, the microblade operating strategy represents a sedentary adaptation. Microblade technology at the beginning of the Jomon differs qualitatively from microblade technology in the Upper Palaeolithic. Since the microcore form becomes less standardized and the distinction between the two methods mentioned above becomes indistinct, intermediate-form microcores, difficult to categorize, increase in number. At this stage, microblade technology seems to lose its behavioural advantage inherent in the Microblade Industry, that is, economical exploitation of lithic raw material suited for a mo-

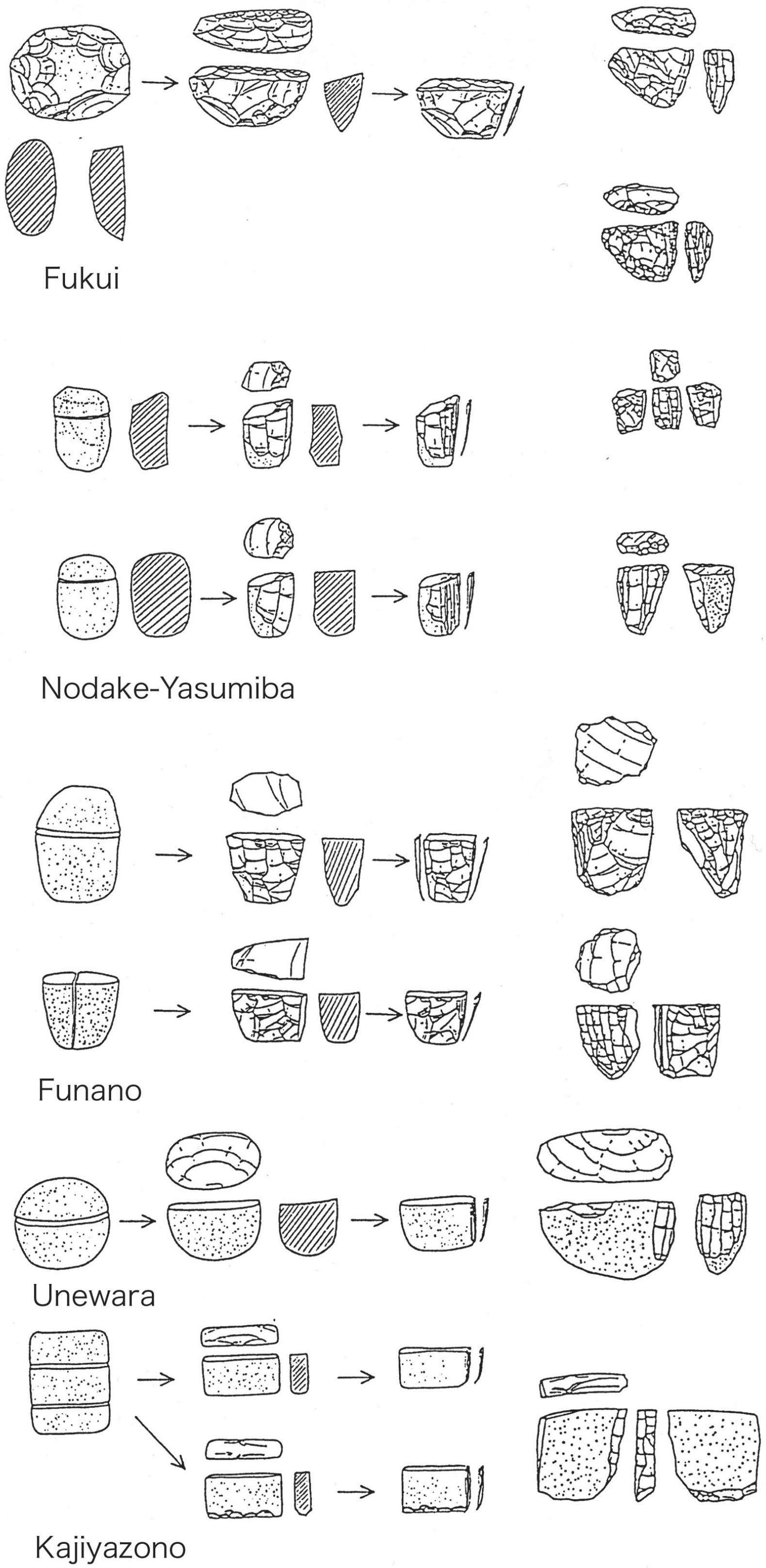


Figure 4.14: Microblade detaching techniques of Kyushu (after Tachibana 1993).

bile strategy, and to persist as a small-sized blade producing technique. A summary of Japanese microblade techniques is given for the convenience of readers in Table 4.2.

GEOGRAPHICAL ENVIRONMENT OF THE JAPAN SEA REGION AND THE INFLOW OF MICROBLADE INDUSTRY

There appear to have existed two inflow routes of the Microblade Industry to the Japanese Archipelago, that is, through Sakhalin Island and the Korean Peninsula. However, since detailed analyses are difficult to make, several aspects of how microblade technology was introduced from the central and lower parts of the Amur River basin via Sakhalin Island (the Hokkaido route), and from northeastern China via the Korean Peninsula (the Korean Peninsula route), remain unknown.

In discussions of how the Microblade Industry spread across the Japanese Archipelago, it is important to consider the role of the Japan Sea. The present condition of the Japan Sea was probably formed around the Pleistocene-Holocene transition. From the information now obtained, it is assumed that landbridges did not exist between the Asian continent and the Japanese Archipelago except for Hokkaido. Even at the Last Glacial Maximum (LGM), the Korea Strait between the Korean Peninsula and Tsushima Island, and the Tsugaru Strait between Hokkaido and Honshu islands, there were very narrow seas separating both sides. But the Tsugaru Strait probably had an ice bridge in the winter season. While the palaeo-Yellow River flowed into the Korea Strait, the palaeo-Amur River flowed into the Mamiya (Tatar) Strait. Since these two rivers flowed into the palaeo-Japan Sea, increasing its freshwater content, the northern part of the Japan Sea was

Table 4.2: Classification of microblade techniques in Japan.

Method	Technique	Sub-technique	Core type
Hokkaido Island			
Yubetsu	Strict Yubetsu	Oshorokko	Oshorokko
		Rankoshi	Rankoshi
		Pirika	Pirika
		Shirataki	Shirataki
		Sakkotsu	Sakkotsu
	Togeshita		Togeshita
Non-Yubetsu	Horoka		Horoka
	Hirosato		Hirosato
	Momijiyama		Momijiyama
Honshu Island			
Yubetsu	Strict Yubetsu	Pirika	Pirika
		Shirataki	Shirataki
		Sakkotsu	Sakkotsu
	Fukui		Fukui
Non-Yubetsu	Nodake-Yasumiba		Nodake-Yasumiba
(Yadegawa)	Horoka/Funano		Horoka/Funano
Kyushu Island			
Yubetsu	Fukui/Saikai		Fukui
Non-Yubetsu	Nodake-Yasumiba		Nodake-Yasumiba
(Yadegawa)	Funano		Funano
	Unewara		Unewara
	Kajiyazono		Kajiyazono

probably covered with vast drift ice fields in winter. Hokkaido became a northern peninsula projecting from the Asian continent, since the Soya Strait formed a landbridge between Hokkaido and Sakhalin, connecting to the continent north of the palaeo- Amur River. These geographic conditions had a strong influence and basically characterized the microblade industry of Hokkaido, which has many features in common with the continent. Microblade technology was introduced to Japan through the Korean Peninsula and the "Hokkaido Peninsula".

OBSIDIAN RESOURCES AND LITHIC EXPLOITATION TERRITORY

A large number of obsidian sources have been studied in detail in the Japanese Archipelago, from Hokkaido in the north to Kyushu in the south (Figure 4.15). This is partly because of the intensive archaeological research conducted all over this relatively small country. The obsidian sources are classified into more than 100 groups by the elemental chemical composition of the raw material. In recent years, a large number of non-destructive X-ray fluorescence spectrometry analyses of stone implements from archaeological sites have been conducted, making it possible to reconstruct the obsidian supply from the sources to the archaeological sites.

Here, we will describe raw material exploitation of the microblade industry from central Honshu, where many source analyses have been conducted. Obsidian sources in this region are as follows (Figures 4.15 and 4.16): (1) the Wada-toge sources in the Central Highlands, which comprise the Wada-toge, Hoshigato, Kirigamine, and Omegura sources; (2) the Yatsugatake sources, also in the Central Highlands, which consist of the Mugikusa-toge, Futagoike, and Tsumetayama sources; (3) the Izu-Hakone sources at the border of Kanagawa and Shizuoka prefectures are the Hatajuku and Kashiwa-toge sources; (4) the Kozu Island (Kozu-jima) sources on the Pacific Ocean coast

Figure 4.15: The major obsidian sources in Japan.

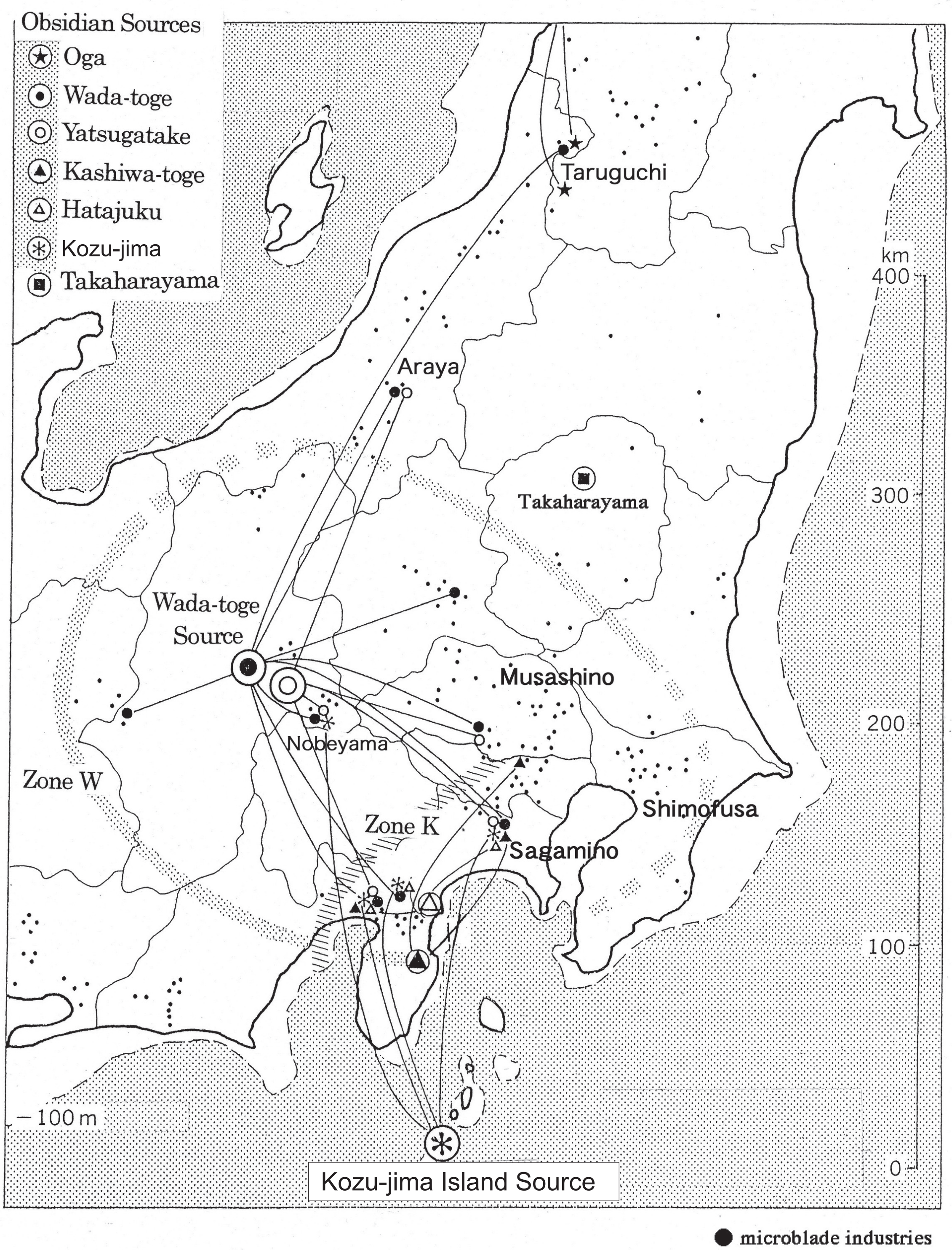


Figure 4.16: Obsidian procurement system in central Honshu.

comprising the Onbase-shima and Sanukazaki sources; and, (5) the Takaharayama sources in the mountains of northern Kanto. The Wada-toge and Yatsugatake sources are located in the Central Highlands of Nagano Prefecture, also called Shinshu, with the former 1200–1500 m asl and the latter approximately 2000 m asl. The Takaharayama sources are also located in a mountainous region, c. 1000 m asl. The Izu-Hakone sources are situated on the Izu Peninsula on the Pacific coast of Honshu, approximately 500 m asl. The Onbase-shima source on Kozu Island is located on the Pacific Ocean coast, 50 km from Honshu in a straight line.

Obsidian procurement was restricted by these geographical conditions. In the Shinshu region (Nagano Prefecture) obsidian sources seem to have been seasonally limited, because of their high altitude location in the mountains. This means that lithic procurement activity was seasonally regulated. In the glacial age, it is assumed that the Wada-toge source group and Mugikusa-toge source were located in the periglacial region near the treeline of the subarctic coniferous forest. Despite the decrease in the amount of snowfall caused by the arid glacial climate, lithic procurement from winter to early spring would have been still extremely difficult. Thus, it is highly probable that humans procured lithic raw material mainly in the summer. In recent years, numerous obsidian mines have been found around Wada-toge, for example, Hoshikuzu-toge, Hoshigato, and Hoshigadai, which all belong to the Jomon period. However, no obsidian mines dating back to the Palaeolithic have been found to date. It is assumed that the utilization of cobbles from around the outcrops and rivers was the most effective lithic procurement strategy to reduce loss of time and optimize the cost-benefit relationship.

Source analyses were conducted by Mochizuki and Tsutsumi (1997) of 2357 obsidian artifacts from nine microblade sites on the Sagamino Plateau, in order to clarify the obsidian supply system of the microblade industry of central Honshu. The analyses identified 718 items of Shinshu origin, 470 items of Izu-Hakone origin, and 1169 items of Kozu Island origin (Mochizuki and Tsutsumi 1997; Table 4.3). Including the results of other source analyses, we were able to reconstruct the system of obsidian procurement in central Honshu (Figure 4.16, Table 4.3). The lithic exploitation pattern at each site may be classified as follows – 1: Shinshu origin, 2: Izu-Hakone origin, 3: Kozu Island origin, 4: Shinshu origin and Izu-Hakone origin, 5: Kozu Island origin and Izu-Hakone origin, and 6: Shinshu and Kozu Island origin. While obsidian from a single origin was exploited predominantly at the 1–3 pattern sites, obsidian from different origins was used at the sites of patterns 4 and 5. Pattern 6, exploiting obsidian of both Shinshu origin and Kozu Island origin, was not found on the Sagamino Plateau; this indicates that obsidian supplies from Shinshu (mountainous zone) and Kozu Island (oceanic zone) are incompatible with each other.

The varied composition of obsidian sources at the microblade sites in Sagamino, containing obsidian of Shinshu, Izu-Hakone, and Kozu Island origins, is sometimes explained as reflecting their different ages. However, the issue does not seem to be that simple. In the authors' opinion, the fact that obsidian from Kozu Island and Shinshu are not found together at the same site was based on the lithic procurement strategy – the season of procurement at Shinshu and Kozu Island may have been different, that is, it was related to the mountain location of the Shinshu source and the Kozu Island source being on an isolated island. Given that seasonality existed in lithic procurement, it may be assumed that Shinshu obsidian was exploited mainly in the summer, because of the difficulties of winter procurement, while obsidian of Kozu Island origin was selected in other seasons.

Based on source analyses at consumer sites (see above), obsidian sources in central Honshu are classified into two categories: major sources, with a distribution range exceeding 100 km and accounting for one-third of the total microblades excavated, and minor sources, locally exploited within a 100 km range accounting for the other two-thirds.

The Wada-toge sources are classified as major sources, supplying obsidian not only to places close to the sources but also to the Nobeyama Highlands 40 km away and to the plateaus of southern Kanto 100–150 km away (Sagamino, Musashino, and Shimofusa); this is supply zone W (Figure 4.16). Examples of distant utilization

No.	Microblade Industry	Shinshu Sources				Izu-Hakone Sources		Kozu source	Total
		Wada	Omegura	Kirigamine	Tateshina	Hatajuku	Kashiwatoge	Kozu	
1	Kamisoyagi Loc.1					52	18	260	330
2	Kamisoyagi Loc.3-C	138							138
3	Kamisoyagi Loc.3-E	2							2
4	Kamisoyagi Loc.4							2	2
5	Fukuda-Fudanotsuji							1	1
6	Nagahori-minami Ⅱ	2							2
7	Daiyama Ⅱ	239	1	98	29		380	1	748
8	Kashiwagaya-nagawosa Ⅳ							349	349
9	Kamiwada-joyama Ⅱ	74		56					130
10	Soyagi-nakamura Ⅱ	1		19	58	1		1	80
11	Kashiwadai-ekimae Ⅰ						7	273	280
12	Kashiwadai-ekimae Ⅱ							97	97
13	Hoonji				1	12		185	198
	Total	456	1	173	88	65	405	1169	2357

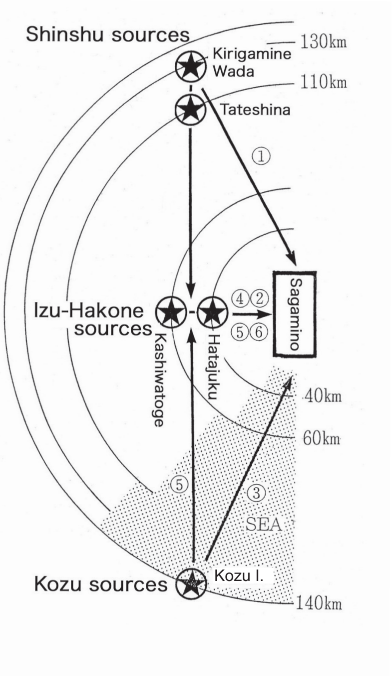


Table 4.3: Sources of obsidian artifacts used in microblade industries of the Sagamino Plateau (after Mochizuki and Tsutsumi 1997).

include the Taruguchi site, Niigata Prefecture, almost 300 km away from the sources, though this may have been an exceptional case.

Major sources are also located on Kozu Island, with obsidian from these sources transported within a 150 km range along the coast of Honshu, including the Sagamino Plateau; this is supply zone K (Figure 4.16). Examples of inland wide range transportation include the Yadegawa site, Nagano Prefecture, in the mountainous highland area 200 km away. Since Kozu Island was not connected to Honshu even during the LGM, obsidian must have been transported by sea. The supply of obsidian from Kozu Island to Honshu was very active at the Microblade Industry stage, though its utilization started in the early Upper Palaeolithic. It may be assumed that, at the Microblade Industry stage, arrangements were made to manage the organization and scheduling of lithic procuring groups to Kozu Island.

Obsidian from the Yatsugatake sources was mainly transported to the Nobeyama area, in contrast to the long distance movement of obsidian from the Wada-toge and Kozu Island sources (Figure 4.16). Obsidian from the Izu Kashiwa-toge and Hakone Hatajuku sources was also brought to sites within a 100 km range, that is, in the Sagamino and Musashino regions, and the base of Ashitaka Mountain. Obsidian from these sources had a limited distribution and amount, since it was inferior in terms of quantity and quality compared to obsidian from the Wada-toge or Kozu Island sources. The Izu Kashiwa-toge and Hakone Hatajuku sources were sometimes used to supplement obsidian from Wada-toge or Kozu Island. The supply system of obsidian from the Takaharayama sources in Tochigi Prefecture is still unclear, since we do not have sufficient results of source analysis. In the preceding Backed Knife Industry period, however, obsidian from Takaharayama was widely utilized on the Shimofusa Plateau in Chiba Prefecture. Thus, it is quite probable that utilization of Takaharayama obsidian continued in the Microblade Industry period on the Shimofusa Plateau, which is more than 100 km distant from the sources.

It has been historically controversial how obsidian was transported: direct procurement or exchange. In recent years, supply based on embedded strategy, proposed by Binford (1980) with respect to Nunamiut ethnography, has also been taken into account in Japanese research. It may further be assumed that risk reducing strategy played a role in lithic procurement (Wiessner 1982).

Taking these models into account, how can we explain the lithic procurement strategy of the Japanese microblade industry? There is no doubt that intensive direct procurement, entailing overseas journeys between Honshu and the small islands, was necessary for the procurement of obsidian from Kozu Island. On the other hand, the transport range of obsidian sometimes reached 250–400 km. At this distance, it can hardly be assumed that obsidian was obtained by direct procurement or embedded strategy, and instead, we may postulate an exchange system based on a communication network between local areas. It is highly probable that an exchange system was arranged in the second half of the Upper Palaeolithic in order to obtain specific material such as obsidian. At the beginning of the Upper Palaeolithic, lithic procurement strategy may be explained by a relatively simple model, such as direct procurement, since the exploitation system of specific materials, including obsidian, had only emerged at that time. In the second half of the Upper Palaeolithic, when local characteristics can be traced in the archaeological records and social systems developed, it seems to be unreasonable to choose one strategy from representative procurement models such as direct procurement, embedded strategy, or exchange. It may be assumed that the procurement strategy was selected with respect to individual raw materials, affected by the following conditions: (1) geographical relationship between the nomadic subsistence territory and the lithic sources, (2) difficulty of resource procurement, which is subject to the resource structure, (3) resource value, that is, lithic quality, and (4) social relationships of the human groups.

Recent archaeometric lithic source analyses have shown that the supply zones of the raw material are different from the traditionally assumed archaeological units, based on the distribution of stone tool types or manufacturing techniques, making it possible to have a new understanding of what a territory is. In the background of this new understanding of territory, we can reconstruct settlement systems, communication networks, and social systems of mobility.

CONCLUSION: THE END OF THE MICROBLADE INDUSTRY AND THE TRANSITION TO THE JOMON PERIOD

The developmental scenario of the microblade industry on Honshu may be described as follows: the spread of the uniform and homogeneous Yadegawa method was followed by the introduction and spread of the Yubetsu method from north (southern Siberia and Inner Mongolia) and south (southern part of the Korean Peninsula) of the Japanese Archipelago. The Upper Palaeolithic culture of Japan, which corresponds to a time of climatic fluctuations at the end of the Pleistocene, is characterized by a reduction of territories and the break-up of large human groups and an increase of smaller local groups. The microblade industry was brought to the Japanese Archipelago against this background of social evolutionary processes.

Since each local group on the Japanese Archipelago attempted to adapt to their local environment, diversified aspects can be observed in the transition process to the Jomon culture, which is defined as a forest-adapted hunting-fishing-gathering complex. Closely related to this, the end of the microblade industry was a complicated and diversified process in each region (Sato 1993). The sedentary hunting-fishing-gathering strategy of the Jomon culture was first adopted in southern Kyushu, where a warm and equable climate preceded that of other regions, and then spread northward. While in southern Kyushu microblade technology was adopted by the primary Jomon, it was rapidly replaced in Honshu by the Incipient Jomon culture (c. 13,000–10,000 BP) with its large-sized point industry and pottery. As the Palaeolithic-like mobile strategy continued on Hokkaido, microblade technology was predominant in this region before the Initial Jomon period (c. 10,000–7000 BP).

5

EMERGENCE AND MOBILITY OF MICROBLADE INDUSTRIES IN THE JAPANESE ISLANDS

Katsuhiro Sano

INTRODUCTION

Microblade industries spread over the Japanese Islands during the terminal Pleistocene, and these industries share technological characteristics with Siberia, Northeast Asia, and Northwest America (Kato 1976, 1989; West 1967). Up to the present, about 1800 sites have been discovered (Tsutsumi 2003a, 2003b), and a chronological framework of microblade industries in the Japanese Palaeolithic has been established (Ono 2004).

Japanese archaeologists have defined a number of different types of microblade cores with particular attention to their morphology and manufacturing processes (Yoshizaki 1961; Tsurumaru 1979; Tachibana 1979). Typological-chronological studies have been made repeatedly on the basis of these types of microblade cores; however, researchers have not yet been able to establish a definite chronology for all of the Japanese Islands. The microblade industries in Japan show wide differences depending on the geographical region. On the other hand, the sites dated by the radiocarbon method have increased recently, and it is possible to estimate the approximate duration of microblade industries.

A large number of microblade sites have been discovered on the islands of Hokkaido and Kyushu (Figure 5.1). The microblade industries in both of these regions show a great degree of assemblage variation. It is difficult to confirm a definitive chronology of these complex assemblages because there are few sites where we can recognize a diachronic relationship between assemblages and the multi-layered stratigraphy. The microblade industries of Honshu Island show various tendencies between different geographical areas. Microblade assemblages with wedge-shaped microblade cores made using the Yubetsu technique (Yoshizaki 1961) have been found in northeastern Honshu. In the central part of Honshu, there are many sites with subconical microblade cores. In southwestern Honshu, microblade assemblages with subconical microblade cores and boat-shaped microblade cores have been found, though analyses of these assemblages are limited because of the insufficient number of excavations conducted there.

With regard to wedge-shaped microblade cores in northeastern Honshu, the chronological framework is more secure because of tephrochronology and radiocarbon dates. Additionally, substantive information on lithic raw materials has been presented, and refitted lithic artifacts provide an exact reconstruction of reduction sequences of the given assemblages. Analyses of lithic raw material acquisition, transportation, and use, allow us to evaluate hominid mobility in prehistory. This paper, therefore, focuses on the mobility of microblade industries with particular reference to northern Honshu. In order to clarify the characteristics of microblade industries, a comparative analysis is attempted between microblade industries and the succeeding bifacial point industries.

RADIOCARBON DATES

Radiocarbon dates of microblade industries in the Japanese Islands range from c. 20,790 BP to c. 8300 BP (Kudo 2003). The oldest dates are from the Kashiwadai 1 site on Hokkaido Island, where charcoal samples have been dated to between 20,790 ± 160 BP (Beta–126175) and 18,830 ± 150 BP (Beta–126177) (Fukui and Koshida 1999), and charcoal samples from the Pirika 1 site, also on Hokkaido, date to between 20,100 ± 335 BP (N–4937) and 19,800 ± 380 BP (KSU–687) (Naganuma 1985). The youngest date is from the Shinmichi 4 site on Hokkaido at 8320 ± 280 BP (KSU–1430) (Onuma *et al.* 1988).

The radiocarbon dates in other parts of Japan are a few thousand years younger than those from Hokkaido (Ono *et al.* 2002). The Araya site on Honshu, where pits and "pit-dwelling-like features" were identified, is dated to between 14,250 ± 105 BP (GrA–5713) and 13,690 ± 80 BP (GrA–5715) (Kitagawa 2003). At the Yasumiba site in central Honshu, some charcoal samples recovered from a hearth associated with a lithic concentration, are dated to 14,300 ± 700 BP (Gak–604) (Sugihara and Ono 1965). At the Yoshioka B site, Honshu, dates for the upper part of layer L1H and for layer L1H are between 16,860 ± 160 BP (Tka–11599) and 12,960 ± 120 BP (NUTA–3035) (Kato *et al.* 1999). Additionally, there are radiocarbon dates for the central Honshu sites of Miyanomae with an age of 14,550 ± 160 BP (NUTA–3637) (Kawano *et al.* 1998) and Tsukimino-Kamino dated to 13,570 ± 410 BP (Gak–10545) (Aida 1986). On Kyushu Island, the Chaen

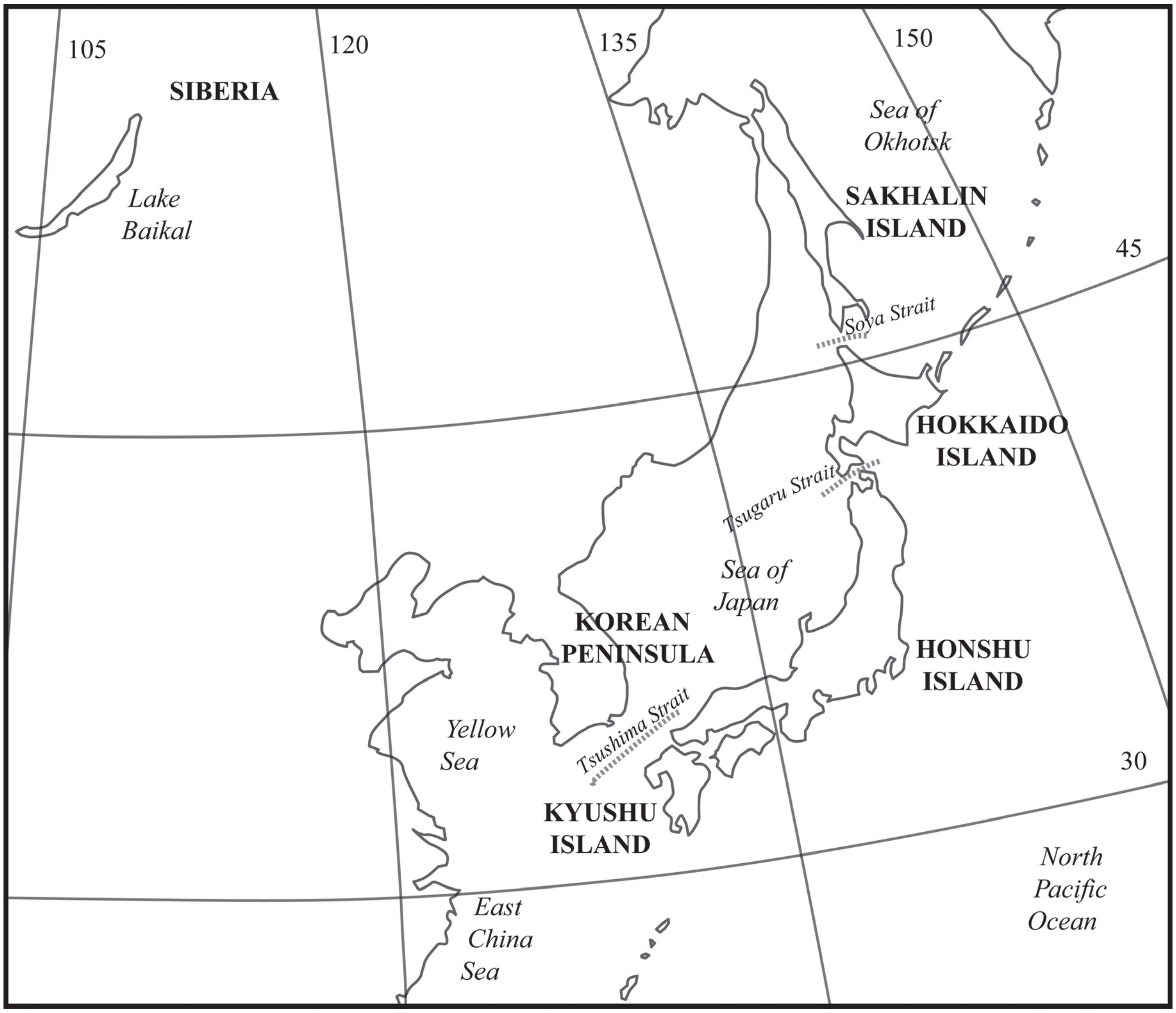


Figure 5.1: Map showing the location of the Japanese Islands and Northeast Asia.

site is dated to 15,470 ± 190 BP (Beta–107730) (Kawamichi 1998), and layer 2 of Fukui Cave is dated to 12,400 ± 350 BP (GaK–949) (Kamaki and Serizawa 1965). In the Fukui Cave, nail-impressed Incipient Jomon pottery has been recovered from layer 2 associated with microblade assemblages.

These results suggest that humans with microblade industries moved to Hokkaido Island earlier than to other parts of the Japanese Islands. Nevertheless, Late Pleistocene deposits on Hokkaido are not well developed, and the sedimentary layers have been modified by periglacial activity. Careful consideration is needed for assessing the association of lithic assemblages and the dates of collected samples. However, the charcoal samples from the Kashiwadai 1 site were recovered from fireplaces associated with lithic concentrations, making these dates quite reliable.

The emergence of microblade industries in Japan, therefore, dates back to around 20,000 BP based on the evidence from Hokkaido. Hokkaido is the northernmost of the Japanese Islands. A landbridge between Hokkaido and the Eurasian continent existed through Sakhalin Island in OIS 2 (Ono 1990). In contrast, the sill depth of the Tsugaru and Tsuhima straits between Hokkaido and Honshu and between Korea and Kyushu, respectively, is approximately 130 m. This depth is close to the sea level drop during the Last Glacial Maximum (hereafter LGM), and it has been suggested that no landbridge was formed between Hokkaido and Honshu. The landbridge between the Korean Peninsula and Kyushu is estimated to have existed for a very short duration in the LGM (Matsui *et al.* 1998). This geographical disconnection may have caused the earlier appearance of microblade industries on Hokkaido compared to other parts of the Japanese Islands (Figure 5.1).

CHRONOLOGY

Various types of microblade cores have been identified in Japan. Nevertheless, not all microblade core types are chronologically equivalent because some types of microblade cores were found together in the same spatial areas of sites. Some researchers regard the different types of microblade cores as the result of adapting to the form and quality of lithic raw materials (Shiraishi 1993; Tamura 1994). A comprehensive chronology, however, has been established for several of the main areas of Japan.

On Hokkaido, the Rankoshi, Togeshita, and Pirika types of microblade cores were recovered below the En-a tephra (Yamahara 2003; Terasaki and Miyamoto 2003) dated to about 18,000 BP. On the other hand, the Sakkotsu, Shirataki, Oshorokko, and Hirosato microblade core types have not been found below the En-a tephra. It has been argued that the Oshorokko and Hirosato microblade core types are from a later phase because they are found in concentrations with stemmed points that also date to a later phase. Togeshita and Pirika types of microblade cores have also been discovered in sites with the Sakkotsu microblade core type (Obihiro-Akira site), and the radiocarbon date is 10,900 ± 500 BP (KSU–889) (Sato and Kitazawa 1987).

On Kyushu, it is possible to confirm the stratigraphic sequence of different types of microblade cores from the Fukui and Senpukuji cave sites. Sugihara (2003) established a chronology in which the Nodake-Yasumiba type (subconical microblade cores) was succeeded by the Funano type (boat-shaped microblade cores) and later by the Fukui type (wedge-shaped microblade cores) on the basis of the stratigraphic and morpho-typological relationship observed at several sites. The appearance of subconical microblade cores, regarded as the oldest phase, is dated to approximately 15,000 BP based on radiocarbon dates from the Chaen site. Subconical microblade cores appear to have been produced in the later phase too. Boat-shaped microblade cores are associated with Incipient Jomon pottery at a number of sites. Additionally, microblade assemblages have been found with arrowheads in some sites. This pattern reveals that the microblade industries of Kyushu continued until a later phase than on Honshu.

While less information is available from western Honshu, a transition from subconical and boat-shaped microblade cores to wedge-shaped microblade cores made with the Yubetsu technique, has been established (Suwama 1988) for central Honshu. The relationship between boat-shaped and wedge-shaped microblade cores is not always chronologically distinct, and some researchers have suggested that the knappers of both assemblage types lived in the same period. At the Yoshioka B site subconical microblade cores are dated to c. 17,000–14,000 BP, but a more precise date is not available because of the large fluctuations in radiocarbon dates. Wedge-shaped microblade cores have been recovered from under and within the As-YP tephra (Maehara and Sekine 1988; Sato and Sano 2002), which is dated to c. 14,000–13,000 BP (Machida and Arai 1992). Considering that the Araya site dates to c. 14,250–13,690 BP (see above), the manufacture of Yubetsu technique wedge-shaped microblade cores in northeastern Honshu possibly emerged about 14,000 BP.

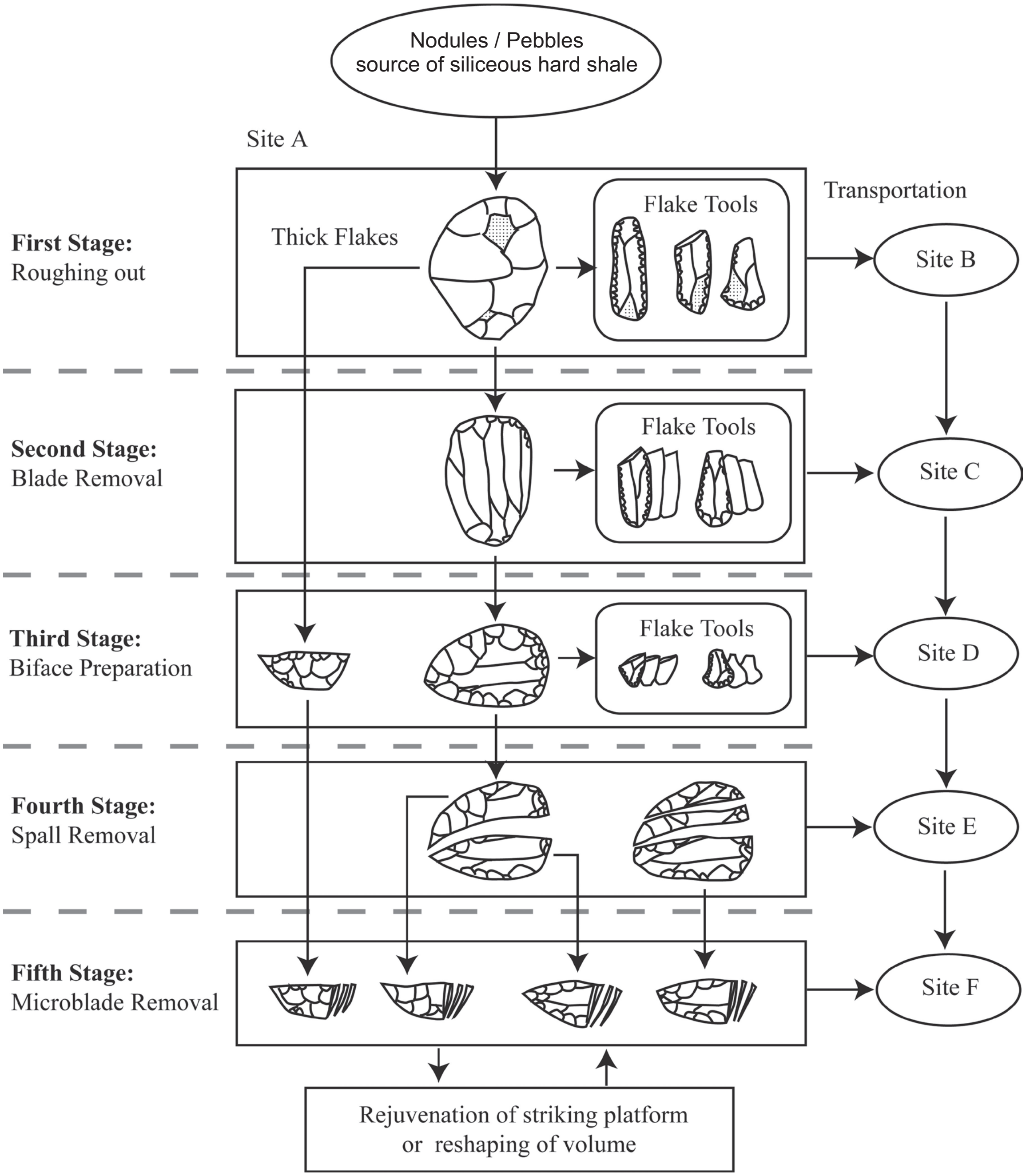


Figure 5.2: Reduction sequences of the microblade industries: The Yubetsu technique, northeastern Honshu.

Nevertheless, a large number of microblade assemblages are found as palimpsests. This means that the chronology based on the archaeological context of individual distribution layers is still open to further discussion. In order to establish a more certain chronology, the correlation between the quality and forms of lithic raw materials and microblade cores has to be evaluated within distinctive geographical settings.

REDUCTION SEQUENCES

The characteristics of lithic assemblages reconstructed from one site represent an expressed pattern derived from various factors. Lithic artifacts were formed by human behaviour from the acquisition of raw materials to the discard of lithic artifacts, and finally affected by post-depositional changes (Butzer 1982; Schiffer 1987).

In general, lithic artifacts are transported to a site in various forms, such as pebbles, cores, flake blanks, and shaped tool blanks. The transported forms of lithic artifacts can be reconstructed by refitting tools and waste flakes. Additionally, the refitted blocks enable us to trace the different stages of core preparation. Reduction sequences can be reconstructed by the synthesis of information from different sites.

A reconstruction of the reduction sequences of microblade industries with wedge-shaped microblade cores manufactured with the Yubetsu technique in northeastern Honshu is illustrated in Figure 5.2. Yubetsu technique wedge-shaped type cores were prepared on bifacial microblade core blanks. The flakes that were produced in the process of preparing the bifaces were exploited as tool blanks. This exploitation of by-products is demonstrated by examples of refitted materials (Sakurai 1992; Serizawa and Sudo 1992). In some instances there is evidence that knappers rejuvenated and reshaped wedge-shaped microblade cores. The reduction sequences of wedged-shaped microblade cores are very systematic and economic.

LITHIC RAW MATERIAL COMPOSITION

Siliceous hard shale, which is one of the sedimentary rocks distributed in northern Honshu (Figure 5.3), was the main raw material used in wedge-shaped microblade core manufacture in northeastern Honshu (Sato 1992b; Nagatsuka 1997; Sano 2002). Here, the composition of raw materials and the distance between sites and the geologic sources of siliceous hard shale are discussed.

Figure 5.4 is a comparison of siliceous hard shale and the amount of other raw materials in conjunction with distance from sites to the sources of siliceous hard shale. The proportion of siliceous hard shale in the microblade industries comprises up to 70% of lithic raw material except for three sites which are the most distant from the sources.

The sites located at a distance of more than 100–200 km from the sources have a high proportion of siliceous hard shale artifacts. At the Nakappara 5B, Nakappara 1G, and Yanagimata A sites, which are the most distant from the sources, this raw material has a frequency of only 5% (Figure 5.4). Sites can be divided into two groups, with Group A showing a high proportion of siliceous hard shale (Nakatsuchi, Shomen-Nakajima (M), Ushirono B, Uenohara, Kashiranashi, Shirakusa, Kashiwahara, Higashimine-Miyukibatake-Nishi, Kidoba, and Oami-Yamadadai No. 8) and Group B with a very low proportion of siliceous hard shale (Nakappara 5B, Nakappara 1G, and Yanagimata A) (Table 5.1).

In the bifacial point industries, the proportion of siliceous hard shale is 30% at the Uenotaira C site, located within 100 km from the sources, but at sites more than 100 km away from the sources, this raw material is rare except at Ushirono A and Karasawa B (Figure 5.5). It is apparent that siliceous hard shale was exploited at bifacial point sites located closer to sources and that local raw materials are dominant.

The average number of different types of raw material in the microblade industries is 6.7, and that of the bifacial point industries is 7.9 (Table 5.1). In particular, Group A microblade industries are less varied with an average number of only 4.8. This indicates uniformity of lithic raw materials in the microblade industries, in contrast to a high degree of diversity in the bifacial point industries.

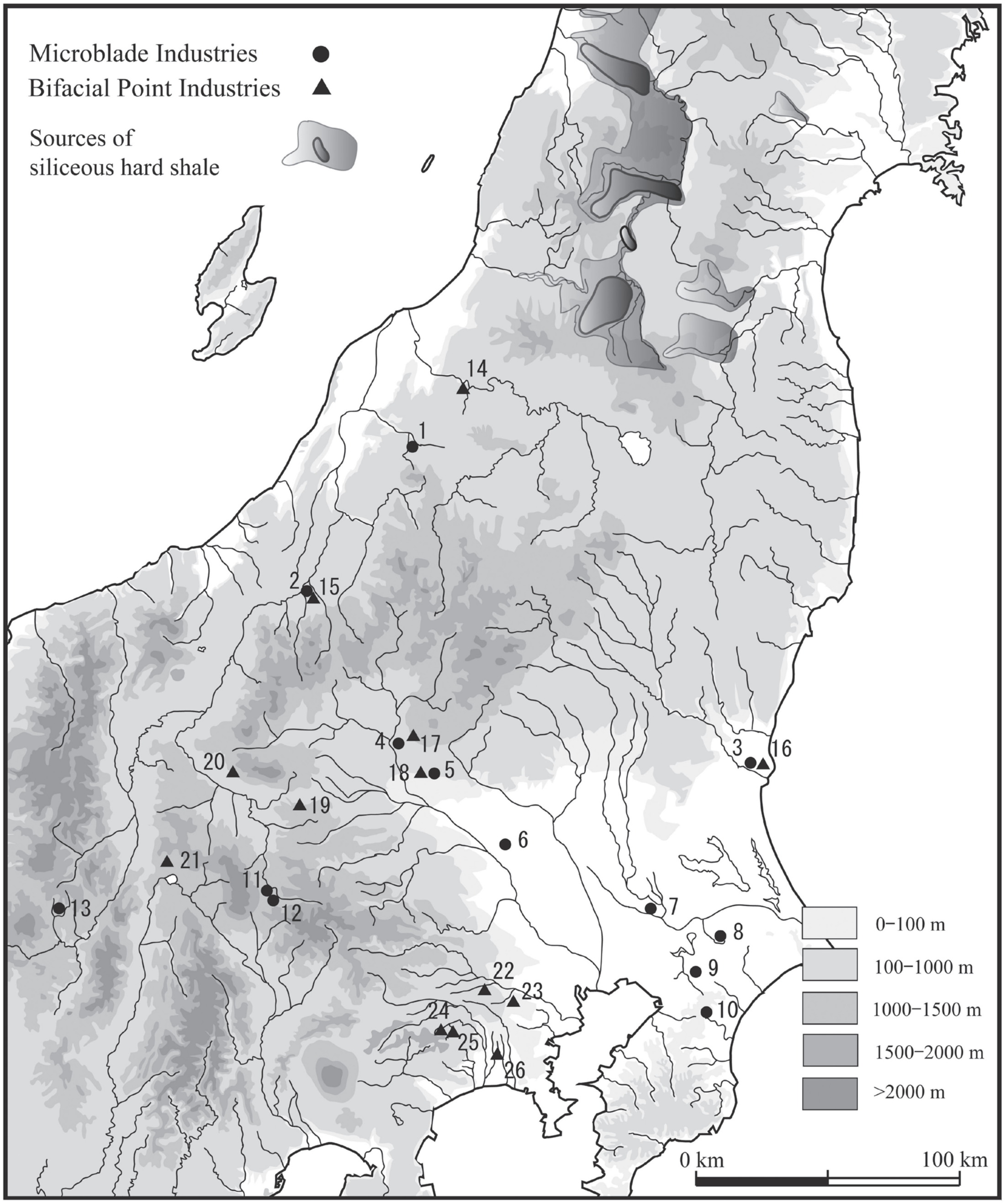


Figure 5.3: Topographic map of northeastern Honshu showing the distribution of the sources of siliceous hard shale and location of sites of the microblade industries and the bifacial point industries.

Microblade Industries: 1. Nakatsuchi; 2. Shomen-Nakajima (M); 3. Ushirono B; 4. Uenohara; 5. Kashiranashi; 6. Shirakusa; 7. Kashiwahara; 8. Higashimine-Miyukibatake-Nishi; 9. Kidoba; 10. Oami-Yamadadai No. 8; 11. Nakappara 5B; 12. Nakappara 1G; 13. Yanagimata A.
Bifacial Point Industries: 14. Uenotaira C; 15. Shomen-Nakajima (B); 16. Ushirono A; 17. Bogaito; 18. Arato-Kita-Sankido; 19. Happusan VI; 20. Karasawa B; 21. Nakajima B; 22. TNT No. 426; 23. TNT No. 27; 24. Kitahara (No. 10/11 North); 25. Minami (No. 2); 26. Yoshioka A.

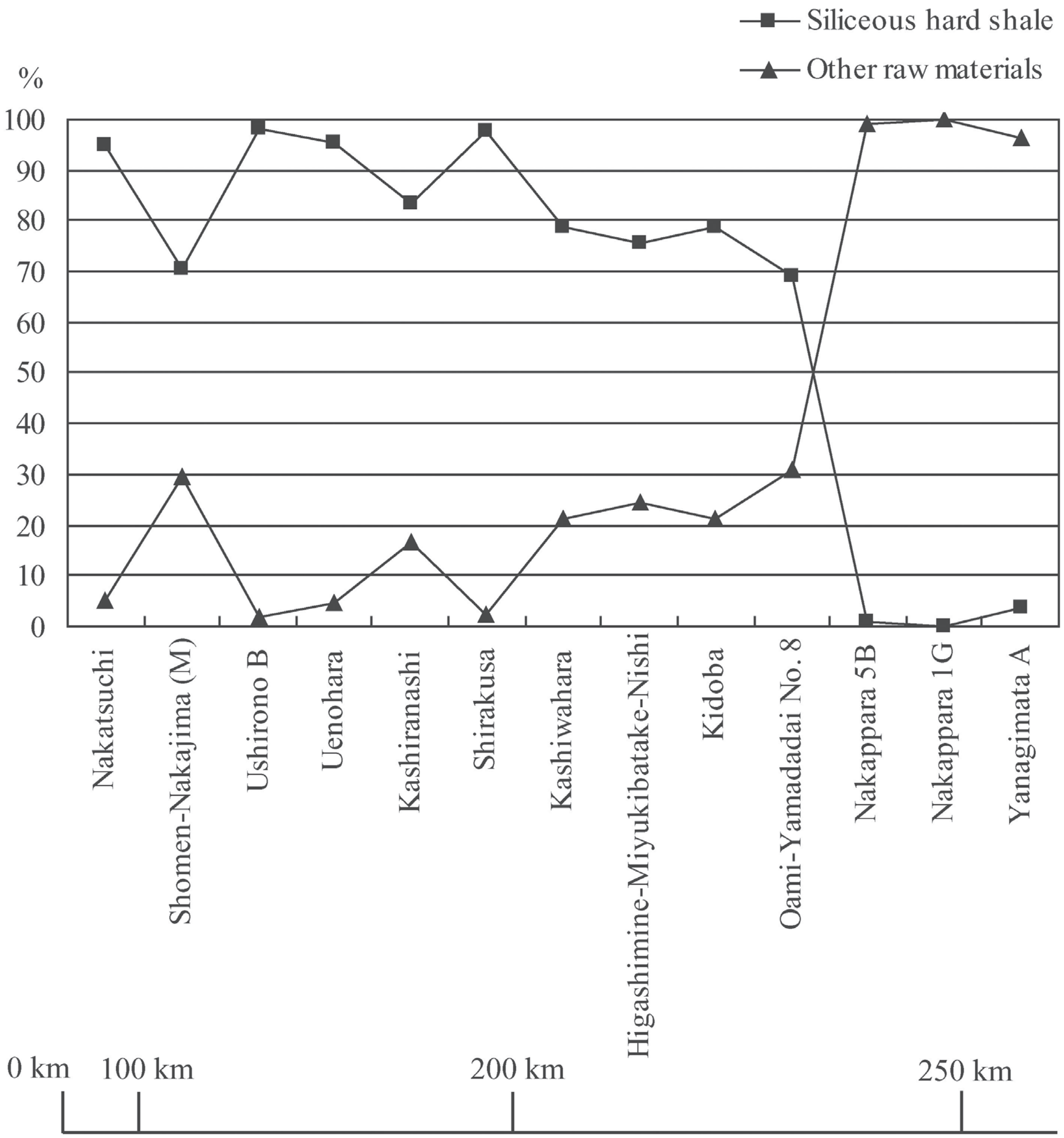


Figure 5.4: Comparison between percentages of siliceous hard shale and other raw materials in conjunction with distance from sites to the sources of siliceous hard shale in microblade industries.

TRANSPORTED FORMS

In excavation reports, researchers divide raw materials into subgroups according to homogeneity, texture, colour, and other characteristics. They assume that a subgroup is identifiable from an individual nodule, and also that different parts of blocks derive from the same parent rock. The same parent rock is usually recognized in the form of pieces of rock, which together are regarded as an approximate transported block. This assumption, however, lacks concrete evidence. The parent rock is not always identical to the actual transported block. There is still a certain degree of methodological flexibility to estimate whether or not homogeneous

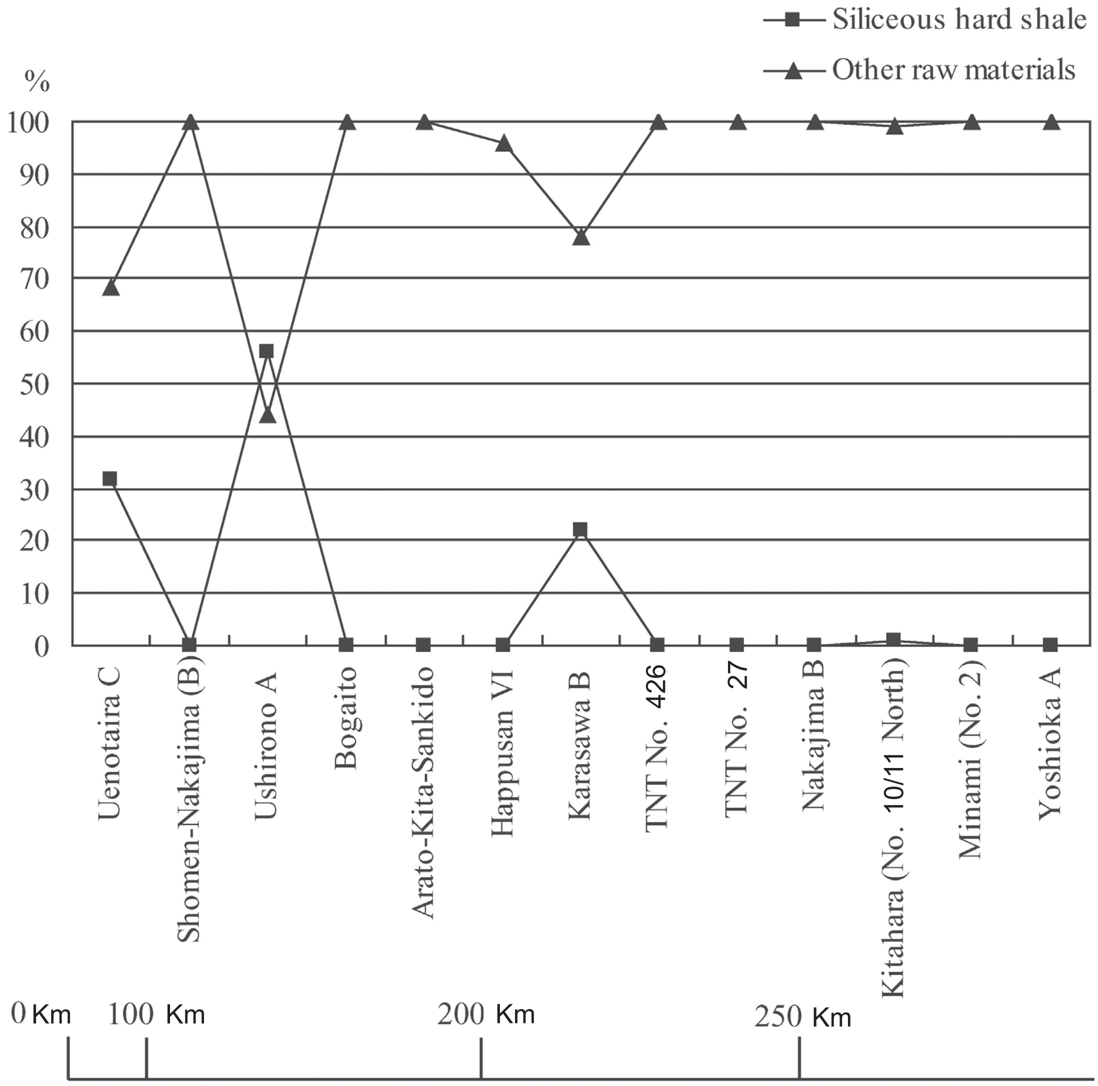


Figure 5.5: Comparison between percentages of siliceous hard shale and other raw materials in conjunction with distance from sites to the sources of siliceous hard shale in bifacial point industries.

broken pebbles are traceable to the same block of rock.

Table 5.2 shows lithic artifact assemblages according to parent rocks of siliceous hard shale. The characteristics of most parent rocks indicate that a high frequency of tools were manufactured from them except for parent Rock No. 108 of the Shomen-Nakajima site (M); Nos. 1, 2, 4, and 7 of Ushirono B site; Nos. 1 and 2 of Uenohara site; and Nos. A6 and A10 of Higashimine-Miyukibatake-Nishi site. Although these parent rocks indicate that a low frequency of retouched flake tools were manufactured from them, they include microblades, and in some cases the total number of unretouched and retouched flakes is very low. Therefore, there is little possibility that the siliceous hard shale was transported as pebbles or roughly prepared forms and that flake blanks were then produced from the primary stage. The the siliceous hard shale was transported to the sites in the form of microblade cores, tools, and flake blanks, and the reduction sequences of microblade cores show different stages among sites. In contrast, the other raw materials were

Table 5.1: Raw material variety of microblade and bifacial point industries.

Microblade Industries		Bifacial Point Industries	
Site	**Number of Raw Material Types**	**Site**	**Number of Raw Material Types**
Nakatsuchi	3	Uenotaira C	12
Shomen-Nakajima (M)	4	Shomen-Nakajima (B)	8
Ushirono B	2	Ushirono A	5
Uenohara	3	Bogaito	3
Kashiranashi	7	Arato-Kita-Sankido	13
Shirakusa	4	Happusan VI	1
Kashiwahara	7	Karasawa B	11
Higashimine-Miyukibatake-Nishi	6	TNT No. 426	8
Kidoba	4	TNT No. 27	11
Oami-Yamadadai No. 8	8	Nakajima B	6
Nakappara 5B	8	Kitahara (No. 10/11 North)	15
Nakappara 1G	5	Minami (No. 2)	3
Yanagimata A	16	Yoshioka A	7
Average Number	**6.7**	**Average Number**	**7.9**
Average (Group A)	**4.8**		
Average (Group B)	**13.0**		

transported as pebbles, pebble tools, and less-prepared blocks. Cores and tools with cortex are dominant in the latter.

Furthermore, in Group A of the microblade industries, the average weight of siliceous hard shale is 696 grams (g) and of the other raw materials it is 905 g (Table 5.3). Though siliceous hard shale is more frequent than other raw materials, the weight of siliceous hard shale is less. This demonstrates that siliceous hard shale was imported as well-prepared small forms, compared to other raw materials that were transported as less-prepared large forms.

It is suggested here that two different raw material acquisition strategies were adopted in the manufacture of microblade industries. In one strategy, raw material was transported in the form of microblade cores, tools, and flake blanks made on siliceous hard shale derived from distant sources, and in the other, pebbles, pebble tools, and less-prepared blocks were brought to sites made on other raw materials derived from local sources.

With regard to the bifacial point industries, large quantities of lithic artifacts have been discovered. The average weight of siliceous hard shale is 321 g, while the mean weight of other raw materials is 21,407 g (Table 5.4). The average weight of siliceous hard shale at the Uenotaira C site, which is within 100 km distance from the sources, is over 1000 g, but for sites located at more than 100 km distance from the sources it is less than 1 g, except for the Uenotaira C and Karasawa B sites. A variety of parent rocks have been identified in the bifacial point assemblages. Parent rock No. 407 from the Shomen-Nakajima (M) site was transported in the form of a pebble, parent rock No. 219 as a roughly prepared large flake, and No. 405 as a tool. At the Uenotaira C site, parent rocks Nos. 1, 3, and 4 were transported in the form of a pebble or as roughly trimmed artifacts. The No. 7 material, the only non-local stone, was imported as a core and as three bifacial points which had been shaped. These results suggest that the raw materials were transported in various forms to the bifacial point sites.

Table 5.2: Lithic artifact assemblages by parent rocks of siliceous hard shale.

