The Development of Urbanism and Pastoral Nomads in the Southern Levant

-Chalcolithic and Early Bronze Age Stone Tool Production Industries and Flint Mines in the Jafr Basin, Southern Jordan-

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy

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April, 2008

ABSTRACT

'The development of urbanism' has been one of the most important topics since V. G Childe's seminal works. This paper will discuss the impact of the development of urbanism in the Southern Levant on pastoral nomads using archaeological data from the Jafr Basin, Southern Jordan. The Jafr Basin is one of the best flint sources in the Southern Levant and yields high quality Eocene flint. In the Early Bronze Age when a number of fortified urban settlements appeared in the Southern Levant, pastoral nomads in the Jafr Basin started intensive flint mining and stone tool production of tabular scrapers. Tabular scrapers were distributed from the basin in large quantities to urban settlements and farming villages. Pastoral nomads in the Negev and Sinai also started utilizing desert resources for urban settelements. It is likely that in the Early Bronze Age the arid areas were economically integrated with the moister zones to a greater degree than before. The development of urbanism had the effect of making pastoral nomads more town and market-oriented. In the Early Bronze Age, a variety of desert products were distributed to sedentary settlements by pastoral nomads. Meanwhile, Early Bronze Age pastoral nomads probably became more dependent for living necessities and luxuries such as cereals, foods, vegetables and clothes on markets in urban communities.

ACKNOWLEDGEMENTS

This thesis was made possible by 'the Jafr Basin Prehistoric Project' by Kanazawa University. This author has been a member of this project since 2001. I would like to express my thanks to the director of the project, Prof. Sumio Fujii at Kanazawa University for his constant support of my research. He generously gave me permission to access chipped stone artifacts collected in the project. I am also grateful to other staffs in the project for their help and advice.

My research was carried out under the supervision of Dr. Douglas Baird at the University of Liverpool. I would like to thank him for his useful suggestions and generous support.

My study at the University of Tokyo was painstakingly supervised over years by Prof. Yoshihiro Nishiaki. I would like to thank him for his lots of encouragement over the years.

I would like to thank the following individuals who permitted me to access their stone tool collections: Dr. Douglas Baird for Tell esh Shuna North and Tell Abu Kharaz and Steven Bourke for Ghassul. I would like to thank Dr. Steven Rosen. He kindly read some parts of my thesis and gave me useful suggestion.

Finally I would like to thank my friends and my family for their support throughout my PhD course. Without them, I could not have finished my thesis.

Masashi ABE

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CHAPTER 1 AIMS OF THIS THESIS

1.1 AIMS OF THIS THESIS

'The development of urbanism' has been one of the most important topics in archaeology since V.G Childe's seminal works (Childe 1950). G Cowgill recently defined an urban settlement as a permanent settlement occupied by a significant number of residents whose activities, roles, practices and identities are significantly different from those of residents in its rural hinterlands. Urban settlements are typically political, economical and religious centres for a surrounding society and loci for wide ranges of specialized production and services. Population of at least a few thousand seems a necessary requirement for a settlment to be urban. 'The development of urbanism' denotes the prevalence of urban settlements in a society (Cowgill 2004).

As in other parts of the world, many archaeologists have tackled this topic in the Southern Levant. In particular, the Chalcolithic and Early Bronze Age (5800BC~2000BC) (Calibrated) are crucial periods in the Southern Levant as they witnessed the development of urbanism.

By the Late Chalcolithic (4500BC~38/3700BC), large settlements over 10 ha had appeared and site hierarchies had developed. Although the settlements have no fortifications, public buildings such as temples and granaries were already being constructed at some major settlements. It is often suggested that Chalcolithic societies are characterized by chiefdom (Levy 1995, Bourke 2002).

In the Early Bronze Age I (38/3700BC～31/3000BC), some large and middle sized settlements became fortified for the first time. Most of the fortified settlements in the period are located in the Jordan Valley (Paz 2002). In the following periods, Early Bronze Age II and III (31/3000～24/2300BC), large fortified settlements appeared all over the Southern Levant. Their size is usually from 10 ha to 20 ha. They are characterized by dense and compact residential areas and public buildings and installations such as bastions, granaries, temples and cisterns. In addition, a massive complex, which was probably a palace, has been discovered recently at Tell Yarmuth (Miroschedji 1999). These features of the settlements strongly suggest that urban societies developed in the Early Bronze Age and that these societies are characterized by city states controlled by palace-based elites (e.g. Ben-Tor 1992, Mazar 1992). City states denote relatively small polities, each consisting of an urban centre surrounded by hinterlands containing villages (Trigger 2003).

Along with these settlement developments, agricultural technologies, economic integration, craft specialization, long distance trade and social stratification also developed in the Chalcolithic and Early Bronze Age (Adams 2002, Fall, Falconer and Lines 2002, Greenberg and Porat 1996, Hauptmann 2000, Miroschedji 2002, A.M. Rosen 2007).

However currently, most studies about the development of urbanism still focus on fortified urban settlements and large villages. Studies on Chalcolithic and Early Bronze Age pastoral nomads in steppes and deserts are limited (Avner 1998, Beit Arieh 2003, Henry 1995, S.A.

Rosen 2002, S.A. Rosen 2003).

The traditional western view assumed that modern pastoral nomads in the Near East are economically isolated and have limited contacts with sedentary groups. The view also overemphasized hostile relationship between pastoral nomadic groups and sedentary groups and neglected the economic contributions made by pastoral nomads. This traditional view was derived from historical sources in the Near East. But these sources were produced by urban-based writers who despised pastoral nomads. In addition, ordinary relationship between sedentary groups and pastoral nomadic groups was rarely recorded (Schwartz 1995). This view had a great influence on archaeology in the Southern Levant. The decline of urban communities was often attributed to violent attacks by pastoral nomads. For example, the Amorite theory argued that invasion by pastoral nomads from Syria destroyed EB II / III urban centres (Kenyon 1964, Redford 1992).

However, since a seminal work by F. Barth (Barth 1961), ethnographers have emphasized the symbiosis between pastoral nomads and settled population. According to E. Marx, modern pastoral nomads depend strongly on towns. Their animal management is focused on products intended to supply markets in towns. They rarely consume their animals by themselves. They also export a variety of desert products such as truffles, medical herbs, falcons and salt to markets in towns. Meanwhile, pastoral nomads acquire most of their daily necessities and luxuries such as foods, cereals, coffee, tobacco, clothes and weapons from markets. Modern pastoral nomads cannot exist without towns (Marx 1992).

According to M. Rowton, this close relationship between pastoral nomads and urban communities represent one of major features throughout the Near Eastern history (Rowton 1974).

In the Near East including the Southern Levant, pastoral lands and agricultural lands are closely interwoven. Seasonal grazing lands visited by pastoral nomads are often located in sedentary zones and encircled by urban settlements. As a result, pastoral nomads in the Near East have had close economic and political contacts with farming populations and urban communities historically. Interaction between pastoral nomads and sedentary population in the Near East is much closer than that in other regions such as Central Asia.

Therefore it is easy to imagine that the appearance of urban communities in the Early Bronze Age may have had a great impact on pastoral nomads. But, currently archaeologists in the Southern Levant have little explored the pastoral nomads in these crucial periods (S.A. Rosen 2002, S.A. Rosen 2003).

Most excavations still focus on major sedentary settlements. In addition, even studies on pastoral nomads concentrate on the origins of pastoral nomads in the Neolithic (S.A. Rosen 2002, S.A. Rosen 2003). Therefore one of the key questions in this thesis is 'how did the development of urbanism in the Early Bronze Age transform pastoral nomads in the periphery? '.

The arid areas in the Southern Levant are rich in a variety of natural resources. All major copper sources in the Southern Levant, that is the Southern Sinai, Timna and Feinan, are located in the arid areas. The two major salt sources, the Dead Sea and Azraq, are also located in the arid areas. The arid areas in the Southern Levant also yield turquoise (the Southern Sinai), bitumen (the Dead Sea) and high quality Eocene flint (the Sinai, Negev, Jafr Basin, East Jordan). These resources were probably desired by Early Bronze Age fortified urban settlements. Pastoral nomads in the arid areas may have played imporant roles in distributing these resources to the urban settlements. The second key question in this thesis is 'how did pastoral nomads exploit desert resources and contribute to the development of the first urban communities in the Early Bronze Age? '.

Archaeological data from the Jafr Basin, Southern Jordan, especially Chalcolithic and Early Bronze Age stone tool production sites, will serve as the primary data to answer these two key questions in this thesis.

The Jafr Basin is the largest inland basin in Jordan. It covers about 15000 k m^2 in Southern Jordan. The mean annual precipitation in the basin is less than 100 mm and vegetation is extremely scarce. Most parts of the basin belong to the Saharo-Arabian desert region. The basin is covered with flint pavement desert, *Hammada*. Only a few perennial water sources such as the Jafr Oasis are known in the basin. The aridity today precludes the possibility of reliable cultivation without irrigation systems. Therefore the basin has been occupied by pastoral nomads for pasturing their animals in the recent past.

In the Chalcolithic and Early Bronze Age, the mean annual precipitation was higher than today. However, archaeological surveys in the basin revealed that the Jafr Basin was probably inhabited by pastoral nomads in the Chalcolithic and Early Bronze Age. Chalcolithic and Early Bronze Age sites in the Jafr Basin are characterized by small pastoral nomadic camp sites and cairns. Currently no Chalcolithic/Early Bronze Age sedentary farming villages are known in the Jafr Basin.

The Jafr Basin is one of the largest Eocene flint sources in the Southern Levant. The archaeological surveys also revealed that large stone tool production industries of tabular scrapers and Jafr blades exploiting the high quality Eocene flint were developed in the Jafr Basin in the Chalcolithic and Early Bronze Age. A number of tabular scraper/Jafr blade production sites and large scale flint mines were discovered in the basin along with the pastoral nomadic camp sites and cairns.

Tabular scrapers are knives/scrapers made on thin, flat and cortical flakes. They are characteristic artifacts of the Chalcolithic and Early Bronze Age in the Southern Levant. They are interpreted as multi-purpose knives used for hide working, butchering and wool shearing. Most Chalcolithic and Early Brone Age sites in the Southern Levant have no traces of tabular scraper production on site although they yield tabular scrapers. In addition, non-local high quality Eocene flint was used as raw material for tabular scrapers. On the basis of these facts, S.A. Rosen suggests that tabular scrapers were produced by limited groups in restricted areas (S.A. Rosen 1997).

The Jafr Basin was probably one of the major sources of tabular scrapers in the Southern Levant. A large number of tabular scrapers were probably supplied to sedentary farming and urban settlements from the Jafr Basin in the Chalcolithic and Early Bronze Age.

Jafr blades are very large, thick and robust blades. The Jafr blade is usually characterized by a large flat plain or natural weathered platform, unidirectional scars (sometimes bidirectional scars) on the dorsal surface, non-prismatic configuration, and large size. Their average width is about 3 cm and their length when complete sometimes reaches over 15 cm. The blades were probably supplied with tabular scrapers from the Jafr Basin to sedentary settlements.

Therefore these stone tool production sites of tabular scrapers and Jafr blades in the Jafr Basin will probably allow important insights into exchange and contacts between arid and moister zone communities in the Southern Levant during the Chalcolithic and Early Bronze Age.

To document full details of these stone tool production sites and their lithic technologies is also one of the main goals in this thesis.

This thesis consists of 11 chapters. Chapter 2 will explain the natural and cultural backgrounds of the Chalcolithic and Early Bronze Age in the Southern Levant. The first half of the chapter will explain modern climate, vegetation, topography and past climate during the Chalcolithic and Early Bronze Age. The second half of the chapter will provides an overview of the development of urban communities in the moister zones. Chalcolithic and Early Bronze Age pastoral nomads in steppes and deserts will be reviewed separately.

Chapter 3 will provide an overview of Chalcolithic and Early Bronze Age chipped stone artifacts. In particular, the chapter will review the development of stone tool industries in terms of the decline of hunting, the development of craft specialization and the appearance of metal tools. Several key stone tool types such as arrowheads, sickle blades and tabular scrapers will be introduced individually.

Chapter 4 will explain the methodology of stone tool analysis in this thesis. Firstly the basics of stone tool production and terminology will be introduced. Then the stone tool classification system and methodology of stone tool analysis used in this thesis will be explained.

Chapter 5 will present the results of archaeological surveys conducted by a Japanese team in the Jafr Basin. Firstly modern geography and research history in the Jafr basin will be reviewed briefly. Then the results of the surveys will be presented. Lastly, each Chalcolithic and Early Bronze Age site discovered by the surveys, including pastoral nomadic camp sites, cairns and stone tool production sites for tabular scrapers and Jafr blades, will be described in detail.

Chapters 6, 7, 8 and 9 will discuss the development of tabular scraper production industry in the Jafr Basin. Chapters 6 and 7 will focus on tabular scraper production in the Jafr Basin. Chapter 6 will examine intensive tabular scraper production sites with large scale flint mines and their lithic technology. Chapter 7 will study less intensive tabular scraper production sites without flint mines and their technology. Chapter 8 will investigate tabular scraper production, distribution and consumption in the Southern Levant more widely. Chapter 9 will give conclusions about the development of the tabular scraper production industry in the Jafr Basin. Chapter 10 will discuss Jafr blade production sites and their lithic technology in the Jafr basin.

General conclusions about transformations of pastoral nomads caused by the development of urbanism and contributions to the first urban communities by pastoral nomads will be given in Chapter 11.

CHAPTER 2 RESEARCH BACKGROUND

2.1 INTRODUCTION

This chapter will give a brief account of the natural and cultural backgrounds of the Chalcolithic and Early Bronze Age in the Southern Levant to place this study in context.

Natural environments always play important roles in human history. For example, Early Bronze Age fortified urban centres in the Southern Levant are much smaller in scale than comtemporary urban centres in Mesopotamia. Fragmented geography in the Southern Levant probably greatly constrained the development of larger urban centres. The modern climate, vegetation and topography in the Southern Levanat will be reviewed in this chapter. The past climate in the Chalcolithic and Early Bronze Age will also be reviewed because climate has often changed significantly in the past and these changes always had great impact on human societies.

The Chalcolithic and Early Bronze Age are crucial periods in the Southern Levant. In particaulr, the Early Bronze Age witnessed the development of urban societies and city states. This chapter will review several important aspects of the Chalcolithic and Early Bronze Age in the Southern Levant, which includes chronology, settlement, subsistence, craft specialization, trade (exchange), mortuary practice, public buildings and socio-political organization. Chalcolithic and Early Bronze Age pastoral nomads in steppes and deserts will also be reviewed separately.

2.2 NATURAL ENVIRONMENTS IN THE SOUTHERN LEVANT

2.2.1 Topography of the Southern Levant

The Levant comprises the east coast of the Mediterranean Sea and the adjacent mountains, plateaus and deserts. The Levant comprises parts of modern Syria and Lebanon, Palestine, Israel and Jordan. The Levant is usually divided into two parts: the Northern Levant and Southern Levant (Fig.2.1). The Southern Levant comprises the modern Jordan, Palestine and Israel, which cover over 120,000 k m^2 in total. Although most geographers exclude the Sinai Peninsula from the Southern Levant, the peninsula had strong cultural relationship with the Southern Levant in the past. Therefore this thesis will discuss the Sinai Peninsula with the Southern Levant.

The topography of the Southern Levant is extremely varied. Tectonic movements of the Rift Valley have divided the topography into several longitudinal strips (Fig.2.2, Fig.2.3) (Held 2005, Kuijt and Goring-Morris 2002, Rast 1992).

In the west, the narrow Mediterranean coastal plain stretches over 250km from the north to the south. At Gaza, its width is about 40 km. However it becomes narrower toward the north. At the Lebanese border, its width is only 5 km. (Held 2005, Kuijt and Goring-Morris 2002, Rast 1992)

The central hilly area is located between the coastal plain and the Rift Valley. Its average height is about 600m. The area receives favourable rainfall. A large valley, the Jezreel Valley, cuts across the hilly area in the north from east to west. The width of the valley reaches about 20 km. The valley has been an important route from the Jordan Valley to the Mediterranean Sea during many periods in the past (Held 2005, Kuijt and Goring-Morris 2002, Rast 1992).

The Negev is situated to the south of the Mediterranean coastal plain and the central hilly area. It covers about 12,000 k m^2. It receives less than 200 mm mean annual rainfall. The Negev is characterized by an arid climate (Held 2005, Kuijt and Goring-Morris 2002, Rast 1992).

To the west and south of the Negev, the Sinai Peninsula stretches out between Egypt and Southern Levant. It covers about 60,000 k m^2. Most parts of the peninsula are covered by deserts receiving less than 50 mm mean annual rainfall. The southern uplands in the Sinai receive slightly higher rainfall (Held 2005, Kuijt and Goring-Morris 2002, Rast 1992).

The Rift Valley is situated to the east of the central hill area and the Negev. The Rift Valley is a part of the 6500 km long Syria-East African Rift Valley. The Jordan Valley is situated in the north of the Rift Valley. This valley is very important historically because large settlements have flourished in the valley. The largest river in the Southern Levant, the Jordan River, runs toward the Dead Sea in the middle of the Jordan Valley. The length of the river reaches over 300 km. The Dead Sea is located in the middle of the Rift Valley covering over 1000 k m^2. The sea is about 400 m below sea level. This is the lowest point in the world. Wadi Araba lies between the Dead Sea and Red Sea. The length of the wadi is about 150 km. In contrast with the fertile Jordan Valley, the climate of Wadi Araba is extremely dry. Its mean annual rainfall is less than 50 mm (Bender 1968, Held 2005, Kuijt and Goring-Morris 2002, Rast 1992).

The Transjordanian Mountains lie on the east side of the Rift Valley. This area is generally higher than the central hilly area. The Transjordanian Mountains are generally over 1000 m. The highest mountain, Jabal Rum, reaches 1734 m. These mountains receive favourable rainfall. Some mountains receive over 600 mm mean annual rainfall (Bender 1974, Held 2005, Kennedy and Bewley 2004, Kuijt and Goring-Morris 2002, Rast 1992).

The Transjordanian Mountains continue into the Transjordanian Plateau. The plateau slopes down gently toward the east, finally reaching Mesopotamia. Most of the plateau is covered by dry steppes and deserts. It receives less than 150 mm rainfall annually. Closed drainage basins such as the Azraq Basin and Jafr Basin are scattered in the deserts. The Azraq Basin is situated in the north of Transjordanian Plateau and covers 12220 k ㎡, This is the second largest inland basin in the plateau. The basin is covered by basalt, limestone, marl and chalk. There are several marshlands in the Azraq Basin. The largest marshland is Qa al Azraq, whose size is about 50 k ㎡. The Azraq Oasis is located in the middle of Qa al Azraq. The oasis attracts a variety of animals and migratory birds. The oasis used to be an important caravan stopping point. The Jafr Basin is located in the south of Transjordanian plateau. It covers about 15000 k ㎡. This is the largest inland basin in the plateau. Most parts of the basin are covered with flint pavement deserts. A number of playas and wadis are distributed in the basin, The largest playa, Qa al Jafr, is located in the centre of the basin and covers about 240 k ㎡. (Bender 1968, Copper 2006, Kennedy and Bewley 2004). The topography and climate of the Jafr Basin will be described in more detail in Chapter 5.

2.2.2 Modern climate and vegetation in the Southern Levant

The modern climate in the Southern Levant is characterized by the Mediterranean climate in a broad sense. It has three seasons: hot dry summers, cool rainy winters and transitional seasons. Hot summers are usually from mid-June to mid-September. August is the hottest month and the temperature rises to over 40 degree in some places. Dry seasons coincide almost exactly with the hot seasons. Dry seasons last for five months from the beginning of May to the beginning of October. The cool winters last roughly from mid-October to mid-April. The coldest month is January. Winters are characterized by modest rainfall. The transitional seasons between winters and summers are characterized by unpredictable conditions with storms (MacDonald 2001).

Precipitation in the Southern Levant is unevenly distributed (Fig.2.3). It decreases from north to south and from west to east. The Mediterranean coastal plain, central hilly area, Jordan Valley and Transjordanian Mountains generally receive higher precipitation of more than 300 mm mean annually. In particular, high mountains and hills receive over 600 mm mean annual precipitation. Most of these areas are cultivable without irrigation. Meanwhile, the Sinai, Negev, Wadi Araba and Transjordanian plateau usually receive less than 200 mm mean precipitation per year. Furthermore rainfall is more variable from year to year and from place to place in these arid areas. These areas are characterized by arid steppes and deserts. For reliable dry farming, at least 200 mm mean annual precipitation is necessary. Therefore these areas have been occupied by pastoral nomads, called '*Bedouins*' by most modern English authors.

The Southern Levant is characterized by a great diversity of flora and vegetation. Over 2500 plant species exist in modern Israel (Danin 1995). This is mainly because four different plant geographical territories are present in the Southern Levant, which include the Mediterranean region, Irano-Turanian steppe region, Saharo-Arabian desert region, and tropical Sudanian region (Fig.2.4) (Zohary 1962, Zohary 1966, Zohary 1973).

The Mediterranean region is generally characterized by woodlands/forests. Oak, pine, pistachio, bay tree and juniper are characteristic. This region receives higher rainfall than other regions and its climate is a sub-humid Mediterranean climate. The typical soil is terra rossa, which makes the region very favourable for agriculture. The region stretches over the coastal plain, the central hilly area, the northern part of the Jordan Valley and the Transjordanian Mountains.. Its mean annual rainfall is usually over 300 mm (Zohary 1962, Zohary 1966, Zohary 1973).

The Irano-Turanian steppe region is characterized by herbaceous and dwarf shrubs. Particularly wormwoods are characteristic. Mean annual precipitation is from 300 mm to 100 mm. The typical soil is gray steppe soil and loess. The region lies between the Mediterranean region and Saharo-Arabian region. The Irano-Turanian steppes can be divided into moist steppes and dry steppes. Moist steppes receive over 150 mm mean precipitation annually while dry steppes receive less than 150 mm mean precipitation per year. Reliable dry farming is impossible in dry steppes without irrigation systems (Baird 1993, Zohary 1962, Zohary 1966, Zohary 1973).

The Saharo-Arabian desert region is characterized by extremely scarce vegetation. The vegetaion is limited to wadis and playas. Shrubs such as the bean caper and the broom plant are typical plants in the region. The mean annual precipitation is less than 100 mm and the climate in the region is a typical desert climate. The main soil is hammada, sands and salines. Reliable farming is impossible without irrigation systems. Dry steppes and Saharo-Arabian deserts cover most parts of the Negev, Sinai and Transjordanian Plateau (Baird 1993, Zohary 1962, Zohary 1966, Zohary 1973).

The tropical Sudanian region penetrates into the Rift Valley from Africa because the Rift Valley is characterized by higher winter temperatures. Its mean annual precipitation is less than 100 mm. The vegetation is characterized by tropical trees and shrubs. Acasias are particularly characteristic (Baird 1993, Zohary 1962, Zohary 1966, Zohary 1973).

2.2.3 Past climate during the Chalcolithic and Early Bronze Age in the Southern Levant

The climate and environments in the Southern Levant were different and obviously changed significantly in the past. These changes always had great impact on human societies. Therefore past climate studies are essential for archaeology. This is particulary important for studying human behaviour in arid areas where vegetation, animals and humans may be very responsive to the shifts in boundaries between woodlands, steppes and deserts and the potential dry farming zones. Past climate and environments are reconstructed by a variety of methods such as palynology, paleolimnology, oxygen isotope analyses and geomorphology (Wilkinson 2003).

According to A. M. Rosen, isotopic analyses of speleothems in Soreq Caves in Israel provide the most complete record of Holocene climate changes in the Southern Levant. The record shows that the period from 8,000 BC (Calibrated) to 5000 BC (from the Pre-Pottery Neolithic B to the middle of Middle Chalcolithic) is pluvial and characterized by very high mean annual precipitation. In particular, the phase around 5600 BC (Early Chalcolithic) was characterized by very warm and extremely wet conditions. In this phase, it received twice the modern mean annual precipitation. Although this pluvial period finished around 5000 BC and the climate became drier, the climate between 4500 BC and 2000 BC (the Late Chalcolithic and Early Bronze Age) was generally still wetter than today. Mean annual precipitation in the Late Chalcolithic and Early Bronze Age was 100 mm higher than today. This period was also characterized by climate fluctuations and interrupted by major dry phases several times, around 5000 BC, around 31/3000 BC and around 2600 BC. Around 2000 BC, constant dry conditions began and lasted until today (A. M. Rosen 1989, A.M. Rosen 1995, A. M. Rosen 2003, A.M. Rosen 2007).

Isotopic analyses of land snails from the Negev reveal almost the same pattern although there are slight differences in dating. They show that the period from the Pre-Pottery Neolithic B to the end of the Middle Chalcolithic was characterized by extremely wet conditions. After this period, the climate became drier gradually. In the second millennium BC, the climate reached modern dry conditions. Other studies also support the above models. Paleolimnological studies of the Dead Sea show that a period of lake evaporation, which reflects dry conditions, began around 2000 BC. Pollen diagrams from Lake Hula also reveal that a severe dry phase, indicated by sharp decline of oak pollen, started around 2000 BC (A. M. Rosen 1989, A. M. Rosen 1995, A.M. Rosen 2003, A.M. Rosen 2007).

In short, the climate during most parts of the Chalcolithic and Early Bronze Age was wetter than today. In particular, the Early Chalcolithic was characterized by extremely wet conditions. In the Chalcolothic and Early Bronze Age, the Mediterranean woodlands/forests and moist steppes stretched wider than today. Potential dry farming zones probably expanded to the south and to the east.

Currently, the number of past climate studies in the Jafr Baisn is limited. C. Davies studied past climates in the Jafr Basin using a 31 m sediment core from Qa al Jafr. (Davies 2005). However the core had no Holocene sequence, probably because of deflation process. Therefore the exact nature of Chalcolithic and Early Bronze Age climates in the Jafr Basin is unknown.

The modern Jafr basin receives less than 100 mm mean annual precipitation and most parts of the basin belong to Saharo-Arabian deserts. The author assumes that the Jafr basin received more precipitation and dry steppes and moist steppes expanded into the Jafr Basin in the Chalcolithic and Early Bronze Age. However, as Chapter 5 will discuss, the basin was probably occupied by pastoral nomads in these periods. Reliable dry farming was probably impossible even in these wetter periods. Chalcolithic/Early Bronze Age settlements in the Jafr basin are characterized by stone tool production sites, cairns and pastoral nomadic camp sites. No

Chalcolithic/Early Bronze Age sedentary villages were discovered in the Jafr Basin.

2.3 THE CHALCOLITHIC AND EARLY BRONZE AGE IN THE SOUTHERN LEVANT

2.3.1 The Chalcolithic in the Southern Levant (Fig.1.5)

2.3.1.1 The Chalcolithic in the Southern Levant

The Chalcolithic and Early Bronze Age in the Southern Levant are very crucial periods as they witnessed the appearance of complex societies (i.e. early civilization in the old fasioned phrase). The term 'complex societies' can be defined as societies in which the basic principle governing social relations was not kinship but a hierarchy of social divisions that cut horizontally across societies and were unequal in power, wealth, and social prestige. In these societies, a small ruling group that used coercive powers to augment its authority was sustained by agricultural surpluses and labour systematically appropriated from a much larger number of agricultural producers (Trigger 2003).

The term 'Chalcolithic' was first introduced by W. F. Albright after excavations at Teleilat el-Ghassul in the Jordan Valley (Albright 1931, Albright 1932). The term was coined from the Greek words, *Chalkos* (copper) and *Lithos* (Stone). In this period, the first copper tools appeared in the Southern Levant although copper tools were still rare and stone tools played important roles in daily life (Levy1986).

The Chalcolithic in the Southern Levant spanned from 5800 BC to 38/3700 BC (Calibrated). The period, especially Late Chalcolithic (4500～38/3700BC), witnessed major social and economic changes such as population growth, appearance of large settlements with public buildings such as temples and granaries, appearance of site hierarchies, developments in metallurgy, craft specialization and agricultural technologies and development of modest social stratification. Although Chalcolithic socio-political organization is hotly debated, 'chiefdoms' had probably developed by the Late Chalcolithic (Bourke 2002, Gilead 1988, Levy 1995). These Chalcolithic developments probably served as the foundation for establishment of fortified urban settlements and developments of 'city states' in the following Early Bronze Age (Levy 1995).

2.3.1.2 Chronology

Y. Garfinkel divided the Chalcolithic into three periods: the Early, Middle and Late Chalcolithic (Garfinkel 1999). Although different divisions are advocated by other researchers (e.g. Bourke 2002, Gopher 1995, Joffe and Dessel 1995, Kerner 2001), this thesis will follow Garfinkel's division because his study is very comprehensive and easy to apply.

The Early Chalcolithic spanned from 5800 BC to 5300 BC. According to Garfinkel, the Early Chalcolithic comprises the Wadi Rabah and its related cultures (e.g. Jericho V III/Pottery Neolithic B). The question of whether these cultures belong to the Neolithic or Chalcolithic has been hotly debated (e.g. Gopher 1995, Kerner 2001). However Garfinkel incorporates these cultures into the Chalcolithic because their material culture is closer to Chalcolithic material culture than Neolithic material culture.

A variety of classic Chalcolithic objects appeared in the Early Chalcolithic for the first time. They include pottery churns, mace-heads and backed sickle blades (Levy 1995, Orelle and Gopher 2000). While arrowheads were important tools in the Neolithic, they almost disappear at sedentary settlements from the Early Chalcolithic onward.

The Middle Chalcolithic is dated from 5300 BC to 4500 BC. The Middle Chalcolithic comprises the Beth Shean and Qatifian cultures. The former is documented in northern Israel, central Israel and the Jordan Valley while the latter appeared in the Negev and Southern Jordan. The Middle Chalcolithic also witnessed several changes in material culture. One classic Chalcolithic pottery shape, the V shaped bowl, appeared in this period. Stone lined silos and infant jar burials also became popular from this period (Garfinkel 1999).

The Late Chalcolithic spanned the period from 4500 BC to 38/3700 BC. It includes the famous Ghassul, Beersheba and Golan cultures. Traditional views place the end of the Late Chalcolithic at around 3500 BC or even later, around 3300 BC (e.g. Joffe and Dessel 1995, Mazar 1992). However, recent radiocarbon dates from several EB I sites and from the latest phase at Ghassul place the end of the Chalcolithic at around 3800/3700 BC (Burton and Levy 2001, Bourke, Zoppi, Meadows, Hua and Gibbins 2004).

A. H. Joffe and J. P. Dessel advocated an internal division of the Late Chalcolithic: the Developed Chalcolithic (4500-3700BC) and Terminal Chalcolithic (3700-3500BC) (Joffe and

Dessel 1995). According to them, the Terminal Chalcolithic is the gap between the Early Bronze Age and Developed Chalcolithic. They insisted that the period was characterized by a scarcity of settlements after the abandonment of major Chalcolithic sites. However the above revision of dating makes their internal division unacceptable. The recent radiocarbon dates support that the Chalcolithic developed to the Early Bronze Age relatively smoothly without a time gap (Bourke 2002, Burton and Levy 2001, Bourke, Zoppi, Meadows, Hua and Gibbins 2004).

The Late Chalcolithic witnessed major social and economic changes (Bourke 2002, Levy 1995). The following sections will focus on the description of this period as it is the most relavant to my research.

2.3.1.3 Settlement

Chalcolithic settlements in the Jordan Valley and Northern Negev, where surveys and excavations have been the most densely conducted, clearly show that the number of settlements had increased (population growth) and settlement hierarchies had developed in these regions by the Late Chalcolithic (Burke 2002, Levy 1995).

In the Jordan Valley, over one hundred Chalcolithic sites are known. While most sites are less than 2 ha, several sites are over 10 ha (Bourke 2002, Joffe 1993). In particular, Ghassul is noteworthy. This site is the largest Chalcolithc site in the Southern Levant and reaches over 25 ha in size. According to S. Bourke, large sites such as Ghassul, Pella and Abu Hamid are usually located beside major wadis in the Jordan Valley. This suggests that intensive cultivation with floodwater irrigation systems was probably vital to these settlements to support their large populations.

Currently over a hundred Late Chalcolithic sites are known in the Northern Negev. While most sites are small villages, several large sites such as Shiqmim, Grar, Gilat, Bir es-Safadi, Nevartim and Zeelim are about 10 ha (Levy 1986, Levy 1995). Several settlement clusters are known along major wadis in the Northern Negev. Every cluster has one large village in its centre. Several small villages are concentrated within 2km of these large villages. This settlement pattern suggests that large villages probably had special functions as centres in surrounding areas (Levy, Burton and Rowan 2006).

A variety of dwelling types were present in the Late Chalcolithic. Natural caves were often used as temporary dwellings. Unique subterranean dwellings are also known in the Northern Negev. They were the earliest dwellings in the Northen Negev and they were replaced by above ground rectangular dwellings in later phases (Levy 1986, Levy 1995).

The most common dwellings in the Late Chalcolithic sedentary settlements are above ground rectangular dwellings. Despite different local conditions, the basic plan of rectangular dwellings was the same throughout the Southern Levant. The typical Late Chalcolithic dwelling is a rectangular building, which consists of an open rectangular courtyard (5-8 m×8-12 m) and one or more broad rooms (2-4 m×5-8 m) on its narrow side. One nuclear family probably lived in each dwelling (Porath 1992).

At Ghassul, these rectangular dwellings were arranged relatively densely around open plazas and streets. High densities of population at large settlements seem clear.

S. J. Bourke reexamined the site plan of Ghassul. According to him, there was clear size differentiation between dwellings at Teleilat el Ghassul. Some dwellings are substantial, multi roomed and equipped with several storage pits, large pithoi and free standing mudbrick bins while others are small and have no storage facilities (Bourke 2001). This suggests that some degree of wealth differentiation in agricultural surplus was already developing among the population at large settlements, although no prominent elite residences like Palace B at Early Bronze Age Yarmuth are known in the Chalcolithic.

Late Chalcolithic large settlements did not have any fortification systems despite their large size. However public buildings were already being constructed at several sites. Large buildings discovered at En Gedi, Gilat and Ghassul are usually interpreted as public temples as will be discussed later.

A large platform was discovered along with several large storage pits at Pella. A massive burnt deposit of pre-sorted wheat grain product discovered on the platform strongly suggests that a large granary probably stood on the platform. The platform and storage pits probably stored a large quantity of grain. It is suggested that they were probably public granaries for communal goals by the excavators (Bourke, Sparks, McLaren, Sowada, Mairs, Meadows, Hikade and Reade 2003). This building was probably a precursor of the famous Early Bronze Age public granary found at Beth Yerah.

2.3.1.4 Subsistence

Traditional views assumed that there was a great jump in agricultural technologies between the Late Chalcolithic and Early Bronze Age. However recent studies show that many agricultural innovations such as flood irrigation farming, olive cultivation, and the secondary use of cattle and donkeys for plough traction and transportation had probably started by the Late Chalcolithic (Bourke 2001, Bourke 2002, Levy 1986, Levy 1995).

The presence of flood irrigation farming in the Late Chalcolithic is supported by several pieces of evidence. Several check dams were indeed found in the Northern Negev although their dating is somewhat doubtful (Levy 1995). Major settlements in the Jordan Valley were usually located near major wadis, which are ideal locations for flood water irrigation (Bourke 2001, Bourke 2002).

Some botanical studies also support this possibility. Silica skeleton formation, which is associated with irrigation farming, was observed on phytolith samples from the Chalcolithic sites in the Northern Negev (Levy 1995, A.M. Rosen 1992). Botanical studies at Ghassul are also suggestive. They reveal that emmer wheat increased toward the Late Chalcolithic. Emmer wheat is well adapted for irrigation while einkorn does not thrive in hot irrigated lowlands such as the Lower Jordan Valley. The focus on emmer wheat hints that intensive cultivation with flood irrigation systems was conducted at Ghassul (Bourke 2001, Bouke 2002, Bourke, Lovell, Sparks, Seaton, Mairs and Meadows 2000).

Although the timing of the introduction of olive cultivation is still debated, measurement of olive pits from Teleilat el Ghassul shows that olives had been cultivated by the Late Chalcolithic (Meadows 1999). In addition, olive wood replaced oak wood as fuel and building materials at sedentary settlements in the Jordan Valley from the Late Chalcolithic onward. Given that the Jordan Valley is not the home of wild olive trees, these olive woods were probably cut from olive orchards near the settlements (Fall, Falconer and Lines 2002). Microscopic analysis of olive pit breakage patterns also shows olives were not only eaten but that olive oil was also produced at Ghassul in the Late Chalcolithic (Bourke 2001, Bourke 2002, Meadows 1999).

In contrast with cultivation, hunting became less important in most of the Late Chalcolithic sedentary settlements. For example, hunted animals are less than 4 % of the fauna at Shiqmim (Levy 1995). The insignificance of hunting activities in the Late Chalcolithic is also supported by the absence of arrowheads at sedentary settlements.

In the Late Chalcolithic, secondary products such as wool, butter and cheese were utilized. Kill off patterns shown by animal bones from Ghassul suggests that cattle were probably kept for the milk and sheep were herded for wool (Bourke 2001, Bourke 2002). The timing of the introduction of dairy products and wool in the Southern Levant still remains unclear. At the moment, the oldest woolen textiles in the Southern Levant were discovered from Late Chalcolithic Nahal Mishmar (Bar-Adon 1980). Given that wool decomposes easily, wool utilization probably started even earlier. The first pottery churns appeared in the Early Chalcolithic (Orrelle and Gopher 2000). The pottery is often assumed to have been related to churning for making butter. However their function is still debated.

Some pieces of evidence also suggest that cattle were probably used for plough traction and transportation in the Late Chalcolithic. Lesions were observed on cattle foot bones from several Late Chalcolithic sites (Grigson 1995). The lesions were probably caused by hard labour such as plough traction and transportation. This view is supported by one bull figurine excavated from En Gedi. The bull is carrying pottery on the back.

There is also a possibility that donkeys were used for transportation in the Late Chalcolithic although evidence is still inadequate. The Late Chalcolithic level of Azor yielded one donkey figurine carrying two pots on the back. Furthermore recent osteological studies also support this view (Grigson 1995, Bourke, Lovell, Sparks, Seaton, Mairs and Meadows 2000).

2.3.1.5 Craft specialization

Craft specialization is one of the important elements for the development of complex societies, C. Costin defined craft specialization as differentiated, regularised, permanent and perhaps institutionalised production system in which producers depend on extra household exchange relations at least in part for their livelihood and consumers depend on them for acquisition of goods they do not produce themselves (Costin 1991).

The Late Chalcolithic witnessed the first appearance of copper tools in the Southern Levant although copper tools were still rare in the Late Chalcolithic (Levy 1995). Copper ores were already used for ornaments and pigments in the Neolithic. However the Neolithic people in the Southern Levant used ores like natural stones. They did not smelt nor melt copper ores.

Late Chalcolithic copper artifacts can be divided into two types: utensils and cult/prestige objects. The former includes awls, fish hooks, adzes, and axes. Copper spearheads and daggers were not present yet. The latter includes mace-heads, standards, vessels and crowns (Levy 1995).

Production loci of copper utensils have often been discovered in the Northern Negev sites such as Abu Matar, Bir es-Safadi, Shiqmim and Mezad Aluf. Copper ores, malachite and cuprite, were transported to the Northern Negev sites from Feinan by direct procurement or exchange. The copper ores were smelted at these settlements using crucibles and bellows. Copper utensils were produced through casting, hammering and annealing (Golden, Levy and Hauptmann 2001). J. Golden, T.E. Levy and A. Hauptmann suggest that these settlements probably produced copper tools for immediate consumption on site rather than for exchange because settlements with production loci are often discovered in the Northern Negev and evidence at these sites show only small scale production. This is also supported by the fact that smelting with crucibles and blowpipes is not suitable for mass production. The long distance, 150 km, between the Negev Sites and Feinan copper mines also prevented mass-production at these settlements.

Cult/prestige copper artifacts have been found at a number of Late Chalcolithic sites including

Shiqmim, Peqiin Cave, Bir esh Safadi, Neve Noy, Givat Haoranim, Palmachim and Nahal Qanah. In particular, the copper hoard of Nahal Mishmar Cave is well known. Over 400 extraordinary copper objects were excavated from the site (Bar-Adon 1980). The lost wax method was employed for their production. These objects were made from arsenical copper. They were probably produced by smelting arsenic rich ores. These ores are not known in the Southern Levant and probably come from Anatolia. Their production sites have not been discovered yet. However recent petrographic studies of cores of the prestige/cult goods clearly show that most of these objects were probably produced in a limited area in the Shephelah using exotic raw material from Anatolia (Namdar, Segal, Goren and Shalev 2004). Unlike the copper utensils, cultic/prestige artifacts were exchanged inter-regionally.

Late Chalcolithic pottery was more standardized in shape and surface treatment than those of the preceding periods. Furthermore slow wheels were introduced to some pottery production. These facts suggest developments in craftmanship and more likelihood of specialization (Garfinkel 1999, Kerner 1997).

Most of the Late Chalcolithic pottery was exchanged only over short distances. Petrographic studies revealed that Late Chalcolithic pottery were usually produced in the vicinity of the settlements. However Cream ware, which was made of clay from Eocene Chalks, was exchanged inter-regionally in the Southern Levant. But the ware occupied only small parts of the assemblages (Gilead and Goren 1989, Goren 1995).

Most Late Chalcolithic stone tools are *ad hoc* tools made on flakes. Given that Late Chalcolithic sites usually yield a number of flake cores, *ad hoc* tools made on flakes were probably manufactured on site at the household level. Local coarse wadi cobbles and pebbles were usually used as raw material for flake cores.

In contrast with flakes, Late Chalcolithic blade production shows signs of modest scale craft specialization. Blades were usually used as blanks for sickle blades and shaped into backed sickle elements. Unlike Early Bronze Age Cannaanean blade production, flint mining was not conducted to acquire raw material. Relatively high quality waddi cobbles and pebbles were collected as raw material probably from nearby wadi bottoms. Late Chalcolithic blade production was technologically simple and did not include careful core preparation and careful platform preparation. Firstly cobbles and pebbles were split. Then blades were knapped from cores using surfaces caused by splitting as striking platforms. Most blade cores are single platform cores and did not show careful core preparation. Cortex often covers much of the core surfaces. Cores are usually small and less than 10 cm in length. Blades were relatively short and lack regularity and long parallel ridges. However, Late Chalcolithic sites usually yielded only a few blade cores or no cores (Baird 2001a, S.A. Rosen 1997, Noy 1998). This strongly suggests that blades were produced by limited members at limited areas inside settlements. In addition, some blades were probably transported to the sites through exchange from neighbouring production sites.

Basalt is a common raw material for domestic tools such as millstones, hammers, axes, hoes, loom weights and whet stones. These basalt utensils were produced and used only in regions near basalt outcrops. In regions without basalt outcrops, other materials such as flint and limestone were utilized.

However elaborate cult/prestige basalt bowls were exceptional. They were traded over long distances. They are usually V shaped bowls and sometimes have fenestrated feet. Production of these elaborate bowls was probably time-consuming. Unlike the ordinary basalt tools, the vessels are found throughout the Southern Levant without regard to distance from basalt outcrops. Petrographic studies by G Rutter show that the basalt vessels were exchanged inter-regionally in the Southern Levant, and that Mount Hermon was one of the major production centres of the bowls. His studies reveal that most basalt bowls discovered at the Northern Negev sites were from Mount Hermon (Rutter 2003).

2.3.1.6 Exchange

In the Late Chalcolithic, most daily commodities were locally manufactured. As already explained, most pottery, stone tools, copper tools and grinding stones were locally produced (Gilead and Goren 1989, S.A. Rosen 1997, Rutter 2003). Only small proportions of them such as Cream ware were exchanged inter-regionally in the Southern Levant.

However non-domestic artifacts such as ornaments and cult/prestige objects were exchanged inter-regionally in the Southern Levant and over long distances from Egypt and Anatolia.

Raw materials for mace-heads and ornaments such as marble, alabaster, serpentinite, faience and exotic shells were imported from Egypt (Bourke 2002). Gold rings, which were probably ingots, excavated from Nahal Qanah were also exchanged from Nubia in Africa (Gopher and Tsuk 1996).

Cult/prestige basalt bowls produced around the Mount Hermon were exchanged inter-regionally in the Southern Levant (Rutter 2003). Cult/prestige copper objects contain a small amount of arsenic. This metal was exchanged over long distances from Anatolia (Golden, Levy, Hauptmann 2001). In addition, these cult/prestige copper objects were probably produced in the Shephelah and exchanged inter-regionally in the Southern Levant.

2.3.1.7 Mortuary practice

In the Pre-Pottery Neolithic, the dead were often buried under floors of dwellings. After the Pottery Neolithic, adult burials were separated from settlements. In the Late Chalcolithic, cemeteries were usually located outside settlements although children were still buried in pottery or pottery sherds under floors of dwellings (Levy 1995).

Several burial types are known in the Late Chalcolithic. Nawamis and cairns were typical burials in the arid areas such as the Sinai, Negev and Transjordan deserts. They usually form large cemeteries, which consist of tens of tombs. They were probably cemeteries of pastoral nomadic groups in arid areas.

Burial caves were more common in the Mediterranean area. They are characterized by natural or artificial caves and secondary burials in ossuaries (Levy 1995).

Mortuary practices in the Late Chalcolithic have important implications for understanding Late Chalcolithic societies. Several Late Chalcolithic cemeteries show that modest social stratification was developed in the Late Chalcolithic.

The site of Adeimeh is generally believed to be a cemetery of Teleilat el Ghassul because the site is situated 2 km to the south of Ghassul and some burials yield Late Chalcolithic pottery. The site was originally excavated by M. Stekelis. S.J. Bourke reexamined the site. According to him, social hierarchies can be observed at the site. Several hundred cist burials were found at the site. These cists usually contained flexed primary burials or secondary burials. While the majority of the cist burials have no mounds, a few finely constructed cist burials are covered with mounds. In addition, the cist burials with mounds are surrounded by dozens of cist burials without mounds. This pattern probably reflects social stratification in the community (Bourke 2002).

Peqiin cave is a burial cave in the Upper Galilee. The cave is relatively small measuring 17 m in length ×5-7 m in width. It included more than 600 secondary burials. Three kinds of burials are discovered: burials with complex anthropomorphic ossuaries, burials with simple ossuaries, and burials without ossuaries. The first type of burial is rare and the third type of burial occupies the majority of burials in the cave. The variation of the burials probably reflects social stratification and anthropomorphic ossuaries were burials of leading persons. The view is also supported by the position of ossuaries. The anthropomorphic ossuaries were usually located at higher position than other burials. Several cult/prestige copper artifacts were also discovered at the cave. These artifacts may have belonged to the anthropomorphic ossuaries (Gal, Smithline and Shalem 1997, Gal, Smithline and Shalem 1999).

2.3.1.8 Public sanctuary

Large complexes discovered at En Gedi, Gilat, and Teleilat el-Ghassul are generally interpreted as public temples on the basis of their unusual artifacts and architectural features (Bourke 2001, Bouke 2002, Levy 1995, Levy 2006).

The complex of En Gedi is situated on a steep hilltop near the western shore of the Dead Sea. It commands a fine view of the Dead Sea. Currently no settlement sites are known near the complex. Therefore the excavator suggests that the complex was a cult centre for inhabitants of the region and of more distant areas. This complex is one of the biggest complexes in the Late Chalcolithic and measures 600 m^2. The complex is enclosed by outer walls and consists of four buildings: two gates and two broad rooms. The bigger broad room is the main building and measures 20 m×5 m. The building has a horseshoe shaped hearth against the interior of the rear wall. The hearth was filled with ashes, burned bones and included a bull figurine, which has two vessels on its back. A cylindrical white crystalline limestone base was found in the right corner of the hearth. The excavator suggests that a sacred object may have stood on the base. Benches were also constructed along the walls of the building. Several pits were found at both ends of the building. These pits contained cornets, pedestal bowls and ibex horns. They are interpreted as offering goods. In particular, the ibex horns are noteworthy. Late Chalcolithic cult/prestige copper artifacts and ossuaries are often decorated with schematized ibex horns. Ibex horns were probably sacred objects in the Late Chalcolithic. A fragment of painted plaster found at the complex hints that the broad rooms may have had wall paintings (Ussishkin1980).

Another large complex was discovered at Teleilat el Ghassul. The complex was located at the top of a hill in the western area of the site. The complex is enclosed by outer walls and measures about 30 m×30 m. This complex is one of the largest complexes in the Late Chalcolithic. It consists of two broad rooms and one semi circular altar. The broad rooms were carefully constructed and had wall paintings. The complex is very similar to En Gedi complex. Like En Gedi compex, pottery figurines were discovered at the complex. A supposed altar was constructed in front of these rooms. A paved path connected the altar with the larger broad room (Bourke 2002, Hennessy 1989).

Gilat is one of the largest farming villages in the Northern Negev. A large complex was found on the top of the mound. The complex is also interpreted as a public temple on the basis of rich supposedly cult artifacts (Levy 2006). The complex consists of several broad rooms and was rebuilt several times. The complex yielded a large number of unusual objects, which include over 200 basalt bowls, violin shaped figurines, a ram figurine with two cornets on its back and an anthropomorphic figurine with a churn on her head. The anthropomorphic figurine has often been interpreted as a sacred statue (Amiran 1989). Furthermore other extraordinary finds such as a dog burial with grave goods, ostrich eggs set in a pit, and mass human burials in a circular monument hint the cultic nature of the complex (Alon and Levy 1989, Levy 1995, Levy 2006).

P. de Miroschedji suggests that these Chalcolithic public temples shared common features and probably imitated ordinary Chalcolithic houses on a larger size. The architectural tradition of the Chalcolithic temples clearly continued until the end of the Early Bronze Age. Putative Early Bronze Age public temples are very similar to the Chalcolithic temples in plan. The same layout tradition may hint that cultic practices did not change radically from the Chalcolthic to the end of the Early Bronze Age (Miroschedji 1993).

2.3.1.9 Social and political organization

The Late Chalcolithic witnessed major social and economic changes, which include population growth, development of settlement hierarchies, appearance of large settlements with public buildings such as temples and granaries, developments in metallurgy, craft specialization and new agricultural technologies. These changes probably concurred with socio-political changes.

Late Chalcolithic social-political organization has been hotly debated for decades. Earlier some scholars argued that there was insufficient evidence for the existence of social hierarchies in the Late Chalcolithic (Gilead 1988, Perrot and Ladiray 1980). However evidence supporting the existence of ranked societies has accumulated since then (Bourke 2002, Levy 1986, Levy 1995).

New excavations and the reexamination of several cemeteries clearly show that there were social hierarchies among burials. Reexamination of the site plan at Teleilat el Ghassul also shows that some degree of wealth differentiation in agricultural surplus developed among dwellings. Late Chalcolithic societies were probably characterized by ranked societies.

As T. E. Levy suggested, the Late Chalcolithic probably witnessed the emergence of chiefdom (Levy 1995). According to C. Renfrew, the chiefdom is a society operating on the principle of ranking, i.e., different social stutus. Different lineages are graded on a scale of prestige, calculated by how closely related one is to the chief. Renfrew suggests that the chiefdom generally had a permanent ritual and ceremonial centre (Levy 1995, Renfrew and Bahn 1991).

In the Late Chalcolithic, chiefs probably played important roles socially and politically. The presence of public temples and granaries at some major settlements suggests that the chiefs probably led communal works such as construction of public buildings and controlled communal agricultural surplus.

2.3.1.10 The end of the Chalcolithic societies

By the end of the Late Chalcolithic, most settlements in the Northern Negev were abandoned. While over 120 Late Chalcolithic sites are known in the Northern Negev, only a few Early EB I sites are known in the area (Gazit 1986). Many hypotheses have been advocated on the abandonment of the Late Chalcolithic villages in the Northern Negev. They include Egyptian invasion, environmental deterioration, weakened political organization and so on (Joffe 1991; Levy 1995). However the exact reason is still unclear.

occupied into the Early Bronze Age I . Many large Chalcolithic settlements such as Tell esh Shuna North, Megiddo, Ein Assawir and Beth Shean probably continued into the EB I (Joffe 1991).

Some Late Chalcolithic artifacts such as cult/prestige copper artifacts disappeared in the Early Bronze Age I . However many Chalcolithic characteristics such as the public temple plan were inherited in the Early Bronze Age. Late Chalcolithic witnessed major social and economic changes. These Chalcolithic developments probably served as the foundation for the establishment of fortified urban settlements and developments of 'city states' in the following Early Bronze Age (Levy 1995).

2.3.2 The Early Bronze Age I in the Southern Levant (Fig.1.6)

2.3.2.1 The Early Bronze Age I in the Southern Levant

The term 'Early Bronze Age' gives rise to confusion because bronze was not used widely until the Midlde Bronze Age in the Southern Levant. Instead, copper was the most important metal through the Early Bronze Age.

The Early Bronze Age in the Southern Levant witnessed the development of urbanism. Especially in the Early Bronze Age II /III, a number of large fortified settlements appeared over most of the Southern Levant. The settlements are characterized by public buildings and city states controlled by palace-based elites (e.g. Ben-Tor 1992, Mazar 1992).

The Early Bronze Age I (EB I) is the first phase of this crucial period. In particular, the second half of EB I (Late EB I) is a phase of developments towards the Early Bronze II/III urban culture (Joffe 1991, Joffe 1993). Fortified settlements appeared for the first time in the Late EB I , Most of the fortified settlements in the EB I were located in the Jordan Valley (Eisenberg 1996, Paz 2002).

Long distance trade between Egypt and the Southern Levant was also established by the Late EB I . It is generally believed that Egyptians colonized the southwestern area of the Southern Levant for trade (Joffe 1993).

2.3.2.2 Chronology

The EB I is generally divided into two phases by ceramic chronology: Early EB I and Late EB I (Joffe 1993, Stager 1992). Early EB I is dated from 38/3700 BC to 34/3300 BC and Late EB I is dated to 34/3300 BC-31/3000 BC by radio carbon dating and cross dating with Egypt (Burton and Levy 2001, Bourke, Zoppi, Meadows, Hua and Gibbins 2004, Philip 2001).

During the Early EB I , Grey Burnished ware and Impressed Slash ware spread in the north area of the Southern Levant. Grey Burnished ware is characterized by grey-black burnished surface. Forms of the ware were restricted to large bowls with a series of knobs. Some bowls have pedestals (Goren and Zuckermann 2000). Impressed Slash ware is characterized by decoration of finger impressions and diagonal slashes (Stager 1992). While Grey Burnished ware spread to the west of the Jordan Valley, the Impressed Slash ware spread to the east of the Jordan Valley.

Early EB I pottery in the south of the Southern Levant was characterized by scalloped decoration and red paint on white wash. The technique of red paint on white wash developed into Line Painted decoration in the Late EB I . A small amount of Egyptian pottery also appeared in the Early EB I settlements in the southwestern area (Joffe 1993). A regular exchange with Egypt probably started in the period.

During the Late EB I , Grain Wash ware and the descendant of Grey Burnished ware, Crackled ware spread in the northern area. Grain Wash ware is characterized by bands of streaky red wash. The classical Grey Burnished ware disappeared at the end of Early EB I . Only its descendant, Crackled ware, is known in the Late EB I . Forms of the ware were restricted to carinated bowls and bowls with projections. These bowls sometime have pedestals.

Line Painted ware spread in the southern area. The Line Painted ware is characterized by groups of painted parallel lines in red or brown on the natural clay surface. Furthermore a significant amount of Egyptian pottery appeared in the southwestern area. It probably reflects Egyptian colonization in the area in the Late EB I (Joffe1993, Philip 2001).

2.3.2.3 Settlement

Currently no fortified settlements are known in the Early EB I. In the Late EB I, some large and middle sized settlements such as Megiddo, Beth Yerah, Tell Abu el Kharaz, Tel Shalem, Tell es-Saidiyeh and Jericho may have become fortified for the first time. In particular, Megiddo is noteworthy. Megiddo reached over 50 ha in this period. This is the largest settlement in the Early Bronze Age in the Southern Levant. Late EB I Megiddo consisted of an upper town and lower town. The upper town was probably fortified and had a large temple in its centre. The unfortified lower town stretched over 50 ha (Finkelstein, Ussishkin and Halpern 2000, Paz 2002).

Like EB II/III fortification walls, Late EB I fortification walls were reinforced practically with other fortification systems. Towers, ditches and gates were discovered at some sites (Paz 2002).

Most of the large fortified settlements in this period are located in the Jordan Valley. Therefore it has been suggested that the Jordan Valley is 'the cradle of urbanization in the Southern Levant' (Finkelstein, Ussishkin and Halpern 2000, Paz 2002) 'Urbanization' probably spread from the Jordan Valley to all over the Southern Levant in the next EB II/III Phase.

Several public buildings are known at several Late EB I settlements. Public temples are known in Megiddo and Hartuv (Finkelstein, Ussishkin and Halpern 2001, Loud 1948, Mazar and Miroschedji 1996). A large circular building at Tel Beth Shean was interpreted as a public granary on the basis of its extraordinary size and a number of large storage jars with charred grain excavated from the building (Mazar 1997). A similar circular building is also known at Palmahim (Braun 1992).

It is generally accepted that the Late EB I also witnessed Egyptian colonization in the southwestern area. Egyptian colonies and administrative centres were established in the area probably for trade. These sites yield Egyptian artifacts such as Egyptian pottery, architectures and administrative tools (Joffe 1993, Miroschedji 2002). The significance of Egyptian colonization will be discussed later.

2.3.2.4 Subsistence

Traditional views assumed that there was a great jump in agricultural technologies between the Late Chalcolithic and Early Bronze Age (e.g. Mazar 1992). However recent archaeological studies show that many agricultural innovations had already started by the Late Chalcolithic (Bourke 2001, Bourke 2002, Levy 1995). Flood irrigation farming, olive cultivation, and secondary use of cattle and donkeys for plough agriculture and transportation probably had started by the Late Chalcolithic.

The EB I period did witness some agricultural innovations. Grape cultivation probably started in the EB I . Grape pips are not known in the Late Chalcolithic. From EB I , grape pips often occur in Southern Levantine botanical assemblages. Several EB I sites such as En Besor, Jawa, Bab edh Dhara and Fidan4 yielded grape pips The grape vine is not native to the Southern Levant. Grape cultivation was probably introduced from Anatolia (Genz 2003).

The cultivation of the grape vine probably developed quickly in the Southern Levant. It is generally believed that wine became a very important trade goods from the Southern Levant to

Egypt along with olive oils from the Late EB I. In fact, Egyptian elite tombs yield a number of Southern Levantine pottery, which probably contained wine and olive oils.

2.3.2.5 Craft specialization

EB I copper tools show some changes from the Late Chalcolithic. The cult/prestige copper objects such as mace-heads, standards and crowns were not produced anymore in the EB I. Meanwhile, utilitarian copper tools such as pins, axes and adzes continued in the EB I. In addition, new copper tools, blade weapons, joined the repertoire in the EB I (Shalev 1994).

Some pieces of evidence show that the availability of copper tools increased in the EB I. Firstly copper axes/adzes replaced flint axes/adzes almost entirely in the EB I (S.A. Rosen 1997). Secondly the incidence of discovery of copper tools at EB I sites is much higher than the Late Chalcolithic (Hanbury-Tenison 1986). Thirdly the first specialized metal production villages appeared near copper mines in the EB I. Several metal production villages such as Fidan4 and Feinan100 were established near the Feinan mines (Wright, Najjar, Last, Moloney, Flender, Gower, Jackson, Kennedy and Shafiq 1998). Other metal production villages such as Magass and Hujayrat al Ghuzlan were also established in Aqaba near Timna (Brückner, Eichmann, Herling, Kallweit, Kerner, Khalil, and Miqdadi 2002). Copper production near mines probably increased copper availability throughout the Southern Levant although copper ores were still smelted using crucibles and blowpipes.

Most Late Chalcolithic stone tools are *ad hoc* tools made on flakes. Given that EB I sites usually yield a number of flake cores, *ad hoc* tools made on flakes were probably manufactured on site at the household level. Local coarse wadi cobbles and pebbles were usually used as raw material for flake cores.

However some stone tools show the development of craft specialization. In particular, the appearance of Canaanean blades in the EB I is noteworthy. Canaanean blades are large prismatic blades.They were usually used as sickle blades. Their width is usually over 2 cm and their length when they are complete sometimes reaches over 20 cm. Canaanean blades are usually thin and have symmetrical trapezoid cross section. Mined large and fresh Eocene flint nodules were used as raw material. Cannanean blade cores usually show careful core preparation and platform preparation. Canaanean blades were probably knapped from cores by indirect percussion with a punch or pressure flaking with special devices such as levers. Canaanean blade production requires a certain degree of knowledge and training. Most EB I sites yield no traces of their production while the blades are typical at most sites. It hints that the blades were produced by specialists at limited sites (S.A. Rosen 1997).

EB I pottery is generally characterized by strong regionalism. Most of the pottery was produced in the vicinity of settlements. However some pottery shows centralized production and inter-regional exchange. The Grey Burnished ware is the typical ware in the northern Early EB I . It is suggested that the ware was an imitation of basalt bowls or tarnished silver vessels (Philip 2001). The ware was probably valued tableware and widely distributed from the Upper

Galilee in the north to the southern coastal plain in the south. Petrographic studies show that the ware was produced around the Jezreel Valley and widely distributed inter-regionally (Goren and Zuckermann 2000).

The cult/prestige basalt bowls were still produced in the EB I . Two forms are known in the EB I : bowls with flaring walls and four handled bowls. The bowls were often buried with the dead in tombs. Petrographic studies by G Rutter show that the EB I basalt bowls were mainly produced around Mount Hermon and exchanged inter-regionally. For example, basalt bowls from Bab edh Dhra and Tell esh Shuna North were derived from the Mount Hermon (Rutter 2003).

2.3.2.6 Trade

Most daily commodities were locally manufactured in the Early Bronze Age I. However some daily commodities such as copper tools and Canaanean blades were exchanged inter-regionally. Cult/prestige goods such as basalt bowls and Grey Burnished ware were also exchanged inter-regionally.

The Late EB I witnessed developments of long distance trade with Egypt. According to Pierre de Miroschedji (Miroschedji 2002), Egypt probably colonized the southwestern area of the Southern Levant. The Egyptian presence is indicated by a variety of Egyptian artifacts such as vessels, architectures, statues and tombs.

The Late EB I sites in the southwestern area yielded three kinds of pottery: local Levantine vessels, locally produced Egyptianized vessels and imported Egyptian vessels. The vessels imported from Egypt are generally storage jars, which probably contained grain/beer from Egypt. The locally produced Egyptianized vessels are mainly for domestic purposes. They include baking moulds for bread, basins for brewing and lotus bowls for serving foods. Local production of the Egyptian daily vessels hints at the presence of Egyptians in the Southern Levant.

In the Late EB I , much Levantine pottery was also excavated from Egyptian elite tombs. It is generally believed that Egyptian colonists in the Southern Levant assembled Levantine local products such as copper, asphalt, olive oil and wine to send them to their homeland (Miroschedji 2002).

Recent excavations at Tell es-Sakan reveal that the site was probably a large administrative centre of Egyptian colonies in the Southern Levant. The site is over 5ha in size and had strong fortification systems. A variety of Egyptian artifacts were excavated at the site. The majority of pottery is locally produced Egyptianized pottery and imported Egyptian pottery. The buildings were also constructed in Egyptian style. A number of Egyptian administrative artifacts such as seals excavated from the site suggest that Tell es-Sakan was a major Egyptian administrative centre. Egyptian officials probably lived at the site to control the colonies and trade between the two lands (Miroschedji, Sadeq, Faltings, Boulez, Moliner, Sykes and Tengberg 2001).