Site	Parent Rock No.	MB	MC (Co) + MC Sp	Number of Tools	Number of Flakes	Percent of Tools (Tools:Flakes)
Shomen-Nakajima (M)	101	9	1	24	5	**83**
	102	6	1	9	17	**35**
	103	1	0	1	2	**33**
	104	0	0	1	0	**100**
	105	0	0	1	0	**100**
	106	0	0	1	0	**100**
	107	2	0	8	4	**67**
	108	1	0	0	12	**0**
Ushirono B	1	90	1	5	277	**2**
	2	38	2	1	168	**1**
	3	0	0	4	37	**10**
	4	37	1	1	67	**1**
	6	1	0	0	0	**-**
	7	0	0	0	2	**0**
	8	0	0	1	0	**100**
	9	0	1	0	0	**-**
	10	1	0	0	0	**-**
Uenohara	1	14	0	0	24	**0**
	2	27	2	4	65	**6**
	3	0	0	1	5	**17**
Higashimine-Miyukibatake-Nishi	A1	0	3	0	0	**-**
	A2	1	1	1	5	**17**
	A3	0	1	0	0	**-**
	A4	0	0	2	0	**100**
	A5	0	0	2	0	**100**
	A6	0	0	0	2	**0**
	A7	0	0	1	0	**100**
	A8	0	0	1	0	**100**
	A9	0	0	1	0	**100**
	A10	0	0	0	1	**0**
	Aa	1	0	6	2	**75**
	Ab	2	0	19	24	**44**
	Ac	5	1	16	16	**50**
	Ad	2	1	7	16	**30**
	Ae	4	0	2	8	**20**
	Af	0	0	3	11	**21**

MB = Microblade, MC = Microblade Core, Co = Core, MC Sp = Microblade Core Spall

Table 5.3: The number and weight of siliceous hard shale and other raw materials in the microblade industries.

Distance	Site	SHS (n)	ORM (n)	SHS (g)	ORM (g)
80 km	Nakatsuchi	75	4	1121	832
140 km	Shomen-Nakajima (M)	110	46	719	934
150 km	Ushirono B	733	13	-	-
170 km	Uenohara	165	8	436	156
170 km	Kashiranashi	354	71	-	-
190 km	Shirakusa	1769	38	1155	1258
200 km	Kashiwahara	158	43	-	-
220 km	Higashimine-Miyukibatake-Nishi	166	54	499	1527
230 km	Kidoba	79	21	285	855
240 km	Oami-Yamadadai No. 8	121	54	660	771
240 km	Nakappara 5B	11	1043	23	6120
240 km	Nakappara 1G	0	1616	0	3548
290 km	Yanagimata A	141	3633	183	28,253
	Average	**299**	**511**	**508**	**4425**
	Average (Group A)	**373**	**35**	**696**	**905**
	Average (Group B)	**51**	**2097**	**69**	**12,640**

SHS = Siliceous Hard Shale
ORM= Other Raw Materials

Table 5.4: The number and weight of siliceous hard shale and other raw materials in the bifacial point industries.

Distance	Site	SHS (n)	ORM (n)	SHS (g)	ORM (g)
50 km	Uenotaira C	292	630	1995	9408
140 km	Shomen-Nakajima (B)	0	1467	0	24,354
140 km	Ushirono A	50	39	-	-
160 km	Bogaito	0	8173	0	14,503
170 km	Arato-Kita-Sankido	0	2107	-	-
210 km	Happusan VI	0	48,549	0	99,126
210 km	Karasawa B	8	28	574	10,430
240 km	TNT No. 426	0	960	0	7465
240 km	TNT No. 27	0	2279	-	-
250 km	Nakajima B	0	4698	-	-
260 km	Kitahara (No. 10/11 North)	7	891	0.9	11,508
260 km	Minami (No. 2)	0	172	0	14,305
260 km	Yoshioka A	0	862	0	1560
	Average	**27**	**5450**	**321**	**21,407**

SHS = Siliceous Hard Shale
ORM = Other Raw Materials

MOBILITY

The people who produced microblade industries in Japan moved exotic lithic raw materials over long distances. They seem not to have spent long periods of time exploiting the resources around sites considering the small quantities and low degree of variety of lithic raw materials that have been found. The light inventories of the microblade industries are suitable to high mobility (Fujimoto 1997), and the systematic and economic exploitation of lithic raw materials effectively reduced the quantity of exploited raw materials.

Studies of the bifacial point industries have determined that siliceous hard shale was not transported to sites located far from the sources. However, about 10 to 100 exotic varieties of obsidian were recovered from several sites. This, therefore, suggests that humans who manufactured bifacial point industries also moved relatively long distances. They may have acquired raw materials at several locations near the sites because large quantities and varieties of raw materials were abandoned. All these factors make it clear that inhabitants of the bifacial point industries' sites spent long periods of time exploiting the resources in the vicinity of their sites and that these sites were occupied for longer periods than microblade sites.

Limited information is available to interpret the transformation of human settlement patterns from the microblade industries and the bifacial point industries. The period of the microblade industries with wedge-shaped microblade cores in northeastern Honshu is dated to approximately 14,000 BP as mentioned above. The radiocarbon age of the Araya site (c. 14,000–13,000 BP), calibrated to c. 16,000–17,000 cal BP (Kitagawa 2003), is just before the Older Dryas. The succeeding period of bifacial point industries is dated to and after the Older Dryas. It has been suggested that the transition from microblade industries to bifacial point industries occurred during a climatic amelioration (Nakagawa *et al.* 2002), with a decrease of the dominant vegetation of conifer forests and a gradual increase of deciduous forests (Tsuji *et al.* 1985; Tsuji 1997).

Nevertheless, it does not necessarily follow that the cause of transformation in mobility is directly linked to the ecological changes. The extreme long distance movement of microblade industries is a unique characteristic of the Japanese Palaeolithic. One phase of the backed blade industries is dated to around the LGM, and had a transportation strategy more similar to that of the bifacial point industries than to the microblade industries. If the change in mobility from microblade industries to bifacial point industries was caused by a climatic oscillation, it should be confirmed by more environmental and archaeological data.

CONCLUSION

The emergence of microblade industries in the Japanese islands is dated to c. 20,000 BP. This date is in accord with the results of tephrochronology. The appearance of microblade industries on Hokkaido is earlier than in other parts of Japan. On Honshu and Kyushu, the oldest dates are c. 17,000–15,000 BP, and these dates are from sites with subconical microblade cores. Wedge-shaped microblade cores spread over northeastern Honshu at c. 14,000 BP, and their manufacture is associated with a particular strategy of raw material exploitation.

Hominids transported siliceous hard shale as the dominant raw material over a distance of more than 200 km for the manufacture of microblade industries in northeastern Honshu. This raw material was transported to sites in the form of microblade cores, tools, and flake blanks, although the total weight of these artifacts was very small. Limited amounts of local raw materials were introduced to sites in the form of pebbles, roughly prepared cores, and cortical flakes. These raw materials indicate a low degree of diversity.

The people who manufactured microblade industries might have moved long distances and occupied residential camps for short durations. They had only a light set of inventories and exploited lithic raw materials systematically and economically. This strategy of raw material exploitation was advantageous to the highly mobile adaptation of the microblade industries.

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6

A REVIEW OF KOREAN MICROLITHIC INDUSTRIES

Christopher J. Norton, Kidong Bae, Hanyong Lee, and John W.K Harris

INTRODUCTION

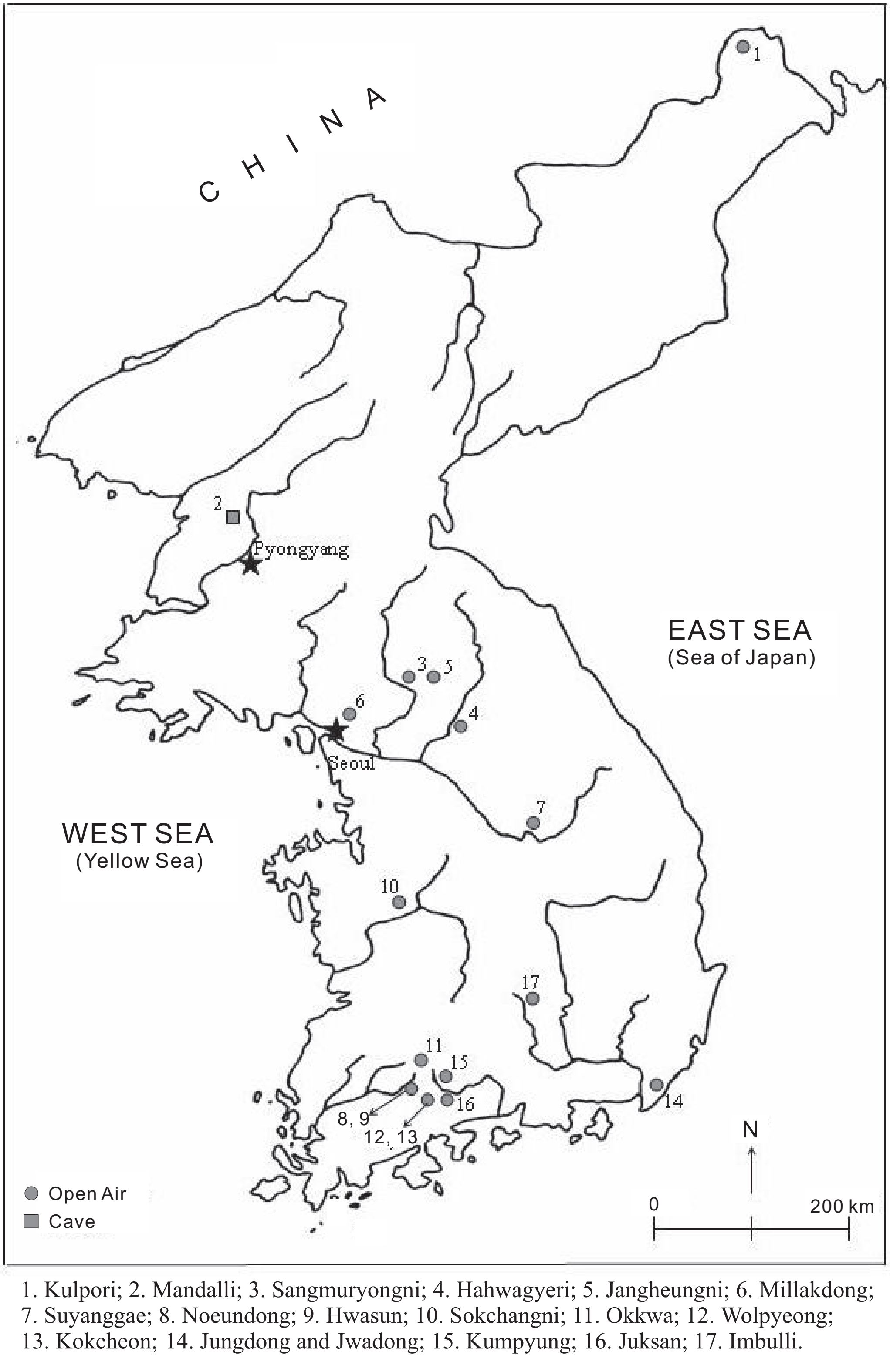
Although Palaeolithic artifacts were initially discovered at the open-air site of Dongkwanjin in the northeastern region of the Korean Peninsula in 1935, the presence of microliths in Korea was only firmly established with their discovery at Kulpori (North Korea) in 1963–1964 and Sokchangni (South Korea) in 1964. Since the 1980s microliths have been recovered from excavations and surveys from at least 17 sites, the majority in South Korea. In this review, the primary Korean microlithic assemblages are discussed, along with the topics of chronology, raw material usage, and artifact typology and technology. Finally, the Korean microliths are evaluated in terms of their position in the broader Northeast Asian picture.

PRIMARY MICROLITHIC ASSEMBLAGES

To date, microliths have been discovered in at least 17 sites in Korea (Figure 6.1; Table 6.1). What follows is a brief description of the primary sites from the northern, central, and southern regions of the Korean Peninsula. Discussion of recent developments in palaeoanthropological studies in modern day North Korea is difficult given the current state of that country's economic and political situation. The severe economic conditions, in addition to a general 'closed door' policy, has resulted in a significant decrease in the number of detailed studies carried out in and disseminated from North Korea in the past two decades. Accordingly, it is extremely difficult for a non-North Korean scholar to estimate how many palaeoanthropological research projects are currently being undertaken or have been carried out over the course of the past decade or so. Fortunately, due to the popularity of archaeology and an economy that is capable of supporting such social scientific research in South Korea, many archaeological surveys and excavations have been carried out south of the Demilitarized Zone (at the 38th parallel separating North and South Korea), particularly over the course of the past two decades. As a result of this interest there has been a significant increase in our overall knowledge of microlithic studies in South Korea (Chang 2002; Norton 2000).

NORTHERN KOREAN PENINSULA

Mandalli is a cave site located 20 km east of Pyongyang, the present day capital city of North Korea. Three stratigraphic levels were determined during excavations, with the most recent one containing Neolithic pottery sherds and bone tools. Mandalli is one of the few Palaeolithic sites on the Korean Peninsula discovered to date that has revealed Upper Palaeolithic artifacts in the same context as *Homo sapiens* remains as well as a large palaeontological assemblage. These Pleistocene deposits were discovered in the middle stratigraphic level. The *H. sapiens* accumulation comprises a calvaria, a mandible, and fragments of another mandible, humerus, femur, and innominate. In addition, the associated faunal assemblage consists of extant animal species, including *Vulpes vulpes*, *Sus* sp., and *Cervus nippon,* and the extinct *Hyaena* sp. Thirteen artifacts were



1. Kulpori; 2. Mandalli; 3. Sangmuryongni; 4. Hahwagyeri; 5. Jangheungni; 6. Millakdong; 7. Suyanggae; 8. Noeundong; 9. Hwasun; 10. Sokchangni; 11. Okkwa; 12. Wolpyeong; 13. Kokcheon; 14. Jungdong and Jwadong; 15. Kumpyung; 16. Juksan; 17. Imbulli.

Figure 6.1: Primary microlithic yielding localities on the Korean Peninsula (see Table 6.1 for site descriptions).

Table 6.1: Primary microlithic localities on the Korean Peninsula.

Location No. on map	*Site Name*	*Open-air/ Cave Site*	*Years Excavated*	*Age Designation*	*Dating Method/ Technique*	*Primary Raw Material*
1	Kulpori	Open-air	1963–1964	Late Pleistocene–Holocene	Artifact assemblage composition	No data
2	Mandalli[1]	Cave	1979–1980	Late Pleistocene/Holocene	Biostratigraphy/ artifact assemblage composition	Obsidian, quartz
3	Sangmuryongni	Open-air	1987–1988	Late Pleistocene	Artifact assemblage composition	Obsidian, quartz
4	Hahwagyeri	Open-air	1991	Terminal Pleistocene	Artifact assemblage composition	Obsidian, crystal quartz
5	Jangheungni	Open-air	1998–2000	24,200 ± 600 BP (SNU00-381)	^{14}C	Obsidian, quartz
6	Millakdong	Open-air	1994–1995	Terminal Pleistocene–Holocene	Artifact assemblage composition	Shale, quartz
7	Suyanggae	Open-air	1983–1985, 1996, 2001	c. 18,630 BP (UCR-2078) c. 16,400 BP (no Lab No. given)	Artifact assemblage composition/^{14}C	Shale
8	Noeundong	Open-air	1998–1999	Late Pleistocene	Artifact assemblage composition	Hornfels, quartz
9	Hwasun	Open-air	1986–1989	c. 15,000 years ago	Artifact assemblage composition	Quartz, hornfels
10	Sokchangni	Open-air	1967, 1990–1992	Late Pleistocene/ 20,830 ± 1880 BP (AERIK-8)	Artifact assemblage composition/^{14}C	Shale, quartz, porphyry
11	Okkwa	Open-air	1990	Late Pleistocene	Artifact assemblage composition	Tuff, porphyry
12	Wolpyeong	Open-air	1995, 1998, 2001	c. 14,000–12,000 years ago	Artifact assemblage composition	Rhyolite
13	Kokcheon	Open-air	1986–1989	Late Pleistocene	Artifact assemblage composition	Quartz, porphyry
14	Jungdong and Jwadong	Open-air	1992–1993	Late Pleistocene	Artifact assemblage composition	Tuff, porphyry, quartz
15	Kumpyung	Open-air	1988	Late Pleistocene	Artifact assemblage composition	Tuff, porphyry
16	Juksan	Open-air	1990	Late Pleistocene	Artifact assemblage composition	Tuff, porphyry
17	Imbulli	Open-air	1989	Late Pleistocene	Artifact assemblage composition	Tuff, porphyry

[1] Mandalli is the only microlithic site in Korea that has also fossils, in addition to human remains, in the same context.

recovered during excavations, of which seven were classified as microblade cores. Obsidian was the primary raw material utilized to produce these artifacts. Two pieces of deer antler appear to have been worked as well. In the lowest stratigraphic level only a palaeontological assemblage was recovered during excavations. Even though Mandalli lacks absolute dates, the presence of microblade artifacts in association with modern humans directly underlying Neolithic deposits suggests an Upper Pleistocene–Holocene period of human occupation. The presence of hyaena remains also indicates that human occupation of the cave was probably not continuous even at this late stage of cultural development (Kim *et al.* 1990; Norton 2000; Park 1992; Seo 1990).

CENTRAL KOREAN PENINSULA

In 1964 Sokchangni had the distinction of being the first Palaeolithic site discovered and excavated in South Korea. Between 1964 and 1992 it was excavated 12 times revealing Lower Palaeolithic, Upper Palaeolithic, and Mesolithic residues (Figure 6.2). The Lower Palaeolithic deposits include choppers, chopping tools, cores, and unifacial flakes produced on local quartz and quartzite river cobbles. The Upper Palaeolithic industry is comprised of flakes and blades manufactured on non-local high quality obsidian, quartz crystal, and rhyolite. Evidence of three habitation sites with hearths may also have been discovered in the Upper Palaeolithic stratigraphic level. Two ^{14}C dates exist for the Upper Pleistocene deposits (c. 20,830 BP and c. 30,690 BP). Further support for an Upper Palaeolithic occupation between c. 20,000 BP and c. 17,000 BP is the presence of vertical soil cracks that Korean geologists have traditionally used as representative evidence of the Last Glacial Maximum (LGM) on the Korean Peninsula. In a level situated above the Upper Palaeolithic deposits, microcores, microblades, microburins, and thumbnail scrapers were discovered (Figure 6.3). It has been difficult to obtain solid ^{14}C dates from this level due to disturbance by farmers over the course of the past five centuries, though it is believed to date to the terminal Pleistocene/Holocene transitional period (Lee and Kim 1992; Sohn 1993).

Suyanggae is an open-air Upper Palaeolithic site located about 100 km southeast of Seoul, along the upper South Han River in Chungbuk Province. It was excavated between 1983 and 1985 by Chungbuk National University as part of a salvage archaeology project preceding construction of the Chungju Dam (Figure 6.4). The presence of anvils, used cores, 18 refitted flakes, and debitage, in addition to a concentration of 48 tanged points suggested to the excavators that Suyanggae represents a multi-occupation site that often served as a lithic workshop. Five separate stratigraphic levels were distinguished, with a diversity of typical flake tools, cores, hammerstones, and anvils recovered

Figure 6.2: Overview of the Sokchangni site (photo from Yonsei University Museum 2001:210; reproduced with permission).

Figure 6.3: Microblade core (length 32 mm) from Sokchangni site (photo from Yonsei University Museum 2001:217; reproduced with permission).

Figure 6.4: Overview of the Suyanggae site (photo from Lee and Woo 1998:85; reproduced with permission).

from level 5 and a number of tanged points, microcores and microcore blades exposed directly above it in level 4 (Figure 6.5). ^{14}C dates taken on associated charcoal suggests an occupation age range between c. 18,630 BP and c. 16,400 BP for level 4, which is the layer where the heaviest concentration of lithics was recovered (Lee 1984, 1985; Lee and Woo 1997; Lee and Yun 1994).

Even though most of the 195 microcores from Suyanggae were produced on local siliceous shale (86%), a few were made on non-local obsidian (7%), and porphyry and chert (6.4%). The interesting aspect of the obsidian utilized for the production of microblades at Suyanggae was that neutron activation analysis of the microblade cores indicated three separate sources for the obsidian. This suggests a number of interesting possible scenarios, including a hunter-gatherer group that traveled widely in search of obsidian, traded with other groups, or that different nomadic tribes occupied Suyanggae possibly at different times or even at the same time (Lee 1984, 1985; Lee and Woo 1997; Lee and Yun 1994).

The open-air site of Hahwagyeri is located along the Hongchon River in Kangwon Province. It was excavated in 1990 and 1991 by Kangwon National University Museum. Hahwagyeri is located in an ecotone where several streams meet rolling hills and with mountains as a close backdrop. This would have been an ideal location for hunter-gatherer groups to successfully hunt and fish and thus would have facilitated long-term occupation of the site. As a result of the excavations, 2609 lithic artifacts were recovered including 21 barbs, 36 arrowheads, 27 microblade cores, and 514 microblades (Figures 6.6 and 6.7). The density and wide diversity of stone tools and debitage found at Hahwagyeri suggested to the excavators that this was a long-term encampment where flintknapping took place regularly, which is additional support for the ecotone hypothesis. The microblades were primarily produced on obsidian, crystal, and quartz. It has been suggested that the obsidian used to produce the stone implements at Hahwagyeri originated from Paektusan, the highest mountain on the Korean Peninsula, though sourcing studies have yet to be conducted (Choi 1992, 1994).

SOUTHERN KOREAN PENINSULA

A number of detailed archaeological surveys carried out in the southwestern region of the Korean Peninsula over the past 15 years have revealed 27 Palaeolithic open-air sites, with the heaviest concentration of localities in the Bosung River basin. The largest and most extensively studied locality found in this region is Wolpyeong. Excavations conducted in 1998 and 2001 by Chosun University revealed cultural deposits within a 66,000 m^2 area. Eight separate stratigraphic levels were identified with the heaviest concentration of artifacts in layers 4 (9465 specimens) and 3 (1300 specimens). Among the lithics, 30 conjoinable flakes and cores were discovered. These characteristics at Wolpyeong suggest that this was a place that served as a home base for extended stays and/or was visited fairly frequently. Blades, microblades, microblade cores, hammers, anvils, an assortment of flakes, and debitage were discovered here. The microblade cores were made primarily of rhyolite, while the rest of the stone tools were produced on vein quartz, with a smaller percentage made of tuff and rhyolite (Figure 6.8). Vein quartz was available locally, while rhyolite and tuff sources are located roughly 10 km away. Based on comparative studies with lithic assemblages from other sites (e.g., Suyanggae) and geologic reconstruction, it is thought that Wolpyeong was occupied between c. 14,000 BP and c. 12,000 BP (Lee 1997, 2002a, 2002b).

CHRONOLOGY

Chronological reconstructions of Palaeolithic sites in Korea have traditionally been problematic. For instance, the age of occupation of the Lower Palaeolithic site of Chongokni has led to a spirited debate with dates ranging between 350,000 years ago and c. 30,000 BP (Bae 2002; Danhara *et al.* 2002; Norton 2000; Norton *et al.* 2004; Seong 2004a; Yi 1989, 1996; Yi *et al.* 1998). One of the primary reasons of the difficulty of obtaining absolute dates in Korean archaeological studies is that the acidic soil prohibits preservation of biodegradable materials at just about all open-air sites that date to the Pleistocene, resulting in a paucity of reliable ^{14}C dates for Palaeolithic sites.

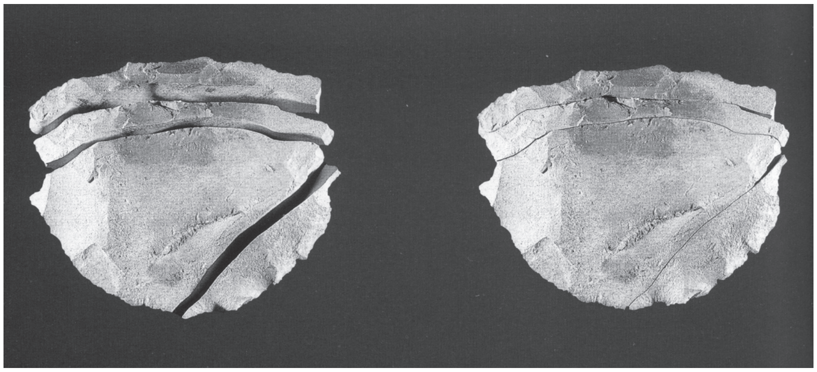


Figure 6.5: Boat-shaped microblade core (length 71 mm) from Suyanggae site (photo from Lee and Woo 1998:124; reproduced with permission).

Figure 6.6: Microblade core (length 25 mm) from Hahwagyeri site (photo from Yonsei University Museum 2001:51; reproduced with permission).

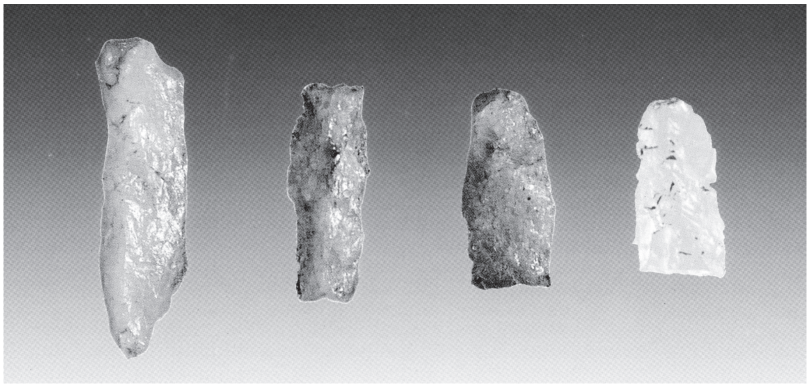


Figure 6.7: Quartz microblades (far left blade – length 21 mm) from Hahwagyeri site (photo from Yonsei University Museum 2001:120; reproduced with permission).

Currently, the earliest dated microliths on the Korean Peninsula are from the Jangheungni site in central Korea with a ^{14}C date of 24,200±600 BP (but see Seong, this volume). Sokchangni and Suyanggae have ^{14}C dates that range between c. 20,000 BP and c. 16,000 BP indicating that microlithic technology was more prevalent at the beginning of the LGM (Chang 2002; Lee and Woo 1998; Lee and Yun 1994).

Instead of utilizing radiocarbon dating, Korean archaeologists have often had to rely on other markers in order to build a general chronological sequence for the transition from blade to microblade technology. For instance, determining presence/absence of AT (Aira-Tanzawa) tephra at archaeological sites in Korea has become more common over the past decade. The AT tephra originates from a volcanic explosion of the Aira caldera that occurred at c. 24,000 BP in Kyushu (Japan), and its presence at archaeological sites as far north as Chongokni and the Shandong Peninsula in northeastern China indicates the extent of the explosion itself. The presence of AT tephra is often used to date many of the Upper Palaeolithic sites in Korea (for example, Koraeri Miryang), though it has sometimes been employed to support chronological reconstructions of Lower Palaeolithic sites as well (such as Chongokni). Even though the AT tephra predates most microlithic sites in Korea, its presence contributes to the reconstruction of chronological sequences of the transition from blade to microblade technologies (Imamura 1996; Norton 2000; Norton *et al.*2004; Seong 1998; Yi *et al.* 1998).

Another useful marker is the presence of vertical soil cracks in stratigraphic profiles (see above). Although there is no conclusive evidence for the formation of these cracks it is believed that they form during cold climates (further studies in Alaska appear to support this hypothesis). Accordingly, the presence of these 'ice wedges' is often thought to represent a chronological period around the LGM. Many of the microcores from the Korean Peninsula are found in stratigraphic levels that either contain these ice wedges or are located directly above them (Lee and Kim 1992; Yi 1989).

Figure 6.8: Microblade core (length 37 mm) from Wolpyeong site (photo from Yonsei University Museum 2001:246; reproduced with permission).

In many cases, site chronologies have been based on lithic typologies. For instance, microcores from Suyanggae, Kokcheon, Taejon, and the lower layer of Sokchangni are characterized as being wedge-shaped with long, single striking platforms. These are considered to be the oldest type of microcore present on the Korean Peninsula. The younger group of microcores display a general decrease in size, a greater diversity in raw material utilized, a simplification of technological processes, evidence of multiple striking platforms on individual cores, and the presence of more exhausted cores. Representative microlithic assemblages are from Wolpyeong, Sangmuryongni, Jungdong, Hahwagyeri, and the upper layer of Sokchangni (Chang 2002).

It is still not well established when microlithic industries disappear from the Korean Peninsula. In general, a diversity of small quartz tools, in addition to pottery sherds and ground stone tools, appear in stratigraphic deposits above microlithic tools. Examples of this are found at Hahwagyeri and Sokchangni. Probably the most representative site of this transition is Kosanni, located on Cheju Island off the southern coast of Korea and dating presumably to c. 10,400–10,200 BP. During the excavations at Kosanni 470 microblades were found in association with 700 projectile points, scrapers, bifaces, burins, and over 1900 Chulmun pottery sherds. This combination of tool types in direct association with pottery is representative of the Upper Palaeolithic/Incipient Neolithic transition in Korea (CNUM 1998; Choi 1994; Norton 2007; Park 1992).

RAW MATERIALS

One possible explanation for the origin of blade and microblade technology in Korea is based on the quality of raw material. It is generally accepted that quartz and quartzite stone tools normally comprise 90–95% of Palaeolithic assemblages in Korea. However, quartz and quartzite are difficult raw materials to work, particularly in the production of uniform tools (Kuhn 1995; Whittaker 1994). With the increased need to produce more standardized stone implements through time it has been suggested that higher quality raw materials were utilized (e.g., obsidian, shale, and tuff), often deriving from non-local sources (Chang 2002; Seong 1998, 2004a). The increased utilization of different raw materials appears to coincide with the transition from the Lower to Upper Palaeolithic in Korea, similar to what occurred in China (Gao and Norton 2002). As evidence from other regions of Northeast Asia (for example, Mongolia: Brantingham *et al.* 2000) suggests, however, raw material constraints cannot completely explain the increased diversity that is associated with the Lower to Upper Palaeolithic transition as it is clear that knappers were capable of getting the most out of the local quartz and quartzite river cobbles in Korea, for example, at the Hahwagyeri site (Figure 6.7).

Regional diversity in raw material utilized in the production of microcores is present in Korea and can be divided into the northern, central, and southern regions. In the north, obsidian believed to have originated from the Paektusan source was the raw material of choice for microcores and microblade production during the terminal Pleistocene (for example, at the Mandalli site). In the central region of the Korean Peninsula, siliceous shale is the most common raw material utilized as evidence from the Suyanggae and Sokchangni lithic assemblages indicates. In the southern region of Korea, microcores were produced on volcanic tuff, with some also produced on siltstone, hornfels, andesite, and obsidian (e.g., at the Wolpyeong, Taejon, and Okkwa sites; Figure 6.9) (Lee 2002a; Seong 1998; Yi *et al.* 1990a). It may be possible that the obsidian found in the southern region originated from the Paektusan source in the north. However, the more parsimonious explanation for the presence of obsidian in the southern region of Korea is that it originated from sources on Kyushu Island in Japan. Only sourcing studies will help to clarify this question.

TYPOLOGY AND TECHNOLOGY

Typological reconstructions of the Korean microcore industries are generally based on the condition of the striking platform, location of microflaking, blank types, and blank preparation. The majority of the Korean microcores belong to the wedge-shaped core category. However, some microcores have been characterized as being conical instead. It is believed that the conical-shaped cores are simply more exhausted forms of wedge-shaped cores. In addition to microcores and microblades, Korean microlithic assemblages are generally comprised of burins, side scrapers, end scrapers, borers, and tanged points, the latter tool type similar to that found in penecontemporaneous Japan (Chang 2002; Lee 2002a; Matsufuji 1987, 1997; Seong 1998).

For typological studies of Korean microlithic industries perhaps the most significant site is Suyanggae. This site is important not only due to the large number of microcores and microblades that were excavated *in situ*, but also because the first attempts of typological and technological analyses of Korean microlithic industries were conducted on the associated artifacts. The Suyanggae microcores can be classified into three types based on the morphology of the striking platform, plain cortex, and flake scar direction. Type I produced microblades that were semi-lunate or boat-shaped through pressure flaking on unprepared platforms. Type II cores had platforms prepared by longitudinal flaking, followed by pressure flaking on the resulting microblades. Type III cores had platforms prepared initially by latitudinal pressure flaking (Lee and Woo 1998; Lee and Yun 1994). These microblade manufacturing techniques are similar to the Yubetsu method in Japan (Aikens and Higuchi 1982), and the Hetao and Sanggan techniques in China (Chen 1984; Gai 1985).

Preliminary comparative studies have been conducted on the Suyanggae (central Korea) and Wolpyeong (southern Korea) microcore assemblages. It has been suggested that variation exists on the striking platforms of the microcores from the two sites. In particular, analyses have indicated that no further retouch was conducted on the Suyanggae microcores once the spall was detached for the modification of the striking platform. In the case of the microcores from the Wolpyeong site, it is believed that additional retouch was

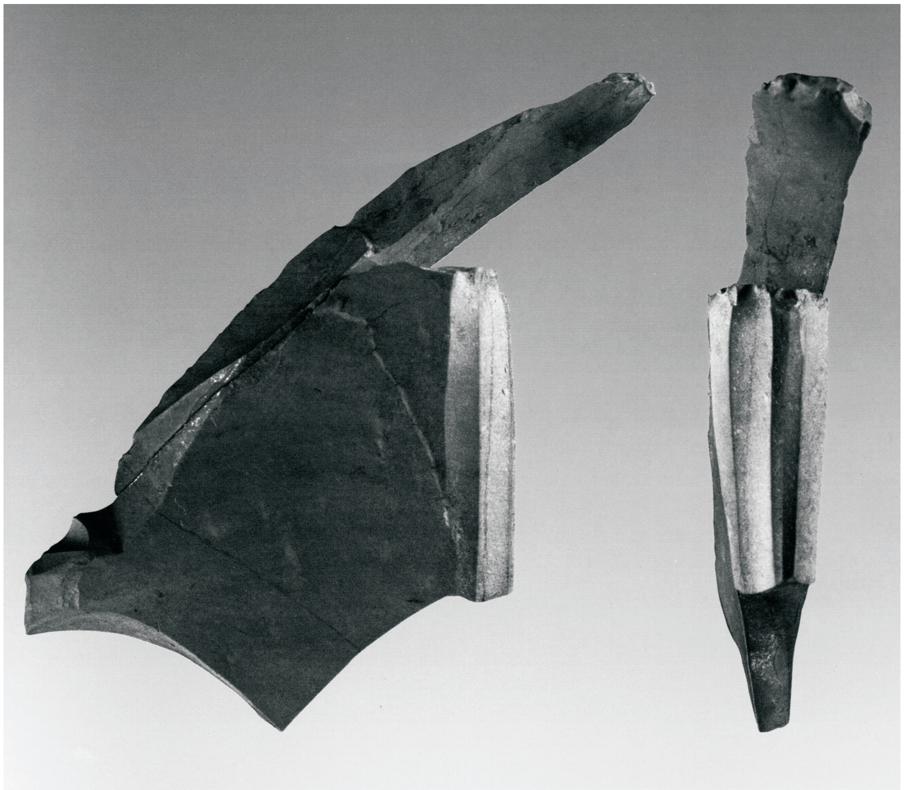


Figure 6.9: Microblade core (length 45 mm) with refits from Okkwa site (photo from Yonsei University Museum 2001:53; reproduced with permission).

carried out which served to further flatten the striking platform. The inter-assemblage variation could be the result of a number of different developments: 1) to some extent different stages of the reduction process; 2) variation in raw materials (Suyanggae: siliceous shale; Wolpyeong: rhyolite and tuff); and/or 3) different functions employed by hunter-gatherers. The additional retouching on the Wolpyeong microcores has led to suggestions that Suyanggae is the older one of the two sites. Also suggestive is that Suyanggae has a ^{14}C date range of c. 18,000–16,000 BP, while artifacts from Wolpyeong have many similarities with the stone toolkit from the Shirataki Hattoridai site in Japan with a ^{14}C date of c. 14,000 BP (Chang 2002; Lee 2002a).

ORIGIN AND DISPERSAL OF KOREAN MICROLITHIC TECHNOLOGY

East Asian microlithic technology is most noted for the presence of wedge-shaped cores that initially appeared in northern China between c. 50,000 years ago and c. 28,000 BP. Korean microliths are considered as one branch of the general East Asian tradition developing sometime after this period. It is relatively easy to build a case for the origin of microlithic technology on the Korean Peninsula to have been a direct result of diffusion from China with some of the technology eventually moving to the Japanese Archipelago through bilateral relations with hunter-gatherer groups from that region. It is not as easy to develop a rationale for the indigenous development of microlithic technology in Korea. Let us first examine the case for diffusion of microlithic knapping technology from China and interaction with hunter-gatherers from Japan.

Up to the early 1970s it was generally believed in China that microliths were only associated with Neolithic and Bronze Age cultural periods. It was not until 1972 that the development of microlithic industries could be pushed back to at least the Upper Palaeolithic. Microcores first began to appear in Chinese Upper Palaeolithic sites between c. 50,000 years ago to c. 28,000 BP. The two primary early sites for the appearance of microliths in China are Salawusu (Uranium-series dates range: c. 50,000–37,000 years ago; ^{14}C date c. 35,340 BP) and Shiyu (^{14}C date c. 28,135 BP). These early dates notwithstanding, microliths do not become common in China until the Upper Palaeolithic/Neolithic transitional stage. It is generally believed that Middle Palaeolithic complexes from Mongolia and/or the Dyuktai culture from Siberia influenced the development of microlithic technology in northern China (Brantingham *et al.* 2000; Chen 1984; Gai 1985; Gao and Norton 2002; Yi and Clark 1985; Zhang 2000).

Jangheungni, with ^{14}C dates of around 24,000 BP, currently represents the earliest appearance of microliths in Korea, followed by Sokchangni and Suyanggae with ^{14}C dates between c. 20,000 BP and c. 16,000 BP. All of these dates postdate the appearance of microliths at Salawusu and Shiyu in China, suggesting that microlithic technology first arose in China and then later spread to other regions of East Asia.

However, the recent discovery of tanged points in stratigraphic levels radiocarbon dated to 38,500 ± 1000 BP (SNU00–261) (Bae and Kim 2003) at the Yonghodong site in central Korea indicates that more advanced lithic technology could have arrived on the Korean Peninsula earlier than generally accepted (Han 2002). Tanged points and microcores are sometimes found in the same stratigraphic levels in Korea [for instance, at Suyanggae (Lee 1984, 1985; Lee and Woo 1998; Lee and Yun 1994)]. Only additional research at the Yonghodong site will reveal whether the ^{14}C date is reliable or the stratigraphic units with two tanged points were subjected to some degree of mixing of younger and older deposits. In addition, microliths have not been found in the same context as the tanged points at Yonghodong. However, if further studies support the Yonghodong findings it could be used as evidence for at least a semi-indigenous development of microlithic technology on the Korean Peninsula that is penecontemporaneous with that from China.

It is clear that microlithic technology discovered on the Korean Peninsula was very similar to what has been found in the Russian Far East around the same time. For instance, tanged points similar to those from Suyanggae are known from the open air site of Ustinovka 1 in the eastern Primorye region of the Russian Far East, indicative of possible cultural contact. Similar backed knives and tanged points appear in archaeological deposits at the Oita site on Kyushu as well suggesting that the technology could have either diffused through Sakhalin Island in the north or from the southern Korean Peninsula. Similar lithic techniques (e.g., Yubetsu, Horoka, and Togeshita) across a very broad region (Korea, Japan, and the Russian Far East) suggest at least minimal cultural contact. The presence of obsidian from Hokkaido in archaeological deposits in Sakhalin and obsidian in southern Korea possibly from nearby Kyushu is further evidence for cultural contact and/or hunter-gatherer migrations throughout the circum-Sea of Japan region (Aikens and Higuchi 1982; Imamura 1996; Kononenko 1997; Kuzmin 2002; Kuzmin *et al.* 2002; Matsufuji 1987, 1997).

FUTURE DIRECTIONS

Although a number of well excavated and studied sites close to 30 have been found, there are still a few limitations that hinder more comprehensive research on the origin and development of microlithic industries on the Korean Peninsula. For instance, probably the most significant problem with the current state of Korean microlithic studies is the dearth of known research in North Korea. Still the two best-known microlithic sites in North Korea are Kulpori and Mandalli, but these were discovered and excavated over a quarter of a century ago. Hopefully, in the future with changes in the political and economic environment on the Korean Peninsula, more collaborative research that involves North Korean scholars will facilitate research geared toward reconstructing the origin and development of microlithic technology across the entire Korean Peninsula.

Three other factors would greatly strengthen the quality of microlithic research in Korean Palaeolithic studies. Firstly, obtaining more absolute dates is critical to reconstructing Upper Palaeolithic lifeways. Due to the paucity of radiocarbon dates it is difficult to develop concrete chronological sequences for site occupation on the Korean Peninsula during the terminal Pleistocene and into the Early Holocene. Secondly, more detailed raw material sourcing analyses are needed to reconstruct general hunter-gatherer mobility patterns and levels of interactions, similar to what has been done in investigating Upper Palaeolithic–Early Neolithic hunter-gatherer movement between Sakhalin and Hokkaido (Kuzmin *et al.* 2002). Thirdly, a paucity of associated faunal remains from Korean sites has resulted in a lack of attempts at reconstructing subsistence patterns of Upper Palaeolithic hunter-gatherers. We are currently planning research specifically designed to address many of these questions.

In the future more advanced typological and technological reconstructions will be conducted on the Korean materials. In addition, with increased studies of these microlithic sites, a stronger chronological model will be developed. It is believed that more detailed analysis of microliths from recently excavated sites (e.g., Wolpyeong) should reveal information regarding the reduction sequences of the microcores. Future research on Korean microlithic industries will lead to a more comprehensive synthesis of hunter-gatherer lifeways and their interaction with other groups in Northeast Asia.

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7

LATE PLEISTOCENE MICROLITHIC ASSEMBLAGES IN KOREA

Chuntaek Seong

INTRODUCTION: MICROLITHIC SITES AND ARTIFACTS IN KOREA

The terminal Pleistocene lithic industries in Korea and adjacent Northeast Asia are dominated by microblade technology. This may suggest that the microlithic adaptation was a general feature of the Late Pleistocene, at least in the Old World, which in turn leads to the conclusion that the growing microlithization toward the end of the Pleistocene is one of the most conspicuous aspects of the evolution of Palaeolithic technology (Kuhn and Elston 2002).

Despite the lack of a universally accepted definition, the term ‘microlith’ is widely used in denoting small stone artifacts, especially very small and thin blades and related artifacts (An 1978). The term “microlithic assemblage” in turn became generally reserved for indicating those lithic assemblages containing microblades and microcores. While one may adopt different criteria in describing how small microliths are, microblades in Northeast Asia are usually 15–50 mm long, 4–7 mm wide, and 1–2 mm thick (Gai 1985; Kato and Tsurumaru 1980; Seong 1998). Microblades were probably mounted in wood or antler shafts as barbs and were also used as spears, darts, and, less likely, arrowheads, indicating that tools with mounted microblades were primarily used for hunting and related activities.

In Korea, most lithic assemblages dating to the terminal Pleistocene contain either microblade cores (or microcores), microblades, or both. Previously, microblade cores were described as boat-shaped artifacts in the Korean literature. However, we do not have a long research history studying microlithic assemblages, although more than 40 years have passed since the first Palaeolithic site, Sokchang-ri (Figure 7.1), in the southern part of the Korean Peninsula, was excavated in the early 1960s (Sohn 1973). Sokchang-ri, in fact, yielded a significant number of microliths, including nine microcores, and the Upper Palaeolithic horizon is dominated by a microlithic assemblage (Figure 7.2). In spite of this, the Sokchang-ri microliths did not command the attention they deserved until the late 1980s and early 1990s. The Upper Palaeolithic site of Suyanggae, excavated in the mid-1980s, produced 195 microcores and numerous microblades, according to the excavator (Lee 1984, 1985, 1989c). Most of the Suyanggae microliths were made of siliceous shale, while obsidian was also used in producing microblades and other artifacts. The tools associated with the microliths at Suyanggae include various end-scrapers and tanged points, together with large tools such as handaxes and choppers. While some have raised the possibility that Suyanggae may represent multiple occupational episodes (e.g., Matsufuji 1998), the association of tanged points and microliths is well reflected by many other collections as discussed below.

Further south, the Juam Dam archaeological salvage expeditions exposed a series of Upper Palaeolithic sites along the Boseong River, and sites yielding microliths include Juksan (Yi *et al.* 1990b), Geumpyeong (Lim and Yi 1988), Gokcheon (Lee *et al.* 1988), and Daejeon (Hwasun) (Lee *et al.* 1988; Lee and Yun 1992b) (Figure 7.1).

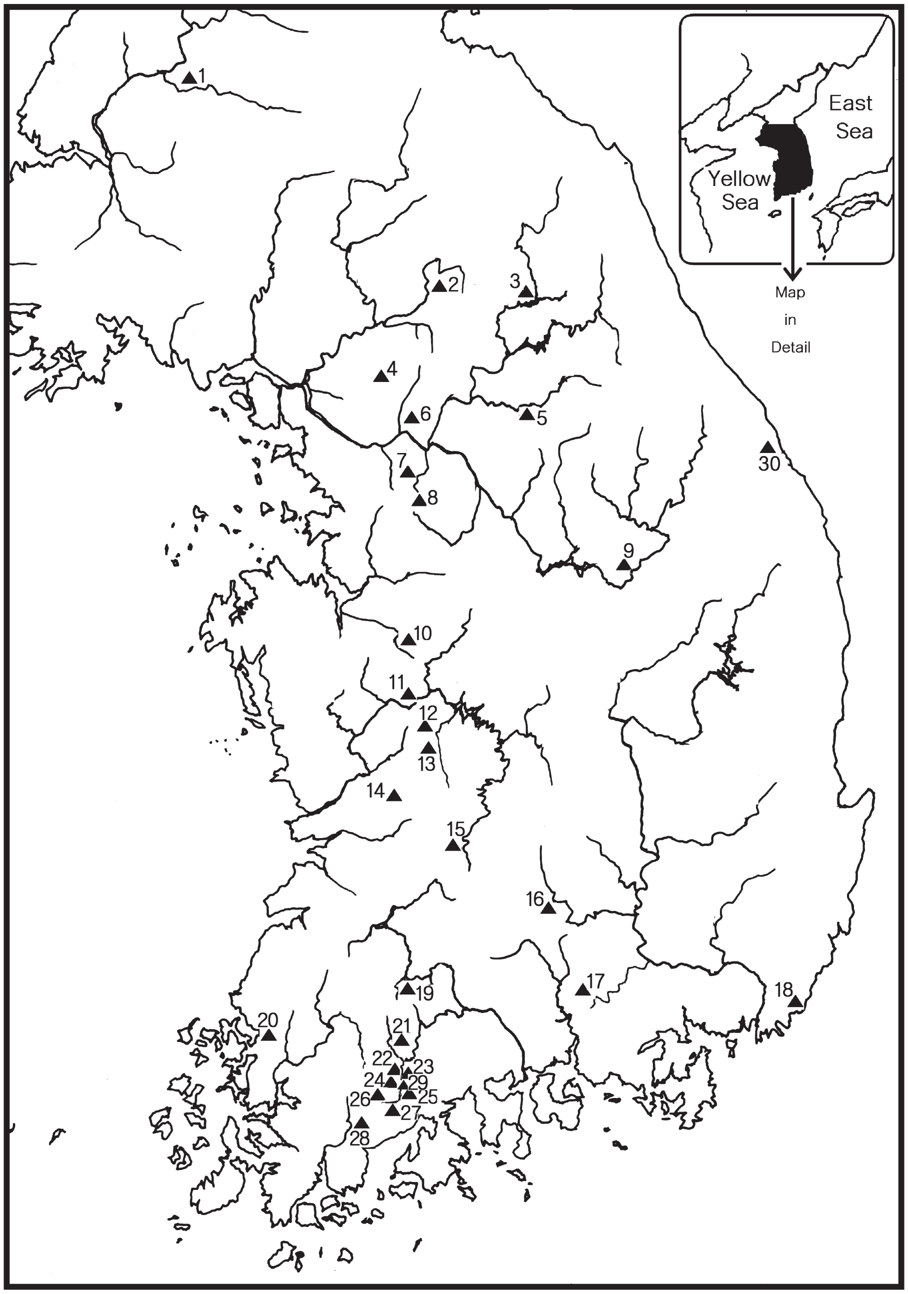

Figure 7.1: Approximate locations of microlithic sites in the Korean Peninsula (administrative position of sites is indicated in brackets). 1. Mandal-ri (Pyongyang); 2. Jangheung-ri (Cheolwon); 3. Sangmuryong-ri (Yanggu); 4. Minrak-dong (Euijeongbu); 5. Hahwagye-ri (Hongcheon); 6. Hopyeong-dong (Namyangju); 7. Sam-ri (Gwangju); 8. Pyeongchang-ri (Yongin); 9. Suyanggae (Danyang); 10. Cheongdang-dong (Cheonan); 11. Sokchang-ri (Gongju); 12. Noeun-dong (Daejeong-dong); 13. Daejeong-dong (Daejeon); 14. Sinmak (Iksan); 15. Jingeuneul (Jinan); 16. Imbul-ri (Geochang); 17. Jiphyeon (Jinju); 18. Jung-dong (Busan); 19. Songjeon-ri and Jusan-ri (Okkwa, Gokseong); 20. Danghasan (Hampyeong); 21. Daejeon (Hwasun); 22. Geumpyeong (Suncheon); 23. Juksan (Suncheon); 24. Gokcheon (Suncheon); 25. Wolpyeong (Suncheon); 26. Yongso (Boseong); 27. Donggoji (Boseong); 28. Sinbuk (Jangheung); 29. Geumseong (Suncheon); 30. Gigok (Donghae).

Microliths subsequently drew increased attention, and several archaeologists began to tackle the issue of microblade techniques (Lee 1989c; Lee and Yun 1994; Seong 1990, 1998). Since the early 1990s, more microlithic sites have become known in Jeollanam-do Province in the southwestern corner of the Korean Peninsula than in any other region of Korea, including the recent addition of important collections from the Wolpyeong and Sinbuk sites (Lee 2002a, 2004) (Figure 7.1). This is because the Palaeolithic archaeological expeditions in the Jeollanam-do area were based on extensive surface surveys along the Boseong River (Lee 1997). Recently, more than 100 microblade cores were collected at the Sinbuk site as well as various types of endscrapers, burins, tanged points, and ground stone axes (Lee 2004). Most of the microliths from the southern part of the peninsula were made of silicified tuff or shale, in contrast to obsidian artifacts from central and northern Korea (Seong 1998, 2004a, 2004b).

In the central part of Korea, the Hahwagye-ri and Sangmuryong-ri sites, located along the Bukhan River, were excavated during the late 1980s and early 1990s and yielded many microliths (Choi 1989; Choi *et al.* 1992) (Figure 7.1). Especially noteworthy is that obsidian artifacts are predominant in the Hahwagye-ri microlithic assemblage, as they are widely recognized in collections from the central part of the Korean Peninsula, like those from Hopyeong (Hong *et al.* 2002), Minrak-dong (Choi *et al.* 1996), Sam-ri (Han *et al.* 2003a), and Mandal-ri near Pyongyang (Kim *et al.* 1990) (Figure 7.1). In a recent

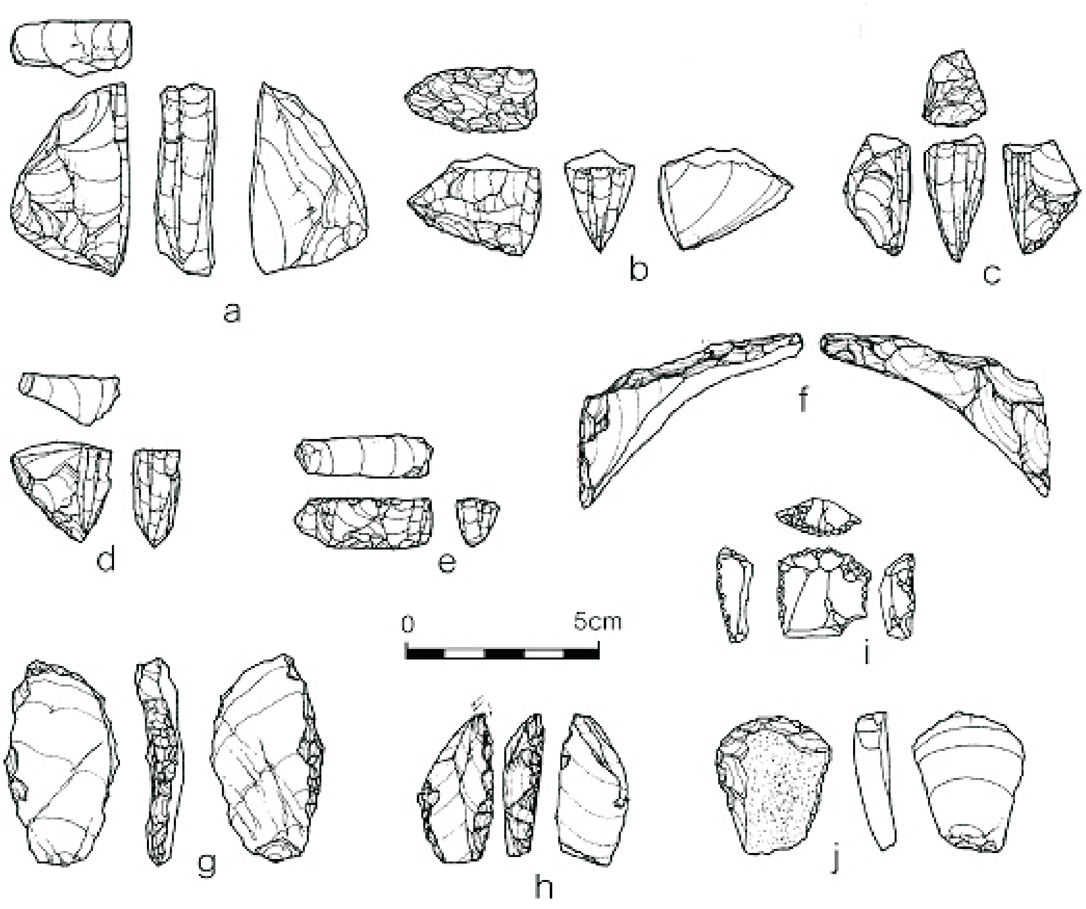

Figure 7.2: Microblade cores and associated artifacts from Sokchang-ri.
a–g: microblade cores and related flakes; h: burin; i and j: endscrapers (modified, based on Jang 2002).

excavation at Hopyeong, numerous microliths, made of obsidian and siliceous shale, were recovered along with other types of very small artifacts, including "microdrills" and tanged points (Hong *et al.* 2002). Palaeolithic sites located along the east coast of Korea have also yielded microliths, as exemplified by a recent excavation of the Gigok site (Lee *et al.* 2005). Obsidian was regularly exploited to produce microliths in northern and central Korea at the end of the Pleistocene in contrast to the southern part.

Despite the brief history of microlithic research, there are some 30 microlithic sites and vast microlithic collections from many archaeological sites throughout the Korean Peninsula (Figure 7.1). Among them, sites yielding ten or more microcores include Hahwagye-ri, Hopyeong, Suyanggae, Wolpyeong, and Sinbuk (Table 7.1). It also needs to be pointed out that excavation reports are currently not available for such important microlithic sites as Hopyeong, Jiphyeon, Jangheung-ri, and Sinbuk.

VARIOUS MICROBLADE TECHNIQUES

Reconstruction of microblade manufacturing techniques on the basis of microcore morphology has been one of the central themes in the study of the microlithic tradition in Korea (e.g., Kim 2002; Jang 1995; Jang 2002; Lee and Yun 1994; Lee *et al.* 1996; Seong 1998) and adjacent countries (e.g., Chen 1984; Chen and Wang 1989; Kato 1992; Lu 1998). The term "tradition" is used here to denote the persistence of largely the same kind of technology through time. The term "wedge-shaped" core is widely used to indicate those cores with a relatively long and slender fluted or blade producing surface, while boat-shaped cores are relatively thick and wide with a rather short fluted surface. However, as I have pointed out elsewhere (Seong 1998), the distinction between wedge-shaped and boat-shaped cores has no sound basis and is often used arbitrarily.

Thanks to Japanese archaeologists, more than 10 specific techniques of producing microblades were reconstructed (Kobayashi 1970; Kato and Tsurumaru 1980; Obata 1987), and most of them are also recognized by Chinese scholars (Chen and Wang 1989; Tang and Gai 1986). These current technological typologies, however, are often overly specific and do not effectively represent the full range of variation. For example, not a few microblades were produced from casual cores, which does not receive due consideration in the current fixed typology. Instead, an analysis of core reduction technology would be best examined if one is mainly concerned with the reduction sequence based on specific stages towards microblade production. According to many useful studies of microblade techniques, three more or less successive stages can be recognized: blank formation, platform preparation, and blade detachment.

There are technological varieties of each of these three steps, and varieties from each step denote various microblade production techniques, such as the Yubetsu, Togeshita, and Hirosato techniques, as recognized by Japanese archaeologists. Given the sophistication of microblade technology, the sequence of core preparation is often determined from the very beginning, and the first step, blank selection and preparation, may result in recognizable differences in the final product. In a broad sense, four types of blank formation are recognized: bifacial, unifacial, conical, and large.

Microcores manufactured on bifacially prepared blanks are often elongated and of oval shape, as exemplified by many of the Suyanggae specimens (Figure 7.3). Called type 1 here, they are usually larger than other types of microcores. Microblade cores that can be assigned to type 2 are in turn often smaller than type 1 cores. Some type 2 cores were unifacially flaked, while others lack any apparent evidence of further flaking and trimming of the face (Figure 7.4: b, d, e). Conical or cylindrical cores which belong to type 3 (Figure 7.4: f) are characterized by a different reduction trajectory than type 1 and 2 cores: the platform was often produced first with subsequent working of the surface. A significant amount of trimming around the platform was required before blade detachment. Large blades or elongated flakes were also worked into microblade cores (type 4), and they reveal a similar morphology to burins as demonstrated by many specimens from the Hahwagye-ri site.

The next step in microblade technology is the preparation of the platform. In a broad sense, three types are recognized: (a) longitudinal detachment of so called ski-spalls (Figures 7.2: f; 7.3: f; 7.4: b), (b) side blow and subsequent trimming, and (c) opportunistic or no further trimming around the platform. A typical Yubetsu technique often recognized by Japanese scholars is the combination of type 1 blank formation and type (a) platform preparation as shown by the Suyanggae specimens (Figure 7.3: e-j).

Microblade detachment is mostly confined to one edge of the core, but may also occur on both ends (Figure 7.4: k) or circumferentially. An exhausted core may have an acutely angled blade

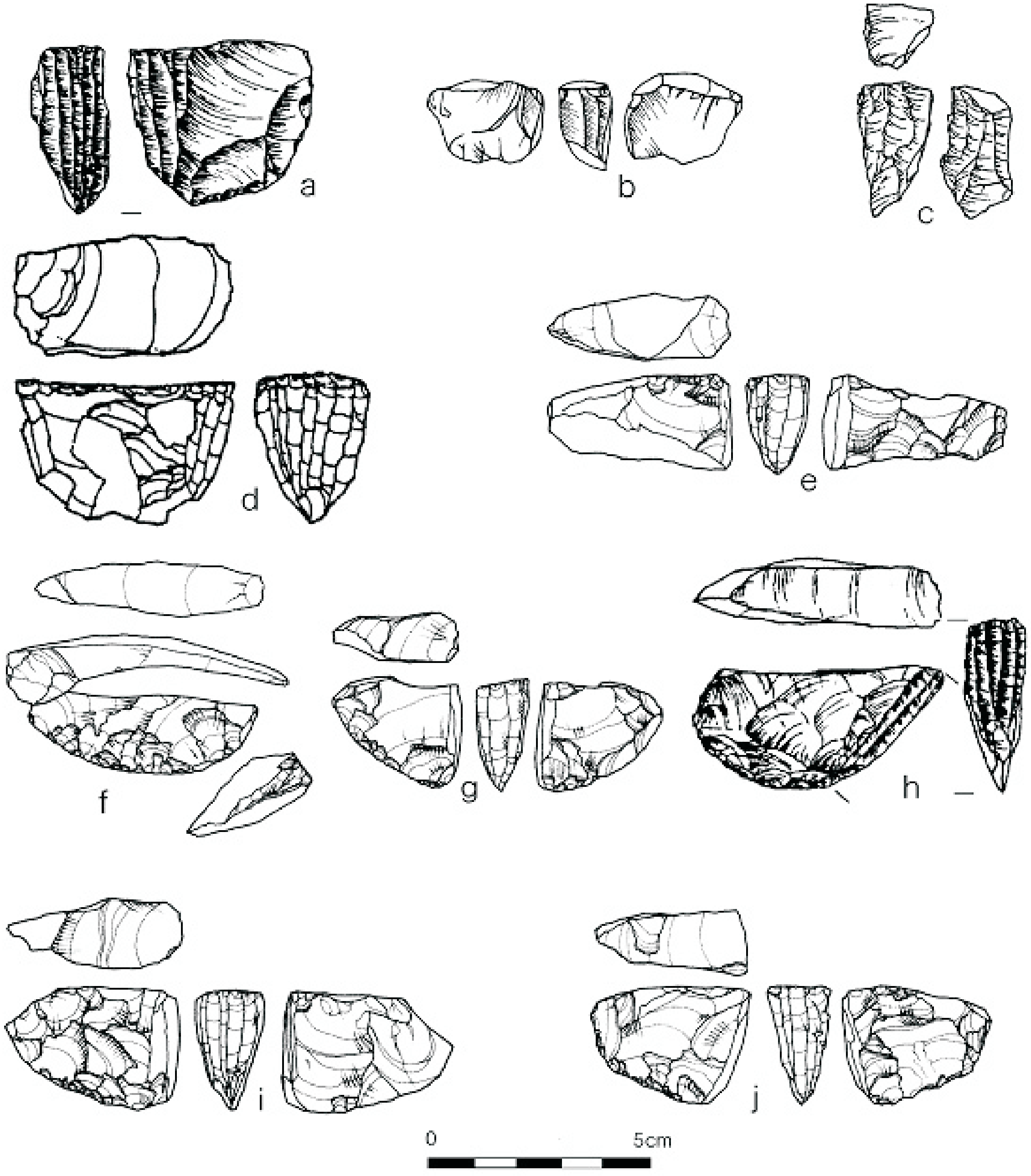

Figure 7.3: Microblade cores from the central part of the Korean Peninsula.
a: Mandal-ri; b: Jangheung-ri; c: Pyeongchang-ri; d: Sangmuryong-ri; e–j: Suyanggae (d, e, f, i, and j after Obata 2004:37).

Table 7.1: Microlithic sites and artifacts in the Korean Peninsula.

	Site	Microliths	Raw material	Date (^{14}C)	Other artifacts	Source
1	Mandal-ri	5 mcores*	Obsidian	no data	Obsidian flakes	Kim *et al.* (1990); Seo (1987)
2	Jangheung-ri	5 mcores	S. shale**, obsidian	24,200 ± 600 BP (SNU00-380); 24,400 ± 600 BP (SNU00-381)	Tanged point	Choi (2001)
3	Sanjuryong-ri	2 mcores, mblades	Obsidian, s. shale	no data	Burins	Choi (1989)
4	Minrak-dong	1 mcore	Obsidian	no data	Obsidian flakes, quartz, crystal core	Choi *et al.* (1996)
5	Hahwagye-ri	27 mcores	Obsidian	no data	Burins, endscrapers	Choi *et al.* (1992)
6	Hopyeong (Hopyeong-dong)	10 mcores, mblades	Obsidian, s. shale	22,200 ± 600 BP (SNU02-327); 21,100 ± 200 BP (SNU02-329); 17,500 ± 200 BP (SNU02-325); 17,400 ± 400 BP (SNU02-326); 16,900 ± 500 BP (SNU02-324); 16,600 ± 720 BP (GX-29423); 16,190 ± 50 BP (GX-29424)	Burins, endscrapers, awls, tanged points, microdrills	Hong *et al.* (2002)
7	Sam-ri	15 mblades	S. shale	no data	Tanged point, burin	Han *et al.* (2003a)
8	Pyeongchang-ri	1 mcore (surface collection)	S. shale	no data	Platform rejuvenation flake	Yi *et al.* (2000)
9	Suyanggae	195 mcores, mblades	S. shale, obsidian	c. 18,630 BP (UCR-2078); c. 16,400 BP (no Lab No. provided)	Tanged points, end-scrapers, handaxes, choppers	Lee (1984, 1985, 1989c); Lee and Yun (1992a)
10	Cheongdang-dong	1 mcore (surface collection)	S. shale	no data	n.a.	Unpublished
11	Sokchang-ri	9 mcores	S. shale, porphyry	20,830 ± 1880 BP (AERIK-8)	Tanged point, end-scrapers	Sohn (1973)
12	Noeun-dong	1 mcore	S. shale	no data	Burins, endscrapers	Han *et al.* (2003b)
13	Daejeong-dong (Daejeon)	1 mcore	S. shale	19,680 ± 90 BP (GX-28422)	Bifacial point	Lee *et al.* (2002)
14	Sinmak	1 mcore (surface collection)	S. shale	no data	Burin, flakes	Kim (2002)

15	Jingeuneul	mblades	S. shale	22,850±350 BP (SNU01-028)	Tanged points	Lee (2001)
16	Imbul-ri	2 mcores	n.a.	no data	Flakes	Nakayama (1989)
17	Jiphyeon Jangheung-ri	Numerous mcores	S. shale	no data	Ground stone axe	Park and Seo (2004)
18	Jung-dong	3 mcores	S. shale	no data	Endscraper, quartzite flakes	Ha (1999)
19	Songjeon-ri (Okkwa County)	2 mcore (surface collection)	S. shale	no data	Ski-spall, refitted to mcore, endscrapers, chopper	Yi *et al.* (1990a)
20	Danghasan	4 mcores	S. shale	no data	Blades and flakes	Choi and Lee (2001)
21	Daejeon (Hwasun)	3 mcores	S. shale	no data	Scraper	Lee and Yun (1992b), Lee *et al.* (1988)
22	Geumpyeong	1 mcore	S. shale	no data	Endscraper	Lim and Yi (1988)
23	Juksan	1 mcore	S. shale	no data	Burin, tanged point	Yi *et al.* (1990a, 1990b)
24	Gokcheon	2 mcores	S. shale	no data	Ski-spalls	Lee *et al.* (1988)
25	Wolpyeong	22 mcores, mblades	S. shale, quartz crystal	no data	Bifacial points, tanged point	Lee (2002a, 2002b)
26	Yongso	1 mcore	S. shale	no data	n.a.	Kim (2002)
27	Donggoji	1 mcore	S. shale	no data	n.a.	Lee (1997)
28	Sinbuk	More than 100 mcores	S. shale, obsidian, quartz crystal	25,500±1000 BP (SNU03-914); 25,420±190 BP (SNU03-569); 21,760±190 BP (SNU03-913); 20,960±80 BP (SNU03-568); 18,540±270 BP (SNU03-915); 18,500±300 BP (SNU03-912)	Tanged points, bifacial points, burins, endscrapers, ground stone artifacts, including axe	Lee (2004)
29	Geumseong	1 mcore	S. shale	no data	n.a.	Kim (2002)
30	Gigok	mcore, mblade	Obsidian, porphyry, quartz crystal	10,200±60 BP (SNU02-542)	Burins, points, awls, endscrapers	Lee *et al.* (2005)

* Mcore, mblade indicate microcore and microblade, respectively.

** Raw material labeled as S. shale is "siliceous shale" or "silicified tuff". While many excavation reports describe the rock as mudstone, hornfels, rhyolite, or andesite, it is likely to represent a similar rock type that could collectively be called 'siliceous shale' or 'silicified tuff' (Seong 2004a, 2004b).

producing surface to the platform (Figure 7.3: h). It also seems that type 1 microcores with bifacial preparation, which are relatively larger than other types, are more or less antecedent to the type 2 and 3 cores (Seong 1998).

ARTIFACTS ASSOCIATED WITH MICROLITHS

Microlithic assemblages in Korea not only contain various small artifacts such as endscrapers, sidescrapers, burins, points, and awls, but also large stone artifacts such as choppers and even handaxes, as exemplified by the Suyanggae collection. Large tools were often made from vein quartz and quartzite cobbles, while small artifacts and microliths were manufactured on such fine-grained rocks as siliceous shale or tuff, and obsidian. Although large tools such as choppers are included in some assemblages, they are still dominated by microblade technology.

Small endscrapers are regularly associated with microliths. Some 79 endscrapers were collected at Suyanggae, and they are mostly made from siliceous shale as were the microblades and microcores (Lee *et al.* 2001; Lee and Kong 2003;

Figure 7.4: Microblade cores from the southern part of the Korean Peninsula.
a: Imbul-ri; b: Songjeon-ri; c–e: Daejeon; f: Geumpyeong; g–m: Wolpyeong (b and f after Jang 2002; c–e after Obata 2004:38; g–m after Lee 2002a).

Figure 7.6: e-f). Various types of endscraper are recognized in terms of the blanks on which they were manufactured, including those with relatively thick flakes and blades as observed in the Wolpyeong (Lee 2002a) and Suyanggae collections.

Tanged points with stemming retouch around the butt are important components in many Upper Palaeolithic assemblages in Korea as well as in western Japan. As shown in Table 7.1, nine microlithic sites have yielded tanged points, including Jangheung-ri, Hopyeong, Sam-ri, Suyanggae, Sokchang-ri, Jingeuneul, Juksan, Wolpyeong, and Sinbuk (Figure 7.5). Tanged points were also discovered at some other Upper Palaeolithic sites, such as Hwadae-ri, Yongho-dong, Yongsan-dong, and Gorye-ri, without being associated with microliths (Obata 2004). At the stratified site of Yongho-dong, a tanged point was unearthed from a layer beneath a horizon that was dated to c. 38,000 BP (Han 2002).

In addition, bifacial points, much larger than tanged points, were collected at the Suyanggae, Daejeong, Sinbuk, and Wolpyeong sites (Lee 2002a, 2004; Figure 7.5: f-g). Recently, ground stone artifacts were also found associated with microliths at several Upper Palaeolithic sites. At Sinbuk, a ground stone axe and other types of ground stone artifacts were found in the same cultural horizon as microliths (Lee 2004). A ground stone axe was also collected at the Jiphyeon site with many microcores and microblades (Park and Seo 2004) (Table 7.1).

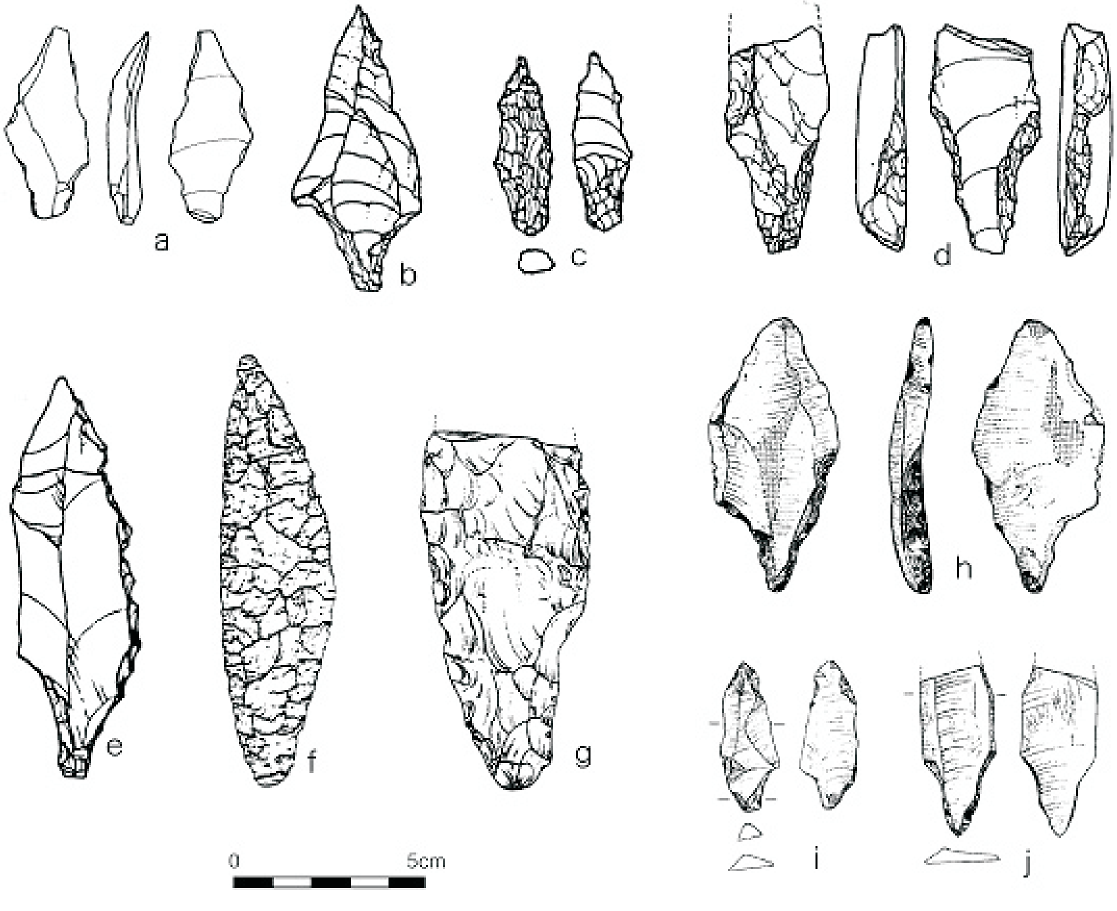

Figure 7.5: Tanged points and bifacial points associated with microliths in Korea.
a: Jangheung-ri; b-c, e: Suyanggae; d, f: Sokchang-ri; g-j: Wolpyeong (b, c, e and f after Jang 2002; g-j after Lee 2002a).

Other interesting and important microliths associated with microcores and microblades include microdrills. At a recent excavation of the Hopyeong site near Seoul, a number of obsidian microdrills were unearthed along with endscrapers and burins. Burins are also regularly associated with microliths as exemplified by the illustrated artifacts from Sokchang-ri (Figure 7.2) and Sangmuryong-ri (Figure 7.6; Table 7.1).

CHRONOLOGY OF MICROLITHIC ASSEMBLAGES

Given that the microlithic tradition marks the Final Pleistocene lithic technology, it seems plausible to assume that microblade technology was established based on the advanced technology of the blade (i.e., not microblades, but large or normal sized blades) industry. While the Upper Palaeolithic, or Late Palaeolithic, is traditionally defined by the dominance of blade technology in lithic assemblages, we do not have clear evidence of this before c. 30,000 BP in Korea.

Only a small amount of archaeological data has been recovered that can be grouped into the blade industry preceding the microlithic one. Nevertheless, the Gorye-ri assemblage from the southeastern corner of the Korean Peninsula contains large blades, blade cores, and tanged points made on blades (Jang 2001; Seo *et al.* 1999), and so do the recent collections from Hwadae-ri (KNUM 2003), Yongho-dong (Han 2002), and Yongsan-dong (JICP 2004).

A few AMS ^{14}C dates show that these blade assemblages are dated to c. 40,000–27,000 BP, and thus, it is safe to say that the blade assemblages predating the microlithic assemblages are commonly characterized by such artifacts as blades,

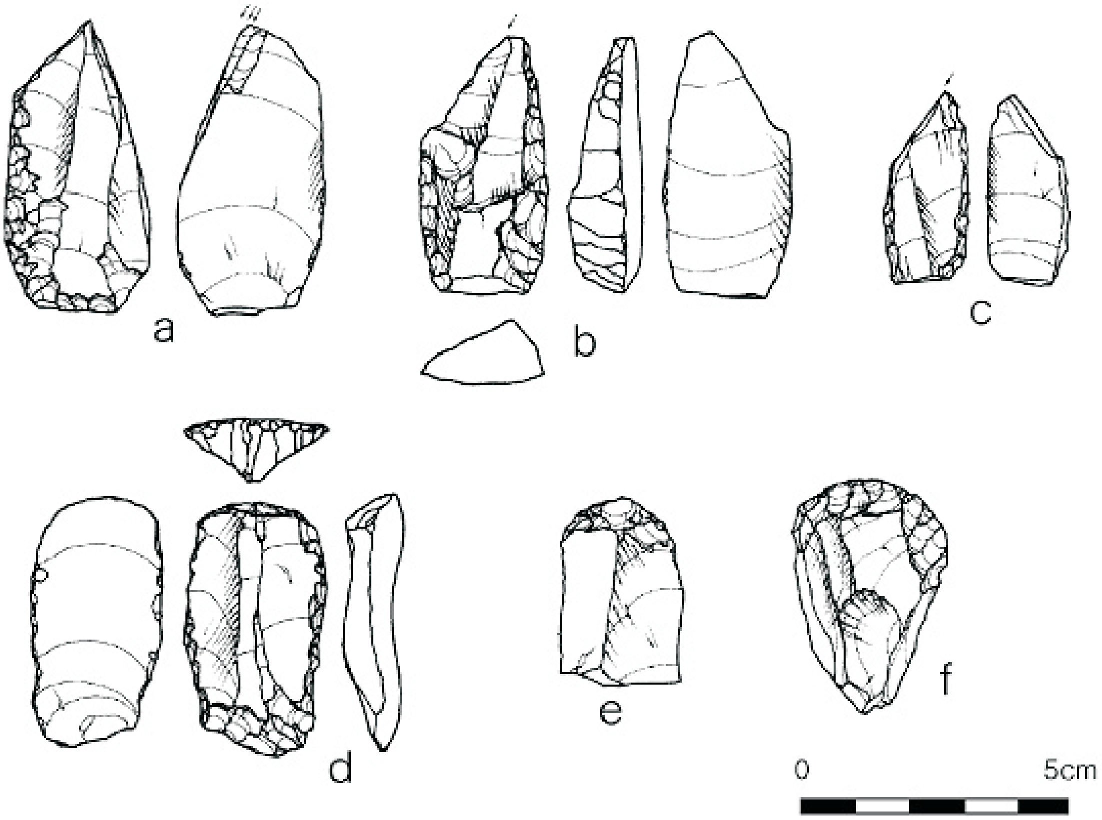

Figure 7.6: Burins and endscrapers associated with microliths in Korea.
a-d: Sangmuryong-ri; e-f: Suyanggae (after Obata 2004:37-38).

blade cores, and, importantly, tanged points. Tanged (or stemmed) points may have some chronological significance, given that they largely predate the microlithic assemblages in western Japan (Matsufuji 2001; Obata 2004). Most of the Gorye-ri artifacts were collected from the deposit above the AT tephra horizon where the AT volcanic ash samples, originating from southern Kyushu Island and dated to c. 25,000–24,000 BP, were collected (Seo *et al.* 1999).

Until the 1990s, only a few chronometric dates for the microlithic tradition were available. The Sokchang-ri artifacts were recovered from a layer immediately below a deposit dated to around 20,000 BP (Sohn 1993), and Suyanggae provided ^{14}C dates of c. 18,630 BP and c. 16,400 BP. Recent progress, however, offers a basis on which we can discuss the time span of the microlithic tradition in Korea.

Despite the insufficient number of absolute dates, it appears that microlithic assemblages are dated to Oxygen Isotope Stage (OIS) 2 and that the microlithic tradition was established by the time of Last Glacial Maximum (LGM), around 20,000 BP. This is well indicated in Table 7.1, which shows the available ^{14}C dates of microlithic sites of the Korean Peninsula. The Jangheung-ri cultural horizon containing microliths yielded two AMS dates of 24,400 ± 600 BP and 24,200 ± 600 BP (Choi 2001), which are among the earliest dates for microlithic assemblages in Northeast Asia (see Kuzmin, this volume). The latest development in chronology of the early microblade complexes in Korea is that the Sinbuk site has the earliest microblade associated ^{14}C date in Korea at c. 25,400 BP (Lee 2004) (Table 7.1). The microlith-bearing horizons at Sockchang-ri (Sohn 1993), Jingeuneul (Lee 2001), Hopyeong (Hong *et al.* 2002), and Daejeon (Lee *et al.* 2002), were dated to c. 22,800–20,000 BP (Table 7.1). Thus, there is no doubt that the emergence of microlithic assemblages extends back to at least 20,000 BP in Korea, and that the microlithic adaptation had become widespread by the onset of the LGM. Table 7.1 also summarizes artifacts associated with microblades and microcores.

The association between the microlithic assemblage and ^{14}C date at Sockchang-ri is unclear. From the description in Sohn (1993) and other literature, the dated sample was likely to have been taken beneath the microlithic horizon. This is, however, based on the interpretation of the vertical stratigraphic profile, rather than the stratigraphic association between the sample and artifacts.

From a very sketchy perspective based on the scale of assemblage comparison, microlithic assemblages containing large blades and tanged points may represent the earlier phase of the microlithic tradition, while those without tanged points indicate the later phase. The earlier microlithic phase may be dated to the last full glacial, approximately 25,000–17,000 BP, as shown by the radiometric dates from Sinbuk, Jingeuneul, Jangheung-ri, Hopyeong, and Suyanggae, where tanged points were found associated with microliths. The later phase of the microlithic tradition may span the rest of the Late Pleistocene, as the ^{14}C date from the Gigok site indicates.

In sum, the Upper Palaeolithic blade and microblade assemblages of Korea show three more or less successive phases: 1) assemblages characterized by blades and tanged points without microliths; 2) assemblages marked by the association of tanged points and microliths; and 3) assemblages with microliths and without tanged points. The first phase is represented by the Hwadae-ri, Yongho-dong, Yongsan-dong, and Gorye-ri sites; the second phase by the Jangheung-ri, Hopyeong, Suyanggae, Sockchang-ri, Jingeuneul, Wolpyeong, Sinbuk, and Juksan sites; and the third phase by the Hahwagye-ri, Gigok, and Jiphyeon Jangheung-ri sites.

THE MICROLITHIC EVOLUTION

While the microlithic tradition characterizes the late Upper Palaeolithic industries, it is not clear when and why it emerged and became established on the Korean Peninsula. Many scholars assume that the microlithic tradition first appeared in the north and then diffused to the south (Kato 1992; Lee 1999), but I do not agree with this simple diffusionist point of view (Seong 2000, 2001). Rather, as I discussed above, little difference in the early dates of microlithic assemblages between northern China and Korea can be recognized (see also Kuzmin, this volume; Keates, this volume). Furthermore, during the last glacial, the Korean Peninsula was simply part of the continent given that the sea shelf of the modern day Yellow Sea was exposed. We cannot, and need not, pinpoint where microblade technology initially originated, and, instead, the research focus should be placed on the ecological and evolutionary processes behind the establishment of the microlithic tradition. Although we do not have sufficient evidence, it would be more reasonable to view the establishment of microlithic technology from an evolutionary perspective focusing on the ecological conditions prompting the high mobility of Late Pleistocene hunter-gatherers.

The distribution of microlithic assemblages in Northeast Asia is largely confined to the northern latitudes, which strongly suggests that the microlithic tradition was closely associated with human adaptation to cold and harsh environments (Elston and Brantingham 2002; Jang 1995; Seong 2000). Given that the emergence of microlithic assemblages could date to the onset of the last full glacial, the hypothesis of cold adaptation is also applicable to the Korean cases as well as northern China and Siberia.

From a behavioural ecological perspective, adaptive responses to harsh environments with an uneven resource distribution are characterized by an increasing dependence on large and medium-sized game. This was the most reliable strategy for last glacial mobile hunter-gatherers (e.g., Kelly 1995; Kuhn and Stiner 2001). Tanged points and microblades were considered as parts of the hunting equipment: a tanged point was likely used individually and inserted into the haft of a projectile weapon, while a series of microblades constituted a composite tool. It is generally thought that microblades were attached to a bone or antler shaft as marginal insets for projectile points and knives, which represent very durable and reliable tools in a harsh environment as Elston and Brantingham (2002) have proposed. While both tanged points and microblades were used in the earlier phase of the microlithic tradition, they were probably used for hunting relatively large and medium-sized game, which was essential for the survival of mobile hunter-gatherers during the LGM. As for the dispersal of microlithic technology, it is likely that high mobility in harsh and unpredictable environments in turn triggered the spread of microblade technology in a relatively short period of time.

The archaeological evidence suggests that tools with microblades dominated the hunting equipment used after the LGM, the period characterized by fluctuating climates and increasing seasonality (COHMAP Project Members 1988). This probably resulted in a situation where high-ranked resources became exhausted regionally due to migration and changing environments, with hunter-gatherers responding by widening their dietary breadth (Kelly 1995). Microblade tools may have been primarily used for hunting large and medium-sized game, but they were also likely to have been used for a variety of other purposes. Low-ranked resources, including small mammals and plant seeds, or even fish, may have been increasingly targeted by post-LGM hunter-gatherers. In this vein, multi-functional composite tools using microblades represented a risk-minimizing strategy in unpredictable environments. This explanation is well applicable to the Korean Palaeolithic data in which assemblages dated to the height of OIS 2 (c. 24,000–17,000 BP) contain both tanged points and microliths, while those dated to c. 17,000–10,000 BP are dominated by microliths and related artifacts without tanged points.

8

GEOARCHAEOLOGICAL ASPECTS OF THE ORIGIN AND SPREAD OF MICROBLADE TECHNOLOGY IN NORTHERN AND CENTRAL ASIA

Yaroslav V. Kuzmin

INTRODUCTION

Northern and Central Asia is the temperate belt of the Asian continent with some adjacent subtropical areas, such as the central and southern parts of the Japanese Archipelago. It includes the territories of Siberia, the Russian Far East, northern China (north of the Yellow River), Mongolia, the Korean Peninsula, and the Japanese Islands (Figure 8.1). The main aim of this review is *to summarize the state-of-the-art knowledge of the chronology and environment of the earliest microblade complexes in Northern and Central Asia, with the focus on Siberia and the Russian Far East.* The chronological patterns for the appearance of microblade technology are of particular importance in this review. Palaeoenvironmental records are used to understand the relationship between the changing climatic and vegetational conditions and human adaptive strategies in the Upper Palaeolithic of Northern and Central Asia.

Microblade tradition sites are defined for the earliest periods as sites with clearly recognizable wedge-shaped cores or those with wedge-shaped cores and microblades. In this review, I use the following definitions of the term "microblade": "[a] small stone blade, typically several centimetres in length, often produced from a conical or wedge-shaped microcore" (Bahn 2001:292); and "[a] very small, narrow blade" (Darvill 2002:259). This is different from the more general term "microlith", which is defined as: 1) "[a] small later Upper Palaeolithic or Mesolithic stone artifact varying in size from approximately 1 to 5 cm (0.4 to 2 inches), and used as the tip of a bone or wooden implement or as an arrow-point" (Bahn 2001:292); 2) "[S]mal flint blade, or fraction of blade, often defined as less than 5 mm long and 4 mm thick" (Shaw and Jameson 1999:396); and 3) "[A] very small tool made on a blade or flake. Often less than 2 cm long, microliths sometimes occur in geometric shapes (e.g., triangles and trapezes), and few of them could have been used without hafting" (Bray and Trump 1982:156–157). In some sources, a more specific definition of particular kinds of microliths is given, i.e., those found in Northern Asia: "[a] tradition of elaborate core preparation for making bladelets found in Siberia, North China, Korea, Japan, and Alaska where bifacially worked wedge-shaped cores are used" (Reynolds 1996:468).

Radiocarbon (hereafter ^{14}C) dates are employed as the primary means of determining the chronology for the beginning of microblade manufacture. Archaeological and chronological data available for the key microblade complexes are critically evaluated. Palaeoenvironmental records for the key archaeological sites, as well as regional summaries for the Late Pleistocene of Siberia and the Russian Far East, and adjacent northern China, Japan, and Korea, are used.

CHRONOLOGY AND ENVIRONMENT OF THE EARLIEST MICROBLADE SITES IN SIBERIA AND THE RUSSIAN FAR EAST

Radiocarbon Chronology of the Earliest Microblade Complexes

The earliest evidence of microblade technology is represented by a few definite microblades and microcores found at the Ust-Karakol 1 and Anui 2

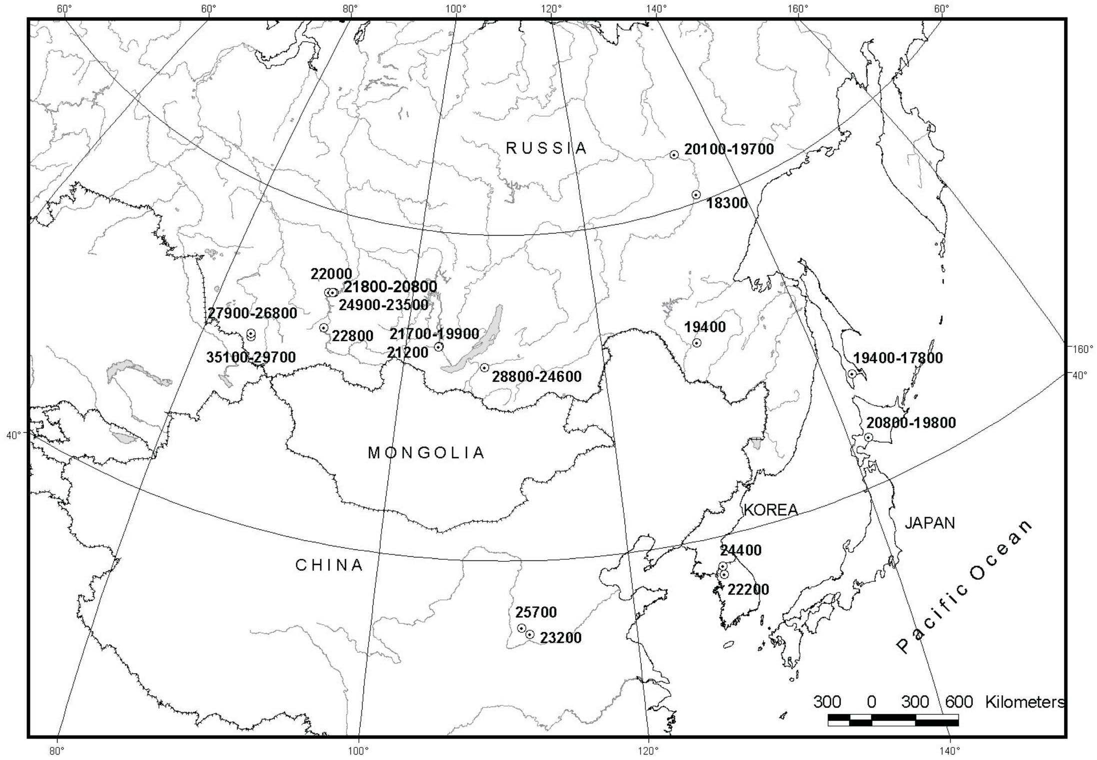

Figure 8.1: ^{14}C dates of the earliest microblade complexes in Northern Asia.

sites in the Altai Mountains in Siberia (Derevianko 2001; Derevianko *et al.* 2003) (Figures 8.1 and 8.2). Layers 11A–9A of the Ust-Karakol 1 site with microblades and microblade cores have ^{14}C dates from hearths: layer 10 – c. 35,100 BP; and layer 9C – from c. 33,400 BP to c. 29,700 BP (Table 8.1) (Derevianko *et al.* 2003:275–298). It should be noted that date AA–32670 (see Table 8.1) was obtained from the hearth in layer 9C (Derevianko *et al.* 2005), and this AMS determination confirms the earlier dates produced by the conventional method (Lab code SOAN). The site of Anui 2, neighbouring Ust-Karakol 1 in the Anui River basin, also has very early ^{14}C dates associated with microblades (Derevianko 2001; Derevianko *et al.* 2003:311–329) (Figures 8.1 and 8.3). For the bottom layer 12 of Anui 2, two ^{14}C values were obtained: c. 27,900 BP and c. 26,800 BP (Table 8.1) (Derevianko *et al.* 2003; see also Keates, this volume). Above layer 12, ^{14}C dates are known for layers 9 through 3, in the general time range of c. 27,100 BP to c. 21,300 BP (Table 8.1). A general taphonomic feature of the Ust-Karakol 1 and Anui 2 sites is that cultural material and associated ^{14}C-dated material have been preserved *in situ*. This can be demonstrated by the good preservation of fossils, which show no traces of rolling or other evidence of re-deposition (Derevianko *et al.* 2003:252).

Microblades might have appeared in the Altai Upper Palaeolithic assemblages even before c. 35,000 BP. This may be true if we take into account their presence in Denisova Cave (main chamber): 15 microblades were found in layer 11 and 67 microblades in layer 9 (Derevianko *et al.* 2003:128–135). Also, seven microblades and one wedge-shaped core were recovered in layer 7 of the entrance part of Denisova Cave (Derevianko *et al.* 2003:172–174; Derevianko and Shunkov 2004). There is one ^{14}C date for the lower part of layer 11 in the main chamber of more than 37,235 BP (SOAN–2504, bone date); and one ^{14}C value of 29,200±360 BP (AA–35321, charcoal date) for the top of layer 11 in the southern gallery (Derevianko *et al.* 2000a). In the entrance to the cave, the age of layer 9 (below layer 7) is 46,000±2300 BP (GX–17602, charcoal date) (Kuzmin and Orlova 1998; Kuzmin 2004).

However, the wide range of ^{14}C dates for layer 11 of the main chamber and lack of wedge-shaped

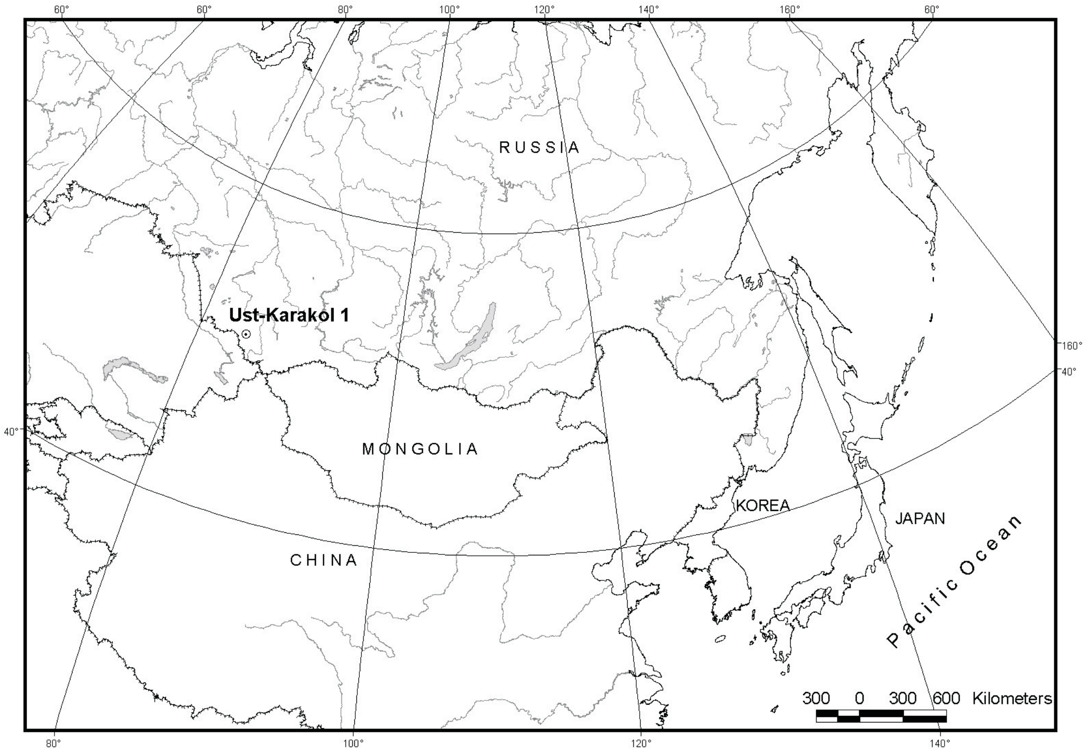

Figure 8.2: Microblade complexes in Northern Asia, c. 35,000-30,000 BP.

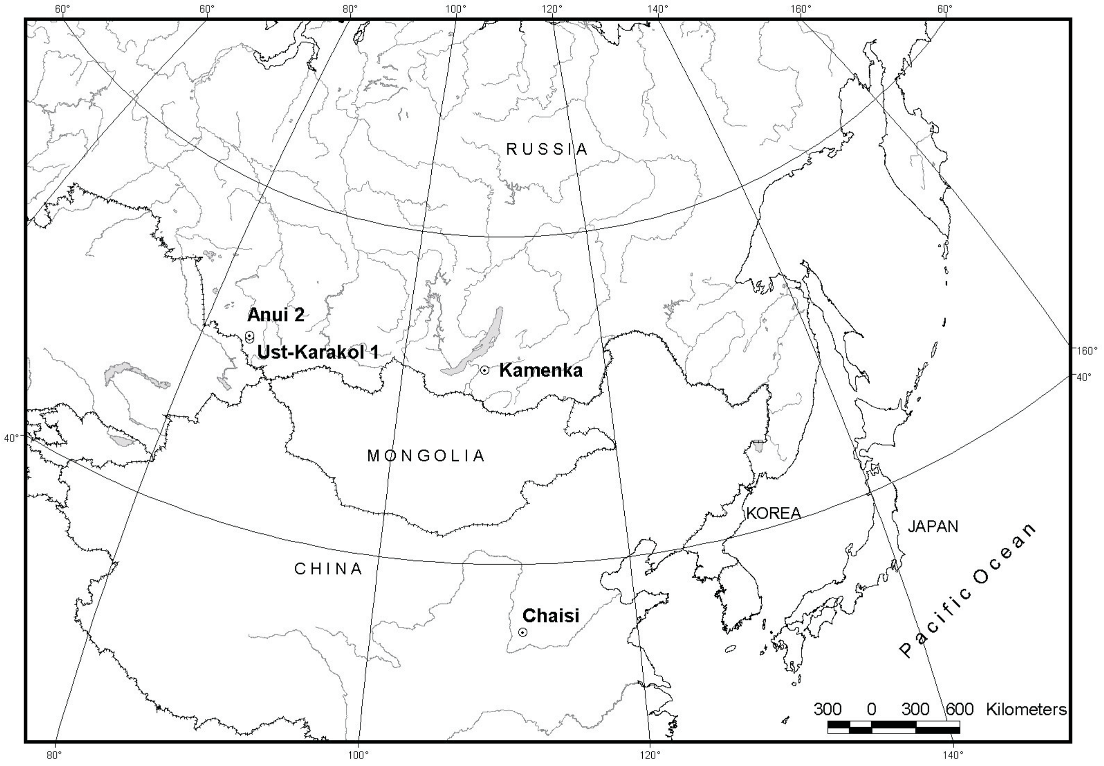

Figure 8.3: Microblade complexes in Northern Asia, c. 30,000-25,000 BP.

Table 8.1: Radiocarbon dates associated with the earliest microblade complexes in Northern Asia.

Region, site, and layer	^{14}C date, BP	Lab Code and No.	Material dated
Siberia			
Ust-Karakol 1, layer 10	35,100 ± 2850	SOAN-3259	Charcoal
Ust-Karakol 1, layer 9C	33,400 ± 1285	SOAN-3257	Charcoal
	31,580 ± 470	AA-32670	Charcoal
	29,860 ± 355	SOAN-3358	Charcoal
	29,720 ± 360	SOAN-3359	Charcoal
Anui 2, layer 12	27,930 ± 1590	IGAN-1425	Humates
	26,810 ± 290	SOAN-3005	Charcoal
Anui 2, layer 9	27,125 ± 580	SOAN-2868	Humates
Kamenka, complex B	28,815 ± 150	SOAN-3032	Bone
	28,060 ± 475	SOAN-2903	Bone
	25,540 ± 300	SOAN-3355	Bone
	24,625 ± 190	SOAN-3031	Bone
Kurtak 4, layer 11	24,890 ± 670	LE-3357	Bone
	24,800 ± 400	GIN-5560	Charcoal
	24,170 ± 230	LE-3351	Charcoal
	24,000 ± 2950	LE-4156	Bone
	23,800 ± 900	LE-4155	Charcoal
	23,470 ± 200	LE-2833a	Charcoal
Ui 1, layer 2	22,830 ± 530	LE-4189	Charcoal
	19,280 ± 200	LE-4257	Bone
	17,520 ± 130	LE-3359	Bone
	16,760 ± 120	LE-3358	Bone
Novoselovo 13, layer 3	22,000 ± 700	LE-3739	Charcoal
Mal'ta, layer 8	21,700 ± 160	OxA-6191	Bone
	21,600 ± 170	GIN-8475	Bone
	21,600 ± 200	GIN-7708	Bone
	21,340 ± 240	OxA-6193	Bone
	21,300 ± 110	GIN-7702	Bone
	21,300 ± 300	GIN-7704	Bone
	21,100 ± 150	GIN-7703	Bone
	21,000 ± 140	GIN-7706	Bone
	20,900 ± 200	GIN-4367	Bone
	20,800 ± 140	GIN-7710	Bone
	20,700 ± 150	GIN-7709	Bone
	20,340 ± 320	OxA-6192	Bone
	19,900 ± 800	GIN-7705	Bone

cores hinders a conclusion about a possible pre-35,000 BP appearance of microblade technology in the Denisova Cave assemblages. Layer 9 of the main chamber so far does not have any ^{14}C dates. Furthermore, the age of layer 7 in the entrance area remains uncertain. Generally, the stratigraphic correlation of the different parts of Denisova Cave is to some extent problematic, and at the present state of research they cannot be directly correlated.

A flat-faced core for chipping off microblades was found in the early Upper Palaeolithic assemblage of layer 6 at the Kara-Bom site, central Altai Mountains (Derevianko and Shunkov 2004:29). Initially, it was identified as a scraper (Derevianko *et al.* 1998a:58). The ^{14}C date of layer 6 at Kara-Bom is c. 43,200 ± 1500 BP (GX–17597) (Goebel *et al.* 1993). Generally, the origin of microblade technology in Northern Asia is closely connected with the appearance of flat-faced

Table 8.1 (continued)

Region, site, and layer	^{14}C date, BP	Lab Code and No.	Material dated
Siberia			
Buret	21,190 ± 100	SOAN-1680	Bone
Krasny Yar, layer 6	19,100 ± 100	GIN-5330	Bone
Ust-Ul'ma 1, layer 2b	19,350 ± 65	SOAN-2619	Charcoal
Ogonki 5, layers 2B-3	19,440 ± 140	Beta-117987	Charcoal
	19,380 ± 190	Beta-115986	Charcoal
	19,320 ± 145	AA-20864	Charcoal
	18,920 ± 150	AA-25434	Charcoal
	17,860 ± 120	AA-23137	Charcoal
Ikhine 2	20,080 ± 150	SOAN-3185	Bone
	19,695 ± 100	SOAN-3186	Bone
Verkhne-Troitskaya, layer 6	18,300 ± 180	LE-905	Wood
China			
Chaisi	25,650 ± 590	ZK-0635	Shell
Xiachuan, layer 2	23,220 ± 1000	ZK-0417	Charcoal
	21,700 ± 1000	ZK-0384	Charcoal
	20,700 ± 600	ZK-0393	Charcoal
	18,560 ± 480	ZK-0497	Peat
	18,375 ± 480	ZK-0494	Silt
	15,940 ± 900	ZK-0385	Charcoal
Japan			
Kashiwadai 1, layer 4	20,790 ± 160	Beta-126175	Charcoal
	20,700 ± 150	Beta-126176	Charcoal
	20,610 ± 160	Beta-126184	Charcoal
	20,370 ± 70	Beta-120883	Charcoal
	20,130 ± 150	Beta-126170	Charcoal
	19,840 ± 70	Beta-120881	Charcoal
Korea			
Janghungri, layer 1	24,400 ± 600	SNU00-381	Charcoal
	24,200 ± 600	SNU00-380	Charcoal
Hopyung, layer 1	22,200 ± 600	SNU02-327	Charcoal
	17,500 ± 200	SNU02-325	Charcoal
	17,400 ± 400	SNU02-326	Charcoal
	16,900 ± 500	SNU02-324	Charcoal

(*tortsovyi*) cores in the early Upper Palaeolithic assemblages (e.g., Derevianko 2001).

Very early animal bone ^{14}C dates were obtained in another area of Siberia, the southern Transbaikal, from the Kamenka site, complex B (Figures 8.1 and 8.3), in direct association with microblades and microcores, from c. 28,800 BP to c. 24,600 BP (Table 8.1) (Lbova 2002). After this time, the earliest microblade sites in Transbaikal are Studenoe 2, layer 4/5, with associated charcoal ^{14}C dates from hearths of 17,225 ± 115 BP (AA–23655) and 17,885 ± 120 BP (AA–23653) (Goebel *et al.* 2000), and Ust-Menza 2, layer 21, with charcoal dates from hearths of 17,600 ± 250 BP (GIN–5464) and 17,190 ± 120 BP (GIN–5464A) (Konstantinov 1994).

In other regions of Siberia (Figures 8.1 and 8.4), the earliest ^{14}C-dated sites associated with microblade technology are:

1) in the Upper Yenisei River basin: a) Kurtak 4, layer 11, with a range from c. 24,900 BP to c. 23,500 BP; b) Ui 1, layer 2, from c. 22,800 BP to c. 16,800 BP; c) Novoselovo 13, layer 3, c. 22,000 BP (Table 8.1); and d) Kashtanka 1, lay-

er 2, 21,800 ± 200 BP (IGAN–1049) and 20,800 ± 600 BP (GIN–6968) (Vasil'ev *et al.* 2002);

2) in the Angara River basin: a) the main component of the Mal'ta site (layer 8), from c. 21,700 BP to c. 19,900 BP ; b) Buret, c. 21,190 BP (Table 8.1, Figure 8.4); and c) Krasny Yar, layer 6, c. 19,100 BP (Table 8.1, Figure 8.5) (Medvedev *et al.* 1996; Hedges *et al.* 1998);

3) in the Russian Far East: a) Ust-Ul'ma 1, layer 2b, c. 19,400 BP, and b) Ogonki 5, layers 2b and 3, from c. 19,400 BP to c. 17,900 BP (Table 8.1) (Derevianko 1996; Vasilevski 2003).

It should be noted that microblade complexes and typical Upper Palaeolithic blade complexes in Siberia coexisted for a long time, until c. 15,000 BP, when microblades and wedge-shaped cores replaced the blade complexes (e.g., Vasil'ev 2001; Zenin 2002).

In Yakutia, the earliest unequivocal ^{14}C dates, associated with the microblade complex of the Dyuktai culture, range in age from c. 24,600 BP (Kuzmin and Orlova 1998) to c. 18,000 BP (Vasil'ev 2001) according to different opinions [for a discussion, see Kuzmin and Orlova (1998:35–37); Vasil'ev *et al.* (2002:508–510)]. Mochanov and Fedoseeva (1996), however, argue for a much earlier age of the Dyuktai complex, that is, c. 35,000–30,000 BP [(for a different opinion, see, for example, Yi and Clark (1985)]. Perhaps the most reliable age estimates for one of the earliest Dyuktai sites, Ikhine 2, may be derived from bone ^{14}C dates, c. 20,100–19,700 BP (Kuzmin and Orlova 1998; Vasil'ev *et al.* 2002; see Table 8.1, Figure 8.5), rather than from possibly 'old' driftwood ^{14}C values of c. 30,200–24,300 BP (see Mochanov and Fedoseeva 1996). In this case, the earliest microblades in Yakutia may now be securely dated from c. 20,100 BP (Ikhine 2) to c. 18,300 BP (Verkhne-Troitskaya, layer 6) (Table 8.1, Figure 8.5).

Thus, it is clear that microblade technology appeared in Siberia long before the Last Glacial Maximum (LGM). At the LGM, c. 20,000–18,000 BP, microblade and non-microblade complexes were contemporaneous in Siberia. Microblade sites are known in several regions – the West Siberian Plain, the Upper Yenisei River basin, the Upper Angara River basin, central Yakutia, southern Transbaikal, the Middle Amur River basin, and Sakhalin Island. Along with the microblade

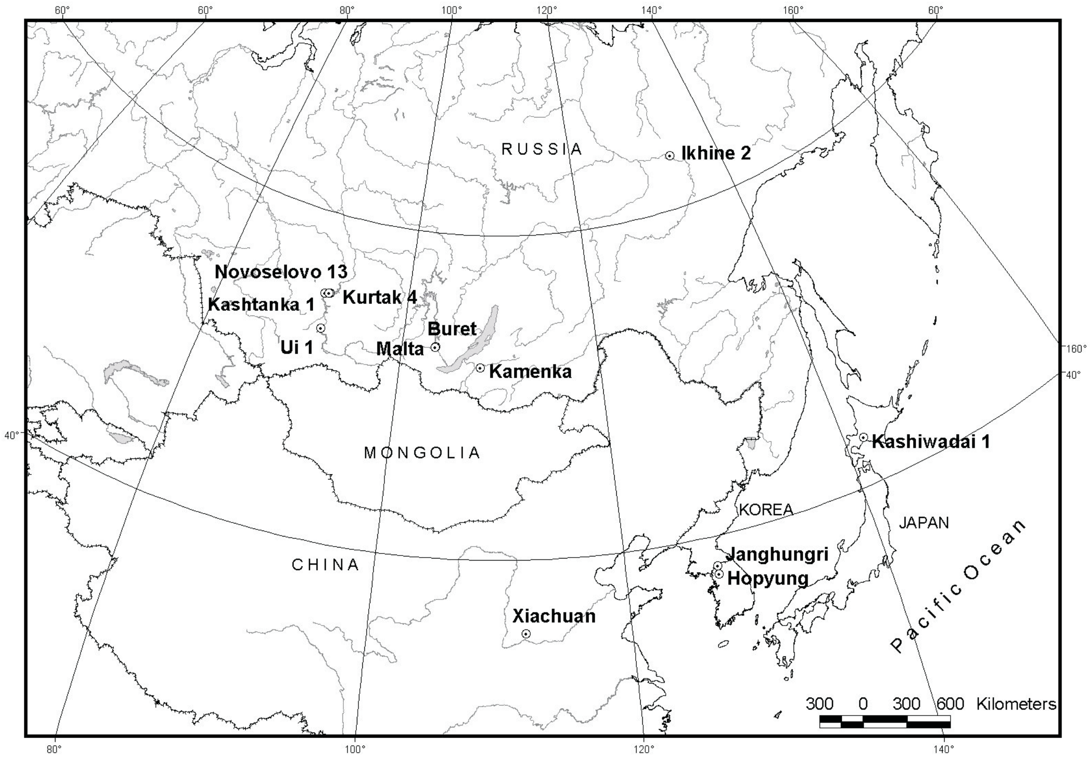

Figure 8.4: **Microblade complexes in Northern Asia, c. 25,000-20,000 BP.**

complexes, sites without microblades have also been identified in different parts of Siberia – the West Siberian Plain (Tomsk and Shestakovo, with charcoal ^{14}C dates) and perhaps the Upper Yenisei River basin (Shlenka and Tarachikha, with mammoth bone ^{14}C dates). Their tool assemblages are dominated by blade and flake industries including small blades (bladelets); these are, however, different from microblades (Zenin 2002).

PALAEOENVIRONMENT OF THE EARLIEST MICROBLADE COMPLEXES

Palaeoenvironmental reconstructions for the earliest microblade sites can be made from records of Siberian Late Pleistocene climates and vegetation (e.g., Kind 1974; Krasnov 1984; Velichko 1993, 2002; see also reviews in Chlachula 2001a, 2001b, 2001c). According to palynological data, at c. 35,000–27,000 BP, the Altai Mountains featured a phytogeographic zone of primarily conifer forests (Derevianko *et al.* 2003:271), with forest steppes and steppes in the Altai Mountain piedmonts (Orlova *et al.* 1998). The environmental reconstruction for layers 11–9 of the Ust-Karakol 1 site is also based on small mammal remains (Agadjanian 2003). It shows that forest and meadow formations existed here at c. 35,000–29,700 BP. Climate at that time was relatively cool and wet compared to the modern one (Derevianko *et al.* 2003). In southern Transbaikal, at c. 28,800–24,600 BP, forest steppe formations dominated the area near the Kamenka site (Lbova *et al.* 2003:184–185). In general, the vegetation of southern Siberia, including Transbaikal and Altai, in the second part of the Karginian Interstadial (c. 35,000–25,000 BP) was represented mainly by forest type formations with a prevalence of conifers (e.g., Tseitlin *et al.* 1984; Belova 1985; Arkhipov and Volkova 1994).

Most of the earliest microblade sites in Siberia correspond to the Sartan Glaciation in a broader sense, c. 24,000–18,000 BP. Gradual cooling caused the diminution of forest formations in Siberia from c. 24,000–22,000 BP. The main vegetation types in central and southern Siberia at the LGM, c. 20,000–18,000 BP, were periglacial steppe and forest steppe (i.e., steppe-type formations with cold-resistant species, such as wormwood and chenopods, and with an admixture of conifers, mainly larch and pine, and some birch); open birch-larch forests; and tundra and forest tundra (Grichuk 1984, 2002:79–89; Tarasov *et al.* 1999, 2000). In the southern Russian Far East, open birch-larch forest with tundra and forest tundra occurred in the higher elevations, with patches of dark-coniferous forest in refugia. Underground permafrost covered most of the northern Asian territory, including all of Siberia and the Russian Far East, northeastern China, and Hokkaido Island, Japan (Velichko 1993).

The concept of a depopulation of Siberia at the LGM was proposed by Goebel (1999, 2002; Goebel *et al.* 2000); a similar view was also expressed by Dolukhanov *et al.* (2002:603). This idea was originally put forward in the 1970s by S. M. Tseitlin (1979). Our data (see Vasil'ev *et al.* 2002; Kuzmin and Keates 2004, 2005) does not confirm a significant decrease in population in Siberia at the LGM, as can be determined by the number of known sites. At least 14 well-dated Upper Palaeolithic sites existed during the LGM in southern and central Siberia, and in the Russian Far East (Figure 8.5). The surface finds of mammoths at the Shlenka and Tarachikha sites, dated to c. 20,100–18,600 BP (Vasil'ev *et al.* 2002:525), and human-modified bison bone at the Tesa site dated to c. 20,000 BP (Belousov *et al.* 2002), also testify in favour of occupation at the LGM. Thus, the model of a "recolonization" of Siberia after c. 18,000 BP by external human populations that had developed microblade technology somewhere south of Siberia at an earlier time (Goebel 2002:122–123) cannot be supported.

CHRONOLOGY AND ENVIRONMENT OF THE EARLIEST MICROBLADE COMPLEXES IN NEIGHBOURING REGIONS OF NORTHERN AND CENTRAL ASIA

Northern China and Mongolia

In northern China, the earliest microblade industries (with "microliths") were found at the Chaisi and Xiachuan sites in the Loess Plateau region (Figures 8.1, 8.3, and 8.4). The ^{14}C dates (given for 5568 years half-life; see Table 8.1) possibly associated with microblade assemblages are c. 25,700 BP for Chaisi (Huang and Hou 1998), and from c. 23,220 BP to c. 15,900 BP for Xiachuan, with the majority of dates within c. 23,200–17,900 BP (Tang 2000).

Tang (2000) roughly dates the Xiachuan site at c. 20,000 BP. The Chaisi ^{14}C value, obtained on shell, could be up to 1000–2000 years too "old", due to a combination of reservoir and hard-water effects (e.g., Taylor 1987). In this case, it is more secure to consider the Xiachuan ^{14}C dates, run mostly on charcoal, as the most reliable age estimate of the earliest microblade technology in northern China.

Environmental conditions in northern China slowly deteriorated beginning at c. 30,000 BP – broadleaf formations decreased, conifers expanded, and the area with underground permafrost increased (e.g., Cui and Xie 1985; Liu 1988). From c. 23,000 BP, climatic cooling accelerated. At the LGM, c. 20,000–18,000 BP, permafrost covered all of the northeastern part of China, southward to 40^0N latitude (Cui and Xie 1985; Cui and Song 1991). The LGM vegetation was represented by tundra north of 45^0N, and by forest tundra and open spruce-fir forests south of 45^0N, with large areas occupied by grass formations (Cui and Xie 1985; Liu 1988; Winkler and Wang 1993).

Data about the age and environment of the earliest microblade assemblages in Mongolia are still scanty. Recently, a microcore and several microblades were identified at the Chikhen Agui site in the Gobi Altai Mountains (Derevianko *et al.* 2001, 2004:217–220). The ^{14}C date associated with this stone artifact complex is 27,430 ± 870 BP (AA–26580).

THE JAPANESE ISLANDS

Recent extensive ^{14}C dating of the microblade complexes in Japan, particularly on Hokkaido Island (Figures 8.1 and 8.4), allows us to establish the age of the earliest microblade sites as c. 20,500 BP (Ono *et al.* 2002). This is the mean value of six individual ^{14}C determinations of layer 4 of the Kashiwadai 1 site, ranging from c. 20,800 BP to c. 19,800 BP (Table 8.1). On Honshu, Kyushu, and Shikoku islands, microblade industries appeared at c. 15,500–13,000 BP (Ono *et al.* 2002; see Sato and Tsutsumi, this volume; Sano, this volume).

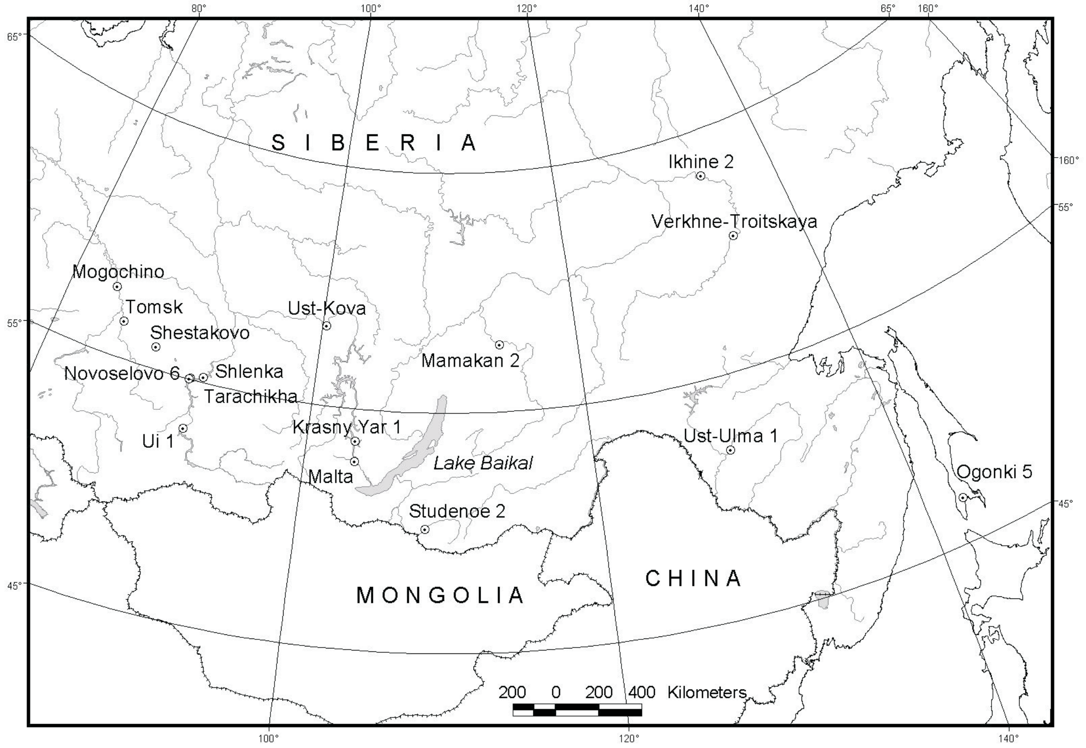

Figure 8.5: **The Upper Palaeolithic sites in Siberia during the Last Glacial Maximum, c. 20,000-18,000 BP.**

The appearance of microblades on Hokkaido thus coincides with the LGM. At this time, a land-bridge connected Hokkaido with Sakhalin Island and mainland Northern Asia, and the width of the Tsugaru Strait, which separates Hokkaido and Honshu, was probably less than 5 km wide (e.g., Tsukada 1985; Kuzmin 1997). Detailed palaeoenvironmental reconstruction for the LGM in Japan (Tsukada 1983, 1985) shows that the eastern part of Hokkaido, affected by the cold water mass of the Sea of Okhotsk, was covered mainly with tundra and forest tundra. Similar vegetation surrounded the earliest microblade site of Ogonki 5 on neighbouring Sakhalin Island (Kuzmin *et al.* 1998). In western Hokkaido, there were boreal conifer forests with a dominance of spruce and fir (Tsukada 1983, 1985).