Some artifacts also hint at some exchange between Anatolia and Southern Levant. Silver artifacts such as silver sheets, earrings, cups and pins were excavated from several EB I sites

(Genz 2001). Arsenic copper was also excavated from several sites (Philip 2001). The silver and arsenic copper were probably transported from Anatolia over long distance although the exact nature of exchange is still unclear.

2.3.2.7 Mortuary practice

In arid areas such as the Negev, Sinai and Transjordan, a number of dolmens, cairns and nawamis were constructed in the EB I . They usually form large cemeteries, which consists of tens or hundreds of tombs. They were probably cemeteries of pastoral nomadic groups in arid areas. These cemeteries are usually prominent in the landscape. Therefore it is generally believed that they were perhaps markers of territories of social groups (D. Ilan 2002).

Rock cut burials and burial caves are typical in the Mediterranean area. Rock cut burials are tombs hollowed out of the ground. Their shape is usually round or oval. Although their entrances have usually collapsed in the past, some rock cut tombs had cylindrical shaft entrances or square masoned openings. Burial caves are burials in natural caves or artificially modified caves (D. Ilan 2002).

Most rock cut burials and burial caves did not form large cemeteries. Only a few burials are found together and each tomb contained only a few corpses. However large cemeteries are also known in a few sites such as Megiddo and Jericho. At Megiddo, about 10 rock cut burials clustered together and each burial contained hundreds of disarticulated individuals (D. Ilan 2002).

As explained above, Egyptians probably colonized the southwestern area in the Southern Levant. Recently one Egyptian tomb was discovered in the area (Levy, Alon, Smith, Van den Brink, Witten, Golden, Grigson, Kansa, Dawson, Holl, Moreno and Kersel 1997). The tomb hints that Egyptians introduced their own mortuary practices into the colonies although the identification of the tomb as an Egyptian tomb is still controversial.

2.3.2.8 Public sanctuaries and public buildings

Several public buildings are known in the Late EB I . Two Late EB I complexes at Megiddo and Hartuv are generally accepted as public temples on the basis of their similarity to the Late Chalcolithic temples (Finkelstein, Ussishkin and Halpern 2001, Loud 1948, Mazar and Miroschedji 1996, Miroschedji 1993).

Hartuv is a 3 ha settlement. A large complex was discovered at its centre. The total size of the complex is estimated to be 500 ㎡. The large size hints at its public character. The complex consists of two broad rooms and one courtyard. The larger broad room is about 6m×15m and has a row of pillar bases in the centre. Furthermore a row of standing stones was embedded into the southern wall. The standing stones probably stood free in the previous phase without any buildings. The excavators suggested that there used to be an open sanctuary with a row of standing stones and this open sanctuary was reformed to the broad room type temple (Mazar and Miroschedji 1996). Although this complex yielded few artifacts, the standing stones hints at the cultic nature of the complex.

Megiddo is situated in the Jezreel valley. The tell is the largest settlement in Late EB I. On the top of the tell, a Late EB I massive complex was discovered. The complex is generally believed to be a public temple. Excavations revealed that the complex was rebuilt several times and became larger over time. At first, there was a pillared broad room. This room was replaced by a modest sized complex. Then the second complex was replaced again by the massive third complex. A number of animal bones discovered at the third complex hint that the animals were probably sacrificed and feasting was conducted at the complex (Finkelstein, Ussishkin and Halpern 2001).

Public granaries are reported at Late EB I sites, Tell Beth Shean and Palmaham although their exact function is unclear because of limited publication. A large circular complex was discovered at Tel Beth Shean. Its large size hints at a public character. The circular complex consists of several rooms and a large pillared hall. The complex yielded a number of large storage jars with charred grains. Therefore the excavator interpreted the complex as a public granary (Mazar 1997). The similar circular complex is also known at Palmahim although the complex was reported only briefly (Braun 1991).

2.3.2.9 Social and political organization

The Early Bronze Age I, especially Late EB I is the first phase of the development of urbanism. Some Late EB I large and middle sized settlements such as Beth Yerah, Megiddo, Tell Abu el Kharaz, Tel Shalem, Tell es-Saidiyeh and Jericho probably became fortified for the first time. Most of the large fortified settlements in the EB I were located in the Jordan Valley. Therefore it has been suggested that the Jordan Valley was 'the cradle of urbanization in the Southern Levant' (Eisenberg 1996, Paz 2002). Late EB I societies, at least in the Jordan Valley were probably characterized by urban societies and 'city states' like the next EB Ⅱ/Ⅲ societies.

2.3.3. The Early Bronze Ⅱ/Ⅲ in the Southern Levant (Fig.2.7)

2.3.3.1 The Early Bronze Age Ⅱ/Ⅲ in the Southern Levant

The Early Bronze Age Ⅱ/Ⅲ(EB Ⅱ/Ⅲ) witnessed the appearance of a number of large fortified settlements over most of the Southern Levant. The large fortified settlements were usually from 10 ha to 20 ha in size and characterized by a high density of population and massive fortification systems. Along with dense and compact residential areas, a variety of public structures and buildings such as bastions, temples, granaries and water facilities were constructed in the settlements. Furthermore one large palace over 6000 ㎡ was discovered recently at Tell Yarmuth (Miroschedji 1999). Although EB Ⅱ/Ⅲ socio-political organization is hotly debated (Ben-Tor 1992, Finkelstein 1995, Chesson and Philip 2003, Mazar 1992, Philip 2001, Philip 2003), the features of the settlements strongly suggests that EB Ⅱ/Ⅲ societies were urban societies and characterized by 'city states', in which palace based elites played important roles.

In the EB Ⅱ/Ⅲ, craft specialization, economic integration and social stratification developed more than the preceding periods. EB Ⅱ/Ⅲ agriculture is characterized by intensive cereal agriculture with flood irrigation systems and an increase of orchard cultivation (Philip 2001).

2.3.3.2 Chronology

The EB II is dated from 31/3000-2850/2750 BC and the EB III is dated from 2850/2750-24/2300 BC by the radio carbon data from several sites (Philip 2001).

At the end of EB I, strong ceramic regionalism disappeared. It suggests development of economic integration and increased contacts between regions. EB II pottery is more homogeneous throughout the Southern Levant. In the EB II, two ceramic regions, north and south, existed in the Southern Levant. The northern area was characterized by Metallic ware and the southern area was characterized by Red-slipped and burnished ware (Philip 2001).

Metallic ware was fired to a high temperature and it rings like metal when it is struck. The ware covered a full range of forms such as jars, vats, jugs, platters and bowls except hole-mouth jars. Petrographic studies show that the ware was mass-produced around the Mount Hermon and distributed in large amounts throughout the north of the southern Levant (Greenberg and Porat 1996). Metallic ware will be discussed in detail later.

Red-slipped and burnished ware in the south was apparently fired to a lower temperature than the Metallic ware and has softer fabrics. However, this ware shared the same ceramic forms as the Metallic wares (Philip 2001).

The transition from EB II pottery to EB III pottery was gradual. But it is generally accepted that the beginning of EBIII is indicated by the appearance of Khirbet Kerak ware. Although Khirbet Kerak ware is restricted mainly to the north, some sites in the south like Bab edh Dhra also yielded pottery influenced by the ware.

Khirbet Kerak ware is red-black burnished ware with distinctive shapes and decoration. This ware lacks local antecedents and has relations with contemporary Anatolian pottery. Hence it has been generally believed that the ware was introduced to the Southern Levant with movements of small groups from Anatolia (Esse 1991, Mazar 1992). But G Philip suggests local introduction without any population movement from Anatolia (Philip 1999).

2.3.3.3 Settlement

The EB II /III period experienced flourishing of large fortified settlements throughout the Southern Levant (Ben-Tor 1992, Richard 2003). Their size is usually from 10 ha to 20ha. Several thousand people probably inhabited the large fortified settlements. A number of smaller villages surrounded them. As will be discussed later, massive amounts of foodstuffs such as grain, oil and vegetable products stored at the palace of Yarmuth suggests that the large fortified settlements probably controlled surrounding villages politically and collected the foodstuffs from them (Miroschdji 2006).

The large fortified settlements are generally characterized by massive fortification systems. The fortification walls were generally rebuilt many times and grew thicker over the time. For example, at Jericho the outer fortification wall was rebuilt over 16 times in the Early Bronze Age (Ben-Tor 1992, Mazar1992).

Furthermore these fortification walls were reinforced practically with other fortification systems. Towers were usually attached to the walls. While semi-circular towers were common during the EB II, rectangular towers replaced them in EB III. The towers enabled defenders to shoot at enemies who were staying in dead areas at the foot of walls or were climbing walls (Herzog 1997). Glacises were also found at several sites. The slopes of mounds, on which walled settlements were located, were covered by artificial reinforcements. For example, the glacis at Tell el Hesi was built of alternating earthen layers of two different soils in so called the sandwich technique. The main function of glacis was to strengthen foundations of fortification walls. In addition, the steep and slippery slopes of the glacis probably obstructed the enemies' access to the settlements. Massive gates and bastions were also discovered at several settlements (Ben-Tor 1992, Mazar 1992, Herzog 1997). A massive gate at Tell el Farah is well known. At the site, the main gate was protected by two large towers on both sides. Bastions became more common in the EB III. They were attached to the fortification walls or stood freely inside settlements (Herzog 1997).

EB II / III fortification systems were designed as practical defences. The main reason for developments of massive fortification systems was probably increasing conflicts between the settlements. In fact, burned layers were often found at the EB II / III settlements (Ben-Tor 1992, Mazar 1992, Herzog 1997).

The large fortified settlements are also characterized by a high density of population. Excavations at some sites such as Arad and Tell el Farah revealed that the settlements were densely packed by domestic dwellings. Moreover excavations at Bab edh Dhra revealed that domestic dwellings expanded beyond the fortification wall (Rast and Schaub 2003).

According to O. Ilan (O. Ilan 2001), there was clear differentiation in the size of domestic dwellings. At Arad, large dwellings (100-126 ㎡) are three to five times larger than small ones (30-45 ㎡). This hints that wealth differentiation was developed among community members. Her study also shows that large domestic dwellings and small domestic dwellings were positioned in different areas inside the settlement. Wealthier inhabitants probably lived in groups at different locations from less wealth inhabitants.

Furthermore massive complexes, which are generally interpreted as palaces, were also discovered at EBIII Megiddo and Tell Yarmuth (Herzog 1997, Miroschedji 1999, Miroschedgi 2006). The size of the complexes surpasses normal domestic dwellings. The complexes at Yarmuth and Megiddo reached 6000 ㎡ and 900 ㎡ respectively. The complexes were walled off from domestic dwelling areas. The complexes perhaps served as ruling elites' residences and administrative centres. Other public buildings such as temples, water facilities and granaries were also discovered in the large fortified settlements. These public buildings and palaces will be discussed in detail later.

Some craft working areas are also known at some sites. At Yarmuth, one area was interpreted as an olive oil workshop by the excavator (Miroschedji 1999). In the area, several non-habitational rooms containing a number of pottery pithoi, pottery basins, grinding stones, mortars, kilns and stone vats, were excavated. Similar installations were also known at other sites such as Beth Yerah and Tell es Saidiyeh.

2.3.3.4 Subsistence

The EB II / III probably experienced intensification of agriculture to support densely populated large settlements. EB II / III agriculture was probably characterized by intensive cereal cultivation with flood irrigation systems. According to A. M. Rosen, silica skeleton formation, which is associated with irrigation farming, was observed on phytolith samples at a number of EB II / III sites (A.M. Rosen 2007).

Botanical studies at Bab edh Dhra are suggestive for understanding the development of agriculture in the EB II / III (Fall, Falconer and Lines 2002). The studies reveal that the percentage of emmer wheat rose in the botanical samples during the EB II when Bab edh Dhra became fortified. Wheat produces the greatest crop yields among cereals. In particular, emmer wheat and bread wheat is well adapted for irrigation while einkorn does not thrive in hot irrigated lowlands such as the Dead Sea coast. The focus on emmer wheat hints that intensive cultivation with flood irrigation systems was conducted to support the densely populated settlement of Bab edh Dhra. However after the EB II, the inhabitants at Bab edh Dhra shifted from emmer wheat to barley cultivation. Barley produces less crop yields than wheat but it is more tolerant of saline soils and aridity. P. Fall, S. E. Falconer and L. Lines argue that the shift was caused by soil salinization. The presence of soil salinization is also supported by high concentrations of boron in wheat and barley from Bab edh Dhra. It is highly probable that the EB II/III large fortified settlements conducted intensive irrigation and they suffered from soil salinization as a consequence.

As already discussed, the cultivation of the olive had started by the Late Chalcolithic and the earliest cultivated grapes are known from EB I sites. However orchard crops became more valued and cultivated more intensively in the EB II/III. Several palynological studies clearly show that olive orchards increased in the Southern Levantine landscape during the EB II/III. A pollen diagram from the Sea of Galilee shows that olive orchards increased and natural oak forests reduced in the Early Bronze II/III(Fall, Falconer and Lines 2002). Furthermore settlement patterns also hint at the intensification of orchard crop cultivation. In the EB II/III, the number of settlements in the uplands increased (Philip 2001). Orchard crops were highly market-oriented crops. The intensification of the orchard crop cultivation was apparently related to the development of markets (Fall, Falconer and Lines 2002).

Given that cereals were intensively cultivated with flood irrigation systems in the lowlands and orchard crops were intensively cultivated in the uplands in the EB II/III, these foodstuffs (cereals, olive oil, wine, olive, grapes) were probably exchanged between the lowlands and uplands (Genz 2003).

2.3.3.5 Craft specialization

Craft specialization is one of the important elements for the development of urban socities (Child 1950). In the EB II/III, craft specialization developed more than the preceding periods in a variety of fields.

In particular, Metallic ware shows a quantum leap from Chalcolithic and Early Bronze Age I pottery in production techniques, intensity and scale. Metallic ware is a typical ware in the northern area of the Southern Levant. The ware covers a full range of forms such as jars, vats, jugs, platters and bowls. Only cooking jars are not known in the forms because the ware is not resistant to thermal shock. The ware rings like metal when it is struck because the ware was fired to a high temperature over 800℃. High quality Lower Cretaceous clay, which is rich in kaolinite, was used as raw material. The ware is characterized by very thin walls, lightness and high quality fabric. In addition, the ware is highly standardized in shape. These facts strongly suggest the development of production techniques. Sophisticated knowledge, a certain degree of training and special equipment such as advanced kilns were necessary to produce the ware. Petrographic analyses show that Metallic ware was produced around Mount Hermon and distributed in large quantity throughout the north area of the Southern Levant. Pottery assemblages at sites, which are situated within 30 km from Mount Hermon, are highly dominated by Metallic ware. At Tel Teo and Tell Dan, Metallic ware is over 80 % of the pottery. Even sites that are located 80-110 km from Mount Hermon yielded a quantity of Metallic ware. For example, Metallic ware represents 50 % pottery at Beth Yerah. Furthermore, given that Metallic ware appeared in its full range of pottery forms at Beth Yerah, not contents in the ware but Metallic ware in itself represents exchanged goods. Imported Metallic ware probably suppressed local pottery production (Greenberg and Porat 1996, Rutter 2003).

EB II /III copper production in Feinan also show a great jump from the preceding periods in production techniques, scale and intensity (Adams 2002, Hauptmann 2000).

During EB I , crucibles and blowpipes were still used for smelting. Smelting with crucibles is not suitable for mass production. In addition, copper ores were mined from the Massive Brown Sandstone Formation which yields coarse ores, with simple open pit mining (Adams 2002).

There was a great shift from small scale crucible smelting to large scaled furnace smelting in EB II /III. A number of smelting furnaces were constructed on hill slopes near mines in EB II / III. The furnaces were operated by natural strong draft and 5000 tons of smelting slag was found around these furnaces. The furnaces were suitable for mass production of copper. New mining technologies, vertical shafts and gallery mines, were also introduced in EB II /III. Hiqh quality ores were mined from deep deposits in the lower Burj Dolomite Shale Formation. Firstly vertical shafts were dug down several metres to the deep deposits and low galleries were dug horizontally from the shafts following the deposits leaving several pillars to support roofs. The introduction of these new technologies hints at intensification of production and increased scale of production in EB II /III (Adams 2002, Hauptmann 2000). Furthermore this is also supported by a newly discovered site, Khirbet Hamra Ifdan, which yielded hundreds of casting moulds along with copper tools and copper ingots (Levy, Adams, Hauptmann, Prange, Schmitt-Strecker and Najjar 2002).

Most EB II/III stone tools were *ad hoc* tools using local coarse flint. Their simple production technologies suggest that they were probably manufactured on site at the household level. However some stone tools were produced by craft specialists. Canaanean blades were continously produced in the EB II/III. They are large prismatic blades. Their width is usually from 2 cm to 3 cm and their length when they are complete sometimes reaches over 20 cm. Despite their large size, Canaanean blades are very thin and have symmetrical cross section. Mined large and fresh flint nodules were probably used as raw material. Canaanean blade production was sophisticated production including flint mining, careful core preparation and platform preparation. Canaanean blades were probably knapped from cores by indirect percussion or pressure flaking with special devices such as levers. Production of the blades required a certain degree of knowledge and training. Furthermore traces of production of the blades are limited only at a few sites. These facts strongly suggest that limited groups were engaged in their production for trade (S.A. Rosen 1997, Shimelmitz, Barkai and Gopher 2000).

In EB II/III, craft specialization probably developed in other fields such as textile production and carpentry although these fields are more difficult to study because they rarely left archaelogical evidence.

2.3.3.6 Trade

As already discussed, Egyptians probably colonized the southwestern area of the Southern Levant in the Late EB I. However the flourishing Egyptian colonies disappeared at the end of

EB I . The reason is still controversial (Miroschedji 2002, Van den Brink and Levy 2002).

After the withdrawal of Egyptian colonies, the Lebanese coast became the main sea-trading partner of Egypt. Imported Lebanese pottery increased in Egypt during the Early Dynasty and Old Kingdom. Byblos was one of the major leading ports in the Lebanese coast. This is supported by the presence of a number of Egyptian artifacts with royal names at Byblos. The main exports from the Lebanon were probably oil, resin and cedar woods. It is also noteworthy that sea-going boats were called 'ships of Byblos' (kpnt) in Egypt (Mirodchedji 2002).

Although the Lebanese coast became the main trading partner, the trade between Egypt and Southern Levant still continued in the EB II /III. Southern Levantine EB II /III pottery has been discovered at Egyptian elite tombs. The main exports from the Southern Levant were probably olive oil, bitumen, and copper. Egyptian artifacts such as gold and stone palettes and bowls with names of Egyptian officals were also found at several EB II /III sites in the Southern Levant. EB II /III trade between Egypt and Southern Levant was probably organized in a different way from the preceding EB I although its exact nature is still unclear (Miroschedji 2002).

Long distance trade with other regions has not yet been studied in detail. However many exotic items were imported from distant regions. Copper tools excavated from Bab edh Dhra contain low percentage of arsenic. Silver artifacts were also found at several sites (Genz 2001). The silver and arsenic copper was probably transported from Anatolia. Lapis lazuli excavated from Bab edh Dhra was imported from Afghanistan and suggests exchange with Syria and

Mesopotamia (Chesson 1999).

EB II/III intra and inter-regional trade in the Southern Levant shows a leap from the preceding periods. In particular, Metallic ware is suggestive. In the preceding periods, most pottery for everyday use was produced in the vicinity of settlements. Only a limited amount of highly valued pottery, such as the Cream ware and Grey Burnished ware, were exchanged intra- and inter-regionally. In contrast, most EB II pottery in the northen area of the Southern Levant was centrally produced around Mount Hermon. The imported Metallic ware covered almost the full range of forms for everyday use. Metallic Ware strongly suggests that the EB II/III periods witnessed development of craft specialization in production level and economic integration (Greenberg and Porat 1996).

The increase of copper production scale in Feinan hints at increased demand for copper in the Southern Levant and Egypt in the EB II/III. Amounts of copper were probably supplied to the Southern Levant and Egypt from Feinan in the EB II/III. As will be discussed in the next section, copper weapons were buried in tombs of wealth members at Bab edh Dhra. Copper weapons probably became wealth and prestige markers in the EB II/III. This is probably one of the reasons for the increased demand (Adams 2002, Chesson 1999, Chesson 2001).

Given that cereals were intensively cultivated with flood irrigation systems in the lowlands and orchard crops were intensively cultivated in the uplands in the EB II/III, it is highly possible that these foodstuffs were exchanged intra and inter regionally.

The development of large fortified settlements over most of the Southern Levant in the EB II / III probably triggered many economic changes. Relatively small autonomous economic areas were integrated and economic regional differentiation developed. Each region intensified and specialized in production of their special products. It also fostered intra and inter regional trade in the Southern Levant.

2.3.3.7 Mortuary practice

In arid areas such as the Negev, Sinai and Transjordan, a number of dolmens, cairns and nawamis were constructed in the EB II /III. They usually form large cemeteries that consist of tens of tombs. They were probably cemeteries of pastoral nomadic groups in arid areas. In contrast, only a few EB II /III cemeteries were discovered near fortified settlements. Only two cemeteries, Jericho and Bab edh Dhra have been intensively excavated (D. Ilan 2002, Shaub and Rast 1989).

Cemeteries at Bab edh Dhra were studied in detail by M. Chesson (Chesson 1999, Chesson 2001). At Bab edh Dhra, cemeteries were located outside the fortified settlement. Rectangular mud-brick structures, charnel houses, were constructed at the cemeteries. The charnel houses contain a number of disarticulated burials with burial goods such as weapons, pottery and ornaments. The number of burials in each charnel house varies from 40 to 200. According to M. Chesson, members from the same family were probably stored at the same charnel house. She also suggests that there is clear hierarchy in size and wealth between charnel houses. The bigger charnel houses contained wealthy items such as non-local pottery, copper weapons, mace-heads, palettes, gold jewelry and precious stone ornaments such as lapis lazuli. In contrast, smaller charnel houses contained only local pottery. Her studies show that wealth differentiation was developed among families at Bab edh Dhra.

Possible elite tombs were also discovered at Bab edh Dhra. A series of elaborate tholoi were found to the west of the settlement. They were badly damaged. However, pieces of bones and EB II / III pottery sherds scattered around the tholoi suggest that they are another type of tomb at Bab edh Dhra. Although their preservation was poor, they have elaborate foundations, which were built of carefully dressed non-local sandstone. Some scholars suggest that the tholoi were possibly individual tombs of ruling elites at Bab edh Dhra (Harrison 2001, Lapp 1970, Schaub and Rast 1989).

2.3.3.8 Palaces, temples and other public buildings

One extraordinary large complex, 'the Palace B', was recently discovered at Tell Yarmuth (Miroschedji 1999, Miroschedji 2006). This complex is generally accepted as an elite residence, palace.

Its size reaches 6000 m². This is the largest building in the Southern Levant during the EB II / III. Furthermore this complex is larger than the Middle and Late Bronze Age palaces in the Southern Levant (Miroschedji 2006).

The Palace B was positioned in a dominating position, 5 m higher than surrounding areas. The palace was also walled off with massive walls. The walls are 2 m in thickness and even remnants of the walls reach over 3 m in height. The complex consists of about 50 rooms and inner courtyards. Stairs in several rooms hint at the presence of an upper storey. The construction techniques were very sophisticated. Mud bricks and walls were very standardized in size. Walls and floors were carefully covered with lime-plaster. Rooms show perfect right angles. According to the excavator, a standard cubit of 52.5 cm was used to plan the complex. Professional builders were probably engaged in the construction (Miroschdji 1999, Miroschedji 2006).

According to P. de Miroschedji (Miroshedji 2006), five functional quarters can be distinguished at the complex: the official area for official meetings and administration, the storage area which stored massive amounts of foodstuffs such as grain, wine, oil, vegetable products and so on, the domestic area for domestic activities such as cooking, the residential area of elites and main courtyard.

The presence of Palace B strongly suggests that social stratification was highly developed in the EB II / III and palace based elites played important roles socially and politically.

Another massive complex, Building 3177, at Megiddo is also interpreted as a palace. The size of the complex reaches 900 m². The complex was separated from other areas with massive walls and consists of several rooms and inner courtyards. Rooms were carefully constructed and some floors were plastered with lime-plaster (Miroschedji 1999, Miroschedji 2006).

Massive complexes discovered at Arad, Ai, Bab edh Dhra, Beth Yerah, Megiddo, Yarmuth and

Khirbet ez Zeraqun are usually interpreted as public temples because of their similarities to Chalcolithic public temples in plan and their large size although their identification is by no means certain because they usually yield few artifacts.

These public temples usually shared several architectural features: elaborate construction, large size, broad room plan with a central row of pillar bases, open space in front of broad rooms and possible altars for statues of divinities. These features were inherited from the Late Chalcolithic public temples (Herzog 1997, Mazar 1992, Miroschedji 1993). Some temples such as Ai were located at the highest position in settlements. Some temples were rebuilt several times and grew in size.

Other public buildings and facilities are also known at several EB II /III sites.The management of water was probably one of the biggest issues in fortified densely populated settlements. Large artificial water reservoirs are known from several EB II/III sites such as Arad, Ai and Tell Handaquq North (Mabry 1995, Herzog 1997). For example at Ai, a minimum 25 m long reservoir was constructed, which could store over 1800 cubic m.

What is interpreted as a public granary complex was discovered at Beth Yerah. This complex measures 30 m×40 m. The complex consists of thick outer walls, a courtyard and broad room. The thick outer walls surrounding a courtyard and broad room are over 10 m in width. Nine circular structures were sunken in the outer walls. Their diameter is about 8 m. The circular structures were interpreted as granaries containing grain on the base of Egyptian arts (Mazar

2001). A. Mazar estimates that the complex could have stored over 1700 tons of grain.

2.3.3.9 Social and political organization

G Cowgill recently defined an urban settlement as a permanent settlement occupied by a significant number of residents whose activities, roles, practices and identities are significantly different from those of residents in its rural hinterlands. Urban settlements are typically political, economical and religious centres for a surrounding society. Population of at least a few thousand seems a necessary requirement for a settlment to be urban (Cowgill 2004).

The EB II /III witnessed the appearance of large fortified settlements over most of the Southern Levant. The size of the settlements is usually from 10 ha to 20 ha. Several thousand people probably inhabited the large fortified settlements. The large fortified settlements were characterized by massive fortification systems and a variety of public buildings and facilities such as temples, cisterns, granaries and palaces. These features of the settlements strongly suggest that the large fortified settlements perfomed specialized functions for surrounding villages and that they can be called urban centres.

Recently EB II /III social and political organization has been hotly debated. Traditional views assume that the EB II /III urban societies were characterized by 'city states', which were controlled by palace based elites (e.g. Ben-Tor 1992, Finkelstein 1995, Mazar 1992). City states denote relatively small polities, each consisting of an urban centre surrounded by hinterlands containing villages (Trigger 2003). However, this 'city states' model is denied by some scholars recently (Chesson and Philip 2003, Philip 2001, Philip 2003).

M. Chesson and G. Philip advocate a new alternative model, 'corporate village model'. They suggest that there is little evidence for the presence of institutionalized elites in the Early Bronze Age in the Southern Levant. According to their model, EB II/III societies were characterized by corporate prosperous village communities without any prominent elites. Despite the lack of any political and economic elites, intensified agriculture and surpluses enabled the development of craft specialization and massive public works. They argue that public buildings such as temples and fortification walls were constructed on a corporate basis by village communities rather than by elites (Chesson and Philip 2003, Philip 2001, Philip 2003).

However, the recently discovered complex, Palace B, at Tell Yarmuth strongly supports the traditional views and suggests that palace-based elites played important roles in EB II/III societies. A relief found at Dashasheh in Upper Egypt is generally accepted to depict an Egyptian military attack on an EB II/III fortified urban settlement in the Southern Levant (Mazar 1992). On the relief, local Asian inhabitants are fighting against Egyptian troops. Inside the fortified centre, one Asian man sits on a throne and is bowed to by other persons. He was probably the ruler who controlled the settlement.

M. Chesson and G. Philip argue that the EB II/III fortified urban settlements are much smaller than the major centres of Mesopotamian city states and they are too small to be accepted as such centres of 'city states' (Chesson and Philip 2003, Philip 2001, Philip 2003). Actually only a few

EB II / III fortified urban settlements are larger than 20ha. However several Mesopotamian centres suggest that they are large enough to be centres of 'city states'. The size of Abu Salabikh, which was the centre of the ancient Mesopotamian city state, Eresh, is only 12 ha. Despite the modest scale of many of these settlements, the model of 'city states' is more appropriate to the EB II / III societies in the Southern Levant than the corporate village model.

2.3.3.10 The end of the Early Bronze Age II / III societies

By the end of EB III, most large fortified settlements were abandoned. The next period, EBIV, was characterized by non-urban settlements. Only a few fortified settlements such as Khirbet Iskandar, are known in the EBIV. In the EBIV, small farming settlements replaced EB II / III large fortified settlements although many aspects in the material culture show continuities between these periods (Richard 2003). The exact reason for the abandonment of large fortified settlements remains unclear. However many hypotheses have been advocated.

The classical 'Amorite theory' argues that invasion by an external group, Amorites from Syria, destroyed EB III large fortified settlements and they settled down in the Southern Levant in the following period. However, this hypothesis is now totally denied (Redford 1992).

Egyptian military invasion is also advocated as a cause for the abandonment of EB III large fortified settlements (Mazar 1992, Richard 2003). A relief at Dashasheh probably depicts an Egyptian military attack on a fortified settlement in the Southern Levant. A hymn found at the tomb of an Egyptian general, Uni, also mentions another Egyptian attack on fortified settlements in the Southern Levant. Egyptian armies probably attacked the Southern Levant several times around the end of EBIII. However the scale and impact of the attacks is still unclear. And this may well have happed through EB II/III.

At present, ecological and internal factors are emphasized more (Redford 1992). Factors such as climate deterioration, internal exhaustion of natural resources and internal conflicts must have been important triggers for the abandonment of EB II/III urban centres.

As already mentioned, past climate studies show that dry conditions had begun by the end of Early Bronze Age (A. M. Rosen 1989, A. M. Rosen 1995, A. M. Rosen 2003). The climate deterioration probably hit the EB II/III intensive agricultural systems and finally caused famine and internal turbulence.

Botanical studies at Bab edh Dhra also show exhaustion of natural resources. As already explained, the inhabitants at Bab edh Dhra shifted from emmer wheat cultivation to barley cultivation in the EBIII. The focus on barley cultivation hints that soil salinization was probably caused by the intensive irrigation agriculture (Fall, Falconer and Lines 2002). The salinization of lands was probably a common problem throughout the Southern Levant.

The increased scale of fortification systems in the EBIII hints at increases of internal conflicts. EBIII fortifications are far more massive than EB II fortifications. Bastions became more common and walls became thicker in the EBIII (Herzog 1997). The increase of internal conflicts may have caused political instability and finally led to the collapse of EB II/III urban society.

2.4 PRE-PROTO HISTORIC PASTORAL NOMADS IN THE SOUTHERN LEVANT

2.4.1 Studies on pre-ptoto historic pastoral nomads in the Southern Levant

The previous sections reviewed developments of Chalcolithic and Early Bronze Age societies in the Southern Levant. But they mainly focused on developments in moister areas, the zone of sedentary settlements.

The following sections will discuss developments of pastoral nomads in steppes and deserts in the Southern Levant in the prehistory and proto-history to complement the previous sections. In contrast with projects dealing with sedentary settlements, archaeological projects in the arid areas are still infrequent at this time.

Before reviewing the evidence for pre and proto historic pastoral nomads, modern pastoral nomads in the Near East will be briefly introduced.

2.4.2 Pastoral nomads and the settled population in the modern era

A large part of the Near East is covered with steppes and deserts. Rainfall in steppes and deserts is too low to support reliable dry farming. However it is enough to support seasonal perennial grazing plants. Therefore the steppes and deserts have traditionally been occupied by pastoral nomads.

Pastoral nomads are a major component of the recent population. Some records show that over 35 % of the population in Iraq in the middle of the 19th century consisted of pastoral nomads (Otsuka 1998). At present, the total number of *Bedouins* (the Arabic speaking pastoral nomads) in the Near East still reaches 600,000 (Held 2005).

Pastoral nomads in the Near East today herd mainly sheep, goats and camels. In particular camels adapt very well to desert environments. Camels have great abilities to conserve water. Even in hot summers, camels only drink water once per 10 days. At one time, camels can drink as much as 100 litres of water. Furthermore, camels can get 0.5 liters of water per 450 g fat by decomposing the fat of their humps on their back (Akagi 1994, Akagi 1998). Therefore pastoral nomads, who live in more arid areas, rely more on herding camels. While the pastoral nomads of the Syrian Desert and Mesopotamia herd sheep, goats and limited number of camels, camels are more important among pastoral nomads in the Arabian Peninsula.

Pastoral nomads have commonly been regarded as threats to settled farming communities. Actually recent ethno-historical documents often recorded looting by pastoral nomads. However, since a seminal work by F. Barth (Barth 1961), symbiosis between pastoral nomads and settled population is emphasized (Barth 1961, Jabbur 1995, Khazanov 1984, Marx 1992, Schwartz 1995).

According to E. Marx, pastoral nomads rely economically on towns. They herd their animals mainly for sale in markets in towns. Pastoral nomads consume only limited numbers of their animals. For example, the pastoral nomads in the Negev consume between 10 and 20 % of their animals by themselves. They consume the animals only on special occasions such as feasts and weddings because the animals represent relatively expensive food. One sheep is as expensive as about 50 kg wheat flour, which can support one family for one month. Therefore pastoral nomads generally keep their animals mainly for sale. Pastoral nomads are the largest producers of meat for the settled population (Fujii 2001b, Jabbur 1995, Marx 1992). They also sell their animal products such as cheese, butter, wool and hide. In addition, they also bring desert products such as truffles, other desert plants, salts, wild falcons and precious stones to markets (Jabbur 1995). Meanwhile they acquire most of their daily necessities and luxuries such as cereals, foods, coffee, tobacco, weapons, metal products and clothes from markets.

E. Marx also suggests that pastoral nomads depend on the settled population for pasture as well. Most pastoral nomads do not live in deserts all the year around. They enter the deserts mainly in rainy seasons when grasses flourish and seasonal water pools appear. In dry seasons, they usually stay in the fringe of cultivated areas. Settled farmers lend pastoral nomads their fields. The pastoral nomads pay fees and their animals feed on stubble (Marx 1992). The farmers also get some benefits. The animals' dung is a good fertilizer for their fields. Furthermore they are sometimes assisted by pastoral nomads with their farm-work.

Governments of states generally regard pastoral nomads as social problems despite their economic contributions. The governments assume that pastoral nomads manage to escape from civil obligations such as military services and taxes. Furthermore it is difficult to control pastoral nomads who live in deserts. Therefore governments sometimes allocate territories to pastoral nomads and allow them autonomous life with little interferences in such territories (Marx 1992). Societies of pastoral nomads are loosely governed by some elders, so-called Sheikhs. They are highly respected leaders and manage to reconcile struggles and organize corporate activities. For the political governments, the relationship with these Sheikhs is very important to keep peaces in marginal areas (Marx 1992).

Actually to demarcate pastoral nomads from the settled population is very difficult because pastoral nomads sometimes settle down and start to engage in cultivation or trade, or infiltrate into towns on occasions such as drought and to exploit business opportunities (Marx 1992, Schwartz 1995). On the other hand, the settled population sometimes abandons their life and adopts a more nomadic life. The spectrum from pastoral nomadism to mixed farming is continuous and there are several intermediate stages between them. For example in some situations, only a few members leave sedentary villages with animals and stay in steppes and deserts over several months for keeping animals. This pattern is usually called 'transhumance' (Marx 1992, Schwartz 1995).

Modern situations of pastoral nomads are not necessarily the case with pastoral nomads in the past. The life of modern pastoral nomads is highly influenced by modern large markets and capitalism. Developments of modern transportation also changed their traditional life. However, some important aspects of modern pastoral nomads, particularly symbiosis between pastoral nomads and settled population and their reliance on towns, probably date back to the past.

According to M. Rowton, this close relationship between pastoral nomads and urban communities represent one of the major features throughout the Near Eastern history (Rowton 1974). In the Near East including the Southern Levant, pastoral lands and agricultural lands are closely interwoven. Seasonal grazing lands visited by pastoral nomads are often located in sedentary zones and encircled by urban settlements. As a result, pastoral nomads in the Near East have had close economic and political contacts with farming population and urban communities historically. Interaction between pastoral nomads and sedentary population in the Near East is much closer than that in other regions such as Central Asia.

2.4.3 Pre-proto historic pastoral nomads in the Southern Levant

The origins of pastoral nomads in the Southern Levant date back to the Neolithic (Betts 1993, Betts 1999, Garrad, Baird, Colledge, Martin and Wright 1994, Goring-Morris 1993, Kuijt and Goring-Morris2002, Martin 1999, S.A. Rosen 2002). In the Neolithic period, domesticated sheep and goats were introduced into hunter-gatherer societies in the arid areas. However, this introduction of domesticated animals did not result in the classical pastoral nomad package. Other elements such as introduction of secondary dairy products, introduction of domesticated donkeys for transportation, appearance of markets (towns) and introduction of camels were still necessary. The appearance of classical pastoral nomad package was very long process and completed in the Late Bronze Age with the introduction of camels (S.A. Rosen 2002).

S. A. Rosen divided this process into four phases: 1. Hunter-gatherer phase, 2. Herder-gatherer phase, 3. Pre-camel pastoral nomadism phase and 4.Camel pastoral nomadism phase (S.A. Rosen 2002). The next sections will review developments of the pre-proto historic pastoral nomads in the Southern Levant following the Rosen's scheme.

2.4.3.1 Hunter-gatherer phase (Pre-Pottery Neolithic B)

During the Pre-Pottery Neolithic B (10,500 BP-8,700 BP Calibrated), the arid areas in the Southern Levant were probably inhabited by small groups of hunter-gatherers. They had no domesticated animals yet (Betts 1993, Betts 1999, Garrad, Baird, Colledge, Martin and Wright 1994, Goring-Morris 1993, Kuijt and Goring-Morris 2002, Martin 1999, S.A. Rosen 2002). Hunting and gathering were their main subsistence. Animal bones from the desert Pre-Pottery Neolithic B sites were dominated by wild ungulates such as gazelle and ibex (Goring-Morris 1993, Martin 1999). A number of arrowheads discovered at the sites also suggest the importance of hunting. The presence of grinding stones at the sites suggests that gathering wild plants was also an important activity. Cultivation was also carried out on a limited scale at several sites.

Habitation sites were usually characterized by curvilinear dwellings (Goring-Morris 1993, Kuijt and Goring-Morris 2002). Their diameter is usually less than 5 m. The dwellings usually form a line or cluster like honeycombs. The total size of habitation sites are usually less than 0.1 ha. It suggests that small hunting bands occupied the sites.

O. Bar-Yosef suggests that these hunter-gatherers probably exported meats of hunted animals to sedentary settlements (Bar-Yosef 2001). However, there is little evidence to support his view. Only a few artifacts such as marine shells and precious stones were exported from the arid areas to the humid areas.

2.4.3.2 Herder-gatherer phase (Pre-Pottery Neolithic C, Pottery Neolithic and Chalcolithic)

After the Pre-Pottery Neolithic B, the first domesticated sheep and goats were introduced into deserts. According to L. Martin, the first domesticated sheep/goats were introduced into deserts soon after the end of the Pre-Pottery Neolithic B. Because the desert was not natural habitat for wild sheep/goats, the sudden appearance of sheep and goats in deserts after the end of the Pre-Pottery Neolithic B strongly suggests introduction of herded animals from other areas (Martin 1999).

There are two models about the origins of herding animals in deserts: Köhler-Rollefson's model and Byrd's model. According to I. Köhler-Rollefson, farming villages such as Ain Ghazal had witnessed increased dependency on domesticated goats by the end of the PPNB. As a consequence, pasturing goats became competitive with cultivation and parts of the population at the villages moved out into steppes and deserts with herded animals. She suggested that they eventually became pastoral nomads in steppes and deserts (Köhler-Rollefson 1992, Martin 1999). In contrast, B. Byrd suggested introduction of herded animals by the indigenous hunter-gatherers. According to his model, the hunter-gatherers in steppes and deserts introduced domestic animals from sedentary farming settlements in humid areas (Byrd 1992). Currently zooarchaeological studies strongly support Byrd's model (Martin 1999).

The first domesticated animals were probably herded only to reduce risk (Martin 1999). But the importance of herding soon increased. By the Chalcolithic, utilization of secondary dairy products such as wool, milk and butter had begun. The introduction of secondary products increased the importance of herding for arid zone exploiting groups. Domesticated donkeys were also introduced for transportation during the Chalcolithic.

Even though domesticated animals were introduced into deserts, hunting and gathering was still an important activity, Gazelle and wild ibex were still hunted on a modest scale (Henry 1995). Some gazelle hunting traps are dated to these periods although their dating and function are still controversial (Avner 1990, Helms and Betts 1989, Eddy and Wendorf 1999). Arrowheads were still a major component in chipped stone assemblages.

The presence of grinding stones at sites suggests that gathering wild plants was also important. Indeed, phytoliths from Chalcolithic sites in Wadi Hisma show that a variety of wild plants were utilized (Henry 1995).

By the Chalcolithic, architecture had changed dramatically. Although dwellings were very similar to the preceding periods, animal pens had appeared in habitation sites. Animal pens were usually round and over 10 m in diameter. Sheep/goat' dung layers were often discovered in the pens (Avner 1990, Avner 1998, Avner, Carmi and Segal 1994, S.A. Rosen 1984, S.A. Rosen 1988a).

Pastoral nomads in these periods exchanged some desert products with sedentary settlements. They exported Dabaa marbles, raw material for beads, and tile flint, raw material for tile knives, to settled population (Cropper 2006).

2.4.4.3 Pre-camel pastoral nomadism (Early Bronze Age~).

S. A. Rosen suggests that the Early Bronze Age witnessed increased exchange between pastoral nomads and sedentary settlements (S.A. Rosen 2002).

For example, copper was probably traded by pastoral nomads in the South Sinai to sedentary settlements. The South Sinai has one of the most important copper sources in the Southern Levant. Several pastoral nomadic camp sites in the South Sinai such as Nabi Salah, Sheikh Mukhsen and Sheikh Awad have been intensively excavated (Beit-Arieh 2003). Like other pastoral nomadic camps, architecture is characterized by animal pens and round dwellings. Subsistence at these sites involved goat herding with limited crop cultivation and hunting. The excavations reveal that the inhabitants were also engaged in copper production on a modest scale. Copper ores, copper slag, crucibles, moulds and copper tools were discovered at these sites. Petrographic studies clearly show that some pottery discovered at the sites was imported from the sedentary zone, probably a fortified urban settlement, Arad. Local pastoral nomads in the South Sinai probably managed copper production and exchanged copper tools to towns. Through the exchange, they probably acquired pottery, cereals and other daily commodities from sedentary settlements in the Southern Levant (Stager 1992).

The Camel site is a small pastoral nomadic camp site in the Central Negev. At the site, grinding stones were produced using local metamorphosed or ferruginous sandstones. The site of Arad yielded a number of grinding stones made on these Central Negev sandstones and no manufacturing loci of the grinding stones was discovered at the site. It strongly suggests that inhabitants in Arad probably acquired the grinding stones from pastoral nomads in the Central Negev (Saidel 1995, S. A. Rosen 2002). The developments of urbanism and economic integration in the moister zone probably changed pastoral nomadic life.

A palace discovered at Yarmuth strongly suggests that social stratification highly developed in sedentary settlements in the Early Bronze Age. However, developments of social stratification in the moister zone probably had limited impact on pastoral nomad societies. Dolmens, cairns and Nawamis are typical burials in the Negev, Sinai and Transjordan in the Early Bronze Age. They usually formed large cemeteries, which consist of tens or hundreds of tombs (D. Ilan 2002). They were probably group cemeteries. Tombs in a cemetery do not show any differences in size, construction method and burial goods. It suggests that pastoral nomadic societies in the Early Bronze Age probably egalitarian societies unlike settled population.

2.4.4.4 Camel pastoral nomadism (Late Bronze Age~).

It is in the second half of the 2nd millennium BC when domesticated camels appeared in the Near East (Köhler-Rollefson 1993). Introduction of domesticated camels probably completed the developments of the classic pastoral nomadic package in deserts. Domesticated camels probably changed pastoral nomadic societies radically. Camels made it possible to advance to extremely arid deserts. In addition, camels gave strong military powers to pastoral nomads. Long distance trade was also intensified by the introduction of camels.

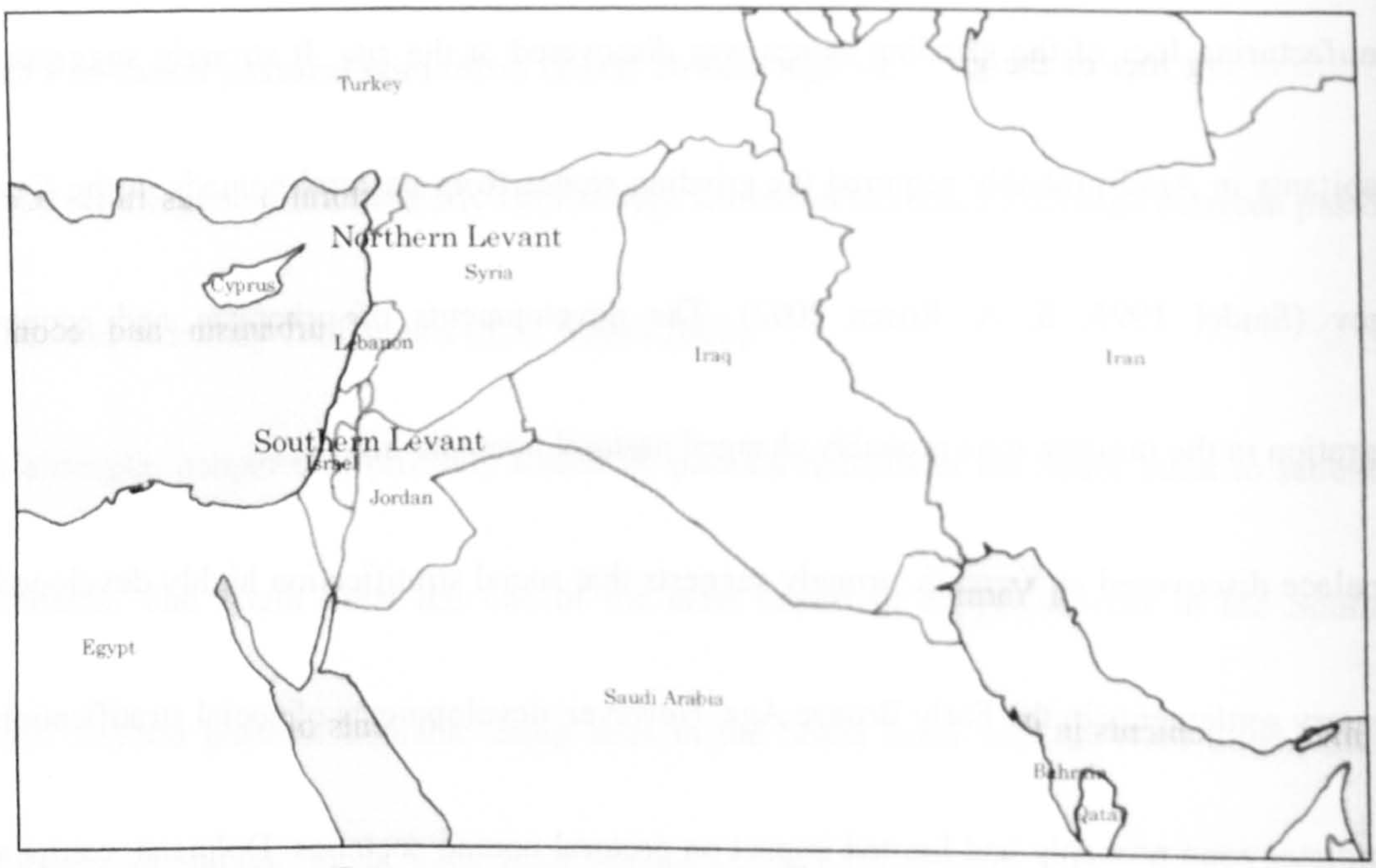


Fig.2.1 Map of the Near East.

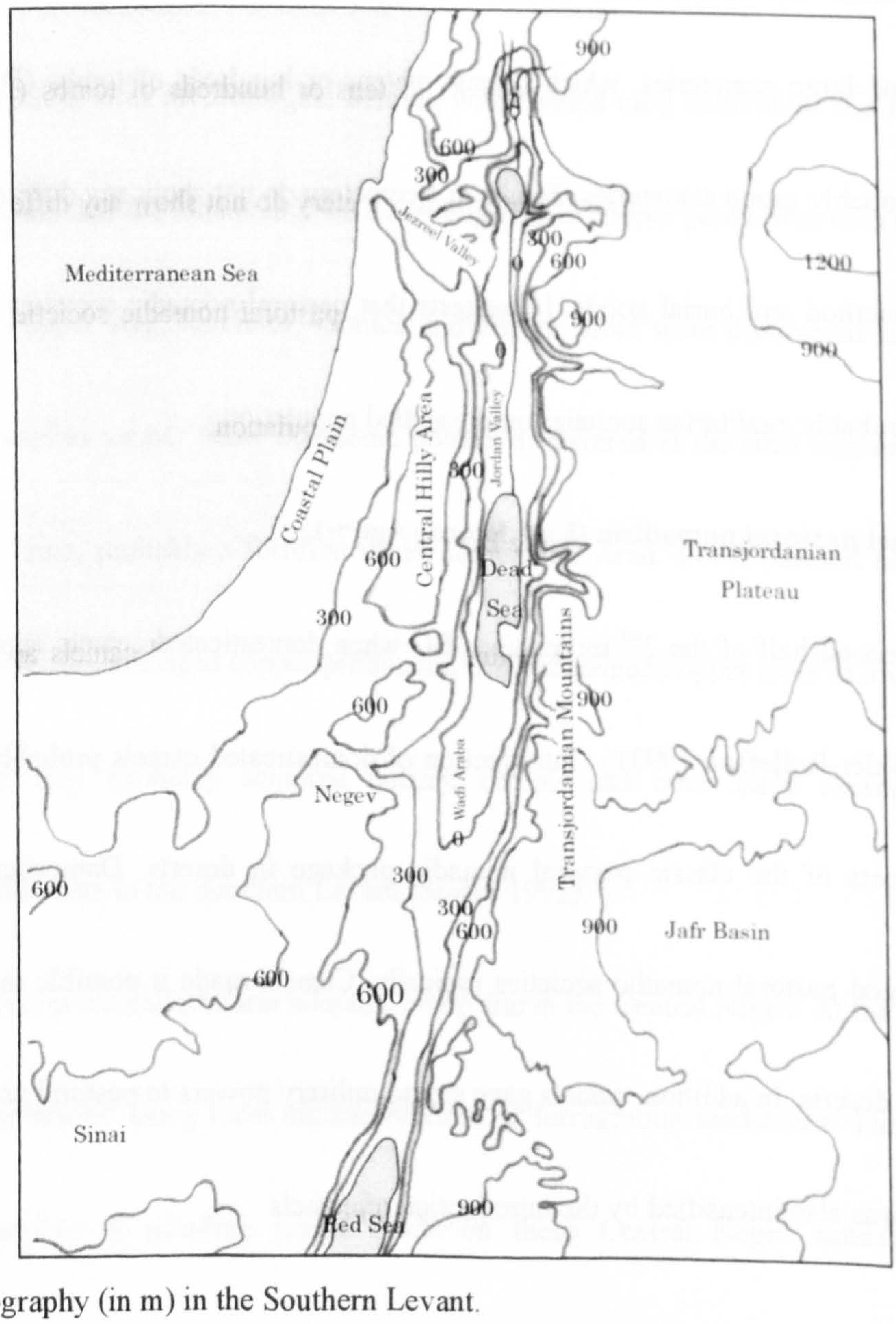


Fig.2.2 Topography (in m) in the Southern Levant.

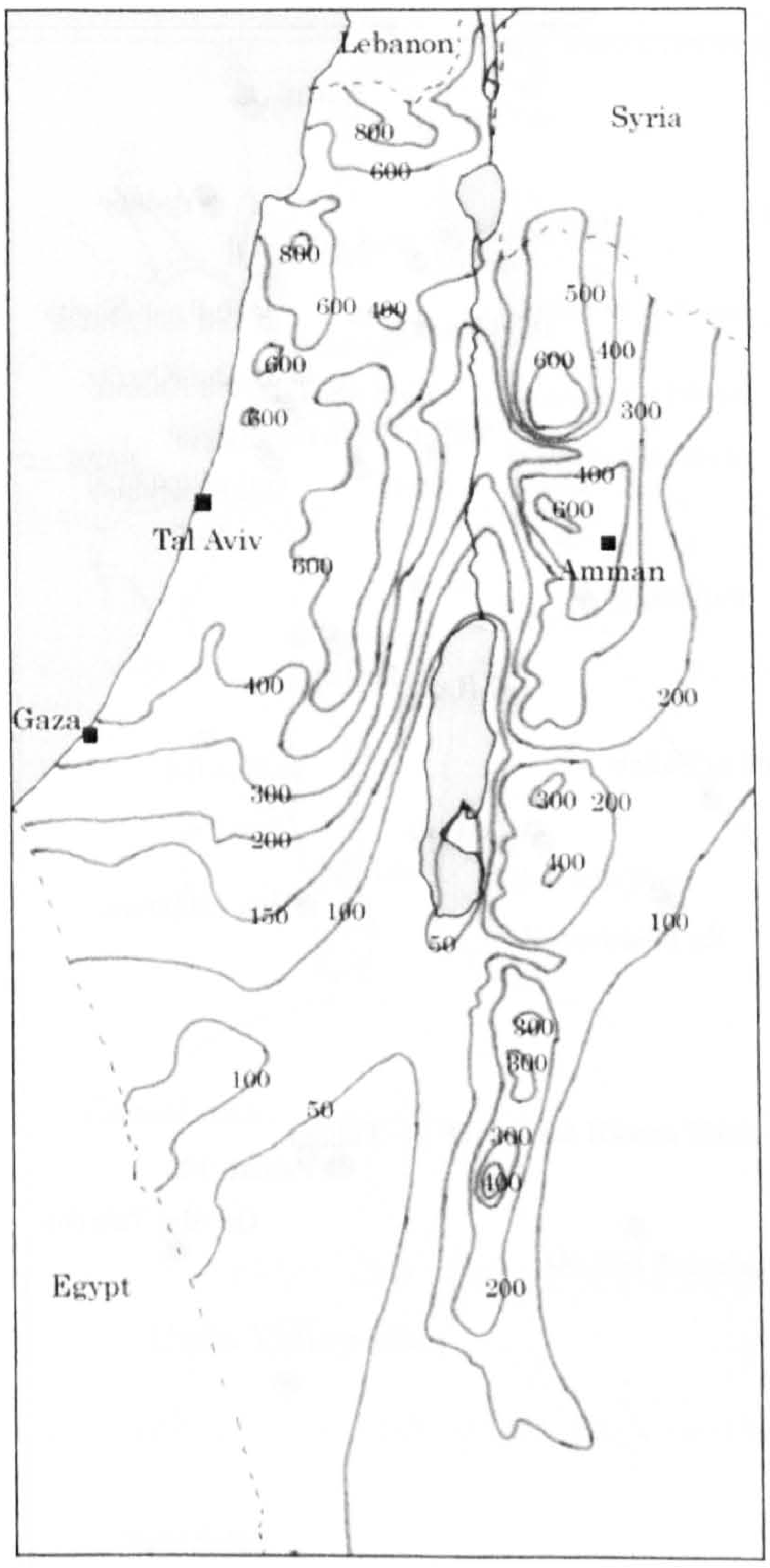


Fig.2.3 Rainfall (in mm) in the Southern Levant (from MacDonald 2001).

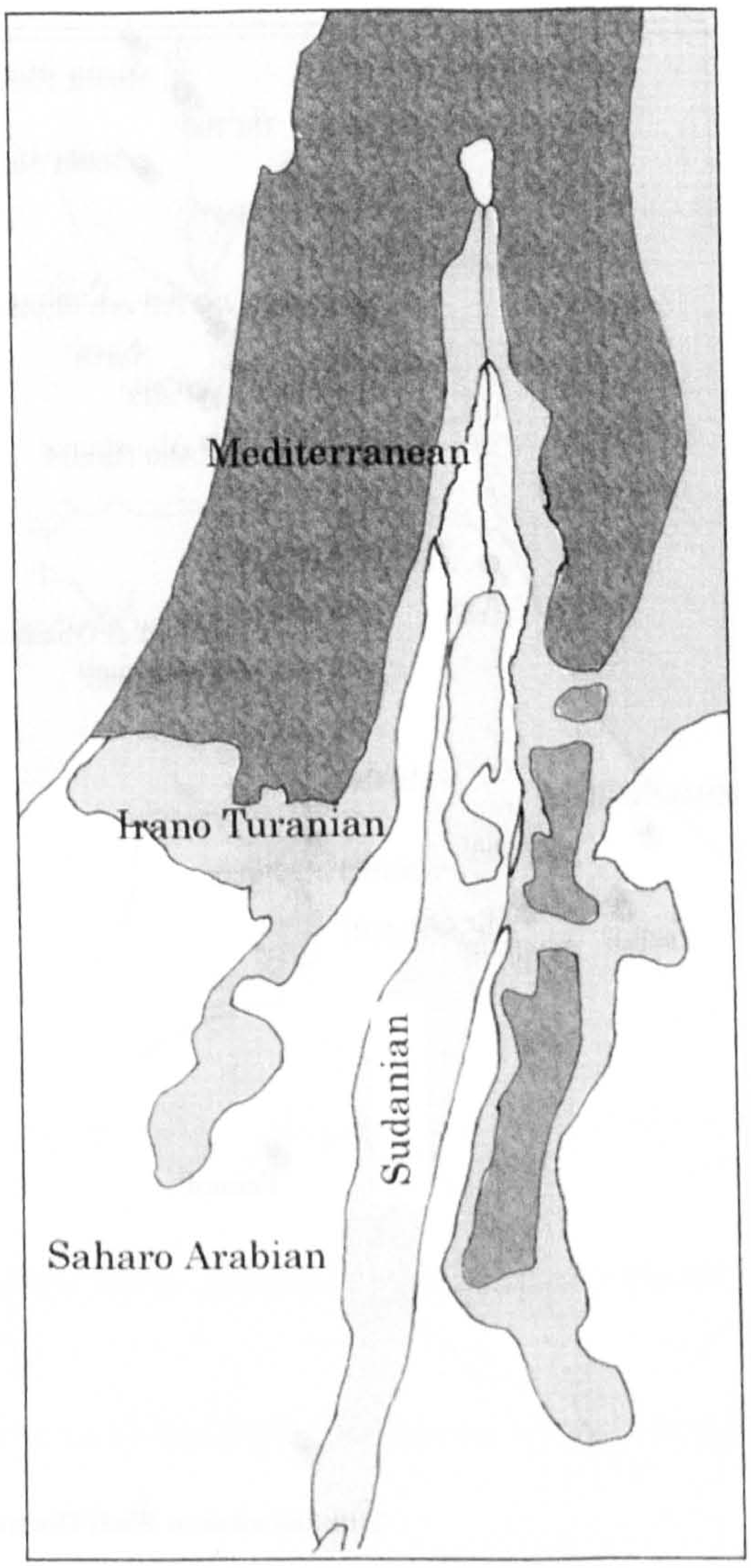


Fig.2.4 Phytogeographic zones in the Southern Levant (S.A. Rosen 1997).

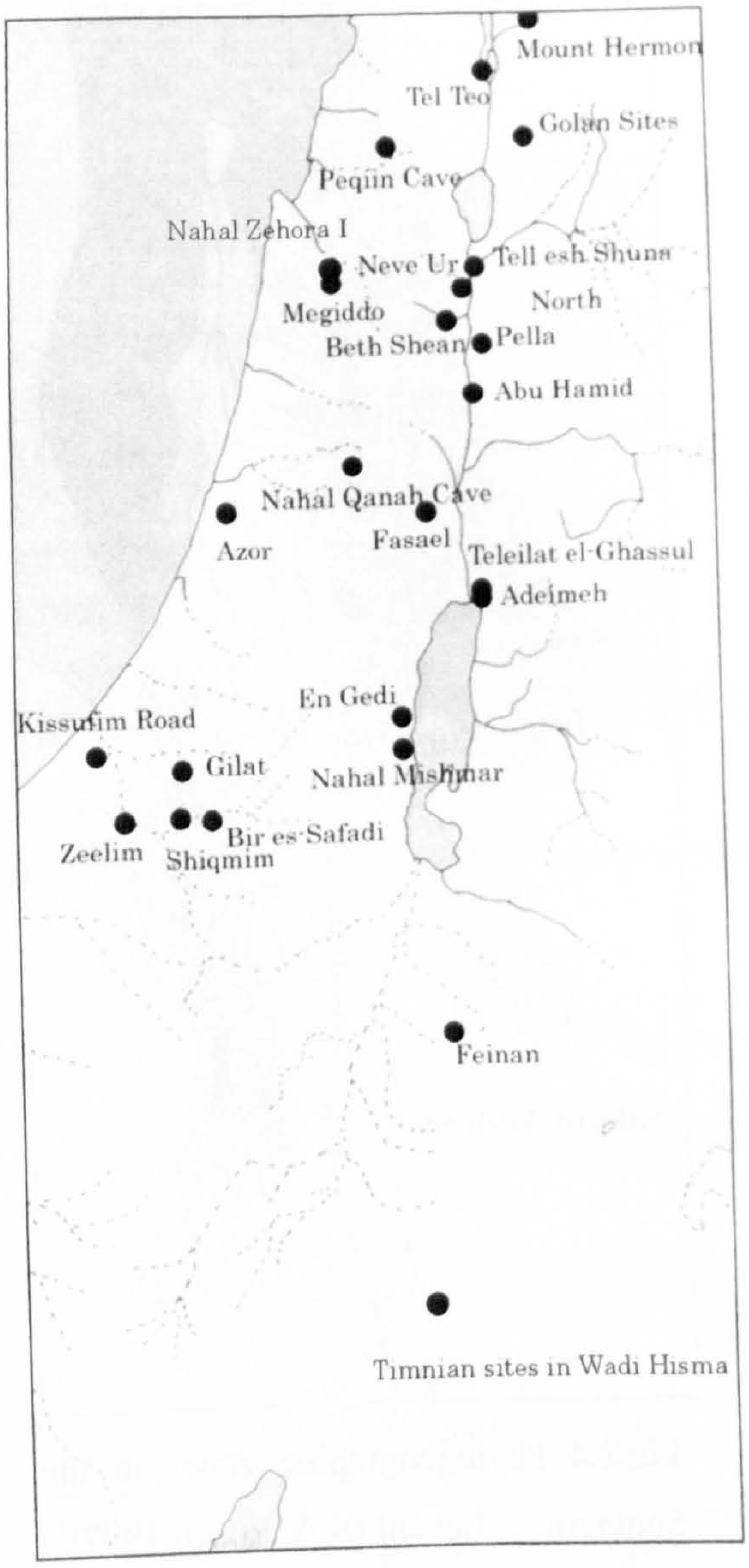


Fig.2.5 Chalcolithic sites mentioned in this chapter.

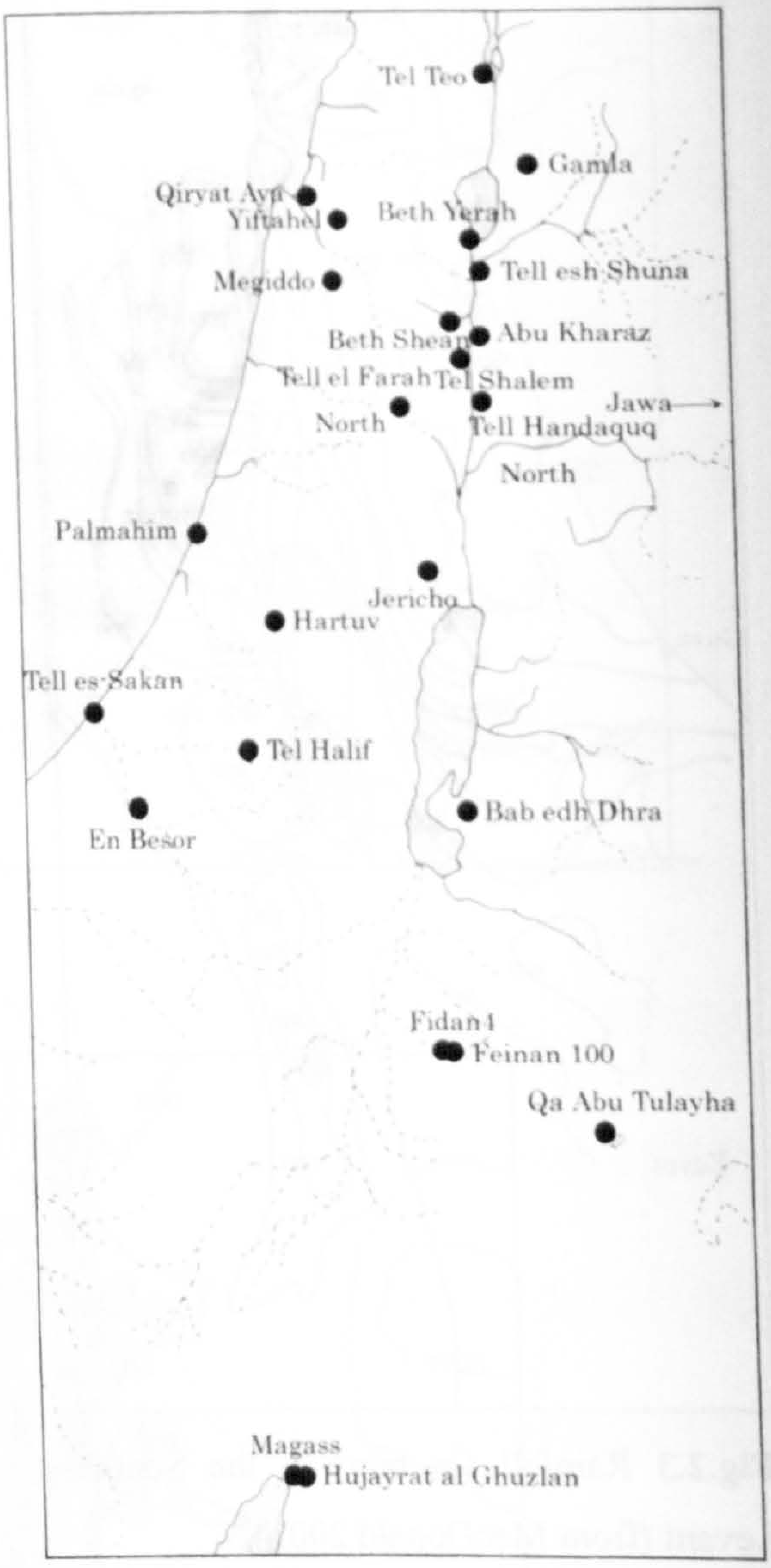


Fig.2.6 EB I sites mentioned in this chapter.

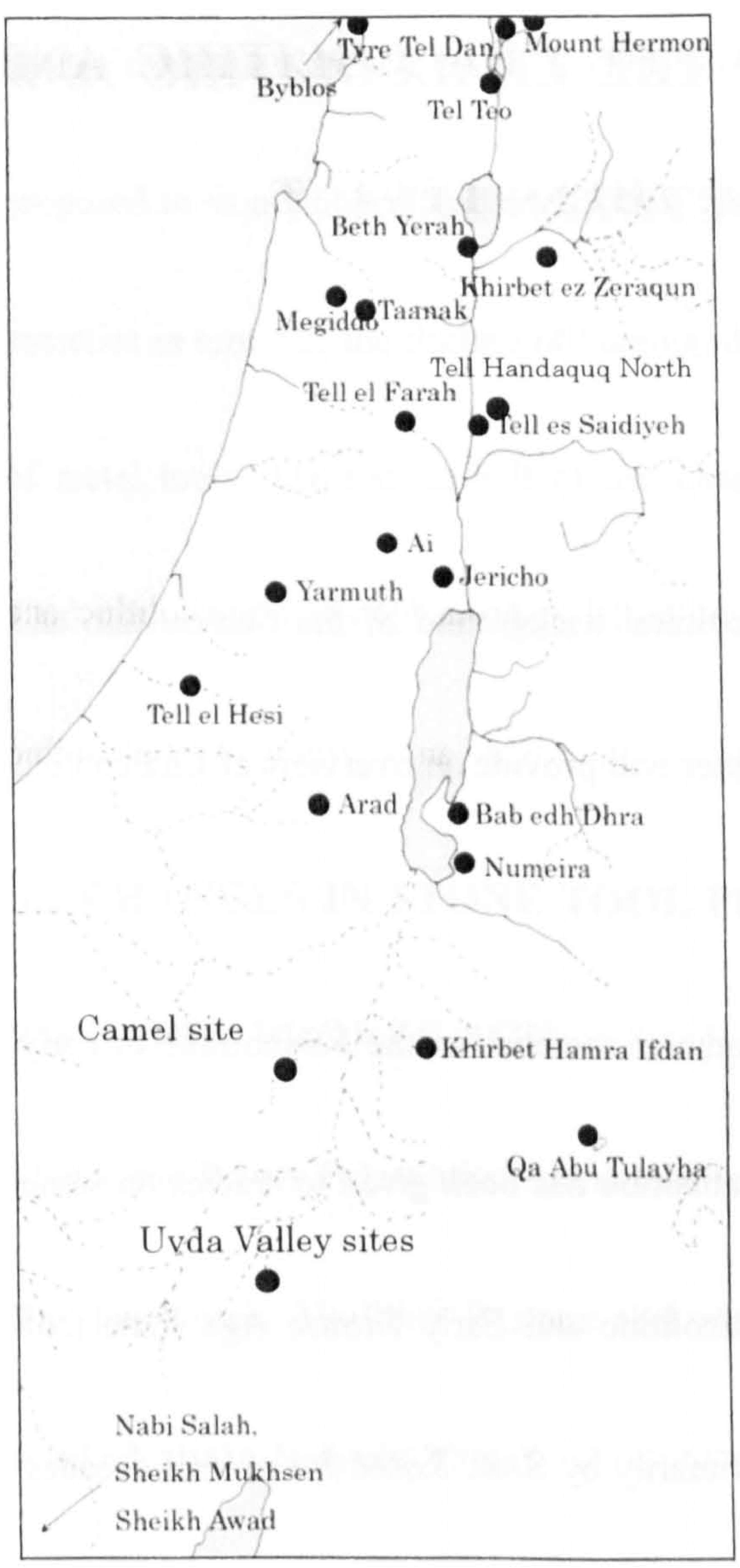


Fig.2.7 EB II ,III sites mentioned in this chapter.

CHAPTER 3 STONE TOOLS IN THE CHALCOLITHIC AND EARLY BRONZE AGE IN THE SOUTHERN LEVANT

3.1 INTRODUTION

The previous chapter reviewed the natural and cultural background of the Chalcolithic and Early Bronze Age in the Southern Levant. This chapter will provide an overview of Chalcolithic and Early Bronze Age stone tools.

Modern stone tool studies still focus on hunter-gatherer societies in the Palaeolithic or early farming societies in the Neolithic. In contrast, less attention has been given to studies on stone tools in early complex societies (Odell 2004). Chalcolithic and Early Bronze Age stone tool studies in the Southern Levant have been pursued primarily by S. A. Rosen for several decades (S.A. Rosen 1997).

However studies about stone tools are very useful for understanding early complex societies. Actually most early complex societies such as the Maya, those of Mesopotamia and Egypt retained developed stone tool industries. Such studies can reveal many aspects of early complex societies such as their chronology, aspects of identities, developments of agricultural technologies, developments of exchange systems and craft specialization (Hartenberger, Rosen and Matney 2000, Odell 2004, Takamiya 2003).

The first half of this chapter will review developments of stone tool industries in the Southern

Levant from the Neolithic to the Early Bronze Age. It will discuss the changes that have been proposed in stone tool production systems from early farming societies to more complex urban societies in terms of the decline of hunting, development of craft specialization and appearance of metal tools. The second half of this chapter will introduce several key stone tools in the Chalcolithic and Early Bronze Age, which are relevant to this thesis.

3.2 CHANGES IN STONE TOOL PRODUCTION FROM THE NEOLITHIC TO EARLY BRONZE AGE

Since the Lower Palaeolithic, stone tool technologies had been developed and sophisticated. The Pre-Pottery Neolithic B stone tool industry witnessed the culmination of this tradition (Nishiaki 1992, Nishiaki 2000a).

A major component of Pre-Pottery Neolithic B stone tool industry is highly blade oriented and characterized by the Naviform blade method. The typical Naviform blade core is characterized by two-opposed angled platforms and one crested ridge on its back (Fig.3.1: 1-3). The cores were named 'Naviform cores' because their profiles look boat-shaped. The Naviform method was a complex method including careful core preparation and platform preparation but could produce very long, prismatic and straight blades (Fig.3.1: 4). The blades could be easily modified into arrowheads, sickles, burins, scrapers and other tools by simple retouching (Fig.3.1: 5-11). In the Pre-Pottery Neolithic B, many tools were made on the Naviform blades and had standard forms.

High quality flint was generally used for the Naviform cores. In the Southern Levant, especially high quality pink/purple flint was preferred. At some sites such as Ain Ghazal, the pink-purple flint was intensively mined (Quintero 1996). Great efforts were made to acquire raw material in the Pre-Pottery Neolithic B.

During the Pre-Pottery Neolithic B, the Mediterranean mixed farming package was completed with introduction of domesticated sheep and goats. As a result, a number of large sedentary settlements such as Ain Ghazal and Es Sifiya flourished in the Southern Levant. However hunting was still important economically and socially even in these sedentary settlements despite the introduction of domesticated animals. Indeed, a variety of large points developed in the Pre-Pottery Neolithic B. The sedentary settlements probably sent hunting expeditions seasonally (Nishiaki 1992, Nishiaki 2000a).

Several ethnographies suggest that groups which exploit mobile and seasonal resources such as wild animals generally prepare more specialized tools carefully with more complicated technologies for reducing the risk of failure in the future (Torrence 1983). According to Y. Nishiaki, the Naviform method was probably developed for reducing the risk of failure of seasonal hunting. The regular Naviform blades were highly portable and could be easily modified into a variety of stone tools such as arrowheads on the spot. They were ideal for seasonal hunting, during which a number of unpredictable events happened (Nishiaki 1992, Nishiaki 2000a).

The Naviform blade method was complex and requires training and experience to achieve. Furthermore raw material was sometimes mined with great efforts. Therefore some scholars suggest that the Naviform blades were probably produced by craft specialists (Wilke and Quintero 1995). However complex technologies are not always related to craft specialists. Several ethnographies suggest that skills to produce complex hunting tools are one of the most important elements for good hunters (Sinclair 2000). In the Pre-Pottery Neolithic B, to master the complex Naviform method was probably important for good hunters.

However at the end of the Pre-Pottery Neolithic B, the complex Naviform blade method was abandoned. In the Pre-Pottery Neolithic C and Pottery Neolithic (Late Neolithic), flakes outnumbered blades in assemblages. High quality flint was not mined any more in these periods. Local coarse wadi cobbles and pebbles were used as raw material for flake and blade production. Even blade production was technologically simple in these periods. It did not include careful core preparation or platform preparation. Cobbles and pebbles were split. Surfaces created by splitting were used as striking platforms and blades were knapped from cores by direct percussion. Most blade cores are single platform cores and did not show any careful core preparation. Cortex often covers much of core surfaces. Cores are usually small and less than 10 cm in length. In contrast with long, prismatic and straight Naviform blades, the Pre-Pottery Neolithic C and Pottery Neolithic blades were short, irregular and lack long parallel ridges

(Baird 2001a, Baird 2001b, Barkai and Gopher 1999, Cropper 2006).

In the Pre-Pottery Neolithic C and Pottery Neolithic, limited tools such as arrowheads and sickle elements had standard forms. The arrowheads are generally small and usually made on blades. They were shaped carefully by invasive pressure flaking because their blanks are short and irregular and required a certain degree of modification (Fig.3.1: 12-21). It is also noteworthy that the number of arrowheads decreased in many assemblages. Sickle elements were also made on the blades (Fig.3.1: 22-27). They are short and have denticulate and backed edges. Most stone tools such as awls/borers and scrapers had no standard forms. They are often called '*ad hoc* tools'. They were made on flakes and shaped less carefully by simple retouching (Baird 2001a, Baird 2001b, Barkai and Gopher 1999, Cropper 2006).

According to Y. Nishiaki, these changes were probably caused by the decline of hunting. Faunal studies clearly show that the hunting was not important any more in Pre-Pottery Neolithic C and Pottery Neolithic sedentary settlements. It is also known that animal herding was added to hunting in the arid areas in these periods. Ethnographic studies suggest that groups which exploit stationary foods such as plant cultivation or domesticated animals preferred expedient technologies (Torrence 1983). In the Pre-Pottery Neolithic C and Pottery Neolithic, the complex Naviform blade method was not necessary any more. Tools, which were knapped and retouched less carefully with limited efforts using local coarse flint, were more preferred (Nishiaki 1992, Nishiaki 2000a).

In the Chalcolithic and Early Bronze Age, the question of the development of craft specialization is one of the key issues of stone tool studies. Most stone tools in these periods were made on flakes and had no standard forms. They were shaped less carefully by simple retouching. Local coarse wadi cobbles and pebbles were usually used as raw material for such tools. Flake cores in these periods are usually single platform cores and did not show any careful core preparation or platform preparation. Cortex usually covers much of core surfaces. These tools are usually called '*ad hoc* tools' (S.A. Rosen 1997). Chalcolithic and Early Bronze Age sites usually yield a number of flake cores. In addition, debris of their production is generally distributed throughout settlements. These facts strongly suggest that *ad hoc* tools were probably produced at the household level (S.A. Rosen 1997).

However, some Chalcolithic and Early Bronze Age stone tools such as tabular scrapers and sickle blades hint at the developments of craft specialization.

Tabular scrapers are knives/scrapers made on thin cortical flakes. They are common tools in the Chalcolithic and Early Bronze Age. As will be discussed later, micro-wear analyses and contextual studies show that tabular scrapers were multi-purpose knives used for butchering, hide working, wool shearing and so on. Unlike *ad hoc* tools, non-local high quality Eocene flint was usually used as raw material. In addition, most sites do not have any traces of tabular scraper production although they yield tabular scrapers. On the basis of these facts, S.A. Rosen argues that tabular scrapers were produced by limited groups in restricted areas (S.A. Rosen

1997). Currently tabular scraper production sites are known in the Sinai, Negev, Eastern Jordan and Jafr Basin (Abe and Fujii 2004, S.A. Rosen 1997, Baird 2001a, Quintero, Wilke and Rollefson 2002). Sedentary settlements in the Mediterranean area probably acquired tabular scrapers from these arid areas.

Chalcolithic and Early Bronze Age sickle blades also hint at the development of craft specialization. Late Chalcolithic blade production shows modest scale craft specialization. Blades were usually used as blanks for sickle blades and shaped into backed sickle elements. In the Late Chalcolithic, flint mining was not conducted to acquire raw material. Local but relatively high quality wadi cobbles and pebbles were collected as raw material for blade production. Late Chalcolithic blade production was technologically simple and did not show major differences from blade production in the Pottery Neolithic. The production did not include any careful core preparation or platform preparation. Firstly cobbles and pebbles were split. Then blades were knapped from cores using surfaces created by splitting as striking platforms. Most blade cores are single platform cores. Cortex usually covers much of core surfaces. Late Chalcolithic blades were relatively short and irregular. Most Late Chalcolithic sedentary settlements yield a number of sickle blades. However, these settlements usually yield only a few blade cores or no blade cores (Baird 2001a, S.A. Rosen 1997, Noy 1998). It strongly suggests that blades were probably produced by limited members at settlements or were supplied from neighboring production sites.

At the beginning of the Early Bronze Age, large prismatic blades, Canaanean blades, appeared in the Mediterranean area (Fig.3.2: 19-21). They were usually used as sickle blades. Their width is usually over 2 cm and their length when they are complete sometimes reaches over 20 cm. Canaanean blades are usually thin and have symmetrical trapezoid cross section. Non local high quality Eocene flint was used as raw material. The blades are generally believed to have been produced by craft specialists (S.A. Rosen 1997). Some pieces of evidence support this view. Firstly large Eocene flint nodules were probably mined for Canaanean blade production with great efforts. Secondly Cannaanean blade production required high skills and special devices. Cannanean blade cores usually show careful core preparation and platform preparation. The blades were probably knapped from cores by indirect percussion with a punch or pressure flaking with special devices such as levers. Thirdly traces of Cannaanean blade production are known only in a few sites near Eocene flint sources (S.A. Rosen 1997, Shimelmitz, Barkai and Gopher 2000). Production centres near Eocene flint sources probably distributed an amount of Canaanean blades intra and inter-regionally.

Introduction of metal tools is also one of the key issues. According to S.A. Rosen, it caused a gradual decline of stone tool production (S.A. Rosen 1997). Copper tools appeared in the Late Chalcolithic for the first time. However the copper tools did not supercede stone tool production immediately. Even after the introduction of copper tools, stone tools still played important roles in daily life. The replacement by metal is a long and complex process. The timing and reasons of replacement by copper tools were different between stone tool types.

In the Late Chalcolithic, copper axes/adzes appear in the archaeological record. However flint axes/adzes were still used (Fig.3.2: 9-12). At the beginning of the Early Bronze Age, flint axes/adzes almost completely disappeared and copper axes/adzes replaced them totally (S.A. Rosen 1997). According to S. A. Rosen, the increased availability of copper tools enabled this replacement. The high incidence of discovery of copper tools at Early Bronze Age sites hints at that increased availability (S.A. Rosen 1997). However the precise reason for the abandonment of flint axes/adzes is still controversial.

In contrast, flint sickle elements were used intensively until the middle of the Iron Age. According to A. Steensberg (Steensberg 1943), flint sickle elements are superior to copper sickles and equal to bronze sickles in utility. This is probably the main reason why flint sickle blades were retained for a long time. S. A. Rosen suggests that only the high levels of production of iron tools could exterminate flint sickle production (S.A. Rosen 1997).

3.3 THE MAIN STONE TOOL TYPES IN THE CHALCOLITHIC AND EARLY BRONZE AGE

This latter half of the chapter will introduce several key stone tools of the Chalcolithic and Early Bronze Age, which .are relavant to my thesis

3.3.1 Arrowheads

In sedentary settlements in the Mediterranean area, items interpreted as arrowheads almost disappear from the Early Chalcolithic onward (Garfinkel 1999). This reflects a radical decline of hunting activities in the area (Levy 1995).

During the Chalcolithic and Early Bronze Age, arrowheads are known most frequently from the arid areas such as the Sinai, Negev and Jordanian deserts. Wild animals such as gazelle, onager and ibex, were still hunted by pastoral nomads on a limited scale (e.g. Henry1995, Horwitz 2003). A number of hunting traps in the Sinai, which are called 'Desert Kites', are also dated to these periods although the dating is still controversial (Helms and Betts 1987).

Several types of arrowheads are known in the arid areas. Small points, which include Nizzanim, Haparsa and Herziliya points, appeared in the Pre-Pottery Neolithic C (Fig.3.1: 12-21) (Baird 2001b). According to S. A. Rosen, these small points may have remained in use until the Early Bronze Age in the arid areas although they were very rare (S.A. Rosen 1997). They were usually smaller than 4cm in length and shaped with pressure flaking. Small blades and micro-blades were preferred as their blanks.

Micro geometrics, which include concave triangles, isosceles triangles, rectangles/trapezoids, and lunates, are also known in the arid areas (Fig.3.2: 1-8). They appeared in the Pre-Pottery Neolithic C and were used until the Early Bronze Age (Baird 2001b, S.A. Rosen 1997). They are generally interpreted as transverse arrowheads on grounds of ethnographic and historic parallels. Ethnographic parallels suggest that such arrowheads were often used with poison. They were usually made on micro-blades or small elongated flakes (S.A. Rosen 1997).

3.3.2 Axes, adzes and chisels

As in the Neolithic, bifacial tools, axes, adzes and chisels are typical tools of the Chalcolithic (Fig.3.2: 9-11). They are more common in sedentary farming settlements than pastoral nomadic camps.

Ethnographic parallels hint that they were usually used for cutting wood and wood working. In addition, they were also used for digging. Some of the subterranean dwellings in the Northern Negev sites have gouge marks, probably made by these tools, on their walls (S.A. Rosen 1997).

They were made on large, thick flakes or chunks by bifacial direct percussion. Chisels are distinguished by their length from axes and adzes (Fig.3.2: 11). Axes are distinguished from adzes by the profiles. Axes usually have symmetrical cross sectioned bits while adze bits have asymmetrical cross sections (Fig.3.2: 9, 10). This difference reflects different hafting methods between adzes and axes. Axes were probably hafted with their working edges parallel to grips of handles and adzes were probably hafted with their working edges perpendicular to grips of handles (S.A. Rosen 1997).

They almost disappeared at the end of the Late Chalcolithic. Early Bronze Age sites yield few axes, adzes, and chisels. Many of these may be residuals. As already discussed, the disappearance must have been related to the increased availability of copper tools in the Early Bronze Age (S.A. Rosen 1997).

3.3.3 Sickles

Sickle blades are defined by sickle gloss on their edges and morphology which is appropriate to reaping. It is well known that reaping grasses produces sickle gloss on the edges of sickle blades although the exact mechanism is still unclear (S.A. Rosen 1997). Sickle blades are common tools in sedentary farming settlements while pastoral nomadic camp sites in the arid areas yield few sickle blades.

Several types of sickle blades in the Chalcolithic and Early Bronze Age will be introduced here.

3.3.3.1 Late Chalcolithic sickles

Late Chalcolithic sickle blades are made on relatively short and irregular blades. Local but relatively high quality wadi cobbles and pebbles were used as raw material for blade production. The blade production was technologically simple. But, as already mentioned, the absence of blade cores or a few blades cores at most sites suggest that blades were probably produced by limited experts at settlements or were supplied from neighboring production sites. Backed truncated sickle blades are typical sickle elements of Ghassul, Beersheva and Golan Chalcolithic culture (Fig.3.2: 12-15). The sickle blade has a working edge on one side, backing on the other side and truncations at both ends. The length of the blade is about 5 cm in length. Several sickle blades were inserted into one sickle handle together (S.A. Rosen 1997).

3.3.3.2 Early Bronze Age sickles

Early Bronze Age sickles can be divided into two groups: Canaanean blades and other sickles.

While the former are distributed mainly in the north of the Southern Levant, the latter are distributed mainly in the south of the Southern Levant (S.A. Rosen 1997).

3.3.3.3 Early Bronze Age sickles: Canaanean sickle blades

Canaanean blades are standardized, large and prismatic blades (Fig.3.2:16-19). Their width is generally from 2 to 3cm and some blades reach over 20 cm in length. The blade is usually thin and has symmetrical trapezoid cross section. High quality Eocene flint was usually used as raw material. The blades were widely distributed throughout the Near East in the fourth and third millennium BC (Anderson and Inizan 1994, Hartenberger, Rosen and Matney 2000, S.A. Rosen 1997).

In the Southern Levant, Canaanean blades first appeared in the Early Bronze Age I and disappeared at the end of the Early Bronze Age IV. They were distributed mainly in the northern area of the Southern Levant. Sites in the Negev, Sinai, Wadi Araba, Southern Transjordanian mountains and Jordan deserts usually yield few Canaanean blades.

Canaanean blades were first defined by R. Neuville. According to him, the main attribute of a Canaanean blade was its trapezoidal section or two parallel ridges running in the centre of its dorsal surface (Neuville 1930). Several years later G. Crowfoot refined his definition (Crowfoot 1948). She added several attributes such as a prepared striking platform and a deep negative bulb on its dorsal surface, which was caused by the previous blade removal.

Canaanean blades were knapped from large single platform prismatic cores. The large blade production required large and homogeneous high quality Eocene flint. Large Eocene flint nodules were probably mined with great efforts. Recent studies by R. Shimelmitz, R. Barkai and A. Gopher reveal that the Canaanean blade production is different from normal blade production (Shimelmitz, Barkai and Gopher 2000). While normal blades were produced by direct percussion, Canaanean blades were produced by indirect percussion with a punch or pressure flaking with special devices such as levers. Canaanean blade cores usually show careful core preparation and platform preparation.

Canaanean blades were usually snapped into several pieces. Several snapped pieces were hafted together into one sickle. Some pieces have sickle gloss on both their edges. This indicates that the pieces were reversed and hafted again when one edge became dull. Some long Canaanean blades with sickle gloss on their edges are also known at several sites. These long blades were probably used as reaping knives (S.A. Rosen 1983a, S.A. Rosen 1997).

Use wear analyses by P.C. Anderson and M. L. Inizan show that they were probably re-used as threshing teeth after their edges became dull (Anderson and Inizan 1994).

As already discussed, most sites yield no traces of blade production. The cores are known from a limited numbers of sites near Eocene flint sources. Most sites probably imported the blades through exchange from production centres near Eocene flint sources. Packets of unused Canaanean blades have been discovered. They were probably bundles in which the blades were exchanged (S.A. Rosen 1997). Rosen also argues that there are several production centres in the

Southern Levant because there are several technological differences between the blades from region to region (Betts 1992, S.A. Rosen 1983a, 1997).

3.3.3.4 Early Bronze Age sickles: other sickles

Canaanean blades were mainly distributed in the northern area of the Southern Levant. Settlements in the Negev, Wadi Araba, Southern Tranjordanian mountains and Southern Transjordanian plateau yield a few Cannaanean blades. In these areas, other types of sickle blades, backed/bitruncated sickle blades and arched backed sickle blades, are more common (S.A. Rosen 1997).

The backed/bitruncated sickle blade has a steep straight retouched back, truncations on both ends and one acute cutting edge. They are similar to Late Chalcolithic sickle blades. The arched backed sickle blade has a steep arched retouched back and one acute cutting edge (Fig.3.2: 20-21). These sickle blades were made on short non-prismatic blades. The blades were usually narrow and less than 2 cm in width. Local coarse wadi cobbles and pebbles were used as raw material. Unlike Canaanean blades, to produce these blades was technologically simple. Firstly cobbles and pebbles were split. Then surfaces created by splitting were used as striking platforms and blades were flaked by direct percussion. The production did not include any careful core preparation or platform preparation. S.A. Rosen argues that these sickle blades were probably produced at the household level on site (S.A. Rosen 1997).

3.3.4 Tabular scrapers

Tabular scrapers are scrapers/knives made on thin, flat and large cortical flakes. They are also referred to as fan scrapers. The term 'fan scraper' is misleading because the fan shaped tabular scrapers were not always common. Therefore the term 'tabular scraper' is more appropriate. They are widely known in the Near East. In the Southern Levant, tabular scrapers appeared in the Pottery Neolithic. Some Pottery Neolithic sites such as Shaar Hagolan yielded a few dubious tabular scrapers (Sekelis 1972). In the Chalcolithic, tabular scrapers became common tools. They disappeared at the end of the Early Bronze Age III. The reasons for their disappearance are still unclear (S.A. Rosen 1997).

Tabular scrapers were distributed throughout the Southern Levant. However the distribution is not even. Tabular scrapers were usually the predominant retouched tools at pastoral nomadic camp sites in the arid areas while they occupied small proportions of assemblages at sedentary settlements. The tools were probably related to pastoral activities rather than harvesting.

Several micro-wear analyses and contextual studies have been carried out on tabular scrapers. They show that tabular scrapers were multi purpose knives used for butchering, hideworking and wool shearing.

M. McConaughy studied tabular scrapers from Bab edh Dhra. His microwear analyses show that the tabular scrapers were used as butchering knives (McConaughy 1979, McConaghy 1980). Micro-wear analyses on tabular scrapers from Shiqmim by Y. Rowan and T. E. Levy concluded that tabular scrapers were used for hideworking and butchering (Rowan and Levy 1991). R.

Unger-Hamilton also studied one tabular scraper with sickle gloss from Jawa and concluded the tabular scraper was used for scraping reeds to produce arrow shafts. However sickle gloss is rarely seen on tabular scrapers. Therefore using tabular scrapers for scraping reeds was perhaps secondary use (Unger-Hamilton 1991).

D.O. Henry suggests that tabular scrapers were also used for wool-shearing on the ground of archaeological contexts (Henry 1995). It is also noteworthy that tabular scrapers were often discovered in ritual contexts such as tombs, shrines and public temples. It suggests that they were also used as ritual knives (S.A. Rosen 1997).

As already discussed, Eocene high quality flint is usually used as the raw material of tabular scrapers. Tabular scraper production sites are known only in the Negev, Sinai, East Jordan and Jafr Basin. Therefore tabular scrapers were probably distributed to the Mediterranean area from these arid areas (S.A. Rosen 1983b, S.A. Rosen 1989, S.A. Rosen 1997).

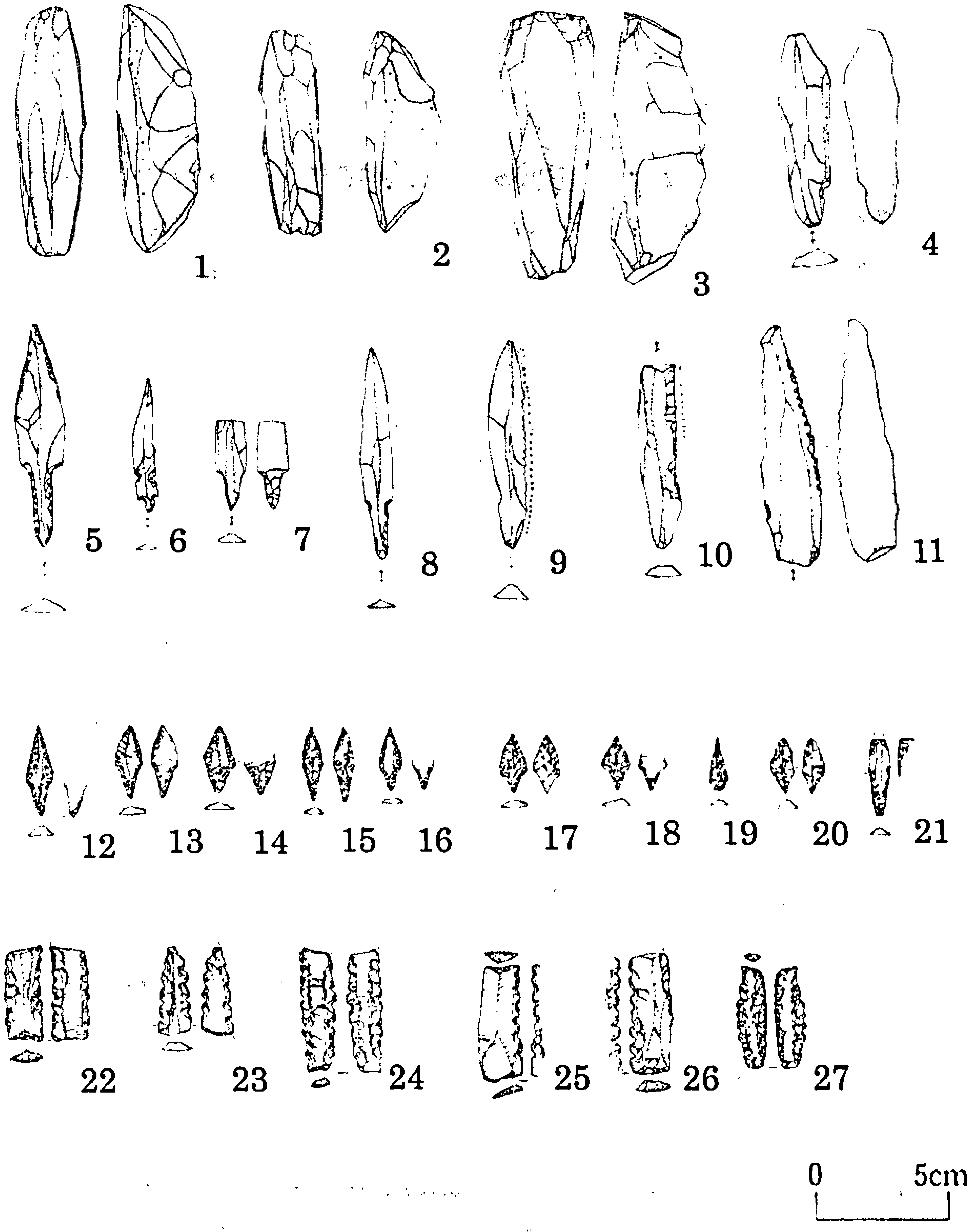


Fig.3.1 Stone tools in the Pre-Pottery Neolithic B, Pre-Pottery Neolithic C and Pottery Neolithic.

1-3: The Naviform cores collected in the Jafr Basin, 4: PPNB blade collected in the Jafr Basin, 5-8: PPNB points collected in the Jafr Basin, 9-11: PPNB sickle blades collected in the Jafr basin, 12-21: The Pottery Neolithic points from Shaar Hagolan (from Alperson and Garfinkel 2002), 22-27: The Pottery Neolithic sickle blades from Shaar Hagolan (from Alperson and Garfinkel 2002).

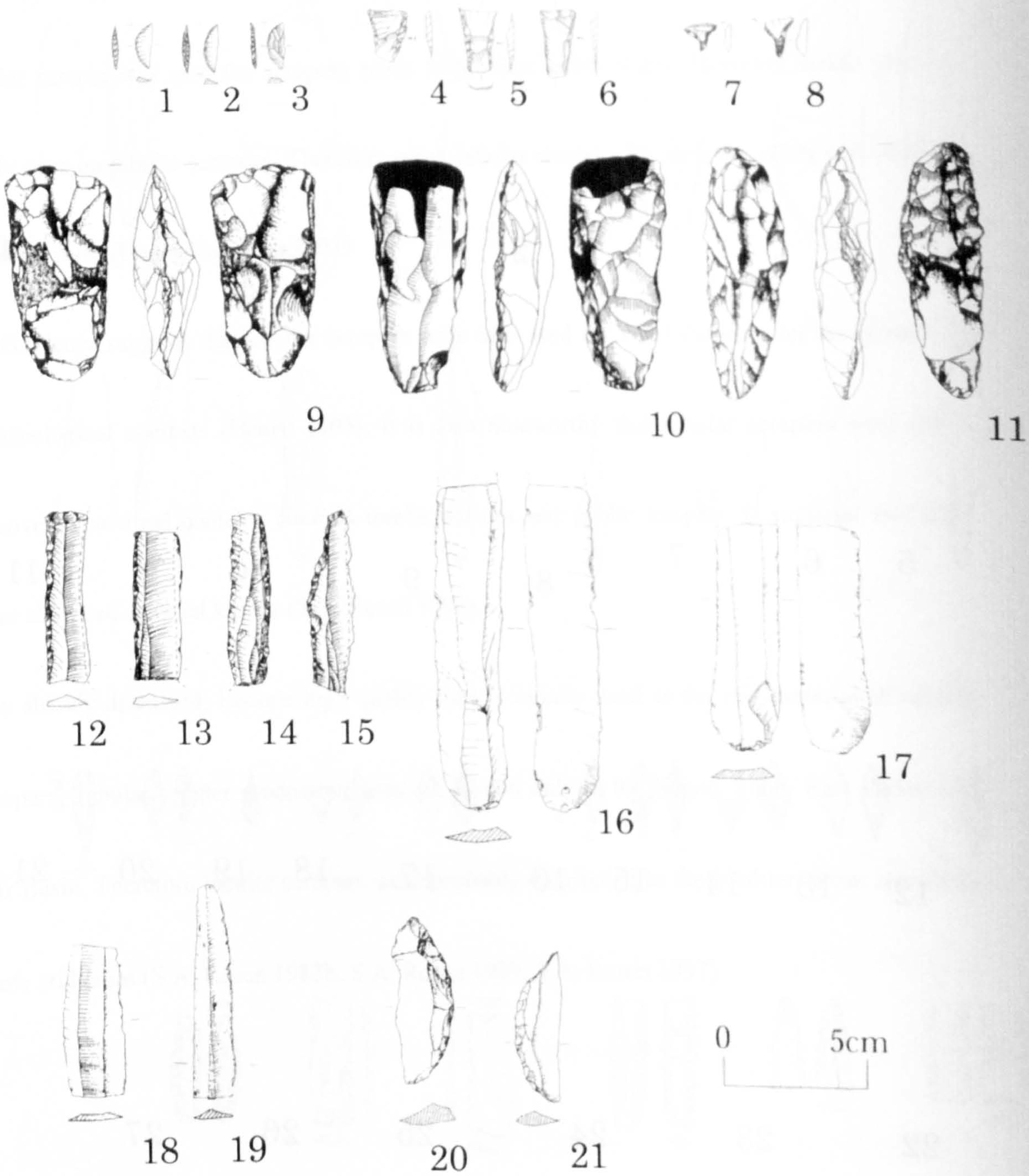


Fig.3.2 Stone tools in the Chalcolithic and Early Bronze Age (from S.A.Rosen 1997).
1-8: Geometric microlithics, 9: Axes, 10: Adze, 11: Chisel, 12-15: Chalcolithic backed truncated sickle blades, 16-19: Canaanean blades, 20-21: Arched backed sickle blades.

CHAPTER 4 METHOD OF STONE TOOL ANALYSIS

4.1 INTRODUCTION

During the Chalcolithic and Early Bronze Age, large scale stone tool production industries producing tabular scrapers and Jafr blades developed in the Jafr Basin, Southern Jordan. As will be explained in the next chapter (See Chapter 5), a number of tabular scraper/Jafr blade production sites and intensive flint mines were discovered in the northwestern part of the basin by a Japanese team. To document full details of these stone tool production industries is one of the main aims in this thesis.

For this goal, a dynamic approach, '*the Chaîne opératoire* ', is adopted in this thesis. The concept of '*Chaîne opératoire*' was advocated by A. Leroi-Gourhan (Leroi-Gourhan 1945). This French term, *Chaîne opératoire,* can be translated as operational sequence in English. The concept is intended to trace activity stage by stage. Since the 1990s, the concept has been used actively for analyzing stone tools. Stone tool analyses using this concept are intended to reconstruct choices in a series of successive stages from raw material procurement, selection of raw material, core reduction, selection of tool blanks and retouching blanks to use, tool reduction and abandonment of stone tools (Grace 1997, Nishiaki 1992, Nishiaki 2000a, Nishiaki 2000b). The final goal of the *Chaîne opératoire* approach is to understand choices made during production and thereby human culture behind the archaeological record. Through reconstructing the *Chaîne opératoire*, choices made by a social group can be revealed. The concept suggests that the most frequently recurring choices are likely to be related to the cultural traditions of the social group (Grace 1997).

According to R. Grace, the main difference between the *Chaîne opératoire* approach and the traditional Bordean typological approach is that the former approach can reveal life histories of stone tools. The latter approach concentrates only on final products and does not reveal any details of sequence of core reduction, tool making and tool reduction. The *Chaîne opératoire* approach is more suitable to study dynamic stone tool production (Grace 1997, Nishiaki 2000b).

4.2 BASICS OF STONE TOOL PRODUTION AND TERMINOLOGY

This section will briefly explain the basics of stone tool production and related terminologies. Stone has been one of the most common materials used for human tools over a few million years. Four basic ways of shaping stones are known: flaking (chipping, knapping), abrading/polishing, pulverizing (pecking, hammering and crumbling) and cutting (Hodges 1989). This section will only discuss flaking.

Some rocks are flaked easily while others are not suitable for flaking. Ideal stones for flaking must possess small internal grain sizes and/or a thoroughly cemented matrix. They also must be brittle, isotropic and homogeneous. Obsidian and flint are highly suitable materials for flaking

(Odell 2004).

The main principle of flaking can be explained by 'the Hertzian cone' (Hodges 1989, Sato 2000). If a blow is applied to a surface of a flint block at the right angle, the shock will be transmitted concentrically (Fig.4.1.a). As a result, a conical cone, which is called 'the Hertzian cone', will be created. If a blow is applied to an edge of a flint block at the correct angle and the blow is strong enough to transmit the shock to the underside of the flint block, a 'flake' will be knapped off from the flint block (Fig.4.1.b). Every complex flaking method such as the Levallois method, Naviform method and Yubetsu method is based on this simple mechanism.

Pieces of stone knapped off by flaking are called 'flakes' in a broader sense (Fig.4.3). As discussed later, 'flakes' in a broader sense includes flakes, blades, chips and chunks. 'Flakes' are also referred to as debitage. Fig.4.2 shows terminologies of 'flakes' (Fig.4.2). Basic features of 'flakes' are listed here.

- Striking platform: The surface area which received the force to detach the flake from the core. An impact point, which was made by the force, can often be seen on the striking platform. The point is the place where the hammer stone hit.
- Ventral surface: The smooth surface of a flake detached from a core. A cone (Hertzian cone) is located adjacent to the striking platform on the ventral surface. Just below the cone, a bulb was also formed as a result of the Hertzian cone. Scars on the bulb are called 'bulbar scars'. Rings and fissures can also be seen on the ventral surface. Rings are concentric circles whose

centre is the impact point. Fissures usually point to the impact point.

- Dorsal surface: The surface of a flake which shows previous flake removals or the original surface of the core.

Pieces from which 'flakes' are detached are called cores. Fig.4.3 shows terminologies of cores (Fig.4.3). Basic features of cores are listed here.

- Striking platforms: Surfaces on cores which received force to detach flakes from cores.
- Flaking (working) surfaces: Surfaces, from which flakes were detached. Scars left by earlier flake removals can be seen on the surfaces.

To detach 'flakes' from cores, several flaking techniques are known. In particular, direct percussion, indirect percussion and pressure debitage were common techniques (Fig.4.4).

Direct percussion is a technique of striking, in which 'flakes' are detached from cores by direct percussion with hammers. Hard stone, soft stone, woods and antlers were probably used as hammers. As discussed later, different modes of hammers yield different 'flakes'.

Indirect percussion is a technique of striking, in which punches are used as intermediates between cores and hammers. Woods, antlers and bones were usually used as punches. The indirect percussion using punches made more accurate blows possible.

Pressure debitage is a technique, in which 'flakes' are detached from cores by pressing with punches or styluses rather than by percussion. This technique was often used for detaching prismatic blades and micro blades from cores or for retouching arrowheads and bifacial tools.

This technique allows very precise flaking.

4.3 CLASSIFICATION SYSTEM OF THE THESIS

This section will explain the basic stone tool classification system used in this thesis. This classification system is based on works by Y. Nishiaki and S. A. Rosen (Nishiaki 2000a, S.A. Rosen 1997). This classification system is developed mainly for description of tabular scraper and Jafr blade production in the Jafr Basin. This system is not intended to cover all Chalcolithic and Early Bronze Age assemblages in the Southern Levant.

Stone tools can be divided into four main categories: flaking tools, cores, debitage and tools. Each category can be divided into several types.

4.3.1 Flaking tools

Flaking tools are tools used for detaching 'flakes' from cores.

Anvil stones: Anvil stones were tools on which flint knapping was conducted. Surfaces of anvil stones sometimes show battering signs, which were probably caused by flint knapping. Limestone was often used as a raw material and they were usually shaped by flaking. However anvil stones are excluded from the chipped stone category in this thesis. They are classified as ground stone, not as chipped stone.

Hammer stones: Hammer stones are rocks which show some signs of battering. These rocks were probably used as percussors for removing 'flakes' from cores. However other activities such as crushing plants leave the same signs of battering. Therefore the exact function of hammer stones is difficult to identify. Beside hammer stones, organic hammers such as antlers and wood may have also been used for flint knapping. However these organic hammers have not survived. Exhausted cores often show signs of battering. Cores were often reused as hammer stones. However in this thesis, these cores with signs of battering are classified as cores, not as hammers. Presence of battering signs on cores will be recorded.

4.3.2 Cores

Cores represent the raw material from which 'flakes' were removed. Cores are divided into several types according to the types of removed 'flakes'. Each core type can be divided into several sub-types. The close classification of each core type will be discussed in each chapter (See Chapter 6, 7 and 10).

Flake cores: Cores showing flake removals. Among them, cores which show tabular scraper blank removals are classified as tabular scraper cores. Tabular scraper cores are generally unexhausted. Only a few tabular scraper blanks were usually flaked from each core.

Blade cores: Cores which show signs of blade removals. Among them, cores which show signs of Jafr blades removals are classified as Jafr blade cores. General features of Jafr blade cores are: high quality raw material (Eocene flint), tabular shaped configuration, absence of complex core preforming, plain or weathered plain striking platform and scars of large non-prismatic blades. They are usually unidirectional cores. Jafr blades cores will be divided into several types (See

Chapter 10).

4.3.3 Debitage ('Flakes')

The term 'debitage' is French and means all pieces detached from cores by percussion or pressure. 'Debitage' is used synonymously with 'flakes' in their broader sense. Debitage includes core trimming elements, flakes, blades and others. Tools are not included in this category.

Core trimming elements: Pieces retaining particular parts of the original core from which they were detached. They are usually detached during core preparation, rejuvenation and core maintenance. They include crested pieces and core tablets. However plunged blades and plunged flakes are excluded from this category.

- Crested pieces: They are usually characterized by triangular section and one central ridge formed by crossed flaking from the original surface of the core. They are usually first blades detached from cores. After removing a crested piece, blades are detached following the scar of the crested blade.
- Core tablets: Core tablets are pieces retaining a part of the striking platform of the original core. They are by-products of core striking platform rejuvenation.

Flakes: Flakes are pieces whose maximum length is less than twice the width. Flakes can be divided into the following several types according to the amount of cortex and/or weathered surface on the dorsal surface.

- Non-cortical flakes: Flakes without any cortex and/or weathered surface.
- Partially cortical flakes: Flakes whose dorsal surface is less than half covered with cortex and/or weathered surface.
- Cortical flakes: Flakes whose dorsal surface is half or more than half covered with cortex and/or weathered surface.
- Tabular scraper flakes (blanks): Flakes which are obviously blanks of tabular scrapers are classified into tabular scraper flakes. Tabular scraper flakes have several distinct characters: thin and flat section and dorsal surface widely covered with cortex.

Blades: Blades are flakes whose lateral edges are parallel or sub-parallel and whose length is greater than twice the width along the axis of debitage. As flakes, blades can be divided into several types according to the amount of cortex and/or weathered surface on the dorsal surface: non-cortical blades, partially cortical blades and cortical blades. Blades are sometimes divided into blades and bladelets according to their size. But this thesis does not use this division because most blades in the samples do not fall into the range used to distinguish bladelets.

- Non-cortical blades: Blades without any cortex nor weathered surface.
- Partially cortical blades: Blades whose dorsal surface is less than half covered with cortex and/or weathered surface.
- Cortical blades: Blades whose dorsal surface is half or more than half covered with cortex and/or weathered surface.

- Jafr blades: Blades with several distinct features are classified into Jafr blades. Typical features of Jafr blades are high quality raw material, and large size. Their width is about 3cm and length is often over 15 cm. A large plain or weathered plain striking platform is also one of the important features. The blades are usually robust and non-prismatic. They usually have unidirectional scars on the dorsal surface.

Others: The category of others includes chips, chunks and thermal flakes.

- Chips: Chips are flakes which are too small to study in detail. In this thesis, flakes whose broadest surface is less than 2cm are classified into chips. This value of 2cm is arbitrary. However any pieces that can be classified into other categories such as broken blades and broken tools are excluded from chips even though their size is smaller than 2cm.

- Chunks (Fragments): Chunks are pieces which are too fragmentary to study in detail. They usually have no clear platforms or clear flaked surfaces.

- Natural thermal flakes: Natural thermal flakes are flakes detached by natural process such as strong sun light. These flakes are characterized by several features: absence of striking platform, concentric rings on the ventral surface, and bowl-shaped ventral surface. Stone tool assemblages in deserts include a large number of natural thermal flakes. Although these flakes are not artificial flakes, some tools were made on thermal flakes.

4.3.4 Tools

Tools are pieces shaped by retouching. Pieces with sickle gloss are also classified into this category even without retouch. Stone tools collected in deserts often show edge damages which resemble retouch. These edge damages were caused by animal/human trampling and/or by strong heat Therefore stone tools with edge damages or questionable retouch are excluded from the category of tools. Tools are usually divided into types in terms of technological and morphological aspects rather than functional aspects even though some forms have functional characters.

Tabular scrapers: Tabular scrapers are retouched pieces on thin, flat and cortical flakes. They usually retain a flat cortex on almost the whole of the dorsal surface. Tabular scrapers can be divided into many types.

Sickle elements: Sickle elements include unretouched pieces and retouched pieces with sickle gloss. Retouched pieces without sickle gloss, which are similar to the retouched pieces with sickle gloss, are also included in this category.

Bifaces: Pieces whose dorsal surface and ventral surface show invasive retouching. This category includes axes, adzes and chisels.

Burins: Burins are retouched pieces which have burin facet retouching.

Borers: Pieces with a pointed bilaterally retouched end (or ends) are classified into borers. This category includes awls, perforators and drills in this thesis.

Denticulates: Denticulates are retouched pieces which have a serrated edge (or edges) as a result of retouching.

Notches: These are pieces with a notch removed from the edge.

Scrapers: Scrapers include end scrapers, round scrapers and side scrapers in this thesis. End scrapers are tools which have one or two abrupt retouched ends. The angle of retouched ends is usually from 60 to 90 degree. Round scrapers are round tools whose perimeter is almost entirely retouched semi-abruptly or abruptly. Side scrapers are tools which have a continuous retouched edge (or edges) along side edges.

Truncation: These are pieces whose ends are trucated by retouch perpendicuar to the longtitudinal axis.

Retouched blades: Retouched blades which can not be classified into other tools

Retouched flakes: Retouched flakes which can not be classified into other tools.

4.4 CHAÍNE OPÉRATOIRE AND EXAMINED ATTRIBUTES

One of the main goals of this thesis is detailed technological studies on tabular scraper and Jafr blade production in the Jafr Basin through the *Chaîne opèratoire* approach.

The following stages of production will be studied: raw material procurement, core preparation, core reduction, core maintenance, core abandonment, blank selection, blank modification and tool use.

To reconstruct these stages, tabular scraper cores, tabular scraper flakes, tabular scrapers, Jafr blade cores and Jafr blades will be analyzed meticulously. The analyzed attributes are listed below.

4.4.1 Tabular scraper cores

(Raw material)

1: Raw material (1) Nodular flint (2) Tabular flint (3) Thermal flint flake.

The Jafr Basin is one of the best flint sources in the Southern Levant (Fig.8.1). High quality Eocene flint is available all over the basin. The Eocene flint is used for tabular scraper production. Its texture is homogeneous and fine grained. Its colour ranges from dark brown to cream and the colour of its cortex ranges from white to orange. The flint used for tabular scraper production is almost identical and shows little variation in texture. Hence raw material is not divided according to its texture.

According to its morphology, raw material for cores is divided into three types: nodular flint, tabular flint and large thermal flakes. The shapes of raw material affect the shapes of tabular scraper blanks and final products (See Chapter 6 and 7). For example, tabular flint is not suitable for knapping end struck tabular scraper blanks.

(General)

2: Core type (1) Uniface (2) Biface (Fig.4.5).

Tabular scraper cores can be divided into two types according to the number of flaking surfaces. Uniface tabular scraper cores are cores with one flaking surface and biface cores have two flaking surfaces.

3: The total number of detached tabular scraper flakes.

The total number of tabular scraper blank scars on each core is counted.

(Measurements of cores) (Fig.4.6)

4: Length.

5: Width.

6: Thickness.

7: Length/Width.

8: Width/Thickness.

Fig.4.6 shows measurements of cores. Cores are measured along the longitudinal axis of the main flaking surface. They are measured to the nearest millimeters. The main flaking surface refers to the surface showing more tabular scraper blank scars.

(Platform of the main scar on the main flaking surface)

9: Platform angle (Fig.4.6).

The platform angle of the main scar on the main flaking surface is measured to the nearest degree. The main scar refers to the largest measurable tabular scraper flake scar on the main flaking surface.

10: Platform type (1) Cortex (2) Weathered (3) Plain (4) Faceted (5) Others (Fig.4.7).

Platform types of main scars are analyzed. Five platform types are defined: Cortex, weathered, plain, faceted and others. Cortex platforms and weathered platforms are natural platforms without any platform preparation. Weathered plain surfaces, which were caused by natural process, were often used as platforms. Plain platforms were prepared by one percussion blow. Faceted platforms were prepared carefully by detaching several flakes. Faceted platforms are usually pointed to increase precision of blows to remove tabular scraper blanks.

(The main flaking surface)

Tabular scraper cores have one or two flaking surfaces. The main flaking surface refers to the surface showing more tabular scraper blank scars.

11: The number of scars of tabular scraper flakes on the main flaking surface.

The total number of tabular scraper blank scars on the main flaking surface is counted.

12: Scar pattern on the main flaking surface (1) One scar (2) Unidirectional (3) Bidirectional (4) Convergence (5) Centripetal (6) Others (Fig.4.8).

Six scar patterns on the main flaking surface are recognized. Fig.4.8 shows these patterns.

(The main scar on the main flaking surface)

The main scar refers to the largest measurable tabular scraper flake scar on the main flaking surface.

13: Length of the main scar.

14: Width of the main scar.

15: Length/Width of the main scar.

Fig.4. 9 shows measurements of main scars. Main scars are measured along the debitage axis of

the main flaking surface. They are measured to the nearest millimetres.

16: Shape of the main scar (1) Symmetrical end struck flake (2) Asymmetrical end struck flake (3) side struck flake (fig.4.10).

Shapes of main scars are classified into three types. Fig.4.10 shows these three types. End struck flakes refer to flakes whose length is greater than the width. Side struck flakes are flakes whose length is equal to or less than the length.

17: Termination of the main scar (1) Normal (2) Hinged (3) Overshot (Plunged) (Fig.4.11).

Termination of main scars is also analyzed. Three types are recognized. These types are shown in Fig.4.11.

3.4.2 Tabular scraper flakes

(Raw material)

(General)

1: Broken (1) Yes (2) No.

2: Shape of flake (1) Symmetrical end struck (2) Asymmetrical end struck (3) Side struck (Fig.4.13).

Tabular scraper flakes are classified into three types according to their shape. Fig.4.13 shows these three types. End struck flakes refer to flakes whose length is greater than the width. They are divided into two types according to their symmetry. Side struck flakes are flakes whose length is equal to or less than the length.

3: Incision (1) Present (2) Absent.

According to S.A. Rosen, incised marks are often observed on the cortex of tabular scrapers from Early Bronze Age sedentary settlements (S.A. Rosen 1997). Therefore the presence or absence of incision on the cortex is recorded.

(Measurements) (Fig.4.12)

4: Length.

5: Width.

6: Thickness.

7: Length/Width.

8: Width/Thickness.

Fig.4.11 shows measurements of tabular scraper flakes. Tabular scraper flakes are measured along the debitage axis. They are measured to the nearest millimeter.

(Butt) (Fig.4.12)

9: Butt width.

10: Butt depth.

They are measured to the nearest millimeter.

11: Angle de chasse.

They are measured to the nearest degree.

12: Flaking angle.

They are measured to the nearest degree.

13: Butt Type (1) Cortex (2) Weathered (3) Plain (4) Faceted (5) Others (Fig.4.7, Fig.4.14).

Five butt types are recognized. Fig.4.14 show these butt types. Cortex and weathered plain butts are related to tabular scraper flake removal without any platform preparation. Weathered plain surfaces, which were caused by natural process, were often preferred as platforms. Plain butts are related to platform preparation by one flaking blow. Faceted butts are usually related to careful platform preparation.

14: Impact point (1) Present (2) Absent.

The presence or absence of an impact point on the striking platform is recorded. The presence of an impact point is usually related to percussion with a harder hammer.

(Dorsal surface)

15: Cortex on dorsal surface (1) Total (2) Cortical (2) Partially cortical (Fig.4.15).

Tabular scrapers generally show intentional retention of cortex on the dorsal surface. Tabular scraper flakes are classified into three types according to the amount of cortex. Total cortical tabular scraper flakes refer to tabular scraper flakes whose dorsal surface is fully covered with cortex. Cortical tabular flakes are flakes whose dorsal surface is half or more than covered with cortex. Partially cortical tabular scraper flakes are flakes whose dorsal surface is less than half covered with cortex.

Most tabular scraper flakes in samples are fragments. Therefore tabular scraper fragments are also divided into the three types according to the amount of cortex on the dorsal surface of tabular scraper flake fragments.

(Ventral surface)

16: Cone (1) Present (2) Absent.

The presence or absence of a cone is recorded. The presence of a cone is usually related to percussion with a harder hammer.

17: Bulb (1) Prominent (2) Prominent weakly (3) Non prominent.

Three types of bulb are recognized. Prominent bulbs are generally related to percussion with harder hammers while non prominent bulbs are related to percussion with soft hammers.

18: Bulbar scar (1) Present (2) Absent.

The presence or absence of a bulbar scar is recorded. The presence of a scar is usually related to percussion with a harder hammer.

19: Lip (1) Present (2) Absent.

The presence or absence of a lip is recorded. The presence of a lip is generally related to percussion with a softer hammer.

20: (Proximal end)

(1) Unexpanded (2) Expanded (3) Unknown (Fig.4.17).

Most tabular scraper flakes in samples were broken into pieces. Therefore the author also analyzed proximal fragments and divided them into three types: Unexpanded, expanded and others. Unexpanded pieces are probably parts of end struck tabular scraper flakes while expanded pieces are probably parts of side struck tabular scraper flakes.

(Distal end)

21: Distal shape (1) Unexpanded (2) Expanded (3) Unknown (Fig.4.16)

Most tabular scraper flakes in samples were broken into pieces. Therefore the author analyzed distal fragments and divided them into three types: Unexpanded, expanded and others. Unexpanded pieces are probably parts of end struck tabular scraper flakes while expanded pieces are probably parts of side struck tabular scraper flakes.

22: Termination (1) Feather (2) Hinged (3) Plunged (Fig.4.18).

Terminations of tabular scrapers are classified into three types: Feather, hinged and plunged. Fig.4.18 shows these types. Tabular scraper flakes with feather termination were the most suitable blanks.

(Profile)

23: Profile (1) Straight (2) Concave (3) Convex (Fig.4.19).

Profiles of tabular scraper flakes are classified into three types. Fig.4.19 shows these types. Tabular scraper flakes with a straight profile are probably the most suitable blanks.

(Hammer mode)

24: Hammer mode (1) I (2) II (3) III (4) IV (5) V (6) Others (Fig.4.20).

According to M. Suzuki, A. Igarashi, K. Onuma, S. Kadowaki, S. Kunitake, Y. Sunada, Y.

Nishiaki, T. Midoshima, T. Yamada and M. Yoshida, the combination of several features such as impact points, lips, bulbs, cones, flaking angle and bulbar scars, is a useful way of to identifying which hammers were used for detaching flakes. They recognized five patterns (Suzuki, Igarashi, Onuma, Kadowaki, Kunitake, Sunada, Nishiaki, Midoshima, Yamada and Yoshida 2002). Fig.4.20 shows these types.

Type I : Type I has a clear impact point and clear cone. Distinctive concentric rings can be seen on the cone. The bulb is prominent.

Type II : Type II has an impact point. However a clear cone and concentric rings can not be observed. The bulb is prominent. Large bulbar scars are often seen on the prominent bulb.

Type III: Type III has no clear impact point. It has a clear lip. The point where flaking starts is wide and outstanding. The bulb is prominent.

Type IV: Type IV has a clear lip. The bulb is prominent weakly. Flaking angle is equal to or more than 100°.

Type V : Type V has a clear lip. The bulb is not prominent. Flaking angle is less than 100°.

According to them, if hammer modes were dominated by Type I , flakes were probably detached with hard stone hammers. If Type I occupies less than 50 % of hammer modes and the rest were occupied by Type II and Type III, flakes were probably detached with soft stone hammers. If Type II and Type III are predominant and the rest were almost occupied by Type IV, flakes were probably detached with antlers or soft stone hammers. If Type IV and Type V are predominant, flakes were probably detached with a wooden hammer.

3.4.3 Tabular scrapers

(Raw material)

(General)

1: Broken (1) Yes (2) No.

2: Shape of tabular scraper (1) Side struck Fan (2) Side struck oval (3) Round (4) End struck oval (5) Elongated (6) Others (Fig.4.22).

Tabular scrapers are divided into several types according to their morphology. Fig.4.22 shows the classification. Tabular scrapers whose width is larger than their length and whose shape is fan shaped are classified into side struck fan shaped tabular scrapers. Tabular scrapers whose ratio of length to width is less than 0.9 and whose shape is oval are classified into side struck oval tabular scrapers. Tabular scrapers whose ratio of the length to the width is equal to or more than 0.9 and less than 1.1 and whose shape is round are classified into round scrapers. Tabular scrapers whose ratio of the length to the width is equal to or more than 1.1 are classified into end struck tabular scrapers. End struck tabular scrapers are also divided into two types; end struck oval and elongated tabular scrapers. Elongated tabular scrapers are scrapers whose length is equal to or greater than twice their width. This classification is used in Chapter 6 and 7.

3: Shape of original blank (1) Symmetrical end struck (2) Asymmetrical end struck (3) Side struck (Fig.4.13).

Shapes of estimated original blanks are recorded.

4: Incision (1) Present (2) Absent.

The presence or absence of an incision is recorded.

(Measurements) (Fig.4.21).

5: Length.

6: Width.

7: Thickness.

8: Length/Width.

9: Width/Thickness.

Fig.4.21 shows measurements of tabular scrapers. Tabular scrapers are measured along their debitage axis. They are measured to the nearest millimeter.

(Butt)

10: Butt length.

11: Butt width.

Fig.4.21 shows measurements of butts. If there is no retouch on butts, butts' length and width are measured. They are measured to the nearest millimeter.

12: Angle de chasse.

13: Flaking angle.

They are measured to the nearest degree.

14: Butt type (1) Cortex (2) Weathered (3) Plain (4) Faceted (5) Others.

Five butt types are recognized. Fig.4.14 shows these butt types.

15: Impact point (1) Present (2) Absent.

The presence or absence of an impact point is recorded.

(Dorsal surface)

16: Cortex on the dorsal surface (1) Total (2) Cortical (2) Partially cortical.

Fig.4.15 shows patterns of cortex on the dorsal surface.

(Ventral surface)

17: Cone (1) Present (2) Absent.

The presence or absence of a cone is recorded.

18: Bulb (1) Prominent (2) Prominent weakly (3) Non prominent.

Bulbs are divided into three types: Prominent, prominent weakly and non-prominent.

19: Bulbar scar (1) Present (2) Absent.

The presence or absence of a bulbar scar is recorded.

20: Lip (1) Present (2) Absent.

The presence or absence of a lip is recorded.

(Profile)

21: Profile (1) Straight (2) Concave (3) Convex.

Profiles of tabular scrapers are recorded. Fig.4.19 show patterns of profiles.