THE KOREAN PENINSULA

In Korea, recent progress with typological studies and ^{14}C dating of the microblade complexes found there (Seong 1998; Choi 2001; Hong *et al.* 2002; Bae and Kim 2003; Kim *et al.* 2004) makes it possible to establish the first appearance of microblade technology at c. 24,000 BP (but see Seong, this volume). The earliest microblade-associated sites are known from the central part of the Korean Peninsula, northeast of the city of Seoul (Figures 8.1 and 8.4). At the Jangheung-ri site, two ^{14}C dates were obtained, c. 24,400 BP and c. 24,200 BP, and at the Hopyeong site, ^{14}C dates from layer 1 range from c. 22,200 BP to c. 16,900 BP (Choi 2001; Hong *et al.* 2002; see Table 8.1). It is worth highlighting that both of these sites include a high percentage of obsidian tools and flakes in the assemblages. At the Janghungri site, for example, the total frequency of obsidian artifacts is 26.5%. The proportion of obsidian material among some of the artifacts is as follows: 80% of microblade cores, 91% of microblades, 60% of arrowheads, and 48% of flakes (Choi 2001:172). It is now obvious that the earliest microblades in Korea are associated with the wide use of obsidian as a raw material, perhaps due to the very suitable quality of obsidian for manufacturing tools with a sharp edge. Other important sites with quite early microblades in Korea are Sokchangni, layer 12 (dated to 20,830 ± 1880 BP; AERIK–8) and Suyanggae (dated to 18,630 BP; UCR–2078) (Bae and Kim 2003).

Environmental data for the second part of the Late Pleistocene in Korea are still insufficient for a detailed reconstruction of the vegetation. If we assume that the vegetation was similar to adjacent northeastern China (e.g., Liu 1988; Winkler and Wang 1993), it is possible to say that during the c. 24,000–20,000 BP time period conifer-broadleaved formations dominated in Korea. During the LGM, the territory north of 38–40^{0}N was covered with predominantly conifer forests, and south of 38–40^{o}N conifer-broadleaved vegetation prevailed (Reynolds and Kaner 1990). At the Suyanggae site, wood macrofossils of pine and spruce species were identified (Park *et al.* 2003). Open spaces, occupied by grass formations, were an important part of the LGM landscapes in Korea, as well as in neighbouring northeastern China (Winkler and Wang 1993).

CONCLUSION

Using the current geoarchaeological data on the oldest microblade complexes in Northern Asia, it is possible to conclude that the earliest evidence of microblade technology is now known for the Altai Mountains region of southern Siberia, dated to c. 35,000 BP, and which existed in quite favourable environmental conditions (conifer forests). Microblade technology subsequently appeared in another area of southern Siberia, the Transbaikal, at c. 28,800 BP in a forest steppe environment. At the same time, blade and flake assemblages continued to be made in Siberia, especially on the West Siberian Plain. The first appearance of microblade technology in Western Siberia is known at c. 15,000 BP.

By about 25,000–20,000 BP, microblade complex sites had appeared across all of Northern Asia, including Korea (c. 24,400 BP) and the Yenisei River basin (c. 24,900 BP). This time period is characterized by the deteriorating climatic conditions at the beginning of the last glaciation. Microblade sites are known from the time of the height of the last glaciation in Japan (c. 20,500 BP), Yakutia (c. 20,100–18,300 BP), and the Russian Far East (c. 19,400 BP). In northern China, the most reliable age estimate of the earliest microblade sites is c. 23,200 BP.

It appears that environmental conditions were not the only factor which may have caused the emergence of microblade technology in Northern Asia. The origin and spread of this new technology over vast territories with different terrains, climates, vegetation, and animals, was a long-term process rather than a sudden appearance just before or during the LGM. Microblade manufacture started in southern Siberia at c. 35,000 BP, and expanded continent-wide at about 25,000–20,000 BP (Figures 8.4 and 8.6). Perhaps environmental conditions were partly responsible for the process of the wide distribution of microblades in Northern Asia after c. 25,000 BP through the mechanism of the diversification of human adaptive strategies under deteriorating climatic conditions. However, more effort is needed to study this process in detail.

At the LGM, microblade complexes were already in place across Northern Asia. Climatic deterioration did not cause a depopulation of the southern part of Siberia and the Russian Far East. Some populations with microblade technology continued to live in the dry and cold environment in different places, including central Yakutia, which featured a very cold continental-type climate. The degree of human adaptation at the time of the LGM was high enough for people to cope with the harsh Siberian environment.

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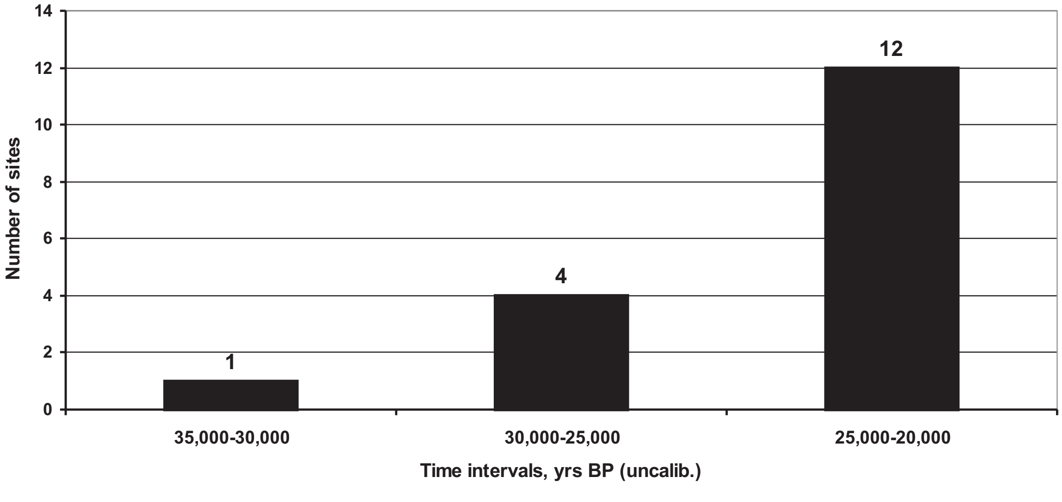

Figure 8.6: **Histogram showing the number of ^{14}C-dated microblade sites in Northern Asia for c. 35,000-20,000 BP.**

9

MICROBLADE TECHNOLOGY IN SIBERIA AND NEIGHBOURING REGIONS: AN OVERVIEW

Susan G. Keates

INTRODUCTION

One of the purposes of this paper is to present the evidence for the earliest microblade assemblages from Siberia. The Siberian evidence for this technology has emerged in the last decade or so and is not well known outside of Russia. The place of origin of microblade technology is still being debated and is placed in various parts of northern or eastern Asia, with most opinions favouring either China (e.g., Jia *et al.* 1972; Gai 1985) or Siberia (e.g., Teilhard and Pei 1944; Derevianko 2001). It is also pertinent to provide definitions of microblade cores and microblades. A microblade is defined as “A type of flake whose length is greater than twice its width and whose width is less than 1.2 cm.”, while microblade cores have a single striking platform and from this a series of small flakes are detached (Akazawa *et al.* 1980:74). Microliths are defined as “a group of stone tool industries based on the production of microblades from special cores that appears at around 18,000 BP and covers an area stretching from the Near East across Central Asia through China, Japan and into North America.” (Sinclair 1996:553). According to another definition, microlithic technology is Mode V technology, and in Africa associated with the Later Stone Age. This technology produced geometric microliths (triangles, crescents, and other shapes) and formed part of composite tools [in the European Mesolithic] (Toth and Schick 1988). Microblades in Siberia were produced from a variety of small cores, including wedge-shaped and conical cores. Microcores also include those on which microblades were detached from the butt, known as *tortsovyi* cores (Abramova 1979). Apart from the “classic” microblades, in Siberia, microblades also include “small flake-blades” (with length more than twice the width); these have a curved shape and non-parallel dorsal arris (S.A. Vasil'ev personal communication 2005). In China, microliths are very small sized cores, microblades and microblade tools (An 1978 in Gai 1985:227). A microlithic industry is characterised by microcores (such as wedge-shaped, conical, and cylindrical types), microblades (c. 2 mm thick), and also scrapers and points, the latter including “projectile points.” “Typical microblades” are distinguished by parallel sides, 20–60 mm length and a width of up to 10 mm (Gai 1985:227).

The sites described in this paper belong to the earliest microblade production sites. The evidence for this is presented with information on the stratigraphic and chronological contexts and on the archaeological materials found associated with microblades and/or microblade cores.

SIBERIA AND THE RUSSIAN FAR EAST

The Gorny Altai

The Gorny (Mountainous) Altai sites are located in southern Siberia (Russia). In this region, where Mousterian and Upper Palaeolithic industries coexisted (e.g., Derevianko 2001; Derevianko and Rybin 2003), a gradual transition from the Middle Palaeolithic to the Upper Palaeolithic has been identified (e.g., Derevianko *et al.* 2003; Derevianko and Shunkov 2004). Two open-air

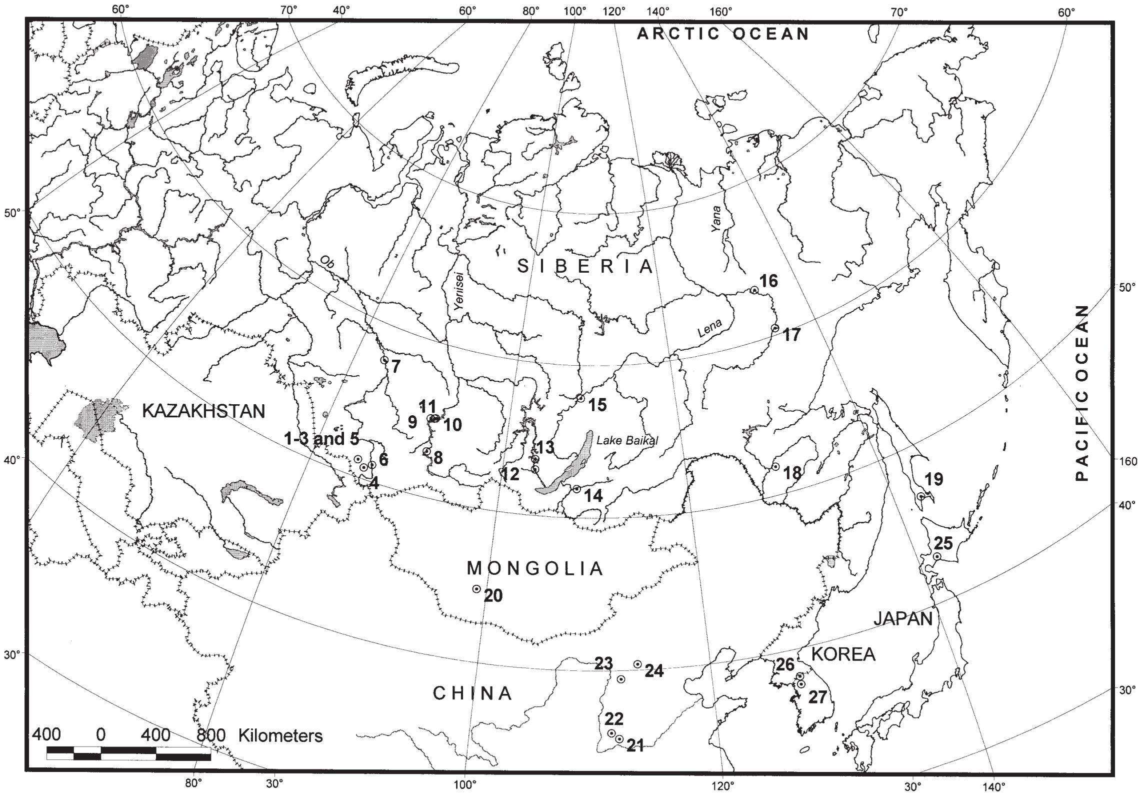

Figure 9.1: Russian, Mongolian, Chinese, Korean, and Japanese sites mentioned in the text. 1. Ust-Karakol 1; 2. Anui 2; 3. Denisova Cave; 4. Kara-Bom; 5. Anui 3; 6. Kara-Tenesh; 7. Mogochino I; 8. Ui 1; 9. Novoselovo 13; 10. Kurtak 4; 11. Kashtanka 1; 12. Mal'ta; 13. Krasny Yar; 14. Kamenka B; 15. Alekseevsk 1; 16. Ikhine 2; 17. Verkhne-Troitskaya; 18. Ust-Ul'ma 1; 19. Ogonki 5; 20. Chikhen Agui; 21. Xiachuan; 22. Dingcun locality 77:01; 23. Shiyu; 24. Xujiayao; 25. Kashiwadai I; 26. Janghungri; 27. Hopyung.

sites in the Altai, Ust-Karakol 1 and Anui 2, and one cave site, Denisova, have yielded evidence of incipient, at Ust-Karakol 1 and Denisova, or true microblade, at Anui 2, technology. These sites constitute some of the most significant sites in the Palaeolithic of the Altai, in terms of the large quantity of archaeological discoveries made there, including fauna and plant remains, and their chronological sequences (see Derevianko *et al.* 2003). Denisova Cave, discovered in 1977, and a large site still under excavation, is one of the best known Palaeolithic sites in the Altai.

Ust-Karakol 1

The earliest evidence of microlithic technology in the Altai has been recorded at Ust-Karakol 1 in stratum 11 (Derevianko 2001; Figure 9.1). Discovered in 1984, this site is located on the slope of a terrace, with the excavation trench nine metres above the Karakol River (Derev'anko and Markin 1998:97). This partially excavated site is situated close to the Anui River on a slope of the Karakol River valley (personal observation 2002). The archaeological deposit is about 6.5 m thick containing 20 layers (e.g., Derevianko 2001). The strata 11 and 10 (A, B, C) sediments are loam, and stratum 9 (A, B, C) contains sandy loessic loams and palaeosols; the thickness of layers is approximately 0.5 m for stratum 11; 0.2–0.3 m for stratum 10; and 0.6 m for stratum 9 (Derevianko *et al.* 2003:242–244). The fauna from strata 7–12 (individual frequencies for strata are not given) comprises *Equus przewalskii* (Przewalskii's horse), *Bison priscus* (bison), *Capra sibirica* (Siberian goat), and *Ovis* *ammon* (mountain sheep) (Derevianko *et al.* 2003:253, Table 57). Stratum 11 is undated (Derevianko 2001), and the upper part of stratum 10, directly bordering on stratum 9 C, is radiocarbon dated to 35,100±2850 BP (SOAN–3259) (Derevianko *et al.* 1998b; Derevianko 2001). Stratum 9 C (stratigraphically below 9 A and 9 B) has four ^{14}C dates ranging from 33,400±1285 BP (SOAN–3257) to 29,720±360 BP (SOAN–3359) (Derevianko *et al.* 1998b*,* 2005; and see Kuzmin, this volume).

Early Upper Palaeolithic artifacts have been identified *in situ* in strata 11 to 8, and these include some Levallois artifacts (Derevianko and Shunkov 2004:26, Fig. 20.4). The Initial Upper Palaeolithic at Ust-Karakol 1 occurs in layers 11–9 and derives from Levallois technology (Derevianko 2001; Derevianko *et al.* 2003). The assemblages include Levallois cores and blades as well as flakes and debitage. Most of the artifacts were manufactured in local raw materials, mainly igneous and sedimentary rocks, including sandstone (Postnov *et al.* 2000).

The lithic artifacts in stratum 11 (with a total of 385 specimens), comprise cores (n. 11), amorphous core-like specimens (n. 3), a broken pebble [worked?], flakes (n. 68), blades (n. 43), fragments and spalls (n. 200), and tools (n. 59, including, among others, retouched flakes and blades, scrapers, borers, and points) (Derevianko *et al.* 2003). Derevianko (2001:82) mentions that the microblade specimens from Ust-Karakol 1 include wedge-shaped and conical cores, carinated end scrapers with microblade removals, and “classical microblades.” Seventeen microblades (Derevianko *et al.* 1998b; Derevianko 2001; Derevianko *et al.* 2003) and a wedge-shaped microblade core (see Derevianko *et al.* 2003: Fig. 153.1; Derevianko 2001, Plate 2) were identified. A more recent source refers to small conical and wedge-shaped microblade cores and microblades (Derevianko and Shunkov 2004:26, Fig. 20.4; see also Derevianko and Volkov 2004). The cores include eight monofrontal single platform cores (Derevianko *et al.* 2003, Fig. 153, 1 and 3), two circumfrontal double platform cores and one bifrontal core (Derevianko *et al.* 2003, Fig. 154, 1 and 2). The microblade cores are wedge-shaped and pyramidal (Derevianko and Shunkov 2004, Fig. 20, 1–4;). A carinated end scraper shows three scars of microblade dimensions, and another carinated endscraper has a cruder appearance (Derevianko and Shunkov 2004, Fig. 21, 12 and 8, respectively). Two monofrontal cores with one striking platform were used to manufacture microblades (Derevianko *et al.* 2003, Fig. 158, 1 and 3; Figure 9.2: 1 and 2). It has been suggested that microblade technology in the Altai, including the Ust-Karakol 1 site, developed from the “… repetitive detachment of elongated blanks from prismatic, conical, and narrow-face cores, including wedge-shaped varieties.” (Derevianko and Shunkov 2004:38; see also Derevianko and Volkov 2004).

The stratum 10 assemblage with a total of 679 lithic artifacts [(Derevianko *et al.* 1998b); total n. 677 according to Derevianko (2001) and Derevianko *et al.* (2003)], comprises cores (n. 6), broken pebbles (n. 9 [worked?]), flakes (n. 116), blades (n. 64), fragments and spalls (n. 378), tools for chipping stone (n. 3 [presumably hammerstones]), and tools (n. 101 or 15.4%, including, among others, 26 retouched flakes, 11 retouched blades, 10 skreblos, seven scrapers, nine burins, and five borers. (Note: Skreblo is the Russian term for large side scrapers.) The cores include a single platform monofrontal type (Derevianko *et al.* 2003, Fig. 155, 4–5) and 16 microblades were found (Derevianko *et al.* 2003, Fig. 157, 4–10; Figure 9.3:1–6). Both of the monofrontal cores have flake scars, and one of these has a flat striking platform (see Derevianko *et al.* 2003, Fig. 155, 5), and neither of these is a microblade or microblade-like core. Apart from prismatic blade cores, a similar proportion of microblade cores have also been identified (Derevianko *et al.* 1998b). Seven microblades from stratum 10 are illustrated (Derevianko *et al.* 2003, Fig. 157, 4–10). Of the four specimens described as backed microblades (Derevianko *et al.* 2003), two (Derevianko and Shunkov 2004, Fig. 21, 1 and 2) have the appearance of flakes. Zenin (2002:41) refers to micro-tools, i.e., micro-points, borers, and backed blades.

In stratum 9 (total of 1099 lithic artifacts), microblade cores and microblades have been recognised (Derevianko *et al.* 1998b, 2003). The stratum 9 artifacts comprise mostly fragments

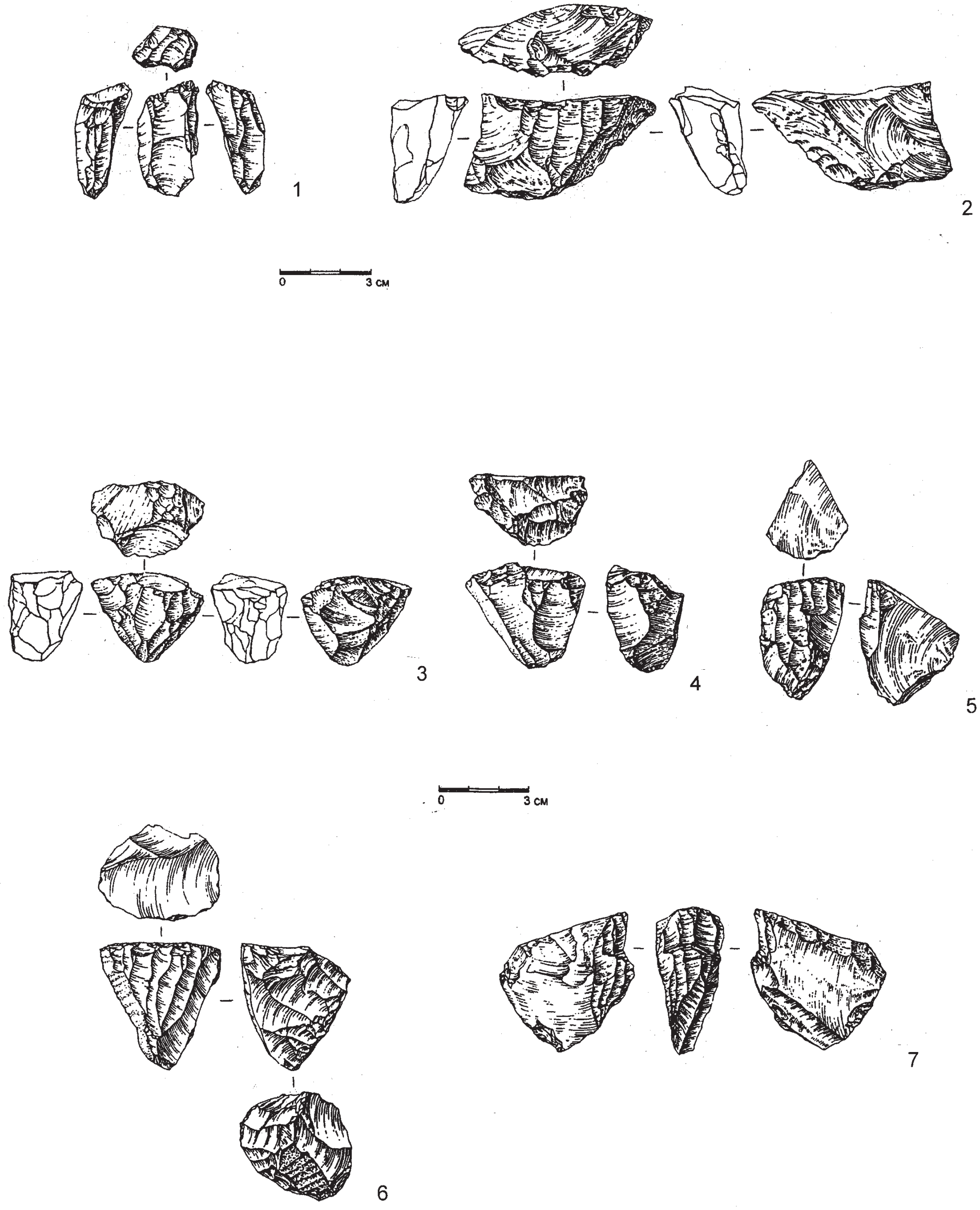

Figure 9.2: Cores from Ust-Karakol 1.
1 and 2. Monofrontal cores with one striking platform, stratum 11; 3 and 6. Conical shaped cores, stratum 9; 4, 5, and 7. Wedge-shaped cores, stratum 9 (after Derevianko *et al.* 2003, Fig. 158).

and spalls (n. 464) and flakes (n. 229). Other artifacts are cores, blades, tools, and hammerstones; tools include borers, skreblos, scrapers, and burins (Derevianko *et al.* 2003). Two conical shaped cores (Figure 9.2: 3 and 6) and three wedge-shaped cores (Figure 9.2: 4, 5, and 7) were found in stratum 9 [(Derevianko *et al.* 2003, Fig. 158, 4 and 3 (conical cores); and Fig. 158, 2, 1, and 6 (wedge-shaped cores)] as well as 29 microblades (Derevianko *et al.* 2003).

Denisova Cave

The Denisova Cave site is located about 3 km away from Ust-Karakol 1 (Figure 9.1). In the main chamber, the Pleistocene sequence contains 13 cultural layers, beginning with layer 22 as the basal layer. The Denisova cave fauna is quite fragmentary and includes *Equus* sp. (horse), *Bison priscus*, *Poephagus mutus* (yak), *Cervus elaphus* (red deer), *Capra sibirica*, and *Ovis ammon* as well as carnivores (Derevianko *et al.* 2003:188). In stratum 11, approximately 1.50 m thick (see Derevianko 2001, Plate 1), the total number of lithic artifacts is 2611. There are also 50 bone tools and five flint ornaments (Derevianko 2001; Derevianko and Shunkov 2004). The lithic artifacts comprise Mousterian, Levallois and, most frequently, Upper Palaeolithic tools; the latter

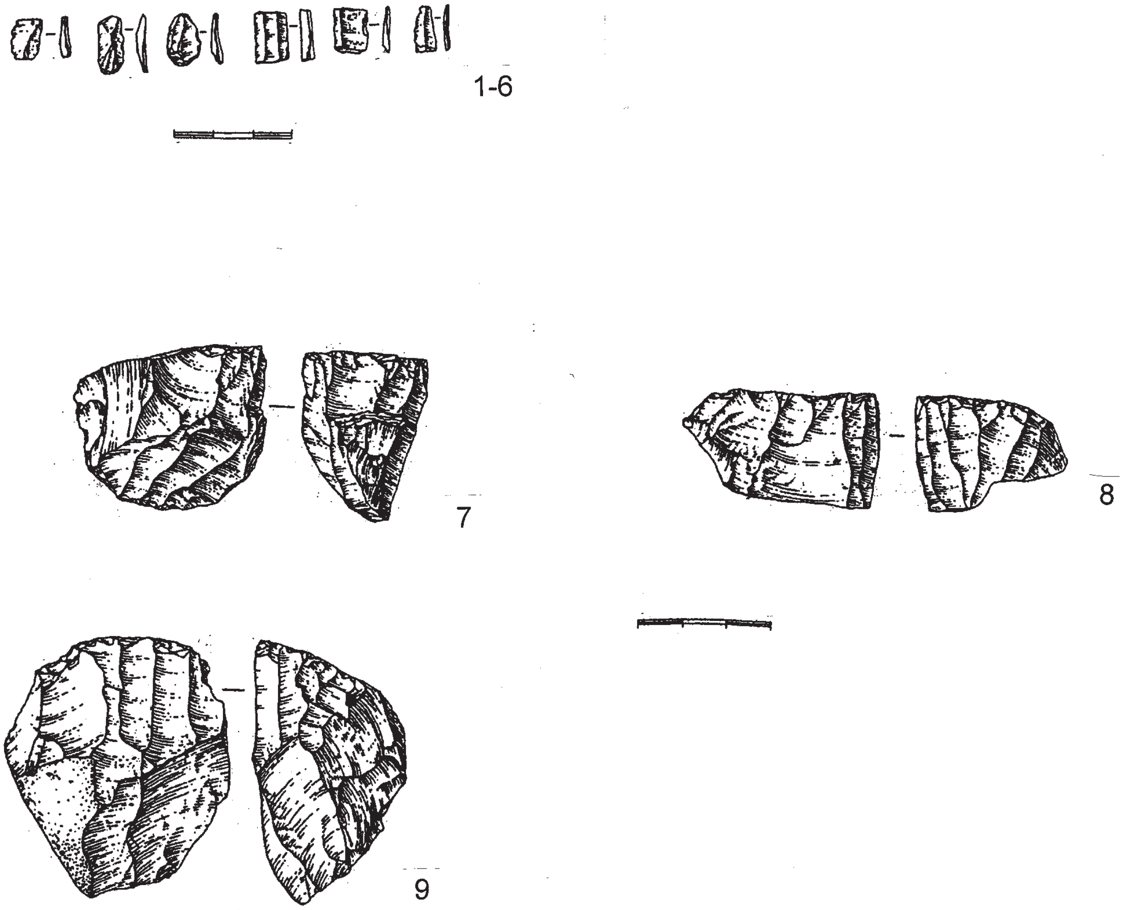

Figure 9.3: Microblades from Ust-Karakol 1 and cores from Anui 2.
1-6. Microblades from Ust-Karakol 1, stratum 10 (after Derevianko *et al.* 2003, Fig. 157); 7. Wedge-shaped core from Anui 2, horizon 8; 8. Prismatic core from Anui 2, horizon 9; 9. Prismatic core from Anui 2, horizon 8 (after Derevianko *et al.* 2003, Fig. 178). Scale represents 3 cm.

include backed blades, *grattoirs*, burins, borers, and foliate bifaces. Fifteen microblades, including backed specimens, were identified (Derevianko *et al.* 2003:132). The stratum 11 assemblage from the main chamber is classified as the initial Upper Palaeolithic or early Upper Palaeolithic (Derevianko 2001), and ^{14}C dated to > 37,235 BP (SOAN–2504; Orlova 1995). Derevianko and Volkov (2004) mention microblades from layer 12 of Denisova Cave, though without illustrations, and that wedge-shaped cores, besides narrow-faced cores, are the most numerous cores beginning in layer 11.

A larger number of microblades (all or some of which are backed) were found in the relatively thick stratum 9 (see Derevianko 2001, Plate 1). This is a late Upper Palaeolithic assemblage (Derevianko *et al.* 2003). Horizons B and C of stratum 9 yielded 49 lithic artifacts including 10 microblades (Derev'anko and Markin 1998:93). In horizon D, 417 lithic artifacts were recorded, including six backed bladelets (Derev'anko and Markin 1998:93). One prismatic core for the manufacture of microblades and 67 microblades, including backed specimens, were identified (Derevianko *et al.* 2003:132). Stratum 9 also includes a unique discovery in the Altai, that is, a geometric microlith (Derev'anko and Markin 1998:93; Derevianko *et al.* 2003:365). No dates are available for stratum 9.

In the terrace (or entrance) section of Denisova Cave, "Elements of microblade flaking" have been observed in stratum 7 (Derevianko *et al.* 2003:368). Levallois-Mousterian artifacts and ornaments also occur in this layer, which is assigned to the early Upper Palaeolithic (Derevianko *et al.* 2003:368). In stratum 7, a core of small dimensions has "negative scars of repeated microblade removals" and was manufactured on jasper; the source of this stone lies at about 30–50 km distance from the cave (Derevianko and Shunkov 2004, Fig. 17.6). Microblades were found in layer 6, which also yielded bone tools and flat beads (or rings) manufactured on ostrich eggshell. Radiometric dates are not available for layers 6 and 7 (Derevianko *et al.* 2003:368). The terrace section fauna includes *Equus ferus* (Pleistocene horse), *Bison* sp./*Poephagus* sp., *O. ammon*, and carnivores (Derevianko *et al.* 2003:197). The single radiocarbon date for the terrace section [the other dates are based on the radiothermoluminescence method (RTL)] is for stratum 9, with a date of 46,000 ± 2300 BP (GX–17602) (Goebel *et al.* 1993). According to palynological data, stratum 6 of the terrace corresponds to the lower part of stratum 9 of the main chamber, and stratum 7 is assumed to be of Karginian age, Oxygen Isotope Stage 3 (Derevianko *et al.* 2003:150–153, 155), with an estimated age of 40,000 to 30,000 years. In the southern gallery section of Denisova Cave, a flat-faced core derives from layer 11 (Figure 9.4) and two microblades were found in layer 9 (Derev'anko and Markin 1998, Figure on page 96, specimens 8: 1 and 2). Layer 11 in the southern gallery is radiocarbon dated to 29,200 ± 360 BP (AA–35321) (Derevianko *et al.* 2000a). The flat-faced core has similarities to a wedge-shape form; an illustration showing all sides of this specimen is clearly necessary for a more informed evaluation. Chen Shen, with reference to the published drawing, argues that the flat-faced core, although manufactured to a form similar to a wedge-shaped core, is different from the latter, with one important difference being that wedge-shaped cores have microblade detachments on the end only, not the sides (Chen Shen personal communication 2005). Nevertheless, cores like the flat-faced example from the Denisova Cave gallery could be

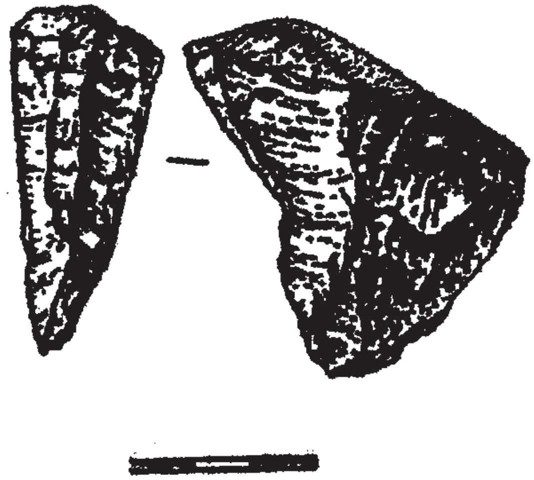

Figure 9.4: Core from Denisova Cave. Flat-faced core, southern gallery, layer 11 (after Derevianko *et al.* 2000a). Scale represents 3 cm.

representative of another, though rare, variety of wedge-shaped core.

Anui 2

The open-air deposit of Anui 2 (Figure 9.1) is situated below Denisova Cave and closer to the Anui River; it is 5–6 m above the Anui River level and has a terrace-like surface. The deposit consists mainly of colluvium; alluvial sediments are in the lower part. There are 15 lithological strata or layers and 12 archaeological horizons at the site; lithological strata 8–13 contain 12 archaeological horizons (Derevianko *et al.* 2003:311, 372). Lithological stratum 6 is 0.5 m thick loam with rock debris and scree; stratum 7 is 0.4 m thick loam with debris; stratum 8 is 0.4 m thick debris and scree with loams; stratum 9 is 0.2.–0.3 m thick loam; stratum 10 is 0.8 m thick debris and scree with loams; stratum 11 is 0.3–0.4 m thick loam; and stratum 12 is 0.3–0.4 m thick debris and scree with loams. The artifacts of Anui 2, horizons 6–12, belong to the middle Upper Palaeolithic (Derevianko *et al.* 2003:355–356). *Bison* sp. was found associated with the artifacts in layer 11, corresponding to horizons 6 and 7 (Derevianko *et al.* 2003:304). In the English translation, no mention is made of an archaeological horizon 7 (see Derevianko *et al.* 2003:372).

The assemblages from Anui 2 date to after 30,000 BP: horizon 12 (at the bottom of geological stratum 13.2 and the contact zone of geological stratum 14; Derevianko *et al.* 2003:311) is radiocarbon dated to 27,930 ± 1590 BP (IGAN–1425) and 26,810 ± 290 BP (SOAN–3005) (Vasil'ev *et al.* 2002). Horizon 11 (at the top of geological stratum 13.2) and horizon 10 (at the bottom of geological stratum 13.1) have no radiometric dates (Derevianko *et al.* 2003:311). Horizon 9 (at the top of geological stratum 13.1) is ^{14}C dated to 27,125 ± 580 BP (SOAN–2868). Horizon 8 (stratum 12) has a ^{14}C range of 24,205 ± 420 BP (SOAN–3006) to 20,350 ± 290 BP (SOAN–2863) (Derevianko *et al.* 2003, Fig. 178).

Raw materials used at Anui 2 are sandstone and mainly effusive rocks (Derevianko *et al.* 2003:311). Of the 761 artifacts from horizon 12, the majority are flakes and blades (63.5%), fragments and spalls (27.2%), and tools (5.9%), with the latter including mostly retouched flakes; other tools are, for example, scrapers, skreblos, and small points. A few cores (n. 6) and one hammerstone have also been found. Cores include a single platform core, two double platform cores, a bifrontal double platform core, and two flat-faced microform cores. (Note: Flat-faced cores are cores with a flattened working surface.) Four backed microblades were also found (Derevianko *et al.* 2003:311–329), and two are illustrated in Derevianko *et al.* (2003, Fig. 187, 4 and 12).

The 3501 artifacts from horizon 11 are for the most part flakes and blades (47.3%) and fragments and spalls (43.1%); the other artifacts are core-like forms and cores (2.9%), broken [worked?] pebbles (2.4%), anvils and hammerstones, and tools (4.2%). The majority of cores are single platform cores; there are also two double-platform cores and an “orthogonal core”, five flat-faced cores, and a wedge-shaped microform core (Derevianko *et al.* 2003:311–329). Two retouched microblades, one microblade with a dull edge, and two micropoints, were also identified (Derevianko *et al.* 2003:372, Fig. 178, 5). The illustrated wedge-shaped core shows small scars, of which a few may be interpreted as microblade scars.

Horizon 10 yielded 6509 artifacts. This assemblage contains mostly flakes and blades (49.3%) and fragments and spalls (42.6%); other artifacts are cores and “core-like tools” (2.1%), broken pebbles (2.6%), stone working tools (3.3%), and tools (3.3.%); the tools include, for example, retouched flakes, skreblos, notched tools, and small points. Among the microtools are three micro-scrapers, two micropoints, and backed microblades. Most of the cores are “single platform parallel cores”; other cores are, among others, a prismatic core and eight flat-faced cores (Derevianko *et al.* 2003:311–329).

The majority of the 2666 artifacts from horizon 9 are fragments and spalls (58.4%), followed by flakes and blades (29.2%), tools (6.8%, mostly retouched flakes, notched tools, and skreblos), core-like forms and cores (2.8%), broken pebbles (2.7%), and a hammerstone. Cores include double platform cores, flat-faced cores, and a prismatic microcore, for example. One of the tools is a backed microblade and another is a micropoint (Derevianko *et al.* 2003:311–329). A prismatic core from horizon 9 has several microblade negatives on two faces (Derevianko *et al.* 2003, Fig. 178, 6; Figure 9.3:8). A wedge-shaped core (Figure 9.3: 7) and a prismatic core (Figure 9.3:9) derive from horizon 8 (Derevianko *et al.* 2003, Fig. 178, 7 and 4). Of the more than 15,000 artifacts from Anui 2 (including rare ornaments), there are seven flat-faced microcores (Derevianko *et al.* 2003:372, Fig. 178, 1 and 2). All of the cores used to produce microblades have a flat base, a slanted striking platform, and platform preparation with evidence of pressure flaking (Derevianko *et al.* 1998b; Derevianko *et al.* 2003:319).

Kara-Bom

Microblades and suggested precursors of wedge-shaped cores have been discovered at the open-air and stratified site of Kara-Bom, situated in the central Altai Mountains, approximately 100 km from Denisova Cave (Figure 9.1). The Kara-Bom deposit is about 5 m thick, and includes six cultural horizons, of which two are Middle Palaeolithic (layers 1 and 2) and two are early Upper Palaeolithic (layers 6 and 5) (e.g., Derevianko 2001). The fauna from cultural layer 6 is *Equus* cf. *hydruntinus*, *C. sibirica*, and *Crocuta spelaea* (hyena). *Bison* sp. was documented in layer 5, and *C. sibirica*, *Bison* sp., and *Equus* sp. in layers 4–1 (Derevianko *et al.* 2000b). Cultural layer 6 is radiocarbon dated to 43,200 ± 1500 BP (GX–17597), layer 5 to 43,300 ± 1600 BP (GX–17596), and layer 4 to 34,180 ± 640 BP (GX–17595) (Goebel *et al.* 1993; Vasil'ev *et al.* 2002). Levallois cores and large blades are characteristic of the Upper Palaeolithic at Kara-Bom (Derevianko and Rybin 2003), and effusive rocks were most often used at this site (Derevianko *et al.* 2000b). Microblades and butt-ended cores thought to be "related to" the microblades were found in cultural layer 6, the earliest Upper Palaeolithic layer at Kara-Bom (Derev'anko and Markin 1998:104). Microblades were also recovered from layer 4, a loam layer with some "fine rubble and scree" and slate fragments (Derev'anko and Markin 1998:103; Derevianko 2001, Plate 3). According to Derevianko *et al.* (1999:180), in the Upper Palaeolithic of Kara-Bom, "the flaking front was moved to the butt end of the core resulting in the production of blanks with characteristic features showing removals of previous flakes. The origin of the wedge-shaped core seems to be associated with this process".

Other sites in Gorny Altai

Microblades and backed microblades were found in strata 12 and 11 of the Anui 3 site (Figure 9.1), located about 1.3 km away from Denisova Cave. This stratified site has 21 layers, and strata 12–10 are loam sediments with rare debris. The only radiometric date is a RTL date for stratum 12 of 54,000 ± 13,000 years (Derevianko and Shunkov 2004). The assemblages from strata 12 and 11 comprise a low frequency of artifacts and these are classified as early Upper Palaeolithic, occurring together with a small number of Middle Palaeolithic artifacts. Artifacts include a prismatic core with parallel working, flake and blade tools, and carinated end scrapers. A microblade and several backed microblades have been identified in these strata (Derevianko and Shunkov 2004, Fig. 23: 6, 1–5 and 7); the microblade may be a fragment of a microblade.

At Kara-Tenesh, in the central Altai Mountains, microblades have been found with "irregular outlines". The four radiocarbon dates for this site range from 42,165 ± 4170 BP (SOAN–2485) to 25,600 ± 430 BP (SOAN–3646) (Vasil'ev *et al.* 2002).

West Siberian Plain

At several open-air localities in the southeastern lowlands of West Siberia, artifacts have been excavated which have similarities to microlithic artifacts. Of the 1348 flint artifacts from Mogochino 1, found on the right bank of the Ob River (Figure 9.1), most are unretouched fragments (73.8%), followed by tools (17.8%; microtools, retouched blades, burins, wedges, end scrapers, side scrapers, and other tools) and nuclei (8.4%) (Derev'anko and Markin 1998). The associated fauna is primarily composed of *M. primigenius,* horse, and *Rangifer tarandus* (reindeer), and, to a lesser extent, *Coelodonta antiquitatis* (woolly rhinoceros) (Derev'anko and Markin 1998). The cultural layer has a single ^{14}C date of 20,150 ± 240 BP (SOAN–1513) (Zenin 2002:29). S.A. Vasil'ev (personal communication 2005), however, argues that the age of Mogochino needs to be confirmed by additional data; he also mentions that the artifacts are "typical for the Afontova-like culture … younger than 18,000–16,000 years ago". Some of the microcores can be compared to wedge-shaped cores (Zenin 2002:29). There are 50 wedge-shaped cores, and one appears to be illustrated in Fig. 44: 4 by Derev'anko and Markin (1998). Three faces of this core are shown, two of which have microblade scars, although this core is not a standardised example of wedge-shaped core technology.

Based on the presently available evidence, microlithic technology was not common in the lowlands of West Siberia, but at the same time research is at a relatively early stage in this vast region and the number of Palaeolithic sites found so far is small (Zenin 2002). Authors have noted "… a clear tendency towards tool dimunition at early Sartan sites." (see Zenin 2002:40). The environment of the West Siberian Plain in the Early Sartan [age] was open tundra, and human mobility in the cold and arid climate may have been instrumental in the size reduction of tools (Zenin 2002).

Upper Yenisei River Basin

Ui 1

Three open-air sites on the banks of the Upper Yenisei River basin have artifactual evidence interpreted as microblade technology. At Ui 1 (Figure 9.1), situated on a terrace of the Ui River at a height of 23–25 m (close to the confluence of the Yenisei and Ui rivers), lithic artifacts were recovered from two horizons in layer 2 of the third terrace in alluvial sands with gravel and pebbles. Three horizons within layer 2 have been recognised (Vasil'ev 1996). The majority of archaeological specimens occur *in situ* and were found in horizons 2 and 3. Microblades derive from the 0.20 m thick cultural layer 2, horizon 2; horizon 2 is in the lower part of geological layer 7. Horizon 3 occurs below horizon 2 and lies at the base of geological layer 7; layer 7 is 0.42 m thick (Vasil'ev 1996:147). There is evidence of permafrost in horizon 3 in the form of ice-wedges, with cracks up to 5 cm wide (Vasil'ev 1996:164, Fig. 139: 10, 11). Artificial stone formations were identified in horizon 2 and hearths in horizon 3. The state of preservation of archaeological materials appears to be good (see Vasil'ev 1996:145–170). The fauna (bones and teeth) from layer 2, horizon 2, is predominantly *Capra* sp. or *Ovis* sp., *Bison priscus*, and *Equus hemionus* (Asiatic wild ass); other species are *Capra sibirica* and *Cervus elaphus* (Vasil'ev 2003, Table 4). Layer 2 has four ^{14}C dates ranging from 22,830 ± 530 BP (LE–4189) to 16,760 ± 120 BP (LE–3358) (Vasil'ev 1996). These dates show a very wide range, i.e., about 6000 years within one layer.

Raw materials used were quartzite and "micro-quartzite" (more than 90%), and, to a far lesser extent, green flint, schist, a gneiss-like stone, a marble-like stone, liparite, and quartz. Most artifacts found in layer 2 were manufactured on quartzite and "micro-quartzite", while schist, flint, and gneiss were more rarely used (Vasil'ev 1996).

The total frequency of stone artifacts in layer 2, horizon 2, is 851, including debitage and tools, and 60 bladelets and microbladelets (Vasil'ev 1996:170, Fig. 142). In layer 2 (horizon 2) 32 cores have been identified of which five are prismatic cores (Vasil'ev 1996:203, Table 13), and "one atypical wedge-shaped core with bifacial retouch of the lower edge" (Vasil'ev 1996:161). Artifacts with secondary retouch number 35 blades, points, chisel-like tools, skreblos, retouched flakes, denticulate tools, notched tools, and scrapers. A retouched bone and a bone point were also found (Vasil'ev 1996).

In layer 2, horizon 3, a total of 4416 lithic artifacts were recorded, including debitage and tools, and 324 bladelets and microbladelets (Vasil'ev 1996:170, Fig. 142). In this layer, 68 cores were identified. Of these, two are classified as wedge-shaped core blanks, one with an elongated oval platform, the other a boat-shaped blank (with "spalls" on the perimeter, and part of the platform used for small flake detachment) (Vasil'ev 1996:164, Fig. 139:10 and 11). One of these cores is interpreted as a preform for a wedge-shaped core. However, this small specimen is a core from which flakes, not microblades, were detached (see Vasil'ev 1996: Fig. 139:11). Conical-like cores and six flat-faced cores were also found (Vasil'ev 1996, Fig. 139:17). According to Vasil'ev (1996:170), some of the Ui 1 cores show the technique of detaching microblades from flat-faced cores. For a more concise independent evaluation, clearer illustrations are needed. There are several microblades, though no specific frequency is given (see Vasil'ev 1996). Whole microblades are rare, and have a length range of 17–19 mm and a width range of 4–7 mm. Of the 125 modified artifacts, 11 are micropoints, three are microchisels, and four are microscrapers (Vasil'ev 1996, Fig. 140, 18). Other specimens are points, chisel-like tools (including *piéces escalieés),* scrapers, skreblos, denticulate tools, notched tools, and multi-functional cores. A bone borer and a fox tooth pendant were also recovered (Vasil'ev 1996). Lithic artifacts from layer 2 are generally small (Vasil'ev 1996).

Novoselovo 13

The site of Novoselovo 13 (Figure 9.1) is on a terrace-like surface of the Yenisei River with a 49 m^2 large square excavated in 1974. Layer 3, an 0.50 cm thick loam, is the lowest cultural layer (Lisitsyn 2000:34–37), and has yielded microcores and microblades (Abramova *et al.* 1991), with a ^{14}C date of 22,000 ± 700 BP (LE–3739) (Vasil'ev *et al.* 2002). *Rangifer tarandus* was found with the artifacts (Lisitsyn 2000:35; Vasil'ev 2003, Table 4). The 26,488 lithic artifacts are mostly small flakes (15,256 or 57.6%) and flakes (9710 or 36.6%); two unworked pebbles are not included in the total count of artifacts here. The assemblage also contains spalls (n. 622), cores and core fragments (n. 92), blades (n. 58), pebbles with flake scars (n. 62), tools (n. 395), and four broken pebbles. There are 51 microcores and 67 bladelets (Abramova *et al.* 1991). Associated with the artifacts is a bead of green "soft stone". The raw materials used at Novoselovo 13 are clayey schist-argillite, chert, flint, and quartzite (Lisitsyn 2000:35). Of the three microcores illustrated by Abramova *et al.* (1991, Fig. 44:1, 6, and 7), one is relatively large (with a length of c. 9.5 cm and a width of c. 4 cm) showing regular negatives approaching blade-size (see Abramova *et al.* 1991, Fig. 44:6). Two of the microcores show microblade scars, and one of these cores is more irregular in morphology than the other (Figure 9.5:1). The second microcore has clear microblade scars on its narrow end (Figure 9.5:2). According to Lisitsyn (2000), microcores are single-platform, double-platform with bidirectional removal on the same side, and single platform with flake removal on three sides (see Lisitsyn 2000, Figs. 30:5, 7, 8). The bladelets (Lisitsyn 2000, Fig. 30:6, 9, 11, 14, 15, 19) include small and larger specimens, some more regular in form than others (Figure 9.5:3–5). Of the three microcores illustrated by Lisitsyn (2000), there is only one specimen with microblade scars, a core which approaches a wedge-shape form (Figure 9.5:6).

Kurtak 4

Kurtak 4 is located on a slope 70–90 m above the Yenisei River (Figure 9.1). The upper cultural layer is in geological layer 11, which occurs 5 m below the ground surface in a loam deposit. The excavation yielded 1763 lithic artifacts and fauna (Lisitsyn 2000). The fauna includes *Mammuthus primigenius* (woolly mammoth), ?*Ursus arctos* (brown bear), *Panthera* sp. (cave lion), *B. priscus, C. elaphus*, *E. hemionus*, and *O. ammon*. The age of the archaeological materials is in the range of 24,890 ± 670 BP (LE–3357) to 23,470 ± 200 BP (LE–2833) based on five ^{14}C dates (Vasil'ev *et al.* 2002). The artifacts include 20 cores, 28 tools, and debitage; none of the tools are standardised. Chert, quartzite, and rarely jasper, marble-like limestone, granite and argillite, were selected for artifact manufacture. One core is described as a proto-type of a prismatic core (Lisitsyn 2000:21, Fig. 8:9), and is a small core with a flat platform and flake scars. Two other cores have radial spalls (Lisitsyn 2000:21, Fig. 8:4 and 6) of which one shows some smaller percussion scars. Lisitsyn (2000:89) suggests that before the origin of microblade technology, humans tried out new ways for stone flaking, with the first such development at Kurtak 4, and which eventually culminated in the development of wedge-shaped cores.

Kashtanka 1

Kashtanka 1 is an open-air site with loess-like deposits where lithic artifacts and fauna were found associated (Derevianko *et al.* 1992; Figure 9.1). The main layer is layer 2 and has ^{14}C dates of 21,800 ± 200 BP (IGAN–1049) and 20,800 ± 600 BP (GIN–6968) (Derevianko *et al.* 1992; Vasil'ev *et al.* 2002). *R. tarandus* predominates in the faunal assemblage; other taxa are *E. hemionus*, *Equus* sp., *B. priscus*, *C. elaphus*, and *Vulpes vulpes* (fox) (Vasil'ev 2003, Table 4). The layer 2 assemblage, with more than 5400 lithic artifacts, contains 11 so-called microcores which are pyramid-like microcores, 86 microblades and 124 pieces of microdebitage. Only a preliminary report has been published (Drozdov *et al.* 1990).

Angara River Basin

Mal'ta

At the Mal’ta site, located in the southern Angara region (Figure 9.1), archaeological materials were recovered from the so-called “cover loams” of the second terrace of the Belaya River, a tributary of the Angara (Lipnina *et al.* 2001).

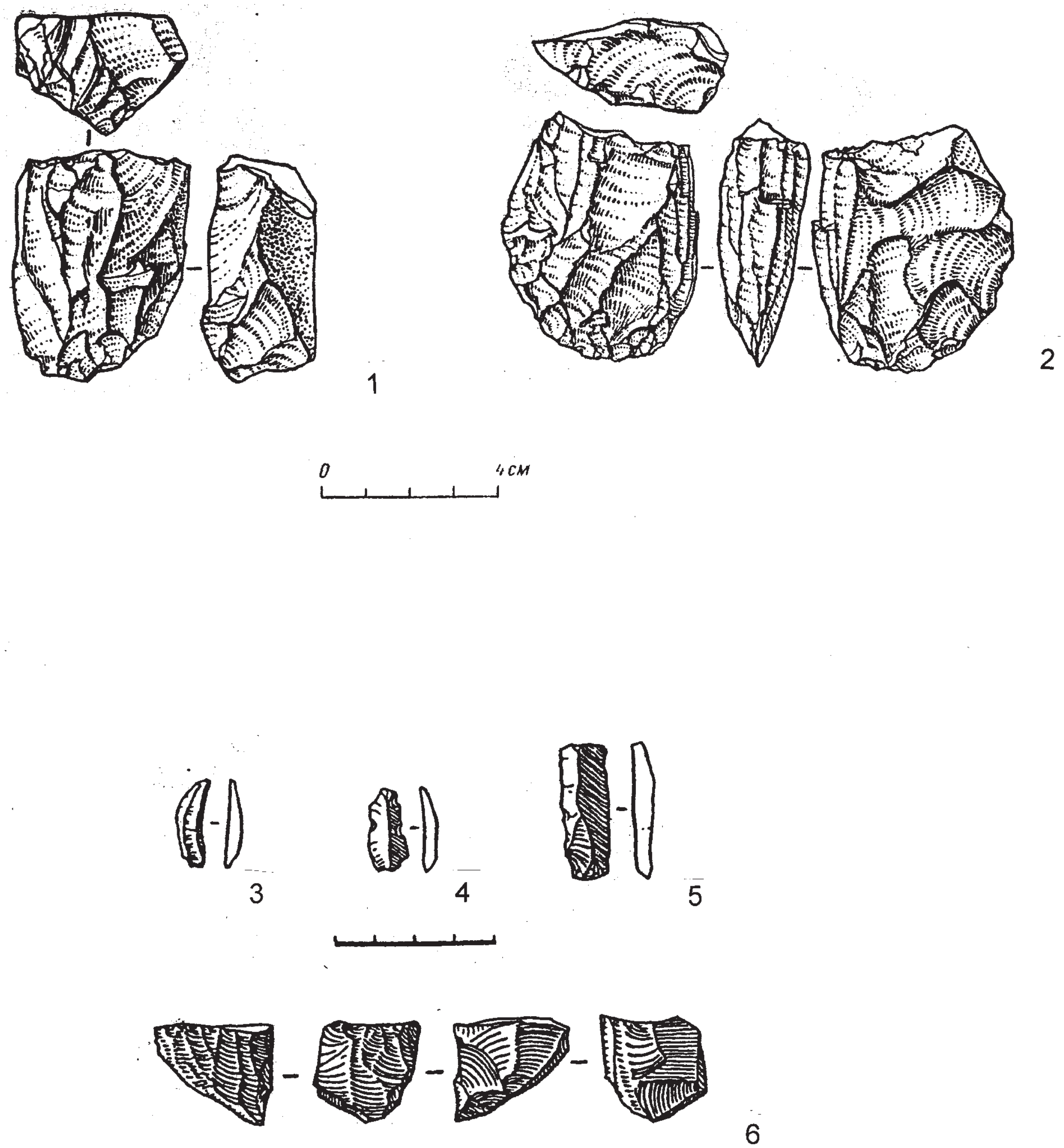

Figure 9.5: Artifacts from Novoselovo 13.
1 and 2. Microcores (after Abramova *et al.* 1991, Fig. 44);
3-5. Bladelets; 6. Microcore (after Lisitsyn 2000, Fig. 30).

The site was discovered by M.M. Gerasimov in 1928 and was excavated in five seasons beginning in 1928 and ending in 1958 (e.g., Medvedev *et al.* 1996). Smaller scale excavations were conducted from 1995 to 1998 under the direction of G.I. Medvedev. Artifacts were found in alluvium of the third terrace (Medvedev 1998:126) in the approximately 0.30–0.50 m thick layer 8 (see Lipnina *et al.* 2001, Fig. 18). Human activity at Mal'ta occurred during a period of "active formation of the solifluction layer" (Medvedev 1998:126). Mammalian fossils and fish bones occurred associated with the artifacts. *R. tarandus* is the most numerous species (Vasil'ev 2003, Table 4). The other mammal species are *M. primigenius, C. antiquitatis, E. caballus* (Pleistocene horse), *B. priscus, Ovis* sp., *?O. nivicola* (snow sheep), and five or six carnivore species (Vasil'ev 2003, Table 4). Thirteen radiocarbon dates were determined for layer 8 ranging from 21,700 ± 160 BP (OxA–6191) to 19,900 ± 800 BP (GIN–7705) (Vasil'ev *et al.* 2002).

A total of 12,263 flaked lithic specimens were found (Medvedev 1998:126) previous to the 1991 to 1999 excavations, when 2350 artifacts were recovered. The stone artifacts were manufactured on hornblendite, quartzite, and jasper-like rock, and mostly flint (Medvedev 1998:126). Among the cores, there is a "flat" blade core of "medium size" (Lipnina *et al.* 2001, Fig. 19:3) and six "microliths", of which the largest is 1.5 cm long, and manufactured by "micro" retouch (Lipnina *et al.* 2001:74). Retouched and truncated bladelets have been identified (Vasil'ev 1993). Medvedev (1998:126, Fig. 109: 5) refers to some cores as "pseudo-wedge-shaped, core-like artifacts", illustrating one specimen wholly flaked on one face and with two irregular microblade scars on the obverse. Other cores with microblade scars are referred to as (1) "single-platform, with multiple fronts of removal" (Medvedev 1998:126, Fig. 109:1; Figure 9.6: 1); (2) "single-platform microcore" (Medvedev 1998:126, Fig. 109:3; Figure 9.6:2); (3) "single-platform with removal fronts on all sides" (Medvedev 1998:126, Fig. 109: 2; Figure 9.6: 3); (4) "single-platform with a 'fan-shaped front'" (Medvedev 1998:126, Fig. 109:6 and 7; Figure 9.6:4 and 5); and (5) "single-platform core '(wedge-shaped)'" (Medvedev 1998:126, Fig. 109: 4; Figure 9.6: 6). S.A. Vasil'ev (personal communication 2005) mentions the occurrence of true wedge-shaped cores at Mal'ta.

Krasny Yar (Krasnyi Iar)

The stratified site of Krasny Yar (Krasny Yar 1 in Vasil'ev *et al.* 2002), situated on the right bank of the Angara River in central Siberia (Figure 9.1), preserves deep and unconsolidated deposits of a complex subaerial origin. The site is located on a 16–20 m thick terrace-like bench. Geological horizon 7 (0.20–0.30 m thick) contains cultural layers V, VI, and VII (Medvedev 1969:31; hereafter referred to as layers). These layers are a lower component of the site and form one cultural stratum (Medvedev 1998:129, 131 and Fig. 117). Layers V, VI, and VII are situated 4.60-6.20 m below the ground surface in light loam, and thin sandy layers separate these layers (Medvedev 1998). The very thin layer VI lies 0.05–0.10 m above the base of geological horizon 7 (Medvedev 1969:31). Layer VI is a loam horizon and layer VII is in sandy deposits (Medvedev 1998). Layer VI is ^{14}C dated to 19,100 ± 100 BP (GIN–5330) (Vasil'ev *et al.* 2002). *C. antiquitatis, R. tarandus* and *B. priscus* were recorded in layer VI, and *R. tarandus*, and ?*B. priscus* in layer VII (Vasil'ev 2003, Table 4).