(Hammer mode)

22: Hammer mode (1) I (2) II (3) III (4) IV (5) V (6) Others.

Hammer modes on tabular scrapers are recorded. Fig.4.20 shows the classification.

(Retouch)

23: Retouch angle (1) Low angle (2) Semi abrupt (3) Abrupt.

Retouch angle is classified into three types. Low angle retouch refers to the retouch whose angle is less than 30°. Semi abrupt retouch refers to retouch whose angles is equal to or more than 30°and less than 60°. Abrupt retouch is retouch whose angle is equal to or more than 60°.

24: Shapes of retouch: (1) Scaled (2) Stepped (3) Parallel (4) Semi-parallel (Fig.4.23).

Dominant shapes of retouch are recorded. Shapes of retouch are divided into four types. These types are shown on Fig.4.23.

25: Degree of retouch (1) Short (2) Long (3) Invasive (Fig.4.24).

Degree of retouch is recorded. Retouch is divided into three types according to its extent. Short retouch refers to retouch whose length or width is less than a quarter of tabular scraper length or width. Long retouch is retouch whose length or width is equal to or greater than a quarter of tabular scraper length or width and less than a half of tabular scraper length or width. Invasive retouch is retouch whose length or width is equal to or greater than a half of tabular scraper length or width.

26 Position of retouch (1) Dorsal retouch (2) Ventral retouch (3) Dorsal and ventral bulb

thinning retouch (4) Dorsal and ventral retouch (5) Dorsal, ventral bulb thinning and ventral retouch (Fig.4.25).

Retouch is classified into five types according to the retouch position. Fig.4.25 shows these types. Tabular scrapers were usually retouched only on the dorsal surface. However some tabular scrapers show ventral retouch and/or ventral bulb thinning retouch.

27.1: Retouch localization on the dorsal surface (1) Round (2) Right (3) Left (4) Distal (5) Proximal (6) Right and distal (7) Right and left (8) Right and proximal (9) Left and distal (10) Left and proximal (11) Distal and proximal (12) Right, left and distal (13) Right, left and proximal (14) Right, distal and proximal (15) Left, distal and proximal (Fig.4.26.1).

Tabular scrapers in the Jafr basin are usually retouched only on the dorsal surface. Retouch on the dorsal surface is classified into 15 types according to its localization.

27.2: Retouch location on dorsal surfaces of proximal fragments of tabular scrapers.

(1) Left, right and Proximal (2) Left (3) Right (4) Proximal (5) Left and right (6) Left and proximal (7) Right and proximal (Fig.4.26.2).

Most tabular scrapers were broken into pieces. Therefore the author also analyzed retouch location of proximal fragments. The author divides them into seven types according to its location.

27.3: Retouch location on dorsal surfaces of distal fragments of tabular scrapers.

(1) Left, right and distal (2) Left (3) Right (4)Distal (5) Left and right (6) Left and distal (7)

Right and distal (Fig.4.26.3).

Most tabular scrapers were broken into pieces. Therefore the author also analyzed retouch location on dorsal surfaces of distal fragments. The author divided them into seven types according to its location.

3.4.4 Jafr blade cores

(Raw material)

1: Raw material (1) Nodular flint (2) Tabular flint.

Flint used for Jafr blade production shows little variation in texture. High quality Eocene flint was always used for Jafr blade production. The flint is fine grained and its colour ranges from dark brown to cream. The flint is usually covered with cortex whose colour ranges from white to orange.

Shapes of raw material are very important for Jafr blade production. The Jafr blade method was closely related to the shape of raw material. Raw material is divided into two types according its shape: nodular flint and tabular flint. Nodular flint has slightly convex surfaces while tabular flint has flat surfaces.

(General)

2: Battered signs (1) Present (2) Absent.

Jafr blade cores were often reused as hammers and show signs of battering. The presence or absence of battering is recorded.

3: The number of flaking surfaces.

The number of flaking surfaces is recorded.

4: The number of platform.

The number of platform is recorded.

(Measurements)

5: Length.

6: Width.

7: Thickness

8: Length/Width.

9: Width/Thickness.

Fig.4.27 shows measurements of cores. Cores are measured along the longitudinal axis of the main flaking surface. They are measured to the nearest millimeters.

(Platform)

10: Platform angle (Fig.4.27).

They are measured to the nearest degree.

11: Platform type (1) Cortex (2) Weathered (3) Plain (4) Others (Fig.4.28).

Platforms of Jafr blade cores are divided into four types. Fig.4.28 shows these types. Cortex and weathered platforms are natural platforms without any platform preparation. Cortex platforms are platforms covered with natural cortex. Weathered platforms are naturally weathered flat platforms caused by natural process. Plain platforms are platforms prepared by one percussion blow.

(Main flaking surface)

12: Scar pattern (1) Unidirectional (2) Bidirectional (Fig.4.29).

Scar patterns on main flaking surfaces are classified into two types. Fig.4.29 shows the types.

13: Shapes of scars (1) Flake (2) Blade (Fig.4.30).

Shapes of scars on main flaking surfaces are recorded. Fig.4.30 shows the types.

14: Termination (1) Normal (2) Hinged (3) Overshot (Plunged) (Fig.4.11).

Termination of scars on main flaking surfaces is also analyzed. Three types are recognized. These types are shown in Fig.4.11.

3.4.5 Jafr blades

(Raw Material)

(General)

1: Position of cortex (1) Distal end (2) Left side (3) Right side (4) Both sides (Left and Right) (5) Proximal end (6) Middle part (7) Absent (Fig.4.32).

Position of cortex on the dorsal surface is recorded. They are divided into 7 types shown on Fig.4.32.

2: Hammer mode (1) I (2) II (3) III (4) IV (5) V (6) Others (Fig.4.20).

Hammer modes are recorded following the method developed by the Japanese researchers

(Suzuki, Igarashi, Onuma, Kadowaki, Kunitake, Sunada, Nishiaki, Midoshima, Yamada and Yoshida 2002). Fig.4.19 shows the types.

(Measurements) (Fig.4.31)

3: Length.

4: Width.

5: Thickness.

6: Butt width.

7: Butt depth.

Fig.4.31 shows measurements of Jafr blades. Jafr blades are measured along their debitage axis. They are measured to the nearest millimeters and to the nearest degree.

(Butt)

8: Butt type (1) Plain (2) Thinned (3) Small (4) Faceted (5) Dihedral (6) Weathered (7) Cortex (8) Others (Fig.4.33).

Butt types of Jafr blades are recorded. Fig.4.33 shows butt types.

9: Overhang removal (1) Faceted (2) Abrasion (3) Absent.

The presence or absence of overhang removal is recorded. Overhang removal was often conducted before blade removal. Two ways of overhang removal are known: by faceting and by abrasion.

(Dorsal Surface)

10: Scar pattern (1) Unidirectional (2) Bidirectional (3) Others (Fig.4.34).

Scar patterns on dorsal surfaces are recorded. Scar patterns are classified into three types. Fig4.34 shows the types.

(Distal end)

11: Distal shape (1) Asymmetrical to the right (2) Asymmetrical to the left (3) Symmetrical, Square (4) Symmetrical, round (5) Symmetrical, pointed (6) Others (Fig.4.35).

Distal shapes of blades are classified into 7types. Fig.4.35 shows the types.

12: Termination (1) Feather (2) Hinged (3) Plunged (Fig.4.18).

Termination of blades is recorded. Fig.4.18 shows termination types

(Shape)

13: Profile (1) Straight (2) Concave (3) Convex (Fig.4.19).

Shapes of profiles are recorded. Fig.4.19 shows the types.

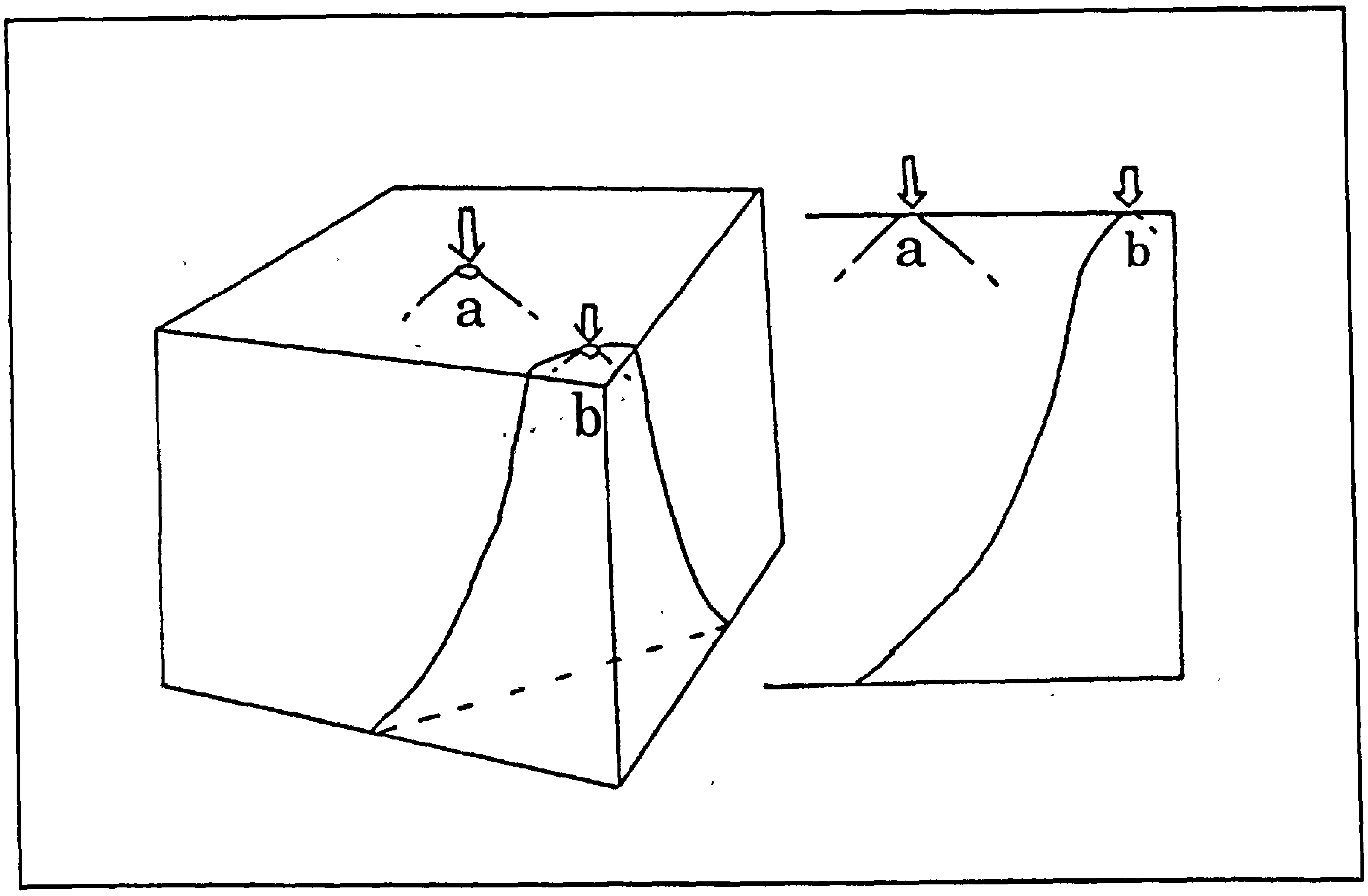


Fig.4.1 Hertzian cone (from Sato 2000)

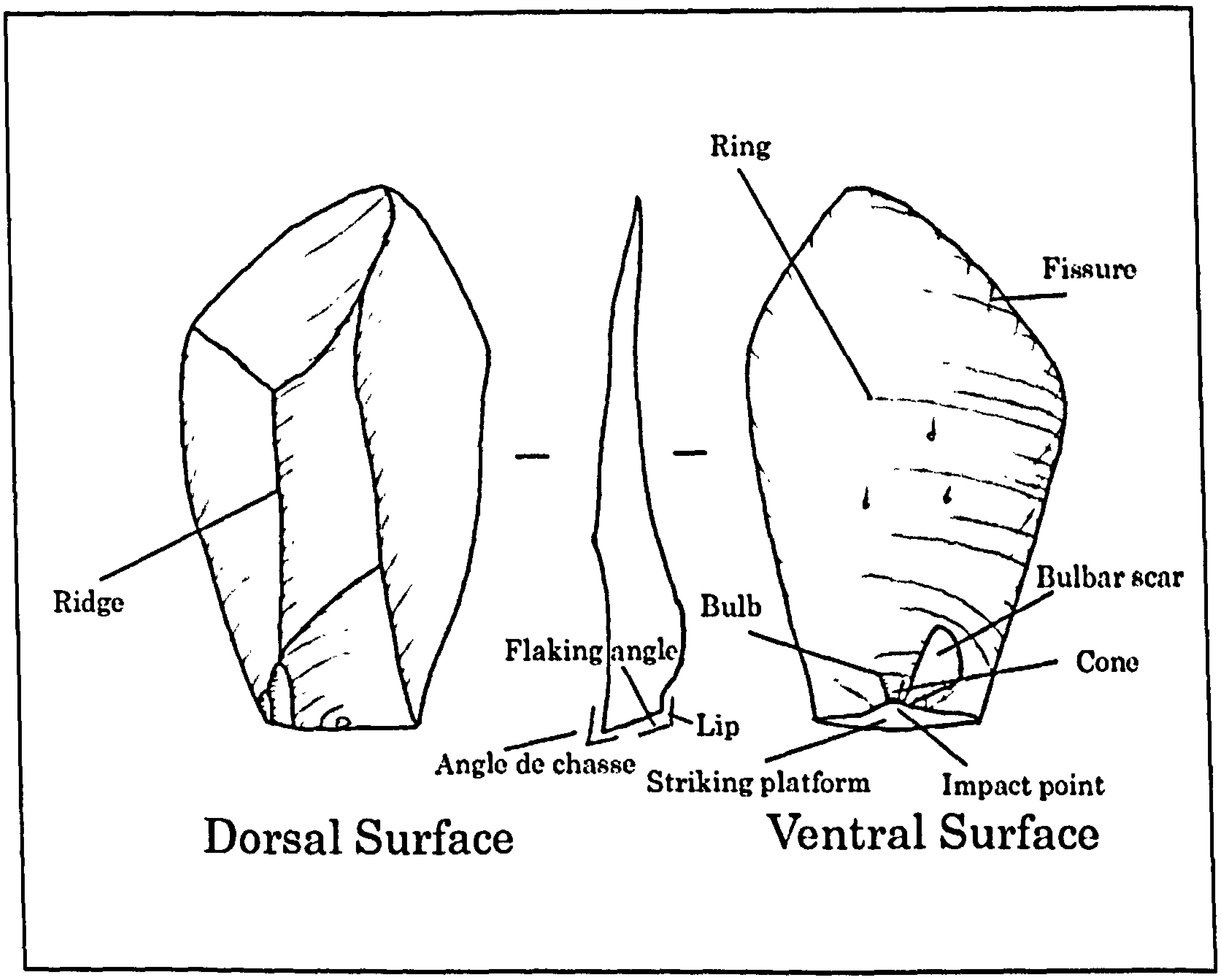


Fig.4.2 Basic features of a 'flake'.

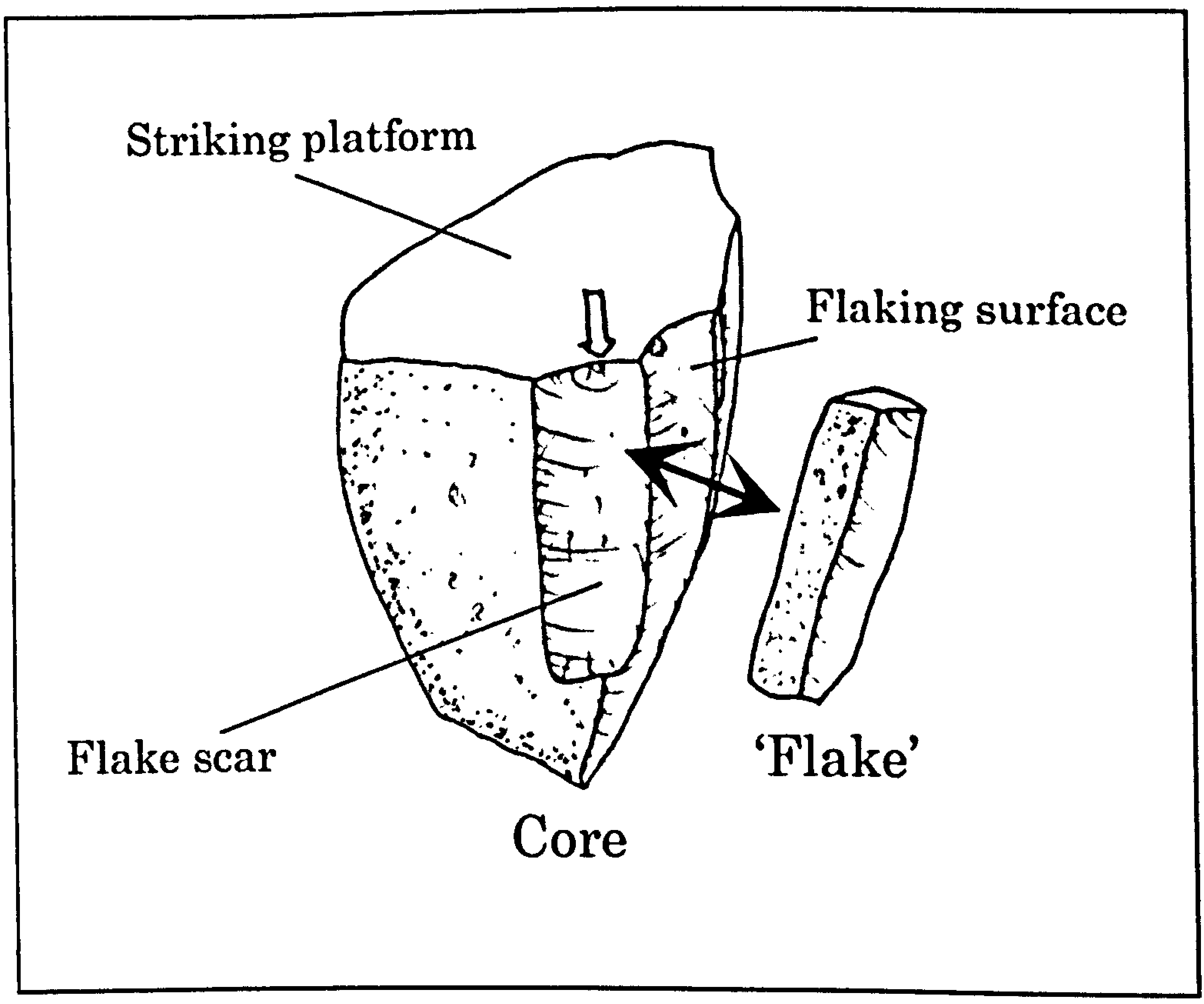


Fig.4.3 Basic features of a core.

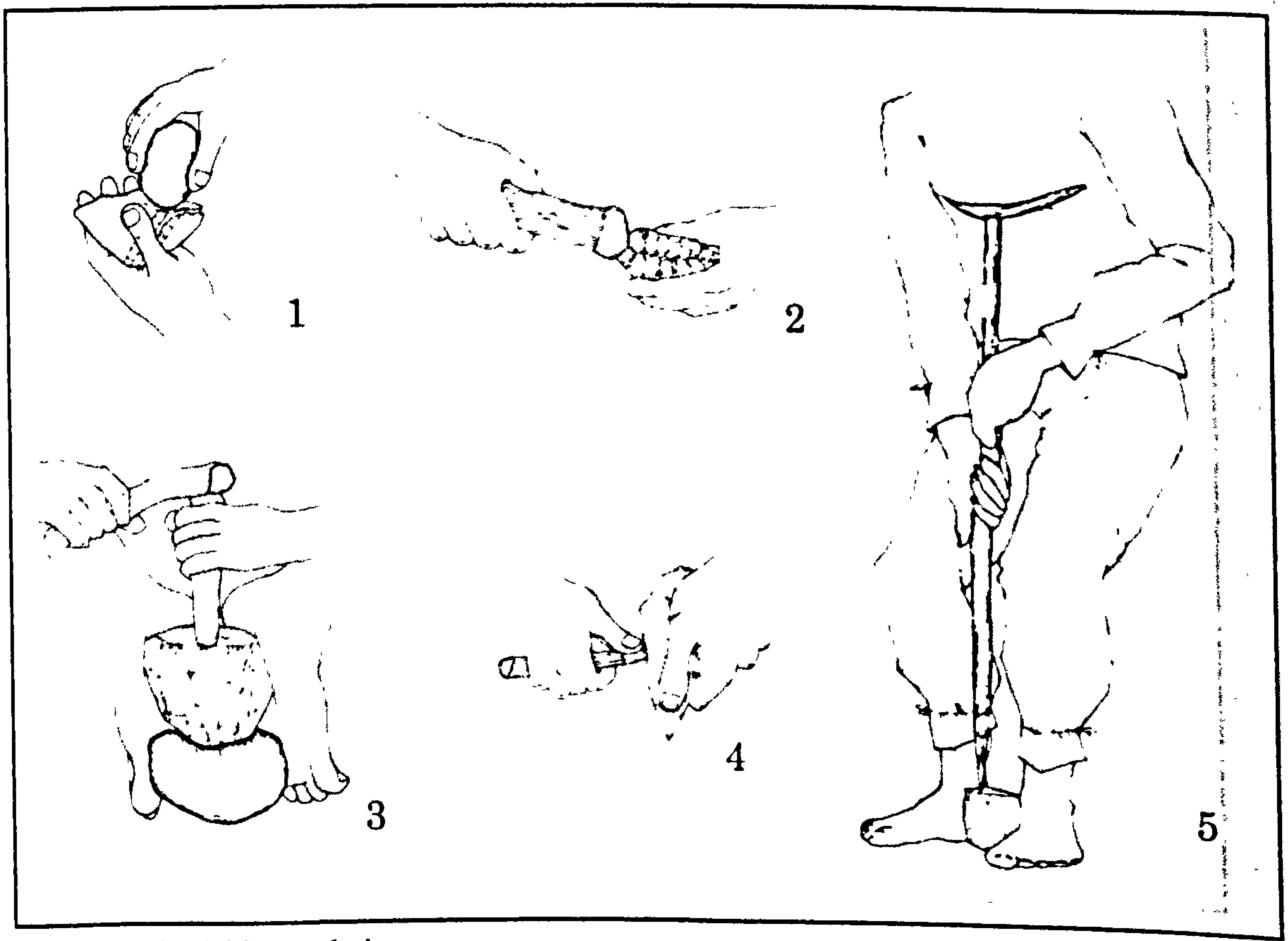


Fig.4.4 Basic flaking techniques.

1: Direct percussion with a hard stone, 2: Direct percussion with a wood stick, 3: Indirect percussion, 4: Pressure flaking with a punch, 5: Pressure flaking with a chest punch (from Paleolithic Culture Society 2000).

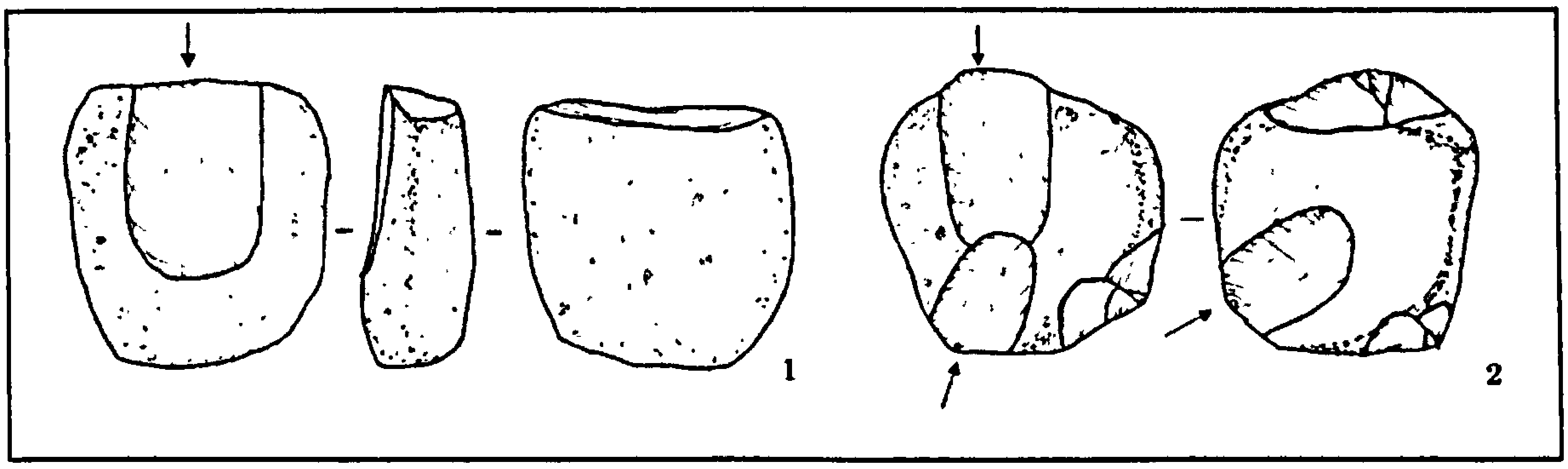


Fig.4.5 Tabular scraper cores.

1: Uniface tabular scraper core, 2: Biface tabular scraper core.

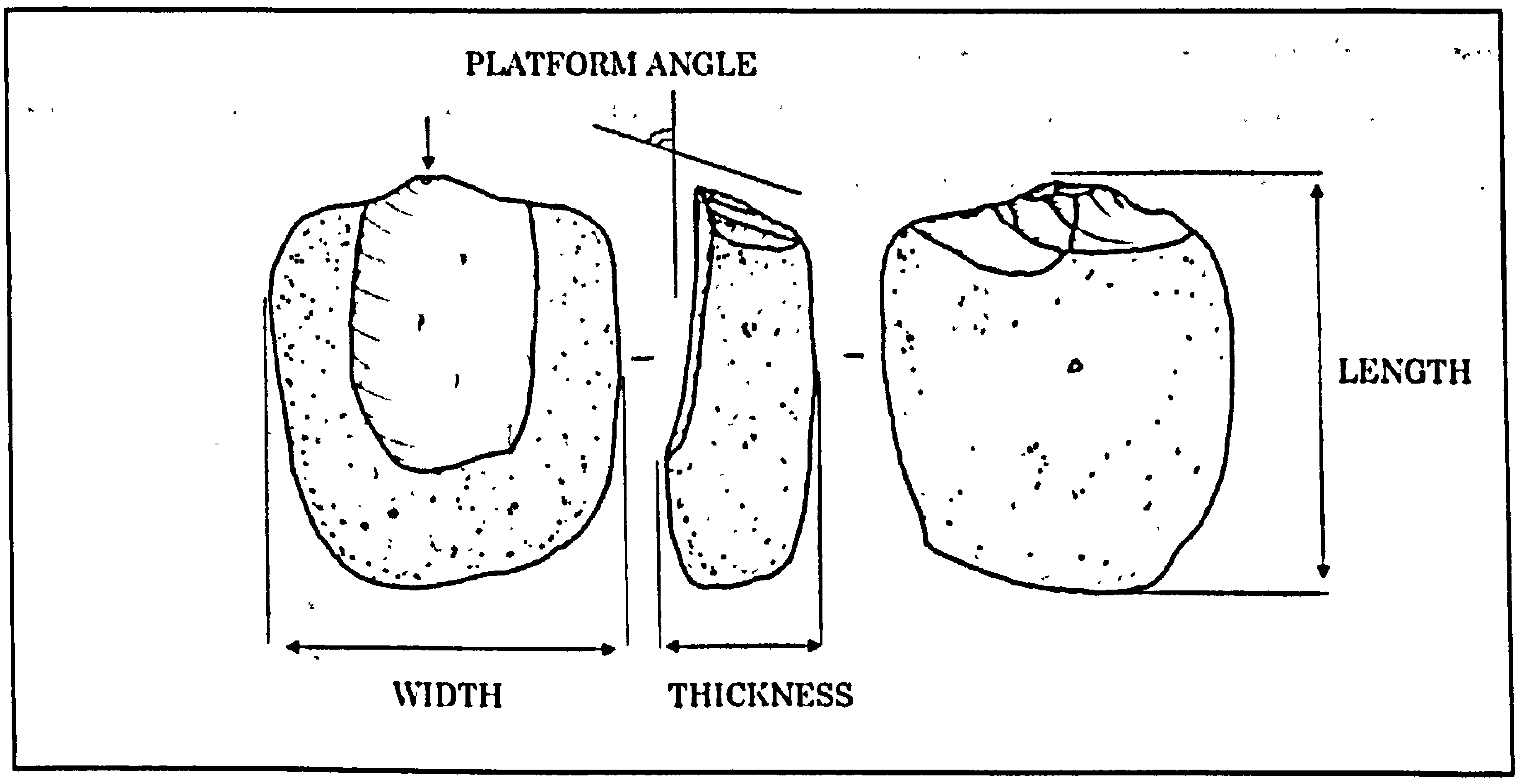


Fig.4.6 Measurements of tabular scraper core.

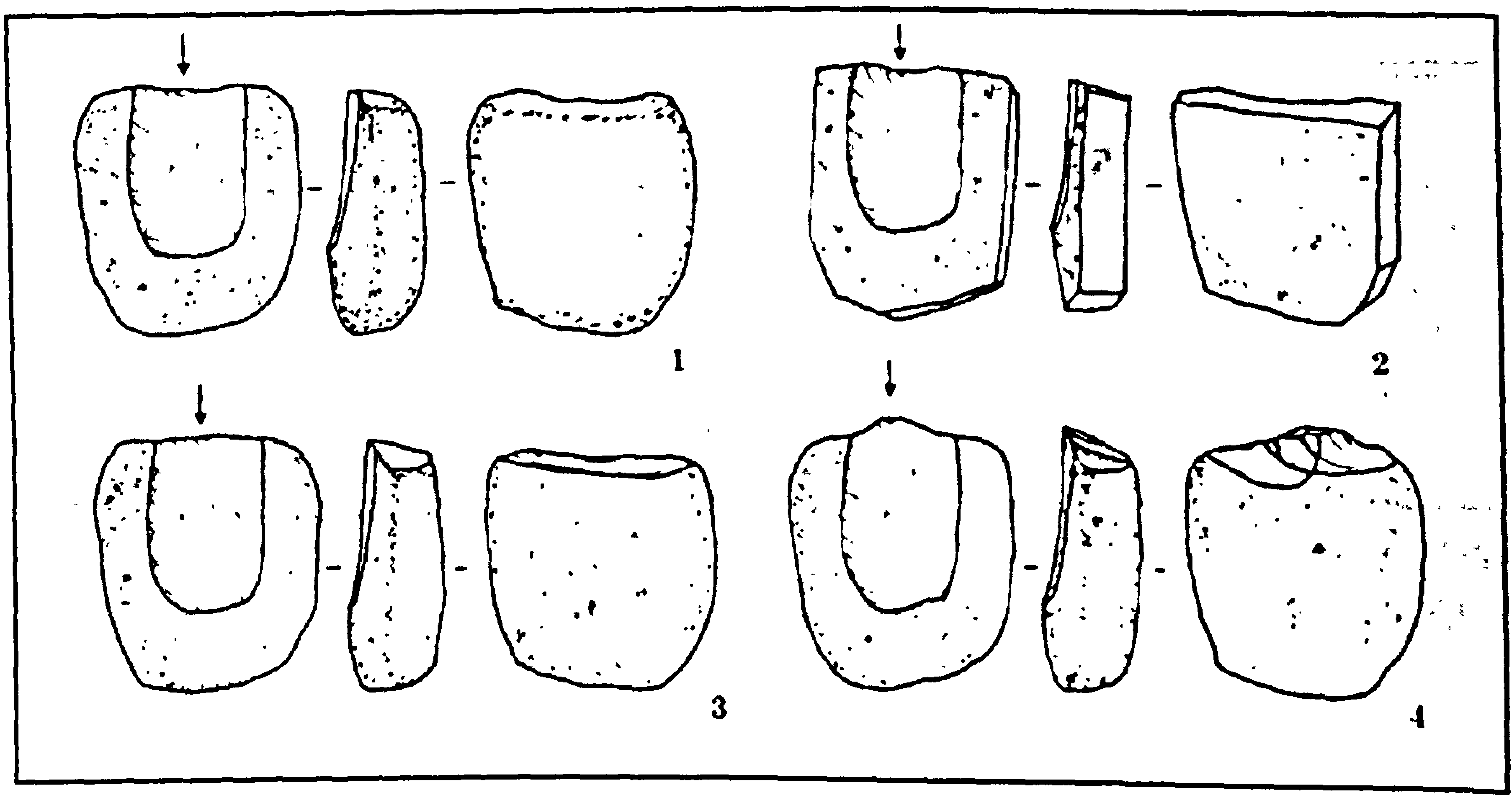


Fig.4.7 Platform types of tabular scraper cores.

1: Cortex platform, 2: Weathered plain platform, 3: Plain platform, 4: Faceted platform (The screen tone represents weathered plain surfaces).

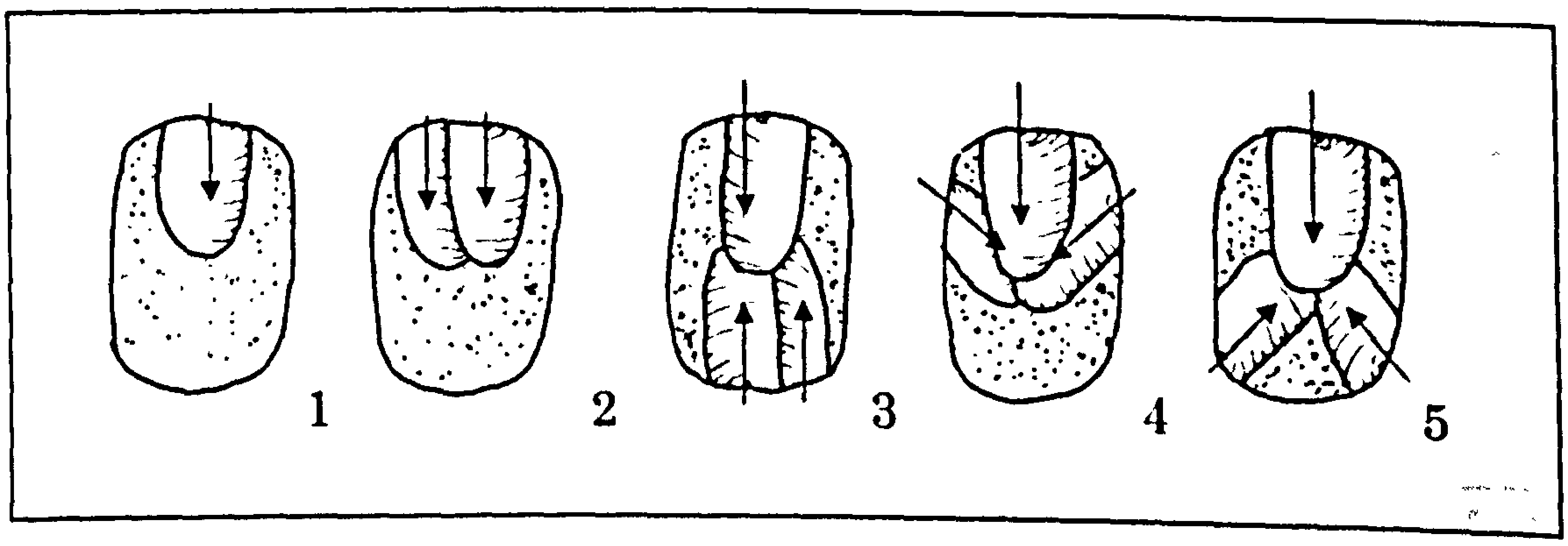


Fig.4.8 Scar patterns on the main flaking surface.

1: One scar, 2: Unidirectional, 3: Bidirectional, 4: Convergence, 5: Centripetal.

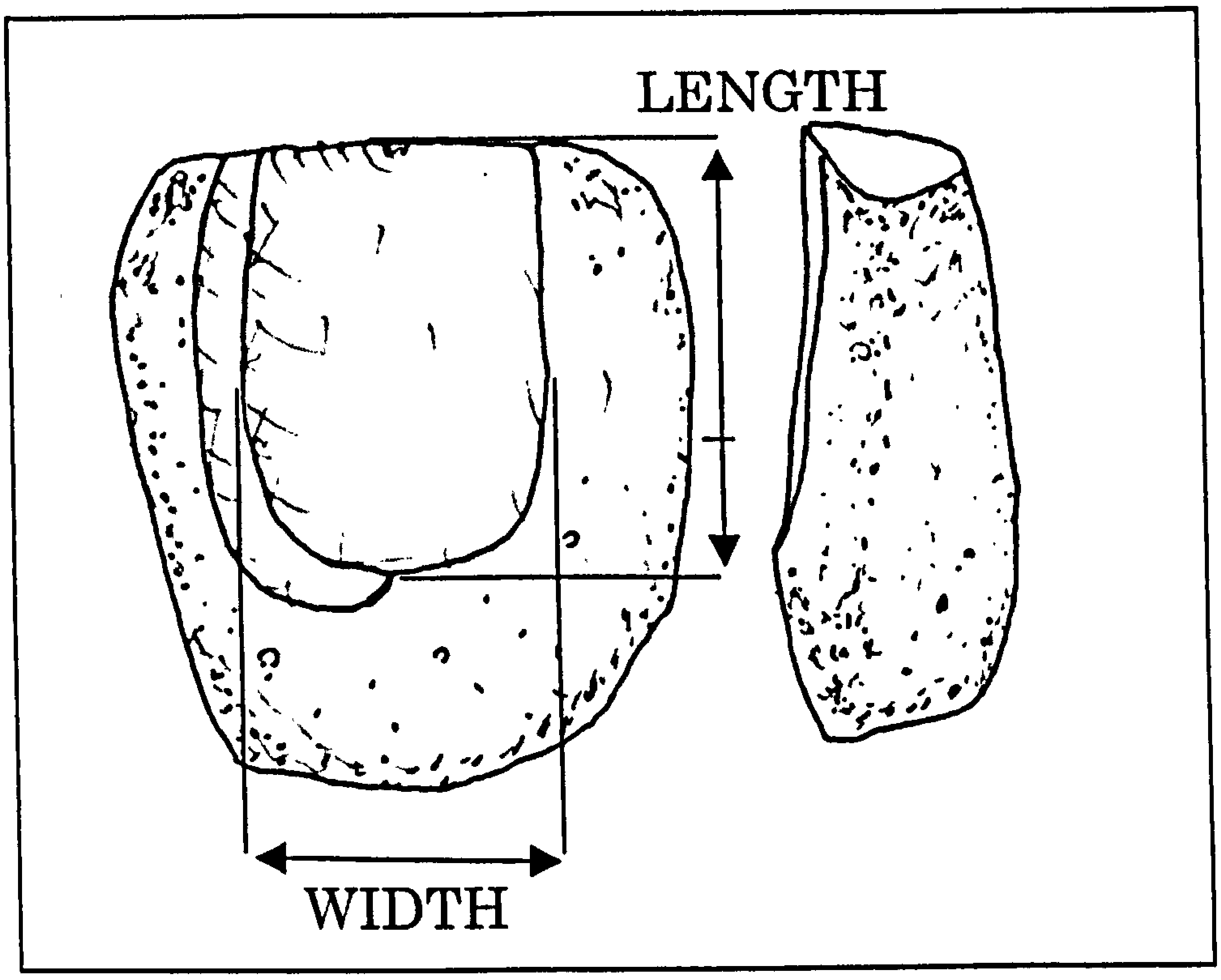


Fig.4.9 Measurements of the main scar on the main flaking surfaces.

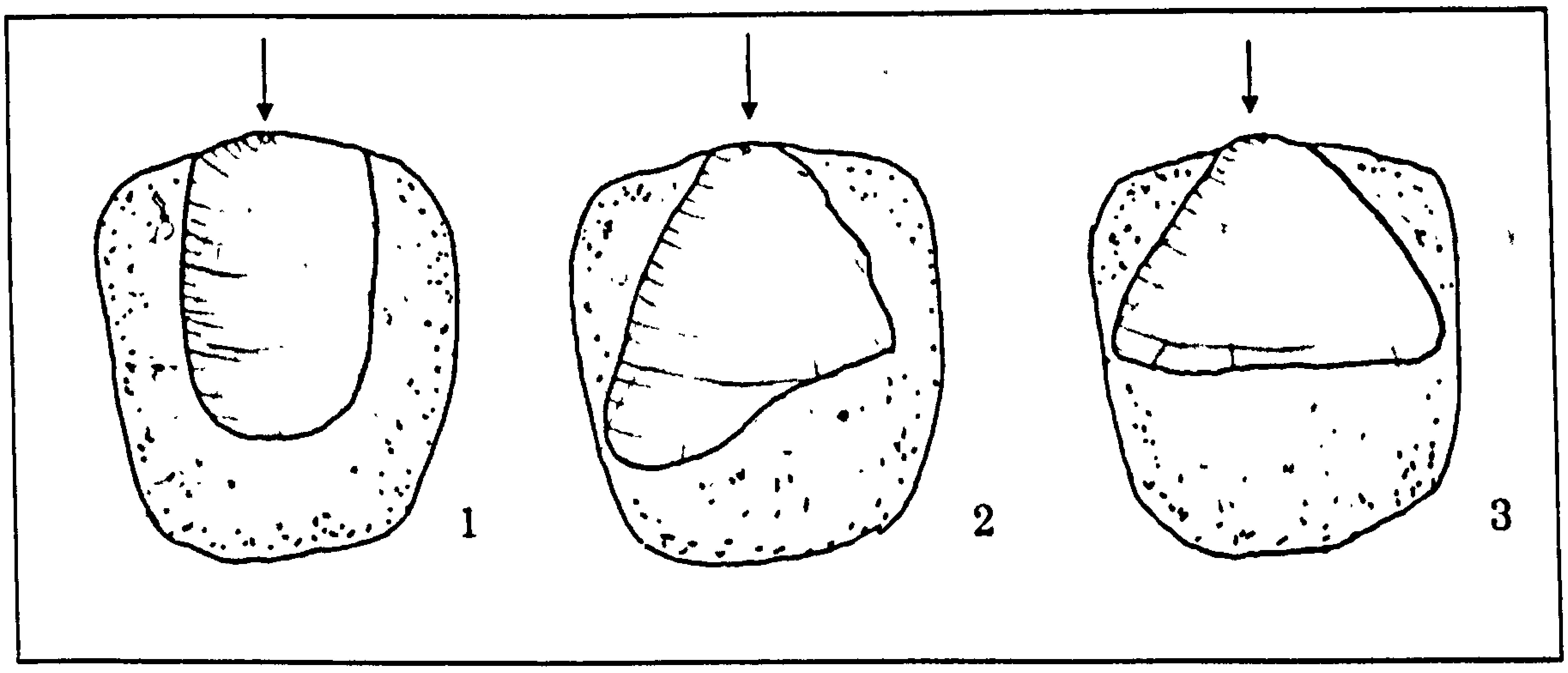


Fig.4.10 Shape of the main scar.

1: Symmetrical end struck flake, 2: Asymmetrical end struck flake, 3: Side struck flake.

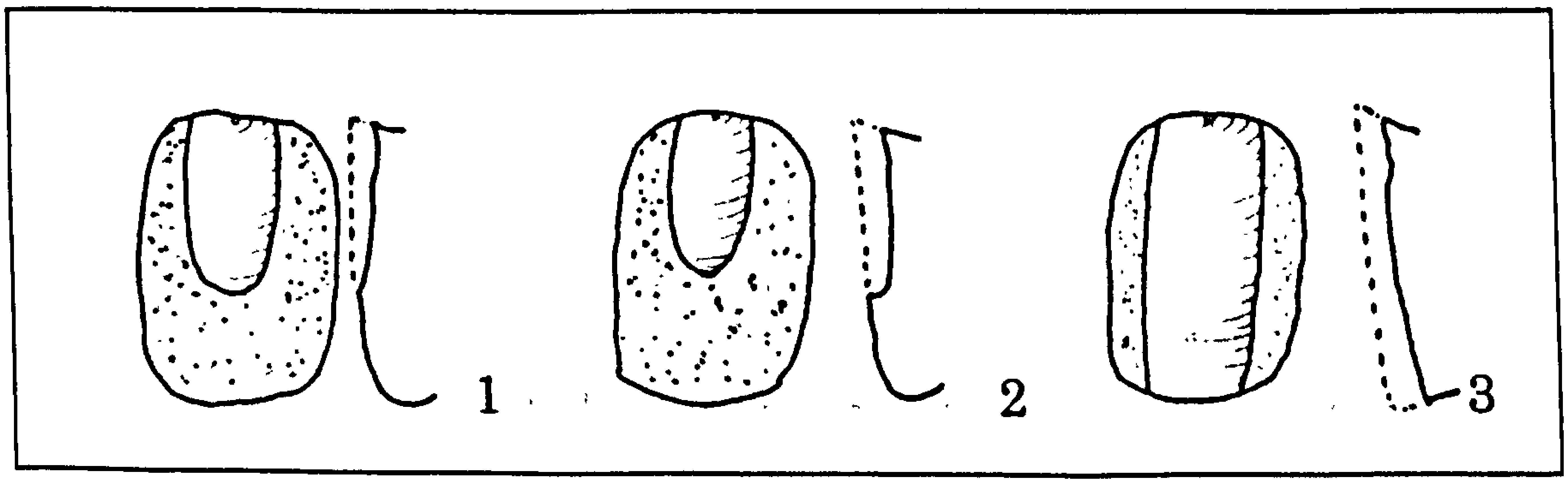


Fig.4.11 Termination of the main scar.

1: Feather, 2: Hinged, 3: Overshot (Plunged).

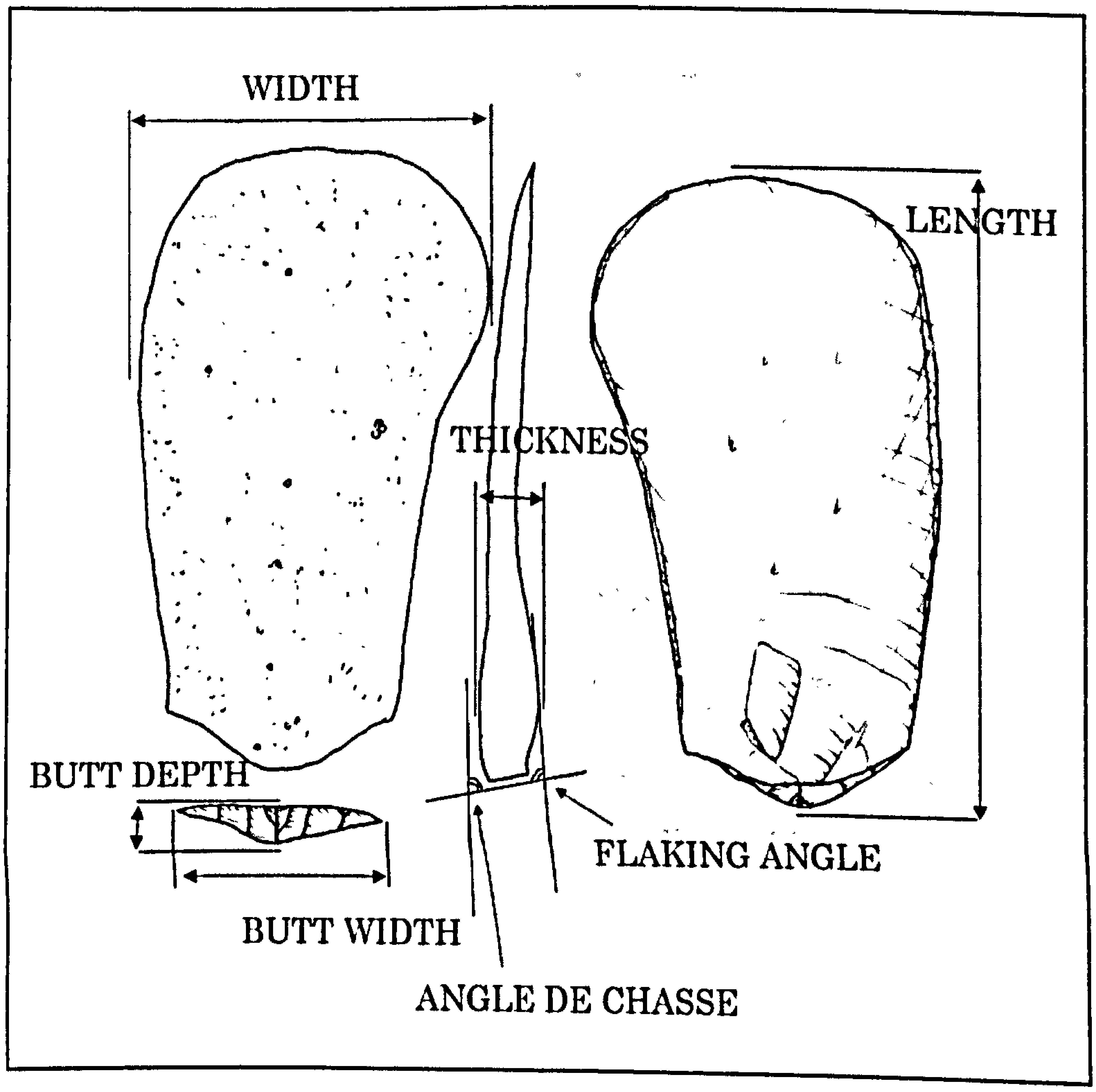


Fig.4.12 Measurements of tabular scraper flakes.

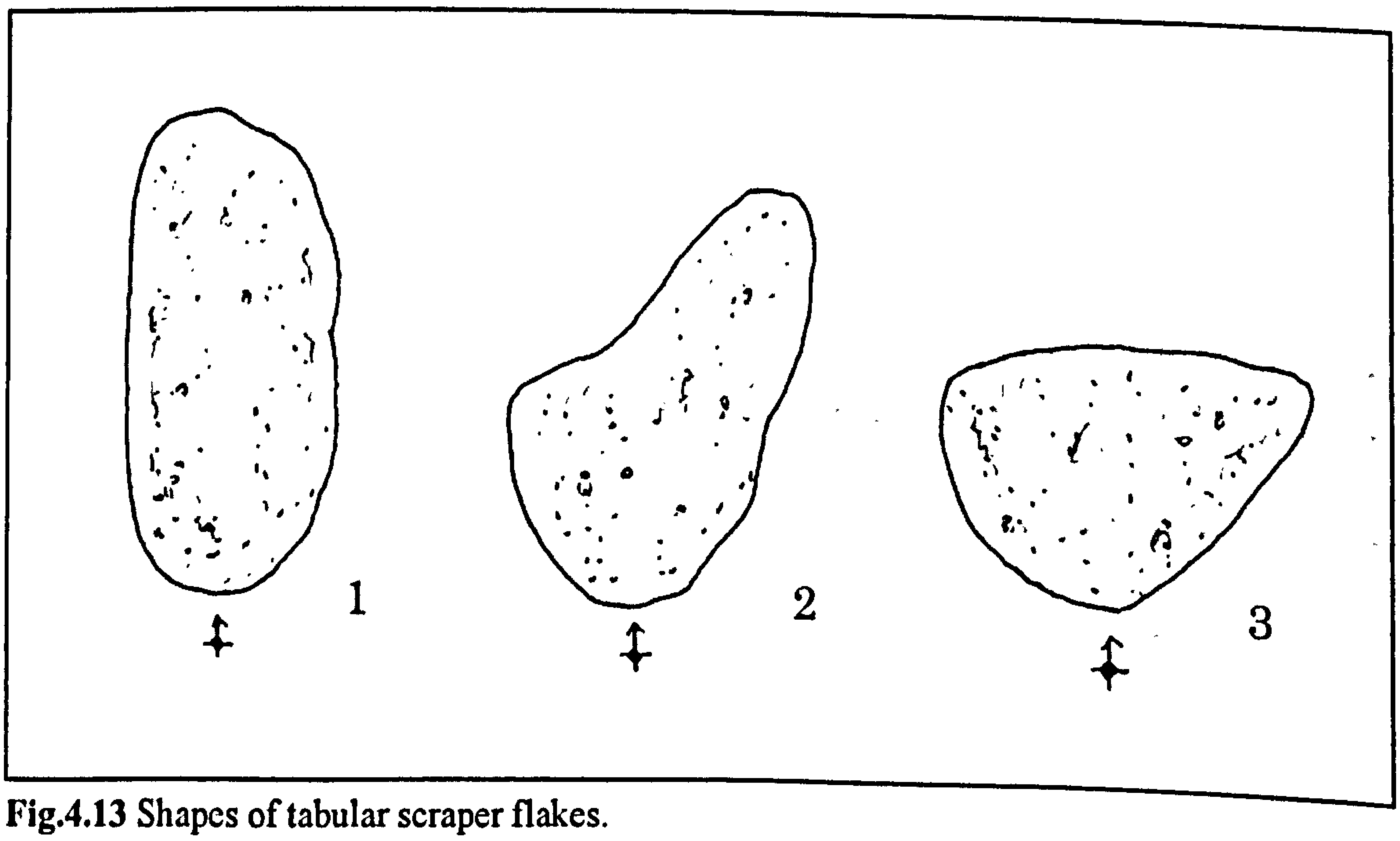


Fig.4.13 Shapes of tabular scraper flakes.

1: Symmetrical end struck, 2: Asymmetrical end struck, 3: Side struck.

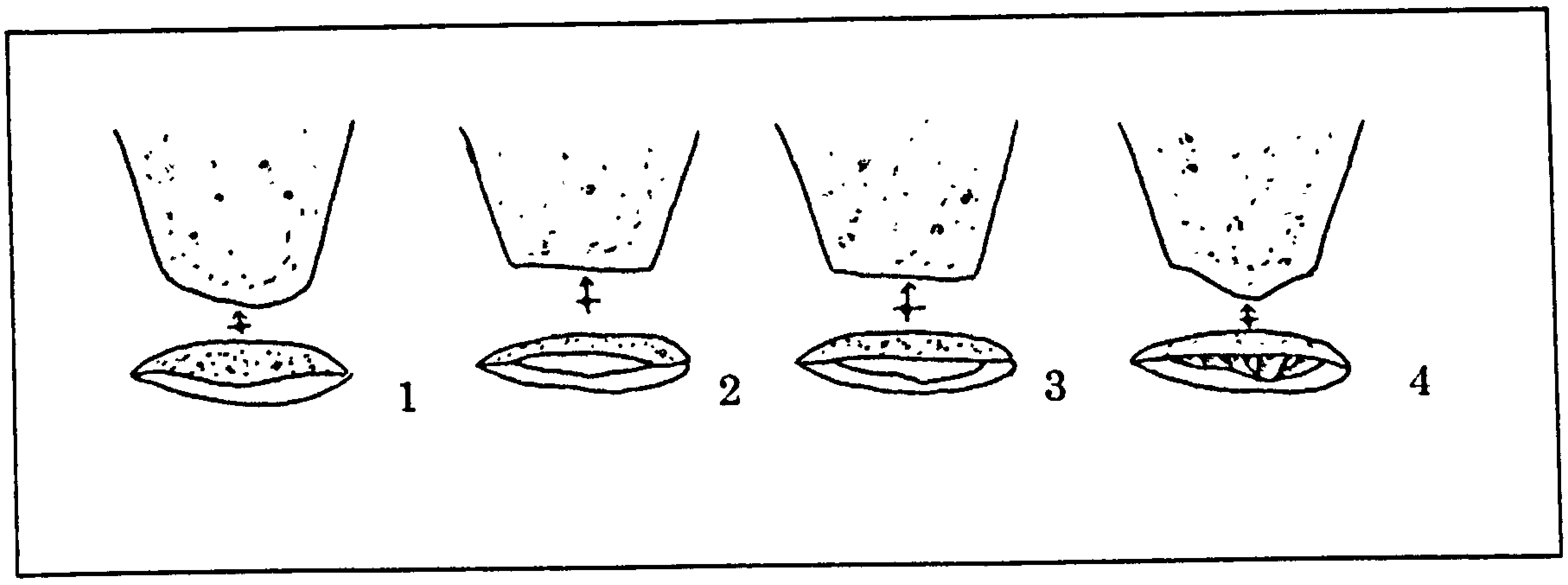


Fig.4.14 Butt types.

1: Cortex, 2: Weathered, 3: Plain, 4: Faceted.

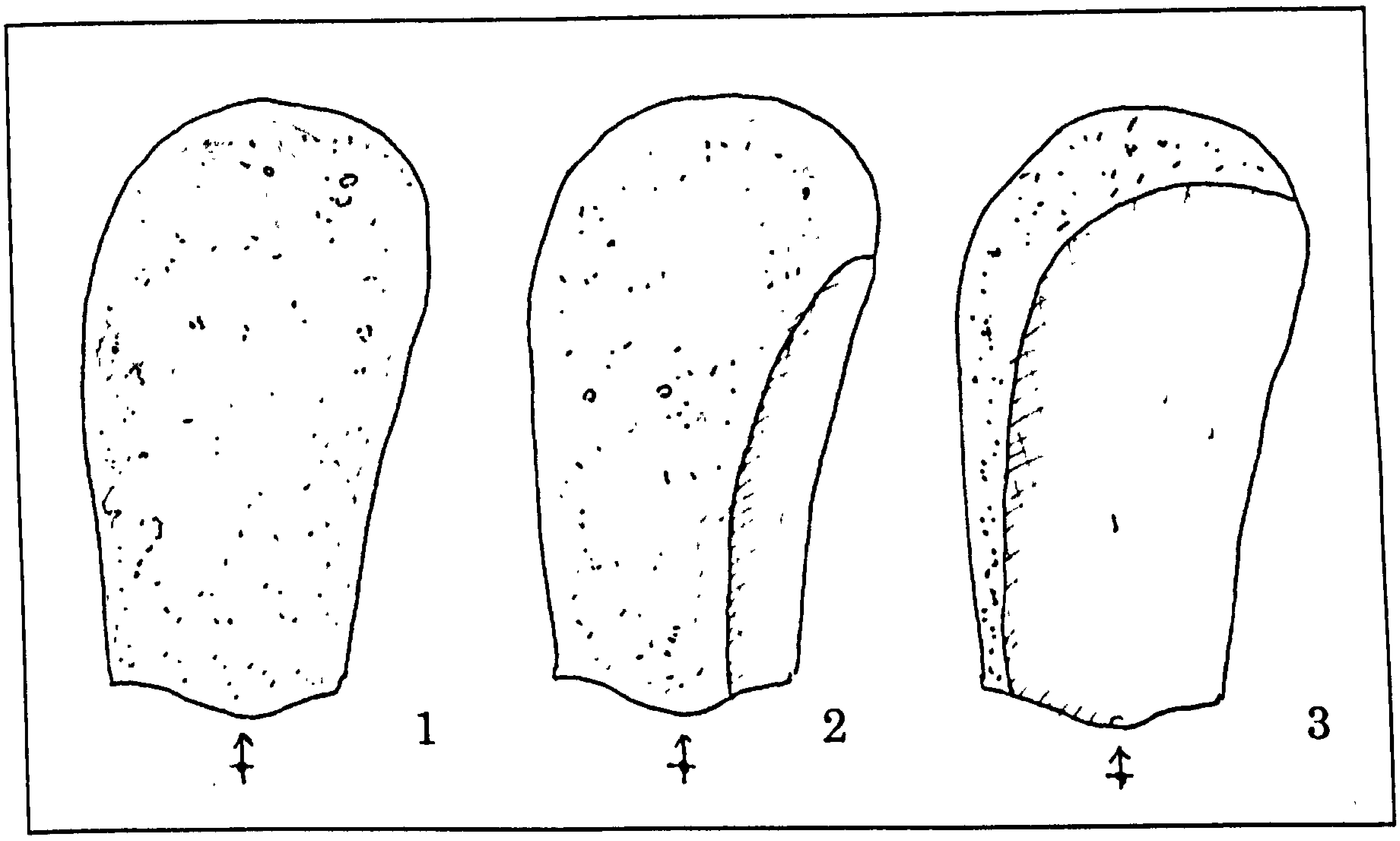


Fig.4.15 Cortex on the dorsal surface.

1: Total, 2: Cortical, 3: Partially cortical.

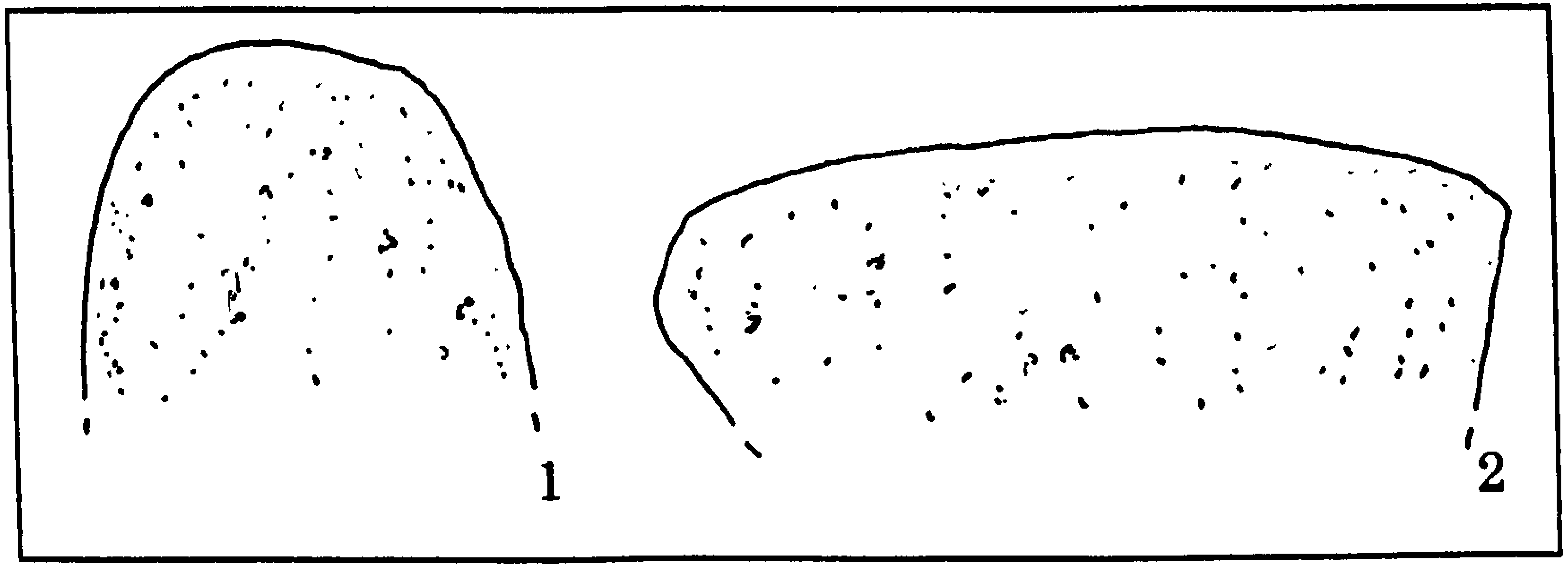


Fig.4.16 Distal ends of broken distal pieces of tabular scraper flakes.

1: Unexpanding, 2: Expanding.

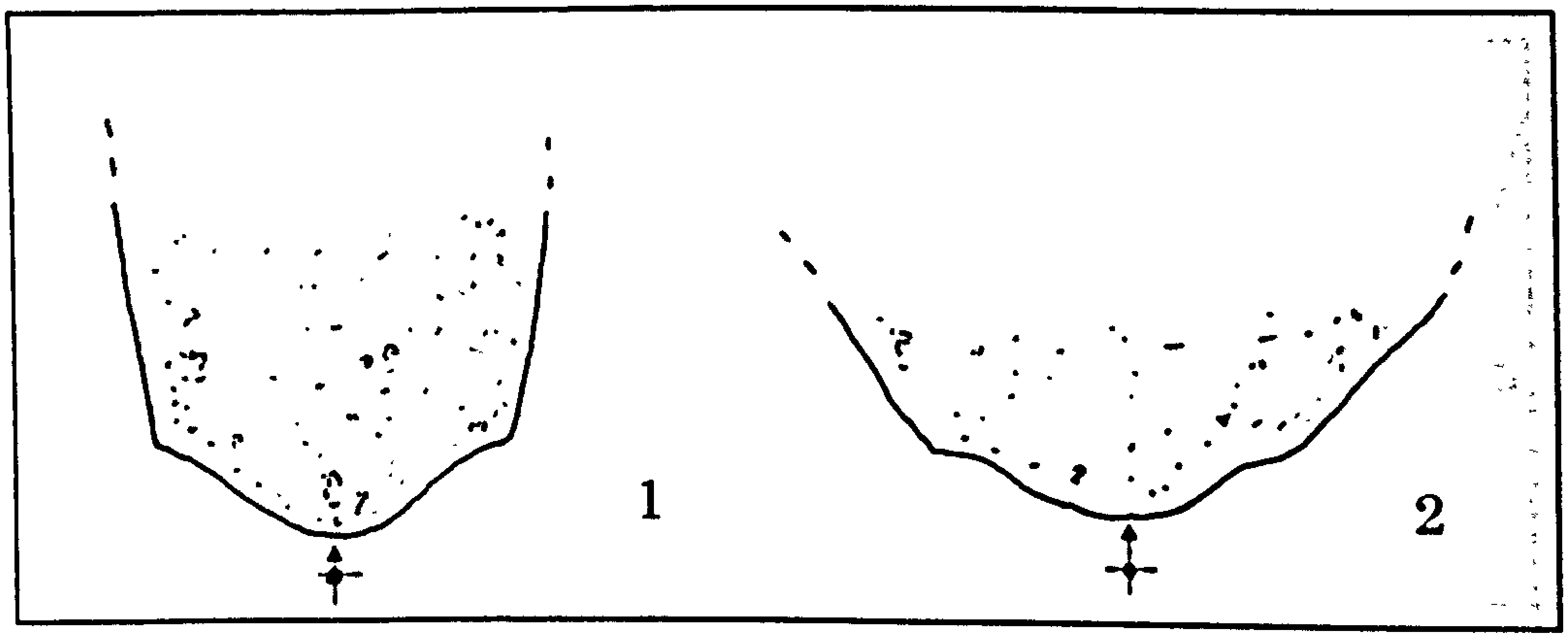


Fig.4.17 Proximal ends of broken proximal pieces of tabular scraper flakes.

1: Unexpanding, 2: Expanding.

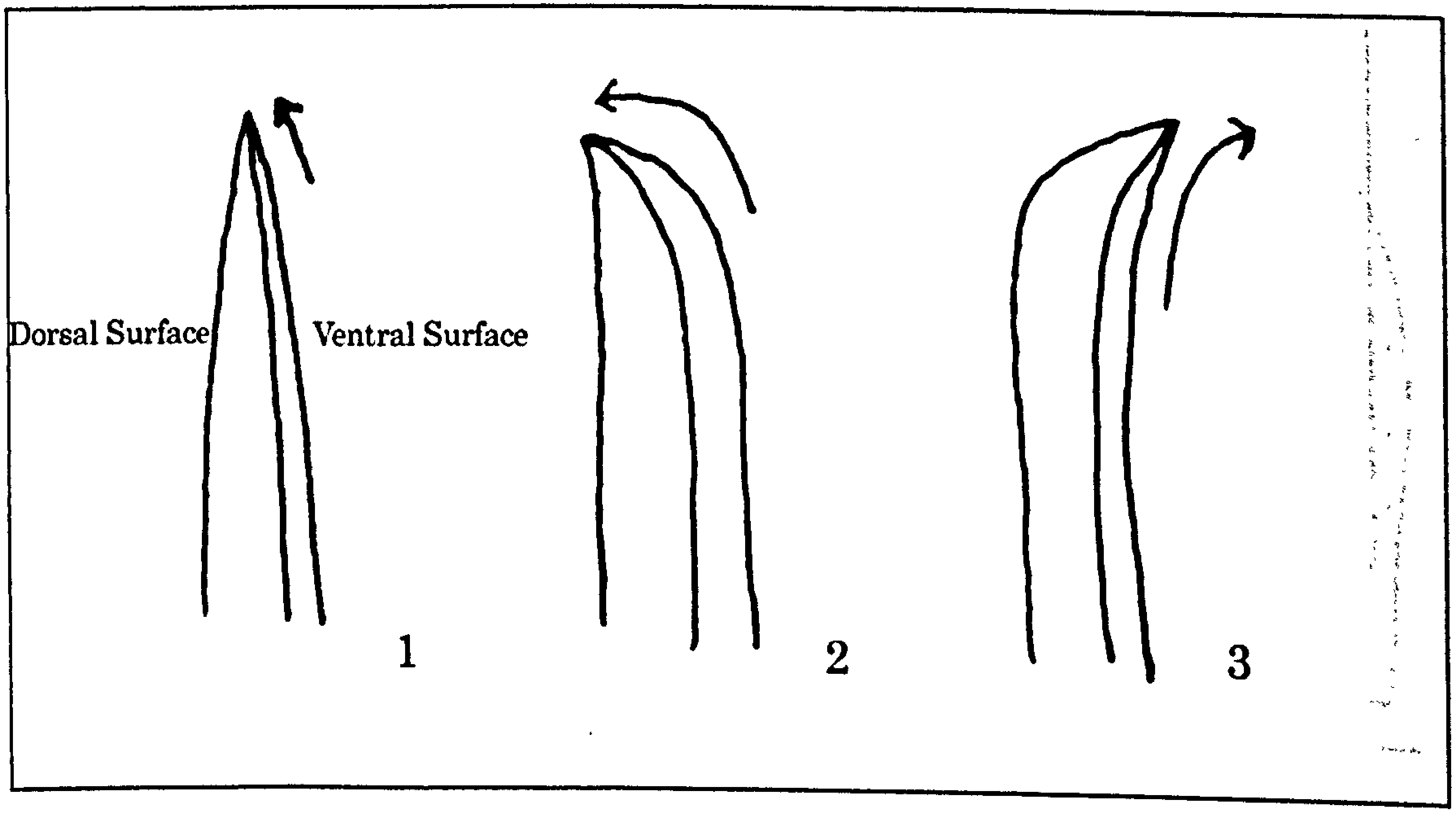


Fig. 4.18 Termination.

1: Feather, 2: Hinged, 3: Plunged.

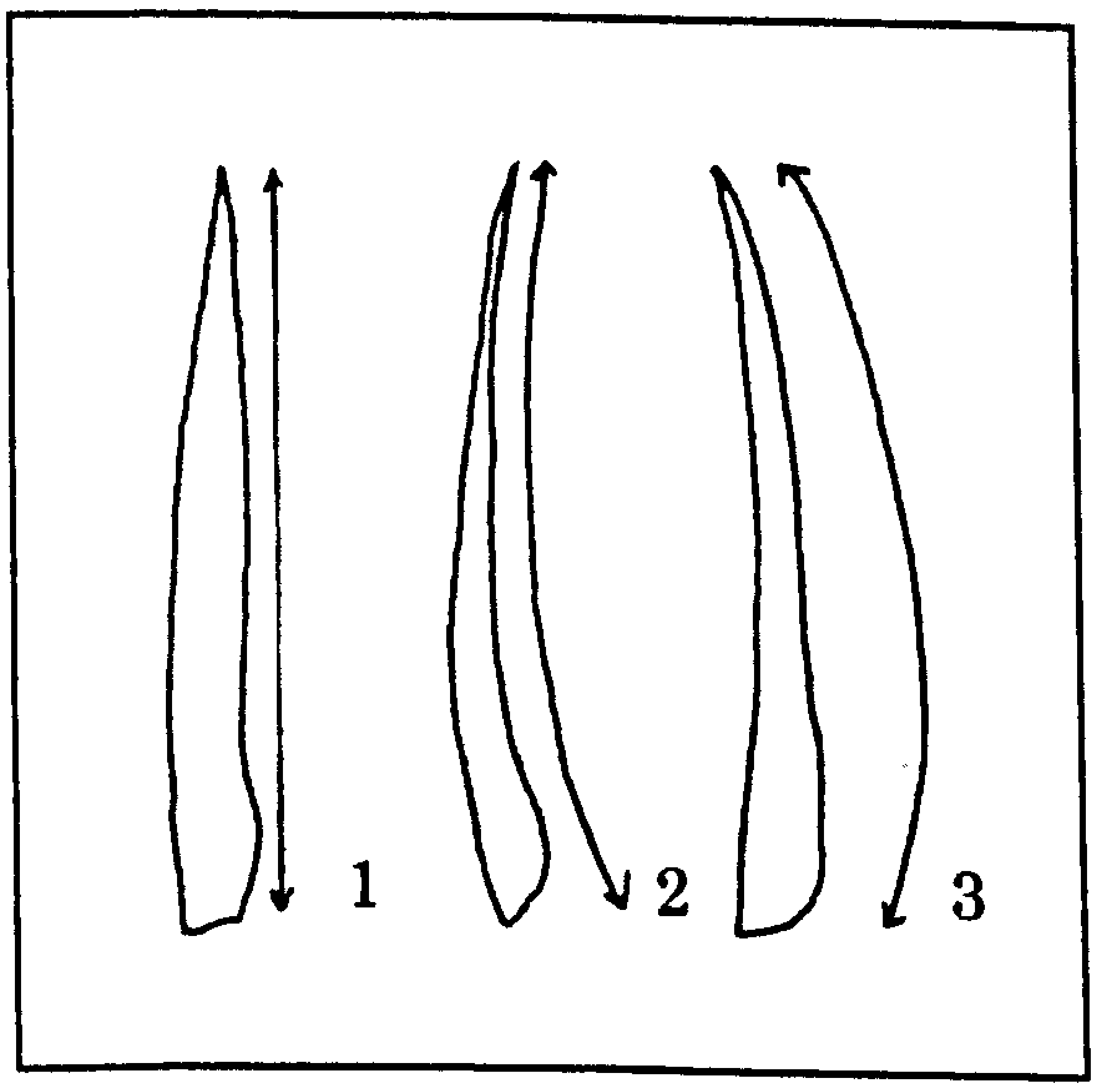


Fig. 4.19 Profile.

1: Straight, 2: Concave, 3: Convex.

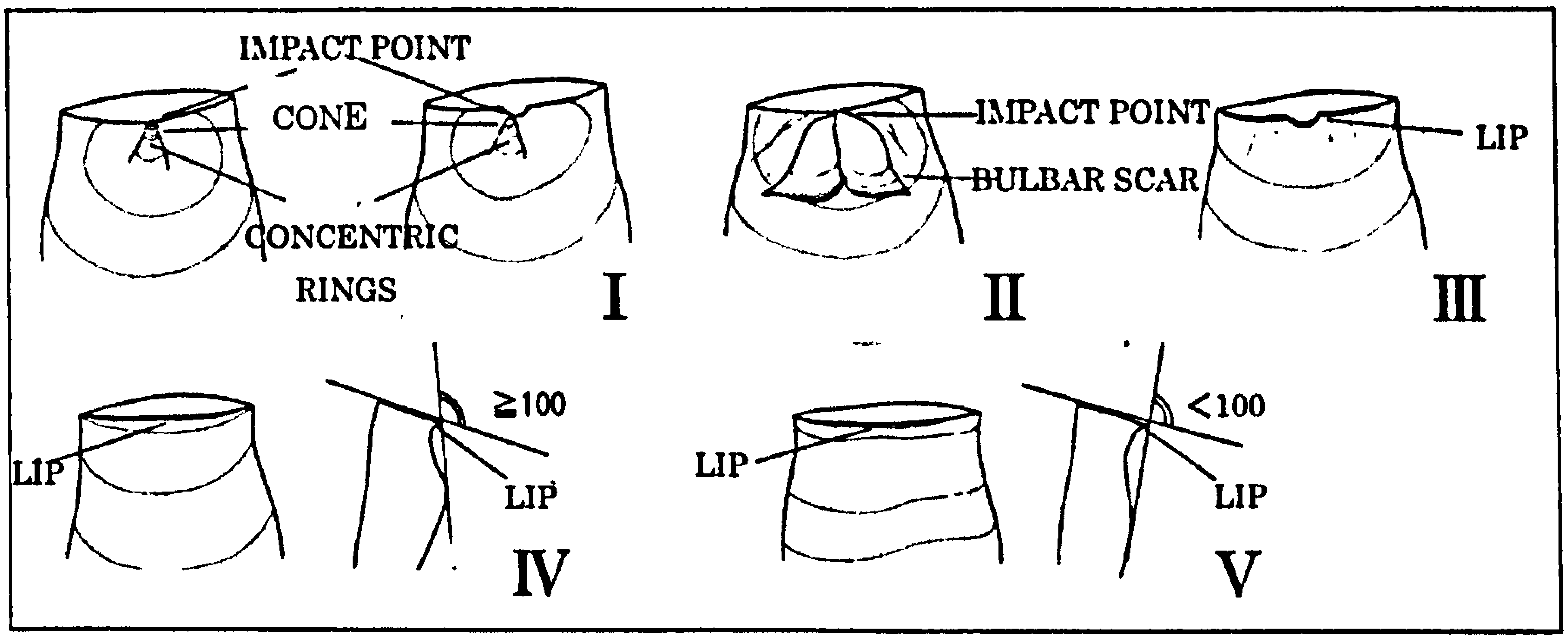


Fig.4.20 Hammer modes (from Suzuki, Igarashi, Onuma, Kadowaki, Kunitake, Sunada, Nishiaki, Midoshima, Yamada and Yoshida 2002).

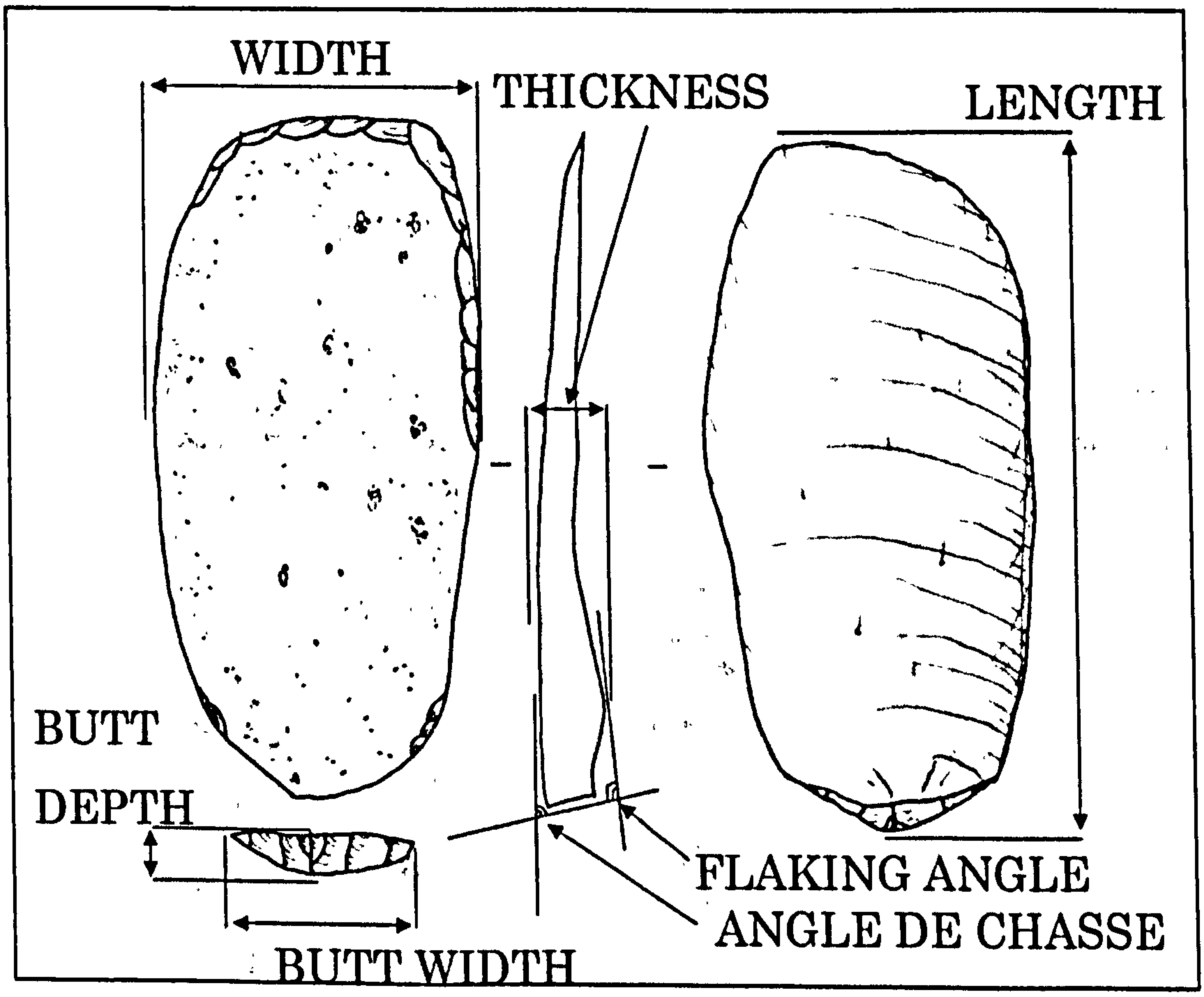


Fig.4.21 Measurements of tabular scrapers.

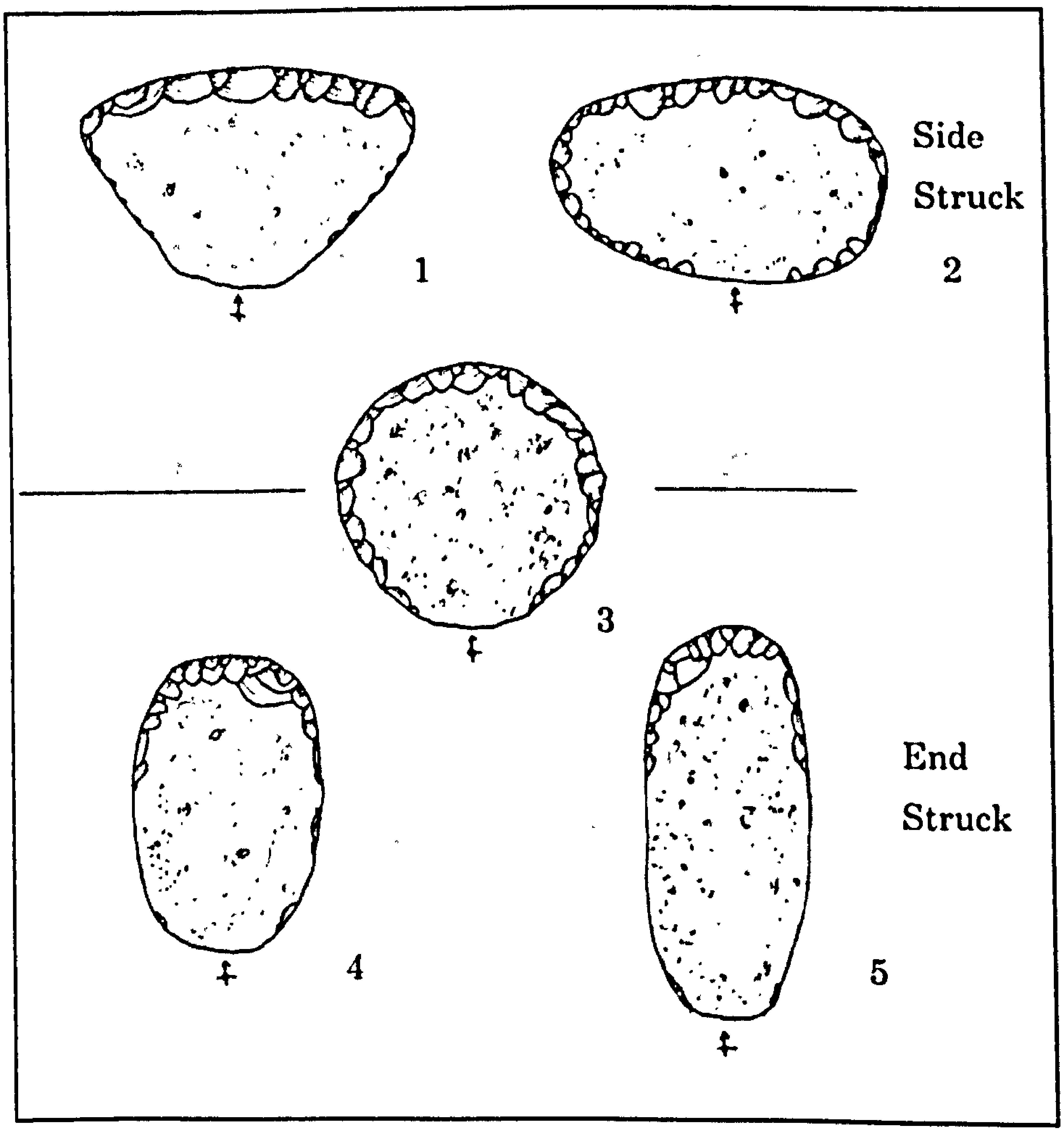


Fig.4.22 Shapes of tabular scrapers.

1: Side struck Fan, 2: Side struck oval, 3: Round, 4: End struck oval, 5: Elongated.

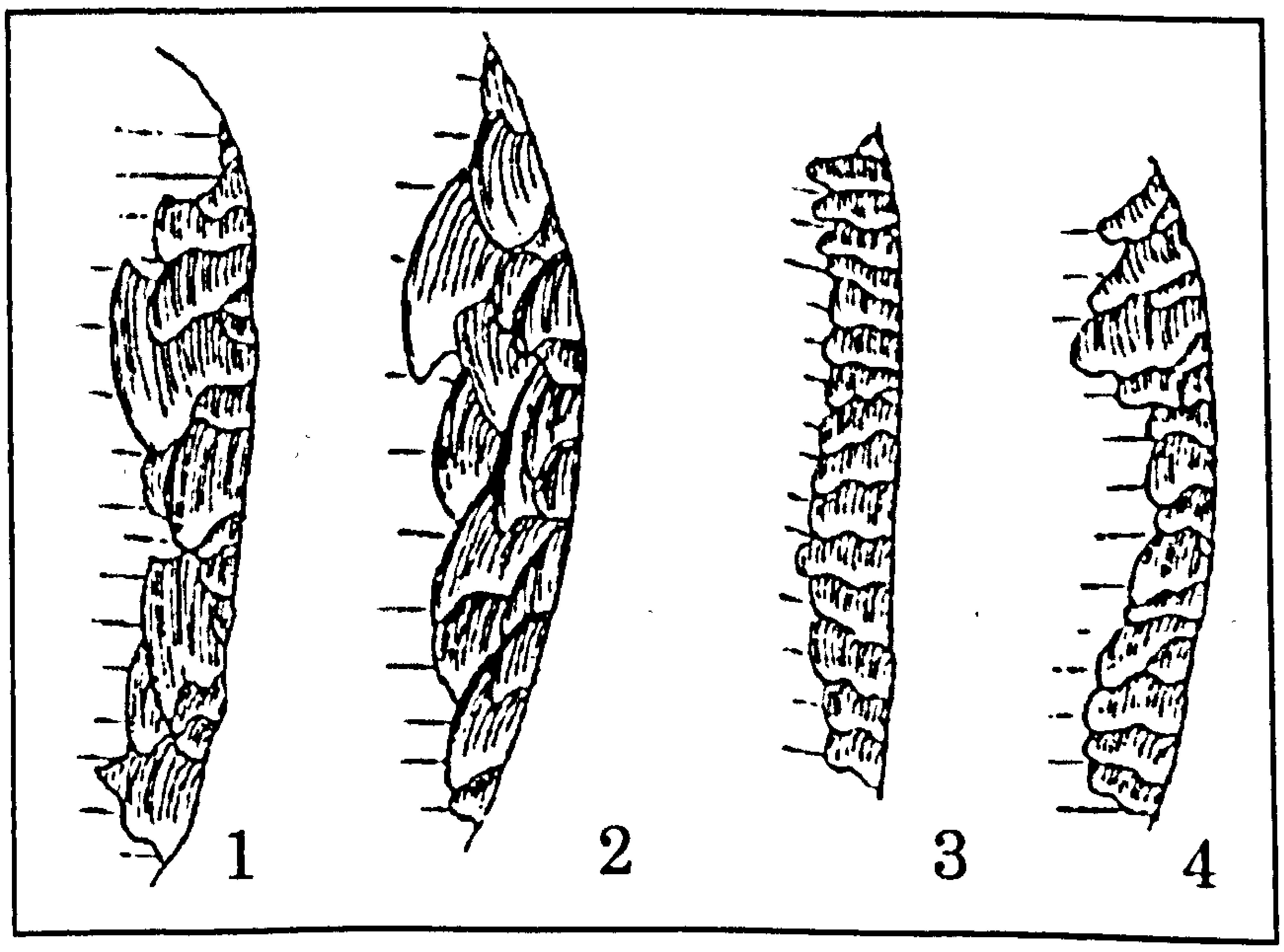


Fig.4.23 Shape of retouch.

1: Scaled, 2: Stepped, 3: Parallel, 4: Semi-parallel.

(from Bordes 1961)

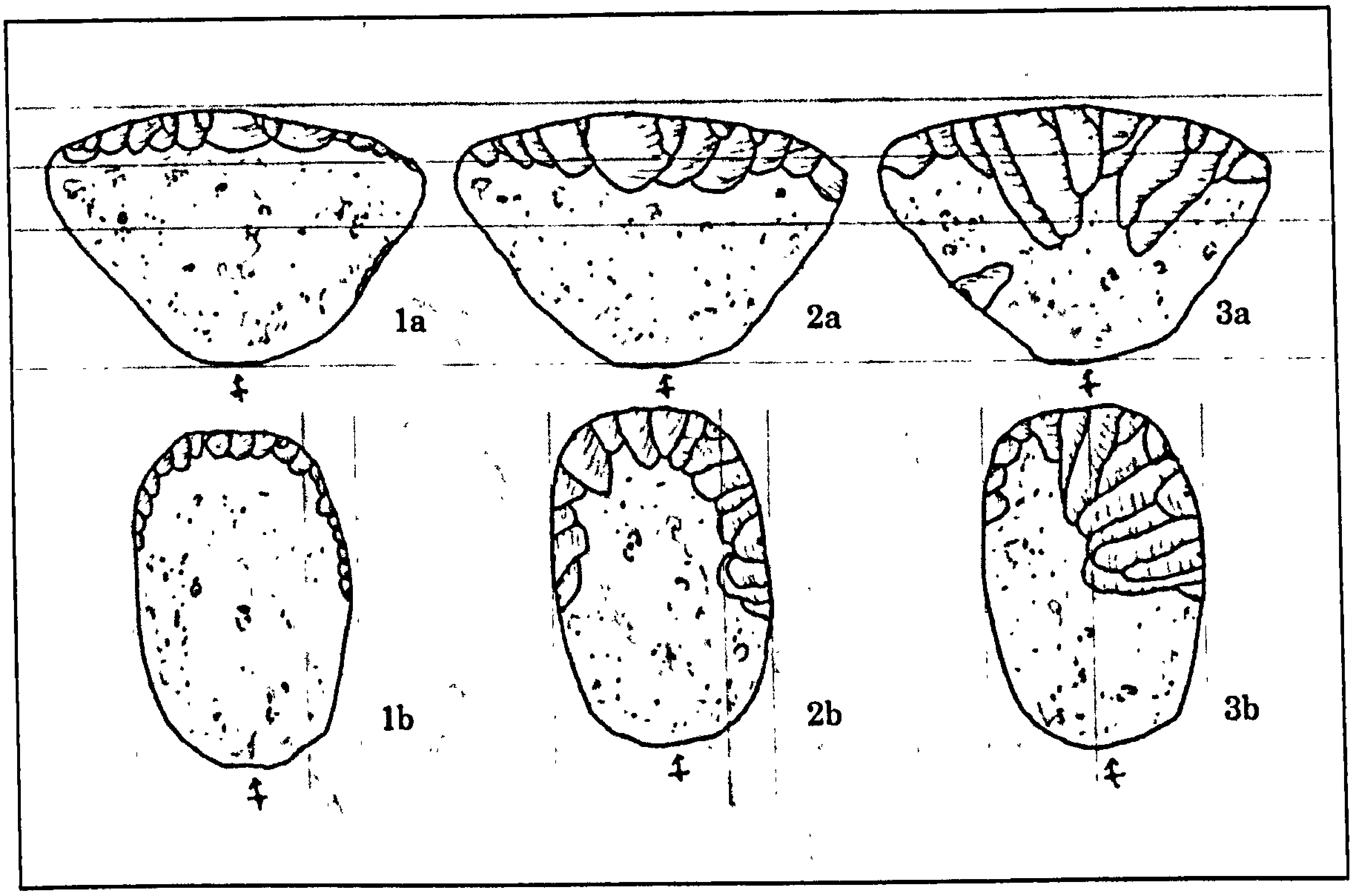


Fig.4.24 Degree of retouch.

1: Short, 2: Long, 3: Invasive.

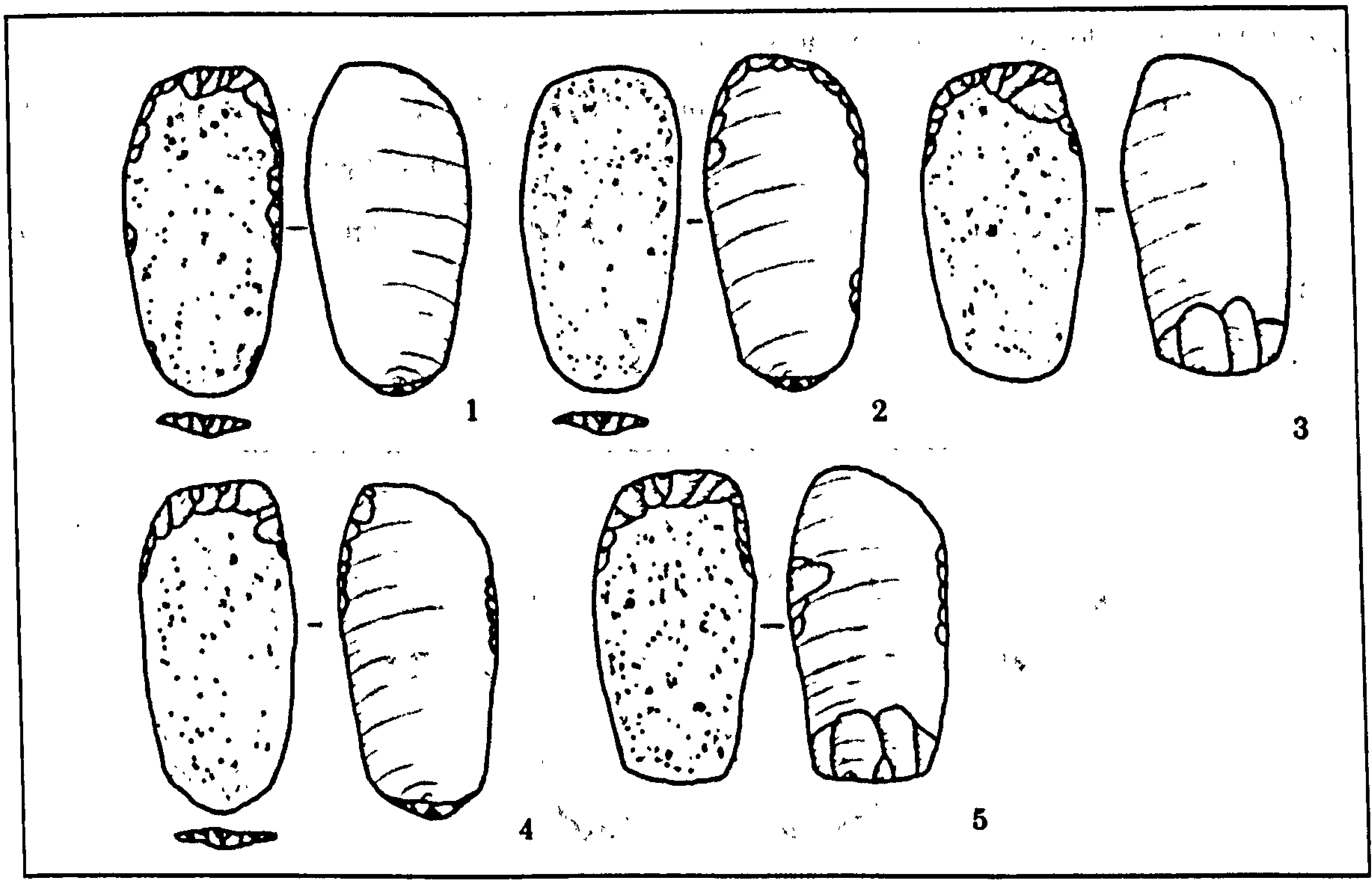


Fig.4.25 Position of retouch.

1: Dorsal retouch, 2: Ventral retouch, 3: Dorsal and ventral bulb thinning retouch, 4: Dorsal and ventral retouch, 5: Dorsal, ventral bulb thinning and ventral retouch.

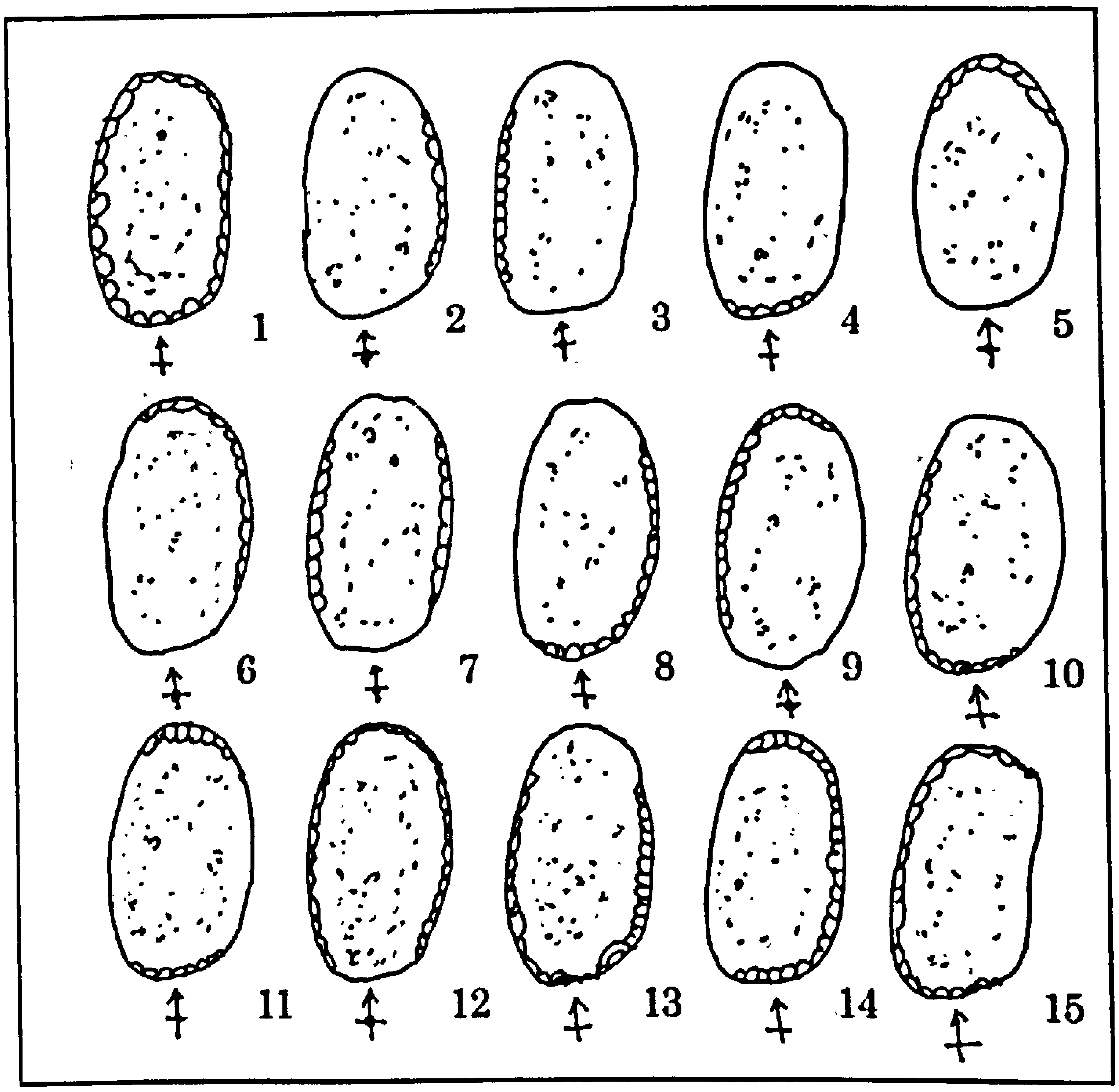


Fig.4.26.1 Retouch localization on the dorsal surface.

1: Round, 2: Right, 3: Left, 4: Distal, 5: Proximal, 6: Right and distal, 7: Right and left, 8: Right and proximal 9: Left and distal, 10: Left and proximal, 11: Distal and proximal, 12: Right, left and distal, 13: Right, left and proximal, 14: Right, distal and proximal, 15: Left, distal and proximal.

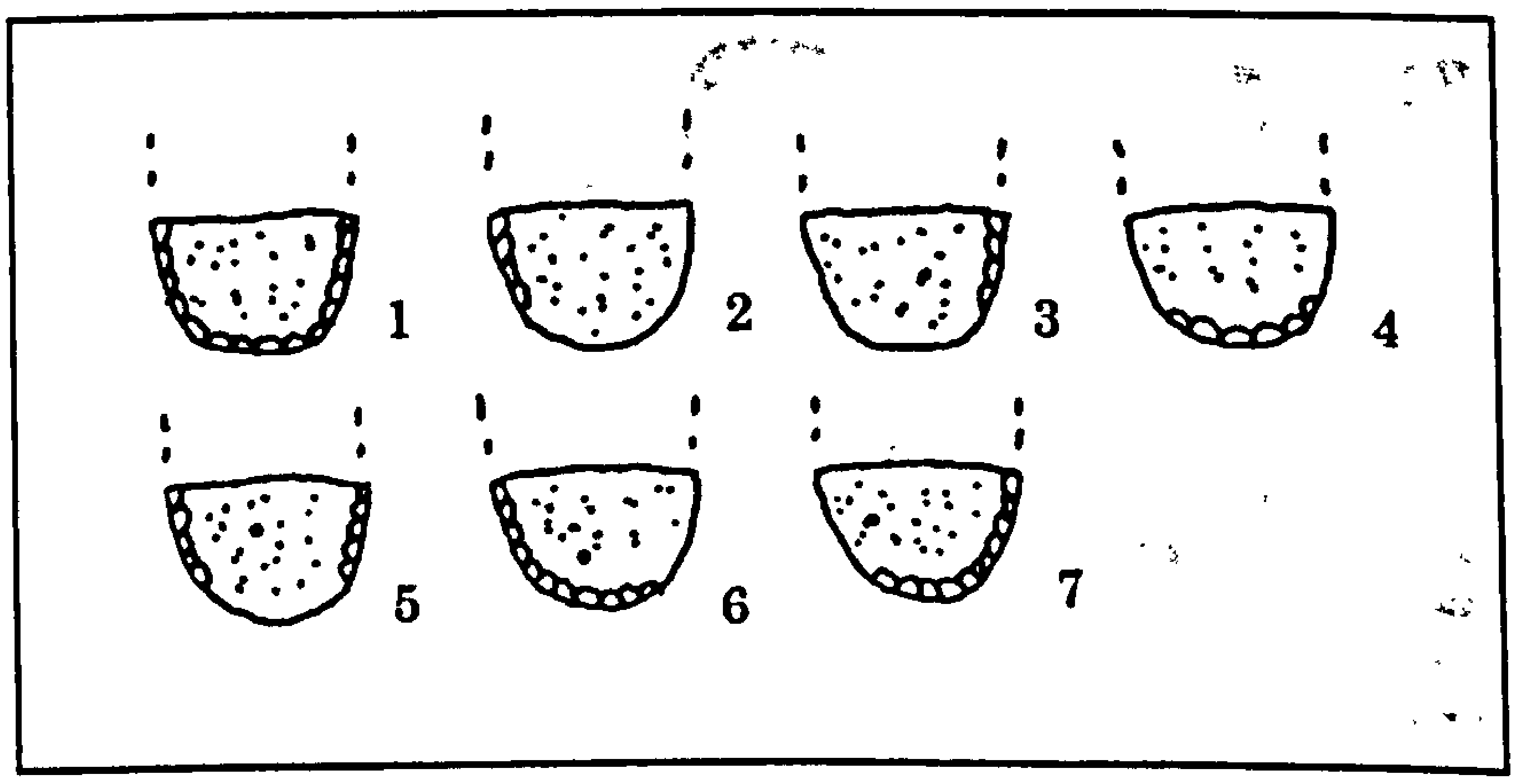


Fig.4.26.2 Retouch location on the dorsal surface of tabular scraper flake proximal fragments.

1: Left, right and proximal, 2: Left, 3: Right, 4: Proximal, 5: Left and right, 6: Left and proximal, 7: Right and proximal.

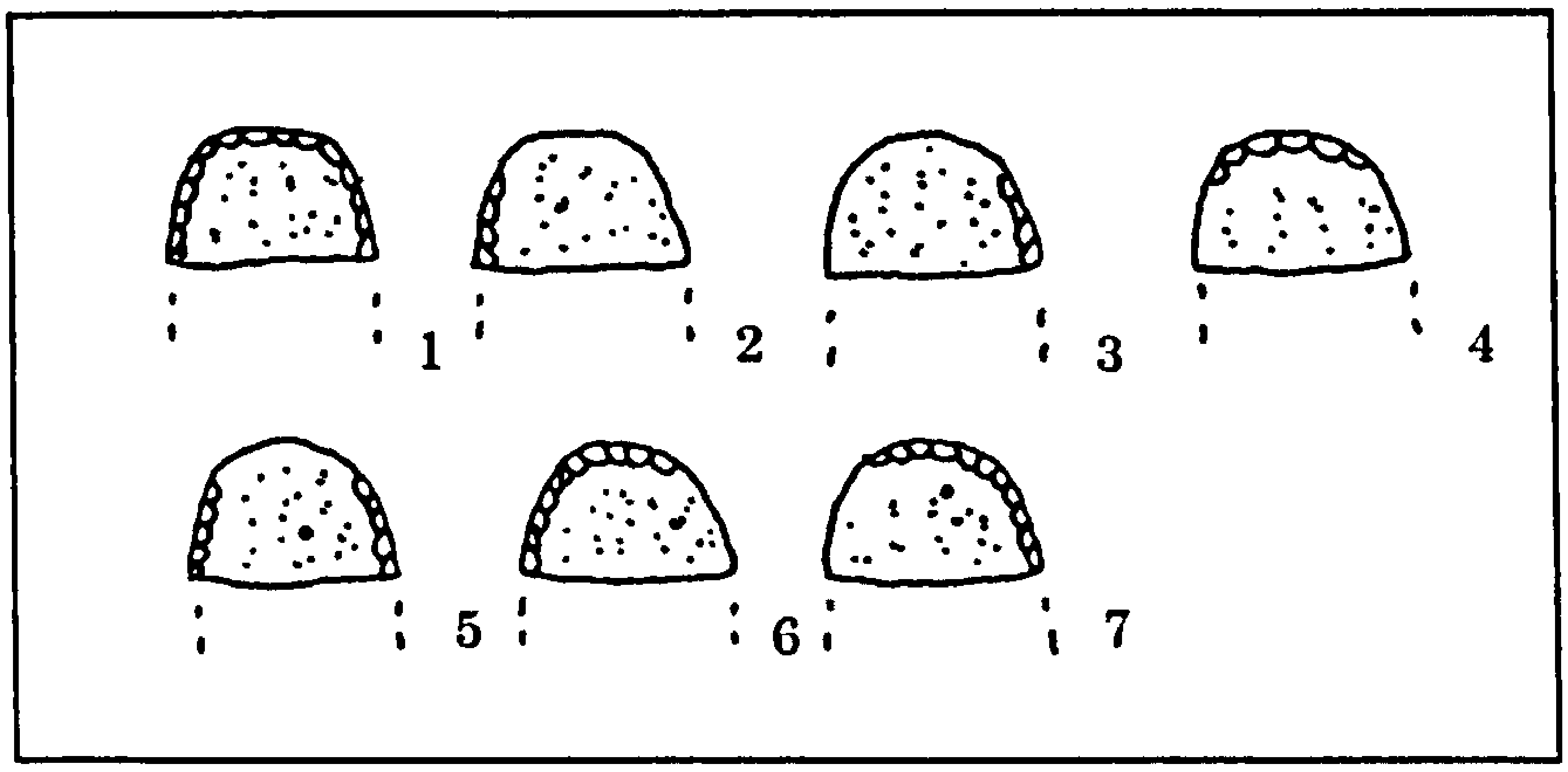


Fig.4.26.3 Retouch location on the dorsal surface of tabular scraper flake distal fragments. 1: Left, right and distal, 2: Left, 3: Right, 4: Distal, 5: Left and right, 6: Left and distal, 7: Right and distal.

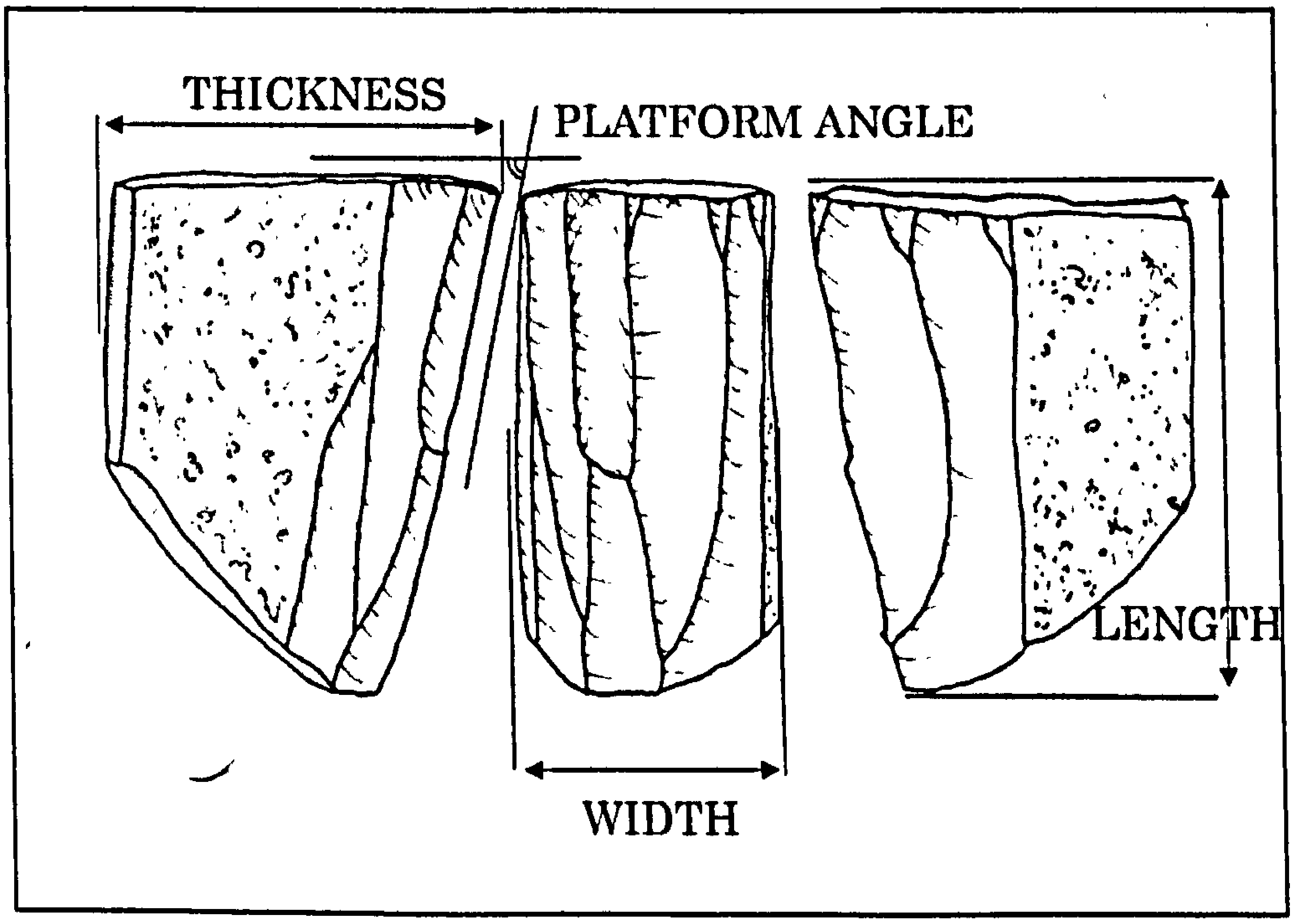


Fig.4.27 Measurements of Jafr blade cores.

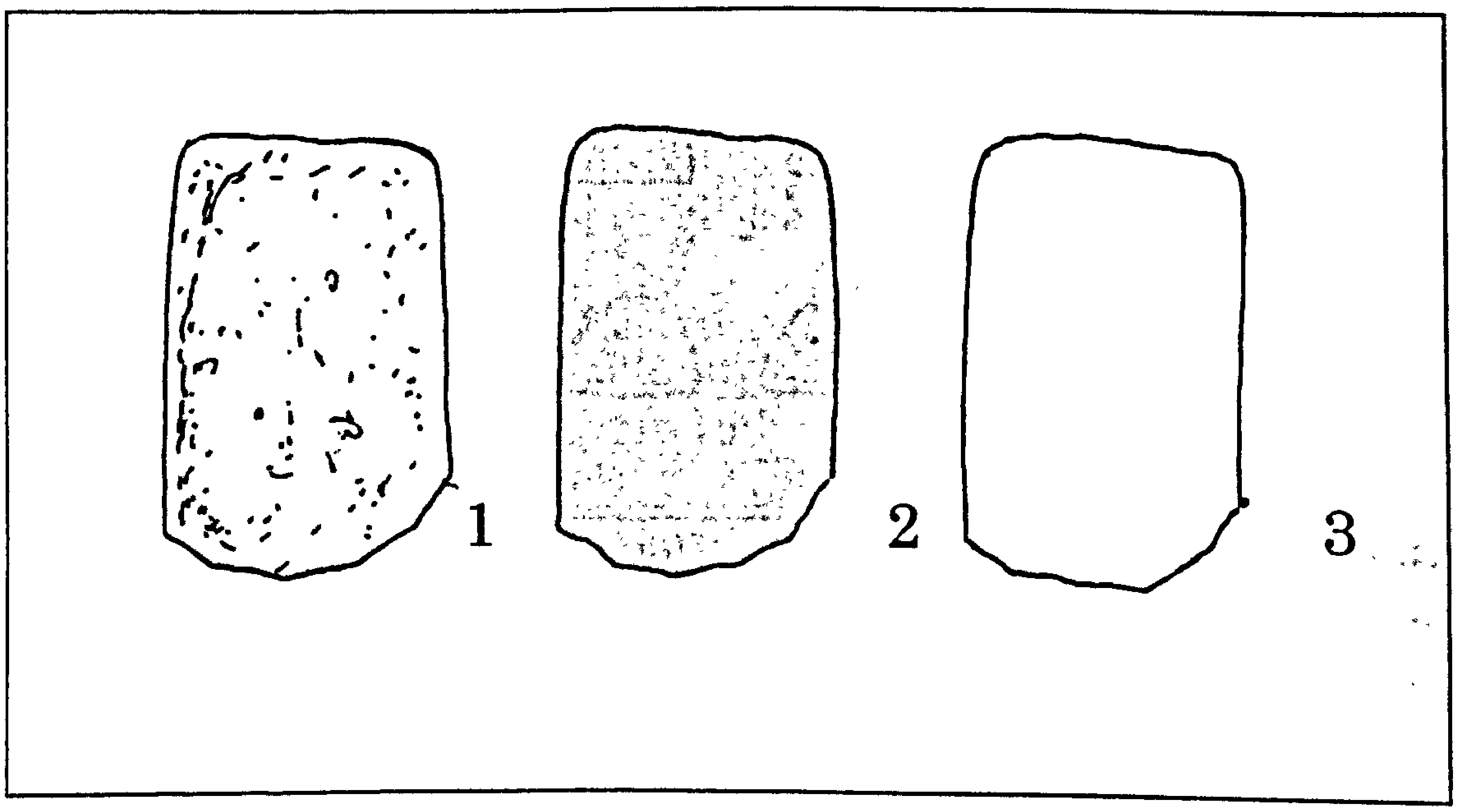


Fig.4.28 Platform type.

1: Cortex, 2: Weathered, 3: Plain.

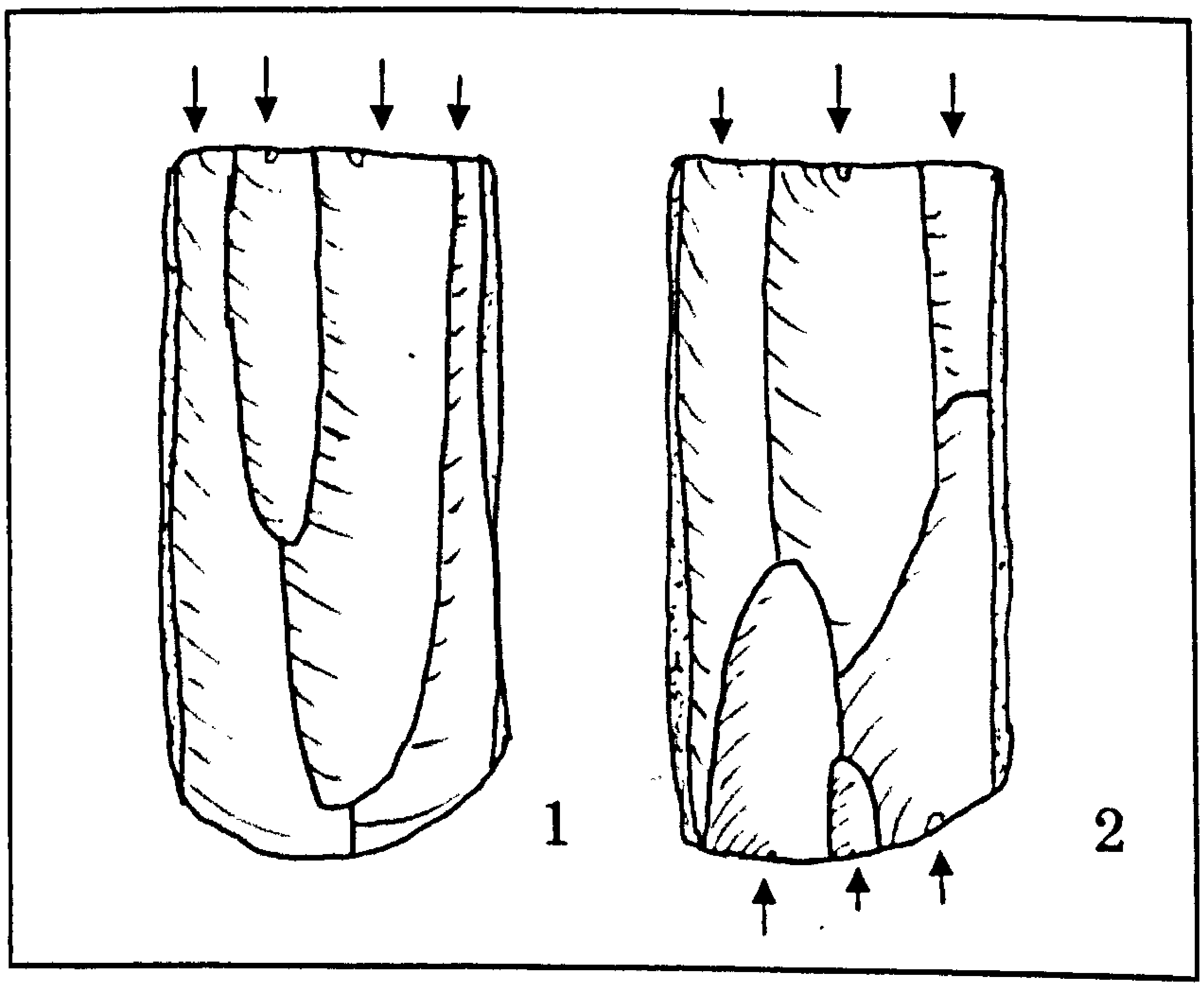


Fig.4.29 Scar pattern on the flaking surface.

1: Unidirectional, 2: Bidirectional.

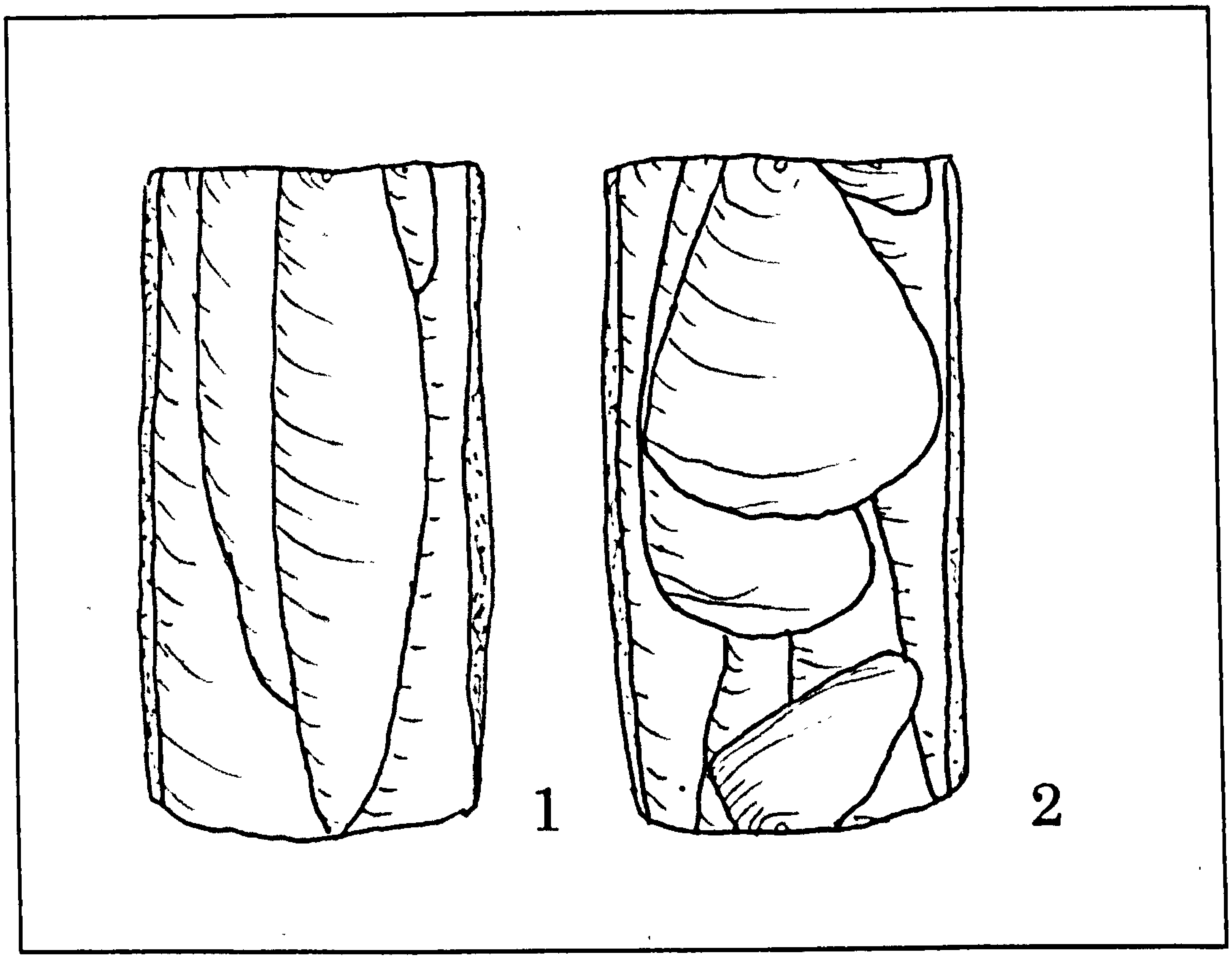


Fig.4.30 Shapes of scars. 1: Flake, 2: Blade.

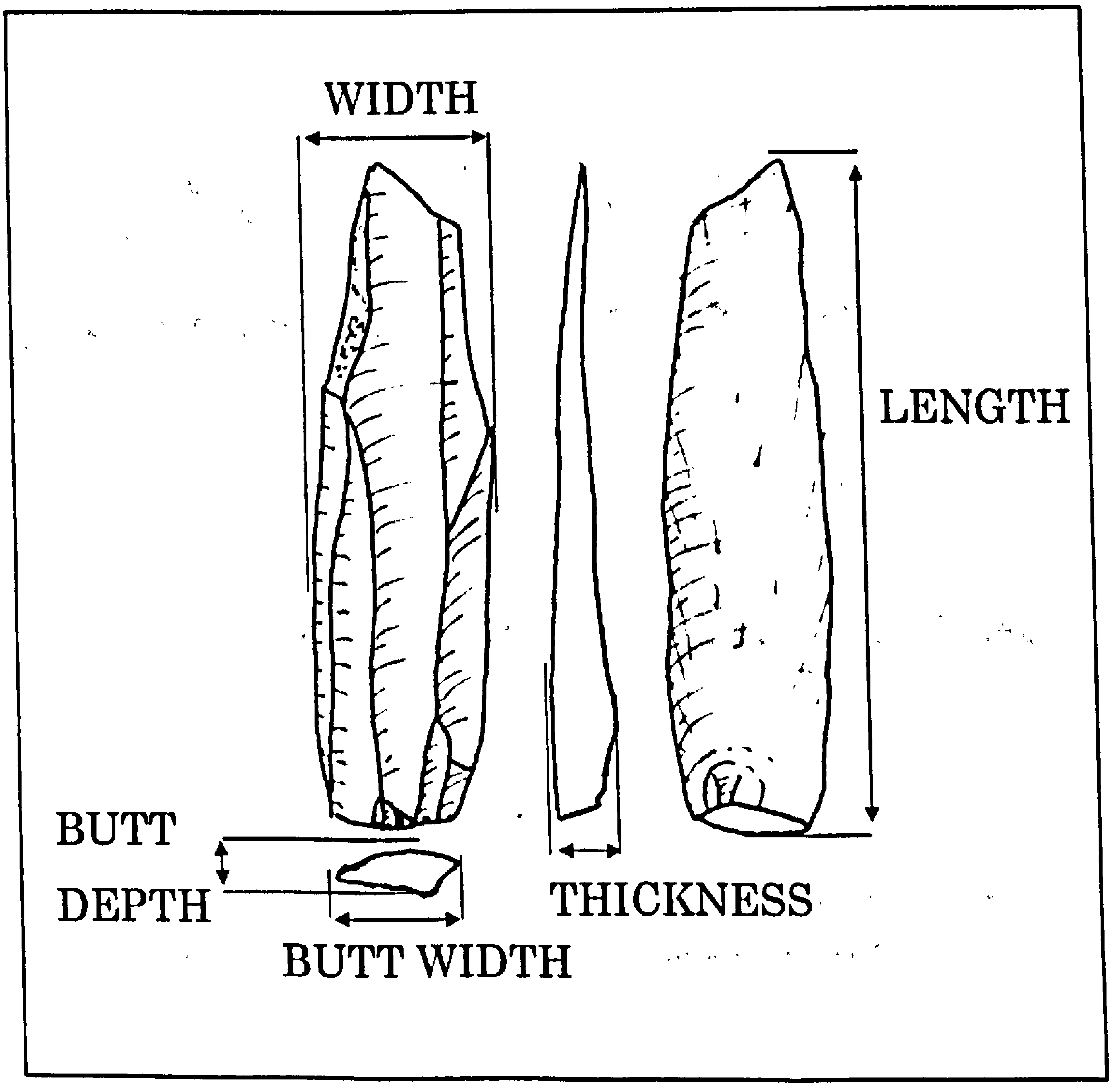


Fig.4.31 Measurements of Jafr blades.