Of the archaeological materials recovered from layer VI, these "...in part, also came from layer VII.", and hearths occur in both of these layers (Medvedev 1998:129). The majority of the 369 artifacts from layer VII are flakes and small chips (87%), many on chalcedony. Artifacts from this layer also include, for example, flakes on flint and quartzite, ostrich eggshell bead blanks, and whetstones. Layer VII yielded six prismatic microblades (Figure 9.7: 1–8) and a "ridge spall struck from the front of a boat-shaped core" (Medvedev 1998, Fig. 118: 4–11, 14; Figure 9.7: 9). More than 2000 artifacts were excavated from layer VI, of which 683 are derived from flaking and 10 are reindeer incisor ornaments. There are also animal bones (n. 595), which Medvedev (1998:130) links to human subsistence. The stone artifacts include amorphous cores, flake fragments, blades, the latter manufactured from quartzite boulders and showing no evidence of preparation, as well as burins and choppers. The raw materials also include argillite. The 17 wedge-shaped cores, with five categories distinguished, were manufactured on flint, chalcedony, and jasper (Medvedev 1998, Fig. 122: 1, 2, 5–8; Figure 9.7: 10–15). Note that in the caption of Figure 122, Medvedev (1998:233) refers to specimens numbered "1, 2, 5, 8" as wedge-shaped cores, and does not list specimens numbered 6 and 7 in the same caption. Specimens 6 and 7 appear to be wedge-shaped cores, too, and are therefore included in Figure 9.7 as specimens numbered 10 and 13. Abramova (1965:125) states that the wedge-shaped core dimensions have a range of 2.3 x 1.9 cm to 4.0 x 3.3 cm.

Transbaikal

Kamenka, complex B

The open-air site of Kamenka is a piedmont slope deposit located on Kamenka hill (Figure 9.1). Eight layers have been identified in this up to

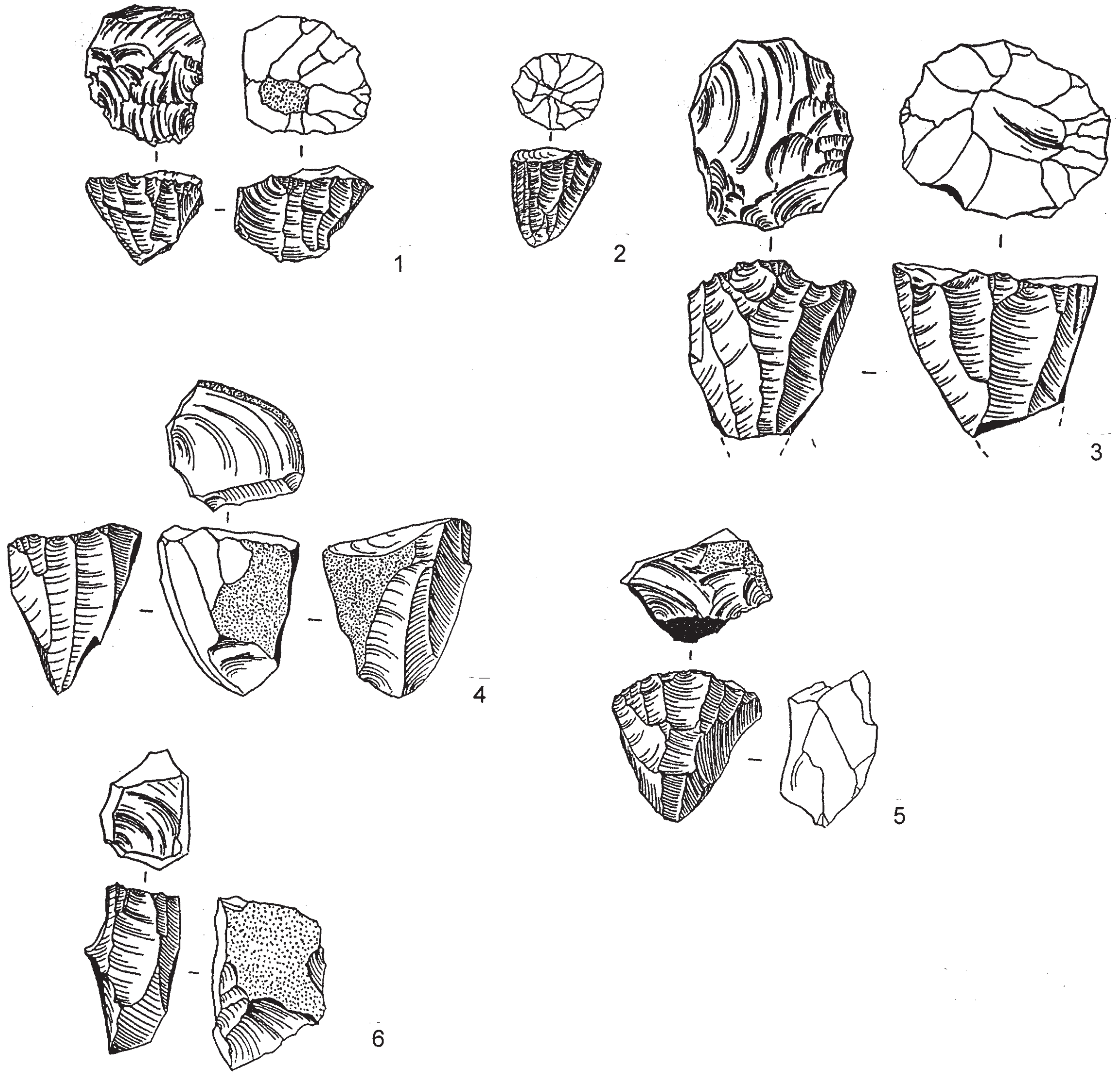

Figure 9.6: Cores from the Mal'ta site.
1. Single-platform, with multiple fronts of removal; 2. Single-platform microcore; 3. Single-platform core with removal fronts on all sides; 4 and 5. Single-platform cores with a "fan-shaped front"; 6. Single-platform core (wedge-shaped) (after Medvedev 1998, Fig. 109). No scale given.

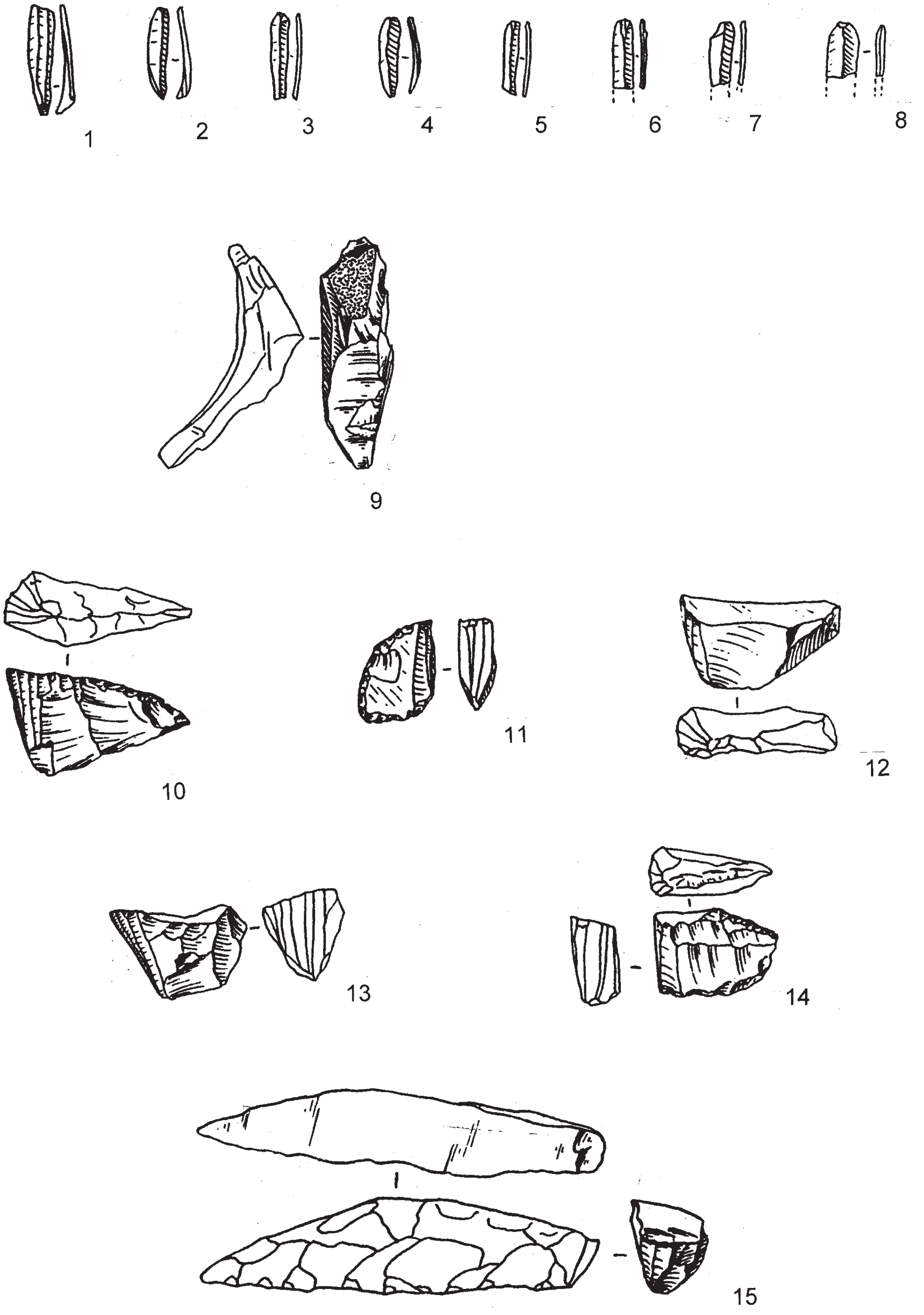

Figure 9.7: Artifacts from Krasny Yar.
1-8. Microblades, layer VII; 9. Ridge spall from boat-shaped core, layer VII; 10-15. Wedge-shaped cores, layer VI (after Medvedev 1998, Figs. 118 and 122). No scale given.

25 m thick slope deposit (Lbova 2000:163). The sediments are colluvial sands intercalated with clays. Slight disturbance of the deposit is possible because of the colluvial nature of the sediments. No information is available on the state of faunal or artifact preservation (see Lbova 2000:42–61; Lbova *et al.* 2003). Artifacts and associated fauna occur in the upper part of layer 6 in complex B of Kamenka; the upper part of layer 6 is about 1 to 1.5 m thick (Lbova 2000:163, Fig. 11). The fauna found is *C. antiquitatis*, *M. primigenius*, *B. priscus*, and *Gazella (Procapra) gutturosa* (Mongolian gazelle) (Lbova 2000:163). The four radiocarbon dates of complex B range from 28,815 ± 150 BP (SOAN–3032) to 24,625 ± 190 BP (SOAN–3031). The Kamenka B lithic technology is classified as early Upper Palaeolithic (Lbova 2002:52).

The assemblage from layer 6 comprises 653 artifacts of which 68 are stone tools, four are bone tools and one is an antler tool (Lbova 2000:47, 52), while Lbova *et al.* (2003:129) refer to 70 lithic tools and five bone tools. Raw materials used were basalt, porphyry, silicified tuff, jasper-like rock, microquartzite, and chalcedony (Lbova 2000). A total of 23 cores were found, including a Levallois core for flake production (Lbova 2000:122). Tools are described as scrapers (including two microscrapers), borers, notched tools, skreblos, knives, chisel-like tools, combined tools, Levallois points, drills, a biface, and a burin. The lithic artifacts include eight microcores in different stages of reduction (Lbova 2000:47, Fig. 13), referred to as residual microcores, and 13 microblades (Lbova *et al.* 2003:129; Lbova 2000, Fig. 13: 1–4). The artifacts also include 15 cores (2.2% of the total assemblage), two of which are classified as proto-wedge-shaped single and double faced cores (Lbova *et al.* 2003). Among the cores are six flat-faced cores. Of these, four have a prismatic monofront and two are described as proto-wedge-shaped cores, single and double faced with amorphous platforms (Lbova 2000, Fig. 13:7, 9; Lbova *et al.* 2003). Two small cores illustrated in Lbova *et al.* (2003, Fig. 46: 3 and 5), show microblade scars. Two proto-wedge-shaped cores are shown in Lbova (2000:48, 165, Fig. 13: 7 and 9). One of these has microblade scars on two faces (Figure 9.8: 1), while the other core, less regular in shape, has microblade scars on one face (Figure 9.8: 2).

Lena River Basin

Alekseevsk 1

The Alekseevsk site 1 is a river terrace locality north of Lake Baikal, where layer 3 (Figure 9.1), of about 0.45 m thickness, yielded several microblade cores and microblades (see Zadonin 1996, Fig. 1). The single radiocarbon date is 22,410 ± 480 BP (LE–3931) (Zadonin 1996). The fauna is *M. primigenius*, ?*C. elaphus*, *Capreolus capreolus* (roe deer), and *R. tarandus* (Vasil'ev

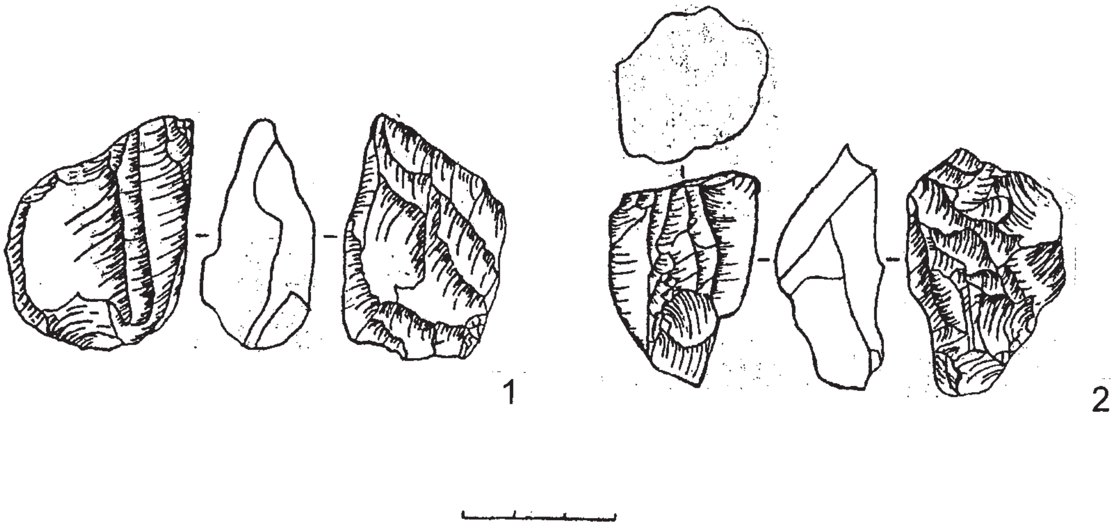

Figure 9.8: Cores from Kamenka B.
1 and 2. "Proto-wedge-shaped cores", layer 6 (after Lbova 2000, Fig. 13).

2003, Table 4). All of the microblade cores show microblade negatives, some more regular than others; none of the cores are of the wedge-shaped or other “true” microblade core type (see Figure 9.9), and S.A. Vasil'ev's examination of the artifacts from this site identified no wedge-shaped cores. Vasil'ev characterizes the artifacts as a “typical Middle Upper Paleolithic industry of Siberia”, comparable to that found in the Yenisei region (S.A. Vasil'ev personal commnication 2005). One of the cores from Alekseevsk site 1, based on the published drawing, is interpreted by Chen Shen as a preform core for a microblade core; it appears that this specimen was worked before microblade production. Furthermore, in Chen Shen’s opinion, these microblade cores are similar to those known from the Levant and the style of retouch on blades and microblades is very similar to that found in Western Asia (Chen Shen personal communication 2005).

Ikhine 2

The site of Ikhine 2 is located on the third terrace of the Aldan River within a 15–16 m thick deposit (Mochanov and Fedoseeva 1996; Figure 9.1). Palaeolithic stratum IIa/Cultural horizon IIa and the underlying Palaeolithic Stratum IIb are in loams with sporadic sand and gravel, and of 0.25–0.30 m and 0.35–0.40 m thickness, respectively. The age of Stratum IIa is estimated to be 25,000–23,000/22,000 years old with reference to ^{14}C dates from deposits below this stratum and the stratigraphic context (Mochanov and Fedoseeva 1996). The ^{14}C age of Palaeolithic

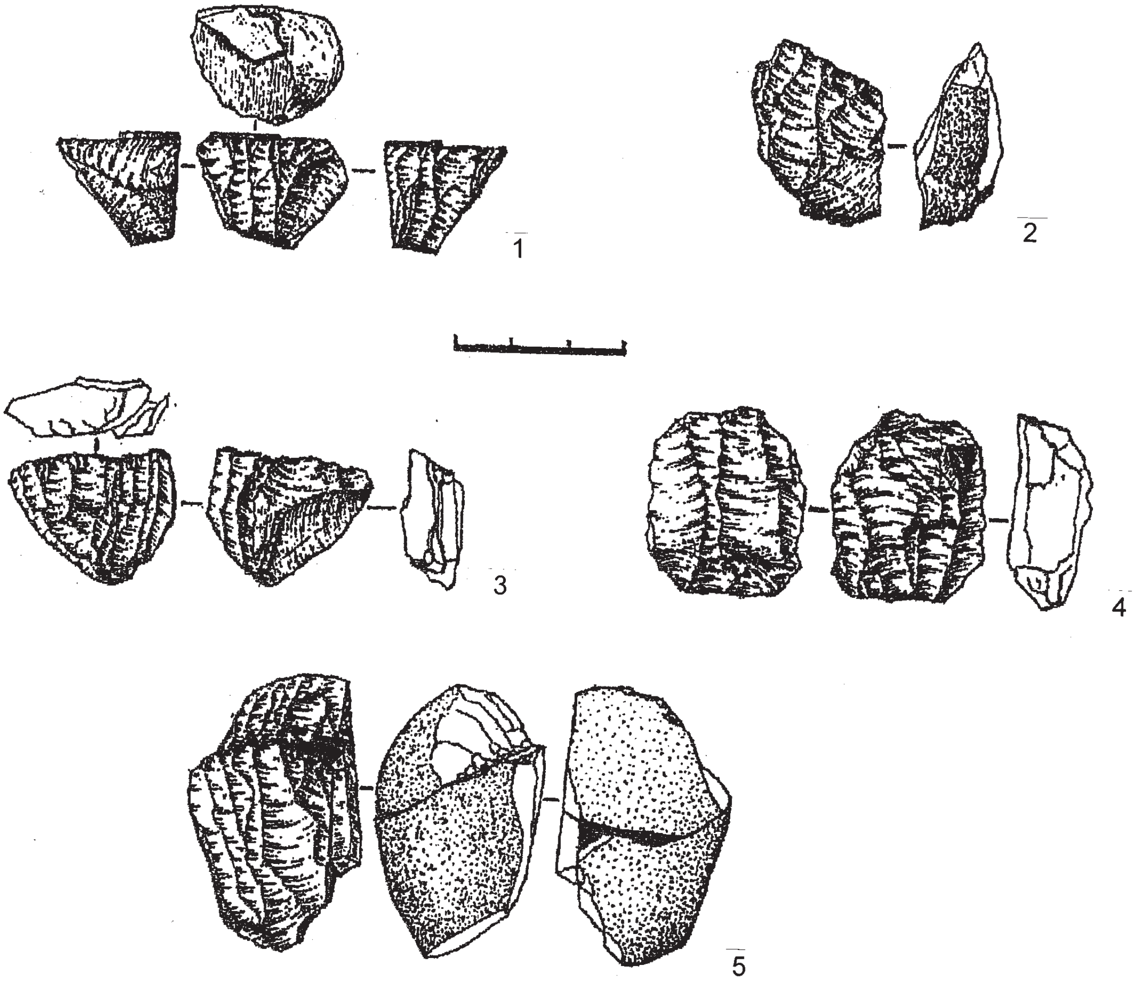

Figure 9.9: Cores from Alekseevsk 1.
1–5. Microblade cores, layer 3 (after Zadonin 1996, Fig. 1). Scale represents 3 cm.

stratum IIb is based on five dates with a range of 30,200±300 BP (GIN–1019) to 24,330±200 BP (LE–1131) (Mochanov and Fedoseeva 1996). Possible re-deposition from permafrost deposits of the dated wood samples has, however, introduced some doubt about the association between the dated wood and the artifacts (e.g., Yi and Clark 1985). The strata IIa and IIb fauna is *E. cabalus*, *B. priscus*, and *R. tarandus* (Vasil'ev 2003, Table 4), with 254 bone fragments from stratum IIa and 202 animal bones from stratum IIb (Mochanov and Fedoseeva 1996).

Palaeolithic stratum IIa yielded 11 lithic artifacts, including blades, flakes, and modified pebbles, on hornfels, diabase, chert, and granite. A wedge-shaped core, also described as a wedge-shaped core blank, and manufactured on a hornfels pebble, was recorded in this stratum. Based on the drawing (see Mochanov and Fedoseeva 1996, Fig. 3–21:c), the classification as a wedge-shaped core or blank cannot be confirmed. Six artifacts were recorded in stratum IIb. A wedge-shaped core, pebble scraper, and flakes were produced on hornfels, chert, argillite, and diabase. The specimen described as a wedge-shaped core/wedge-shaped core blank is not convincing (see Mochanov and Fedoseeva 1996, Fig. 3–21:e), and may rather be described as a (retouched?) flake. According to Kashin's (2003, by personal communication S.A. Vasil'ev 2005) examination of the Ikhine 2 collection, he has profound doubts about the wedge-shaped core from stratum IIb. S.A. Vasil'ev (personal communication 2005) points out that the stratum IIa “wedge-shaped core” is a “crude pebble” with a few scars, which Y.A. Mochanov diagnosed as a questionable core blank. Goebel (2002) has also expressed doubts about a microblade industry at this site. Considering the small number of artifacts found in these layers [and Palaeolithic strata IIc and IId with a total of four artifacts, see Mochanov and Fedoseeva (1996)] and the composition of the assemblages, the evidence for *in situ* evidence of lithic tool manufacture needs to be confirmed.

Verkhne-Troitskaya

The Verkhne-Troitskaya site is situated on the second terrace of the Aldan River (Figure 9.1). Most of the site appears to have been destroyed by lateral erosion and ice wedges. Three cultural units are recognised at the site. Lithic artifacts were found in the c. 0.80 m thick geological layer 6 (see Mochanov and Fedoseeva 1996, Fig. 3–11), which contains the Palaeolithic cultural stratum III. The artifacts were excavated 5 cm from above the place where a sample for radiocarbon dating was collected; the ^{14}C age is 18,300±180 BP (LE–905). A total of 52 lithic artifacts, an ivory needle, and 49 split animal bones were found [bison, horse, *M. primigenius*, *C. antiquitatis, R. tarandus* and *Canis lupus* (wolf)]. Flakes, blades, tools, and other artifacts, were predominantly manufactured on chert; diabase was used to make one artifact (see Mochanov and Fedoseeva 1996:181). Two wedge-shaped cores show several microblade scars at one end (see Mochanov and Fedoseeva 1996, Fig. 3–12:a, b). A blade inset is also shown (Mochanov and Fedoseeva 1996, Fig. 3–12:c). The collection of 87 artifacts eroded from the river terrace includes 10 wedge-shaped cores (Mochanov and Fedoseeva 1996).

The Russian Far East

Ust-Ul'ma 1

In the Amur River basin, the Ust-Ul'ma 1 site has yielded typical microcores and microblades, with the earliest recorded in layer 2b (Derevianko 1996; Figure 9.1). Ust-Ul'ma 1 is situated in colluvial loam on the terrace-like surface of the Ul'ma River about 25 m above the river level (Derevianko and Zenin 1995, Fig. 2). The archaeological materials occur within a thin layer, and four cultural layers (1, 2a, 2b, and 3) were identified. Fauna was not found. There was no evidence of redeposition, and artifact preservation is very good (Derevianko and Zenin 1995). The ^{14}C determination for Ust-Ul'ma 1 dates layer 2b to 19,350±65 BP (SOAN–2619) (Derevianko and Zenin 1995). Layer 2b is located at the base of dark-brown “mild” clay. Here, a total of 9249 lithic artifacts were found (cores, flakes, blades, and tools), and raw materials are liparite pebbles, jasper and flint. Most artifacts are described as waste materials (95.9%), and these occurred in the pit of a hearth (Derevianko and Zenin 1995:87). Of the 180 cores, 18 wedge-shaped cores were identified; other cores include, amongst others, “simple” single platform cores and seven Levallois cores (Derevianko and Zenin 1995:88, Fig. 37:1–3, 5–7, 39:5–9; and see Derevianko 1998, Fig. 179). Layer 3, which lies below layer 2b, also contains microcores and microblades (Derevianko 1996). This layer is a “thick stratum” composed of red-brown “mild” clay and includes lamination and 209 lithic artifacts, including two cores, as well as flakes and tools. Artifacts were manufactured on liparite pebbles as well as sandstone. Cores include two wedge-shaped cores and a “simple” single platform core (Derevianko and Zenin 1995:88, Fig. 52:3).

Ogonki 5

In southern Sakhalin, the river terrace locality of Ogonki 5, locality 1 (horizon 3), in a loam deposit on the left bank of the Lyutoga River (Figure 9.1), has yielded microcores and microblades from stratum 3 (a clay “layer”), and from substratum 2B (loamy soil) (Vasilevski 2003), with three ^{14}C dates ranging from 19,320 ± 145 BP (AA–20864) to 17,860 ± 120 BP (AA–23137) (Vasil'ev *et al.* 2002; see also Kuzmin, this volume). Fauna was not found (Vasilevski 2003). Horizon 3 is strata 2B and 3 with a thickness of 0.4–0.7 m (Vasilevski 2003), and both strata are treated as one, that is, the lower assemblage. The 11,450 lithic artifacts include 66 wedge-shaped cores, 8390 flakes, spalls, chips, and burin microspalls, and 339 “standard” microblades as well as microchips and “needle-like” microblades; there are also amorphous cores, a few refits, blades and blade tools, rare retouched tools, and an incompletely polished adze. Flint, obsidian, basalt, and chert are mentioned as raw materials (Vasilevski 2003:60, Figs. 10–12). Charcoal and hematite were found associated (Vasilevski 2003).

MONGOLIA

Chikhen Agui

Microlithic artifacts in Mongolia have a wide distribution and usually occur as surface finds in desert and steppe environments (e.g., Maringer 1950; and see Chen and Wang 1989:147–148 for a review). The only radiometrically dated site with microblade technology in Mongolia is Chikhen Agui (Figure 9.1). This cave site is located in the northern Gobi Desert, where 1385 stone artifacts were excavated from cultural horizon 3. The assemblage includes cores, debitage [(the majority of which are flakes (n. 395) and scalar debitage (n. 584)], and tools, thus representing evidence of on site tool manufacturing activity. Cores are mainly “Levallois-like”; the 35 tools are for the main part points and scrapers, with “specific tools”, burins, and knives in lower frequency (Derevianko *et al.* 2001:30). One of the cores is described as a microblade core, exhibiting “Levallois-like and prismatic techniques”, and the first of its kind known from a Late Pleistocene context in Mongolia (Derevianko *et al.* 2001). One face shows a few long and narrow scars, and one end was flaked (Derevianko *et al.* 2001), in cross-section giving the appearance of a wedge-shaped core (Figure 9.10). This core and the 24 microblades from this site are thought to represent an incipient microblade technique; microblade width is less than 70 mm (Derevianko *et al.* 2001). Charcoal from a hearth in the Pleistocene horizon was used to determine the radiocarbon chronology of the assemblage to 27,432 ± 872 BP (AA–26580; Derevianko *et al.* 2001:33, Fig. 6).

CHINA, JAPAN AND KOREA

In neighbouring regions of Siberia, microlithic technology, when it appears, is standardised. Here I will present the Chinese evidence in more detail. The earliest localities in China include Xiachuan (e.g., Wang *et al.* 1994; see below; and see Chun Chen, this volume). All Chinese radiocarbon dates are cited with the Libby half-life of 5568 years.

China

In China, microblades are known from more than 200 assemblages and findspots (Lu 1998; and see Chun Chen, this volume). At localities in the Xiachuan Basin (east of the Fen River in Qinshui County, southern Shanxi Province; Figure 9.1), excavations between 1972 and 1973 recovered Late Palaeolithic artifacts (Wang *et al.* 1978; see also Jia and Huang 1985). Lithic artifacts, animal bones, charcoal, and ash were found associated in layer 2 (Lu 1998), that is, layer 5 (the upper cultural layer) of Wang *et al.* (1978:262). This layer reaches a thickness of 1.0–1.5 m (Wang *et al.* 1978). Of the 1800 lithic artifacts, most are microlithic and others are large tools, such as grinding stones and adzes (Wang *et al.* 1978). The radiocarbon dates for layer 2 range from 23,220 ± 1000 BP (ZK–0417; The Institute of Archaeology 1991:40) to 15,940 ± 900 BP (ZK–0385; The Institute of Archaeology 1991:40). However, samples were collected from four localities, and were not taken in a sequence from the depositional profiles, raising some doubt about the ^{14}C chronology of Xiachuan (Chen and Wang 1989:135, 156; and see Wu and Wang 1985). The microlithic artifacts, including microcores and microblades, were manufactured on flakes and blades of black flint (Wang *et al.* 1978) and Lu (1998; and see Keates 2003) also mentions chert. Wedge-shaped cores are characteristic of this assemblage, while conical and boat-shaped cores were also identified, and manufactured by indirect percussion (Wang *et al.* 1978; Chen 1983). Tools were produced using pressure flaking, and the majority of tools are backed knives, burins, awls, bifacial foliate points, small triangular points, borers, and end scrapers. Tang (2000) suggests that most core scrapers from Xiachuan could be microblade cores (see Fig. 10 in Wang *et al.* 1978). Microcores and microblades comprise approximately 22.6% of the Xiachuan artifacts (Lu 1998). Most of the microblades were truncated at the ends and not retouched (Lu 1998), and comparison to truncated microblades hafted into bones at some Neolithic sites in China could indicate a similar use for the Xiachuan microblades (Jia 1978 in Lu 1998).

At 25,650 ± 800 BP (ZK–0635; on freshwater mollusc shell sampled from the Pleistocene sand gravel layer, but with no further contextual information given; The Institute of Archaeology 1991:33; Wang *et al.* 1994), the Chaisi site, also known as Dingcun locality 77:01, in the Fen River valley, Xiangfen County, southern Shanxi Province (Figure 9.1), is known as one of the earliest microblade sites in China (e.g., Wang *et al.* 1994; Huang and Hou 1998). It should, however, be pointed out that the excavators of locality 77:01, Wang *et al.* (1994) speculate that this locality may be a secondary deposit. The microblade cores and microblades are of a highly standardised microblade technology, and manufactured in black flint (Wang *et al.* 1994, Plate 10; personal observation 1994).

At the Shiyu site (in the Datong Basin of northern Shanxi Province; Figure 9.1), more than 15,000 lithic artifacts and many fossils (including burnt

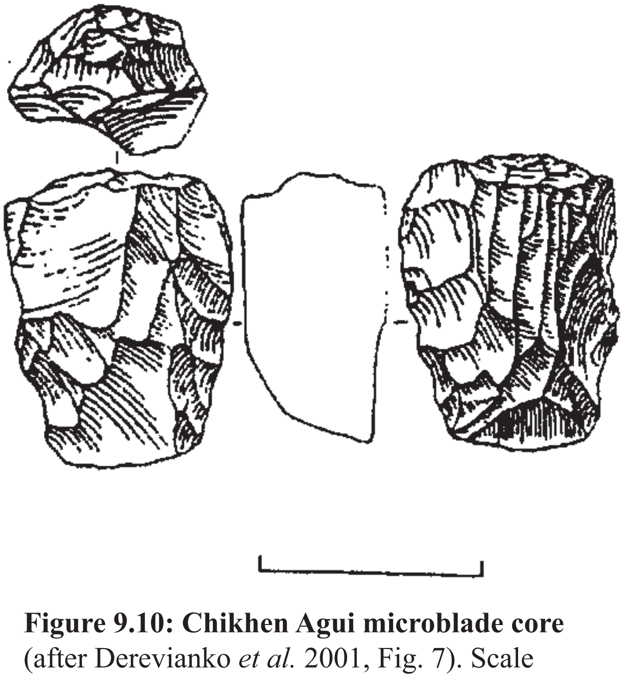

Figure 9.10: Chikhen Agui microblade core (after Derevianko *et al.* 2001, Fig. 7). Scale represents 3 cm.

bones) were found associated in fluvial sands and gravels; most artifacts are small (Jia *et al.* 1972), with some standardisation (Jia and Huang 1985). The composition of the fauna indicates a cool steppe environment (Gai 1985:231). The single radiocarbon date for Shiyu is for layer 2, with a date of 28,130±1370 BP (ZK–0109; The Institute of Archaeology 1991:41). Jia *et al.* (1972, Fig. 4.14 and Plate 1:8) refer to a "fan shaped stone core tool", while Gai (1985) mentions microlithic cores from Shiyu. As Aigner (1981:227, Fig. 77.14) argues, this core, manufactured on a retouched flake, is similar to a microcore of wedge-shape type (see also Chen and Olsen 1990:277, Fig. 15.2.1; Figure 9.11:2). There is no (other) evidence for a microblade industry (Aigner 1981:227; Chen and Wang 1989). In contrast, Chen and Wang (1989:128) interpret this core as "accidental", manufactured by bipolar percussion.

It is also worth mentioning Gai Pei's (1991:23) finding of what he describes as a "cone artifact of yellow isotopic rock which has all of the attributes of a wedge-shaped microcore. This artifact, made on a flake, with a D-shaped cross-section, has negative microblade scars on one end, demonstrating an initial effort at microblade core manufacture in China." This specimen is from the early Late Pleistocene site of Xujiayao (e.g., Wu and Wang 1985; Chen and Yuan 1988; Liu *et al.* 1992; Keates 2001) in northern Shanxi Province, northern China (Figure 9.1). However, no illustration of this artifact is provided (Gai 1991:23), although the description of this specimen may be of potential interest for studies concerning the origin of microblade technology. The predominantly small tools are argued to identify Xujiayao as an important antecedent of microlithic technology in China (e.g., Jia and Wei 1976; Qiu 1985), in-

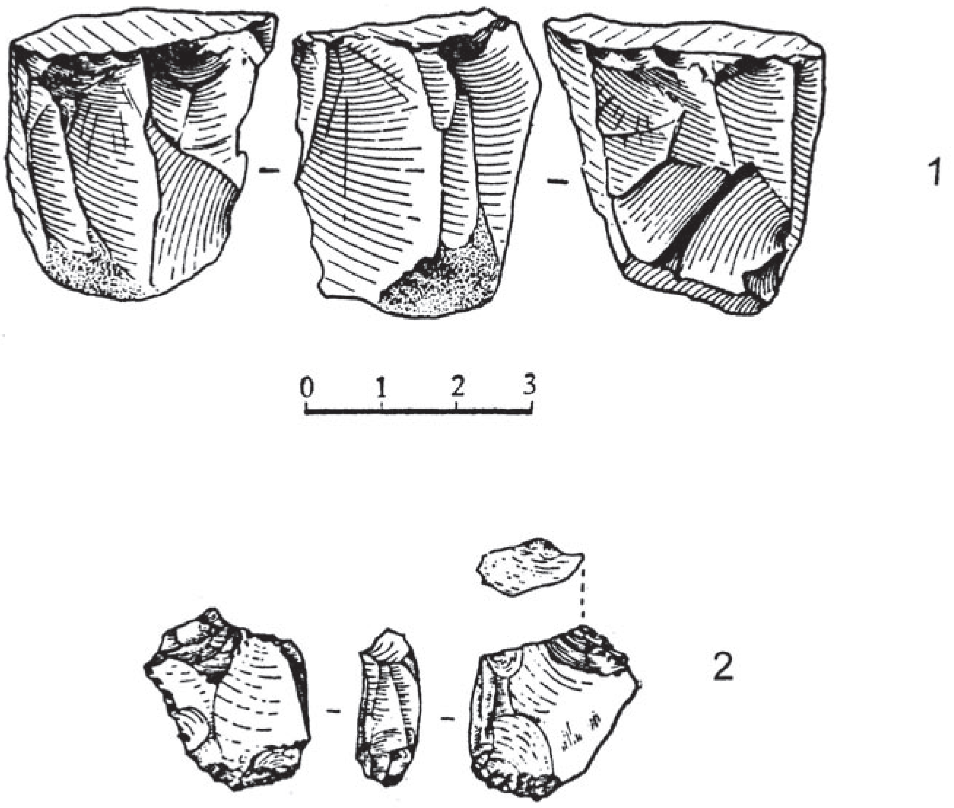

Figure 9.11: Cores from China.
1. Funnel-shaped core from Xujiayao (after Jia and Wei 1976, Fig. 5:1).
2. Shiyu fan shaped stone core tool (after Jia *et al.* 1972, Fig. 4.14), life-size.

cluding the discoidal and proto-prismatic cores from this site (Jia *et al.* 1979). Most cores at Xujiayao are small and none have prepared striking platforms (see Jia *et al.* 1979; Qiu 1985; personal observation of selected artifacts at the Institute of Vertebrate Paleontology and Paleoanthropology (Beijing) and at the Xujiayao site, 1989 and 2002). One of the illustrations of the Xujiayao artifacts includes a proto-prismatic core [classified by Jia and Wei (1976) as a "primitive ridge column shaped core"] with a flat striking platform and a few microblade-shaped negatives (see Jia and Wei 1976, Fig. 5:1, see also Fig. 5:2; Qiu 1985, Fig. 10.13; Figure 9.11: 1).

Japan and Korea

The earliest microblade locality in Japan is the Kashiwadai 1 site on Hokkaido, northern Japan. Microblade cores and microblades derive from layer 4, dated to c. 20,000 BP (Terasaki and Miyamoto 2003; see Sato and Tsutsumi, and Sano, this volume). In the central part of the Korean Peninsula, Janghungri at c. 24,000 BP (Bae and Kim 2003) and Hopyong at c. 22,000 BP (Hong *et al.* 2002; see Norton *et al.* and Seong, this volume) are the earliest microblade sites. At Kashiwadai 1, Janghungri, and Hopyong, obsidian was the main raw material used for microblade manufacture, and the microblade industries from these sites are highly standardised.

DISCUSSION AND CONCLUDING REMARKS

The microcores from the Altai do not evince the standardisation that was subsequently to become a distinctive feature of microlithic technology. Indeed, a number of these cores cannot be classified as typical microblade cores, such as the wedge-shaped type, and some are unconvincing. The frequency of suggested "precursors" of microblade cores and of specimens which are morphologically close to microcores at the earliest sites is usually small with a larger number of microblades. Atypical microblade cores occur at Ui 1 as mentioned above and also at the middle Upper Palaeolithic Tarachikha and Afanas'eva Gora sites in the Yenisei River basin (S.A. Vasil'ev personal communication 2005).

The first appearance of microblade technology is in the Siberian Altai, specifically at the Ust-Karakol 1 site (layer 11) and Denisova Cave (layer 11), with a minimum age of 37,000 years. Concerning the earliest microblades from Kara-Bom (layer 6), dated to c. 43,000 BP, more data on the cores would help to determine if these produced the microblades.

The latest known appearance of microblade cores and microblades in the Altai is at c. 26,000 BP, at Anui 2. While layer 11 of the main chamber in Denisova Cave contains microblades, there are no microblade cores. Were the microblades introduced to Denisova from elsewhere or are these in the unexcavated sections of this site? More specific information is necessary on several aspects of microblade flaking found at Denisova Cave as well as additional radiocarbon dating in order to better determine the technological and chronological evidence of this site. The suggestion that microblade technologies in Siberia make their first appearance after the Last Glacial Maximum (Goebel 2002), can, in view of the Altai evidence, now be abandoned. The chronological evidence as a whole shows a west to east pattern, that is, the earliest microblade sites are in the Altai, with later sites in Eastern Siberia, the Russian Far East, China, Korea, and Japan. S.A. Vasil'ev (personal communication 2005), sees a gradual development of microlithic technology in the Upper Palaeolithic of Siberia.

The other point that needs to be made about the significance of the early microlithic artifacts from the Altai, is that there appear to be no other microlithic localities here except for the few mentioned above, unlike regions such as the Transbaikal and the Russian Far East. It therefore appears that microblade technology was abandoned in the Altai, and was used at a later stage in regions further to the east.

Given the early radiometric dates of the Altai sites and what in some cases can be referred to as incipient "true" microblade technology, a case can be made for the origin of microblade technology in the Altai of Siberia. In Siberia, early microblade technology is associated with small and large tool assemblages and late Mousterian artifacts. In China, the specimen from Shiyu, which for some authors has similarities to a wedge-shaped core, is part of the so-called small tool technology of northern China (e.g., Zhang 1985). Gai (1978 in Aigner 1981:234) suggested a Late Pleistocene derivation of wedge-shaped microcore technology. In northern China, blade technology did not precede microblade technology (Aigner 1981:273), in contrast to Siberia (see above), with the apparent exception of large blade tools at the c. 27,000–25,000 year old Shuidonggou Locality 2 (Ordos Plateau) as well as bipolar bladelets (Madsen *et al.* 2001). The earlier dates for microblade technology in the Altai and the rare occurrence of blade tools in China, are indications that microblade technology did not originate in China. However, some technological aspects from China are intriguing, and before analyses of whole asssemblages are conducted to establish the *chaîne opératoire* and precise documentation of their chronological contexts is made, the possibility remains that microblade technology in this region is earlier than might be assumed on the evidence presently available.

In Central Asia, Coon (1957:250) proposed that the technology and morphology of carinated steep scrapers, one of the characteristics of the Aurignacian, at the Upper Palaeolithic cave site of Kara Kamar, layer III (northern Afghanistan, c. 34,000 BP), "anticipated the microlithic technique…". Although lacking radiometric dates, the Middle Palaeolithic assemblage of Teshik Tash cave in Uzbekistan, contains five prismatic cores (Movius 1953:394, Fig. 11:5). The illustrated specimen is small, has a flat striking platform, and shows several small flake scars; Davis (1978, Fig. 2.7) refers to these artifacts as "carinated endscrapers/bladelet cores". Carinated end scrapers are also known from the Altai, for example, at Ust-Karakol 1, layer 11 (see above), and one may speculate about the significance of the contemporaneity of these tools and microblade core technology.

Recent discoveries in Indonesia of microblades and a burin core at Liang Bua (Sector IV) on the island of Flores, electon spin resonance/Uranium-series (ESR/U-series) dated from c. 95,000–74,000 years ago to c. 12,000 BP radiocarbon years (Morwood *et al.* 2004), are also worth mentioning. These artifacts are associated with radial cores, flakes, blades, points, and perforators, predominantly manufactured on volcanic stones and chert, and Morwood *et al.* (2004) suggest that the micoblades could have been hafted. The burin core (see Morwood *et al.* 2004, Fig. 5), shows that the Liang Bua microblade technology is different from the "classic" microblade technology found in East and Northeast Asia. The point to be made here is that the Flores microblades and core indicate an early age for this technology.

Microlithic technology may have been invented as a risk-minimizing strategy, particularly in environments of Northeast Asia with very cold winter seasons where the need to secure large animals was a significant part of human adaptation; microliths are assumed to have been hafted and used as weapons (e.g., Elston and Brantingham 2002; see also Kuhn and Elston 2002). To examine more comprehensively the role microlithic technology played in Late Pleistocene hunter-gatherer life, far more detailed data on artifacts, environment, and resource subsistence should be collected.

ACKNOWLEDGEMENTS

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10 THE MICROBLADE COMPLEXES OF ALASKA AND THE YUKON: EARLY INTERIOR AND COASTAL ADAPTATIONS

Robert E. Ackerman

INTRODUCTION

In his 1999 survey of microblade sites in Alaska, Cook (1999) noted that there were over 650 sites that contained microblades. His site listing, derived from the Alaska Historical Resources Survey, did not extend to sites in the Yukon Territory, British Columbia, or Siberia (Cook 1999). While only about 10% of the reported Alaskan sites with microblades or microblade cores had been dated, Cook (1999) noted that there was a wide range of dates with the earliest occurrence of microblades around 12,000 BP and the most recent at 300–400 BP. Some of the late dates for microblades, however, appeared to be questionable due to site disturbance, non-cultural (wildfires) charcoal samples, problems with sample selection, and undetermined factors.

THE CAMPUS SITE AS A LATE DENALI OCCUPATION

A good example of a reportedly questionable late occupation with microblades is the Campus site (Figure 10.1:1) in Fairbanks (Mobley 1991, 1996). Dates for the site were discordant, with the lower 20–30 cm of the site dating to 2725 ± 125 BP (Beta–7075), 40 ± 110 BP (Beta–10878), 240 ± 120 BP (Beta–7224), and 3500 ± 140 BP (Beta–6829) (Mobley 1991, 1996). The younger dates were discarded resulting in an age estimate of 2700 BP to 3500 BP for the microblade component, or roughly around 3000 BP (Mobley 1991, 1996). The assemblage contained side-notched points and tabular cores of the Northern Archaic tradition as well as tool forms typical of the Denali complex (West 1967), i.e., wedge-shaped, frontally fluted microblade cores, microblades, Donnelly burins, flat topped scrapers, and lanceolate bifaces (Mobley 1996) prompting Mobley (Mobley 1991, 1996) to consider that the Campus site had been occupied "around 3000 years ago by people who practiced several lithic technologies, including microblade technology" (Mobley 1996:301). In my review of Mobley's 1991 Campus site monograph (Ackerman 1992a), I found difficulties with this interpretation as the author suggested that the Denali complex type of microblade core (a frontally fluted, wedge-shaped core with a pronounced keel and core rejuvenation by platform tablet removal) was in use as late as 3000 years ago when elsewhere in Alaska Denali type microblade cores had been replaced by tabular, prismatic, conical to cylindrical, and blocky types of microblade cores associated with the Late Tundra (c. 8000–6000 BP), Northern Archaic (c. 6000–4000 BP), and Arctic Small Tool (c. 4000–3000 BP) traditions (Ackerman 2001a; Anderson 1988; Campbell 1962; Irving 1962). Subsequent re-excavation of the Campus site resulted in a new date of 6850 ± 70 BP (Beta–97212) (Pearson and Powers 2001) and a re-evaluation of the site assemblage. As the investigators noted, "the Campus site contained either early to mid-Holocene occupations of the Denali complex and Northern Archaic tradition, or one or more early Northern Archaic occupation(s) that included microblades from wedge-shaped cores" (Pearson and Powers 2001:100). While the c. 6800 BP date increased the age of the Campus site by several thousand years (Pearson and Powers 2001), the investigation did not clarify the association of Denali and Northern Archaic tradition tool forms. Did the hallmark of the Denali complex, the wedge-shaped, frontally fluted microblade core whose platform was rejuvenated by the removal of platform tablets, persist into the middle and perhaps into the Late Holocene (Dixon 1985), at a time when other microblade core types belonging to later cultural traditions were present? Also troubling are the relationships between microblade and non-microblade cultural complexes/ traditions, but more of this later.

ASIAN ORIGINS

While there are questions regarding the initial dating of microblade technology in Alaska and the adjacent Yukon Territory, there is general agree-

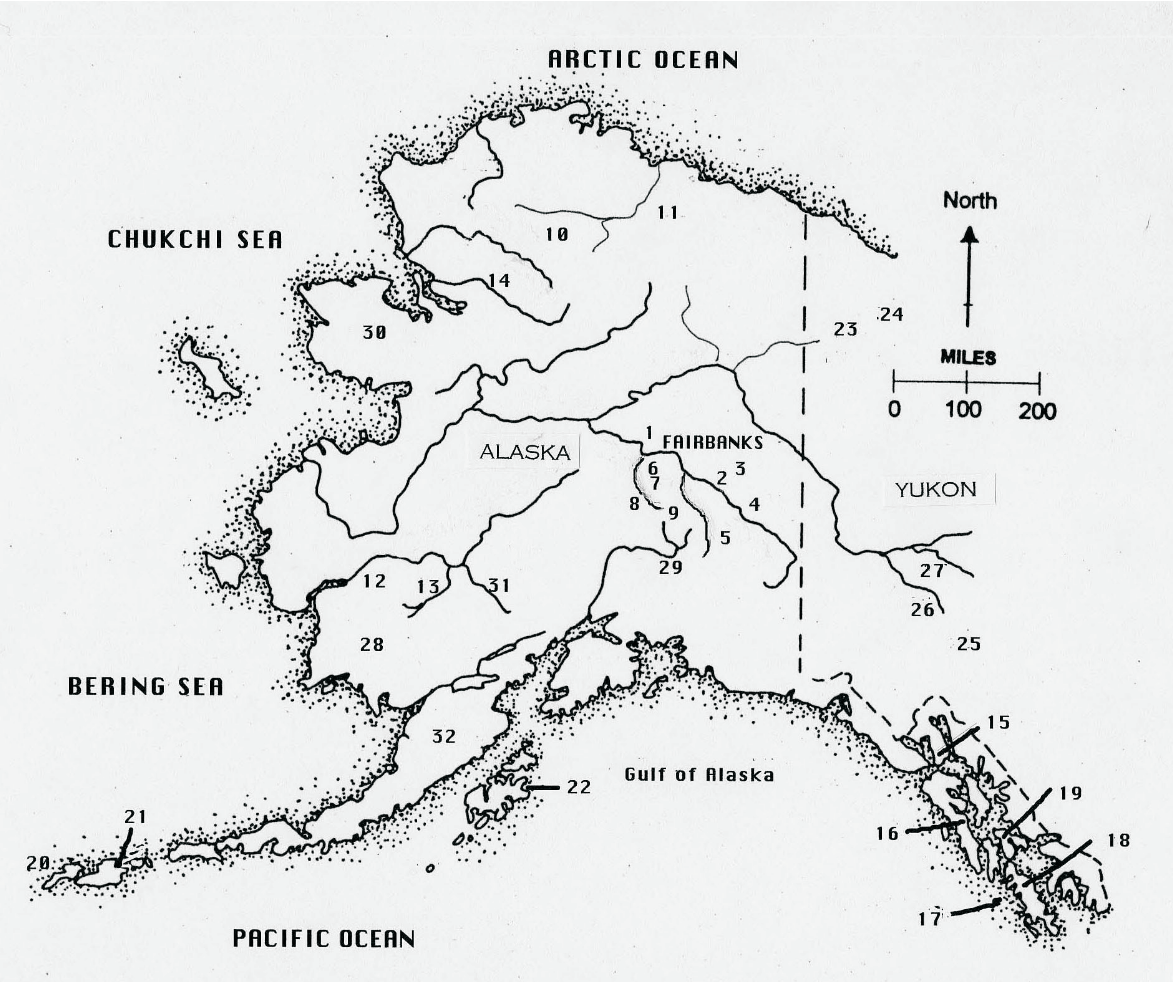

Figure 10.1: Alaskan and Yukon sites mentioned in text.
(1) Campus, (2) Broken Mammoth, (3) Swan Point, (4) Healy Lake, (5) Donnelly Ridge, (6) Moose Creek, (7) Walker Road, (8) Little Panguingue Creek and Panguingue Creek, (9) Dry Creek, (10) Mesa, (11) Putu-Bedwell, (12) Spein Mountain, (13) Ilnuk, (14) Onion Portage, (15) Ground Hog Bay 2, (16) Hidden Falls, (17) Chuck Lake, (18) Thorne River, (19) Irish Creek, (20) Anangula, (21) Hog Island, (22) Rice Creek and Zaimka Mound, (23) Bluefish Caves, (24) Rock River, (25) Annie Lake, (26) Kelly Creek, (27) Otter Falls, (28) Kagati Lake, (29) Whitmore Ridge, (30) Trail Creek Caves, (31) Lime Hills Cave 1, (32) Naknek and Ugashik River sites.

ment that the technology has Asian origins. What is open to question is whether the microblade complex, known as Dyuktai in Siberia (Mochanov and Fedoseeva 1996) and the American Paleoarctic (Anderson 1970a) or Denali (West 1967) in Alaska, represents the tool kit brought in by the entry population or whether it is an addition to a core and blade technology utilized by already established occupants (Müller-Beck 1982).

Nelson (1937) was the first to note similarities between the microblade cores from the Campus site (Figure 10.1:1) and those microblade cores that he recovered from undated contexts in Mongolia. Investigations conducted in the Aldan River region of Yakutia (Dyuktai culture; Figure 10.2:1–8) (Mochanov and Fedoseeva 1996) and in the lower Amur River region of the Russian Far East (Selemdga sites; Figure 10.2:9) (Derevianko 1996) have revealed the presence of frontally fluted, wedge-shaped microblade cores with the platform rejuvenated by the removal of platform tablets (the hallmark of Dyuktai and Denali complexes) by at least 20,000 BP. Archaeological sites with Dyuktai-like microblade cores in Chukotka (Dikov 1985, 1988, 1996, 1997; Figure 10.2) indicate an eastward expansion of the Dyuktai complex, but, unfortunately, none of these sites have been dated. Dikov (1997), through morphological comparisons, equated the Chukotka microblade complexes with the Late Ushki Palaeolithic culture (level 6 of the Ushki sites) of Kamchatka (Figure 10.2:10). Level 6 has been dated at 10,360 ± 220 BP (MAG–401) and 10,760 ± 110 BP (MAG–219) (Dikov 1996; Dolukhanov *et al.* 2002; Kuzmin 1994; Vasil'ev *et al.* 2002). A recent date average of 10,350 ± 30 BP (Goebel *et al.* 2003) for level 6 of the Ushki site complex supports the earlier assessment. Given that the microblade component in the Swan Point site in central Alaska dates prior to c. 12,000 BP (Holmes *et al.* 1996), it would seem that the Late Ushki Palaeolithic culture of Kamchatka represents a side branch off the main route of cultural transmission. It would appear that an early group of people with a Dyuktai based tool kit initially bypassed Kamchatka in their move eastward onto the Beringian platform and thence into Alaska by before 12,000 BP. This script ignores the enigmatic level 7 of the Ushki 1 site (Figure 10.2:10) with its stemmed points and proposed dates of 14,300 ± 200 BP (GIN–167) and 14,200 ± 700 BP (MAG–550) (Dikov 1996) and the lack of fit of the level 7 inventory within either the Siberian or Alaskan chronological sequences.

THE PROBLEM OF EARLY CONTEMPORARY CULTURAL COMPLEXES IN ALASKA

The arrival time of the earliest Asian immigrants in Alaska and what they brought with them is then a continuing research problem that seems to be redefined as each new site is uncovered. At present, there are three Alaskan cultural complexes (Denali, Nenana, and Mesa) whose advocates vie for cultural priority, setting forth hypotheses regarding the early settlement of Alaska. The first hypothesis is that the entering or founder populations of Upper Palaeolithic folk brought with them a tool kit containing bifaces as well as microblades (Denali complex sites, Figure 10.1: 1–6, 8–9, 13–16, 19, 30–32, Figure 10.3) (Ackerman 1996d; Anderson 1988; Dumond 1981; Henn 1978; Larsen 1968; West 1967, 1975, 1981, 1996a). Advocates of the second hypothesis postulate that Alaska was first occupied by Upper Palaeolithic hunter-gatherers with a complex distinguished by small triangular or ovate bifacial points (Chindadn points) and tools made on blades (Nenana complex sites, Figure 10.1: 2–4, 6, 7, 9, Figure 10.4) (Cook 1969, 1996; Goebel *et al.* 1991, 1996; Goebel and Slobodin 1999; Hoffecker *et al.* 1993, 1996; Powers *et al.* 1983, 1990; Powers and Hoffecker 1989; Yesner 2001; Yesner *et al.* 1992). No microblades were found in Nenana complex assemblages. The third hypothesis for an early settlement of Alaska sharply diverges from the other two. Rather than focusing on movements out of Asia, investigators working in the central Brooks Range of northern Alaska (Mesa complex sites, Figure 10.1:10–11, Figure 10.5) and southwestern Alaska (Spein Mountain site, Figure 10.1:12, Figure 10.6) have stressed the importance of an early in-place Paleoindian type of adaptation (Mesa complex with a cluster of dates between c. 10,300 BP and c. 9700 BP, but with two early outliers at c. 11,700 BP and c. 11,200 BP) (Ackerman 1996b, 2001b; Bever

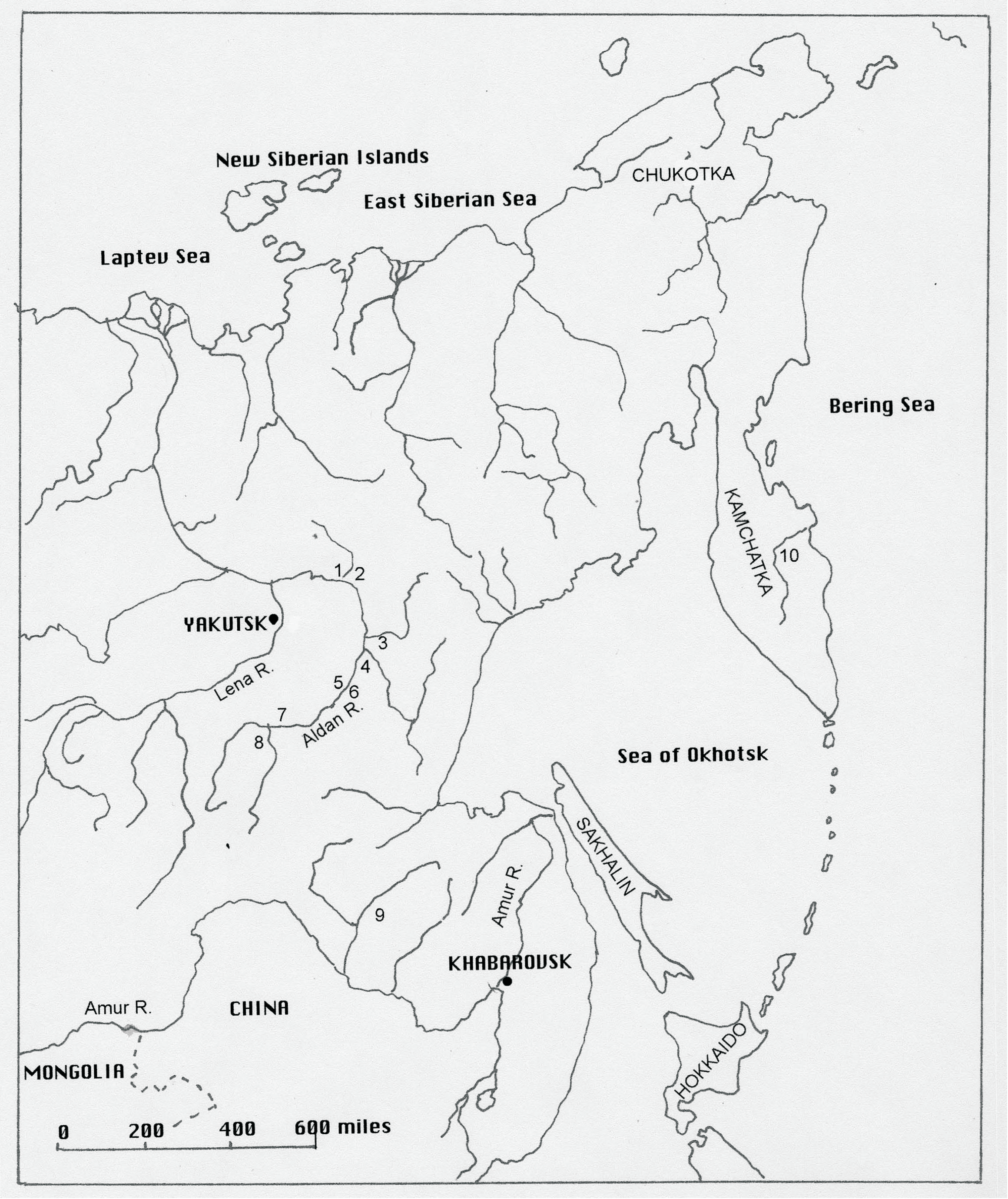

Figure 10.2: Siberian sites mentioned in text.
Dyuktai sites: (1) Ikhine 2, (2) Ikhine 1, (3) Ezhantsy, (4) Verkhne-Troitskaya, (5) Ust-Mil 2, (6) Dyuktai Cave, (7) Tumulur, (8) Ust-Timpton.
Selemdzha sites: (9) Ust-Ul'ma 1 and 2.
Ushki sites: (10) Ushki sites: Ushki 1–5.