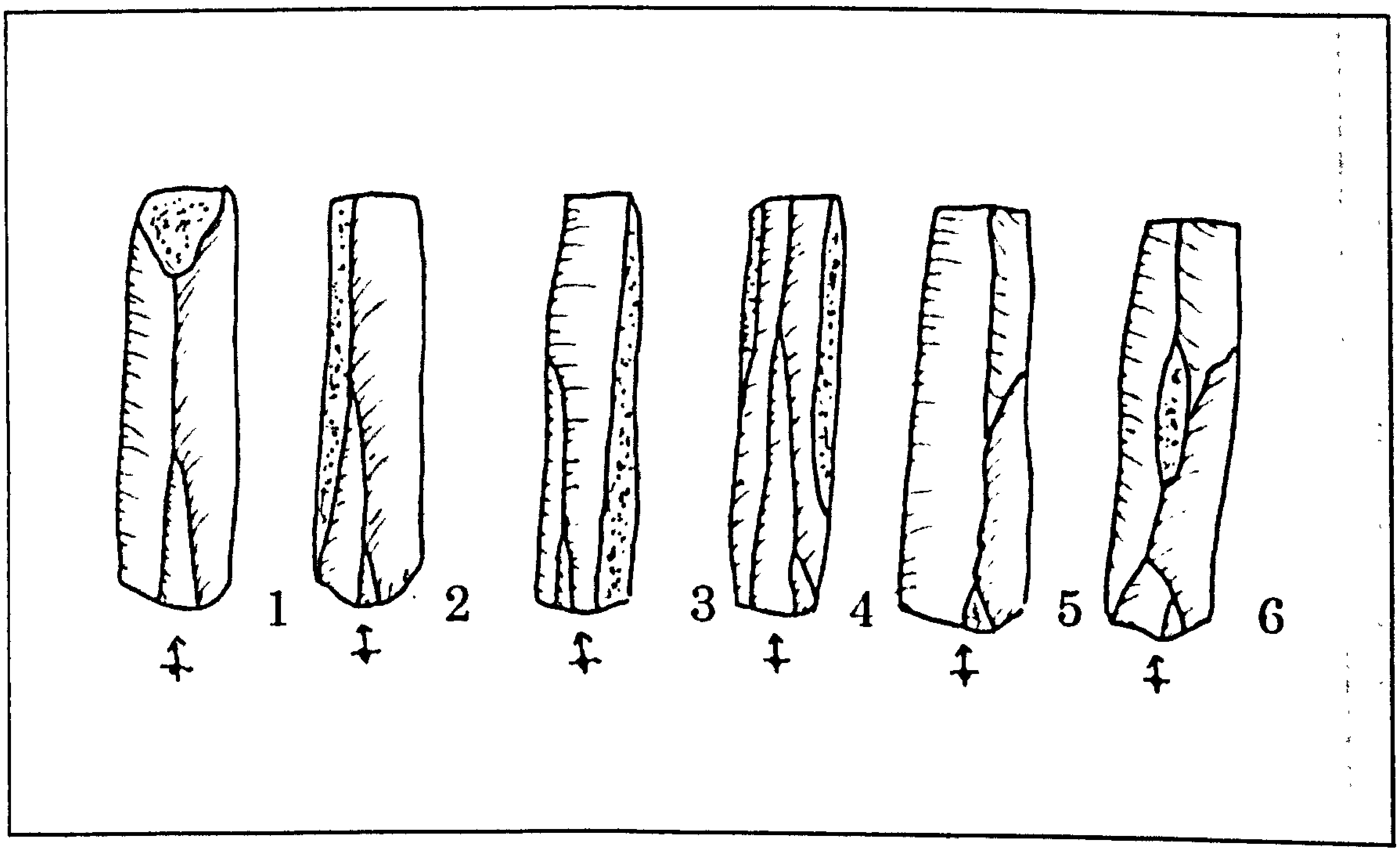


Fig.4.32 Position of cortex.

1: Distal end, 2: Left side, 3: Right side, 4: Both sides, 5: Proximal end, 6: Middle part.

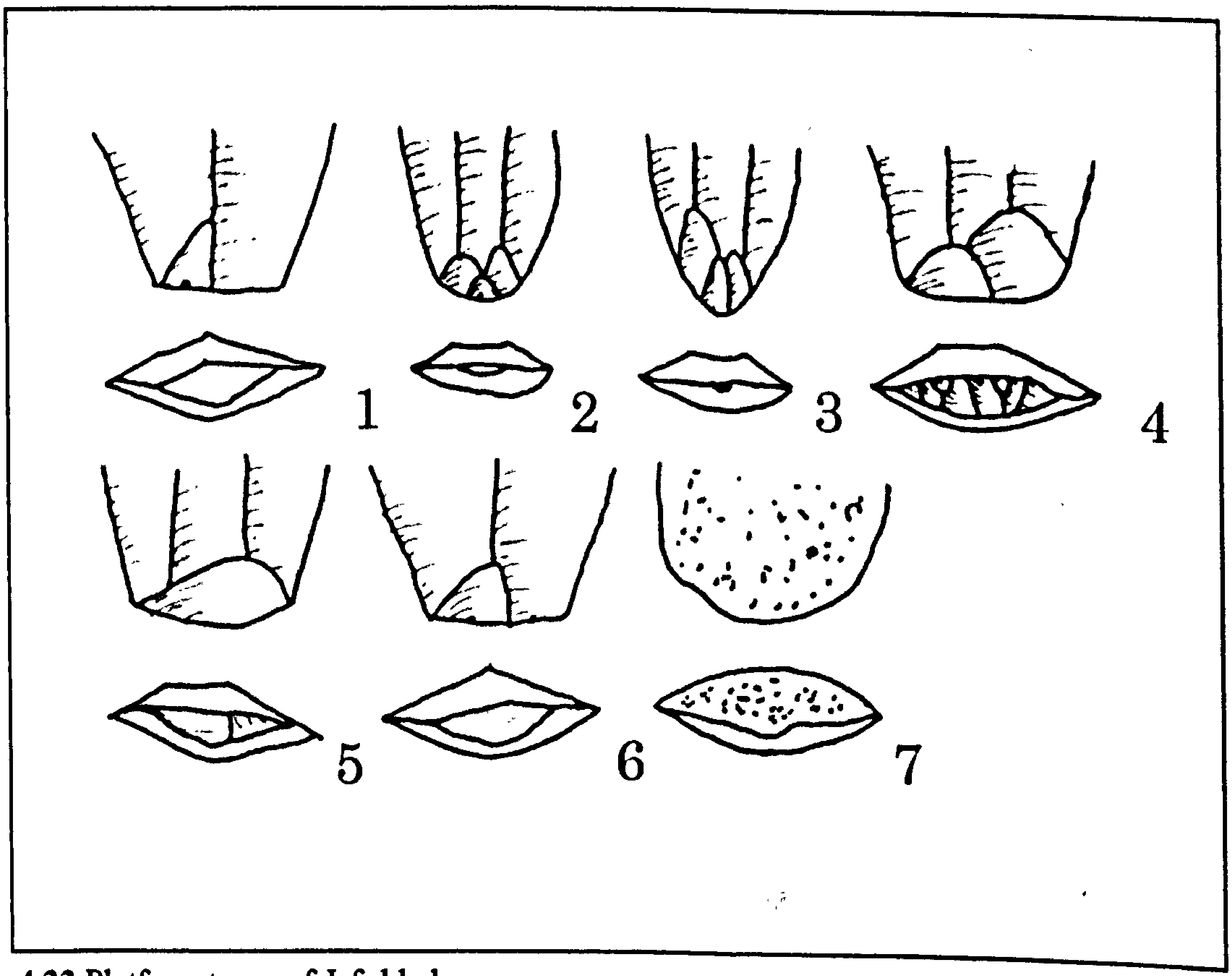


Fig.4.33 Platform types of Jafr blades.

1: Plain, 2: Thinned, 3: Small, 4: Faceted, 5: Dihedral, 6: Weathered, 7: Cortex.

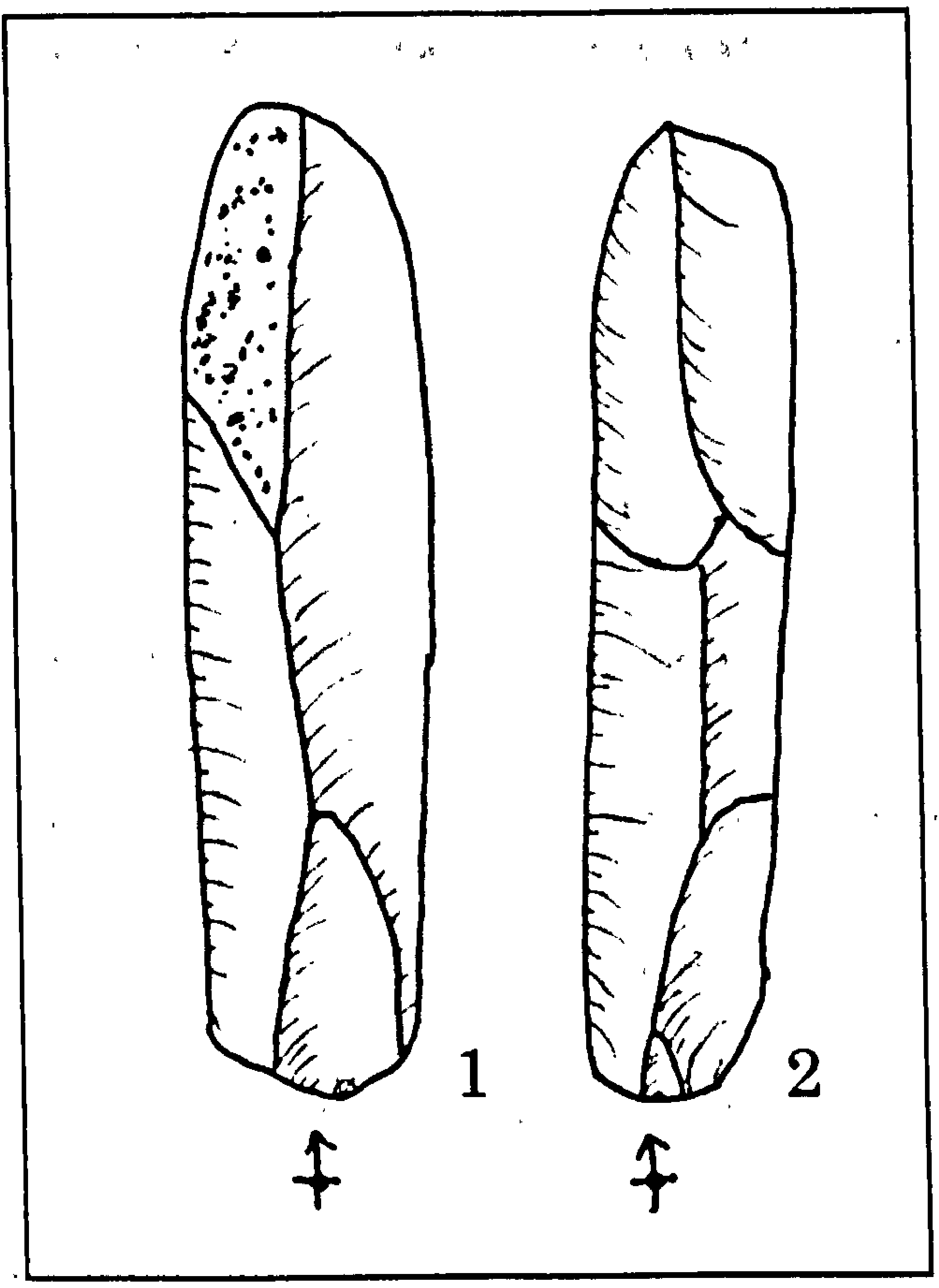


Fig.4.34 Scar pattern on the dorsal surface.
1: Unidirectional, 2: Bidirectional.

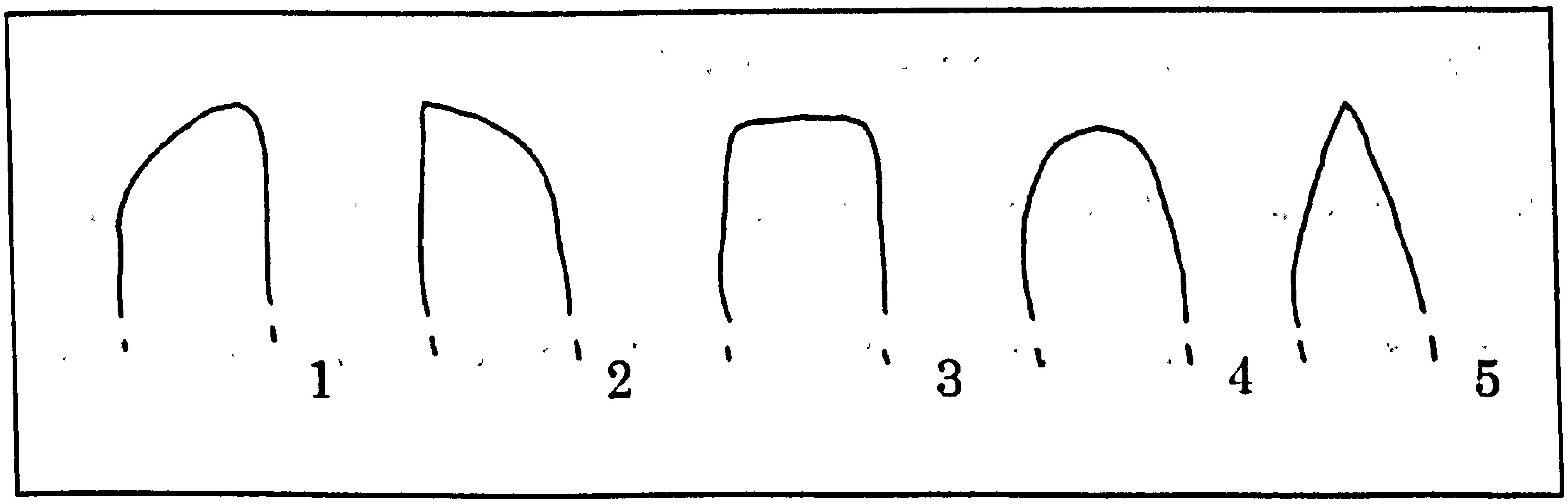


Fig.4.35 Distal Shape.
1: Asymmetrical to the right, 2: Asymmetrical to the left, 3: Symmetrical, square, 4: Symmetrical, round, 5: Symmetrical, pointed.

Chapter 5 ARCHAEOLOGICAL SURVEYS IN THE JAFR BASIN

5.1 INTRODUCTION

This chapter will present results of archaeological surveys in the Jafr Basin by Kanazawa University. Firstly modern geography and research history in the Jafr basin will be reviewed briefly. Secondly results of the surveys will be presented. In particular, the survey data concerning Chalcolithic and Early Bronze Age will be summarized. Lastly each Chalcolithic and Early Bronze Age site discovered by the surveys including pastoral nomadic camp sites, cairns and stone tool production sites of tabular scrapers and Jafr blades will be described in detail.

5.2 THE JAFR BASIN AND ARCHAEOLOGICAL RESEARCH

The Jafr Basin is the largest inland basin in Jordan. It covers about 15,000 k ㎡ area of the southern Transjordanian Plateau (Fig.5.1). The elevation of the basin is relatively high ranging from about 850 m in its centre to about 1200 m in its western fringe. Geographically, most parts of the basin are characterized by extensive flint pavement desert, *Hammada*. A number of wadis and playas are distributed throughout the basin (Fig.5.1, Fig.5.2). The largest playa, Qa al Jafr, is located in the centre of the basin and covers about 240 k ㎡ (Bender 1968, Fujii 1996, Fujii 2002b, Fujii and Abe in press, Quintero and Wilke 1998a, Quintero and Wilke 1998b, Quintero, Wilke and Rollefson 2002).

The natural environment in the basin is characterized by extreme aridity. Most of the basin belongs to the Saharo-Arabian desert region. The mean annual precipitation is less than 100 mm and permanent water sources (wells and springs) are limited in number in the basin (Fig.5.1). Al Jafr Oasis is one of the precious permanent water sources. Vegetation is very scarce and only a few shrubs are distributed around wadis and playa lakes. The summer in the basin is characterized by extreme heat and aridity while the winter is characterized by cold and meagre rainfall. The aridity of the basin almost precludes the possibility of stable cultivation without irrigation systems. Therefore with the exception of a few traditional settlements such as Maan, the basin has traditionally been occupied by pastoral nomads, *Bedouins*, especially for winter grazing (Bender 1968, Fujii 1996, Fujii 2002b, Fujii and Abe in press, Quintero and Wilke 1998a, Quintero and Wilke 1998b, Quintero, Wilke and Rollefson 2002).

The Transjordanian Mountains lie to the west of the Jafr Basin. The mountains are generally higher than 1200 m and receive over 200 mm annual precipitation (Fig.5.1). The area is also rich in permanent water sources. Therefore sedentary farming settlements have traditionally existed in the area (Bender 1968, Fujii 1996, Fujii 2002b, Fujii and Abe in press, Quintero and Wilke 1998a, Quintero and Wilke 1998b, Quintero, Wilke and Rollefson 2002).

According to local *Bedouins*, they have traditionally followed east-west seasonal movements between the Jafr Basin and western Transjordanian Mountains although their migration pattern is variable (Fig.5.1).

Local *Bedouins* explained to the author that they usually stay in the fringe of the western mountains in the arid/summer seasons, which span from March to October. In summers, the Jafr Basin has neither pasture nor water pools for flocks. Furthermore the basin is too arid to remain there. In contrast, the western mountains are cool and still rich in water sources and pasture even in summers. The pastoral nomads keep their animals on the fringe of agricultural fields or sometimes borrow the settled population's fields for feeding their animals on the stubble.

In the rainy/winter seasons, which span from October to February, they move down and stay in the Jafr Basin. Pasture and water pools, which appear in the rainy seasons, enable them to keep their flocks in the basin. In addition, the basin is characterized by mild winters. In contrast, the western mountains are very cold and sometime receive heavy snowfall.

In contrast with other arid areas such as the Negev, Sinai and East Jordan, the Jafr Basin had been sparsely investigated archaeologically. Before 1970, a few researchers had conducted archaeological surveys in the basin (Field 1960, Huckriede and Wiesemeann 1968, Rhotert 1938). After their research, the basin had been almost entirely ignored for a few decades.

However, in 1990's, archaeological research restarted. An American team led by L. A. Quintero and P. J. Wilke surveyed the northeastern part of the Jafr Basin in 1997 and 1999 (Quintero and Wilke 1998a, Quintero and Wike 1998b, Quintero, Wilke and Rollefson 2002). At the same time, a Japanese team also started their project in the northwestern part of the Jafr Basin.

The Japanese archaeological project started in 1995. The project is led by S. Fujii at Kanazawa

University (Abe 2002, Abe and Fujii 2004, Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002 c, Fujii 2003, Fujii 2004a, Fujii 2004b, Fujii 2005a, Fujii 2005b, Fujii 2006a, Fujii 2006b, Fujii and Abe in press). The project is named 'the Jafr Basin Prehistoric Project'. The main aim of the project is to reveal the origins and developments of pastoral nomads in the area. The project has conducted a number of excavations at a variety of sites from the Epi-Paleolithic to the Historical Age. The project is still going on. The author has been a member of the project since 2001.

A series of archaeological surveys have been conducted along with several excavations as a part of the project (Abe and Fujii 2004, Fujii 1996, Fujii 2002b, Fujii and Abe in press). The surveys focused mainly on the northwestern part of the Jafr Basin (Fig.5.1, Fig.5.2, Fig.8.1). The northwestern part receives slightly higher mean annual precipitation than other parts of the basin although it receives less than 100 mm mean annual precipitation (Fig.5.1). Therefore more archaeological sites are present in the northwestern part than in other parts of the basin. In addition, the Eocene bedrock, Umm Rijam Formation, is extensively exposed in the northwestern part of the basin (Fig.8.1). This formation yields high quality Eocene flint (Fig.8.1) (Rech, Quintero, Wilke and Winer 2007).

The first preliminary survey was conducted in 1995 to identify one site to excavate in the following seasons (Fujii 1996). As a result, Qa Abu Tulayha (JF9503), a large tabular scraper production site with flint mines, was discovered. The site was intensively excavated from 1997 to 2002. Short low intensity surveys were conducted in 1997, 1998 and 2000 during intervals between the excavations. Each of these surveys spanned only several days. In the winter 2001-2002 and summer 2002, large scale surveys were conducted over a few weeks in total. Most of the sites were recorded in these two seasons (Abe and Fujii 2004, Fujii 2002b, Fujii and Abe in press). 4 members took part in the survey in the winter 2001-2002 while 6 members took part in the survey in the summer 2002.

The total surveyed area covers about 2500 k m^2 area of the north western Jafr Basin (Fig.5.1, Fig.5.2, Fig.8.1). However, the intensity of the surveys is very low and the methodology of the surveys was not systematic. Sites were prospected for by driving a Land Rover along tracks, major wadis and playas. The team also asked local *Bedouins* about archaeological sites. Once sites were discovered, the site was recorded using GPS. The survey team usually stayed at each site for about an hour to record the sites. Simple maps of sites were made and diagnostic artifacts were subject to random collection. The team was accompanied by local *Bedouins* during surveys. They taught us the local names of sites.

Some Chalcolithic and Early Bronze Age sites discovered by the surveys were excavated. As already mentioned, Qa Abu Tulayha (JF9503) was excavated from 1997 to 2002. Several Chalcolithic/Early Bronze Age cairns at JF0204, JF0206 and JF0208 were also excavated in 2003 and 2004 (Fujii 2004a, Fujii 2005a, Fujii 2005b).

The project is still in progress and the number of discovered sites was still increasing after the summer 2002. However this chapter will deal only with sites which were discovered before the end of the summer 2002 season.

5.3 RESULTS OF JAPANESE ARCHAEOLOGICAL SURVEYS IN THE JAFR BASIN

By the end of the summer 2002 season, a total of 60 sites had been recorded by the Japanese team in the northwestern part of the Jafr Basin (Fig.5.2, Fig.8.1). The sites cover from the Lower Palaeolithic sites to Islamic sites.

The most important discovery by these surveys was the high frequency of Chalcolithic/Early Bronze Age tabular scraper production sites. In total, 25 tabular scraper production sites were discovered (JF9503, JF9801, JF0101, JF0102, JF0103, JF0105, JF0106, JF0107, JF0109, JF0110, JF0124, JF0126, JF0151, JF0152, JF0153, JF0155, JF0211, JF0212, JF0209, JF0210, JF0213, JF0214, JF0215, JF0216 and JF0217). They are characterized by a large quantity of tabular scraper cores and debitage. They make up almost half of the recorded sites (Fig.5.2).

This high frequency of tabular scraper production sites was also recorded in the northeastern part of the Jafr Basin by the American team (Quintero and Wilke 1998, Quintero, Wilke and Rollefson 2002). They recorded 114 sites in total. Of the 114, 79 sites are Chalcolithic/Early Bronze Age tabular scraper production sites. These facts strongly suggest that a large stone tool production industry of tabular scrapers developed in the Jafr Basin in the Chalcolithic and Early

Bronze Age.

Tabular scrapers are scrapers/knives made on thin and flat cortical flakes (See Chapter 3). They were common tools in the Chalcolithic and Early Bronze Age in the Southern Levant. They were probably multi-purpose knives used for butchering, hide working, wool shearing and so on. Non-local high quality Eocene flint was used as their raw material while local flint was used as raw material for most other stone tools. In addition, most sites do not have any traces of tabular scraper production although they yield tabular scrapers. On the basis of these facts, S.A. Rosen suggested that tabular scrapers were produced by limited groups in restricted areas (S.A. Rosen 1997).

The discovery of a number of tabular scraper production sites in the Jafr Basin strongly supports Rosen's idea. The Jafr Basin was probably one of the major sources of tabular scrapers in the Southern Levant. In fact, the basin is one of the best and biggest Eocene flint sources in the Southern Levant (Fig.8.1). Other tabular scraper production sources are also known in the Sinai, Negev and East Jordan although they were reported only briefly (Baird 2001a, Carter 2001, S.A. Rosen 1997, Wasse and Rollefson 2005).

In this thesis, the author divides tabular scraper production sites in the Jafr Basin into two types according to presence of flint mining. The author denominates tabular scraper production sites with flint mining 'Qa Abu Tulayha type' and tabular scraper production sites without flint mining 'Gurta Siyyata type'.

The 'Qa Abu Tulayha type' includes 6 sites: JF9503, JF0211, JF0212, JF0215, JF0216 and JF0217. The 'Gurta Siyyata type' includes 19 sites: JF9801, JF0101, JF0102, JF0103, JF0105, JF0106, JF0107, JF0109, JF0110, JF0124, JF0126, JF0151, JF0152, JF0153, JF0155, JF0209, JF0210, JF0213 and JF0214.

Qa Abu Tulayha type sites and Gurta Siyyata type sites are totally different in several points such as presence or absence of flint mining, site location, the nature of utilised raw material, intensiveness of tabular scraper production, final products and so on. This chapter will give only a brief explanation of these differences. Chapter 6, 7, 8 and 9 will discuss these differences in detail.

Qa Abu Tulayha type sites are tabular scraper production sites with flint mining. They are usually located in flat terrain. Their size ranges from 2.3 ha to 0.15 ha. Remains of intensively exploited flint mines with mining trenches and pits were discovered at every Qa Abu Tulyha type sites. Mining trenches and pits are visible even without excavations. They were usually filled with white silt (Fig.5.39, Fig.5.42, Fig.5.47, Fig.5.52). Large and fresh flint nodules, which are usually bigger than the size of a human head, were intensively mined. At JF0212, the largest Qa Abu Tulayha type site, a flint mining trench whose length is over 700m was discovered (Fig.5,40). It is estimated that as many as 410 tons of flint nodules were mined from that trench. Even at the smallest Qa Abu Tulayha type site, JF0216, 60 tons of flint nodules were probably extracted (Fig.5,49) (These values were calculated on the basis of excavations at Qa Abu

Tulayha. See Chapter 6). Great efforts were made to acquire the raw material at Qa Abu Tulayha type sites.

At Qa Abu Tulayha type sites, tabular scraper cores and debitage are scattered densely around the trenches/pits (Fig.5.38, Fig.5.39, Fig.5.41, Fig.5.42, Fig.5.43, Fig.5.47, Fig.5.48, Fig.5.50, Fig.5.52). Heaps of limestone and chalk were also often discovered. They were probably mined along with the flint nodules and discarded around the trenches and pits (Fig.5.39).

The density of tabular scraper cores at Qa Abu Tulayha type sites is extremely high. There are 10 tabular scraper cores per 1 m^2 in core reduction areas on average (See Chapter 6). Tabular scraper cores usually form circular clusters. About 30 tabular scraper cores form each cluster. The size of clusters is about 3 m in diameter and some clusters are annular. It is likely that a flint knapper sat down and detached tabular scraper blanks in such locations discarding cores to form a cluster. One cluster was probably created in one work episode by one knapper.

At the largest Qa Abu Tulayha type site, JF0212, there are about 13600 tabular scraper cores. The site probably yielded about 33000 tabular scraper blanks. Even at the smallest site, JF0216, there are 2000 tabular scraper cores and about 4800 tabular scraper blanks were produced (These values were calculated on the basis of excavations at Qa Abu Tulayha. See Chapter 6).

Large end struck oval/elongated tabular scrapers were the main products at Qa Abu Tulayha type sites. Their size is about 15 cm in length and 10 cm in width on average. To produce a reasonable quantity of such large and long tabular scrapers, extracted large flint nodules were necessary (Fig.5.59, Fig.5.60, Fig.5.61).

Gurta Siyyata type sites are tabular scraper production sites using small flint blocks collected on the surface instead of mined flint nodules. No flint mining pits or trenches are found at Gurta Siyyata type sites. Only limited efforts were made to acquire the raw material. The sites are generally located in geologically dissected environments such as the escarpments of tablelands, slopes of hills and valley walls, where Eocene flint beds are exposed. The flint beds were naturally shattered into small flint blocks. These small flint blocks cover the surface. The size of the blocks is slightly bigger than fist size. The flint blocks on the surface were used for tabular scraper production (Fig.5.53, Fig.5.54, Fig.5.55, Fig.5.56, Fig.5.57, Fig.5.58).

Gurta Siyyata type tabular scraper production sites vary in size. The largest site is 25 ha and smallest site is only 0.2 ha. At the sites, tabular scraper cores are spread very thinly. The density of tabular scraper cores and debitage is extremely low. There are usually less than 0.5 cores per 1 m². The cores rarely form core clusters (See Chapter 7).

About 125000 tabular scraper cores are present at the largest site while there are 1000 tabular scraper cores at the smallest site (These values were calculated on the basis of excavations at JF0106 and JF0153. See Chapter 7).

Small side struck fan shaped tabular scrapers were the main products at Gurta Siyyata type sites (Fig.5.53, Fig.5.54, Fig.5.55, Fig.5.56, Fig.5.57, Fig.5.58). Their size is about 7 cm in length ×9 cm in width on average. Large and long tabular scrapers can not be produced from small flint blocks on the surface.

To make these differences clearer, several tabular scraper production sites will be studied in detail in Chapter 6 and Chapter 7. As the sample of Qa Abu Tulayha type sites, the site of Qa Abu Tulayha (JF9503) and its stone tool artifacts will be analyzed in Chapter 6. The site was intensively excavated from 1997 to 2002 (Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002 c, Fujii 2003). As examples of Gurta Siyyata type sites, JF0106 and JF 0153 and stone tool artifacts from Gurta Siyyata type sites will be analyzed in Chapter 7.

Along with tabular scraper production, a large number of Jafr blades were also produced in the basin. A number of Jafr blades and Jafr blade cores are also scattered at most of the tabular scraper production sites (Table.10.1). At least, 20 of 25 tabular scraper production sites include Jafr blade production loci.

In particular, Jafr blade production was more common at Gurta Siyyata type tabular scraper production sites. The largest Gurta Siyyata type site probably yielded 25000 Jafr blade cores. Even the smallest Gurta Siyyata type site yielded 200 Jafr blade cores (These values were calculated on the basis of excavations at JF0106 and JF0153. See Chapter 10). In contrast, Jafr blade cores are extremely rare at Qa Abu Tulayha type sites.

Jafr blades are large non-prismatic blades (Fig.5.63). They are characterized by large plain or natural flat weathered platforms, uni-directional scars on dorsal surfaces, non-prismatic configurations, and large size. The average width of the blades is about 3 cm. Some blades are over 15 cm in length. The blades used to be dated mistakenly to the Palaeolithic. But now they are securely dated to the Chalcolithic/Early Bronze Age on the basis of excavations at Qa Abu Tulayha (Abe 2002, Fujii 1999, Fujii 2000, Fujii 2002a) (See Chapter 10). Small tabular flint blocks collected on the surface were used as raw material. Jafr blade production is very simple and took advantage of the original tabular forms of flint blocks. The production does not include any complicated or careful knapping processes. The main desired products of Jafr blade production were blades knapped from the central parts of the cores.

The Jafr blades were probably exported outside the Jafr Basin with tabular scrapers. Some blades excavated at some EB sedentary settlements in the Southern Jordan resemble Jafr blades in texture and techno-typology. The Jafr blade production in the Jafr Basin will be discussed in detail in Chapter 10.

Excepting a number of tabular scraper and Jafr blade production sites, only a few Chalcolithic/Early Bronze Age sites were found in the Jafr Basin. They include cairn fields (JF0204, JF0206, JF0208) and habitation sites (JF9701, JF9706, JF9801).

Every cairn field was excavated and securely dated to the Chalcolithic/Early Bronze Age (Fujii 2004a, Fujii 2005a, Fujii 2005b). These cairn fields consist of a few dozen cairns (Fig.5.30, Fig.5.31, Fig.5.32). Cairns at JF0204 and JF0206 usually consist of a mound and attached rectangular courtyard (Fig.4.30, Fig.4.31). The mound cover a round cist in the centre and rectangular structure attached to them. Cairns at JF0204 and JF0208 yielded no human bones. These cairns yielded EB I pottery which are very similar to pottery excavated from EB I sites such as Hujayrat al Ghuazlan, Tall al Magass and Wadi Faynan 100 (Khalil, Eichmann and Schmidt 2003, Wright, Najjar, Last, Moloney, Flender, Gower, Jackson, Kennedy and Shafiq 1998).

Cairns at JF0208 have cists in their centre and upright stone walls enclose the cists. Large cobbles cover the cists and enclosures (Fig.4.32). Excavations revealed that these cairns contain secondary multiple burials. Carins yielded several large oval/elongated tabular scrapers. The cairn field, JF0208 is noteworthy because the site is prominent in the landscape.

Habitation sites are usually characterized by several enclosures and small rooms attached to them (Fig.5.3, Fig.5.4, Fig.5.5, Fig.5.7). Enclosures are usually round and over 10 m in diameter. They were constructed of medium and large fieldstones standing several courses high. Given that similar structures are used as animal pens by modern pastoral nomads, the enclosures were probably animal pens. Small rooms are usually about 5 m in diameter and were probably dwellings. At these sites, sediments are very shallow and limited number of artifacts are scattered. Although excavations were not conducted at these sites, these facts strongly suggest that these habitation sites were probably small seasonal pastoral nomadic camp sites. They were probably occupied for days, weeks or months, sometimes repeatedly rather than years like Mediterranean villages. These sites are usually located near wadis that provide good pasture in winter seasons. These sites are dated to the Chalcolithic and Early Bronze Age because a few tabular scraper fragments were collected at these sites.

No Chalcolithic/Early Bronze Age sedentary farming settlements were discovered by the surveys. It suggests that the Jafr Basin was probably occupied by pastoral nomads during the Chalcolithic and Early Bronze Age like the modern situation although past climate studies show that the climate in the Chalcolithic and Early Bronze Age was generally wetter than today (A. M. Rosen 1989, A. M. Rosen 1995, A.M. Rosen 2003, A.M. Rosen 2007, See Chapter 2).

5.4 DESCRIPTION OF CHALCOLITHIC AND EARLY BRONZE AGE SITES DISCOVERED BY SURVEYS

5.4.1. Sites discovered in the Season of 1995

Site JF9503 (See Chapter 6)

Name: Qa Abu Tulayha.

Location: On a low hill between Qa Abu Tulayha and Wadi ar-Ruwayshid.

Latitude and longitude: N30°27'590", E35°56'570".

Elevation: 980 m.

Site size: Unknown.

Main periods: Late Neolithic, Early Bronze Age.

Site character: Funerary complex (Late Neolithic), Tabular scraper (Qa Abu Tulayha type) and

Jafr blades production site (Early Bronze Age) (Qa Abu Tulayha type tabular scraper production sites can be dated to the Early Bronze Age while Gurta Siyyata type sites can be dated to the Chalcolithic and Early Bronze Age. See Chapter 9).

Estimated weight of mined flint nodules at the site: 350 tons.

Estimated number of tabular scraper cores at the site: 14000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: A handful of Jafr blade cores.

Description: The site of Qa Abu Tulayha is situated on a small flat hill between Qa Abu Tulayha and Wadi ar Ruwayshid. Chapter 6 will give a more detailed description about the site. This section will give only a brief introduction. The site was discovered in 1995 and excavated intensively from 1997 to 2002 by S. Fujii at Kanazawa University (Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002 c, Fujii 2003). During the Early Bronze Age, tabular scrapers were intensively produced at the site. The site is one of the largest tabular scraper production sites with flint mining in the Jafr Basin. The site comprises several flint mines and round strucrures. It is estimated that about 350 tons of flint nodules were mined in total at the site (See Chapter 6). Jafr blades were also produced along with tabular scrapers. But the scale of the production is much smaller than tabular scraper production (See Chapter 10). Furthermore the site was also utilized in the Late Neolithic. The Late Neolithic occupation has no relationship with tabular scraper and Jafr blade production. During the Late Neolithic, a series of rectangular structures were constructed (See Chapter 6).

The structures have cairns on their southeast. The size of the rectangular structures is about 8 m by 7 m and the diameter of cairns is about 2m. These rectangular structures run in a line. S. Fujii interpreted the rectangular structures as funerary buildings accompanying cairn burials although no cairns yielded human bones.

5.4.2. Sites discovered in the season of 1997

Site JF9701 (Fig.5.3, Fig.5.4)

Name: Wadi Abu Hathaneh.

Location: On the northern and southern banks of Wadi Abu Hathaneh.

Latitude and longitude: N30°31'684", E35°51'322".

Elevation: 1037 m.

Site size: Unknown.

Main periods: Chalcolithic/Early Bronze Age.

Site character: Pastoral nomadic camp.

Description: Several circular enclosures were discovered on the northern and southern banks of Wadi Abu Hathaneh (Fig.5.3). The enclosures are usually over 10m in diameter (Fig.5.4). The enclosures were probably animal pens for flocks. Some tabular scraper fragments and coarse pottery shards were collected inside some of the enclosures. The enclosures can be dated to the Chalcolithic/Early Bronze Age on the basis of tabular scrapers although the pottery shards are not diagnostic.

Site JF9706 (Fig.5.5, Fig.5.6)

Name: Unknown.

Location: On a low hill between Qa Abu Tulayha and Wadi ar-Ruwayshid.

Latitude and Longitude: N30°27'777", E35°56'993".

Elevation: 1004 m.

Site size: 0.02 ha.

Main periods: The Chalcolithic/Early Bronze Age.

Site character: Pastoral nomadic camp.

Description: A large circular enclosure was found at the site (Fig.5.5). The diameter of the enclosure is about 15 m. A small round structure adjoins it on the west. The author assumes that the site was probably a pastoral nomadic camp site consisting of an animal pen and small room. A few tabular scrapers collected at the site hint that the structures can be dated to the Chalcolithic/Early Bronze Age. It is noteworthy that a few tabular scraper cores were also collected inside the enclosure (Fig.5.6). It suggests that tabular scraper production was also conducted on a very limited scale along with animal herding.

5.4.3. Sites discovered in the season of 1998

Site JF9801 (Fig.5.7)

Name: Wadi Ayriya.

Location: On the west bank of Wadi Ayriya.

Latitude and Longitude: N30°30'969", E36°02'458".

Elevation: 994 m.

Site size: 0.06 ha (pastoral nomadic camp site), 0.5 ha (stone tool production site).

Main period: Chalcolithic/Early Bronze Age.

Site character: Pastoral nomadic camp, Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 2500 tabular scraper cores.

Estimated number of Jafr blade cores: 500 Jafr blade cores.

Description: Three circular enclosures were discovered at the site (Fig.5.7). The diameter of the enclosures is about 15 m on average. They were probably animal pens. Two small round structures, which were probably used for dwellings, were attached to these enclosures. The diameter of the small round structures is about 5 m. The site was probably a pastoral nomadic camp site. A few tabular scrapers were collected at the structures. Therefore the structures can be dated to the Chalcolithic/Early Bronze Age. Although the structures are located near a tabular scraper/Jafr blade production area, they did not yield any traces of the stone tool production. The relationship between these structures and the stone tool production area are unclear. A tabular scraper/Jafr blade production area was discovered on a slope near the structures. Small flint blocks cover the slope. The size of the blocks was slightly larger than that of a human fist. Small side struck fan shaped tabular scrapers and Jafr blades were produced from the flint blocks collected on the surface. No flint mines were found at the site. Tabular scraper cores and Jafr blade cores are spread sparsely over an area of 100 m by 50 m on the slope. The density of the cores is very low. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that 2500 tabular scraper cores and 500 Jafr blade cores are present at the site.

5.4.4. Sites discovered in the winter 2001-2002

Site JF0101 (Fig.5.8, Fig.5.9, Fig.5.10, Fig.5.11, Fig.5.53:1-2, Fig.5.63:3)

Name: Unknown

Location: On the western slope of Jabal Umm Rijam.

Latitude and longitude: N30°40'021", E35°51'513".

Elevation: 1008 m.

Site size: 25 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 125000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: 25000 Jafr blade cores.

Description: The site is situated on the steep western slope of the tableland of Jabal Umm Rijam (Fig.5.8, Fig.5.9, Fig.5.10). Jabal Umm Rijam is a flat tableland situated in the northwestern corner of the survey area and to the southeast of the modern village of Jurf ed Darawish (Fig.5.2). The western slope is covered by small flint blocks, which were naturally broken off from exposed Eocene flint beds (Fig.5.10). The size of small flint blocks is usually slightly bigger than fist size. These small flint blocks on the surface were picked up and used as raw material for stone tool production. No flint mines were discovered. Small fan shaped tabular scrapers and Jafr blades were the main products at the site (Fig.5.11, Fig.5.53, Fig.5.63). Tabular scraper cores, Jafr blade cores and debitage are spread thinly over an area of about 550 m×450 m (Fig.5.9, Fig.5.10), but the density of cores is very low. Cores clusters were rarely found at the site. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that 125000 tabular scraper cores and 25000 Jafr blade cores are present at the site. A few limestone cairns were also discovered at the site. Their diameter is about 2 m. Their exact date is unknown in the absence of excavations. But it is likely that these cairns were not the Chalcolithic/Early Bronze Age cairns because they are different from the Chalcolithic/Early Bronze Age cairns at JF0204, JF0206 and JF0206 typologically.

Site JF0102 (Fig.5.12, Fig.5.13, Fig.5.53:3-4, Fig.5.54:1, Fig.5.62:1)

Name: Unknown.

Location: On the western slope of Jabal Umm Rijam.

Latitude and longitude: N30°39'264", E35°51'110".

Elevation: 1021 m.

Site size: 1.5 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 7500 tabular scraper cores

Estimated number of Jafr blade cores at the site: 1500 Jafr blade cores

Description: The site of JF0102 and JF0101 are situated on the same slope. JF0102 is about 700 m to the south of JF0101. As JF0101, the slope is covered by small natural flint blocks. Exposed flint beds were weathered and naturally shattered into the small flint blocks.The flint blocks on the surface were used for small fan shaped tabular scraper and Jafr blade production (Fig.5.53:3-4, Fig.5.54:1, Fig.5.62:1). No flint mines were discovered at the site. Tabular scraper cores, Jafr blade cores and debitage are spread sparsely over the area of 100 m by 150 m. The density of cores is very low. Cores rarely formed core clusters. On the basis of the date in JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that about 7500 tabular scraper cores and 1500 Jafr blade cores are probably scattered at the site. Six cairns were also discovered at the site (Fig.5.13). The size of cairns ranges from 3 m to 5 m. Cairns were built of limestone slabs. Most cairns were illegally excavated. The date of cairns is unknown because no artifacts were scattered around the cairns. However they are probably not Chalcolithic/Early Bronze Age cairns because they have no typological similarities with the Chalcolithic/Early Bronze Age cairns at JF0204, JF0206 and JF0206.

Site JF0103 (Fig.5.14, Fig.5.54:2, 4, Fig.5.63:5)

Name: Unknown.

Location: On the western slope of Jebel Umm Rijam.

Latitude and longitude: N30°36'824", E35°52'168".

Elevation: 1074 m.

Site size: Unknown.

Main period: Chalcolithic/Early Bronze Age.

Site Character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper core at the site: Unknown.

Estimated number of Jafr blade cores at the sites: Unknown.

Description: The site is also situated on the western slope of Jebel Umm Rijam. A few dozen cairns were found at the site. The size of cairns ranges from 1 m to 2 m (Fig.5.14). Some of them have been illegally excavated. Although their precise date is not clear, they cannot be dated to the Chalcolithic/Early Bronze Age because they have no typological similarities with the Chalcolithic/Early Bronze Age cairns at JF0204, JF0206 and JF0208. The cairns consist of several flat fieldstones. Several flat fieldstones were placed in a circular form and form a cairn. The site is also covered by small flint blocks. The size of the blocks is usually slightly larger than fist size. The flint blocks on the surface were used for stone tool production. Small side struck fan shaped tabular scrapers, and Jafr blades were the main products at the site (Fig.5.54:2,4, Fig.5,63:3). Tabular scraper cores, Jafr blade cores and associated debitage are spread thinly over the site. The exact size of the scatter is not clear. The density of cores is quite low. Core clusters were rarely found at the site.

Site JF0105 (Fig.5.15, Fig.5.16)

Name: Unknown.

Location: On a terrace of an unnamed hill.

Latitude and longitude: N30°32′418″, E35°55′477″.

Elevation: 1052 m.

Site size: 2.5 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 12500 tabular scraper cores

Estimated number of Jafr blade cores at the site: 2500 Jafr blade cores

Description: The site is on an unnamed low hill. The hill is paved by small flint blocks (Fig.5.15). The size of the blocks is slightly larger than fist size. In some places, flint beds are still exposed. The flint beds were weathered and naturally shattered into flint blocks. The blocks on the surface were selected as raw material for small side struck fan shaped tabular scraper and Jafr blade production. No flint mines were found at the site. Tabular scrapers cores, Jafr blades cores, and associated debitage are spread thinly over an area of 250 m×100 m. The density of the cores is very low. Core clusters were rarely observed at the site. On the basis of the data from JF0106 and JF0153, it is estimated that 12500 tabular scraper cores and 2500 Jafr blade cores are scattered thinly at the site.

Site JF0106 (See Chapter 7, Fig.5.54:3, Fig.5.55:1, Fig.5.62:2, 4)

Name: Unknown.

Location: On an unnamed low hill.

Latitude and longitude: N30°32'500", E35°55'746".

Elevation: 1063 m.

Site size: 1.5 ha.

Main periods: The Chalcolithic/Early Bronze Age, PPNB

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 7500 tabular scraper cores.

Estimated number of Jafr blade cores at the site: 1500 Jafr blade cores.

Description: The site is on an unnamed low hill. Four limestone cairns are situated on the top of the hill. Their diameter ranges from 1 m to 4 m. Their date is unknown. But these cairns are probably not Chalcolithic and Early Bronze Age cairns because they have no typological similarities with the Chalcolithic/Early Bronze Age cairns at JF0204, JF0206 and JF0206. The hill is covered with small flint blocks, which were broken from the Eocene flint beds (Fig.7.1-Fig.7.7). The chunks on the surface were picked up and used as raw material for tabular scraper and Jafr blade production. No flint mines were discovered at the site. Tabular scraper cores, Jafr blade cores and associated debitage are spread sparsely over an area of 150 m×100 m on the slope of the hill. The density of cores is very low. Core clusters are rarely found. It is estimated that 7500 tabular scraper cores and 1500 Jafr blade cores are scattered thinly at the site. The site was excavated in 2005. Chapter 7 will give more detailed site description. A production locus of PPNB Naviform blades was also found at the site. Naviform cores and associated debitage are spread densely over an area of 5 m×5 m.

Site JF0107 (Fig.5.17, Fig.5.18, Fig.5.55:2, Fig.5.56:2, Fig.5.62: 8, Fig.5.63:2, 8)

Name: Unknown.

Location: On a low unnamed hill.

Latitude and longitude: N30°31'232", E36°02'426".

Elevation: 1000 m.

Site size: 0.64 ha.

Main periods: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 3200 tabular scraper cores.

Estimated number of Jafr blade cores at the site: 640 Jafr blade cores.

Description: The site is situated on a low unnamed hill. The hill is covered with small flint blocks. Eocene flint beds embedded in limestone were weathered and naturally shattered into flint blocks. The blocks are usually slightly larger than fist size. In some places, the Eocene flint beds are still exposed. Among these flint blocks, tabular scraper cores, Jafr blade cores and associated debitage are sparsely scattered over an area of 80 m×80 m. The flint blocks on the surface were picked up and used for tabular scraper and Jafr blade production. The density of the cores is very low. On the basis of the data from JF0106 and JF0153, it is estimated that 3200 tabular scraper cores and 640 Jafr blade cores are scattered thinly at the area. No evidence for flint mines was found at the site.

Site JF0109 (Fig.5.19, Fig.5.20, Fig.5.21, Fig.5.56:3).

Name: Unknown.

Location: On a low hill to the west of Wadi Ayriya.

Latitude and longitude: N30°31'035", E36°02'379".

Elevation: 1001 m.

Site size: 2.6 ha.

Main periods: Chalcolithic/Early Bronze Age.

Site Character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site

Estimated number of tabular scraper cores at the site: 13000 tabular scraper cores

Estimated number of Jafr blade cores at the site: 2600 Jafr blade cores

Description: The site is situated on a low hill, which is situated to the west of Wadi Ayriya. A few small limestone cairns, whose diameter is about 1.5 m, are situated on the top of the hill (Fig.5.20). Cairns are very small and low. Each cairn consists of several fieldstones. The date of the cairns is unknown in the absence of excavations. The slopes of the hill are paved by small flint blocks, which were originally derived from Eocene flint beds. The blocks on the surface were picked up and used as raw material for tabular scraper and Jafr blade production. Tabular scraper cores, Jafr blade cores, and debitage are thinly spread over an area of 200 m×130 m on the southwestern slope of the hill. The density of cores is quite low. On the basis of the date in JF0106 and JF0153 (See Chapter 6 and Chapter 9), it is estimated that 13000 tabular scraper cores and 2600 tabular scraper cores are scattered sparsely at the site.

Site JF0110 (Fig.5.22, Fig.5.56:1, Fig.5.63:7)

Name: Gurta Siyyata.

Location: On the western slope of Gurta Siyyata.

Latitude and longitude: N30°32'000", E36°05'708".

Elevation: 1039 m.

Site size: 9 ha.

Main periods: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site

Estimated number of tabular scraper cores: 45000 tabular scraper cores

Estimated number of Jafr blade cores: 9000 Jafr blade cores

Gurta Siyyata is a steep rock hill situated in the northeastern part of the survey area. The western slope of the hill was paved with small flint blocks (Fig.5.22). The blocks were slightly bigger than fist size. The blocks on the surface were used as raw material for small side struck fan shaped tabular scraper and Jafr blade production (Fig.5.56:1, Fig.5.63:7). Tabular scraper cores, Jafr blade cores and debitage are sparsely spread over an area of 300 m×300 m among natural flint blocks. The density of the cores is low. Core clusters are rarely found at the site. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that 45000 tabular scraper cores and 9000 Jafr blade cores were thinly scattered over the site.

Site JF0124 (Fig.5.23, Fig.5.24, Fig.5.57:1-3)

Name: Wadi Dursi

Location: On the western bank of Wadi Dursi.

Latitude and longitude: N30°24'785", E35°54'504".

Elevation: 975 m.

Site size: 0.2 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 1000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: 200 Jafr blade cores.

Description: The site is situated on the western bank of Wadi Dursi. The size of the site is about 0.2 ha. The bank is covered with natural angular flint blocks (Fig.5.23). Eocene flint beds are exposed in some places. The flint beds were weathered and shattered into blocks. The flint blocks on the surface were used for small side struck tabular scraper and Jafr blade production

(Fig.5.24, Fig.5.57:1-3). The cores are sparsely spread over an area of 100 m by 20 m. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that 1000 tabular scraper cores and 200 Jafr blade cores were present at the site. However the density of cores is very low. Core clusters are rarely found at the site.

Site JF0126 (Fig.5.25, Fig.5.26)

Name: Wadi Bayir.

Location: On the eastern bank of Wadi Bayir.

Latitude and longitude: N30°46'192", E36°40'846".

Elevation: 906 m.

Site size: 1ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyta type) production site.

Estimated number of tabular scraper cores: 5000 tabular scraper cores.

Description: Bayir is a small village situated to the northwest of the Jafr Basin. The site was discovered during an excursion to Bayir. The site is situated on the eastern bank of Wadi Bayir. The slope is paved by natural angular flint chunks (Fig.5.25). Eocene flint beds, which were embedded in limestone, were weathered and naturally shattered into chunks. The flint chunks on the surface were picked up and used as raw materials for tabular scraper production. Small side struck blanks were knapped from the flint chunks (Fig.5.26). Small side struck fan shaped tabular scrapers on the blanks were the main products at the site. Tabular scraper cores and debitage are sparsely spread over about 50 m by 250 m area. On the basis of the data from JF0106 and JF0153 (See Chapter 7), it is estimated that 5000 tabular scraper cores are scattered over the area. However the density of cores is quite low. Core clusters are rarely observed at the site.

Site JF0151 (Fig.5.27, Fig.5.57:4)

Name: Unknown.

Location: On the western slope of Jabal Umm Rijam.

Latitude and longitude: N30°39'573", E35°51'469".

Elevation: 1012 m.

Site size: 1 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyta type) and Jafr blade production site.

Estimated number of tabular scraper cores: 5000 tabular scraper cores.

Estimated number of Jafr blade cores: 1000 Jafr blade cores.

Description: The site of JF0151 is situated about 300m to the south of JF0101. As JF0101, the site is on the western slope of the tableland of Jebel Umm Rijim (Fig.5.27). The slope is covered by small flint blocks. Eocene flint beds were weathered and shattered into blocks. The flint blocks on the surface were picked up and used for stone tool production. Small side struck fan shaped tabular scrapers on small side struck blanks and Jafr blades were the main products at the site (Fig.5.57:4). On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that about 5000 tabular scraper cores, 1000 Jafr blade cores and debitage are sparsely spread over an area of 100 m by 100 m. The density of the cores is very low. Core clusters were rarely observed at the site. No flint mines were discovered.

Site JF0152 (Fig.5.28, Fig.5.29)

Name: Unknown.

Location: On the western bank of an unnamed wadi.

Latitude and longitude: N30°31'825", E35°57'911".

Elevation: 1026 m.

Site size: 0.8 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores: 4000 tabular scraper cores.

Estimated number of Jafr blade cores: 800 Jafr blade cores.

Description: The site is situated on the western bank of an unnamed small wadi (Fig.5.28). The bank is covered by small flint blocks (Fig.5.29). The size of the flint blocks is usually slightly bigger than fist size. The flint blocks on the surface were picked up and used for stone tool production. Small side struck fan shaped tabular scrapers and Jafr blades were the main products at the site. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that about 4000 tabular scraper cores, 800 Jafr blade cores and debitage are thinly spread over an area of 100 m by 80 m. The density of the cores is low. Tabular scraper cores do not form any clusters. No flint mines were found at the site. Several graves were also discovered at the site (Fig.5.28). However the graves were probably modern Islamic graves. They are oriented east-west and have flat, upright headstones.

Site JF0153 (See Chapter 7, Fig.5.58:1, Fig.5.63:4, 6)

Name: Unknown.

Location: Tausu Abu Tulayha.

Latitude and longitude: N30°32'039", E35°58'971".

Elevation: 1055 m.

Site size: 6 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores: 30000 tabular scraper cores.

Estimated number of Jafr blade cores: 6000 Jafr blade cores.

Description: The site is situated on the hill of Tausu Abu Tulayha. The hill is about 300 m×200 m in size. All of the slopes of the hill are covered with natural angular flint chunks. Eocene flint beds embedded in limestone were weathered and naturally shattered into chunks. In some places, the Eocene flint beds are still exposed. The chunks are usually small and slightly bigger than fist size. The flint chunks on the surface were used as raw material for tabular scraper and Jafr blade production. Tabular scraper cores, Jafr blade cores and associated debitage are sparsely spread over the slopes. It is estimated that about 30000 tabular scraper cores and 6000 Jafr blade cores are present at the site. No flint mines were discovered. Chapter 7 will provide a more detailed description of the site.

Site JF0155 (Fig.5.62:3)

Name: Wadi Abu Tulayha.

Location: On the western bank of Wadi Abu Tulayha.

Latitude and longitude: N30°30'540", E35°58'269".

Elevation: 1011m.

Site size: 0.2 ha (tabular scraper production area).

Main periods: Pre-Pottery Neolithic B, Chalcolithic/Early Bronze Age.

Site character: Hunting camp (PPNB), Tabular scraper (Gurta Siyyta type) production site (Chalcolithic/Early Bronze Age)

Estimated number of tabular scraper cores: Unknown.

Description: The site is situated on the west bank of Wadi Abu Tulayha. The site consists of PPNB subterranean dwellings and a Chalcolithic/Early Bronze Age tabular scraper production area (Fujii 2006a, Fujii 2006b, Fujii and Abe in press). At the production area, tabular scraper cores and debitage are extremely thinly scattered over an area of 50 m×30 m. The density of cores is extremely low. Small natural angular flint chunks are available on the surface in the area. The chunks on the surface were picked up and used for tabular scraper production. Small fan shaped tabular scrapers were the main products at the site.

5.4.5 Sites discovered in the summer 2002

Site JF0204 (Fig.5.30)

Name: Wadi Burma South.

Location: On a bank of Wadi Burma.

Latitude and longitude: N30°38'481", E35°49'787".

Elevation: 1017 m.

Site size: Unknown

Main period: Early Bronze Age.

Site character: Cairn field.

Description: Wadi Burma is situated to the west of Jebel Umm Rijam. It is a branch of Wadi Hasa and flows northwards. The site is situated on a bank of Wadi Burma. Several cairns were discovered at the sites (Fujii 2004a). Two cairns were excavated in 2003 (Fig.5.30). The excavations reveal that the cairns can be dated to the Early Bronze Age. These cairns yielded EB I pottery that is very similar to pottery excavated from EB I sites such as Hujayrat al Ghuazlan, Tall al Magass and Wadi Faynan 100 (Khalil, Eichmann and Schmidt 2003, Wright, Najjar, Last, Moloney, Flender, Gower, Jackson, Kennedy and Shafiq 1998). Cairns consist of a mound and attached rectangular courtyard (Fig.5.30). The mound covers a round cist room in the centre and rectangular structure attached to the cist. The cists yielded no human bones probably because of soil conditions.

Site JF0206 (Fig.5.31)

Name: Wadi Burma North.

Location: On a bank of Wadi Burma.

Latitude and longitude: N30°39'561", E35°50'684".

Elevation: 1000 m.

Site size: Unknown.

Main periods: Early Bronze Age.

Site character: Cairn field.

Description: The site of JF0206 is to the north of JF0204. A few dozen cairns were discovered at JF0206 on a bank of Wadi Burma (Fujii 2005b). These cairns were typologically very similar to those at JF0204. However some cairns at JF0206 have no courtyard (Fig.5.31, Fig.5.32). A mound usually covers a round cist and rectangular or oblong structure (Fig.5.32). Three cairns were excavated in 2004. These cairns yielded EB I pottery shards. However no human bone was discovered in the cairns probably because of soil conditions.

Site JF0208 (Fig.5.32)

Name: Talat Abydah.

Location: In the northwestern fringe of Jebel Umm Rijam.

Latitude and longitude: N30°39'944", E35°53'085".

Elevation: 1070 m.

Site size: Unknown.

Main periods: Chalcolithic/Early Bronze Age.

Site character: Cairn field.

Description: The site of Talat Abydah is a small cairn field discovered on the northwestern fringe of the tableland of Jebel Umm Rijam (Fig.5.2). The site is prominent in the landscape and commands a fine view. In total, 22 Chalcolithic/Early Bronze Age cairns are located at the site. These cairns have cists in the centre and upright stone walls enclose the cists (Fig.5.32). Large cobbles cover the cists and enclosures. The diameter of cairns is about 8m and the height is about 1m on average. Three cairns were excavated in 2004. The excavation revealed that these cairns contain secondary multiple burials. These cairns yielded several large end struck oval/elongated tabular scrapers. Therefore these cairns can be dated to the Chalcolithic/Early Bronze Age (Fujii 2005a).

Site JF0209 (Fig.5.33)

Name: Talat Abydah.

Location: On the northwestern slope of Jebel Umm Rijam.

Latitude and longitude: N30°40'273", E35°53'142".

Elevation: 1022 m.

Site size: 15 ha.

Main periods: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 75000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: 15000 Jafr blade cores.

Description: The site is situated on the northwestern slope of table land of Jebel Umm Rijam and a few hundreds meter to the north of the site of JF0208. The site is sparsely covered by small flint blocks (Fig.5.33). In some places, Eocene flint beds are exposed. The Eocene flint beds were weathered and naturally shattered into small blocks. The blocks on the surface were used as raw material for stone tool production. No flint mines were found at the site. Small side struck fan shaped tabular scrapers and Jafr blades were the main products at the site. Tabular scraper cores, Jafr blade cores and associated debitage are thinly scattered over an area of 500 m×300 m. However tabular scraper core clusters were observed in some places. Each cluster consists of a few dozen tabular scraper cores. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that 75000 tabular scraper cores and 15000 Jafr blade cores are present at the site.

Site JF0210 (Fig.5.34, Fig.5.35)

Name: Talat Abydah.

Location: On the western slope of Jebel Umm Rijam.

Latitude and longitude: N30°38'967", E35°51'626".

Elevation: 1094 m.

Site size: Over 20 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores at the site: 100000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: 20000 Jafr blade cores.

Description: The site is situated on a spur which protrudes from the western slope of Jebel Umm Rijam (Fig.5.34, Fig.5.35). The site commands a fine view of Wadi Burma. A few dozen limestone cairns were constructed on the spur. The diameter of cairns is about 5m on average. Although the date of cairns is unknown in the absence of excavations, it is likely that they are not Chalcolithic/Early Bronze Age cairns because these cairns have no similarities with the Chalcolithic and Early Bronze Age cairns at JF0204, JF0206 and JF0208. Slopes of the spur are covered by small flint blocks. In some places, flint beds are exposed. The flint beds were weathered and naturally shattered into blocks. The flint blocks are usually slightly bigger than human fist size. The blocks on the surface were picked up and used as raw material for tabular scraper and Jafr blade production. No flint mines were discovered at the site. Small side struck tabular scarper blanks were flaked from the small flint blocks. Small fan shaped tabular scrapers were produced on the blanks. Tabular scraper cores and Jafr blade cores are thinly spread over the slopes.The size of the site is probably over 20 ha. On the basis of the data from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that about 100000 tabular scraper cores and 20000 Jafr blade cores are probably present at the site. However the density of cores is extremely low and the cores rarely form core clusters.

Site JF0211 (Fig.5.36, Fig.5.37, Fig.5.38, Fig.5.39, Fig.5.59, Fig.5.63:1)

Name: Jebel Umm Rijam.

Location: In the western area of Jebel Umm Rijam.

Latitude and longitude: N30°39'168", E35°52'541".

Elevation: 1097 m.

Site size: 1.2 ha.

Main period: Early Bronze Age.

Site character: Tabular scraper (Qa Abu Tulayha type) and Jafr blade production site.

Estimated weight of mined flint nodules: 330 tons.

Estimated number of tabular scraper cores at the site: 11000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: Only a handful of Jafr blade cores.

Description: The site is situated in the western area of the tableland of Jebel Umm Rijam. The site measures over 600 m in length and 20 m in width. The size of the site is over 1.2 ha. A long flint mining trench was found at the site (Fig.5.36, Fig.5.39). Only some parts of the trench (only 100 m) are clearly visible in the centre of the site (Fig.5.39). But the original length of trench is probably over 600 m. The trench runs in an arc from the north to south. On the basis of the data from Qa Abu Tulayha (See Chapter 6), it is estimated that 330 tons of large flint nodules were mined at the site. The nodules are usually bigger than the size of a human head (Fig.5.59). Large end struck tabular scraper blanks were mainly detached from the nodules (Fig.5.59). Large end struck oval/elongated tabular scrapers on the blanks were the main products at the site. Core reduction was conducted mainly on the southern side of the trench (Fig.5.36, Fig.5.39). Tabular scraper cores and debitage are densely spread on the southern side (Fig.5.38, Fig.5.39). About 11000 tabular scraper cores are probably present on the southern side. Tabular scraper cores usually form clusters. Each core cluster consists of a few dozen tabular scraper cores. In contrast with the southern side, traces of core reduction are rare on the northern side of the trench. Instead of cores, a number of limestone chunks and flint chunks were distributed on the northern side of the trench. The northern side was probably a dump area. Limestone chunks, which were extracted with flint nodules and flint chunks, which were not suitable for flint knapping, were probably discarded on the side (Fig.5.39). One round structure, which was built of flint nodules, was also found in the northwestern fringe of the site (Fig.5.37). The diameter of the structure is about 3m. An organic roof probably covered the structure. The date of the structure is unknown in the absence of excavations. However there is a possibility that the structure was used by flint knappers. Along with intensive tabular scraper production, Jafr blades were also produced on a much smaller scale. A handful of Jafr blades and cores were collected at the site (Fig.5.63:1).

Site JF0212 (Fig.5.40, Fig.5.41, Fig.5.42, Fig.5.43, Fig.5.60:1-2, Fig.5.61:1-2, Fig.5.62:5)

Name: Jebel Umm Rijam.

Location: In the western fringe of Jebel Umm Rijam.

Latitude and longitude: N30°39'161", E35°52'203".

Elevation: 1083 m.

Site size: 2.3 ha.

Main period: Early Bronze Age.

Site character: Tabular scraper production site (Qa Abu Tulayha type).

Estimated weight of mined flint nodules: 408 tons.

Estimated number of tabular scraper cores at the site: 13600 tabular scraper cores.

Description: The site is situated in the western fringe of the tableland of Jebel Umm Rijam and 500 m west of the site of JF0211. The site measures 750 m in length and 30 m in width. The size of the site is about 2.3 ha. A long flint mining trench was found at the site (Fig.5.40, Fig.5.41). The flint mining trench is about 750 m in length. On the basis of excavations at Qa Abu Tulayha (See Chapter 6), it is estimated that about 410 tons of large flint nodules were extracted from the trench (Fig.5.41). The nodules are usually bigger than the size of a human head. Large end struck tabular scraper blanks were detached from the nodules and turned into large end struck oval/elongated tabular scrapers as the main products at the site (Fig.5.60, Fig.5.61). Core reduction was conducted mainly on the northern side of the trench (Fig.5.41, Fig.5.42). Tabular scraper cores and debitage are densely scattered on northern side. A number of core clusters were observed. Each cluster consists of a few dozen tabular scraper cores. In contrast to the northern edge, traces of tabular scraper production are rare on the southern edge of the trench. The southern side was probably a dump area. The limestone debris and unworked flint chunks, which were probably mined with flint nodules, are scattered on the southern side.

Site JF0213 (Fig.5.44)

Name: Jebel Umm Rijam.

Location: In the western fringe of Jebel Umm Rijam.

Latitude and longitude: N30°38'203", E35°52'207".

Elevation: 1091 m.

Site size: 0.3 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores: 1500 tabular scraper cores.

Estimated number of tabular scraper cores: 300 Jafr blade cores.

Description: The site is situated in the western fringe of the tableland of Jebel Umm Rijam. The site commands a fine view of Wadi Burma. Several cairns were discovered at the site. Although the precise date of the cairns is unknown, they are probably not Chalcolithic and Early Bronze Age cairns. Tabular scraper cores, Jafr blade cores and debitage are also thinly spread over two areas. One measures 200 m×10 m and the other area measures 100 m×10 m. The total size of the site is about 0.3 ha. The area is covered by small flint chunks. Eocene flint beds embedded in limestone were weathered and naturally shattered into chunks. The size of chunks is usually slightly bigger than fist size. The flint chunks on the surface were used for tabular scraper and Jafr blade production. The density of cores is very low. Core clusters were rarely found at the site. No flint mines were discovered. On the basis of the evidence from JF0106 and JF0153 (See Chapter 7 and Chapter 10), about 1500 tabular scraper cores and 300 Jafr blade cores are probably present at the site.

Site JF0214 (Fig.5.45)

Name: Wadi Abu Awafi.

Location: On the banks of Wadi Awafi in Jebel Umm Rijam.

Latitude and longitude: N30°38'835", E35°53'796".

Elevation: 1055 m.

Site size: 2.5 ha.

Main period: Chalcolithic/Early Bronze Age.

Site character: Tabular scraper (Gurta Siyyata type) and Jafr blade production site.

Estimated number of tabular scraper cores: 12500 tabular scraper cores.

Estimated number of Jafr blade cores: 2500 Jafr blade cores.

Description: The site is situated on both sides of Wadi Abu Awafi. Remains of tabular scraper production and Jafr blade production are distributed thinly over two areas (Fig.5.45). One area measures 150 m×100 m and the other area measures 100 m×100 m. The total size of the site is about 2.5 ha. The slopes of the wadi are covered with small flint blocks, which were naturally broken off from Eocene flint beds. The size of flint blocks is usually slightly bigger than fist size. These flint blocks on the surface were used for stone tool production. Small side struck tabular scraper flakes were detached from the flint blocks. Small fan shaped tabular scrapers on the blanks were the main products at the site. Tabular scraper cores, Jafr blade cores and debitage are thinly scattered among natural flint blocks. The density of cores is quite low. Core clusters were rarely found at the site. No flint mines were discovered. On the basis of theevidence from JF0106 and JF0153 (See Chapter 7 and Chapter 10), it is estimated that about 12500 tabular scraper cores and 2500 Jafr blade cores are probably present at the site.

Site JF0215 (Fig.5.46, Fig.5.47, Fig.5.48)

Name: Wadi Abu Awafi.

Location: On the west side of Wadi Abu Awafi in Jebel Umm Rijam.

Latitude and longitude: N30°37'470"; E35°55'611".

Elevation: 1078 m.

Site size: 0.36 ha.

Main period: Early Bronze Age.

Site character: Tabular scraper production site (Qa Abu Tulayha type).

Estimated weight of mined flint nodules: 99 tons.

Estimated number of tabular scraper cores at the site: 3300 tabular scraper cores.

Description: The site is situated on the west side of Wadi Abu Awafi, which flows in Jebel Umm Rijam (Fig.5.46). The site measures about 180 m in length×20 m in width. One long flint mining trench was discovered at the site. The length of the trench reaches 180 m. The trench is filled with white silt and meanders from northwest to southeast. On the basis of excavations at Qa Abu Tulayha (See Chapter 6), it is estimated that about 100 tons of flint nodules were mined from the trench. Mined flint nodules are usually large and measure 30 cm×30 cm×20 cm on average. Several large tabular scraper blanks (usually large end struck blanks) were detached from each nodule. Core reduction was conducted mainly on the western side of the trench. Tabular scraper cores and debitage are densely distributed on the western side (Fig.5.47). About 3300 tabular scraper cores are probably present. Tabular scraper cores usually form core clusters. One cluster is about 3 m in diameter and consists of a few dozen tabular scraper cores. Each core cluster probably represents one work episode by one knapper. In contrast, remains of tabular scraper production are rare on the eastern side of the trench. The mined limestone, chalk and flint nodules, which were probably unsuitable for flint knapping, were discarded on the eastern side (Fig.5.47).

Site JF0216 (Fig.5.49, Fig.5.50)

Name: Wadi Abu Awafi.

Location: On the north side of Wadi Abu Awafi in Jebel Umm Rijam.

Latitude and longitude: N30°37'470", E35°55'611".

Elevation: 1078 m.

Site size: 0.15 ha.

Main periods: Early Bronze Age.

Site character: Tabular scraper (Qa Abu Tulayha type) and Jafr blade production.

Estimated weight of mined flint nodules: 60 tons.

Estimated number of tabular scraper cores at the site: 2000 tabular scraper cores.

Estimated number of Jafr blade cores at the site: A handful of Jafr blade cores.

Description: The site is situated on the northern side of Wadi Abu Awafi and 2 km to the south of JF0215. The site measures 0.15 ha in size. Two flint mining trenches were discovered at the site. One trench is about 50 m and the other trench is 60 m in length. They meander from north to south. The trenches are filled with white silt. On the basis of the evidence from Qa Abu Tulayha (See Chapter 6), it is estimated that about 60 tons of large flint nodules were mined at the site. Mined nodules are usually bigger than the size of a human head. Core reduction was conducted mainly on the western edge of the trenches. Tabular scraper cores and debitage are densely scattered on the western edge. About 2000 tabular scraper cores are probably present. Large end struck tabular scraper flakes were detached from the cores. The density of cores is very high and a number of core clusters were observed. In contrast with the western edge, tabular scraper cores and debitage are rare on the eastern edge of the trenches. Limestone chunks, which were mined with the nodules, and unworked flint chunks were discarded on the eastern edge. A handful of Jafr blades and cores were also collected at the site.

Site JF0217 (Fig.5.51, Fig.5.52)

Name: Unknown.

Location: 3 km to the west of Wadi Abu Awafi in Jebel Umm Rijam.

Latitude and longitude: N30°36'499", E35°55'674".

Elevation: 1077 m.

Site size: 1.9 ha.

Main periods: Early Bronze Age.

Site Character: Tabular scraper production site (Qa Abu Tulayha type).

Estimated weight of mined flint nodules: 420 tons

Estimated number of tabular scraper cores at the site: 14000 tabular scraper cores.

Description: The site is situated 3 km to the west of Wadi Abu Awafi in Jebel Umm Rijam. Tabular scraper cores and debitage are densely spread over two areas (Fig.5.51). One area measures about 200 m ×70 m and the other area measures 100 m×50m. The total size of the site is about 1.9 ha. On the basis of the evidence from Qa Abu Tulayha (See Chapter 6), about 14000 tabular scraper cores are present in total at the site. At least 10 flint mining trenches were found at the site. Their length ranges from 20 m to 50 m. It is estimated that in total 420 tons of large flint nodules were mined. Flint nodules were usually bigger than the size of a human head. Several large end struck tabular scraper blanks were detached from each nodule. A number of tabular scraper cores are densely spread around the trenches. Several heaps of limestone and chalk were also discovered. This limestone and chalk was probably mined with the flint nodules. The density of tabular scraper cores is extremely high. Tabular scraper cores usually form core clusters. Each core cluster consists of about 30 tabular scraper cores. One cluster was probably formed in a single work episode.

5.5 SUMMARY

This chapter presented the results of archaeological surveys in the northwestern part of the Jafr Basin by Kanazawa University.

The surveys revealed that the Jafr Basin was probably occupied by pastoral nomads in the Chalcolithic and Early Bronze Age although it was wetter than today during these periods. Chalcolithic and Early Bronze Age sites in the Jafr Basin are characterized by small seasonal pastoral nomadic camp sites and cairns. No Chalcolithic/Early Bronze Age sedentary farming villages are known in the basin.

The most important discovery by the surveys was the high frequency of Chalcolithic/Early

Bronze Age tabular scraper production sites. Kanazawa University discovered 60 sites in total ranging from the Lower Palaeolithic sites to Islamic sites. Of the 60 sites, 25 are Chalcolithic/Early Bronze Age tabular scraper production sites. These sites are characterized by a large quantity of tabular scraper cores and debitage. It is estimated that over 500000 tabular scraper cores are present in total at these sites. Given the low intensity of the surveys, there are probably over a hundred tabular scraper production sites in the northwestern part of the Jafr Basin.

These facts strongly suggest that a large stone tool production industry of tabular scrapers developed in the Jafr Basin during the Chalcolithic and Early Bronze Age.

Tabular scraper production sites can be divided into two types according to presence of flint mining. The author denominates tabular scraper production sites with flint mining 'Qa Abu Tulayha type' and tabular scraper production sites without flint mining 'Gurta Siyyata type'. These types are totally different in several points such as the presence or absence of flint mining, site location, the nature of utilised raw material, intensiveness of production and final products. Chapter 6 will study Qa Abu Tulayha type tabular scraper production sites and Chapter 7 will study Gurta Siyyata type tabular scraper production sites in detail.

Along with tabular scrapers, a large number of Jafr blades were also produced in the basin. Of 25 tabular scraper production sites, 20 produced a number of Jafr blades. It is estimated that there are probably over 90000 Jafr blade cores in total at these sites. Jafr blade production will be studied in detail in Chapter 10.

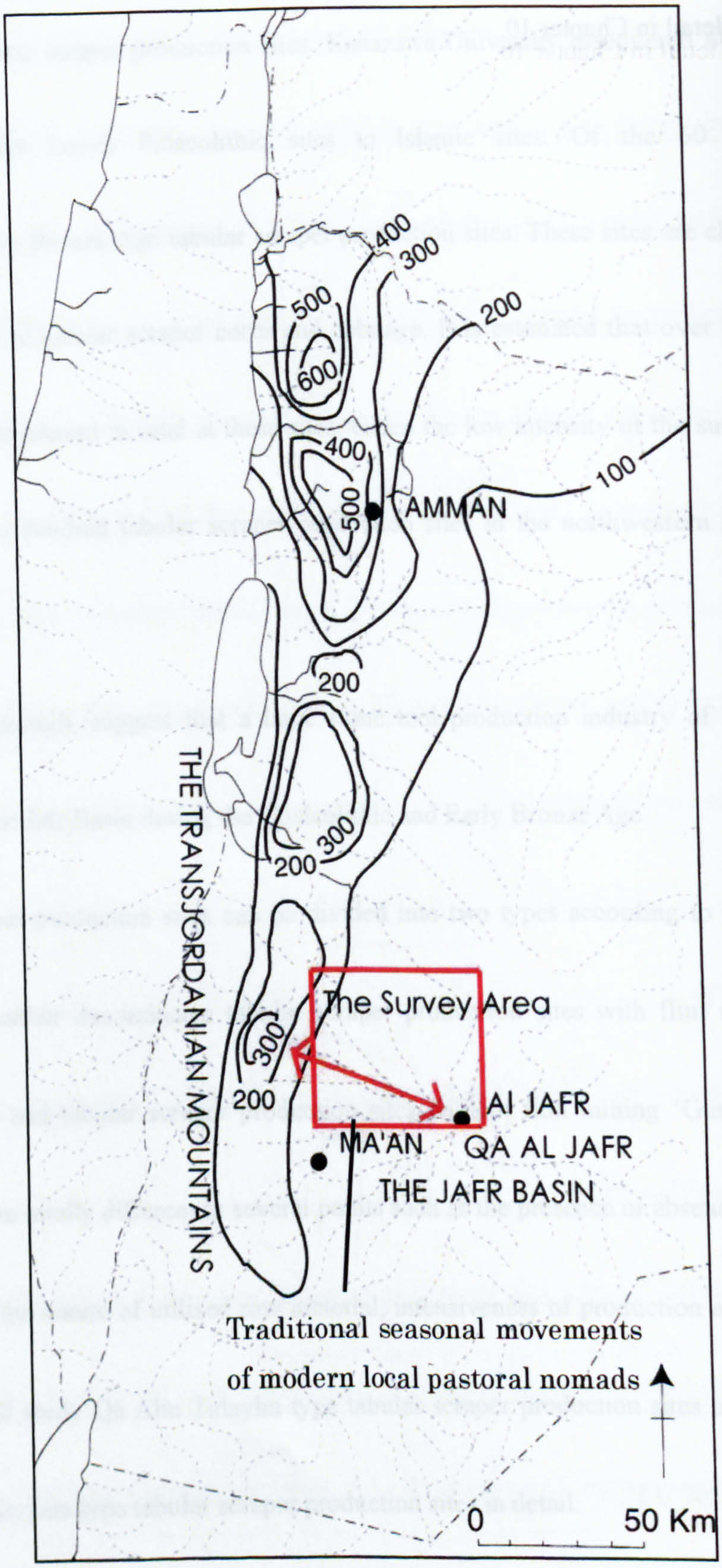


Fig.5.1 Map of mean annual rainfall in Jordan (from Kennedy and Bewley 2004).

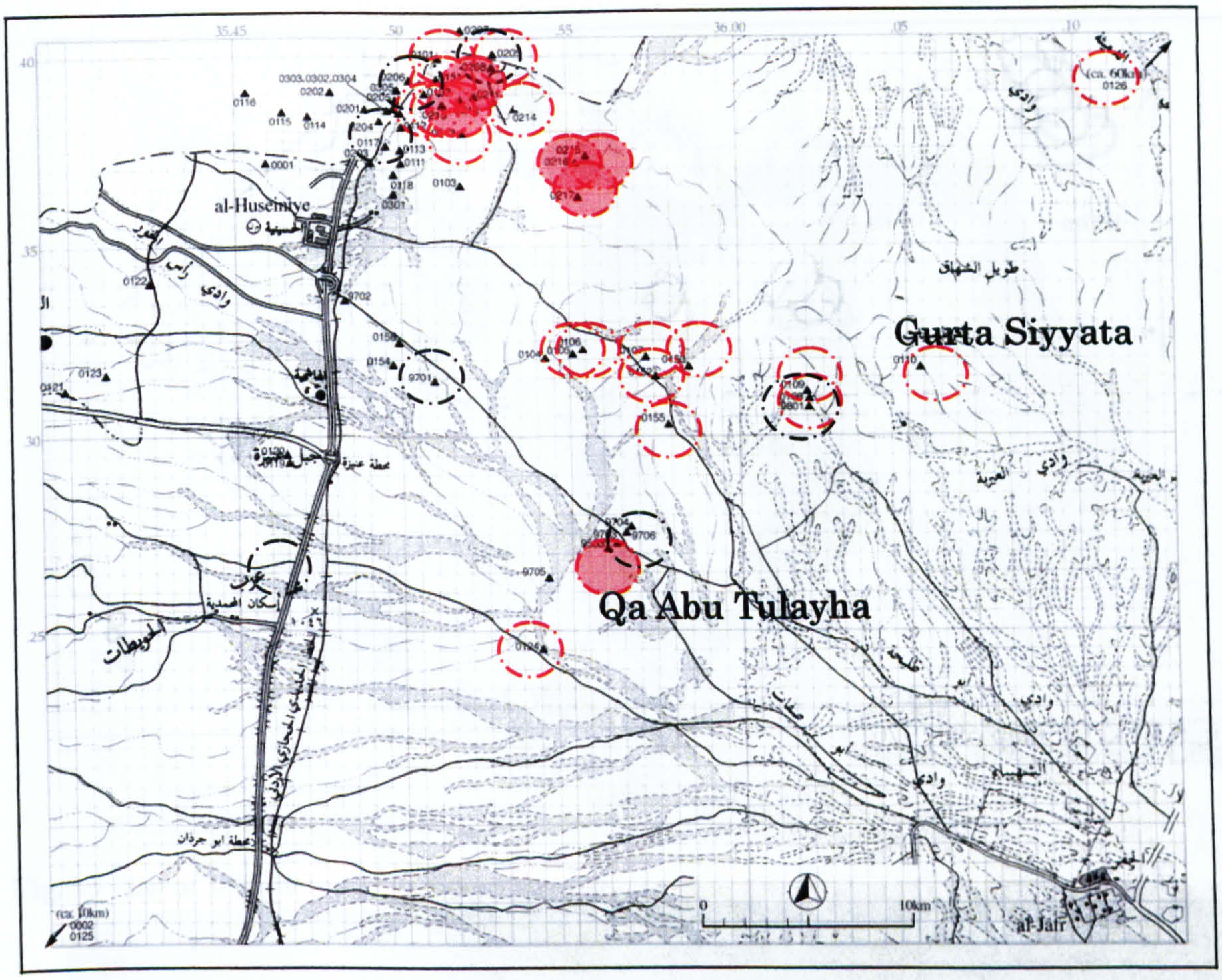


Fig.5.2 Chalcolithic and Early Bronze Age sites in the survey area.

○: Gurta Siyyata type tabular scraper production sites.

●: Qa Abu Tulayha type tabular scraper production sites.

○: Cairn fields or pastoral nomadic camp sites.

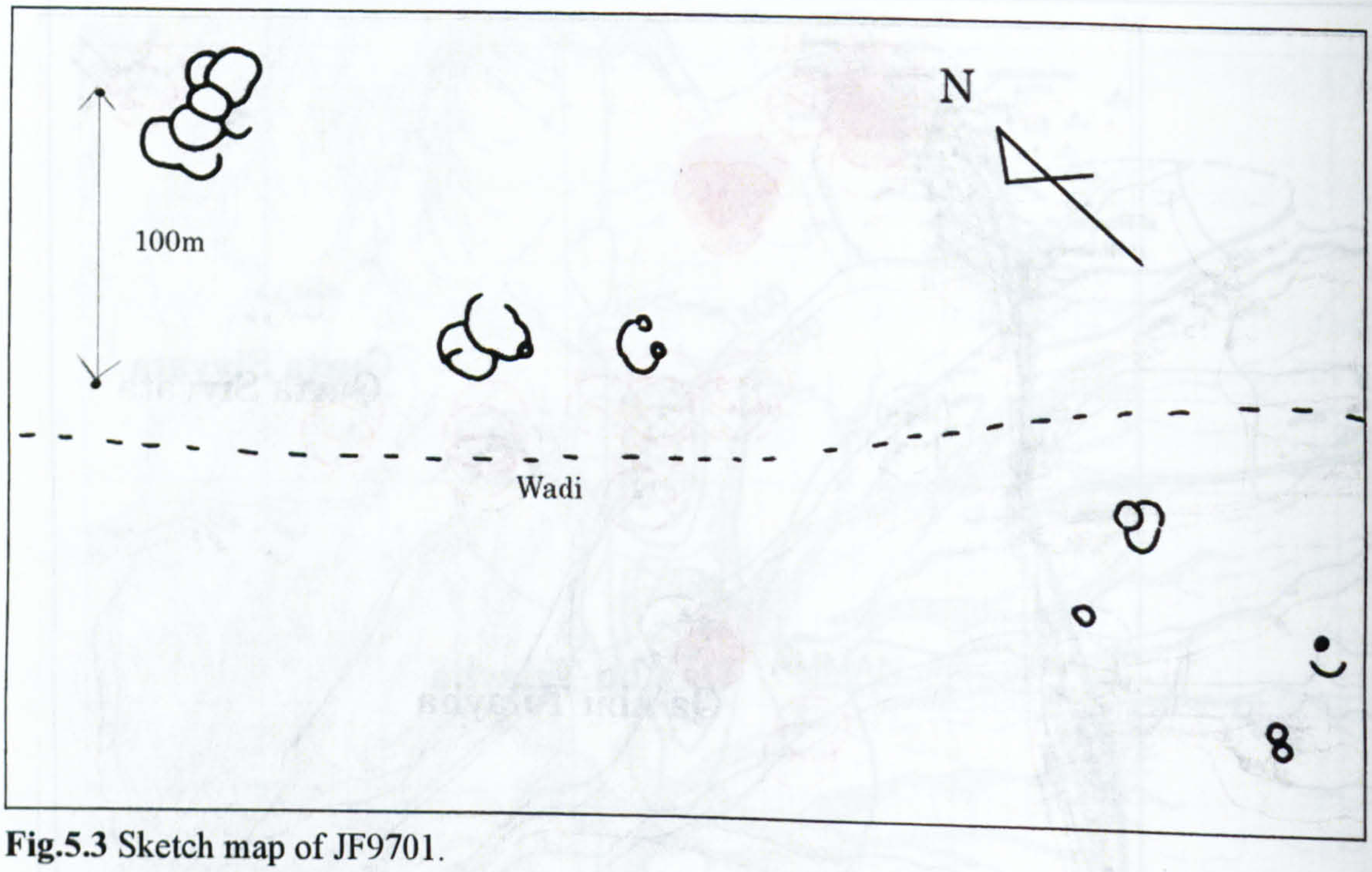


Fig.5.3 Sketch map of JF9701.

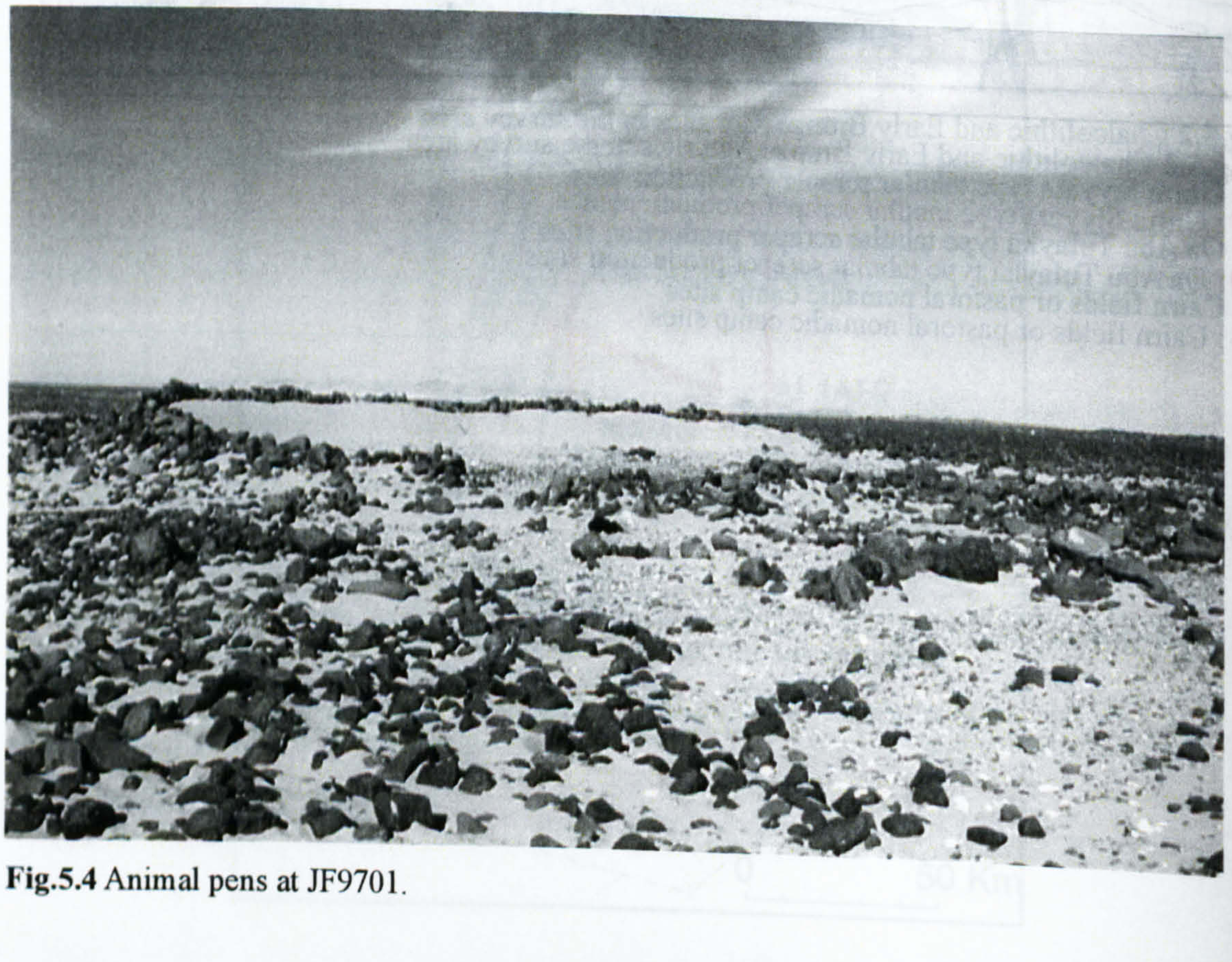


Fig.5.4 Animal pens at JF9701.

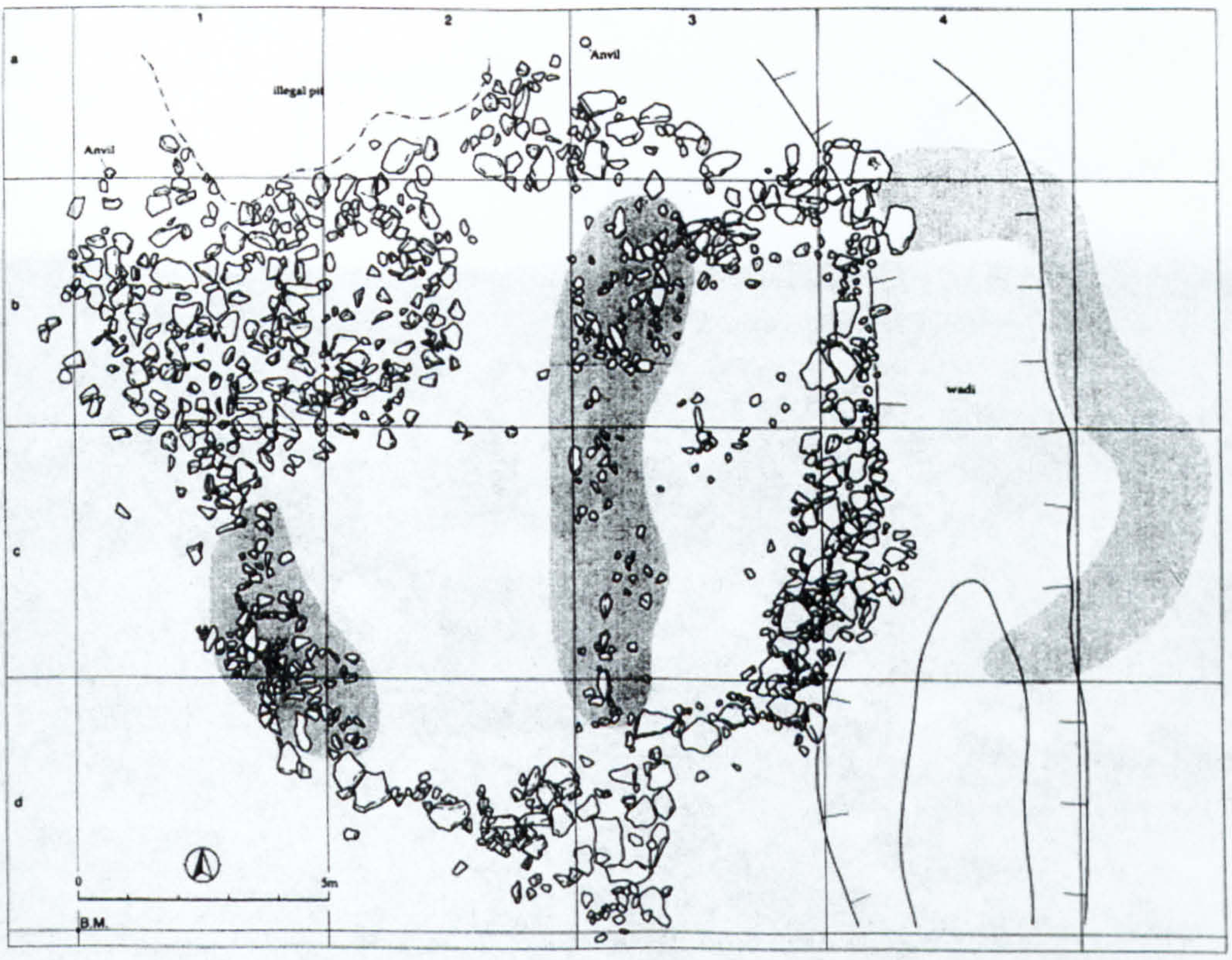


Fig.5.5 Plan of JF9706.

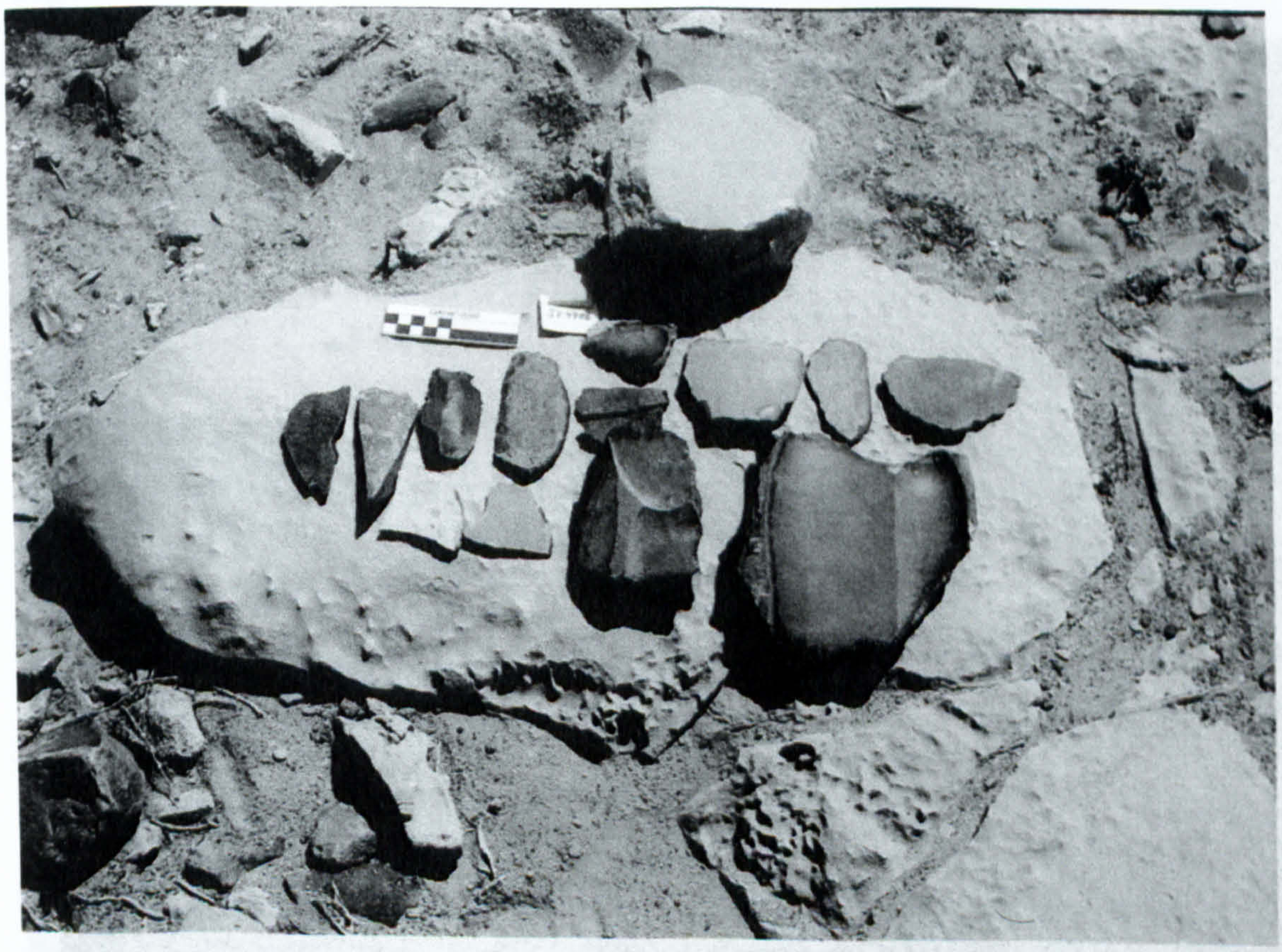


Fig.5.6 Surface collection at JF9706. Several tabular scrapers and tabular scraper cores were collected.

Fig.5.7 Enclosures and round structures at JF9801.

Fig.5.8 Jebel Umm Rijam from the west. A number of tabular scraper production sites are located in Jebel Umm Rijam.

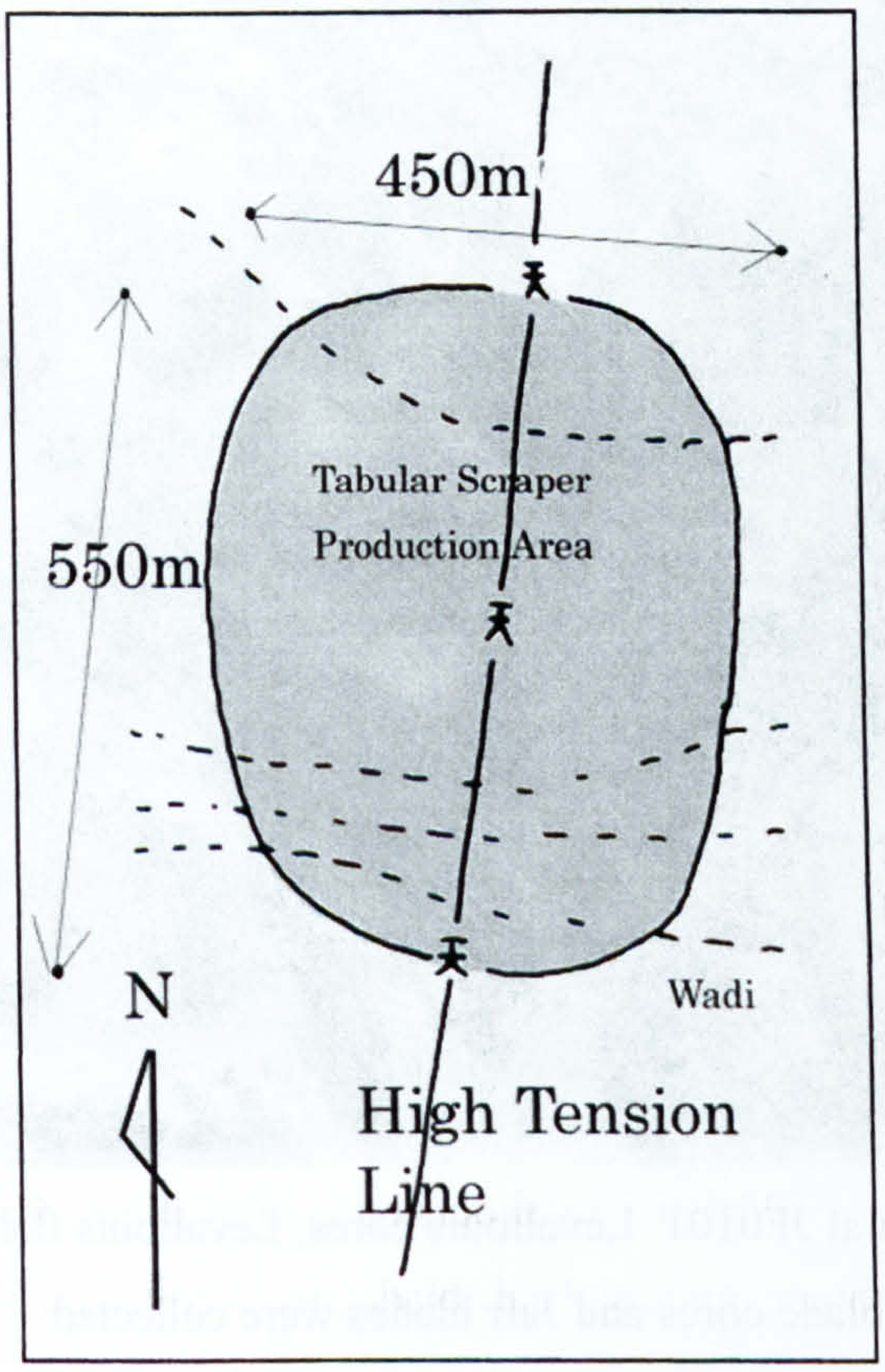


Fig.5.9 Sketch map of JF0101.

Fig.5.10 JF0101 on the western slope of Jebel Umm Rijam. The view is to the south.

Fig.5.11 Surface collection at JF0101. Levallouis cores, Levallouis flakes, tabular scraper cores, tabular scraper flakes, Jafr blade cores and Jafr blades were collected.

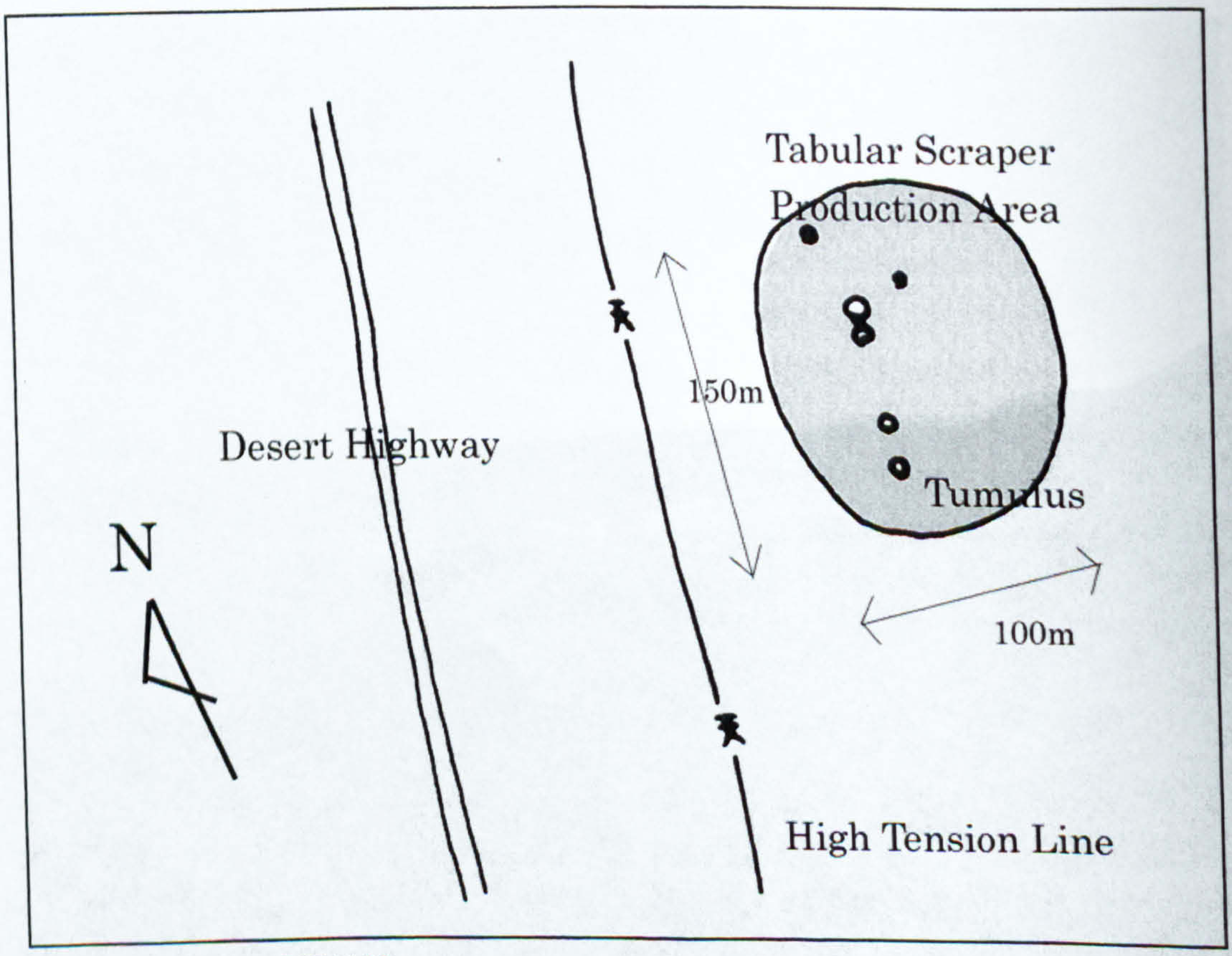


Fig.5.12 Sketch map of JF0102.

Fig.5.13 Cairns at JF0102.

Fig.5.14 JF0103.

Fig.5.15 JF0105.

Fig.5.16 Surface collection at JF0105. It includes a Levallouis core, blade core, tabular scraper cores, tabular scraper blanks and Jafr blade core.

Fig.5.17 JF0107. The view is to the south.

Fig.5.18 Surface collection at JF0107 including tabular scraper cores, Jafr blades and Jafr blade cores.

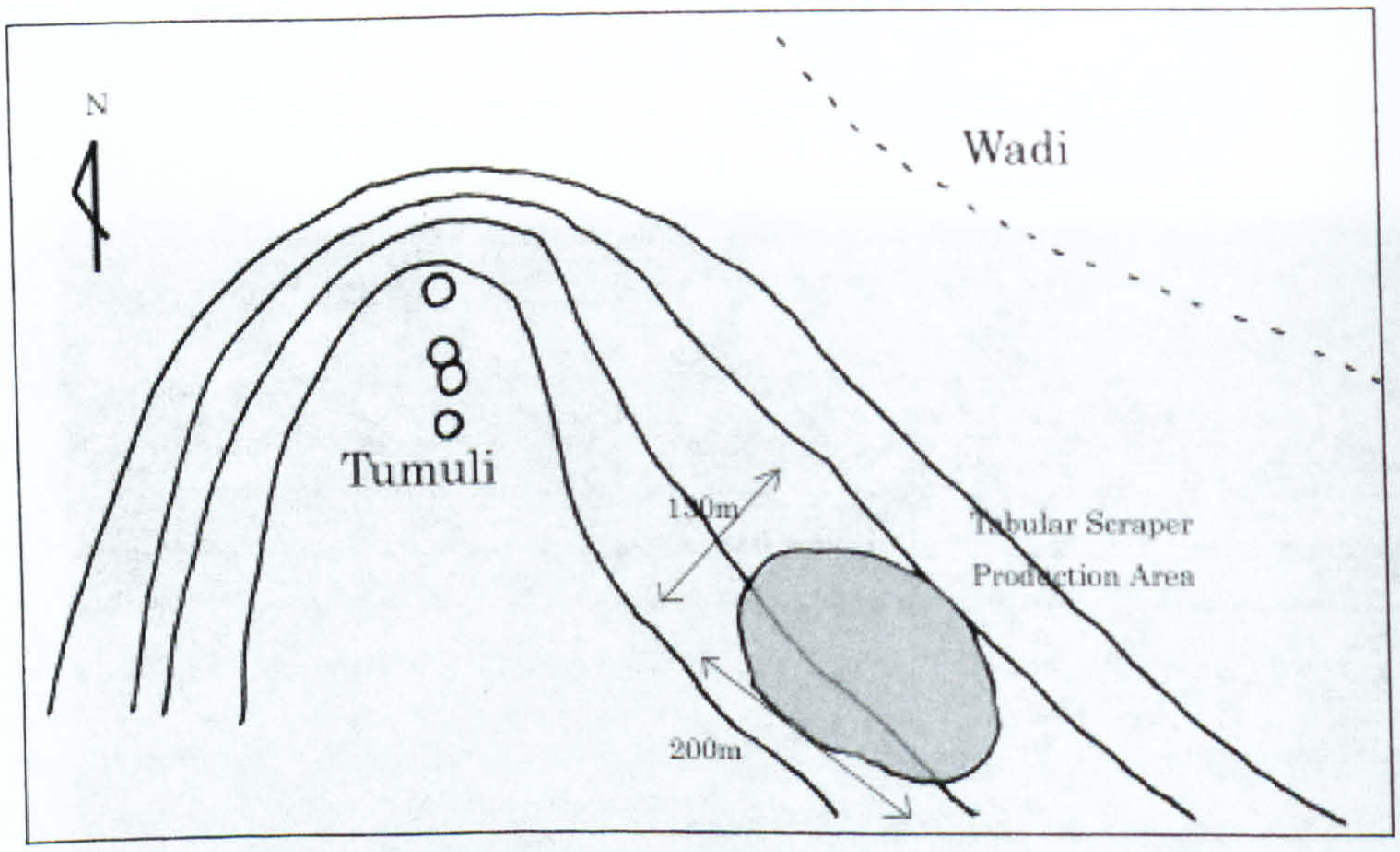


Fig.5.19 Sketch map of JF0109.

Fig.5.20 Cairns at JF0109 from the south.

Fig.5.21 A typical tabular scraper core at JF0109.

Fig.5.22 JF0110. The view is from the southwest.

Fig.5.23 JF0124.

Fig.5.24 Surface collection at JF 0124 including tabular scraper cores, tabular scraper flake and Jafr blades.

Fig.5.25 JF0126.

Fig.5.26 Typical tabular scraper cores at JF0126.

Fig.5.27 JF0151. The view is to the north.

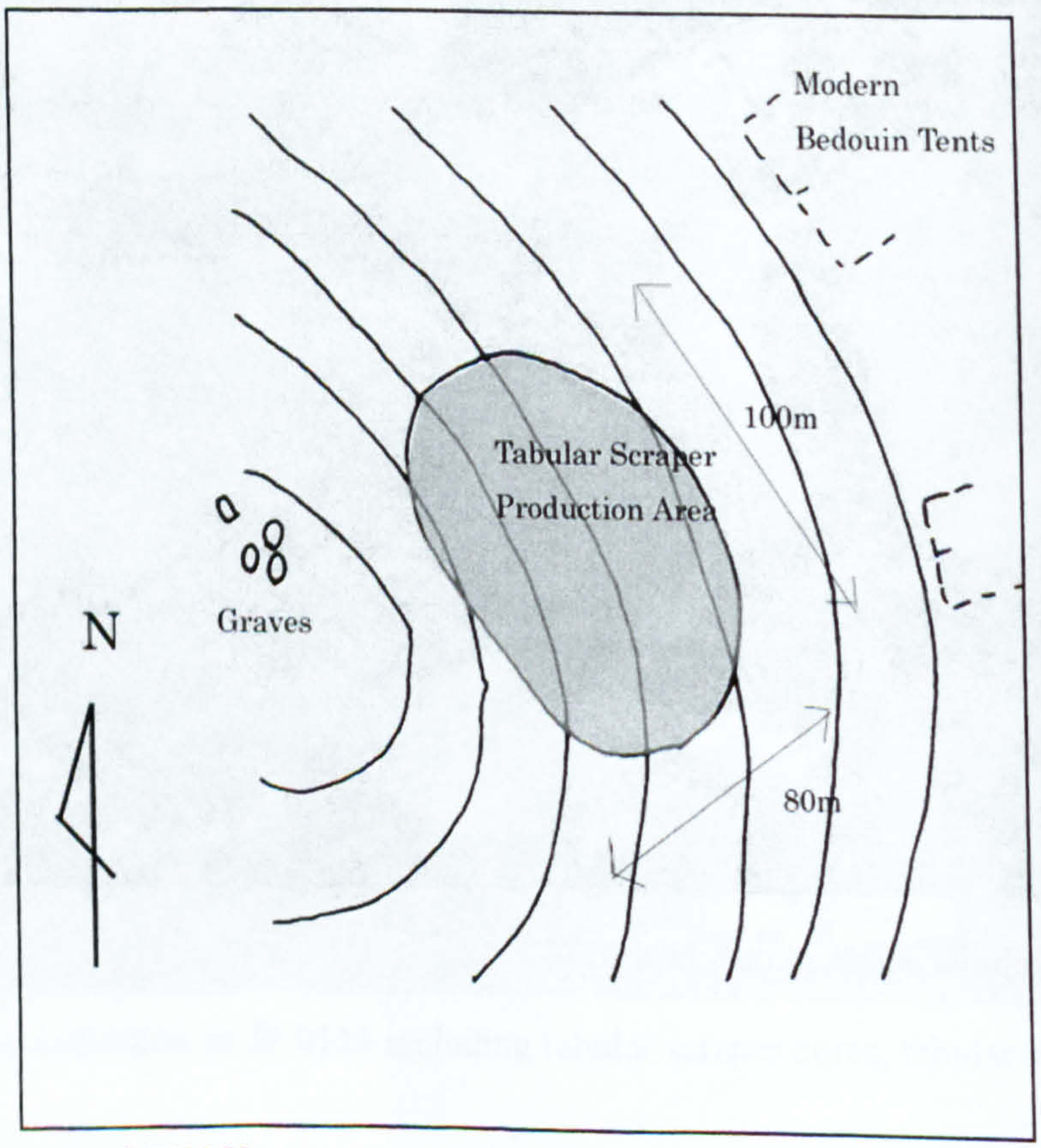


Fig.5.28 Sketch map of JF0152.

Fig.5.29 JF0152.

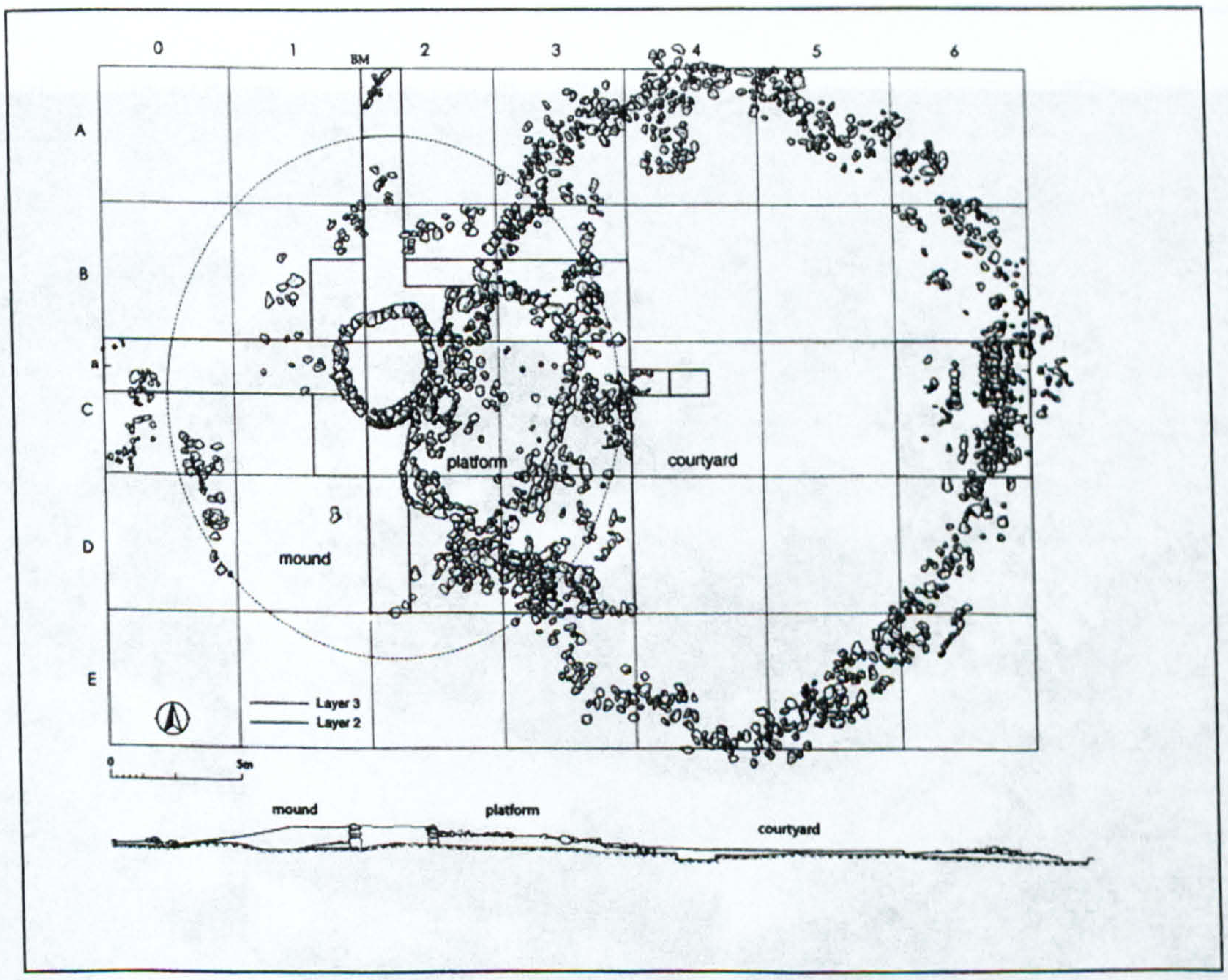


Fig.5.30 Plan of an Early Bronze Age cairn at JF0204 (From Fujii 2004a).

Fig.5.31 An Early Bronze Age grave after removal of the southern half part at JF0206.

Fig.5.32 A cairn at JF0208.

Fig.5.33 JF0209.

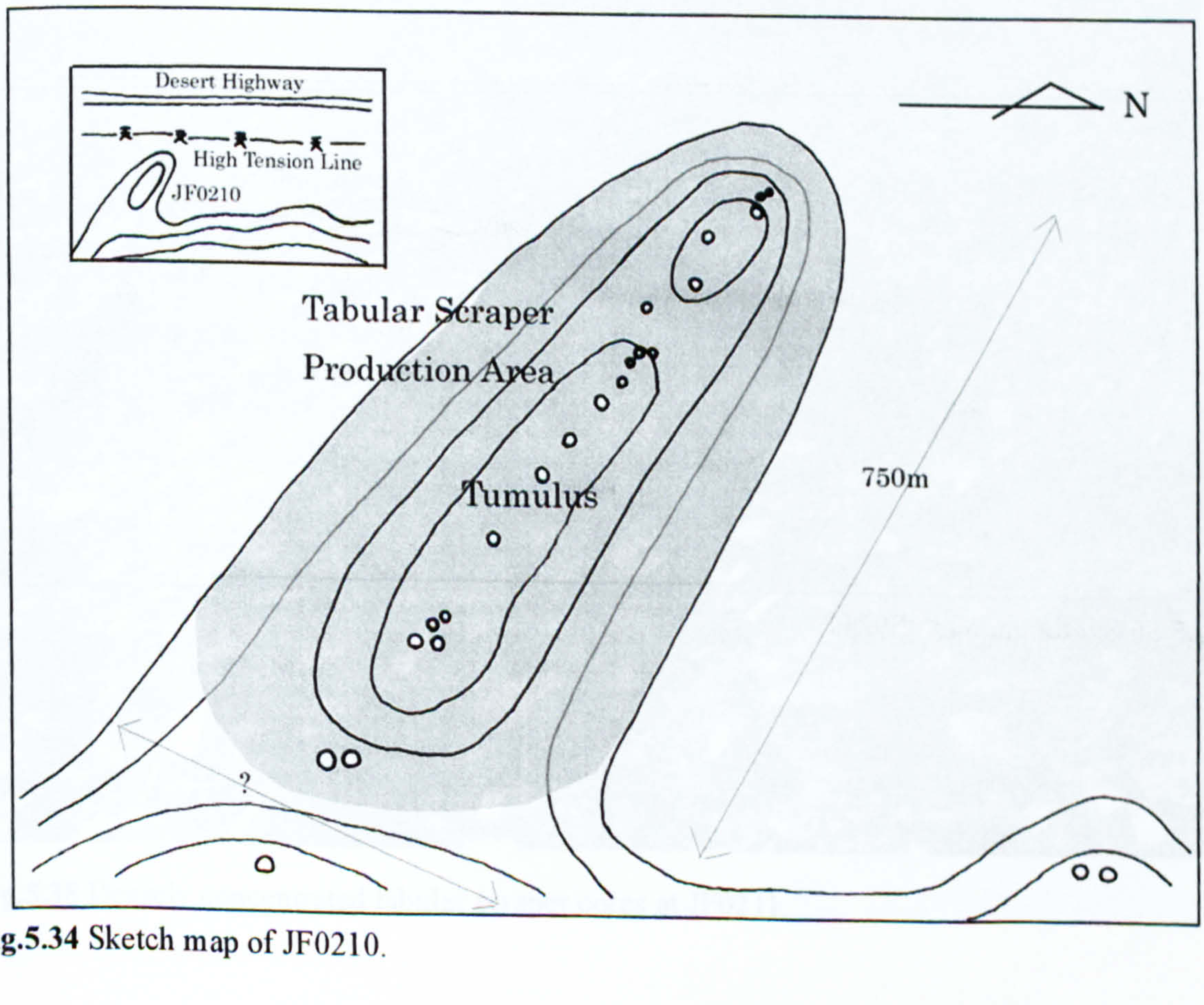


Fig.5.34 Sketch map of JF0210.

Fig.5.35 JF210 from the west.

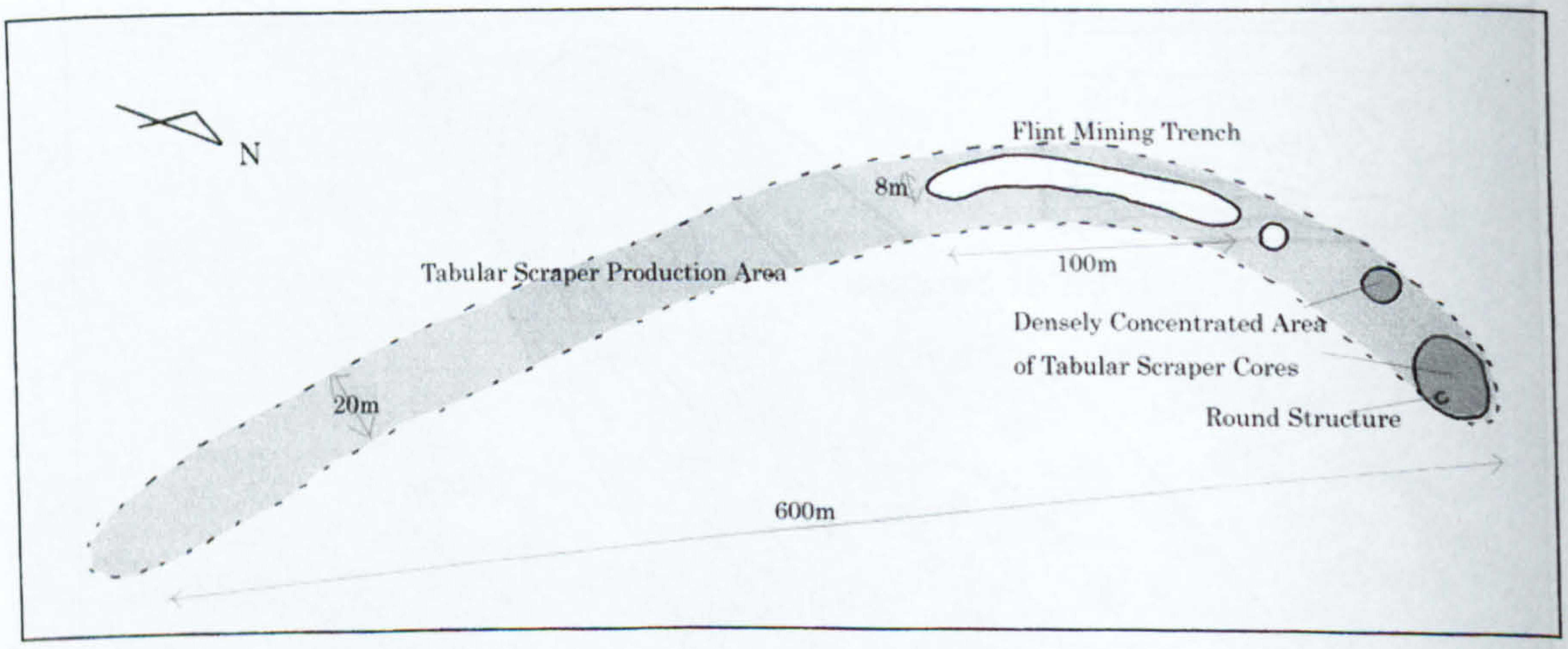


Fig.5.36 Sketch map of JF0211.

Fig.5.37 The round structure at the western edge of JF0211.

Fig.5.38 Densely concentrated tabular scraper cores at JF0211.