2000; Kunz *et al.* 2003; Kunz 1982; Kunz and Reanier 1996; Reanier 1995, 1996; Reanier and Kunz 1994). The Mesa complex is characterized by an emphasis on lanceolate bifacial projectile points, bifacial knives, scrapers, gravers, burins, and notches (Ackerman 1996b, 2001b; Bever 1999, 2000, 2001; Kunz *et al.* 1999, 2003; Figures 10.5 and 10.6), and does not appear to have any apparent links to either the Denali or Nenana cultural complexes. The Mesa complex is seen as a Paleoindian cultural expression based on similarities with the techno-complex of late Paleoindian sites to the south and reflects adaptations made during the terminal Pleistocene (Bever 1999, 2000, 2001). The relatively short temporal interval of the Mesa complex occupation from c. 10,300–9700 BP (aside from the c. 11,000 year old outliers) as opposed to the longer duration of the Denali complex, is regarded as evidence of a very transitional cultural complex occasioned by the movement of Paleoindians from the south (Bever 2001) or by the movement of Alaskan Paleoindians to the south (Kunz *et al.* 2003). Whatever the source or trajectory of the Mesa complex, suffice it to say that during the period from 12,000/11,000 BP to 9000 BP in Alaska there were three rather distinctive technological traditions whose cultural relationships have yet to be determined. West (1996b) included the Denali, Nenana, and Mesa complexes in his Beringian tradition, while Holmes (2001) grouped all three within his Beringian period, both schemes thus avoiding the question of cultural relationships. Kunz (Kunz *et al.* 2003) made Denali a part of the Nenana complex, but left the Mesa complex as a separate entity.

INTERIOR ALASKAN MICROBLADE COMPLEXES

While consideration of these three contemporaneous cultural complexes at the end of the Pleistocene is certainly worthy of further exploration, I now turn to the specifics of microblade complexes and their place in the early prehistory of Alaska. Recognizably, the Denali complex (West 1967, 1975, 1981, 1996a) is the most widespread of the early cultural complexes with sites found throughout Alaska and into adjacent Yukon Territory. Regional differences in the site assemblages as well as placement within the temporal sequence are evident. At the Onion Portage site in northwestern Alaska (Figure 10.1:14), for example, wedge-shaped microblade cores and microblades were associated with face-faceted blade cores and blades in the Akmak component dating to 9570 ± 150 BP (K–1583) (Anderson 1970a, 1988; Figure 10.7:g–l). The association of microblades with blades from epi-Levallois-like cores led Anderson (1970a) to create the American Paleoarctic tradition. Microblade technology without the associated blade industry continued into the later Kobuk component (c. 8200–8000 BP) of the American Paleoarctic tradition (Anderson 1988; Figure 10.7:a–f). Anderson's (1970a) concept of the American Paleoarctic tradition proved to be too broad to fit the site assemblages discovered in the Tangle Lakes area of south-central Alaska (Figure 10.1:5). Here there were sites with microblades and bifaces, but without an associated blade industry prompting West (1967, 1975, 1981, 1984, 1987, 1996a, 1996b) to create a new archaeological complex, the Denali complex dating to between about 9500 BP and about 10,000 BP. Somewhat earlier dates were recovered from level 2 of the Dry Creek site (Figure 10.1:9, Figure 10.3) in the Nenana River valley of central Alaska, extending the age range to 10,690 ± 250 BP (SI–1561) (Hoffecker *et al.* 1993, 1996; Hoffecker 2001; Powers *et al.* 1983; Powers and Hamilton 1978). The basal dates for the Denali complex covered between c. 10,600 BP and c. 10,500 BP until charcoal samples from the lowest level of the Swan Point site (Figure 10.1:3, Figure 10.8) on Shaw Creek in the Tanana River valley of central Alaska provided new ^{14}C age estimates (Holmes 1998, 2001; Holmes *et al.* 1996). Recent investigations in the lowest cultural level, zone IV (Denali complex), resulted in the recovery of wedge-shaped, frontally fluted microblade cores, ridge flakes, platform tablets, transverse and dihedral burins (Figure 10.3:l–o), hammerstones, and cobble choppers/scrapers (not illustrated in Figure 10.3) with dates in excess of c. 12,000 BP (Holmes 1998, 2001; Holmes *et al.* 1996; C.E. Holmes personal communication 2003). A clear stratigraphic interval separates

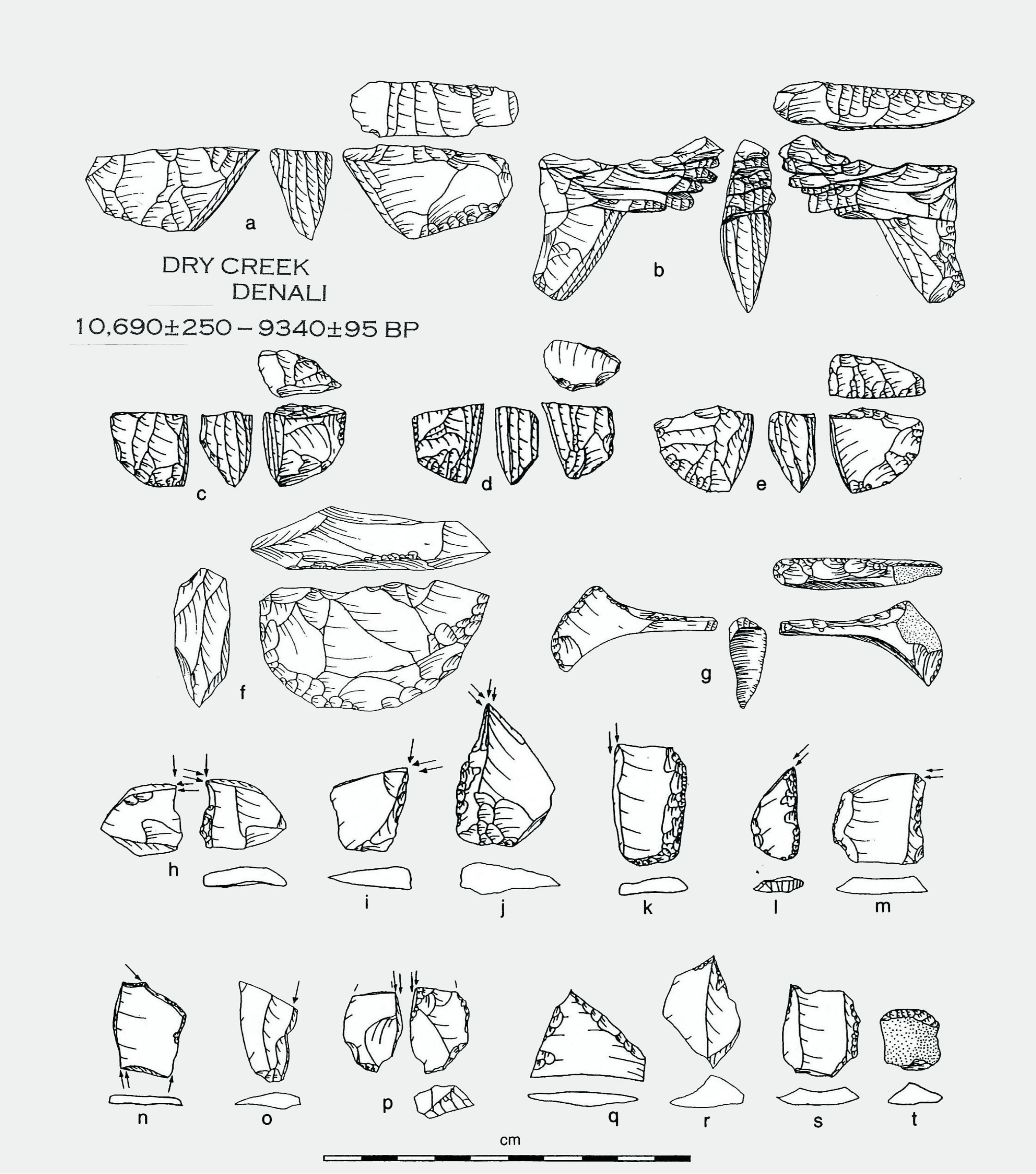

Figure 10.3: Denali component of the Dry Creek site.
Wedge-shaped microblade cores (a-e, b with attached core tablets), wedge-shaped core preform (f), core tablet (g), burins (h-p), retouched flakes (q-s), end scraper (t) (after Hoffecker *et al.* 1996).

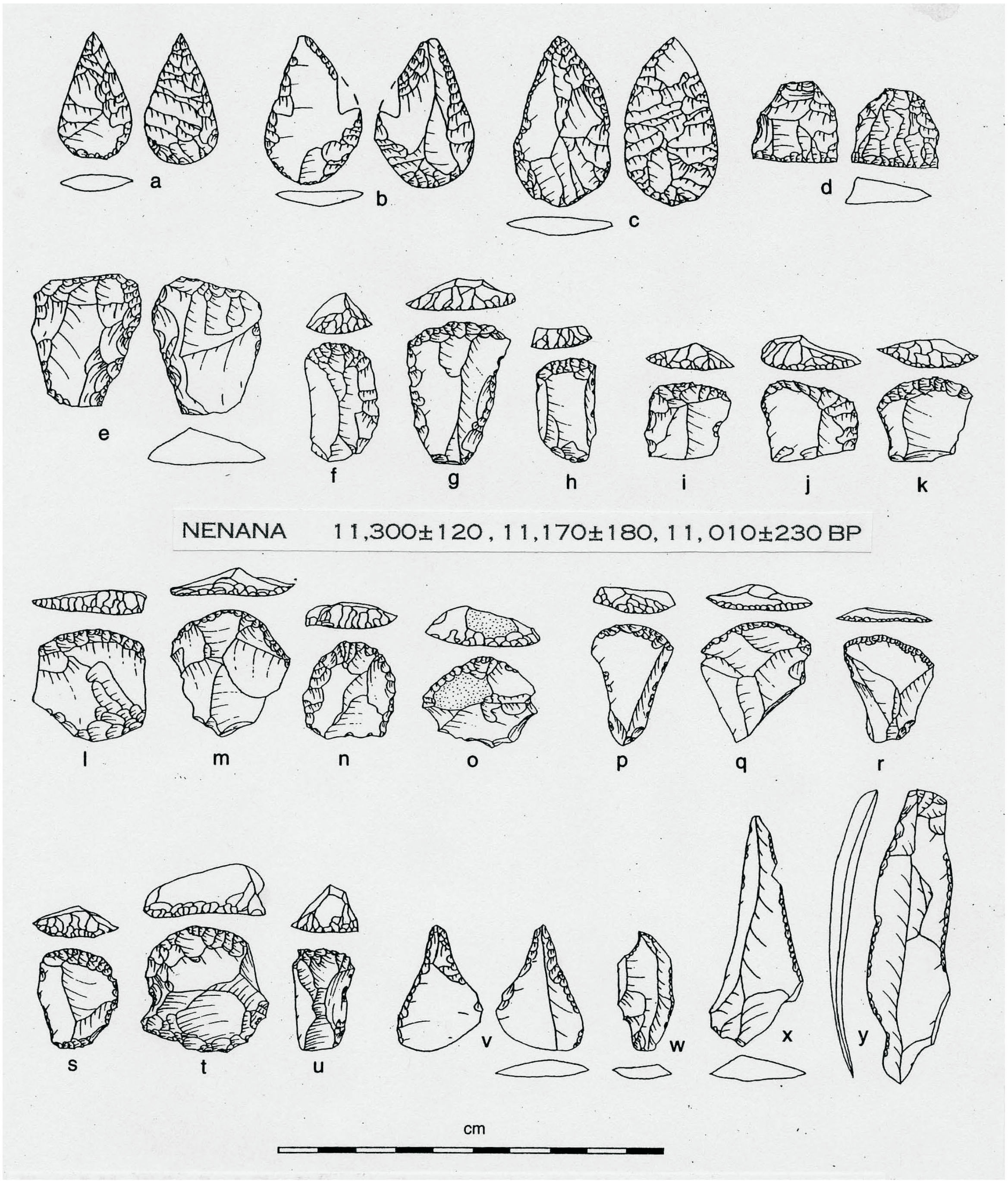

Figure 10.4: Nenana complex at the Walker Road site.
Chindadn projectile points (a-c), wedges (d and e), end scrapers on blades (f-k), end scrapers on flakes (l-u), perforators (v and w), retouched blades (x and y) (after Goebel *et al.* 1996).

cultural zone IV from cultural zone III where a Nenana complex (Figure 10.8:d–k) with small triangular to ovate bifacial points, basal fragments of lanceolate to concave based projectile points, and large bifacial scrapers or choppers, has been dated at 10,280±80 BP (Beta–56666) (Holmes 1998, 2001; Holmes *et al.* 1996:322).

The Swan Point sequence, however, appears to differ from those of other sites where Nenana underlies Denali. The Broken Mammoth site (Figure 10.1:2), also on Shaw Creek and downstream from the Swan Point site, contained a Nenana complex (Figure 10.9:m–q) in level III that dated to between 10,270±110 BP (WSU–4263) and 10,790±230 BP (WSU–4019). Level IV, dating to between 11,040±80 BP (CAMS–7203) and 11,770±210 BP (WSU–4351), contained, besides chipping debris, a core/scraper, a

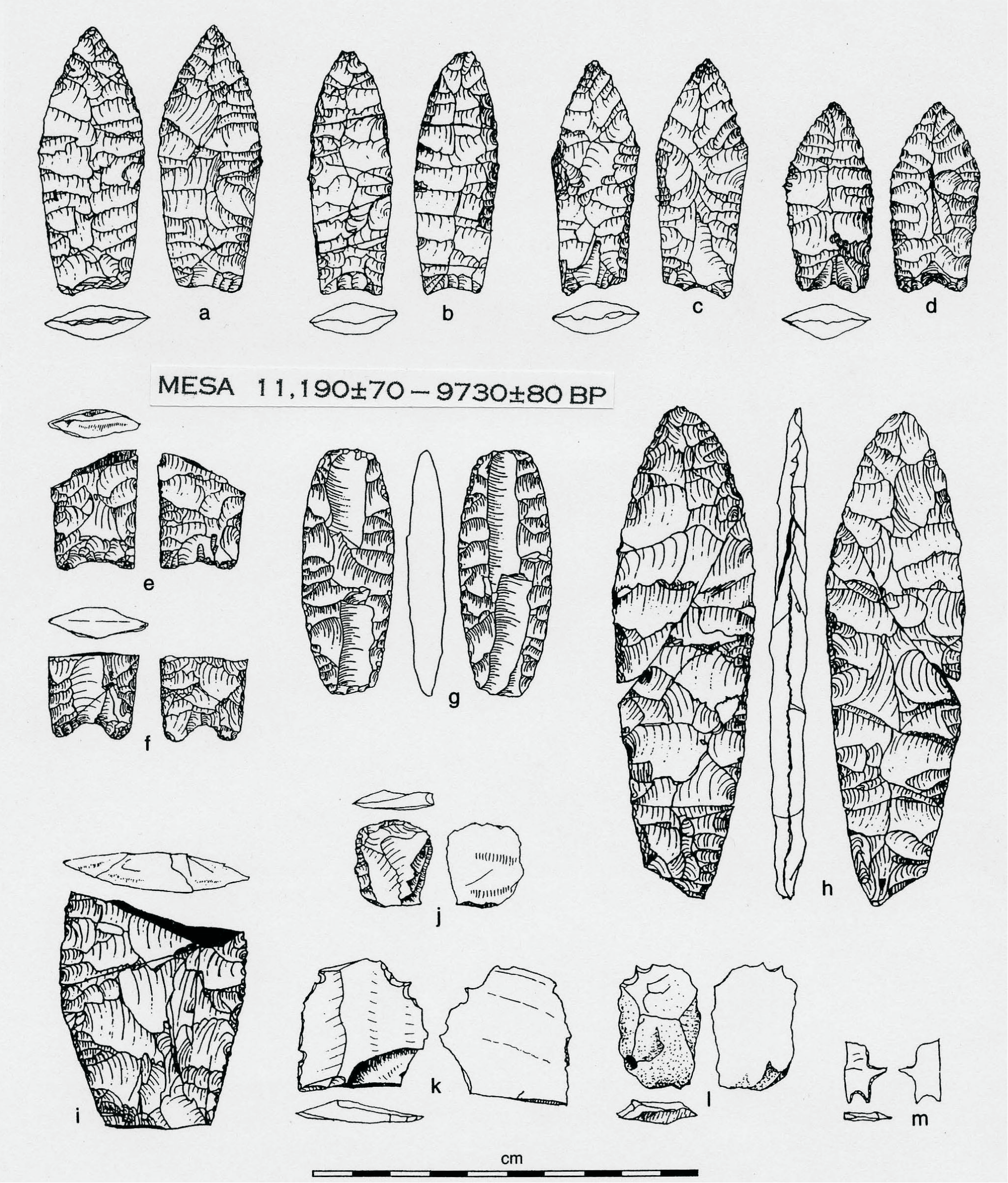

Figure 10.5: Mesa site complex.
Projectile points (a-f), biface with bipolar fluting (g), large bifaces (h and i), end scraper (j), gravers (k-m) (after Kunz and Reanier 1996).

modified flake, and three shaped mammoth ivory rods or points (Holmes 1996). Level IV has not been assigned to a cultural complex as yet (Figure 10.9), and it remains to be determined if that level should be assigned to the Nenana complex. The component with wedge-shaped microblade cores and microblades together with lanceolate points (Figure 10.9:a–l), instead of being an early cultural complex at the Broken Mammoth site, turned out to be rather late, possibly found only in level II (c. 7700–7200 BP) and in the upper cultural horizons, levels IA and IB (c. 4600 BP and c. 2000 BP; Hoffecker 2001; Holmes 1996; Yesner and Pearson 2002). This late occurrence has been interpreted as support for the Late Holocene persistence of

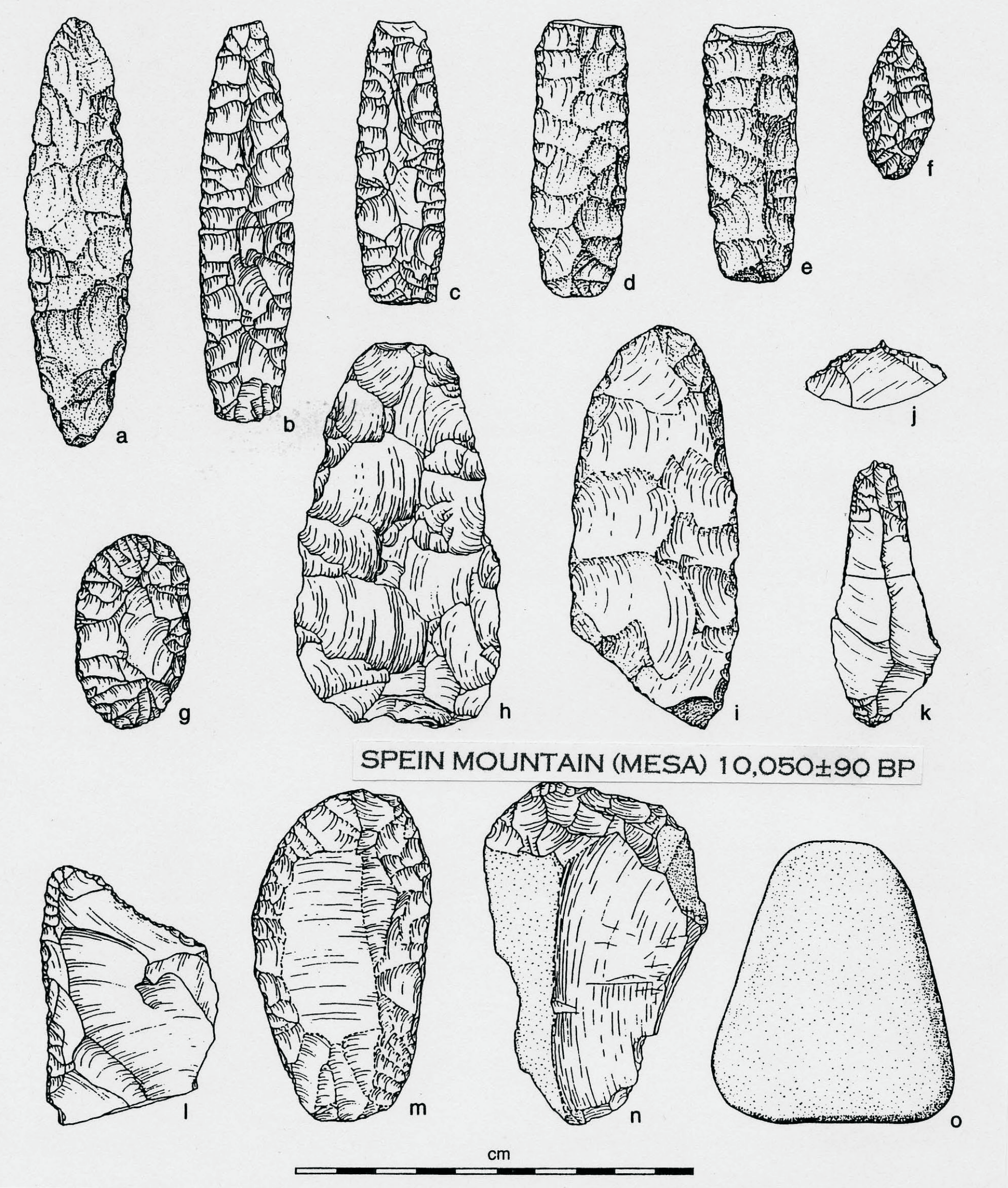

Figure 10.6: Spein Mountain site (Mesa complex).
Projectile points (a-f), bifacial adze blade insert (g), biface preforms (h and i), gravers (j and k), flake knife (l), end scrapers (m and n), whetstone (o) (after Ackerman 1996b).

the Denali complex (Dixon 1985; Yesner and Pearson 2002). The age assignment of between c. 4500 BP and c. 2000 BP for wedge-shaped, frontally fluted microblade cores at the Broken Mammoth site is admittedly puzzling for by 7400 ± 80 BP (WSU–4426) at the Swan Point site there were sub-conical to tabular microblade cores (Holmes *et al.* 1996; Figure 10.8: a–c) demonstrating that new core forms were already in use prior to the time of the hypothesized Late Holocene Denali component at Broken Mammoth. The tabular microblade cores at the Swan Point site (Figure 10.8:a) are likely associated with a side-notched projectile point complex. The conical microblade cores (Figure 10.8:b) are similar to those found in the Late Tundra tradition (Figure 10.17:a–c) (Ackerman 1985, 1987, 2001a; West *et al.* 1996).

As an aside, I should note that there are often problems with dating the upper levels of the rela-

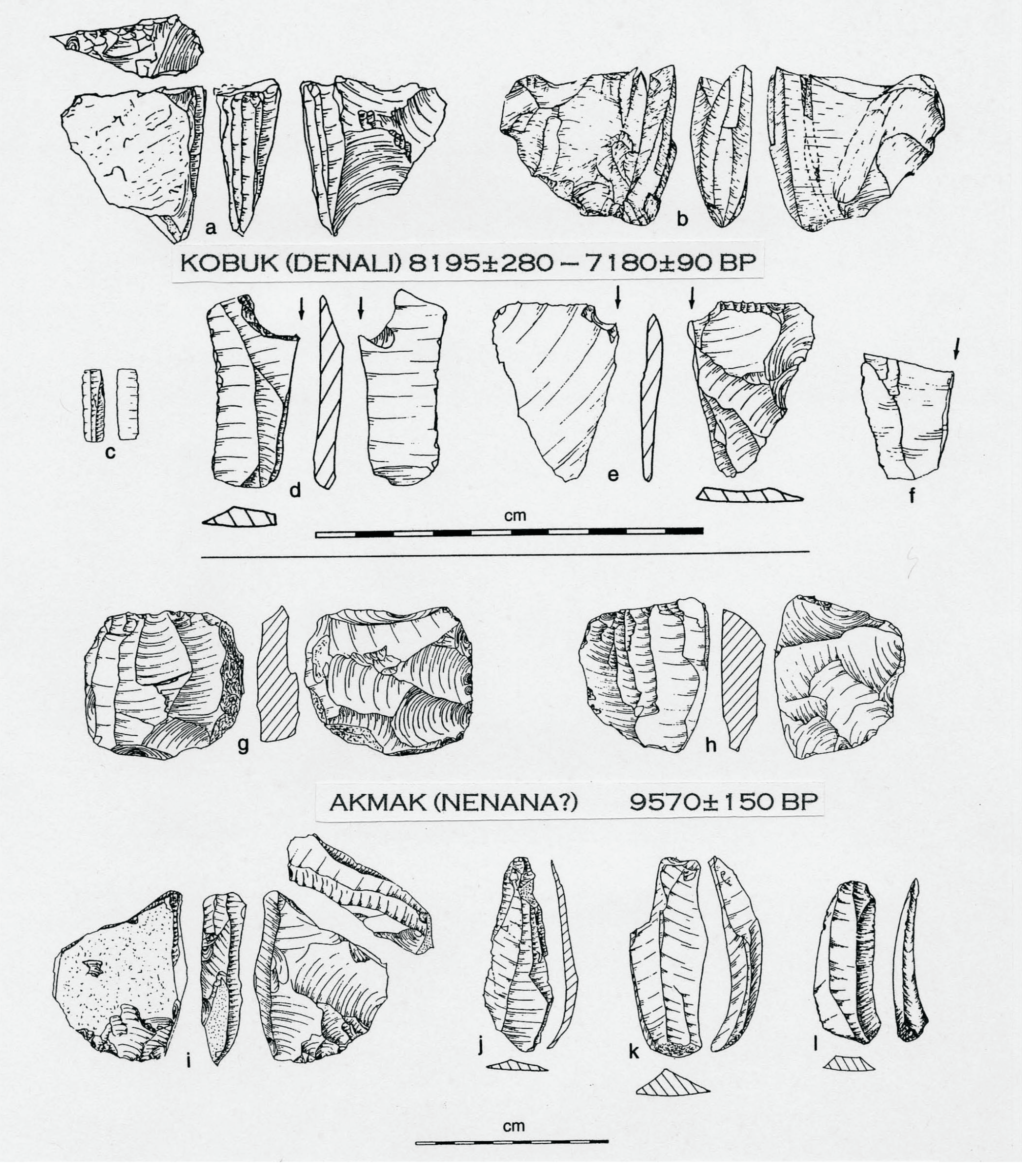

Figure 10.7: Onion Portage site, Akmak (a, c–e, g–l) and Kobuk (b, f) components. Wedge-shaped microblade cores (a and b), microblade (c), burins (d–f), face-faceted blade cores (g and h), edge-faceted blade core (i), large blades (j–l) (after West 1996c).

tively shallow, loess-capped archaeological sites in Alaska. During the last 4000 years there has been a dramatic increase in wildfires across Alaska (Thorson and Hamilton 1977). Charcoal is often plentiful in the upper deposits of ridge-topped sites and such samples are open to question unless there is clear evidence of a human agency. My own experience at the Ilnuk site, a Denali camp and workshop on a ridge overlooking the Holitna River in southwestern Alaska (Figure 10.1:13), is a case in point (Ackerman 1996e). All of our samples of charcoal, even those that we thought were associated with calcined bone and hence a hearth, dated to less than 4000 BP, much to our disappointment. All samples came from sediments above a tephra layer derived from the c. 4000 BP eruption of the Aniakchuk Volcano (Riehle *et al.* 1987). It turned out that we had dated charcoal left behind by a series of wildfires. To add to the confusion, we found that cryoturbation had moved artifacts from beneath the ash layer into the covering aeolian sediments. Fortunately, much of the Denali component was recovered from beneath the ash layer, but as yet remains undated.

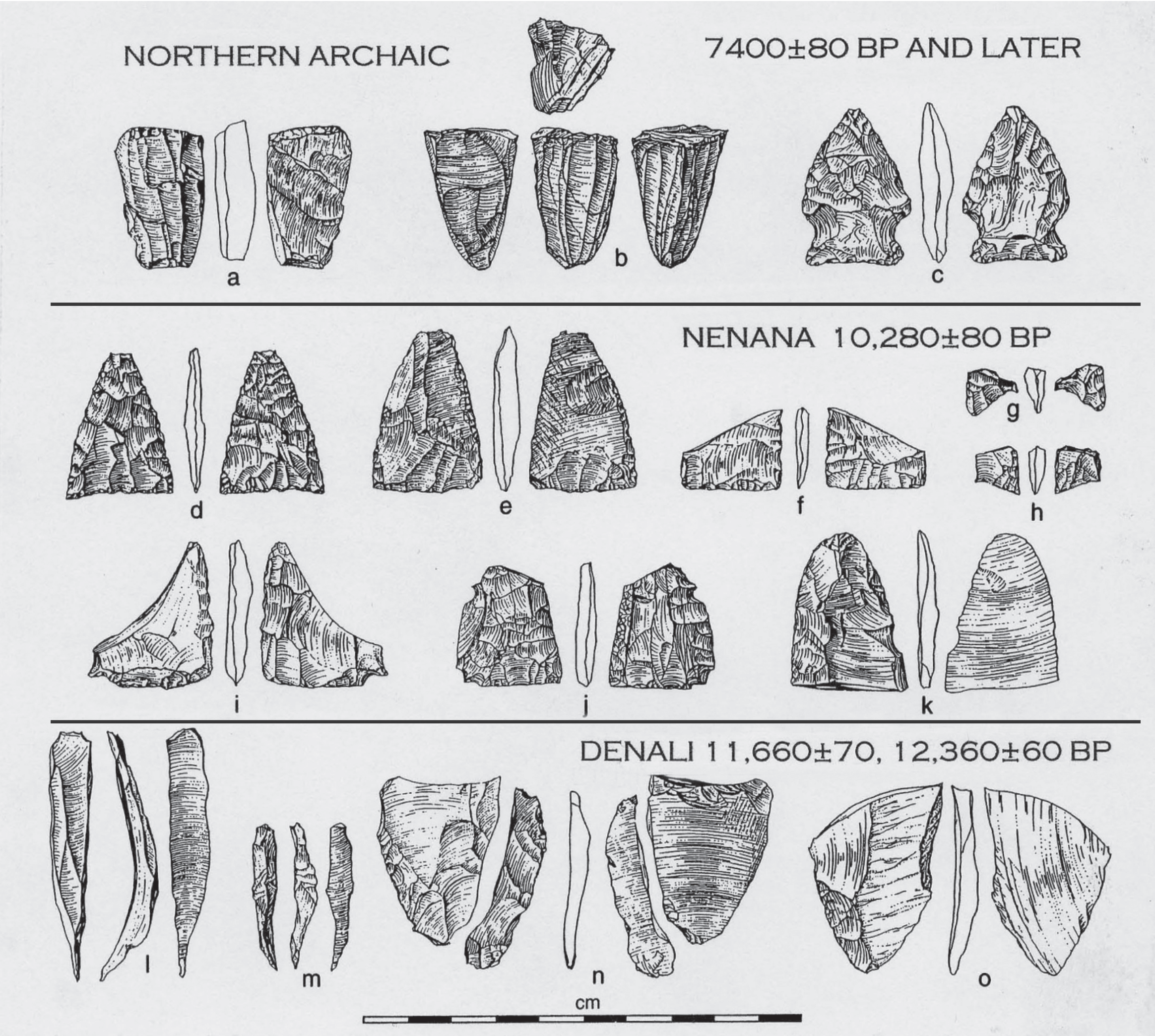

Figure 10.8: Swan Point site, upper (a–c), middle (d–j), and lower (k–o) components. Microblade cores (a and b), projectile points (c–h), perforators on projectile point fragments (i and j), large blade (k), microblade core preparation flakes (l and m), burins (n and o) (after Holmes *et al.* 1996).

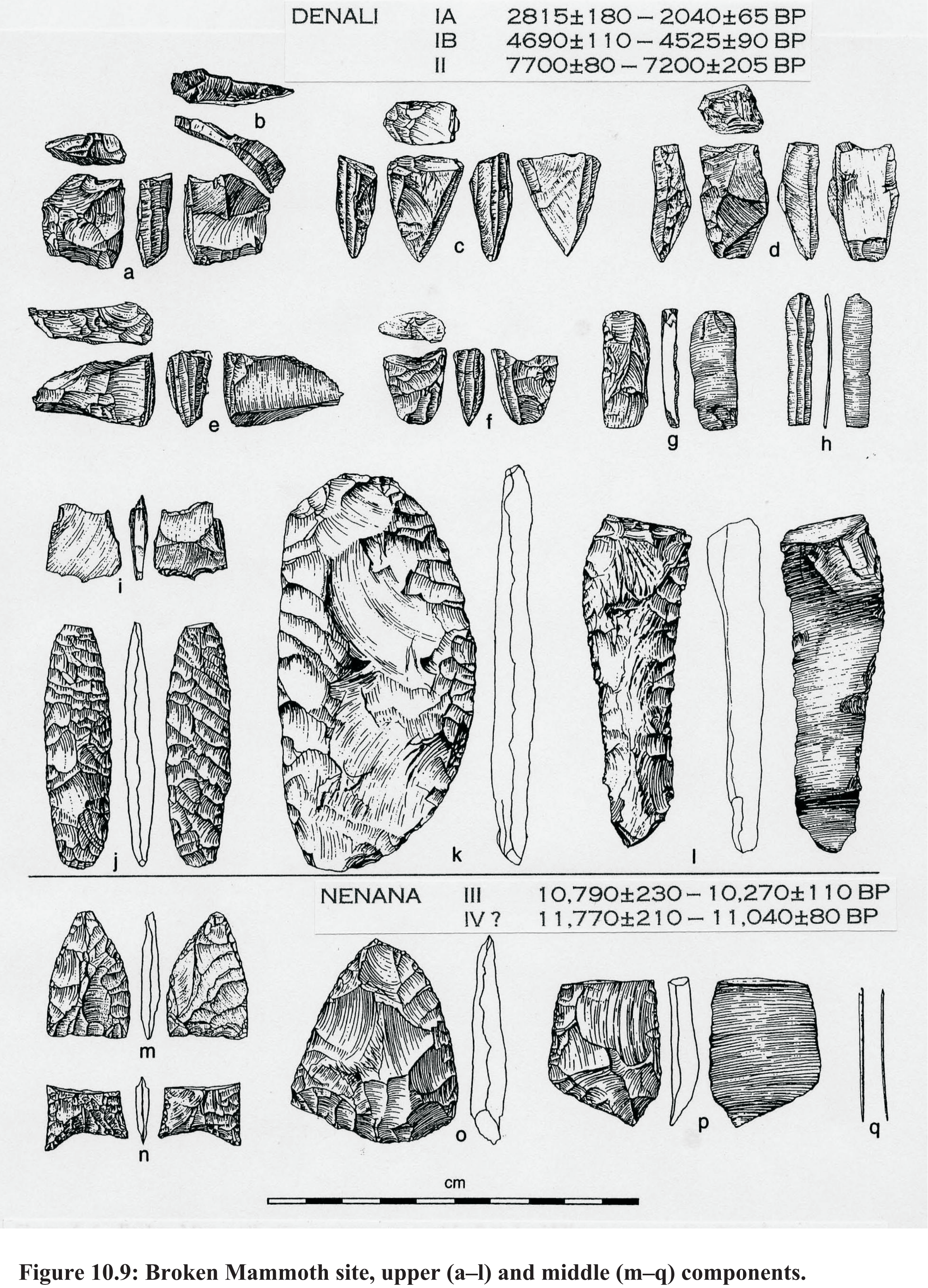

Figure 10.9: Broken Mammoth site, upper (a–l) and middle (m–q) components. Wedge-shaped microblade cores (a, c–f), microblade core tablets (b and g), microblade (h), burin (i), projectile points (j, m, n), bifaces (k and o), modified blades (l and p), eyed bone needle (q) (after Holmes 1996).

COASTAL ALASKAN MICROBLADE COMPLEXES

Leaving interior Alaska for the moment, the presence of Denali type microblade cores and microblades in coastal sites in southeastern Alaska demonstrate that the technological complex was not restricted to interior big game hunters. The sites in southeastern Alaska would have required the use of watercraft and the focus would have been on marine resources. One of the sites, Ground Hog Bay 2 (Figure 10.1:15), was found on an elevated marine terrace back of a small embayment that opened into Icy Strait (Ackerman 1980, 1990,

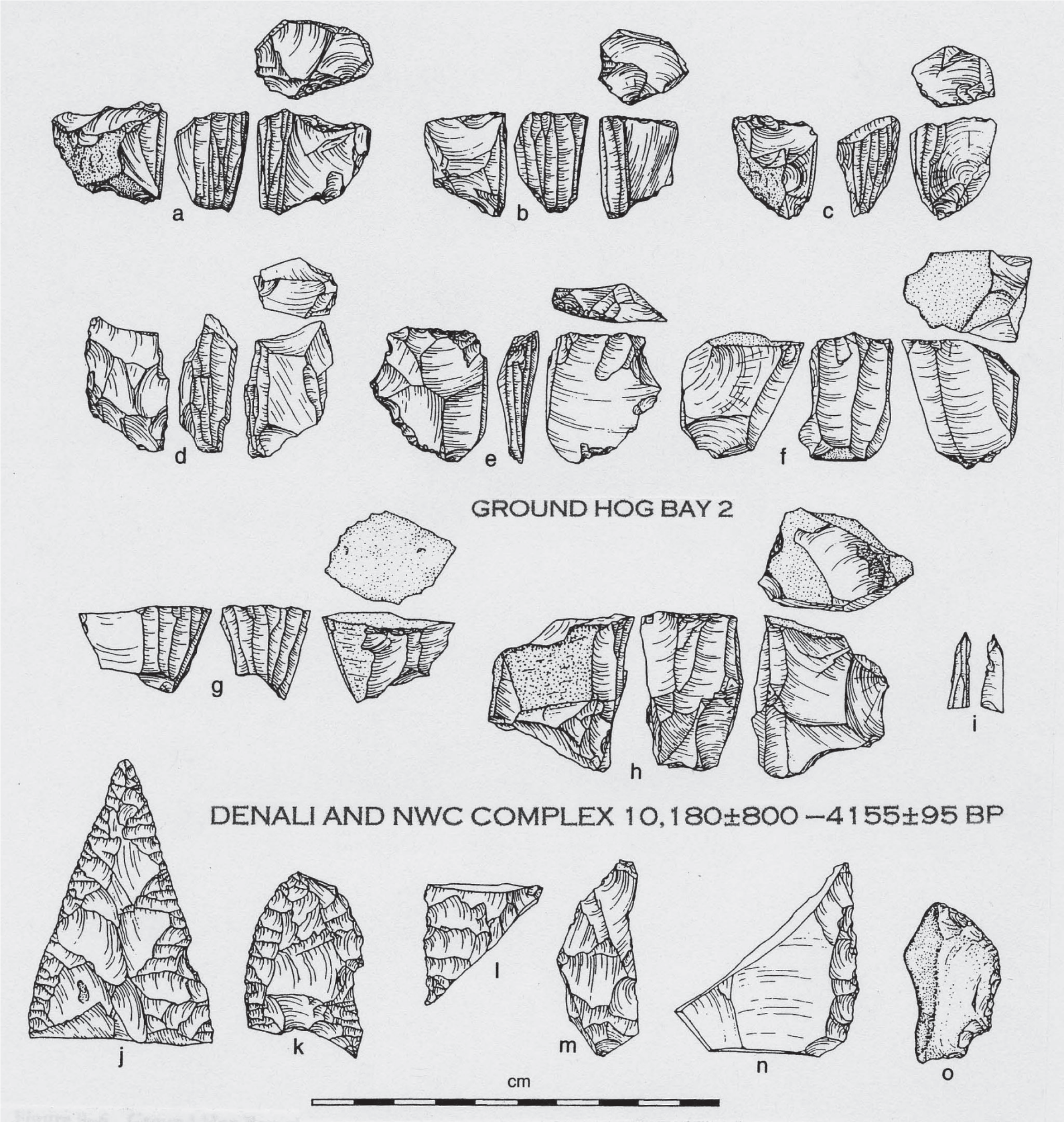

Figure 10.10: Ground Hog Bay, site 2, lower component.
Wedge-shaped microblade cores (a–d), Donnelly type burin (e), blocky to cuboid cores (f–h), microblade with graver tip (i), biface fragments (j–m), side scrapers (n and o) (after Ackerman 1996d). (NWC = Northwest Coast)

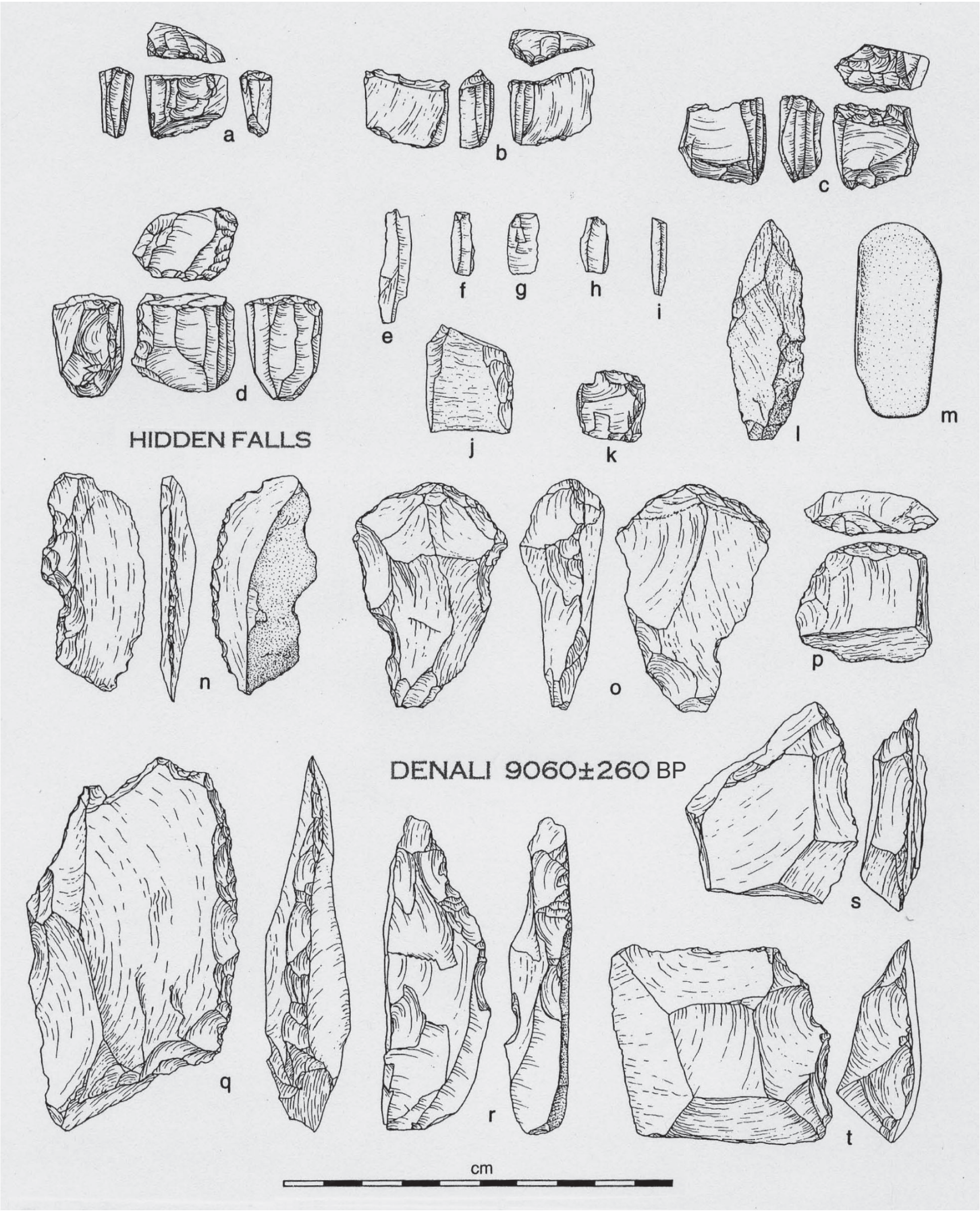

Figure 10.11: Hidden Falls site, lower component.
Microblade cores (a–d), microblades (e–i), burins (j and k), unifacial blade or point (l), abrader (m), notched scrapers (n and o), end scraper (p), side scrapers (q and r), core scrapers (s and t) (after Davis 1996).

1992b, 1996c, 1996d; Ackerman *et al.* 1979). Another site, the Hidden Falls site on Baranof Island (Figure 10.1:16), was positioned on an elevated terrace that overlooked Kasnyku Bay and Chatham Strait (Davis 1989, 1990, 1996). Both sites contained basal components with frontally fluted, wedge-shaped microblade cores of obsidian and dated to between c. 10,000 BP and c. 8000 BP (Figures 10.10 and 10.11). Microblade production continued at the Ground Hog Bay 2 site to perhaps as late as 4200 BP, but during the later part of the interval the frontally fluted, wedge-shaped microblade cores of obsidian (Figure 10.10:a–d) were replaced by blocky to cuboid cores of chert or argillite (Figure 10.10: f–h; Ackerman 1996d). At the Hidden Falls site there was a temporal hiatus of several thousand years after the c. 9500–9000 BP dated microblade component (Davis 1989, 1990, 1996). By about 4600 BP shell middens and ground stone tools became an integral part of the cultural sequence (Lightfoot 1989).

The Chuck Lake site (Figure 10.1:17, Figure 10.12) on Heceta Island provided new data on the modifications in microblade core technology that occurred as new sources of raw materials were utilized (Ackerman 1990, 1992b, 1996c; Ackerman *et al.* 1985). Instead of using obsidian as a raw material as had the early occupants of the Ground Hog Bay 2 and Hidden Falls sites, a resource that had to be obtained from quarries on Sumez Island (Moss and Erlandson 2001) or from Mount Edziza on the Stikine River (Fladmark 1985), occupants of the Chuck Lake site by c. 8200 BP had turned to the use of local raw materials, such as argillite, with the result that the core

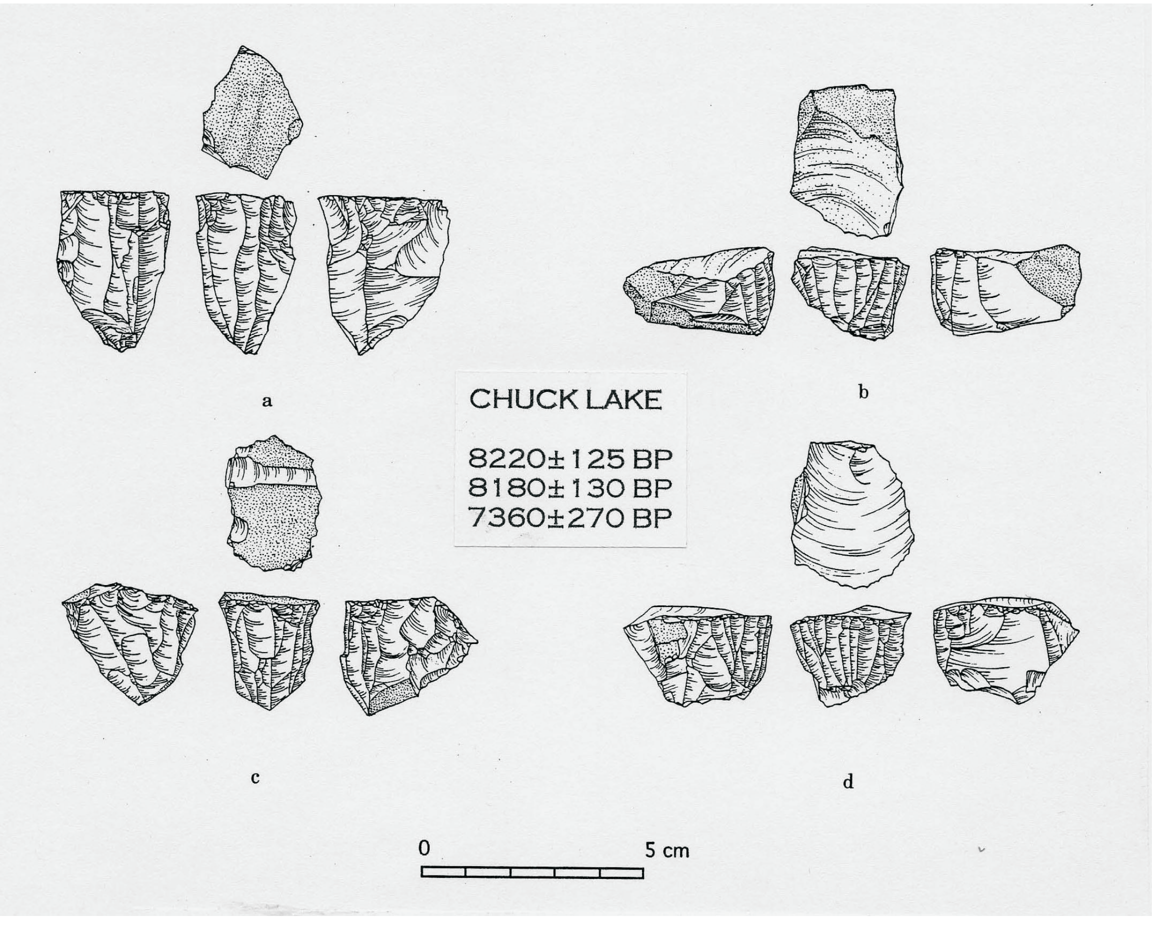

Figure 10.12: Chuck Lake site.
Cuboid to cylindrical microblade cores (a-d) (after Ackerman 1996c).

forms were prismatic rather than wedge-shaped and microblades were detached from around the circumference of the core rather than being restricted to a narrow frontal flute face (Ackerman 1996c; Ackerman *et al.* 1985; Figure 10.12). Platforms were either natural or flattened by the removal of flakes struck from the margins (Ackerman 1996c; Ackerman *et al.* 1985). Similar cores had been found in later levels of the Ground Hog Bay 2 site (Ackerman 1996d; Figure 10.10:f–h). Both wedge-shaped and prismatic microblade cores were recovered from the c. 7600 year old

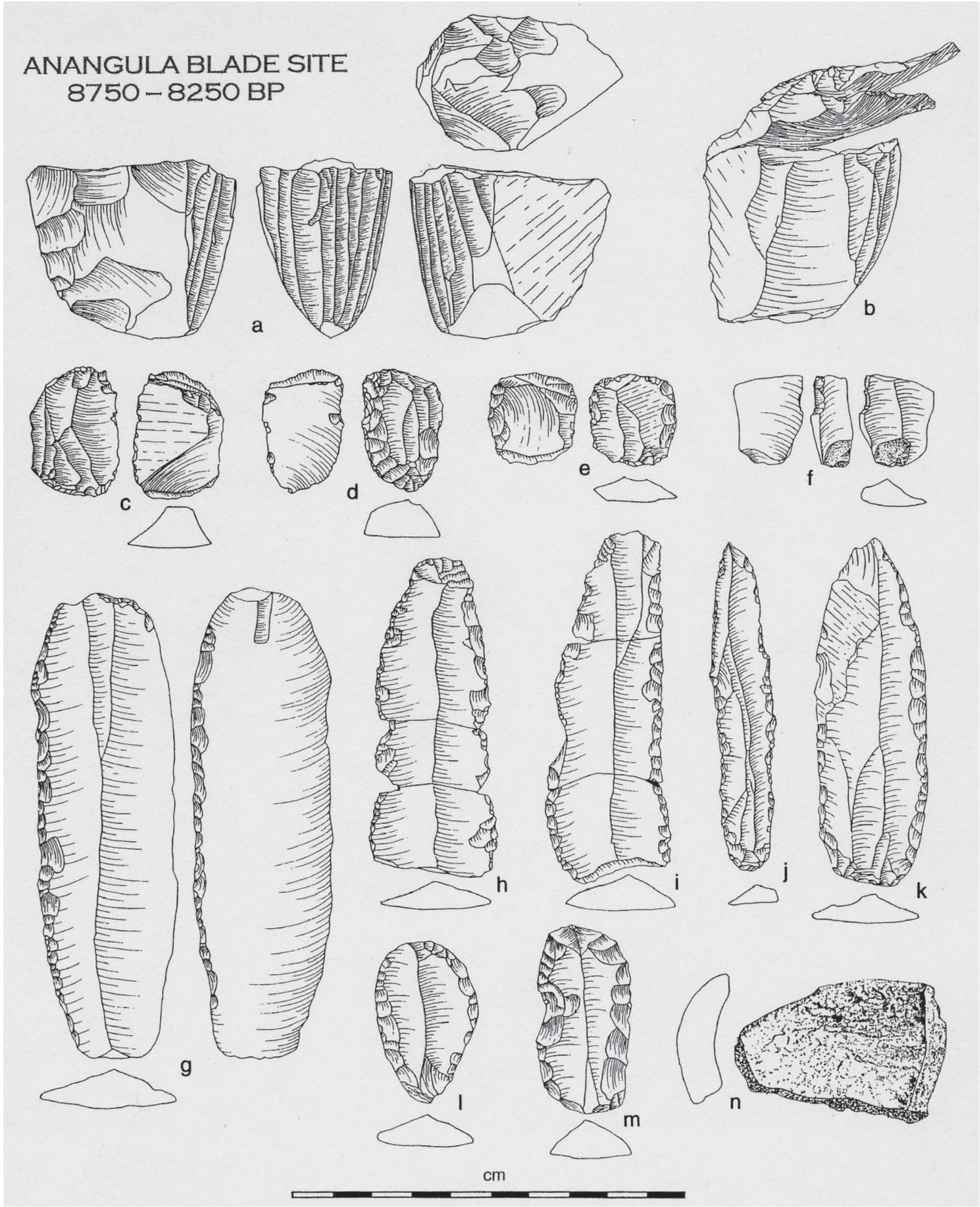

Figure 10.13: Anangula Blade site.
Blade cores (a and b), transverse burins (c-e), blades with marginal retouch (g-k), end/side scrapers (l and m), stone bowl fragment (n), angle burin (f)
(after McCartney and Veltre 1996).

Thorne River site (Figure 10.1:18) on Prince of Wales Island (Dale *et al.* 1989), and only prismatic to cuboid cores at the c. 5000 year old Irish Creek site (Moss *et al.* 1996; Figure 10.1:19).

The southeastern Alaskan site data revealed that people with a Denali type microblade technology initially occupied the mainland and nearby islands by at least 10,000–9500 BP, employed the use of watercraft, used marine resources, and probably reached the area via a coastal route during a time of rising sea levels at the close of the Pleistocene (Ackerman 2003). In Alaska, this is the earliest evidence of a maritime adaptation.

The occupation of the Aleutian Islands and Kodiak Island would come somewhat later as a Sumnagin-related cultural complex in the c. 9000–7000 BP time range (Ackerman 1992b; Knecht and Davis 2001). Initial occupations on Anangula

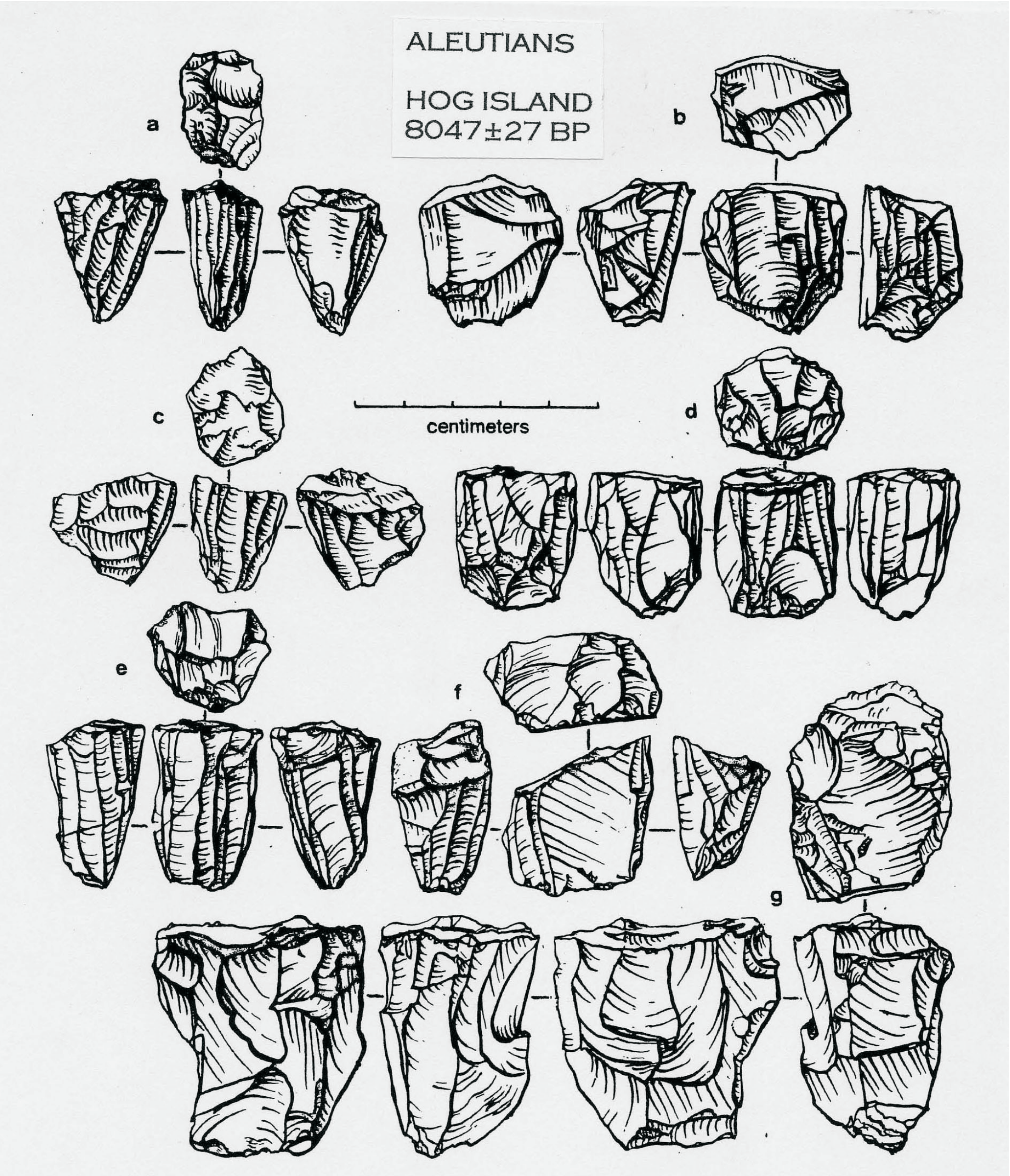

Figure 10.14: Hog Island site.
Blade cores (a-g) (after Dumond and Knecht 2001).

Island (Figure 10.1:20, Figure 10.13) off Umnak Island (Aigner 1978; Laughlin 1975; Laughlin and Aigner 1966; McCartney *et al.* 1998; McCartney and Veltre 1996) and on Hog Island in Unalaska Bay (Figure 10.1:21, Figure 10.14; Dumond and Knecht 2001; Knecht and Davis 2001) were marked by blade industries with no associated bifaces. Later microblade complexes (c. 6600–6000 BP) recovered from the Zaimka Mound, Rice Ridge, and Tanginak Springs sites on Kodiak Island (Figure 10.1:22), were said to have been based upon the core and blade industries of the eastern Aleutians rather than the Denali complexes of the adjacent Alaska Peninsula (Steffian *et al.* 2002). If so, this would give additional credence to a separate centre of early maritime development in the Eastern Aleutians-Kodiak Island region as opposed to the southeastern Alaskan region where striking resemblances between the microblade cores from the Ground Hog Bay 2 site and those from the Denali complex of the Ilnuk site on the Holitna River of southwestern Alaska have been noted.

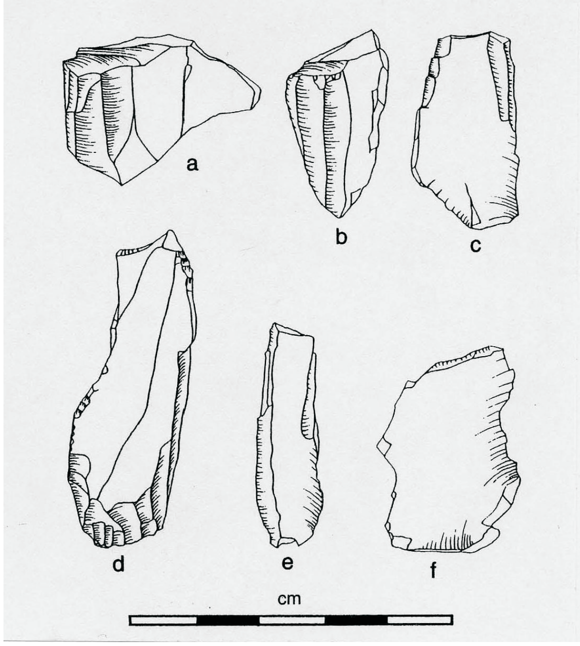

Figure 10.15: Bluefish Cave 2 site. Microblade cores (a and b), angle burins (c-f) (after Ackerman 1996f).

YUKON TERRITORY MICROBLADE COMPLEXES

Returning to the interior, microblades appeared in the Yukon Territory at rather different times and often were associated with rather different assemblages (Clark and Gotthardt 1999). The earliest reported occurrence is in the northern Yukon at the Bluefish Caves (Figure 10.1:23, Figure 10.15) with a suggested occupation of between 13,000 BP and 10,000 BP (Cinq-Mars 1990). If the dating is correct, peoples with a microblade technology were in the northern part of the Yukon Territory while similar microblade using groups were in the Nenana and Tanana valleys of central Alaska. One would wish for other similarly aged sites in the northern Yukon and adjacent Alaska to support the Bluefish Cave record. There is then an apparent gap of several thousand years, for there are no other reports of microblades until considerably later when macroblades and possibly microblades were found at sites associated with the Northern Cordilleran tradition (Gotthardt 1990). Sites in the Rock River area in the northern Yukon (Figure 10.1:24) contained blades, small blades that might be considered microblades, and the Kamut type of bifacial projectile point. The association of a Campus type microblade core with a date of 7160±60 BP (Beta–97212) is, however, uncertain (Clark 2001; Clark and Gotthardt 1999). A more certain association is the date of 7310±40 BP (Beta–154960) obtained from a bone dart point from an alpine ice patch in the Coast Mountains of southwest Yukon (Hare *et al.* 2004). Lateral slots were cut into the dart point for the insertion of microblades. It would appear that arming of antler or bone throwing darts was by insetting microblades into side slots or tipping them with stone bifacial points (Hare *et al.* 2004). As yet neither microblades nor microblade cores have been reported from the alpine ice patches. An Acosta culture complex found on the north shore of Great Bear Lake in the Mackenzie District contained Donnelly type burins and Kamut points linking it to the Rock River sites in the Yukon, but the assemblage lacked microblades (Clark and Gotthardt 1999). Microblades, but no cores or core tablets, were recovered from a site near Annie Lake just south of Whitehorse (Figure 10.1:25) that dated between c. 7160 BP and c. 6320 BP and has been assigned to the Little Arm phase of the Yukon sequence (Clark 2001; Greer 1993). Extensive collections of Denali type microblade cores were recovered at workshop concentrations at Kelly Creek (Figure 10.16) and at Otter Falls (Figure 10.1:26, 27; Clark 2001; Clark and Gotthardt 1999). The Kelly Creek site is estimated to date between c. 7000 BP and c. 4500 BP (Clark and Gotthardt 1999), while the Otter Falls site has a late date of 4570±50 BP (Workman 1978) that has been questioned as too recent. There is then considerable evidence of the spread of the Denali complex to western Canada, but the evidence is quite uneven. Clark (2001:66) noted that "...some Cordilleran peoples appear to have been familiar with microblades, but their industry was not based on the Denali or Campus type of core." The later appearance of microblades in the southern part of the Yukon Territory and at the Pointed Mountain

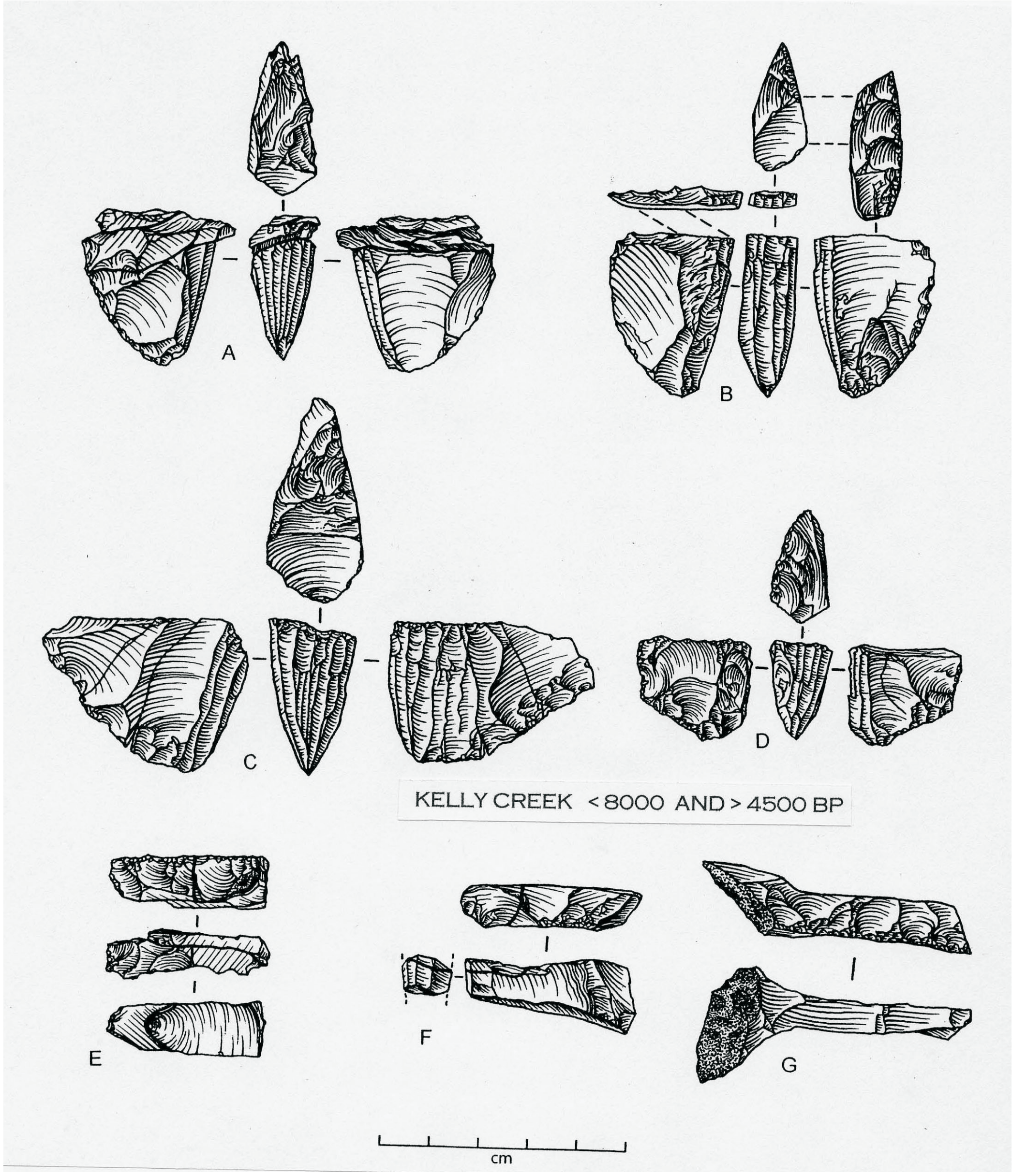

Figure 10.16: Kelly Creek site.
Wedge-shaped microblade cores (A-D), platform tablets (E-G) (after Clark 2001).

site in the Mackenzie District between c. 6000 BP and c. 4000 BP (Morrison 1987) has been associated with the Northwest Microblade tradition (MacNeish 1954), a loosely defined tradition that encompassed a variety of microblade core types, bifacial tools such as side-notched, corner-notched, and leaf-shaped points and knives, flake burins, and macroblades (Clark 2001; MacNeish 1954). Dates for the Northwest Microblade tradition range from c. 8000–7000 BP to as late as c. 4500 BP at the Otter Falls site where classic Denali type cores were recovered (Workman 1978). The prehistoric complexes in the Yukon Territory seem to reflect a mix of influences with microblade technology coming from Alaska to the west, and projectile point assemblages from British Columbia and Alberta to the south. During the time when there was increasing evidence for a Denali presence in the Yukon Territory there was also evidence of a Northern Archaic component. These Northern Archaic components have conical, cylindrical, pyramidal, cuboid, tetrahedral, and scalene types of microblade cores (Clark 2001), suggesting that by the mid-Holocene the Yukon Territory is subject to many cultural currents.

LATER ALASKAN CULTURAL COMPLEXES

Returning to Alaska, the Denali cultural complex was replaced by a culture complex known as the Sumnagin in Siberia (Mochanov 1984, 1993) and by the Late Tundra tradition in Alaska (Ackerman 2001a) that includes sites such as the previously mentioned Anangula (Aigner 1978; McCartney and Veltre 1996), Hog Island (Dumond and Knecht 2001; Knecht and Davis 2001), Kagati Lake (Ackerman 1987; Figure 10.1:28), and Whitmore Ridge (West *et al.* 1996; Figure 10.1:29, Figure 10.17) sites. These sites are characterized by an emphasis on blade/microblade production where the blades/microblades were detached from the circumference of prismatic to conical cores. Platforms were created and modified by the removal of platform flakes detached from the edges of the platform. Often, when step fractures prevented the further removal of blades, the entire top of the core was removed as an oval to round platform tablet. In terms of technology, both blade and microblade cores were similar in morphology although different in size, and reflected similar manufacturing procedures. While bifaces were rare to non-existent in the Sumnagin culture of Siberia (Mochanov and Fedoseeva 1984) and are absent in the assemblage from the Anangula site (Aigner 1978), bifaces were recovered with blades at the Kagati Lake (Ackerman 1987) and Whitmore Ridge (West *et al.* 1996) sites. The Sumnagin culture in Siberia spans the period from about 10,500/9500 BP to about 6200 BP (Mochanov and Fedoseeva 1984), whereas sites of the Late Tundra tradition are largely undated with the exception of Anangula with an occupation between about 8250 BP and 8750 BP (McCartney and Veltre 1996). There does not seem to be any cultural overlap between the Dyuktai/Denali and Sumnagin derived complexes in either Siberia or Alaska. It is as if an entering cultural wedge were inserted between the Dyuktai cultural complex and the following Neolithic cultures in Siberia, and between the Denali complex and the Northern Archaic tradition in Alaska. In some Northern Archaic sites there are tabular, prismatic to blocky microblade cores (Campbell 1961, 1962; Dixon 1985; Dumond 1981, 1984), while in others there is no evidence of a blade or microblade technology (Ackerman 1963, 1964, 1985, 1994, 2004; Anderson 1988). There may have been a sharing of elements from both the Denali complex and Northern Archaic tradition in some of the Yukon sites as that is where the multi-complex Northwest Microblade tradition concept was developed (Clark 2001). In many parts of Alaska this does not seem to be the case. I would prefer to derive those microblade cores that are found in Northern Archaic tradition sites from an intermediate complex or tradition between the Denali and the Northern Archaic tradition (Ackerman 2001a).

It is only with the Arctic Small Tool tradition in Alaska (Irving 1962, 1964), beginning roughly about 4500 BP, that there is a return to an emphasis on microblades, a tool kit that is strongly reminiscent of the Siberian Neolithic. The assemblage is characterized by bifacially flaked, small end and side blades made on flakes or microblades. These end blades and side blades were inserted into antler arrowheads similar to the practice of

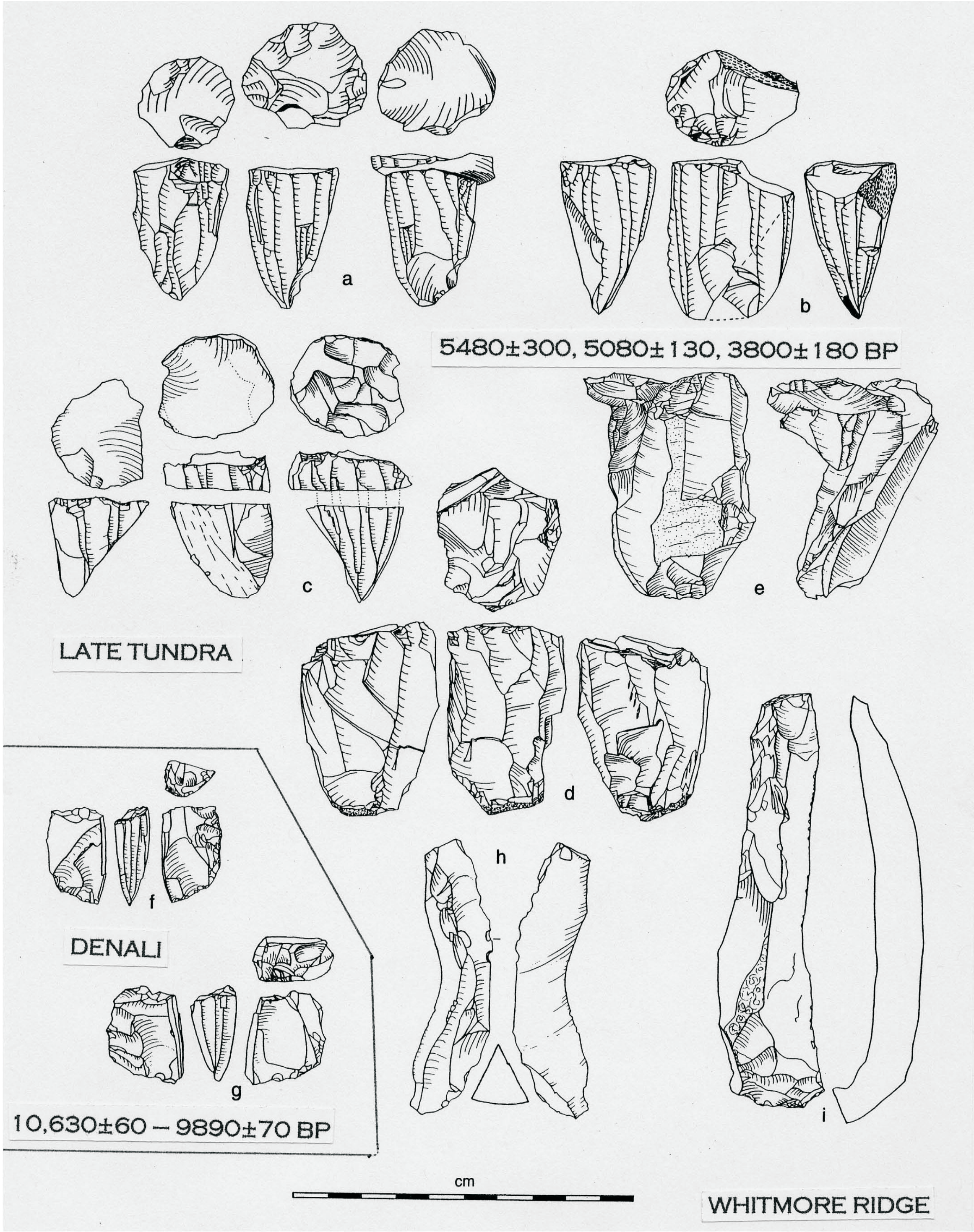

Figure 10.17: Whitmore Ridge site.
Conical cores with articulating core tablets (a-c), subconical cores (d and e), wedge-shaped microblade cores (f and g), crested blades (h and i) (after West *et al.* 1996).

using microblade inserts earlier in the Denali complex (Ackerman 1996a). With the onset of the Choris/Norton phase, c. 3000 BP, microblades disappeared as part of the cultural inventory of mainland Alaska.

WHY MICROBLADES?

The age and distribution of microblades has been briefly touched upon in the above discussion, but why did microblades rather suddenly become very popular in Asia around 18,000–20,000 BP and why their continued use during the Late Pleistocene and Early to Middle Holocene in Alaska? The function of microblades has been extensively discussed in the archaeological literature (Knecht 1997a, 1997b), and microblades have been recovered in end hafted and side hafted implements in Siberian sites dating from the Upper Palaeolithic into the Neolithic/Bronze ages (Abramova 1979; Derevianko *et al.* 1998c; Dikov 1996; Pitul'ko 1993; Pitul'ko and Kasparov 1996). Their use has been largely associated with bone or antler projectile points in the Arctic where cold temperatures mitigate against the use of stone points that become extremely brittle in low temperatures (Guthrie 1983) and where use efficiency and risk-minimizing are relevant (Elston and Brantingham 2002; Knecht 1997a, 1997b). Does this explain their relatively sudden popularity? In a very provocative paper, Mason *et al.* (2001) noted that the greatest number of Denali complex site occupations in Alaska are associated with a temperature decline between c. 8500 cal BP and c. 8000 cal BP (roughly 8000–7500 BP). They hypothesized that periods of cooler conditions would have promoted caribou herd increases (Mason *et al.* 2001). Expanding on this idea, was the onset of cooler conditions during the Sartan (i.e., Late Wisconsin) glacial stadials also a time of similar herd increases throughout Beringia?

Further, why or how did the increase in certain herd animals such as caribou bring about an increased interest in microblades? I think that the answer may lie in the type of hunting strategies employed (Churchill 1993). This was demonstrated by the recovery of organic hunting implements during our excavation of a cave in the Lime Hills region of southwestern Alaska (Ackerman 1996a; Figure 10.1:31). In the 3rd cultural horizon of the cave we recovered three fragments of side slotted antler arrowheads, a base and mid section of an antler side slotted spearhead, and 56 microblades. Since the organic artifacts provided evidence for the use of microblades, their recovery was particularly important. The largest antler arrowhead fragment (10.72 cm long) consisted of a beveled tang and a mid section with two opposing and continuous side slots that extended 3.72 cm back from the broken end (Figure 10.18:b). The arrowhead was ground to an oval cross-section (maximal width 5.8–7.0 mm). A charcoal sample found below the side-slotted arrowhead provided a date of 9530±60 BP (Beta-67667) (Ackerman 1996a). The two other arrowpoint fragments were tip sections revealing that the side slots went almost to

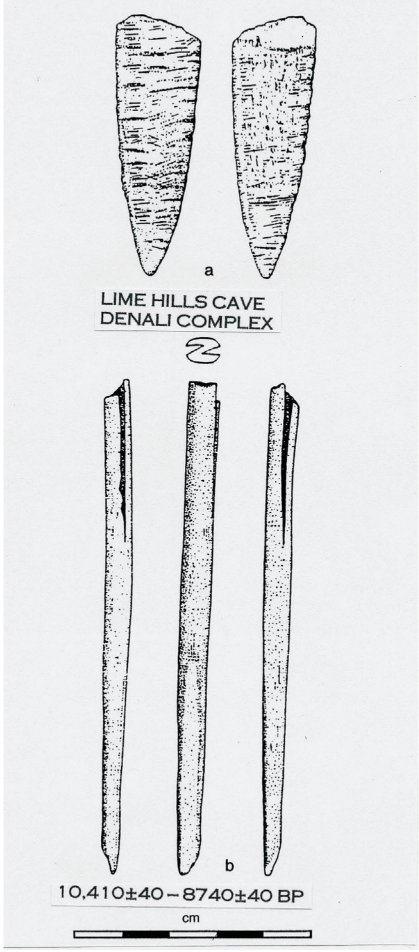

Figure 10.18: Lime Hills Cave 1 site. Base of a bone point (a), basal section of a side-slotted arrowhead (b) (after Ackerman 1996a).

the tapered tip. One of the tip fragments dates to 8740±40 BP (SR–5036/CAMS–55199). Almost identical arrowheads with grooves for microblades and with beveled tangs were found in layer 3 at the Trail Creek Cave 2 site on Seward Peninsula (Larsen 1968; Figure 10.1:30; Figure 10.19). A caribou bone sample from the same layer as the arrowheads has a date of 9070±150 BP (K–980) (Larsen 1968). We also recovered a basal (Figure 10.18:a) and a mid section of a spearhead with opposing slots for side blades in the Lime Hills Cave 1 that provided an AMS date of 10,410±40 BP (SR–5042/CAMS–56519).

The arrowhead grooves were 3.2–3.8 mm in depth and the spearhead grooves were 3.5–4.5 mm in depth. As the majority (36) of the microblades were 4–6 mm wide, these would protrude between 1 and 2 mm beyond the side of the arrowheads and less than 1 mm to about 1.5 mm on the spearhead. The spearhead would have had a better cutting edge through use of the wider microblades (15 examples at 6–8 mm). Our width measurements indicated that most of the discarded microblades in the cave were used as insets in arrowheads rather than for spearheads.

The dates for the antler arrow and spearheads from the caves in Trail Creek (Larsen 1968) and Lime Hills (Ackerman 1996a) fall well within the early part of the Denali complex demonstrating that an important use of microblades was for the arming of arrows as well as dart or spearheads. As noted by Churchill (1993), the bow and arrow is an efficient weapon in encounter hunting of dispersed animals. The Lime Hills cave was a stop-over for hunters who were pursuing scattered caribou during the summer following the spring migration and before the herd assembly in the fall. The Trail Creek caves served a similar function. Bow and arrow technology may serve as an explanation for the appearance of microblades beginning some 18,000–20,000 BP in Siberia as it is for the popularity of microblades in Denali sites

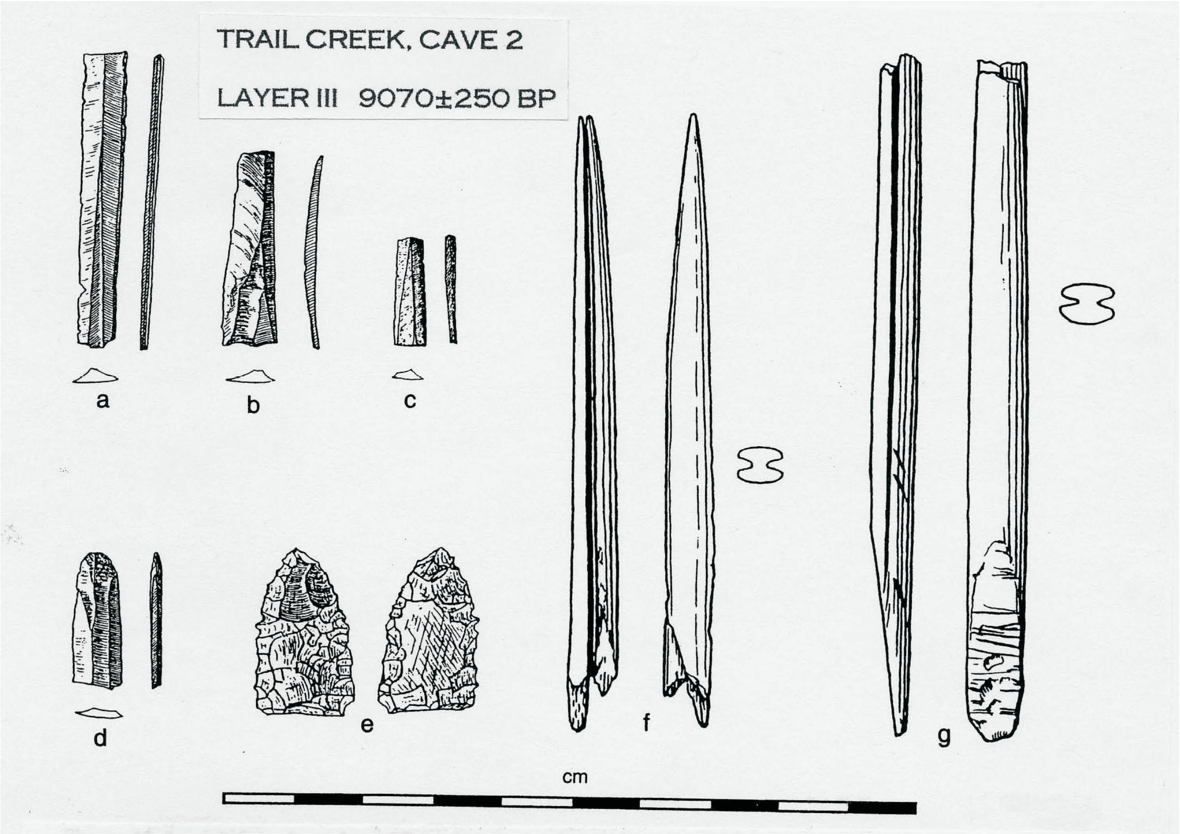

Figure 10.19: Trail Creek Cave 2 site.
Microblades (a-d), biface (e), slotted antler arrowheads (f-g) (after C. West 1996).

during the Late Pleistocene to Early Holocene of Alaska. Without the evidence of antler side-slotted arrowheads from the limestone caves of Trail Creek and Lime Hills dating to some 9000 BP, a very recent date for bow and arrow technology in Alaska would still be considered.

The recent recovery of bilaterally slotted bone points from the Rice Ridge site on Kodiak Island (Steffian *et al.* 2002) demonstrates that the practice of inserting side blades as armatures for spears or arrowheads was not restricted to interior hunting practices. The Rice Ridge site, dating to 6180 ± 305 BP (GX–14672) (Ocean Bay I in the Kodiak Island sequence), contained a faunal assemblage that was roughly 75% mammal remains (sea otter, harbour seal, whale, and sea lion or fur seal) and 25% fish (Steffian *et al.* 2002). Slotted points with microblade inserts were replaced by ground slate lanceolate forms during Ocean Bay II marking the demise of the microblade industry in the region (Steffian *et al.* 2002).

The presence of microblades at coastal sites in southeastern Alaska by at least 9500–9000 BP would additionally suggest that there was a rather widespread cultural complex with tool kit that included bone and antler hunting implements armed with inset microblades that spread along the North Pacific coast of northwestern America. An earlier arrival into the ice-free areas of western and central Alaska has been noted.

RESEARCH STILL AT THE PIONEERING STAGE

Microblade technology had its origins in Asia, but the cultural priority of one region over another in Asia is still an open question. Within Siberia, the only certainty is that the spread of microblade technology was to the east and north. The arrival date at the edge of central Beringia remains unknown. By somewhat before 12,000 BP microblade assemblages were in central Alaska. At this time or just a bit later, artifact complexes known as the Nenana and Mesa complicate the picture. Whether these are alternate technologies, task assemblages that are part of a larger as yet undefined cultural complex, or just different groups of people populating the landscape remains unknown. This is the task for present and future generations of northern archaeologists to unravel.

11

THE SPREAD OF MICROBLADE TECHNOLOGY IN NORTHWESTERN NORTH AMERICA

Martin Magne and Daryl Fedje

INTRODUCTION

In 1983 Roy Carlson wrote: "Someday the archaeologist will be able to plug in his retroscope, punch in his hypothesis, and obtain probability readings and simulated models based on all relevant data." (Carlson 1983:96). In this paper we use a kind of retroscope, contour-mapping technology, to examine the geographic and temporal distribution of early microblade technology in the North American "Far West". We also examine the long-standing proposal of Borden (1968) and Dumond (1969; see also Carlson 1983, 1998) that microblades in northwestern North America are the signature of Early Holocene movement of proto-Na-Dene or early Athapaskan speakers from the Beringian region. Carlson appears to support the Athapaskan linkage as well when he writes "The distribution of the microblade tradition correlates best with the distribution of Tlingit, Haida and Athapaskan, and this distribution likely represents the ancestors of people speaking these languages, although it is not all unlikely that the ancestors of the Eskimo and Aleut were also the bearers of microblade technology" (Carlson 1983:93).

We tend to side with Carlson's approach to lump together the various terms for Early Holocene microblade and core occurrences in the far western areas of North America. Starting with his view that the technological distinctions arise as a function of time and space, we use modern mapping technology to plot microblade and microblade core assemblages, and remark on the principal patterns that are revealed.

EARLY HOLOCENE MICROBLADE DISTRIBUTION

The oldest North American microblade assemblages are to be found in central Alaska, in the form of the Denali complex, which is fairly widespread in Alaska at c. 10,500 BP[1] (West 1967, 1996a, 1996b, 1998). Its earliest manifestation may be the 11,600 BP assemblage at Swan Point (Holmes *et al.* 1996). Outside of central Alaska the majority of early (>8000 BP) microblade assemblages in North America (Figure 11.1) are found at coastal sites along the southern Alaska Panhandle and northern Canadian Pacific coast. In interior North America, south of Alaska, evidence of early microblade technology is limited to a few sites on the east side of the Canadian Rocky Mountains (Fladmark *et al.* 1988; Fedje *et al.* 1995; Sanger 1968b). After c. 8000 BP microblade technology is more broadly distributed in the "Far West". The cores produced by microblade manufacturing technology are usually immediately recognizable, but there are definite variants. In Alaska, Yukon, and the Subarctic, the most common form is that which we call Denali or Campus. These are narrow-platformed, have bifacially retouched bases, and most characteristically exhibit platform preparation produced by a blow perpendicular to the flute face. Often these are also called "wedge-shaped", a term we prefer to avoid, since in fact most microblade cores of all forms are "wedge-shaped" in some way. The second most common form is what we call the Northwest Coast variant, which are mostly pro-

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[1] All dates are in uncorrected radiocarbon years before present unless otherwise noted.

duced from large flakes or pebbles, have wide platforms that are not retouched or rejuvenated (or only very occasionally), but do exhibit flute face rejuvenation (as seen in facial rejuvenation flakes), and can ultimately result in "circular" or even "conical" shaped core forms at the end of their manufacturing trajectories (Magne 2004). The Northwest Coast variant often takes the "boat-shaped" or "tongue-shaped" form. The third but less common type we refer to as "tabular", although in many respects such as platform rejuvenation, this type is most similar to the Campus form. Interestingly, this tabular form is that which we see in the two dated sites of Vermilion Lakes and Charlie Lake Cave (although each only has a single microblade core), in the Canadian Rocky Mountains. Another important but undated Canadian locality, on the Plains at High River in southern Alberta, exhibits more typical Campus type bifacial body manufacturing in its three known cores, discussed below. A key distinction among these microblade core-bearing assem-

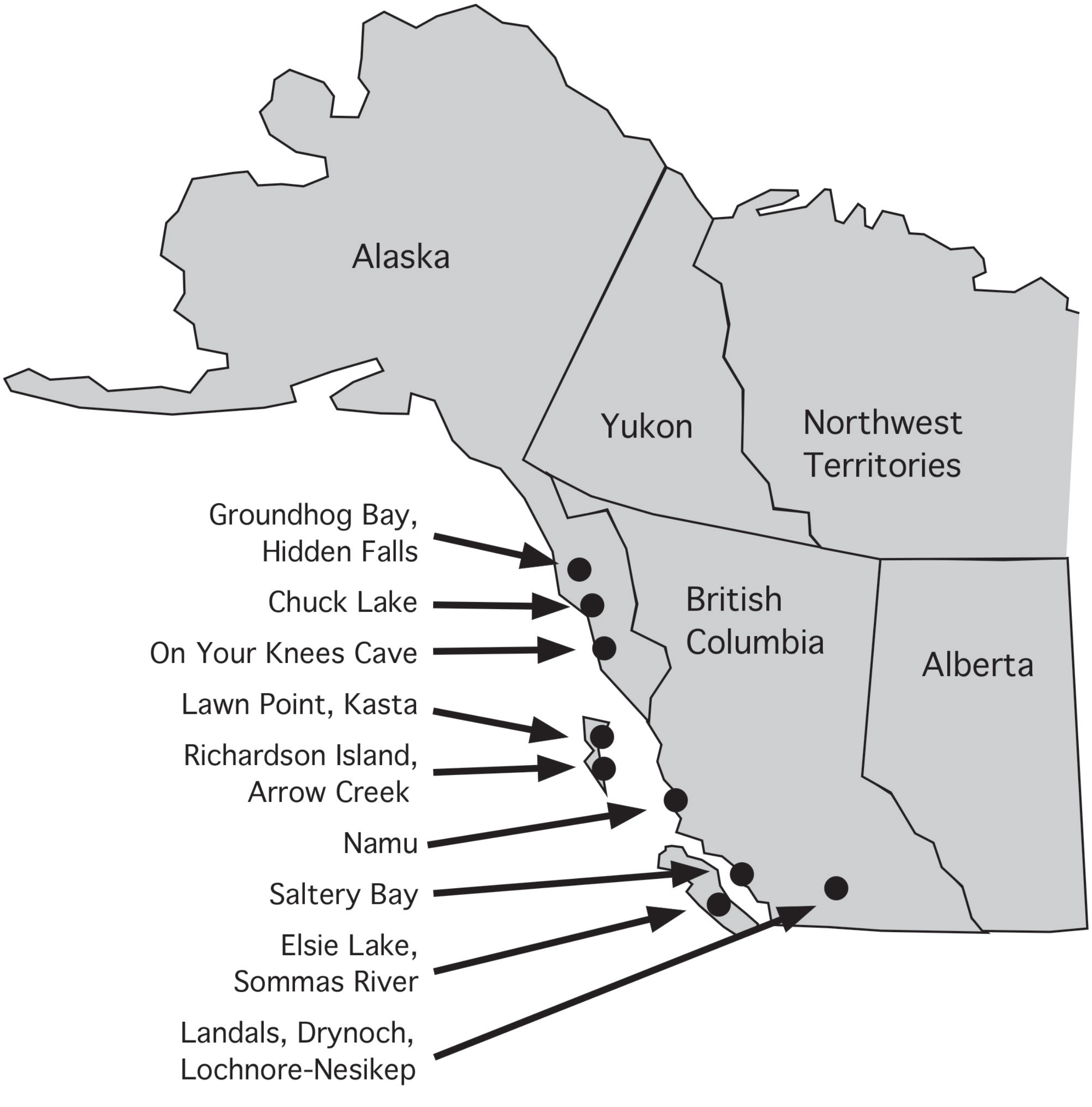

Figure 11.1: Early Holocene Northwest Coast microblade sites.

blages is that only those containing Denali-like cores have true burins, whether they be Donnelly burins with prepared notches to facilitate burin removal (see, for example, West 1967; LeBlanc and Ives 1986), or simple burin-on-flakes. We observed these fairly frequently when we examined the Campus and Dry Creek assemblages, among others. Ackerman (1996c:127) shows a Donnelly burin-scraper from Ground Hog Bay 2, but the associated microblade cores are clearly what we would call Northwest Coast variants. Very occasionally burin-like artifacts are found in the coastal British Columbia sites, but they appear to be accidental. Among the Northwest Coast variants we include the Ice Mountain Microblade Industry (IMMI; Smith 1971; Fladmark 1985) found in the vicinity of Mount Edziza, a primary obsidian source in northwestern British Columbia. Although Smith (1971) claimed these were mostly like Asian Shirataki cores, Fladmark (1985) clearly demonstrates that they are different from those and quite variable, and that the key distinctions are very acute (30 to 60 degrees) platform angles, a thin core (which is comparable to Denali types), and occasionally bases shaped almost like stems. Most of the IMMI cores, however, are not manufactured from split bifacial blanks. At Mount Edziza the microblade industry dates from 4900 BP to 1140 BP (Fladmark 1985:177).

NORTHWEST COAST VARIANT DISPERSION

As we move out of interior Alaska down the Pacific coast the incidence of true Denali or Campus-like microblade cores declines rapidly. On the Alaska Panhandle microblade cores and microblades appear in archipelago environments at about 9500 BP at Ground Hog Bay and Hidden Falls where Ackerman (1996c, 1996d) considers both Denali and Northwest Coast variants to be present (Figure 11.1).

Moving southerly and forward in time on the northern Northwest Coast, microblade technology is well represented at a 9200 BP to 8500 BP component in On Your Knees Cave (PET–408) where location and stable isotope analyses of human bone indicate a maritime adaptation (Dixon 1999, 2001, 2002; Figure 11.1). The Northwest Coast forms continue to the Haida Gwaii (8900–7000 BP) set of sites – Richardson Island, Arrow Creek, Lyell Bay, Lawn Point, and Kasta (Fedje and Christensen 1999; Fladmark 1986; Figure 11.1). These contain a large number of microblade cores and blades in well-dated contexts (Figure 11.2). They post-date an earlier, apparently non-microblade, archaeological record now firmly dated from 10,500 BP to 9000 BP (Fedje *et al.* 2004). The Namu sample (Figure 11.3; Carlson 1983, 1996) on the central coast of British Columbia dates to shortly after 9000 BP (Figure 11.1). Microblade technology endures in this northern coastal area through to c. 5000 BP. On the Kodiak Archipelago, the Ocean Bay tradition sites have abundant microblades and cores, and are of the Northwest Coast variant. Microblades appear at about 7500 BP in Ocean Bay I and are no longer present by 4500 BP in Ocean Bay II (Steffian *et al.* 2002).

The Northwest Coast variant-type microblade technology also disperses southerly along the coast and up river valleys into the interior of British Columbia and the U.S. Northwest. Microblade components on Vancouver Island and in the Strait of Georgia area (Mitchell 1968; McMillan 1996; Wright 1996; J. Maxwell personal communication 2004; Figure 11.3) are mostly undated, especially early ones, but they appear to be Early to Middle Holocene in age based on geological context and associated lithic technology. This is substantiated by the recently discovered Saltery Bay site on the east side of the central Strait of Georgia that dates from 6750 BP to 6050 BP (A. Mason personal communication 2005; Figure 11.1). This technology reached the British Columbia interior by 8500 BP at the Landals and Drynoch Slide sites and somewhat later (7500 BP) the Lochnore-Nesikep sites (Sanger 1968a; Figure 11.1). It is also present in southern Oregon and in the Columbia River region by c. 8000 BP at such sites as Cascadia Cave and Layser Cave (Sanger 1970a; Newman 1966; Daugherty *et al.* 1987a, 1987b). Recent reporting of 7500 BP Northwest Coast type cores from Eel Point on San Clemente Island, California (Cassidy *et al.* 2004), hint at an even more extensive coastal dispersal.

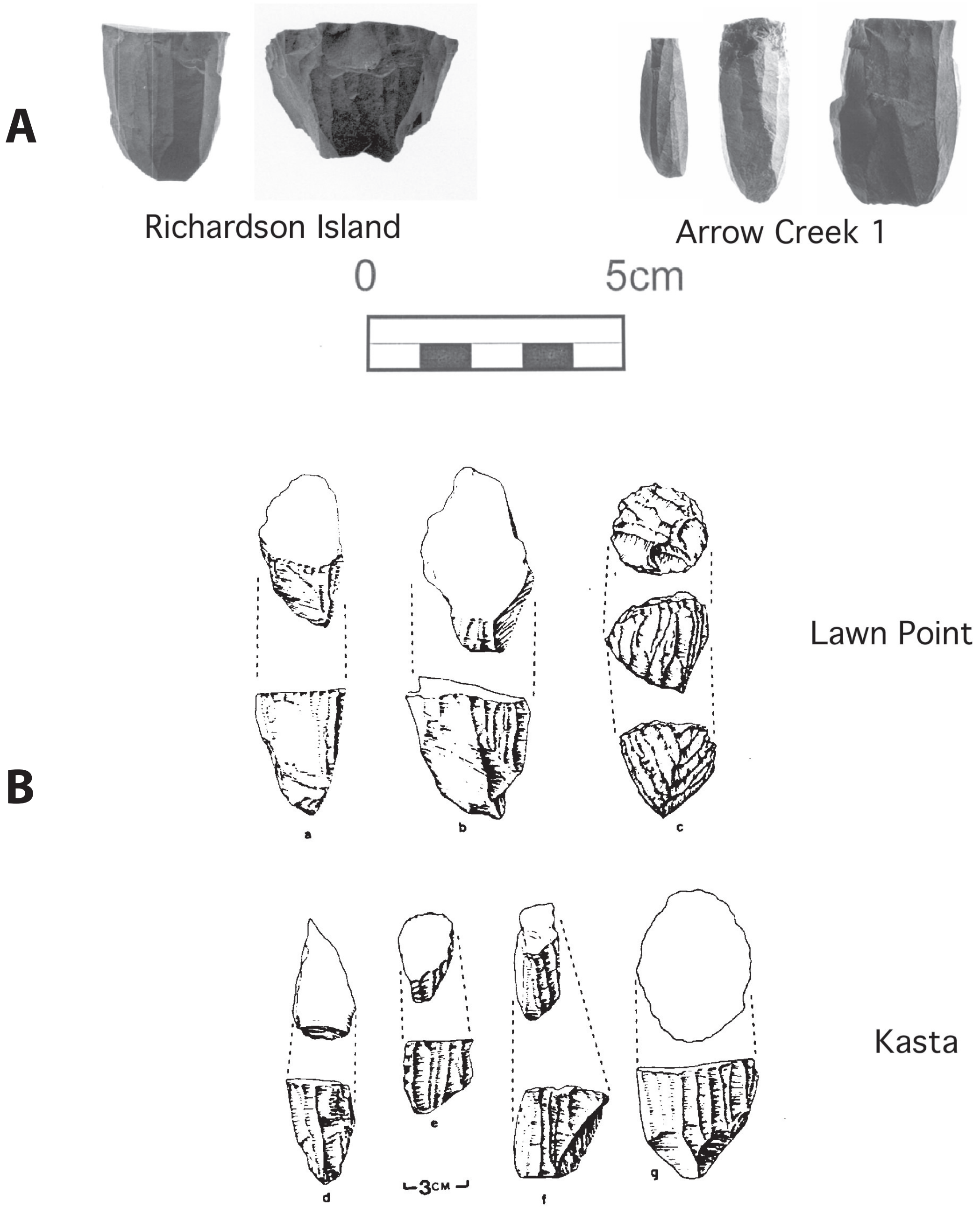

Figure 11.2: Early Holocene microblade cores from Haida Gwaii.
A: Richardson Island and Arrow Creek 1 (photos by J. McSporran);
B: Lawn Point and Kasta (drawings courtesy of Knut Fladmark).

EASTERN SLOPES DENALI-TYPE DISPERSION

In the Canadian Rocky Mountains area (Figure 11.4), early tabular-type microblade cores were found by Fladmark (1996:11) at Charlie Lake Cave dating to c. 9500 BP, and by Fedje (Fedje *et al.* 1995) at Vermilion Lakes dated to c. 9600 BP. One Denali type core has been found in an undated surface context east of the Rockies at Fort Vermilion in northern Alberta (Pyszczyk 1991; Figure 11.4) and three more are known from High River in southern Alberta (Sanger 1968b; Wilson and Visser 1990; Figure 11.4). One of the High River cores is made of Knife River flint, which is quarried in

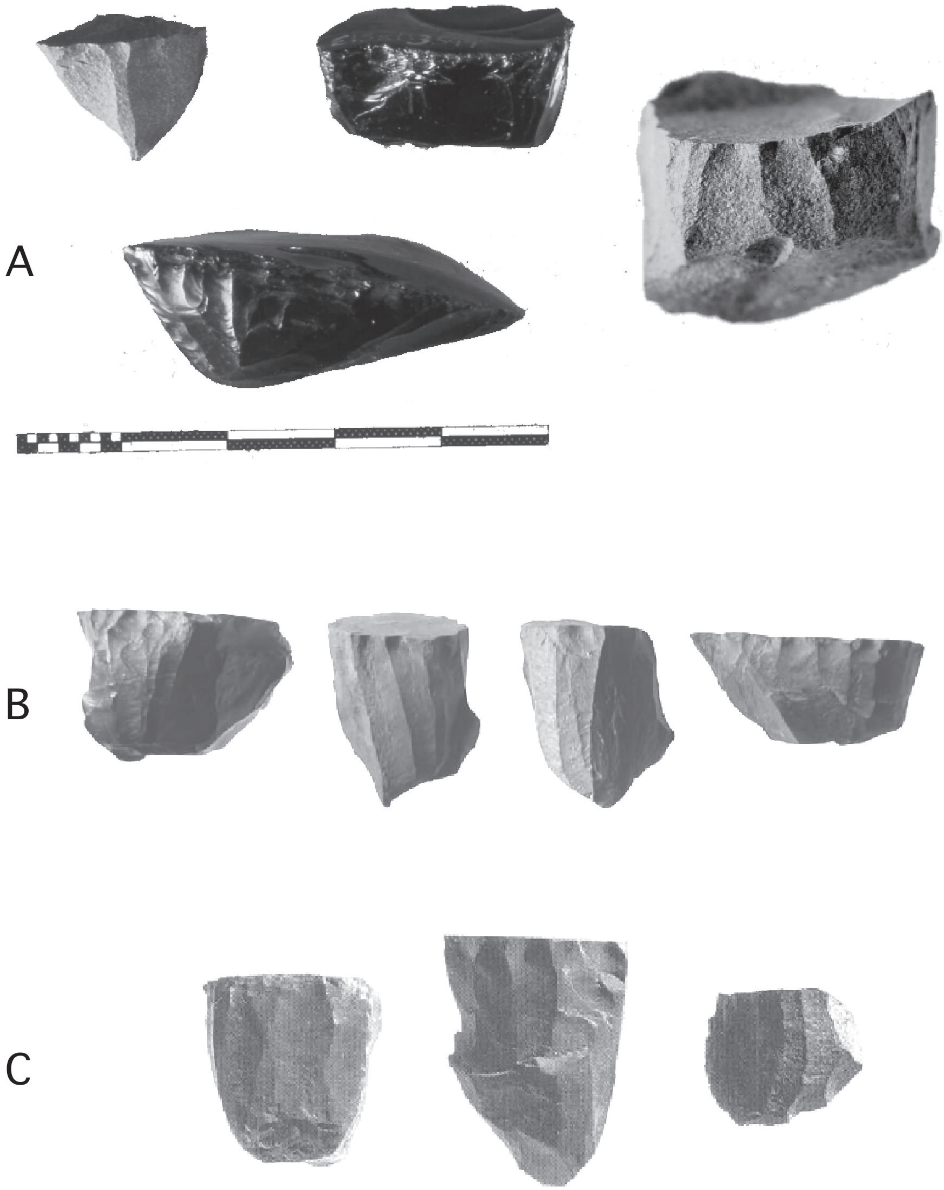

Figure 11.3: Microblade cores from the British Columbia central coast and Vancouver Island. A: Namu (photo courtesy of Roy Carlson); B: Elsie Lake (photo courtesy of Joanne McSporran); C: Somass River (from McMillan 1996).

North Dakota. Although the cores are surface finds, Cody complex artifacts made of Knife River flint with similar degrees of patination are found in direct association with the microblade cores, so a date of c. 9000–10,000 BP is possible. There is no direct evidence for Denali or tabular microblade technology in the western Canadian Plains and Rocky Mountains after c. 9500 BP.

LATE HOLOCENE MICROBLADE DISTRIBUTION

Sanger's (1970a) Plateau Microblade tradition was at its maximum c. 7000–3500 BP, but he recognized that microblades "continue up to the Christian era" (Sanger 1970a:123). Investigating the Late Holocene movement of Athapaskan speakers in the interior of British Columbia and

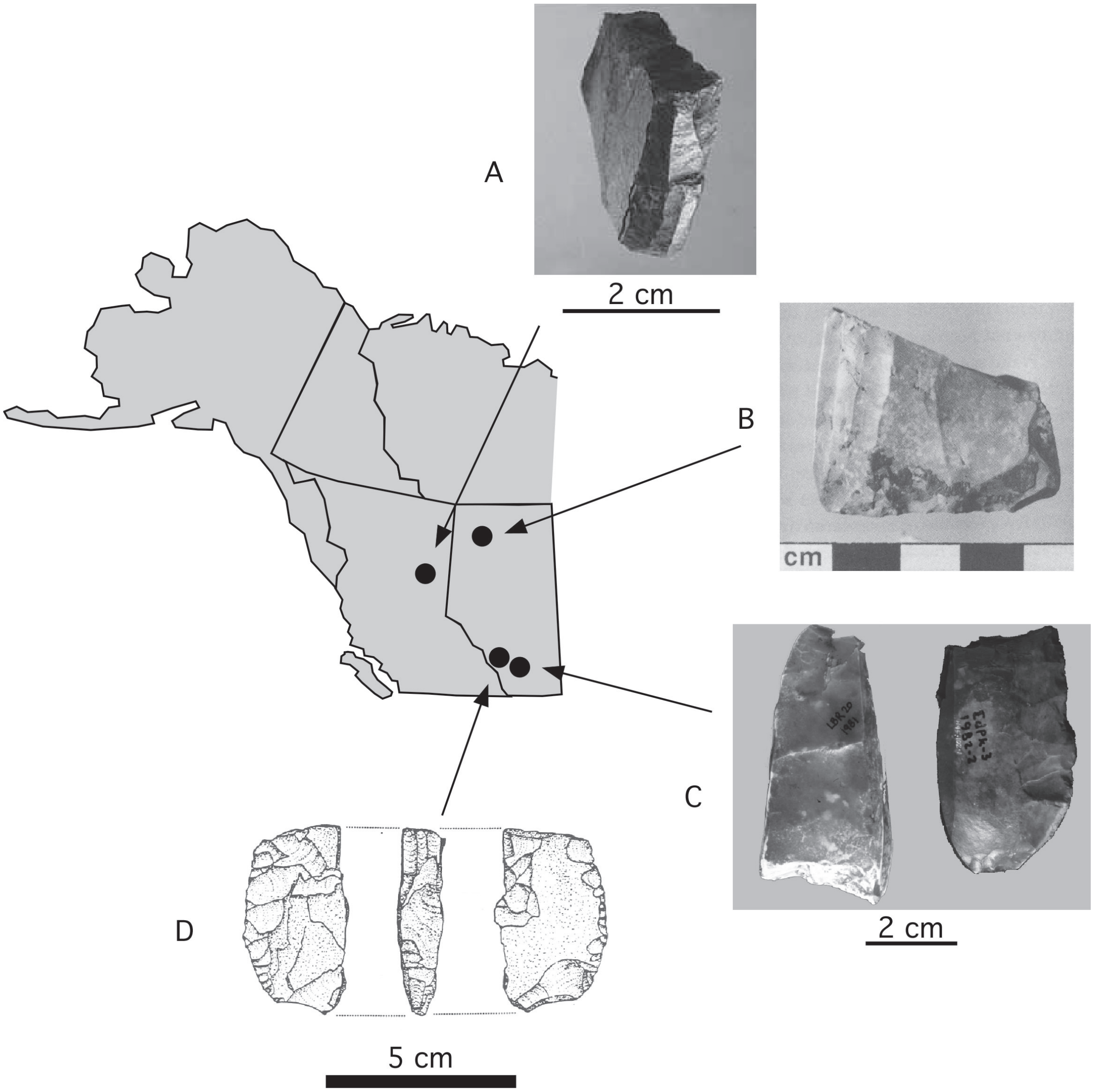

Figure 11.4: Microblade sites from the eastern slopes of the Rocky Mountains. A: Charlie Lake Cave (photo courtesy of Knut Fladmark); B: Fort Vermilion (after Pyszczyk 1991); C: High River; D: Vermilion Lakes drawing by J. McSporran).

the Plains regions of North America, Magne and Matson (Magne 2001; Magne and Matson 1987; Matson and Magne 2007) have shown that there are a number of sites in the west where microblades are directly associated with late prehistoric and ethnohistoric Athapaskan occupations in Alaska, the Yukon, the British Columbia plateau, and in southwestern Oregon at AD 1000 to AD 1500 and possibly later.

Microblade cores are also present in late prehistoric contexts in northern Alberta and in the Northwest Territories including Peace Point (Stevenson 1986) in two components (dated to 2200 BP and ethnohistoric times) and at Bezya in northeastern Alberta (composite date of 3900 BP; LeBlanc and Ives 1986). At the northeast end of Great Bear Lake, Clark (1982) mentions microblades occurring around the hearth of a surface rectangular structure at site MdPs 5, but dismisses their late association, stating that these are "not likely to be associated with historic structures." (Clark 1982:116). Several late prehistoric sites at Anahim Lake contain microblades in association with house features and Wilmeth (1977) considered those to be mixed. In fact, he proposed his principle of housepit-construction-causing-assemblage-mixing (Wilmeth 1977) to account for microblades in those houses even though they are quite shallow and were not constructed like classic earth covered pithouses. Dismissal of late microblades is a common theme in western North American archaeology (see also West's (1975) defense of early dates for the Denali complex), although that practice was challenged nearly 30 years ago (Helmer 1977). Alaskan researchers inform us that late prehistoric microblade components are a fairly common occurrence there as well (P. Bowers personal communication 1999; J. P. Cook personal communication 1999). While we focus here on Early Holocene occurrences, we show later that late prehistoric microblade assemblages are actually very common.

DATABASES AND DISPERSAL PATTERNS

Modern databases allow examination of the spatial and temporal distributions of microblade technology. Ideally, we would employ a sample including only sites or areas where we can date both the initial arrival and full duration of the Microblade tradition and we will continue to refine our database in this way and in others. For example, sites such as Broken Mammoth and Dry Creek in central Alaska and Richardson Island and Namu on the Northwest Coast provide clear timelines for the transition from an earlier non-microblade technology.

At present we have to work with a less than perfect database. We have gathered the oldest date, most recent date, and two intervening dates for each site, although most by far have only one date. In many cases, the "oldest date" probably does not date the arrival of microblade technology to the region. In other cases, the dates obtained are only assigned to the microblade components by the original researchers, with qualifications. This exercise is an experiment in revealing patterns that we hope we and others can refine in the future. We were able to obtain unpublished archaeological site records for microblades and microblade cores from the provinces and territories of Alberta, British Columbia, Yukon, Northwest Territories, and Nunavut. These provinces and territories provided Excel spreadsheets downloaded from their official databases. This initially gave us a list of 487 Canadian sites. Once we removed the non-Northwest Microblade tradition complexes, that is, Dorset, Pre-Dorset and Arctic Small Tool, or questionable sites, and added a few sites from published sources, we were left with a list of 196, with radiocarbon dates for 58 of those. A few of these may yet be dubious, and there are no doubt more sites not listed in the government databases.

In the United States, statewide data of this sort do not exist in database format in SHPO (State Historical Preservation Officer) offices, so we gathered an initial sample from the literature, at this time only referring to dated sites. The U.S. data sample consists of a total of 59 sites, with 34 from Alaska and 25 from Washington and Oregon states. Our entire sample now consists of 255 sites, 117 of which are dated (Table 11.1), and a total of 329 individual radiocarbon dates. We recognize that some of the microblade components' associations with microblades are subject to debate and we refer below primarily to the oldest dates

Table 11.1: List of dated microblade sites and oldest dates (years BP, uncorrected) used in the analyses.

SITE	OLDEST DATE
EdRg-1	140
EeRb-140	160
MjTp-1	210
Skagit 45WH253	580
EeRj-55	600
FcSi-1	790
KdVo-3	810
Judd Peak N.	1070
45GR88	1080
EcRg-2AA	1120
EeRj-93	1270
Daniktco	1300
KbTx-2	1340
Skagit 45WH283	1380
Skagit 45WH241	1430
45DO243	1530
DiQj-5	1660
Rogue River 35JA190	1700
KbVo-1	1790
Donnelly Ridge	1830
Potlatch	1870
JhVq-1	1890
Skagit 45WH300	1940
IaTr-2	1975
IgPc-2	2210
JlRq-1	2265
DiQw-2	2500
DiQm-4	2530
45DO211	2580
EdRk-7	2605
DjSf-13	2770
HiTp-1	2850
45DO242	2860
DcRt-13	2910
EeRk-4	2965
45DO326	2997
JgVu-3	3020
JiVr-1	3220
FhUa-1	3300
Lisburne Site	3470
JeVd-15	3480
45OK18	3512
45OK258	3605
EeRh-3	3920
45OK288	3980
Hhov-73	3990
45OK11	4010
45DO204	4030
Wells 45OK382	4040
EeRf-1	4220
Ilnuk	4390
JgVf-2	4570
HiTp-63	4870
45OK208	4950
GdTc-16	5050
EeRb-144	5170
EdQx-41	5480
35DO47	5859
JjVu-4	5870
KaVa-3	5890
Judd Peak S.	5970
Kettle Falls 45FE45F	5980
FgTw-4	6010
Rice Ridge	6080
EdQx-42	6290
Zaimka	6390
Ryegrass Coulee	6470
Tanginak Spring	6600
Long Lake	6605
Layser Cave	6650
NkTm-8	6650
EdRk-8	6650
Saltery Bay	6750
Campus	6850
FjUb-10	6980
JeVc-20	7030
JcUr-3	7160
JfVg-1	7195
DiRa-9	7400
FiTx-3	7400
Drynoch Slide	7530
Thorne River	7650
EdRi-2	7670
Broken Mammoth	7700
JdTg-2	7790
Crag Point	7790
Graveyard Point	7895
Cascadia Cave	7910
Chuck Lake	8220
1355T	8500
Anangula	8700
1354T	8800
766T	8900
1127T	8900
Ugashick Narrows	8995
ElSx-1	9000
Hidden Falls	9060
Trail Creek Caves	9070
Healy Lake	9100
Sparks Point	9200
Ground Hog Bay 2	9220
On Your Knees	9280
Owl Ridge	9325
Chugwater	9460
Charlie Lake Cave	9500
Gerstle River	9510
Lime Hills	9530
Vermilion Lakes	9600
Onion Portage	9815
Little Panguingue Ck	10,180
Panguingue Creek	10,180
Phipps	10,230
Whitmore Ridge	10,270
Gallagher Flint Stn.	10,540
Dry Creek	10,600
Moose Creek	10,640
Swan Point	11,660

available; however, for the experimental purposes of this paper the data are sufficient.

In all of the analyses to follow we refer to uncalibrated dates before present as reported. Plotting those sites yields the map shown here (Figure 11.5). The U.S. data cannot be considered representative of pure geographic distribution so we cannot speak of the entire Far West, but the most concentrated areas of microblades in Canada are in the southwestern Yukon, Haida Gwaii (Queen Charlotte Islands), southern and central British Columbia. The figure also shows the distribution of those sites for which we have radiocarbon dates. That sample is representative of the general distribution so we are fairly confident in seeing what the dates show about the spread of microblade technology. We must keep in mind, however, that these data are not representative of all dated sites, particularly from Alaska.

When we look at the statistical distribution of all dates provided (Figure 11.6a), the most striking feature of the histogram is its bimodality. In the graph of all dates (n = 329), there are peaks of dates at about 2000 BP and 8000 BP. A histogram of only the oldest dates in the sample (n = 117) changes the distribution to a more irregular one, but the overall early and late preponderance with a middle prehistoric decline is still evident (Figure 11.6b).

These patterns may truly represent the temporal spread of microblade technology in the Northwest even though this sample is incomplete. There may be several reasons why microblade sites appear to decline in frequency at about 5000 BP. For example, the pattern may simply represent sampling error; there may be many more sites with middle prehistoric dates that have not been found and dated; people may have reduced their use of microblades during this time, possibly as a result of environmental changes leading to fewer requirements for tasks associated with microblades; microblade-using cultures moved out of certain areas and concentrated themselves in other areas (again, essentially a sampling issue); or, overall population levels may have been less during those times. This appears to be the case, for example, in the Upper Columbia region of the Plateau, which demonstrates a 400 year-long hiatus in radiocarbon dates from all types of archaeological sites at 4199–3800 cal BP, attributed to environmental

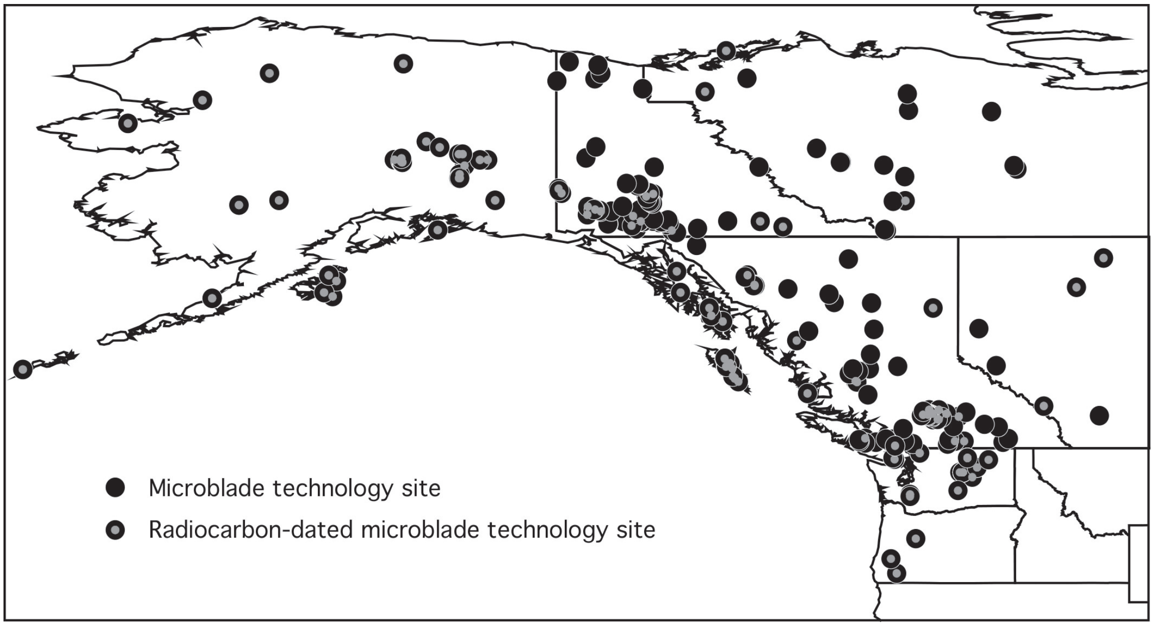

Figure 11.5: Distribution of a sample of microblade technology sites. Note that some sites overlap at this scale.

degradation (Goodale *et al.* 2004). Nonetheless, the many late microblade component occurrences cannot be simply the result of dating errors or sampling bias. Some late dates may have resulted from mixing of shallow sites but, we believe it unlikely that this is true of all cases, or even most. Note also that several assemblages in protohistoric contexts have no radiocarbon dates so they are not part of the database and therefore do not influence this graph.

Surface contour plots (using Surfer; Golden Software 1997) of the radiocarbon dates show patterns that pose some challenging questions about the spread of microblade technology in the Northwest. Here we work with the oldest dates available for the sites or microblade components, the ratio-

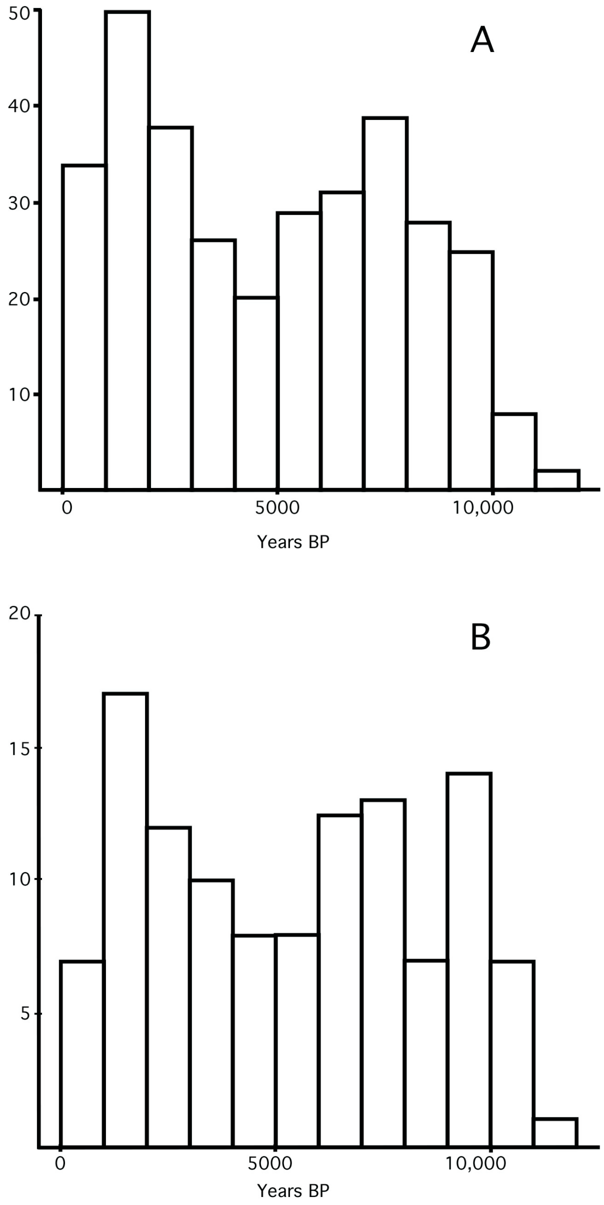

Figure 11.6: Histograms of dates for microblade sites and components, 1000 year intervals.
a. All dates, n = 329; b. Oldest dates only, n = 117.

nale being that if we are interested in the spread of microblade technology, then the most relevant dates are those of first arrival. At the same time, since many components have only single dates, the perseverance of microblade technology across the Northwest is not neglected. We first apply a Kriging contour method, a normal default for this kind of contouring, to interpolate between data points. We later change the programme settings to explore the effects of various "smoothing" options. When we contour the oldest (or only) dates for each site (Figure 11.7) the main initial dispersal nodes are firstly central Alaska, secondly the Rocky Mountains and the Alaska Panhandle, and thirdly Queen Charlotte Sound and northern Oregon. In other words, microblades first arrive from the west into interior Alaska. They then appear to occur independently on the northern Northwest Coast and in the southern Canadian Rockies. On the west coast this technology disperses south to Namu and eventually to Oregon and California (not shown). The apparently independent rise at several locations along the coast and inland may simply reflect data gaps where we only have undated assemblages (such as the Vancouver Island area), and the drowning of Early Holocene shorelines by rising sea levels. Interpretation of the early microblade occurrences at sites such as Charlie Lake Cave and Vermilion Lakes on the eastern flanks of the Rocky Mountains is constrained by an absence of any dated Early Holocene microblade cores in the area between these sites and the Denali "heartland" of central Alaska.

Contour mapping options can allow different levels of confidence in the data to be expressed, slightly changing the patterns. For example, using an "Inverse Distance to a Power" method, rather than the "Kriging" method used above (that is more faithful to the individual data point grid), the "bullseye effect" can be controlled. What this means is that a strong "bullseye" or "power" effect is acceptable when we know our data to be evenly distributed and we are less interested in interpolating between points. Furthermore, the data can be "smoothed" to greater or lesser degrees, to reduce the influence of individual points

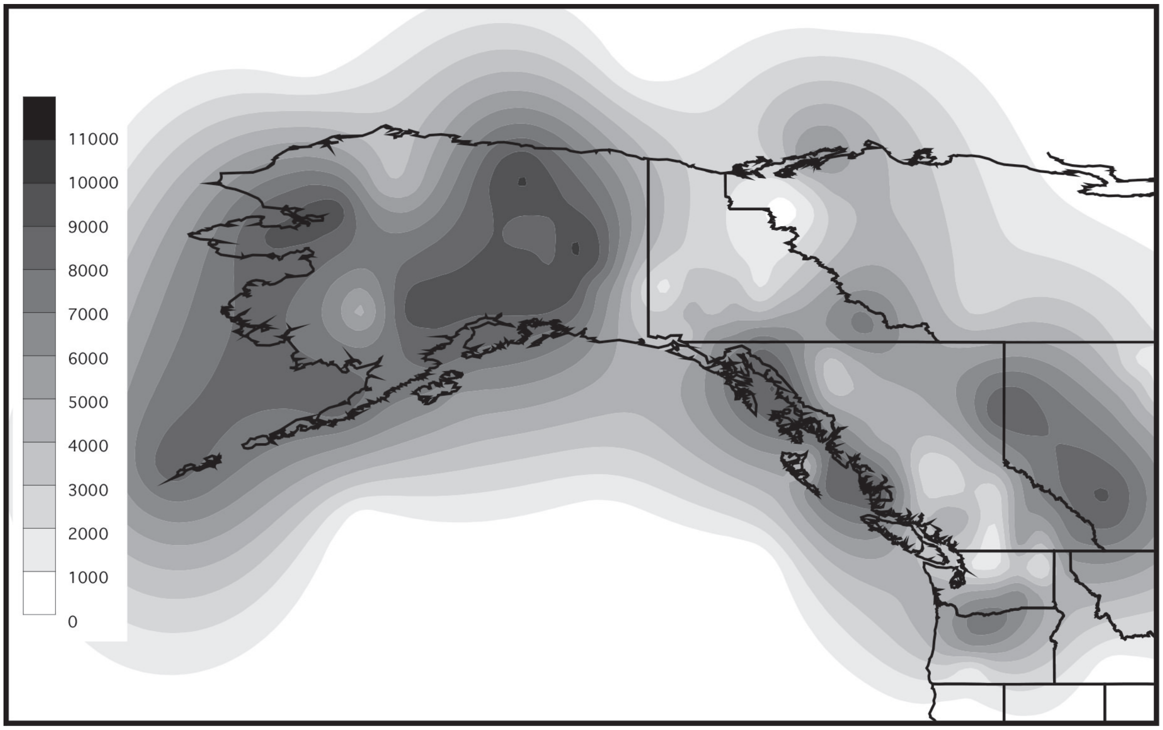

Figure 11.7: Surface contour plot of microblade sites, oldest dates only, 1000 year interval, Kriging method.

in predicting neighbouring nodes of the output grid. Thus, when the “Power” and “Smoothing” parameters are altered to recognize that, indeed, our data are not evenly distributed across space, and that individual points may strongly influence neighbouring areas, we arrive at what may be a more accurate depiction of microblade distribution through time (Figure 11.8a). In this case, the earliest distributions appear strongly tied to mountain environments in Alaska, the coast, and the Rocky Mountains. When the data are smoothed even further (Figure 11.8b), the Rocky Mountains effects drop out and the pattern of early dispersal is from central Alaska to the Northwest Coast and then fairly evenly from those centres. Still, the spread into the Rocky Mountains appears to be from northern British Columbia.

Clearly, core Alaska remains a central area of microblade use from the Late Pleistocene through the mid-Holocene, but in the Late Holocene microblade use in Alaska appears to shift westward. During the Early Holocene new centres arise in the Panhandle-Haida Gwaii region, and also in southeastern Yukon and the Canadian Rockies, as well as in northwestern Oregon. The northern Rockies appear linked via east-west river systems in northern British Columbia and southern Yukon. A spread to the southern British Columbia interior appears to take place about 8500 BP, and although one would think that the Fraser River system would be the logical connection, the Rockies appear more closely connected to the southern British Columbia interior. Meanwhile, mid-Holocene microblade sites in the Gulf of Georgia appear more closely connected to the coastal manifestations. From the Middle to Late Holocene a general spread northward and eastward is apparent. Furthermore, nodes appear at about 5000 BP in the Terrace area east of Haida Gwaii, in southwestern Yukon, and in south-central British Columbia. Finally, late prehistoric microblade occurrences appear most prevalent on the British Columbia interior plateau and the extreme northwest area of the Northwest Territories.

These plots support a coastal north to south dispersal of the Northwest Microblade tradition, with eastward spreads up major river valleys to the interior areas. The derivation of Denali type cores recovered from the east slope of the Rockies is unclear, and only more complete and more precise data should refine these patterns. Early microblade dispersal patterns have the appearance here of a leap-frog series of events, jumping southwesterly from interior Alaska to the coast and southeasterly to the Rocky Mountains, then easterly via the Bella Coola, Fraser and/or Columbia valleys into the interior of British Columbia and the U.S. "Far West". The leapfrogging is likely an artifact of sampling and the geological history of the coastal margin, especially with regard to the sea level history for that area south of the central Northwest Coast (Clague *et al.* 1982). Not surprisingly, this early technology is abundantly evident on those parts of the Northwest Coast (Alaska Panhandle to Namu) where c. 9000–5000 BP shorelines are stranded inland due to isostatically-driven sea level history and very sparse where eustatically-driven sea level history has drowned all c. 9000–5000 BP shorelines (south of Namu).

While gaps in the distribution of Northwest Coast microblade technology may be an artifact of sampling, the possibility of true geographic gaps should be considered. For example, the ethnographies and archaeologies of historic and protohistoric period Athapaskans demonstrate rapid long distance movements and their historic distribution shows that small nodes of them existed within the territories of other ethnolinguistic groups.

Microblades remain in use in interior Alaska throughout the Holocene and probably spread down from there through Yukon to the Rocky Mountains, although pre-9000 BP assemblages are not recorded in the central to southern Yukon. The microblades at Bluefish Caves, in northern Yukon, though probably older than 10,000 BP, are not well dated. Outside of Alaska, during the Middle to Late Holocene microblades appear to settle in the southern Yukon, western Mackenzie District, and on the southern British Columbia-northern Washington state plateau, and enter the Gulf of Georgia region. Microblade technology then spreads northeastward, mainly in the central Northwest Territories and northern Alberta.

WHYS AND WHEREFORES

Why microblade technology replaced a pre-existing adaptation is unclear. The Early Holocene

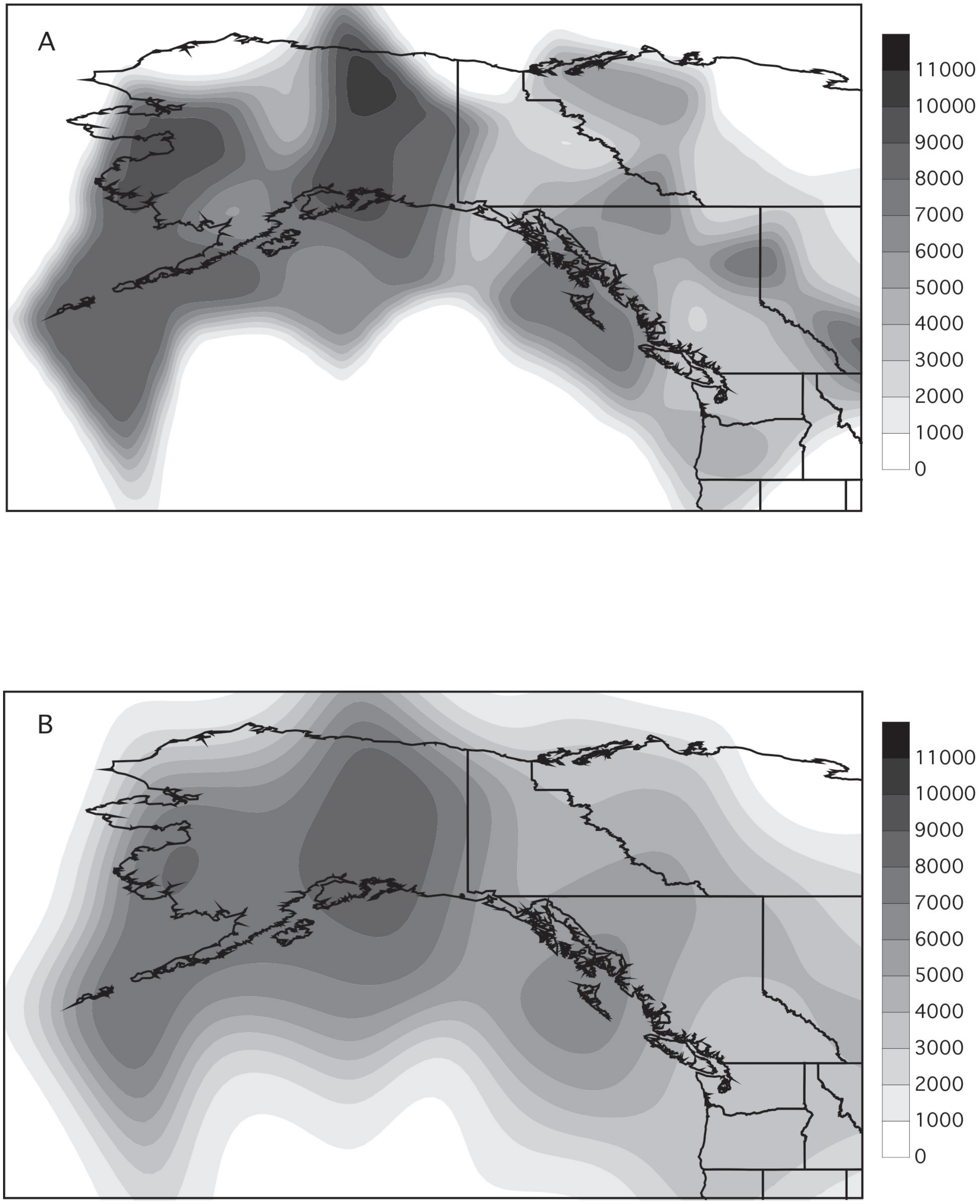

Figure 11.8: Surface contour plot of microblade sites, oldest dates only, 1000 year interval, inverse distance to power method, varying degrees of smoothing. A. Power = 25, Smoothing = 10; B. Power = 25, Smoothing = 20.

dispersal patterns seen in the contour plots seem to point to mountain adaptations being a key to microblade manufacture. Possibly it was simply a technological development that proved advantageous. Potentially it was a sufficiently specialized adaptation to allow exploitation of heretofore-unused environmental niches (effectively filling in the human landscape).

Alternatively, it was always there if needed, spurred on by gradual or abrupt change. Whether its arrival was simply through diffusion or a combination of ethnic assimilation or replacement is also not clear, although a number of researchers suggest microblade technology may have arrived in the Americas shortly after 11,000 BP with the Na-Dene antecedents of the Athapaskans (Scott and Turner 1997; Greenberg *et al.* 1986; Lell *et al.* 2002; Yesner 1996; Goebel 2002).

But why was the door open in the first place? What happened at c. 10,500 BP in central Alaska, c. 9500 BP on the Northwest Coast, and c. 8500 BP in the British Columbia interior? In Alaska researchers have raised the possibility that Younger Dryas cooling may have necessitated a shift to a highly mobile technology for more marginal resources (Mason *et al.* 2001; Goebel 2002; Elston and Brantingham 2002; Yesner 1996). Possibly, environmental change may have stressed the existing population and provided an opening for a more mobile and flexible microlithic adaptation. On the northern Northwest Coast the period c. 10,000–9000 BP was a time of significant environmental change. Sea level changes and climate change may be worked together to affect availability, distribution, and abundance of a variety of terrestrial, intertidal, and anadromous resources (Fedje *et al.* 2001, 2004). In Haida Gwaii, for example, sea levels rose sharply from over 100 m below modern to 15 m above modern levels, drowning large areas of the formerly exposed continental shelf. At the same time there was a rapid and significant rise in atmospheric and oceanic temperatures. This warming accelerated the development and altitudinal migration of closed forests to positions significantly higher than those of today (Walker and Pellatt 2004; Pellatt and Mathewes 1994).

The consequences of these changes are just starting to be examined, but must have included huge shifts in the distribution of animal and plant species. In Haida Gwaii, for example, several animals became locally extinct at this time including brown bear, caribou, deer, and possibly fox. There is also evidence for smaller populations of black bear and salmon after c. 9500 BP (Fedje *et al.* 2004). These changes may have necessitated an adaptive response from the local population that could be mediated through the introduction or resurrection of microblade technology. Alternatively, they may have provided a window of opportunity for immigration of a people with a highly mobile Denali type adaptation. The specific advantage of microblade technology is unclear, but heightened mobility would be a distinct advantage with fewer predictable intertidal and interior resources. A similar environmentally triggered shift might be considered for the c. 8500 BP arrival of microblade technology to the interior of the Northwest (Stryd and Rousseau 1996). This is the time of the xerothermic maximum (Walker and Pellatt 2004) that has been suggested to have made parts of the Northwest interior and Plains more marginal to human occupation. Perhaps this could be mitigated in part with a high mobility, ”Athapaskan type” adaptation.

ATHAPASKAN AND PROTO-NA-DENE CORRELATES

When the distribution of Athapaskan speakers is laid over our site sample (Figure 11.9), the map reveals a good, though not perfect, correspondence of microblades with the distribution of Athapaskan and Na-Dene languages, even extending into the states of Washington and Oregon. Several areas are of particular note. The strong concentration of microblades in southwestern Yukon would likely be matched by a full sample from Alaska, both areas of the Athapaskan homeland. Secondly, the central British Columbia concentration fits well with the largest group of southern Subarctic Athapaskans, the Carrier. Thirdly, the southern British Columbia concentration focuses on the location that was known for the Nicola, a small band that was a possible offshoot of Chilcotin. The dribble of sites through Washington and Oregon is interesting in light of small Athapaskan groups' locations there. Additionally, if we include Na-

Dene-related people such as the Eyak, Tlingit, and Haida, an even stronger correspondence can be seen (Dumond 1969; Greenberg 1987; Yesner and Pearson 2002). Whether or not Tlingit and Haida are related to Na-Dene languages continues to be debated among linguists, although Tlingit would appear to be more closely connected. This connection, proposed by Sapir (1915), was dismissed subsequently by Goddard (1920), Krauss (1973, 1979) and others, but recent research supports Sapir's hypothesis (Ramer 1996; Renner 1995). An enlightening review of the Na-Dene controversy by Dürr and Renner (1995) does much to clarify the inconsistent methodologies and misun-

Figure 11.9: Distribution of Northwest Microblade tradition sites and Athapaskan groups at contact. The 196 sites are from the Alberta, British Columbia, Yukon Territory, Northwest Territories, and Nunavut Territory databases, >1 microblade. Alaska and Pacific Northwest US data are incomplete.

derstandings that have characterized this debate. Ruhlen (1998) proposes that Na-Dene has a central Siberian origin, as shown by relationships of Ket (the sole remaining Yeniseian language) to the Na-Dene family. Since microblade-using cultures of northwestern North America likely originated in Northeast Asia, this proposal deserves additional examination, although it is beyond the scope of this paper.

Vancouver Island, Strait of Georgia, and northern Washington State exhibit two other concentrations of microblade sites. These sites are well outside of known Athapaskan territory and thus throw a wrench in the hypothesis although prehistoric persistence of a number of pockets of Athapaskans, comparable to the extinct southeast Alaskan coastal Athapaskans, remains a possibility (traders-specialists at outposts along the coast). Finally, although the Apachean area shows no microblades, we have recently heard from J. Torres (personal communication 2003) that he has microblades in 16th century Navajo sites.

We acknowledge the discussion by Yesner and Pearson (2002) that while a linguistic correspondence to microblades may exist, archaeologists have yet to determine confidently whether this is a coincidence, whether microblades had a seasonal-subsistence function that was widely spread, or what the patterns mean. Historical linguistics and archaeology both deal with far-from-complete data, so both disciplines should make use of insights provided by each other and allow for continuing research into areas that may not be so well illuminated. In light of the late prehistoric and ethnohistoric microblade occurrences in Athapaskan assemblages and in what must be early Na-Dene assemblages, our view is that the correlation is strong evidence that proto-Athapaskan and Athapaskan speakers were the primary makers of microblades in northwestern North America.

CONCLUSIONS

We have attempted here to synthesize what is known of the spread of microblades in northern and western North America, supplementing previous impressions with surface contour plots of microblade site ages. Additional data from Alaska, and refinement of the radiocarbon dates will undoubtedly improve the patterns seen here. The evidence is consistent with an initial entry of microblades with proto-Na-Dene people sometime around 11,000 BP, becoming well placed in central Alaska by c. 10,500 BP. This technology becomes entrenched on the north coast after c. 9500 BP where it remains until c. 5000 BP. Also at c. 9500 BP it is weakly represented along the Canadian Rocky Mountains. By c. 9000 BP the technology is present both in marine and inland mountain environments. Microblade technology spreads from the coast into the interior areas of Yukon, southern British Columbia, and the U.S. Northwest by c. 8000 BP where it remains well represented until about 3000 BP. Following c. 3000 BP, microblades continue to spread east and north, especially in southern British Columbia, Yukon, and the western Northwest Territories. Finally, in the Late Holocene, microblade technology is represented in identifiable Athapaskan assemblages in British Columbia, Yukon, Northwest Territories, and northern Alberta. As a graphic way of illustrating our preliminary conclusions, we present Figure 11.10, which shows a model of microblade technology movements through the Late Pleistocene to Middle Holocene periods. Overall we believe there is continuing evidence that proto-Na-Dene, Na-Dene, and Athapaskan people were the primary users of microblade technology in North America. The strong microblade presence in Haida Gwaii may provide support for the hypothesis that Haida are descendent from proto-Na-Dene.

Certainly there are many avenues yet to explore. The distribution of Denali cores versus Northwest Coast cores could be a way of looking at age distributions in the absence of radiocarbon dates. This would depend on obtaining firm dates for Denali techniques in Canada or firmer core typologies. Magne (1996) has shown, for example, that for Haida Gwaii, simple measurements across various core types may distinguish the general ages of microblade cores. Analyses that would incorporate broader technological elements such as biface types and raw materials such as obsidian sources, along with microblade technology, would likely help sort out techno-cultural succession patterns in more definite ways than we have

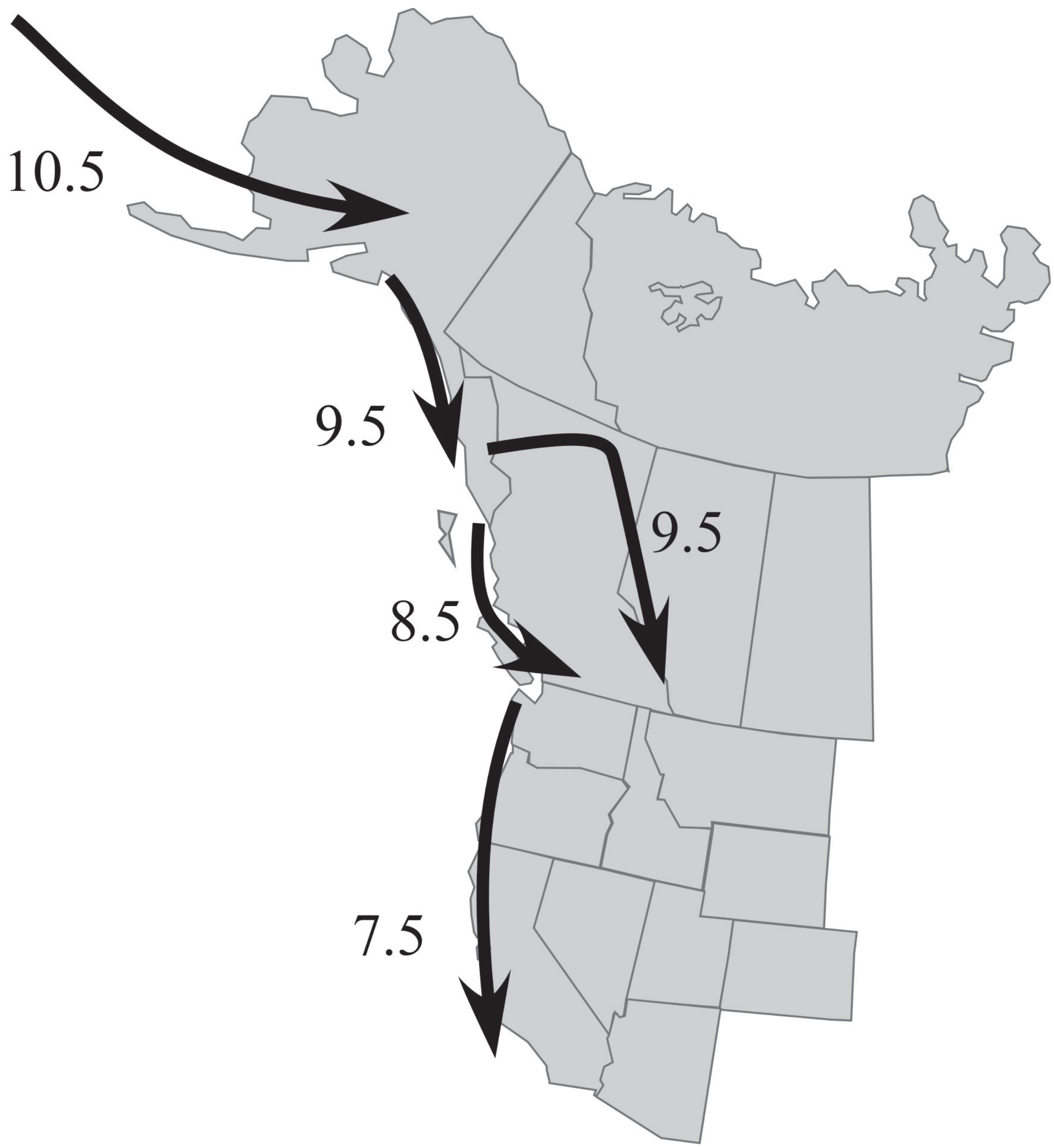

Figure 11.10: Model of the spread of Early Holocene microblade technology in western North America, thousands of radiocarbon years before present.

shown here. We do not understand much about why different core forms were manufactured, although we believe that raw material morphology at source (cobble sources, quarry extractions of varying thicknesses, incipient cleavages, etc.) is a key factor. As for major routes of dispersal, microblade technology could very well have spread rapidly via pre-existing trade routes along the main inlets and river valleys feeding the coast and along the coast itself. Ethnographic connections include Tanaina Athapaskans, Eyak-Athapaskans, and Tlingit to interior Alaska; Dry Bay Athapaskans and Tlingit into Yukon Territory; and Tsetsaut Athapaskans into interior British Columbia. In early historic times, for example, the coastal

Tlingit chiefs each had their own inland Athapaskan trading partners.

The linkages we propose among linguistic groups and ancient movements are captured in the following quote:

"There is an old story that says how some strange people came from the western ocean. Among them were two sisters. They landed on Dall Island in southeastern Alaska. There the sisters met and married men whose people were coming down the rivers from interior North America. One sister went with her family to the Queen Charlotte Islands. Her children grew and multiplied into the Haida Nation. The other sister went with her family to Prince of Wales Island. She became the ancestress or Mother of the Tlingit Nation." (Larson and Larson 1977).

ACKNOWLEDGEMENTS

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CONCLUSION: IN SEARCH OF THE ORIGINS OF MICROBLADES AND MICROBLADE TECHNOLOGY

Fumiko Ikawa-Smith

INTRODUCTION

Apart from the *Foreword* (by Carlson) and the *Introduction* (by Kuzmin, Keates and Shen), the body of this volume is made up of ten papers, representing different approaches and perspectives on the emergence and dispersal of microblade technology in Northern Asia and North America. The ten chapters cover a vast area, with two each focusing, though not exclusively, on five regions, four in Northern Asia and one in North America: namely, chapters 2 and 3 on China, chapters 4 and 5 on the Japanese Archipelago, chapters 6 and 7 on the Korean Peninsula, chapters 8 and 9 on Siberia, and chapters 10 and 11 on northwestern North America. The time range covered is also great, ranging from the Late Pleistocene before the Last Glacial Maximum (LGM) (chapters 8 and 9 for Siberia) to the Early and Middle Holocene in North America (chapters 10 and 11). The subject matter discussed is highly varied, not only because of the immense range of time-space distribution of the materials and the research interests of the authors, but also because of the differences in the history of research and the academic traditions of the countries where the materials were investigated.

The problem orientations of the two papers on each of the five regions are complimentary in some cases, and overlapping in others. In the case of China, Siberia, and the New World, three of the chapters present an overview of the archaeological assemblages (Chun Chen on China, Keates on Siberia, and Ackerman on North America), while the other chapters pursue a particular line of inquiry, such as a re-evaluation of a cultural complex as constructed for a certain part of the region (Chen Shen on the Shandong Peninsula of China), examination of the chronometric dates and the palaeoenvironmental backgrounds for the microblade assemblages (Kuzmin on Siberia and surrounding regions), or demonstration of the dispersal patterns by means of modern data processing methods (Magne and Fedje on northwestern North America). On the other hand, we have two overview papers each for Korea and Japan, set in similar, but not identical, techno-typological frameworks, leading to somewhat different interpretations about the emergence and dispersal of microblade technology in the peninsular regions of Northeast Asia.

Unevenness of data across the regions, arising in part from the difference in research history and approaches, makes inter-regional comparison a challenging task. The unevenness is quite striking, for example, in the numbers we are dealing with. The extremes are offered by Japan, on the one hand, and northern North America, on the other. Sato and Tsutsumi report that, as of 2003, 83,137 microblades have been recovered from as many as 1792 sites in the Japanese Archipelago. For the total area of 378,000 km^2, the density of microblade sites would be at the rate of one site per 211 km^2 of the land surface. For northwestern North America, Magne and Fedje were able to collect information on 59 archaeological sites where microblades have been recovered in Alaska, Washington, and Oregon states (with the total area of 1,959,000 km^2) and 196 sites from the Canadian provinces of Alberta and British

Columbia, and the Yukon and Nunavut territories, and Northwest Territories (with the combined area of 5,526,000 km^2). The North American total of 225 sites in 7,485,000 km^2 works out at one microblade site in an area of 33,267 km^2. On the other hand, 329 individual ^{14}C dates have been obtained from 117 of the 255 North American sites, representing 45.9% in contrast to less than 1% of the 1792 Japanese sites that have been chronometrically dated. The very detailed chronology of microblade assemblages for various areas of Japan is based on stratigraphic positions of the cultural layers, in relation to each other and to ^{14}C-dated tephra horizons, as well as on techno-typological reasoning. I will return to the techno-typological analyses later in this paper.

BIRTHPLACE OF MICROBLADE TECHNOLOGY

We might now turn to the major theme of the Montreal 2004 Symposium, and this book that followed it, by sorting the data in search for the place where microblade technology may have originated. In the first place, two of the five regions under consideration are NOT claimed to be such a place by both sets of the authors. For North America, where the earliest acceptable radiocarbon date for an assemblage containing microblades is c. 11,600 BP (Magne and Fedje, this volume) or c. 12,360 BP according to Bever (2006) for the Denali complex horizon at Swan Point in central Alaska, both Ackerman (this volume) and Magne and Fedje (this volume) find that this represents one of the oldest evidence left by the migrants from Northeast Asia. Association of this complex with the Na-Dene speakers has been suggested by several authors in the past, and is supported in this volume by Magne and Fedje. This is followed by the appearance in the coastal area of southern Alaska and British Columbia of what is called the Northwest Coast variant at about 9500 BP, and by the Late Tundra tradition that echoes the Sumnagin complex of Siberia. The dates of the first occurrences of these complexes/variants/traditions clearly suggest that they represent the last episodes of microblade dispersal out of Northern Asia.

For Japan, the word “emergence” is sometimes used by the authors, but it actually means, both to Sato and Tsutsumi (this volume) and to Sano (this volume), the appearance by migration or diffusion of microblade technology from the continent. It is thought to have reached the northern end of the archipelago, by way of the Sakhalin-Hokkaido route in the north, and to Kyushu in the south by way of the Korean Peninsula. Disregarding an outlier date in excess of c. 30,000 BP, the earliest accepted ^{14}C date for microblades in Japan is 20,790 ± 160 BP for layer 4 of the Kashiwadai 1 site in southwestern Hokkaido (Hokkaido Maizobunkazai Centre 1999; for a brief discussion in English, see Ikawa-Smith 2004:304). The appearance of microblade technology in Kyushu, by way of Korea, is thought to be somewhat later than in Hokkaido. The earliest ^{14}C date of about 15,000 BP is for the microblades detached from sub-conical cores at the Chaen site in Nagasaki Prefecture, not far from the famous Fukui Cave, where the wedge-shaped microcores, associated with linear relief pottery, have been dated to about 12,700 BP.

Although the total number of archaeological sites where microblades were recovered is much smaller in the Korean Peninsula than in Japan, in the neighbourhood of some 30, a greater proportion of those have been chronometrically dated. The ^{14}C dates indicate that microblade industries were well-established in Korea before the LGM. The earliest ^{14}C dates are 24,400 ± 600 BP and 24,200 ± 600 BP for the Jangheung-ri assemblage. The dates compare favourably with the two earliest ^{14}C dates from China, namely, 25,650 ± 590 BP for Chaisi and the oldest of the Xiachuan layer 2 dates of 23,900 ± 1000 BP. In view of this, and in view of the fact that a large part of the present Yellow Sea was dry during the cold phases of the Pleistocene, Seong (this volume) feels that the appearance of microblade technology in Korea should not be seen simply as the result of southward diffusion from the continent. Rather, he seems to favour the view that the Korean Peninsula was a part of continental Asia, where the ecological and evolutionary processes leading to the emergence of microblade technology took place. Norton and co-authors (this volume), on the other hand, who find it difficult "to develop a rationale for the indigenous development of microlithic technology in Korea" state that "Korean microliths are considered as one branch of the general East Asian tradition developing sometime after" their initial appearance in northern China between c. 50,000 and c. 28,000 years ago. It is interesting to note that neither Chen Shen (this volume) nor Chun Chen (this volume) presents a strong argument for the indigenous origin of microblade industries in China. Chun Chen simply states that the similarities of microblade remains in East Asia and North America, particularly the wedge-shaped cores, lead him to believe that they share a common, single origin, whose exact location at the moment remains unknown.

This leaves us with Siberia and the area immediately surrounding it. The task of reviewing the evidence here is made easy by Keates' (this volume) discussion of relevant archaeological assemblages and Kuzmin's (this volume) systematic examination of the ^{14}C dates and the environmental contexts, accompanied by a table of 66 ^{14}C values from 18 sites (Table 8.1), and the useful maps showing the distribution of the dated sites in four temporal segments (Figures 8.2–8.5). While his chart starts with Ust-Karakol 1, layers 10 and 9 C, dated to about 35,000–30,000 BP, he and Keates cite Russian sources (Derevianko *et al.* 2000b), which suggest that the microblade technology emerged in the Gorny Altai (Altai Mountains) area during the process of the Middle to Upper Palaeolithic transition. The examples include layer 12 of Anui 3 (with a radiothermoluminescence (RTL) date of 54,000 ± 13,000 years ago), the occupation levels 6 and 5 (^{14}C dates of 43,200 ± 1500 BP and 43,000 ± 1600 BP, respectively) of Kara-Bom, and layers 11, 9 and 7 of Denisova Cave (with the earliest date of c. 37,000 BP), where the assemblages that consist of "Levallois-Mousterian" as well as early Upper Palaeolithic artifacts, also contain microblades and small cores that are variously described as "wedge-shaped", "proto-wedge-shaped", "monofrontal", "flat-faced", or "butt-ended".

This reminds us of the "transitional industries" in the Levant, about which Meignen and Bar-Yosef (2002:17) remarked: "The lithic assemblages from the early Upper Paleolithic are characterized by the production of blades and bladelets." Indeed, Derevianko and Rybin (2003:47–48) observed that the Middle to Upper Palaeolithic transition occurred approximately at the same time in the Altai and in western Eurasia, and that the striking parallelism may be due in part to the "interaction between migrating human communities", as well as to ecological and demographic conditions some 50,000–40,000 years ago. It appears that the archaeological materials recovered at the Obi-Rakhmat Cave in Uzbekistan, located between the Altai Mountains and the Levant, indicate that the Middle to Upper Palaeolithic transition took place in this region of Central Asia almost contemporaneously as in the Gorny Altai and the Levant, and that the assemblages also include a small number of microblades and "flat-faced" cores (Krivoshapkin *et al.* 2006). In this connection, it is interesting to note the presence at Denisova Cave of a single geometric microlith, as well as the fact that these very early microblades from the Gorny Altai sites, such as Denisova Cave and Anui 2 and 3, are often retouched. The backed bladelets, sometimes made into geometric forms, are characteristic of the microlithic industries of western Eurasia and Africa. These, probably, are among the indications of such interactions between human communities referred to above. The Gorny Altai area, then, is more likely to be part of the general area in Eurasia where blade-based technologies developed, rather than the direct ancestral homeland of the microblade industries of Northeast Asia and northern North America.

In any event, few archaeologists would object to describing these small cores of the Gorny Altai as "proto-wedge-shaped". Few would disagree, either, with a statement that what we have here in the Altai Mountains area, dating back to at least c. 35,000 BP, is probably a "precursor" of the microblade industry, which later spread widely through Northeast Asia and eventually reached the New World. This area of Siberia, after all, is where we find the earliest occurrence of blade technology in northeastern Eurasia, and various procedures for microblade core preparation and microblade detachment are variations of the classic blade technique. The question is how

Table 12.1. Numerical significance of microblades in early assemblages with comparative figures from Japan.

Site	Stratum/ Horizon/ Layer	^{14}C Date, BP	Total lithic specimens reported	Microblades (backed or retouched)	Percentage of microblades in total lithics	"Wedge-shaped" microblade cores reported	Source
Gorny Altai							
Denisova Cave	Str. 11	>37,235	2,611	15 (some)	0.5%	>1	Keates (this volume); Kuzmin (this volume)
	Str. 9	N/A	466	77 (most)	16.5%	—	
Ust-Karakol 1	Str. 11	N/A	365	17	4.7%	2 (?)	
	Str. 10	35,100±2850	679	16 (some)	2.4%	—	
	Str. 9	From 33,400±1285 to 29,720±360	1,099	29	2.6%	3	
Anui 2	Hor. 12	27,930±1590 26,810±360	761	4 (yes)	0.5%	—	
	Hor. 11	N/A	3,501	2 (yes)	0.06%	1	
	Hor. 10	N/A	6,509	>1 (yes)	—	—	
	Hor. 9	27,125±580	2,666	1 (yes)	0.04%	—	
Upper Yenisei River Basin							
Novoselovo 13	Layer 3	22,000±700	26,488	67	0.3%	1 (?)	Keates (this volume); Kimura (1997:228–229); Kuzmin (this volume); Vasil'ev *et al.* (2002)
Kashtanka 1	Layer 2	21,800±200 20,800±600	5,400	86	1.6%	—	
Ui 1	Layer 2, Hor. 3	22,830±530 19,280±200 17,520±130 16,767±120	4,416	321	7.3%	2 (preforms)	
	Layer 2 Hor. 2		851	60	7.1%	1	
Kokorevo I	Layers 2 & 3	From 15,900±250 to 12,940±270	65,072	809	1.2%	69	
Angara River Basin							
Mal'ta	Layer 8	From 21,700±160 to 19,900±100	14,513	6 (yes)	0.4%	Yes	Keates (this volume); Kuzmin (this volume)
Krasny Yar	Layer 6	19,100±100	>2,000	?	?	17	
	Layer 7	N/A	369	8	2.2%	—	
Lena River Basin							
Ikhine 2	Str. 2b	From 30,200±300 to 24,330±200	6	0	—	1 (?)	Keates (this volume); Kuzmin (this volume); Kimura (1997:244–245); Mochanov and Fedoseeva (1996)
	Str. 2a	N/A	11	2	18.2%	1 (?)	
Verkhne-Troitskaya	Layer 6 (Str. 3)	18,300±180	52	5	9.6%	2	
Russian Far East							
Ust-Ul'ma	Layer 3	N/A	209	?	?	2	Keates (this volume); Kuzmin (this volume)
	Layer 2b	19,350±65	9,249	?	?	2	
Ogonki 5	Hor. 3	From 19,320±145 to 17,860±120	11,450	339	3.0%	66	
Transbaikal							
Kamenka, complex B	Layer 6	From 28,815±150 to 24,625±190	70	13	18.8%	2 ("proto wedge-shaped" cores)	Keates (this volume); Kuzmin (this volume)
Mongolia							
Chikhen Agui	Stratum 3	27,432±872	1385	24	1.7%	1 (?)	Keates (this volume); Kuzmin (this volume)

Table 12.1 (continued)

Site	Stratum/ Horizon/ Layer	^{14}C Date, BP	Total lithic specimens reported	Microblades (backed or retouched)	Percentage of microblades in total lithics	"Wedge-shaped" microblade cores reported	Source
North China							
Shiyu	Layer 2	28,130±1370	>15,000	0	0	1 (?)	Chen (this volume); Chen and Wang (1989); Keates (this volume); Lu (1998); Tang (2000)
Chaisi		25,650±590	?	?	?	?	
Xiachuan	Layer 2	From 23,900±1000 to 16,400±900	1348	85	13%	15	
Japan							
Kashiwadai 1	Layer 4	From 20,70±160 to 19,840±70	3365	625	18.6%	5	Hokkaido Maizobunkazai Center (1999); Ono *et al.* (2002); Sano (this volume); Tsutsumi (2003a)
Pirika	Layer 1	20,100±335 20,900±260	109,498	1107	1.0%	30	
Araya		14,250±105 13690±80	7228	1183	16.4%	56	
Chaen	Layer 5	15,470±190	1907	422	22.1%	28	
	Layer 4	N/A	2531	738	29.2%	14	

"proto" this proto-type was. This may well have been where microblades of Northeast Asia and North America were born. Where, and when did the proto-type become a full-grown microblade industry?

MICROBLADES AND MICROBLADE INDUSTRIES

The microblades of Northeast Asia and northern North America are thought to have been used in a composite tool, set into a groove along the side of a point made of organic materials such as bone, antler, and ivory. Examples of such points are known from several sites, such as Lime Hills Cave 1 and Trail Creek Cave 2 in Alaska (Ackerman, this volume) and Afontova Gora 2, Kokorevo 1, and Oshurkovo in Siberia (Chard 1974; Kimura 1997). It has been argued that the combination of the sharp edge provided by the stone and the resilience of the organic material in low temperature produced a strong and lethal weapon, advantageous for human groups coping in the cold climate (Elston and Brantingham 2002). The organic element of this useful weapon, however, has not been recovered from China, Korea, or Japan. In the absence of clear evidence in the form of grooved points made of organic materials, the archaeological indications of the use of microblades in a composite tool may include: (1) the presence of microblades that are standardized in form and dimensions, (2) their presence in an assemblage in a substantial number, and (3) the absence of steep retouch that would interfere with insertion into the groove. After some frustrating attempts to discover where and when such archaeological indications occurred, by jiggling various figures in my head, I decided to arrange some key numbers in a table form (Table 12.1). To the assemblages out of Kuzmin's ^{14}C date list (this volume) on which Keates' detailed description (this volume) provides us with relevant data, I added, for comparative purposes, a few "obvious" microblade industry sites such as Kokorevo 1, Kashiwadai 1, Pirika, and Araya for which equivalent data are available.

The limited utility of such a table became apparent as soon as I began collecting numbers. The "total number of lithic specimens reported", against which the numerical significance of microblades was to be measured, varies wildly, from over 60,000 for the combined layers 2 and 3 of the Kokorevo 1 site to only six for Ikhine stratum 2b. The variation is due, in part, to the kinds of activities that took place at the sites in prehistoric times, but mostly, it seems, to the operational practice of the archaeological investigation concerned: the length and intensity of the excavation, inclusion of waste flakes and minute chips into the "total" count, the use and mesh size of the screen for recovery of small items, etc. A large discrepancy exists even between two "obvious" microblade industry assemblages in the same area of the same country, as we note that the proportion of microblades for the layer 4 assemblage of Kashiwadai 1 in southwestern Hokkaido is 18.6%, as against 1.0% for layer 1 of the nearby site of Pirika, where as many as 109,496 lithic items were recovered and recorded.

Nevertheless, Table 12.1 does show that during the c. 28,000–27,000 BP period, microblades or bladelets accounted for less than 1% of the lithic specimens recovered from strata 12 through 9 of the Anui 2 site in the Altai Mountains area. On the other hand, they constituted higher proportions of the "transitional" and "Initial Upper Palaeolithic" assemblages of Denisova Cave and Ust-Karakol 1, even though they are older. Most of the small blades of the Gorny Altai, including the ones from Anui 2, are retouched bladelets, which, as I mentioned above, show greater affinity to the microlithic industries of western Eurasia than to those in the area further east in Eurasia. I am also intrigued by Keates' observation (this volume) that microblades disappear from the Altai Mountains region after about 26,000 BP. Is the situation analogous to the "Proto-Aurignacian" of southern Europe, which flourished between 39,000 BP and 33,000 BP, to be abandoned in favour of "classic" Upper Palaeolithic industries (Kuhn and Elson 2002)? Microlithic industries re-appeared in southern Europe later in the Pleistocene, but they do not seem to be the results of *in situ* developments out of the "Proto-Aurignacian" of earlier times. Is there a similar temporal and cultural discontinuity between the pre-26,000 BP Gorny Altai assemblages and the numerous microblade assemblages that appear just before the LGM in the Yenisei, Angara, and Lena River basins as well as in North China, the Korean Peninsula, and the Japanese Archipelago? Even though there are several assemblages that appear to date to the critical interval of c. 26,000–22,000 BP, particularly in Transbaikal, Mongolia, and North China, the data available to us are insufficient even to formulate a speculative hypothesis.

In sum, I am unable to find when, where, and how the "proto" microblade technology of the Altai Mountains became what most of us would agree to call a "real" microblade industry, characterized by a substantial number of standardized microblades, suitable to be used as insets in a point made of organic material. Clearly, a simple tabulation of the numbers available to us is not the way to reach the answers.

COMPARATIVE STUDIES OF PRODUCTION PROCEDURE

We now turn to the techno-typological approach which Chun Chen (this volume) advocates as an "appropriate way to distinguish the attribute of microblade cores and trace .... prehistoric affinities in time and space." Magne and Fedje (this volume) also noted, in their concluding section, that a finer core typology and technological analysis of reduction procedure than those currently in use by New World archaeologists might help increase our understanding of age distribution patterns of microblade industries in the New World.

This indeed has been the approach used by the Japanese researchers, who, for various reasons as discussed elsewhere (Ikawa-Smith 1975; Ono *et al.* 2002), relied less on direct chronometric dating of archaeological assemblages than on relative stratigraphy and typological comparison for chronology building. For the microblades found in the Japanese Archipelago, Sato and Tsutsumi (this volume) distinguish no fewer than 12 different reduction procedures, and Sano (this volume) uses a very similar classificatory framework. The procedures, named after a type site, are divided into two categories: the Yubetsu method group in which the cores are first made into a biface prior to platform preparation and microblade detachment, and the non-Yubetsu methods that do not prepare the core blanks into a biface first. The critical attributes used in distinguishing the seven types in the first group and the five types in the second one are explained by Sato and Tsurumi (this volume), and are illustrated in Tables 4.1 and 4.2 and Figures 4.3 and 4.4. Some of the core types are associated with ^{14}C determinations (e.g., the Rankoshi and Pirika types at Kashiwadai 1, and the Pirika and Fukui types also at their type sites), while some others are found in clear stratigraphic relations to well-dated tephra horizons. Thus, the Togeshita, Rankoshi, and Pirika types are assigned ages earlier than c. 18,000 BP, an average of ^{14}C dates for the Eniwa-a Pumice that fell over a large part of Hokkaido, while the Oshorokko, Shirataki, and Sakkotsu types postdate c. 18,000 BP (Table 12.2). Using these key dates, and stratigraphic relations with each other, Japanese researchers have constructed a detailed chronology of microblade industries.

The Japanese method of reconstructing reduction sequences is based on painstaking refitting of remnant cores, microblades, spalls, and all the other residues collected at the site, which Masakazu Yoshizaki pioneered during the 1950s with the materials from the Shirataki site group. He named the procedure "Yubetsu technique" after the river along which the numerous Palaeolithic sites were located in Shirataki Village, Hokkaido (Yoshizaki 1961). Following the identification a few years later by Morlan (1967) of the Horoka technique, named after one of the Shirataki localities, a number of new microblade reduction procedures and core types have been defined and redefined, and various classificatory systems have been proposed. Although, as Sano reports in this volume, some authors have suggested that the different core types are the results of adapting to the form and quality of lithic materials available, the underlying assumption in reconstructing the reduction procedure is that the flint knapper proceeds according to a mental template and that the remnant cores and spalls recovered from the sites are a collective reflection of this norm, rather than the residue of a dynamic process in which the knapper makes a series of decisions to meet various contingencies, including the nature of the lithic material and his/her errors.

Starting from China, Chun Chen discusses microblade industries of East Asia and northwestern North America in terms of the 6-type system which he developed for the microblade cores from Xiachuan, on which he began working in the early 1980s (Chen 1984, 1992, this volume; Chen and Wang 1989). Although I am aware that he has experimented with microblade replication while he was a graduate student at McGill University, his six types have been constructed largely on the basis of detailed examination of cores recovered from the sites.

The link between the 12-type Japanese system and Chen's 6-type system is provided by Tang and Gai (1986), both of whom spent some time in Japan. C. Tang in particular is quite familiar

Table 12.2. Comparison of techno-typological classifications.

Japan (Sato and Tsutsumi, this volume; Sano, this volume)		**China** (Chen, this volume; Shen, this volume; Tang and Gai 1986)		**North America** (Ackerman, this volume; Magne and Fedje, this volume)	**Siberia** (Mochanov 1980)	**Korea** (Seong, this volume)
Yubetsu Method	Togeshita (>18,000 BP)	Yangyuan	Wedge-shaped	Denali	Dyuktai	Type 1
	Rankoshi (>18,000 BP)					
	Pirika (<18,000 BP)					
	Oshorokko (<18,000 BP)	Sanggan				
	Shirataki (<18,000BP)	Hetao				
	Sakkotsu (<18,000 BP)					
	Fukui (Saikai technique)	Xiachuan				
Non-Yubetsu Method	Horoka/Funano	Boat-shaped		Northwest Coast		Type 2 Type 3 Type 4
	Hirosato					
	Momijiyama	Cylindrical Conical Semi-conical Funnel-shaped				
	Nodake/Yasumiba (Yadegawa method)			Late Tundra	Sumnagin	
	Unewara/Kajiyazono					

with the Japanese approach to the reconstruction of microblade reduction procedure from his graduate work at Japanese universities (Tang 1996). Table 12.2 is my attempt to juxtapose the frameworks for techno-typological comparison used in Japan and China.

Fitting Korea into this comparative chart was rather difficult. Seong (this volume) comments, quite rightly, I think, that the technological typologies currently used by Japanese and Chinese scholars "are often overly specific and do not effectively represent the full range of variation." As to the four core types Seong proposes for Korea, his Type 1 seems to have the attributes of the Yubetsu-Denali-Dyuktai group of wedge-shaped cores, but I could not be any more specific than to place all of his types 2, 3, and 4 in the non-Yubetsu type group.

Adding the classifications used in Siberia and North America to Table 12.2 was relatively simple, due, probably, to my own ignorance. Other than those which occur in Dorset and Pre-Dorset contexts, North American microblade cores are discussed in terms of three categories (Ackerman, this volume; Magne and Fedje, this volume): Denali, which corresponds to the generalized "wedge-shaped" category; the Northwest Coast variant, which often takes a "tongue-shaped" or "boat-shaped" form, like Horoka/Funano of Japan; and the conical-cylindrical variety, referred to as the Late Tundra tradition by Ackerman, who links it to the Sumnagin complex of Siberia. For Siberia, I follow here the Dyuktai-Sumnagin dichotomy proposed by Mochanov (1980) a quarter of a century ago. I read in Japanese sources that various microcore types have been proposed by Russian scholars and that some Japanese scholars identify most of the named Japanese core types in Russian collections (e.g., Kato 2003; Kimura 1997; Sato 2003b), but details are not available to me at this time to incorporate the information into Table 12.2. When such information is placed before a gathering of regional experts who can evaluate it with the knowledge of the microblade technologies in respective regions, we may be in the position to better understand the patterns of the dispersal of microblade industries and the movements and interactions of humans which the patterns may represent. We might even point to the general direction, at least, of the places where the various techniques/methods/types originated.

In the meantime, Table 12.2 is what I could glean from the papers in this collection. I should be very much surprised if I did not commit grave errors of misunderstanding and misrepresentation. If this generates comments and further discussion, it would have served its purpose very well. It is quite obvious from the foregoing that we need to pool our knowledge and merge our research skills, with the view to coordinating our terminology and analytical frameworks, if we are to have effective inter-regional comparisons of microblade technologies.

WHERE DO WE GO FROM HERE?

A comprehensive collection such as this always points up the gaps in our knowledge. As Binford (1991) said at the end of another collection of papers, "There is Always More We Need to Know." In our case, some of the gaps are the products of the past and present geopolitical environments, that are beyond our control. The most obvious one continuing today is the lack of information about the current state of microblade research in North Korea. In other cases, cross-border access to information is becoming easier in recent decades, and collaborative research by international teams has been launched at several locations covered in this book. Nevertheless, perusal of the papers in this collection makes it clear that many of us have limited knowledge of what is going on beyond our respective borders, or, more precisely, beyond the linguistic barriers. It is hoped that the growing trends towards international cooperation and interaction will continue, and that we will have another opportunity for a face-to-face exchange of opinions.

Before such an opportunity arises, we might explore new horizons. One of the ways is to expand our scope and examine those microblade assemblages of northern China and Mongolia that also contain pottery and ground stone tools. These assemblages, assigned to the "Neolithic" age in Chinese archaeology, have often been excluded from comparative studies of microblade industries. Yet, the wedge-shaped microblades of the Fukui Cave, that are associated with linear relief pottery and ^{14}C dates of 12,400 ± 350 BP (GaK–949) and 12,700 ± 500 BP (GaK–950), have always been an integral part of the interregional comparison of microblade technologies. Pottery also occurs in association with microblades at a number of sites in the Russian Far East (e.g., Kononenko and Tabarev 1995), and Norton *et al.* (this volume) mention that 900 Chulmum pottery sherds were found in association with 470 microblades at the Kosanni site on Cheju Island, indirectly dated to c. 10,400–10,200 BP. Seong (this volume), on the other hand, reports that ground stone axes have been recovered from the Sinbuk and Jiphyeon sites in association with numerous microblade cores, and Keates (this volume) tells us that "an incompletely polished adze" was found at the Ogonki 5 site in Sakhalin. Sinbuk, one of the southernmost sites on the Korean Peninsula, is dated to about 25,000–18,500 BP, and Ogonki 5 to about 19,000–18,000 BP. Presence of partially polished or ground stone tools does not signify the "Neolithic" status of an assemblage, as over 300 examples have been recovered from unmistakable Pleistocene contexts at more than 30 Palaeolithic sites in the southern part of the Japanese Archipelago (Ikawa-Smith 2004:294–296). While many of the "microliths" in the "Neolithic" assemblages of northern China are literally small stone tools, not the microblades we are concerned with here (Lu 1998), there surely must be some genuine microblade assemblages that have been assigned to the "Neolithic" period, solely on the basis of association with ground stone artifacts and/or pottery. Stratigraphic contexts of these should be examined, and ^{14}C dates obtained, if possible, and the assemblages should be added to our corpus of data for comparative studies.

Admittedly, these assemblages, like the Fukui and Senpukuji assemblages of Japan, the Kosanni of Korea, and Gromatukha, Osipovka, and Ustinovka of the Russian Far East, would be relatively late, and have no direct relevance to the 'origins' question which is the central issue here. Nevertheless, inclusion of these assemblages into our consideration could help us to go beyond the current emphasis on techno-typologies and chronology building. It would broaden our perspective regarding the questions of **What were microblades used for?** and **Why did they spread so fast and wide?**

From the distribution of microblade sites across Northeast Asia and northern North America, it has generally been assumed that microblades gave some advantages to the humans living in cold climates, where plant resources would be scarce and hunting would be the major subsistence activity. This idea has been enhanced with the persuasive arguments advanced by such authors as Elston and Brantingham (2002) and Goebel (2002). Many of the papers in this volume referred to the environmental deterioration, cooling temperature, uneven distribution of animals, shrinkage of habitable space, and need for high mobility, all of which would have been true much of the time, but one wonders "*Was it always that cold*?" and "*Did they live on hunting alone*?" Kuzmin (this volume), who presents succinct summaries of the environmental conditions for the first appearance of microblades in each of the major areas covered in this volume, also remarks that microblades spread through a vast area with different terrains, climate, vegetation, and animals, but that we lack detailed information about the nature of the environments.

Indeed, we need to know more about the environments in which the microblade users lived, and what they lived on. Extracting fine-grained environmental information would be a challenging task in much of the area under consideration, because of the conditions unfavourable to preservation of organic materials. The locations of the Yubetsu method microblade sites at the confluence of major rivers led Japanese researchers to hypothesize a possible dependence on anadromous fish as a seasonably predictable and abundant resource (Sato and Tsutsumi, this volume). Good evidence for inland fishing apparently exists for some of the microblade assemblages in the Russian Far East, while the distribution of microblade sites in northern China along rivers and lake shores (Lu 1998) may indicate the use of aquatic resources there as well. Lu (1998:104, 107) also mentions the occurrence of microblades in central and northern China with evidence of cereal cultivation, suggesting possible use of microblades in plant harvesting activity. Hard corroborative evidence either of fishing or plant processing is yet to be presented, but neither is there any concrete evidence of mammal hunting, at least from Korea and Japan, because of the poor preservation conditions. Someday we might get extremely fortunate and recover some tell-tale ecofacts. Or, perhaps, sufficient amounts of residues, be they blood, lipids, phytoliths, or starch grains, might be retrieved from the surface of the stone tools, leading to the identification of species to which the tools were exposed. We might then find that microblades were used in far more diversified contexts than we had imagined, and that their versatility and flexibility would have been particularly useful for humans coping in the rapidly changing environments of the final Pleistocene and Early Holocene. With unpredictable resource availability, possession of adaptable tool-kits, which made quick diversification of subsistence activities possible, could have been of decided advantage.

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