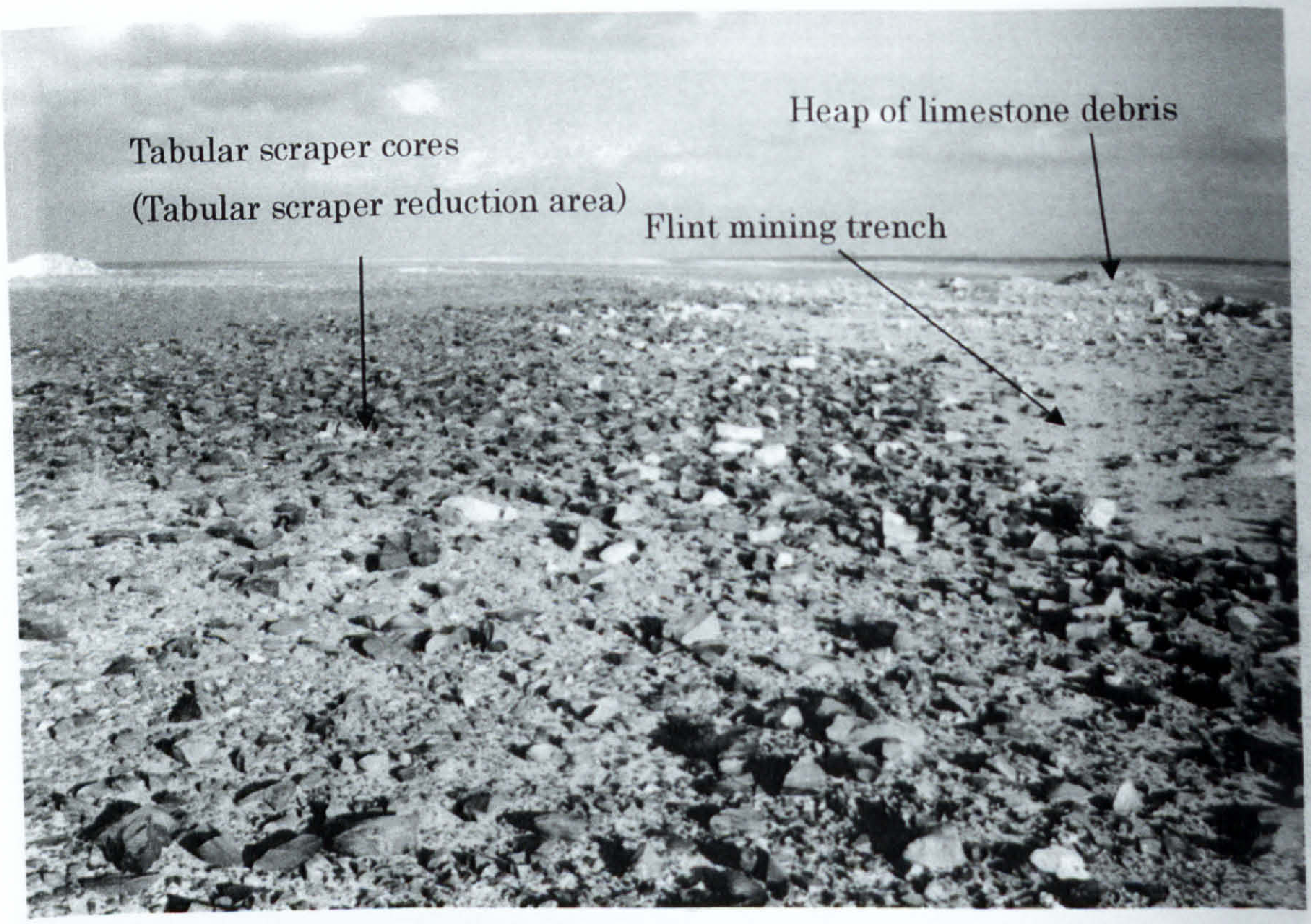


Fig.5.39 JF211.

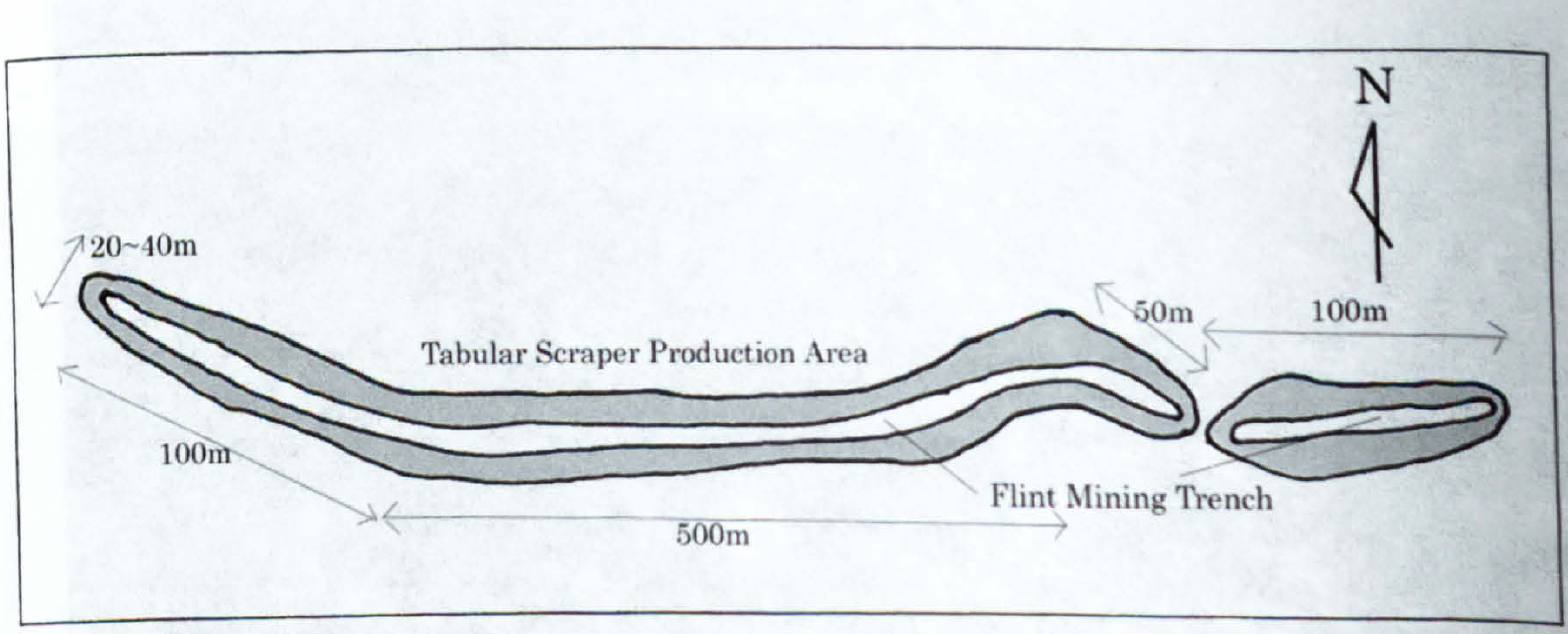


Fig.5.40 Sketch Map of JF0212.

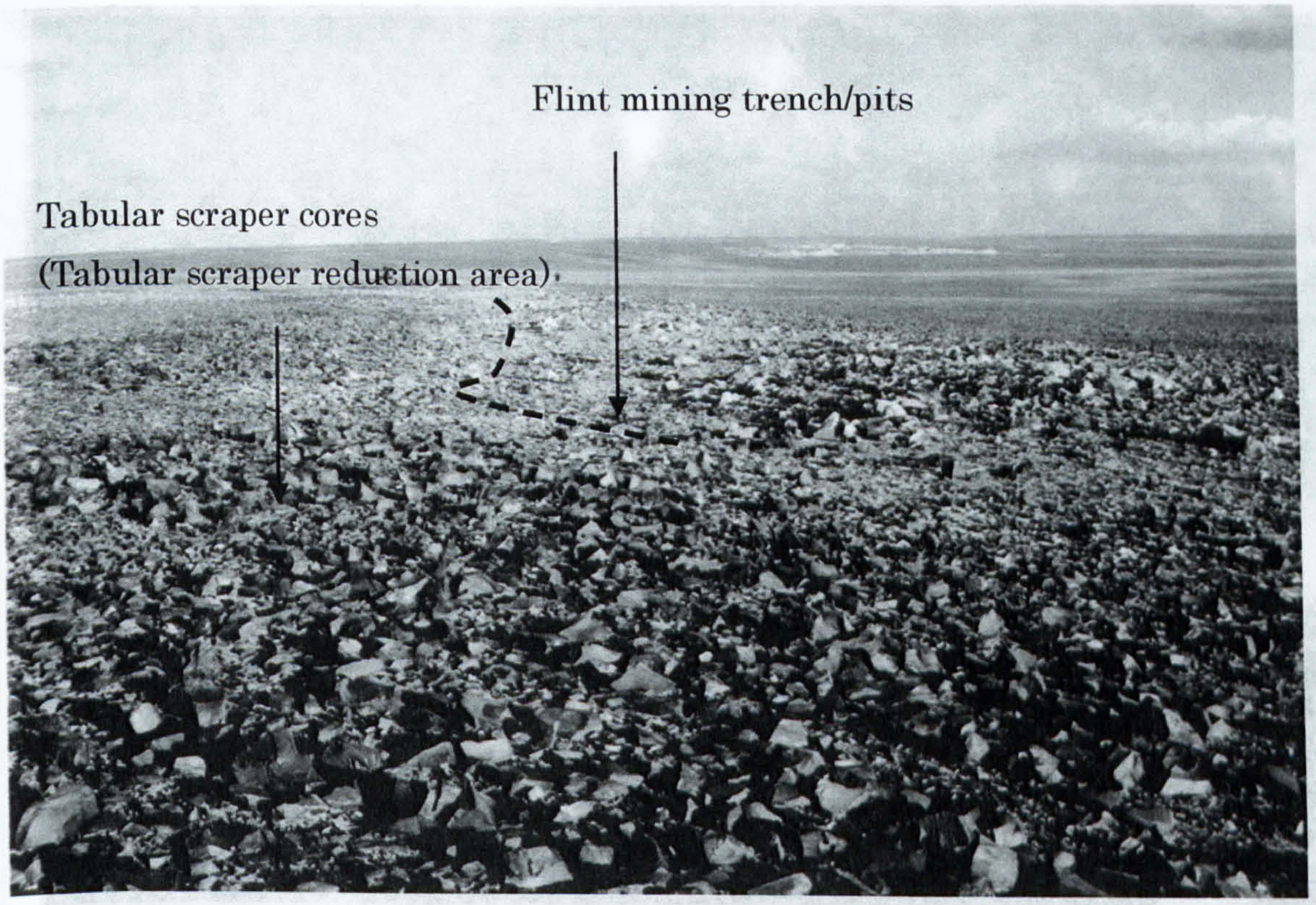


Fig.5.41 JF0212 from the west.

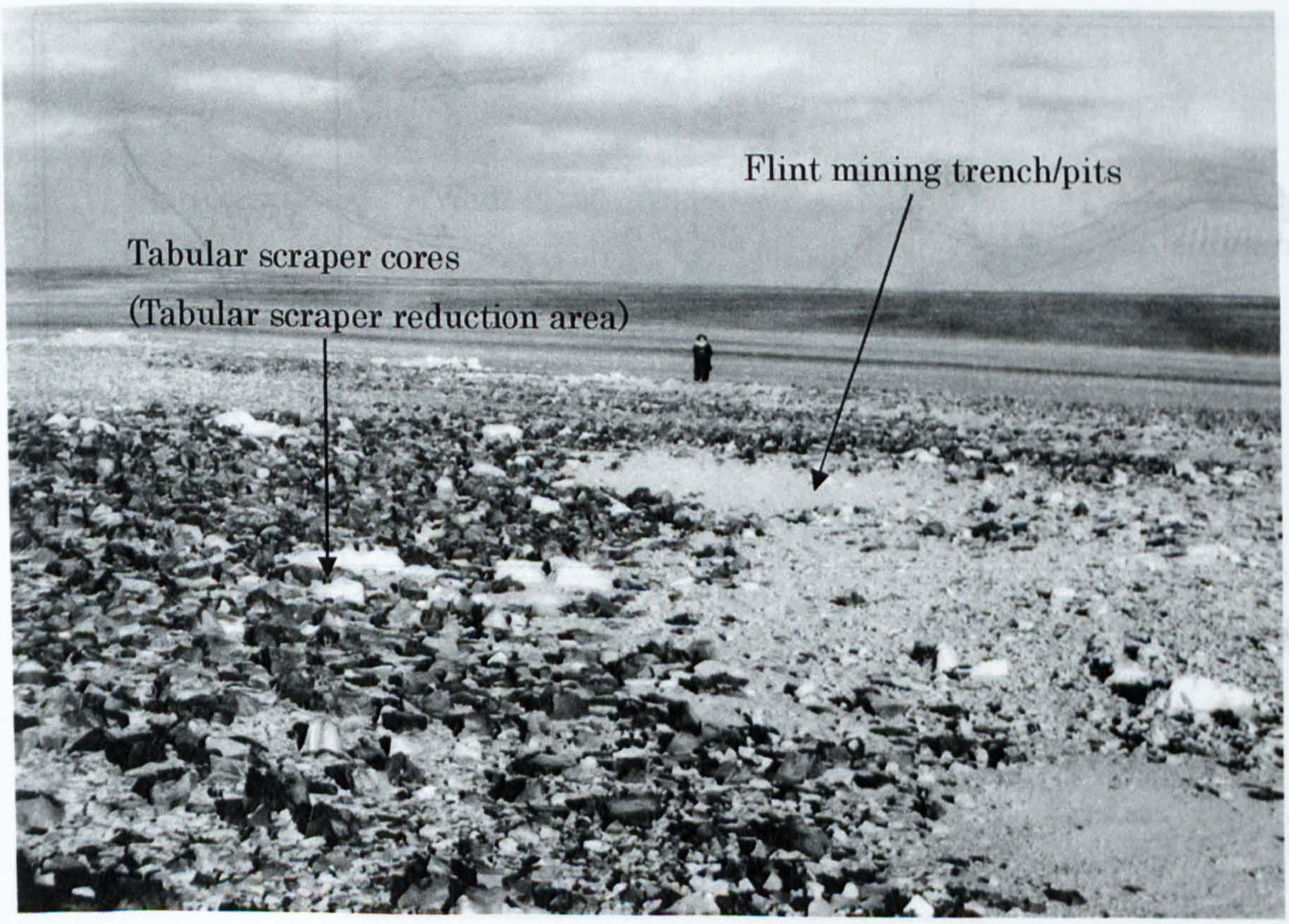


Fig.5.42 JF0212 from the west.

Fig.5.43 Tabular scraper cores at JF0212.

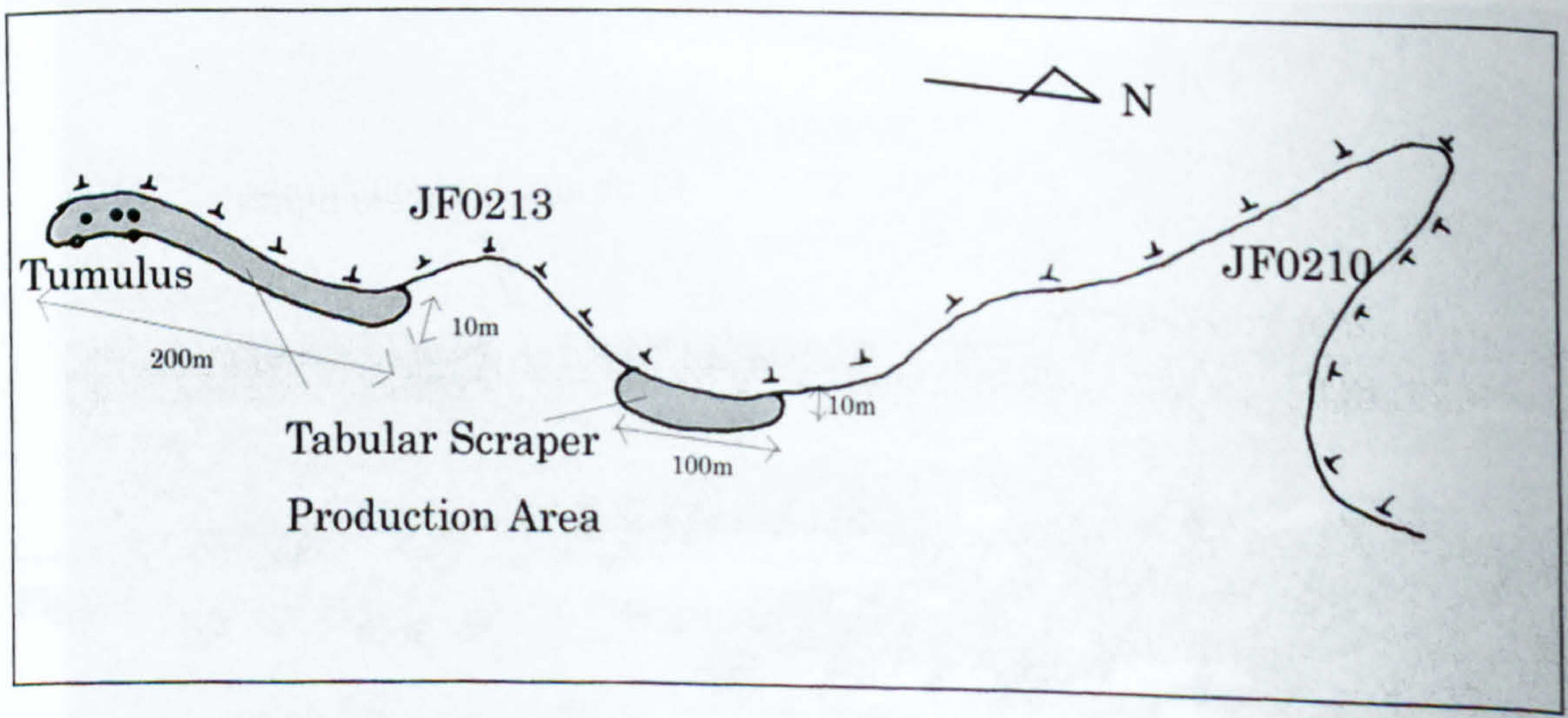


Fig.5.44 Sketch map of JF0213.

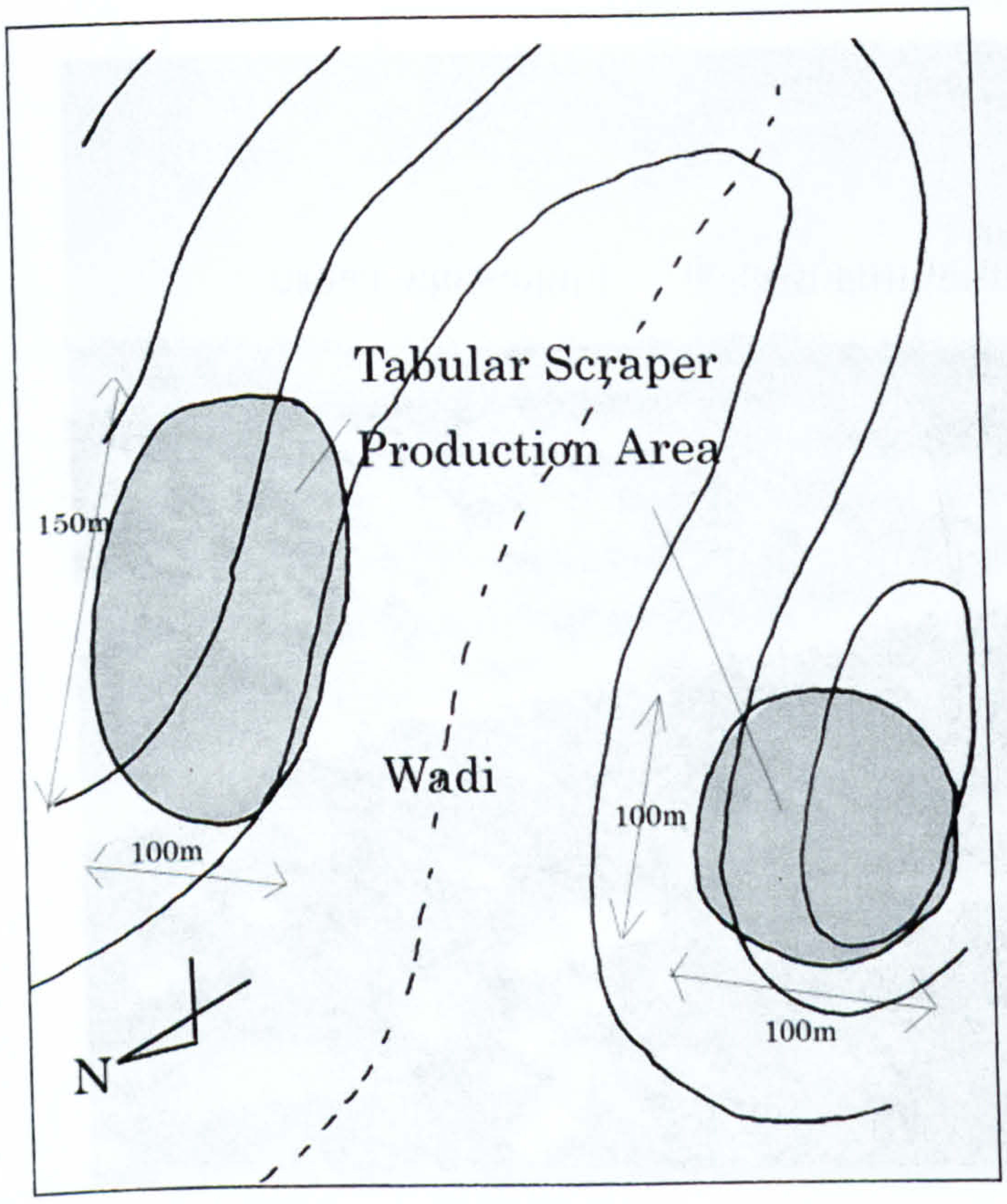


Fig.5.45 Sketch map of JF0214.

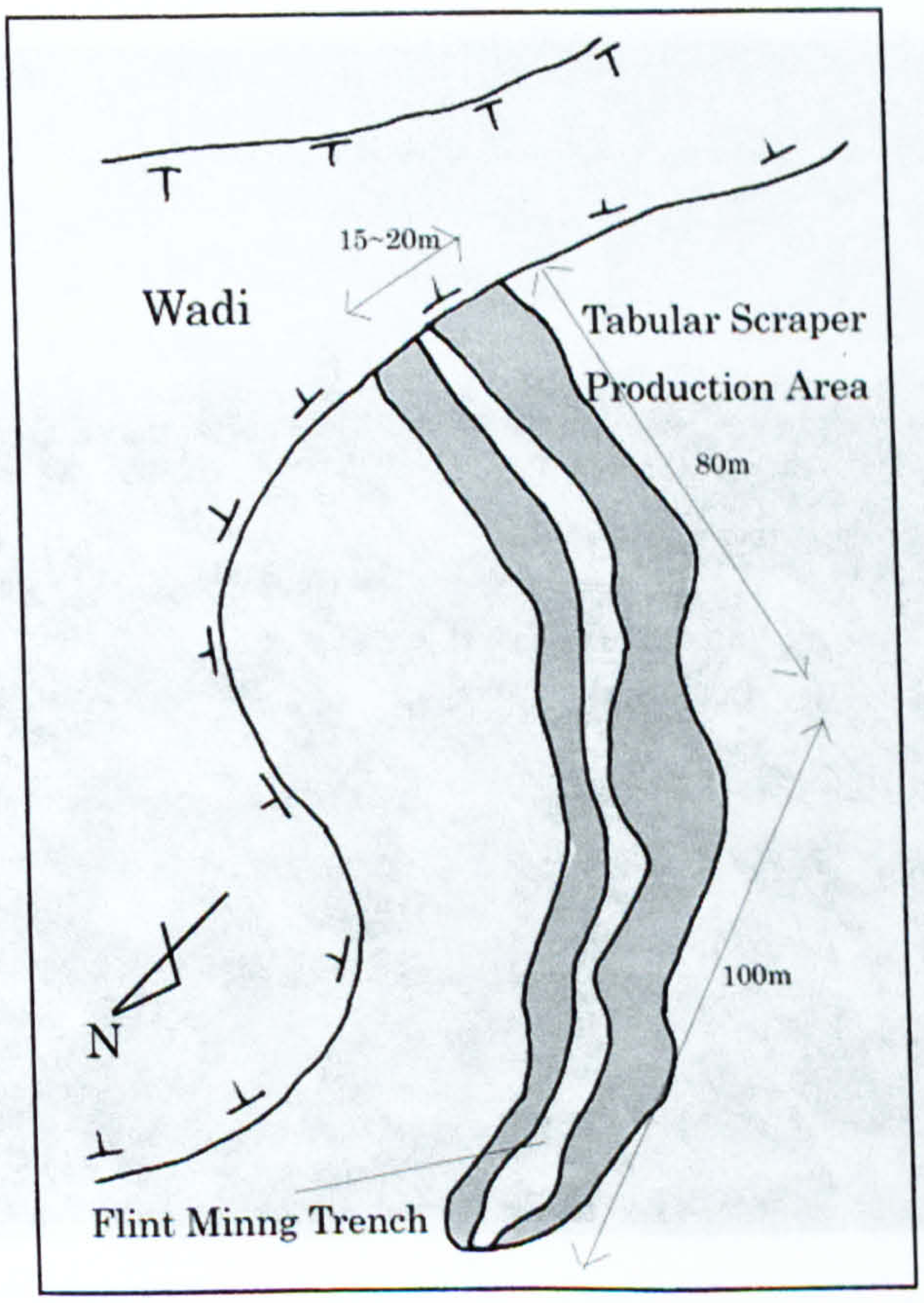


Fig.5.46 Sketch map of JF0215.

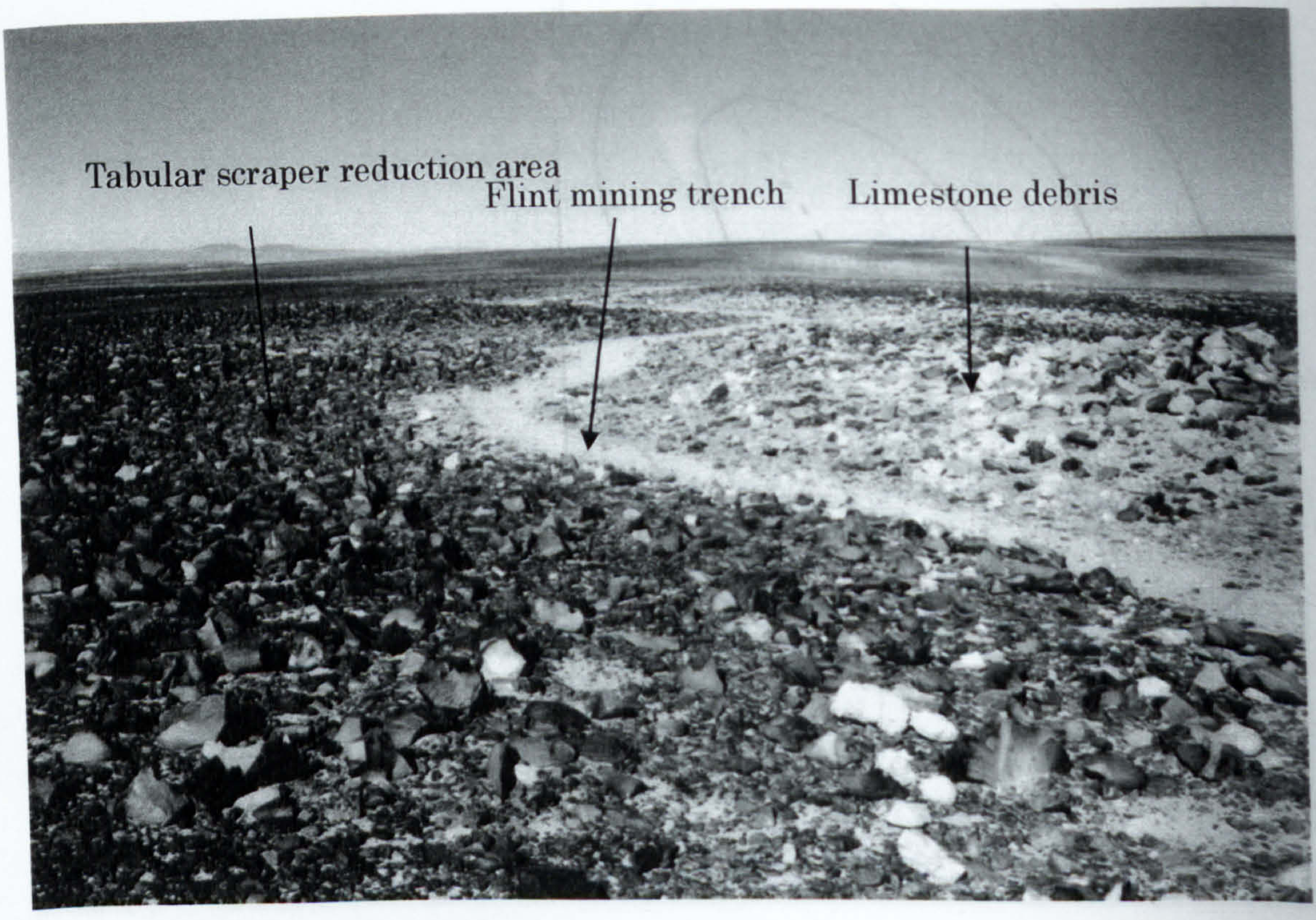


Fig.5.47 JF215. The view is from the east.

Fig.5.48 JF215.

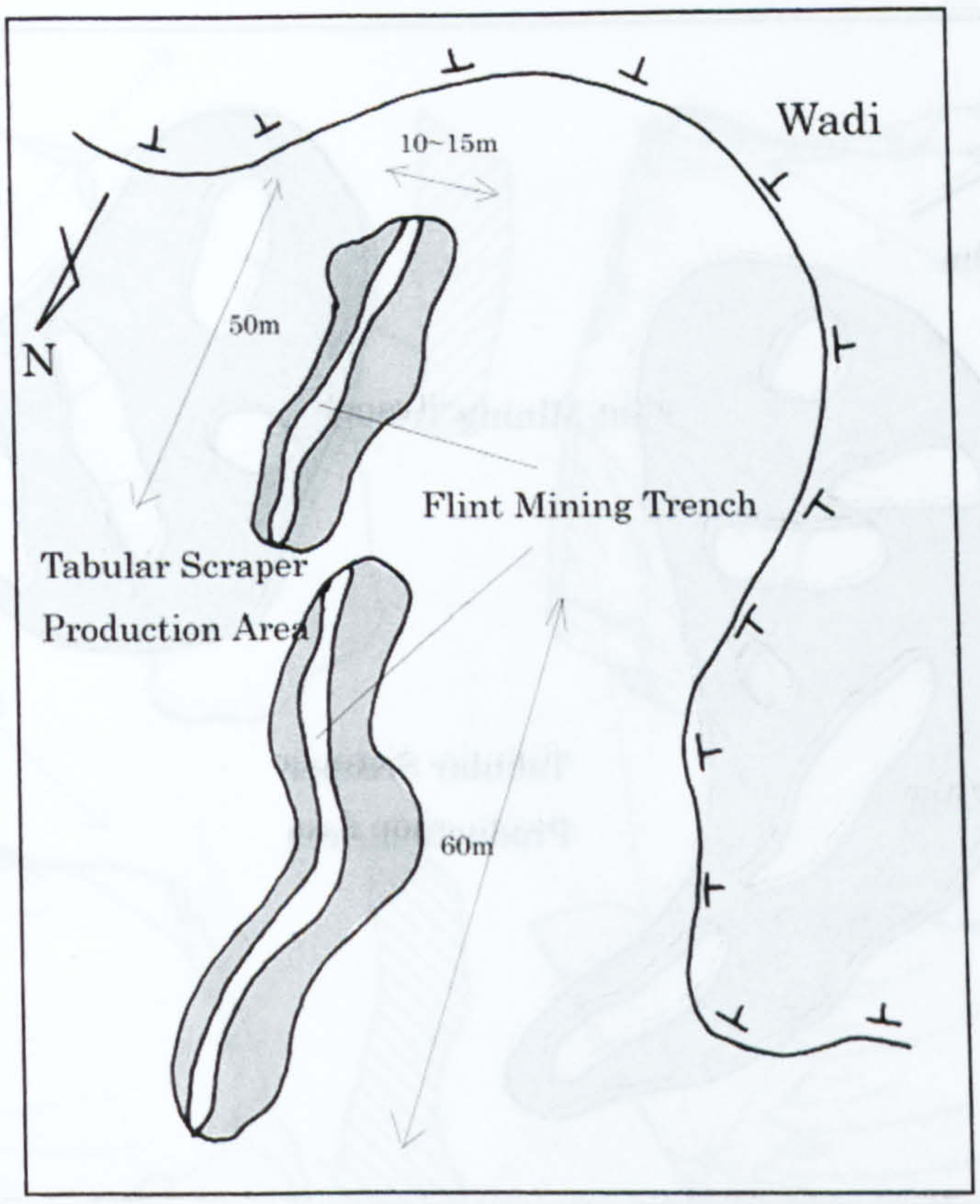


Fig.5.49 Sketch map of JF0216.

Fig.5.50 JF216.

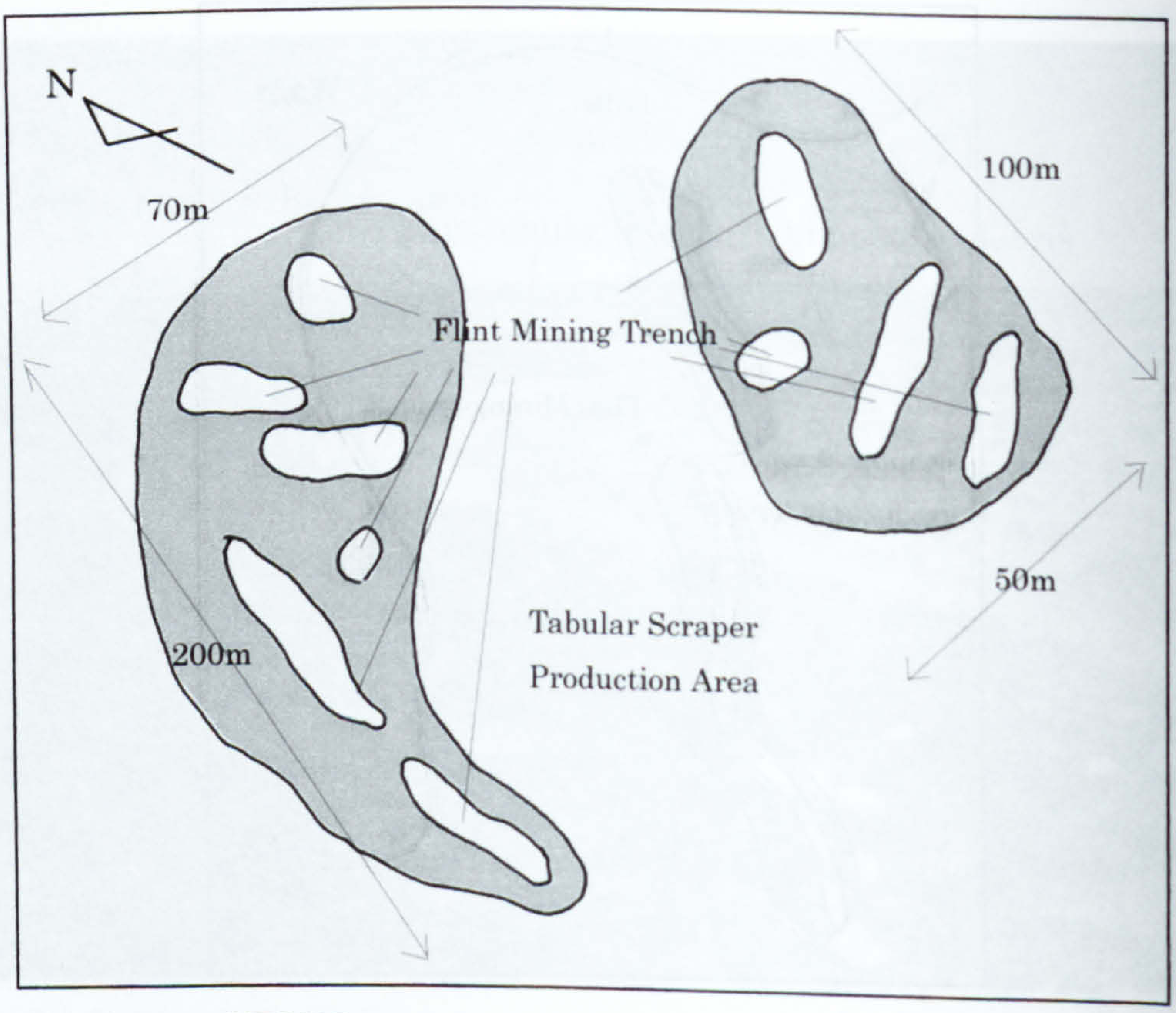


Fig.5.51 Sketch map of JF0217.

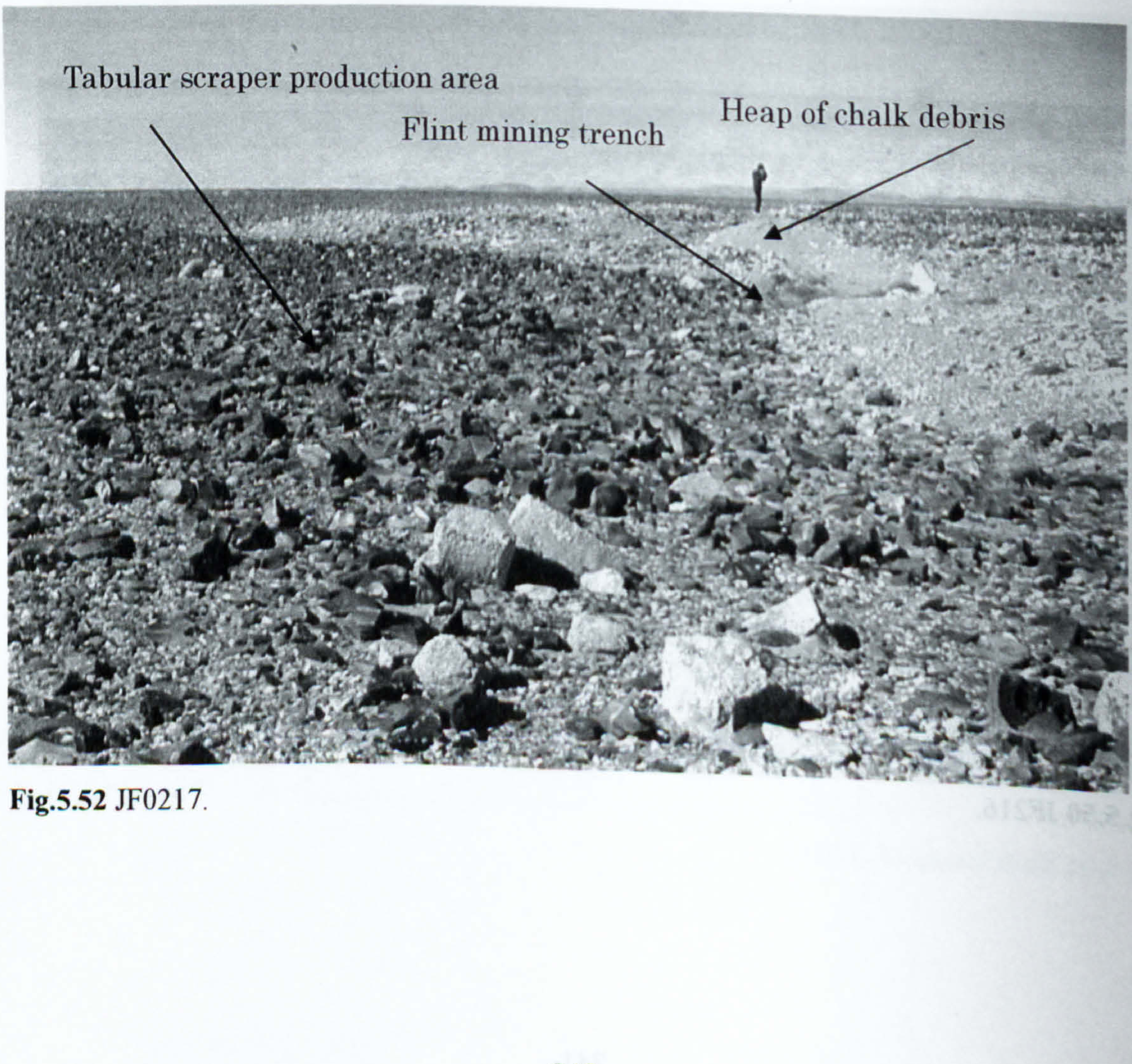


Fig.5.52 JF0217.

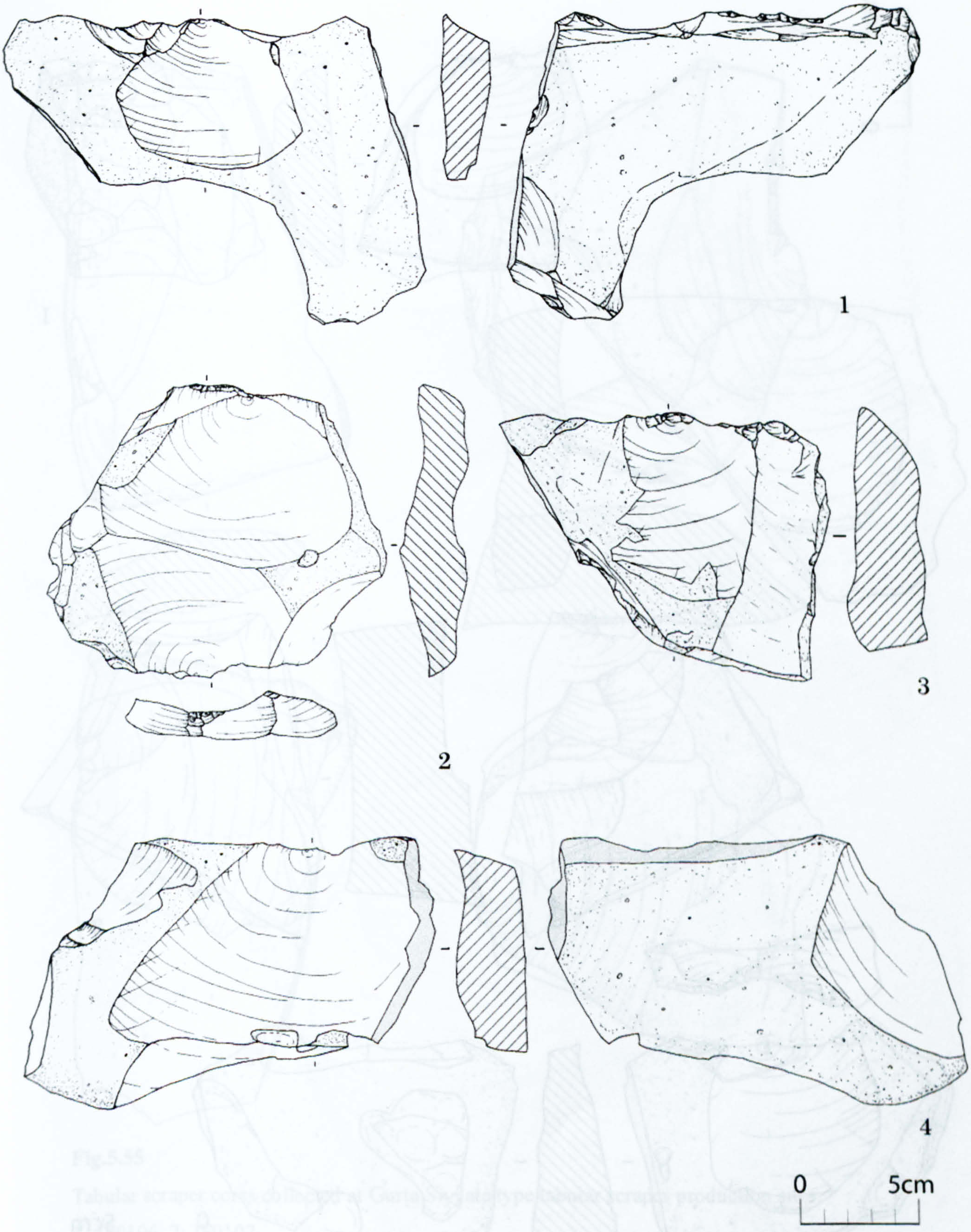


Fig.5.53 Tabular scraper cores collected at Gurta Siyyata type tabular scraper production sites.

1-2: JF0101, 3-4: JF0102.

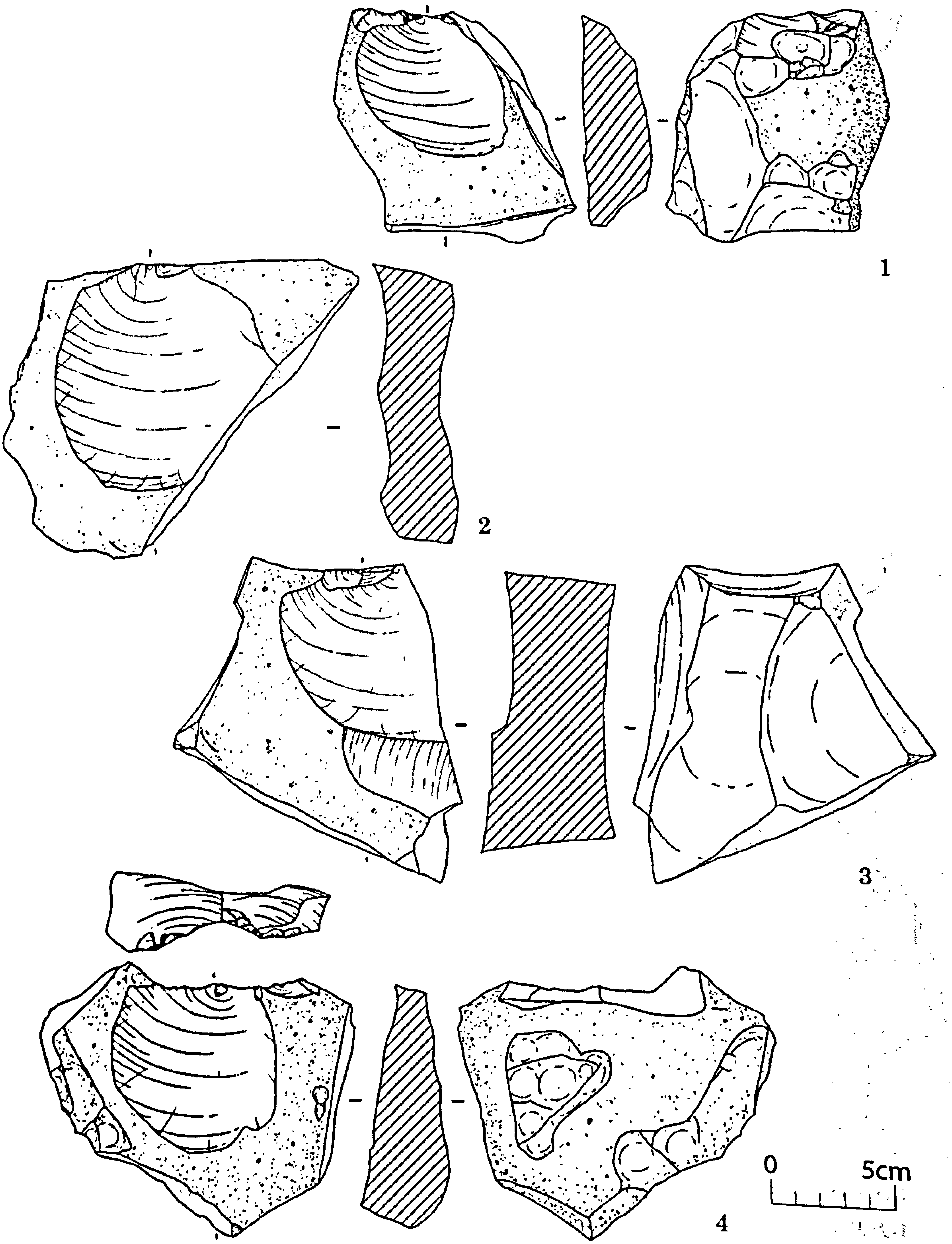


Fig.5.54 Tabular scraper cores collected at Gurta Siyyata type tabular scraper production sites. 1: JF0102, 2, 4: JF0103, 3: JF0106.

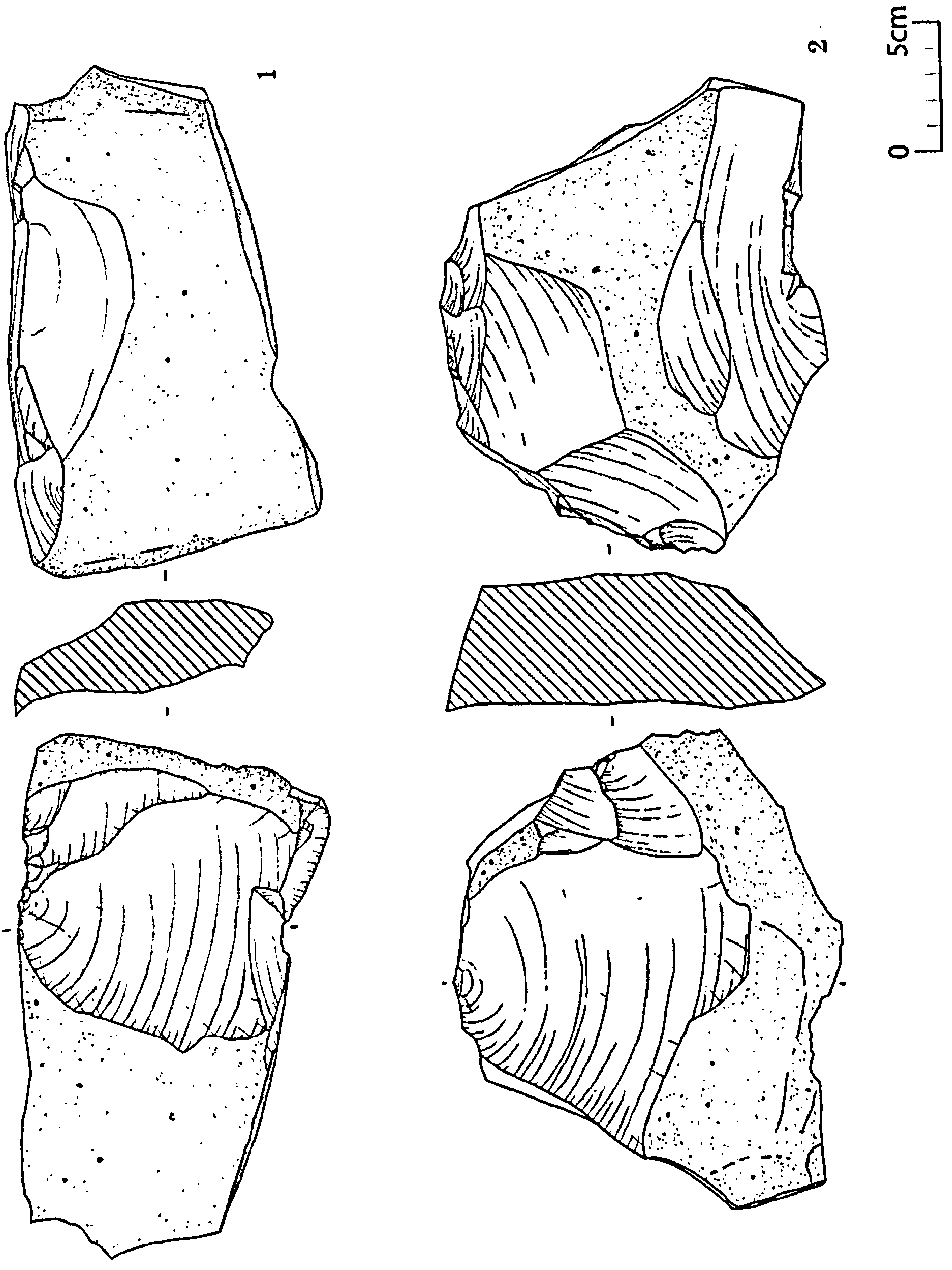


Fig.5.55

Tabular scraper cores collected at Gurta Siyyata type tabular scraper production sites.

1: JF0106, 2: JF0107.

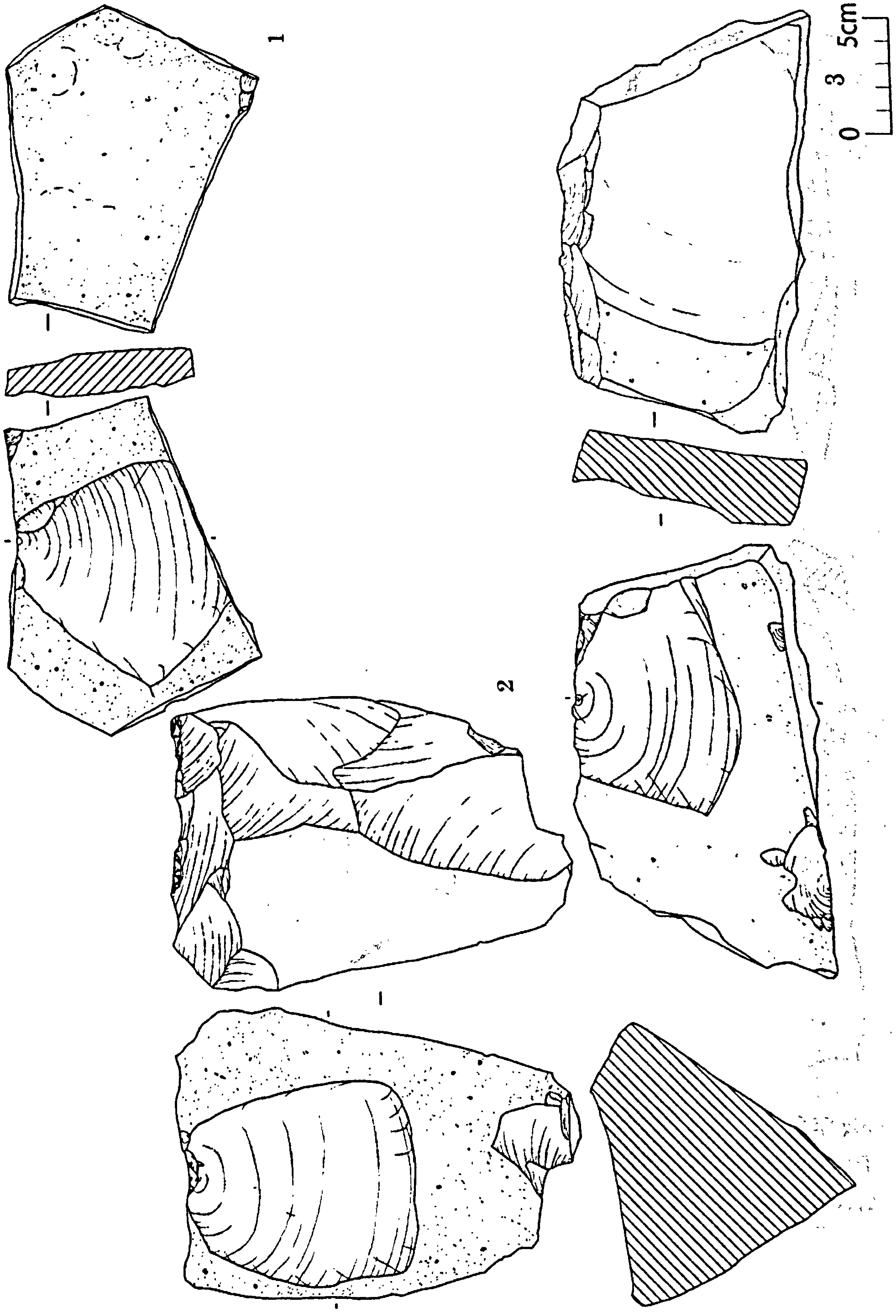


Fig.5.56 Tabular scraper cores collected at Gurta Siyyata type tabular scraper production sites. 1: JF0110, 2: JF0107, 3: JF0109.

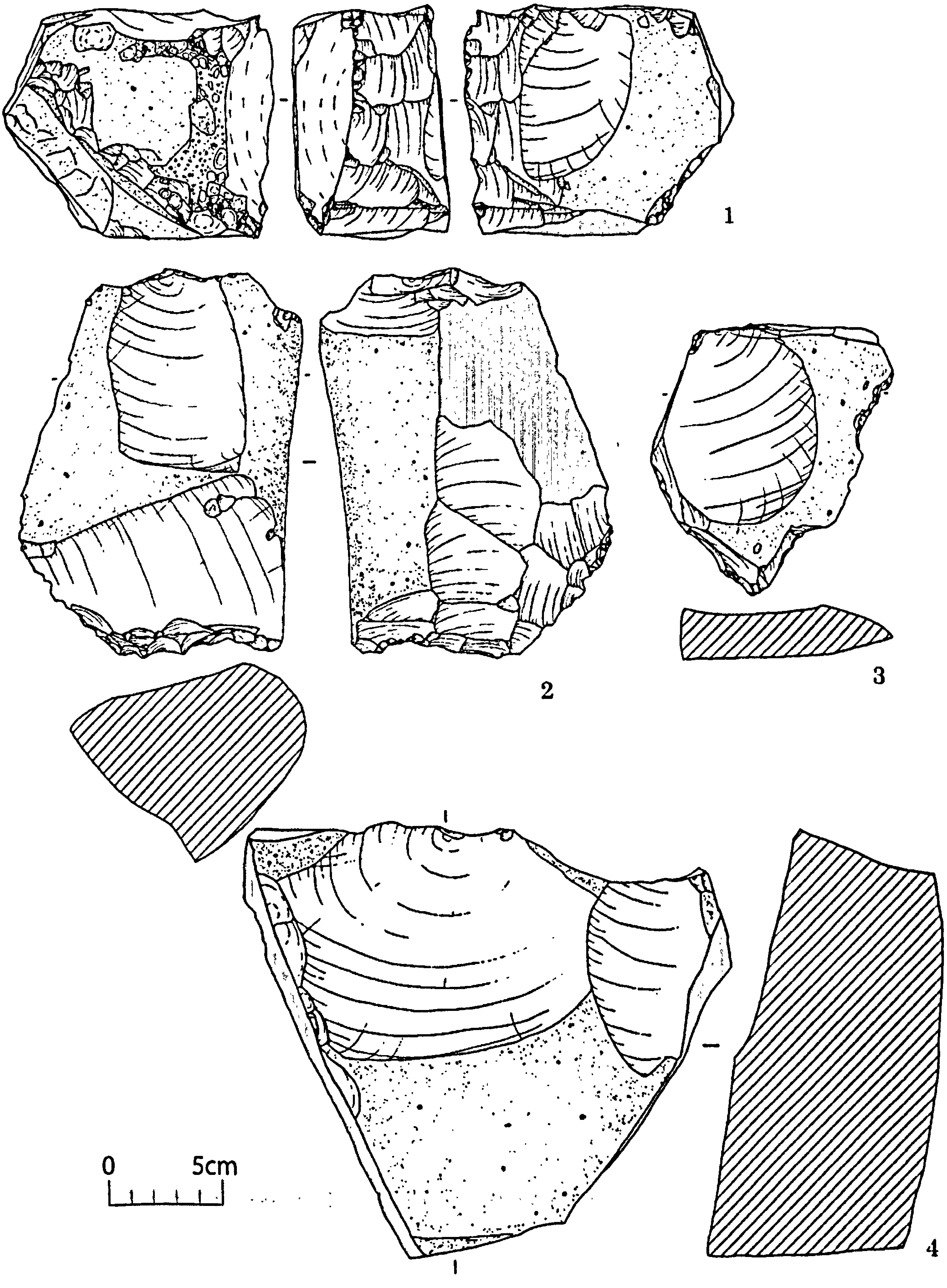


Fig.5.57 Tabular scraper cores collected at Gurta Siyyata type tabular scraper production sites. 1-3: JF0124, 4: JF0151.

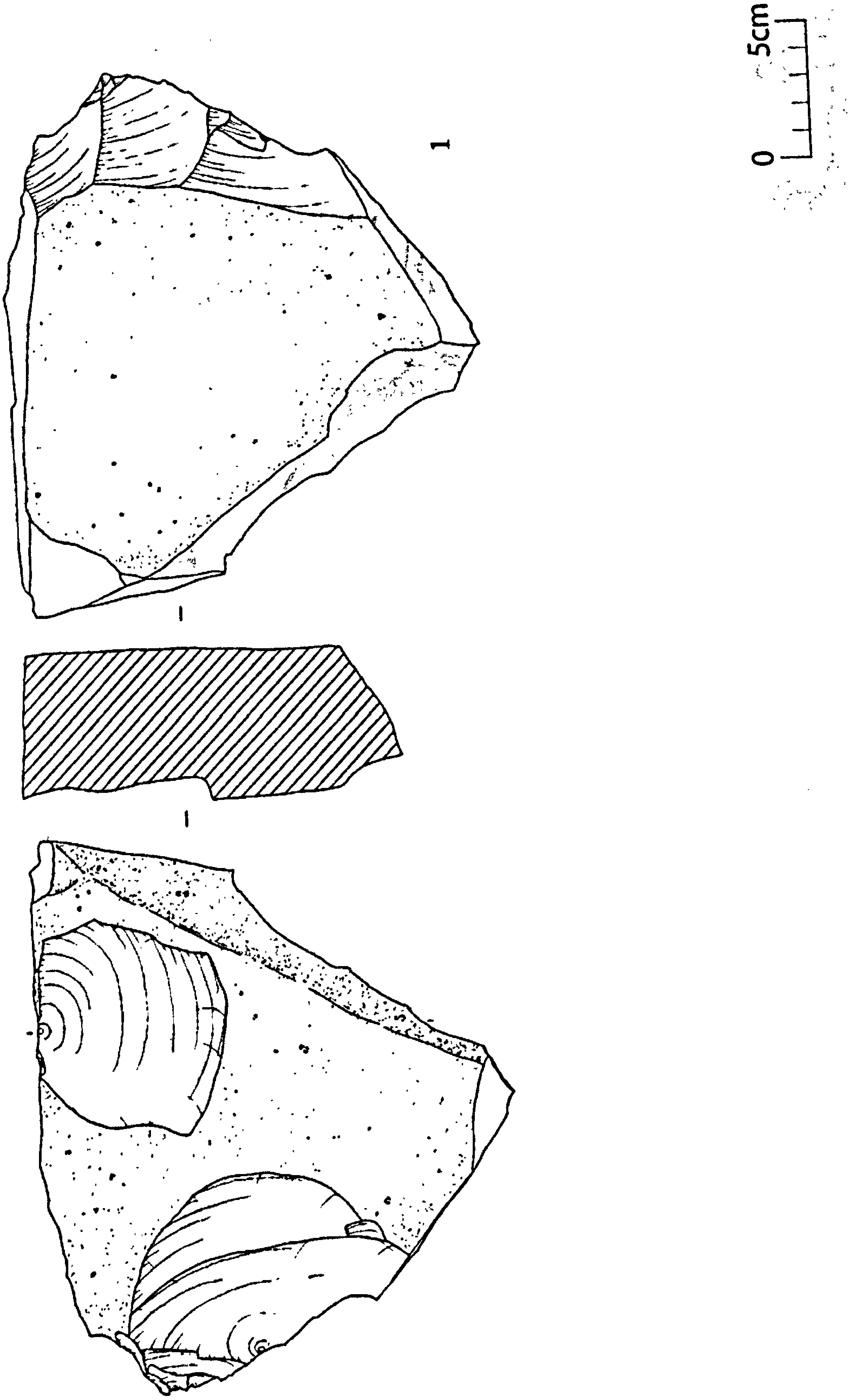


Fig.5.58 Tabular scraper cores collected at Gurta Siyyata type tabular scraper production sites.
1: JF0153.

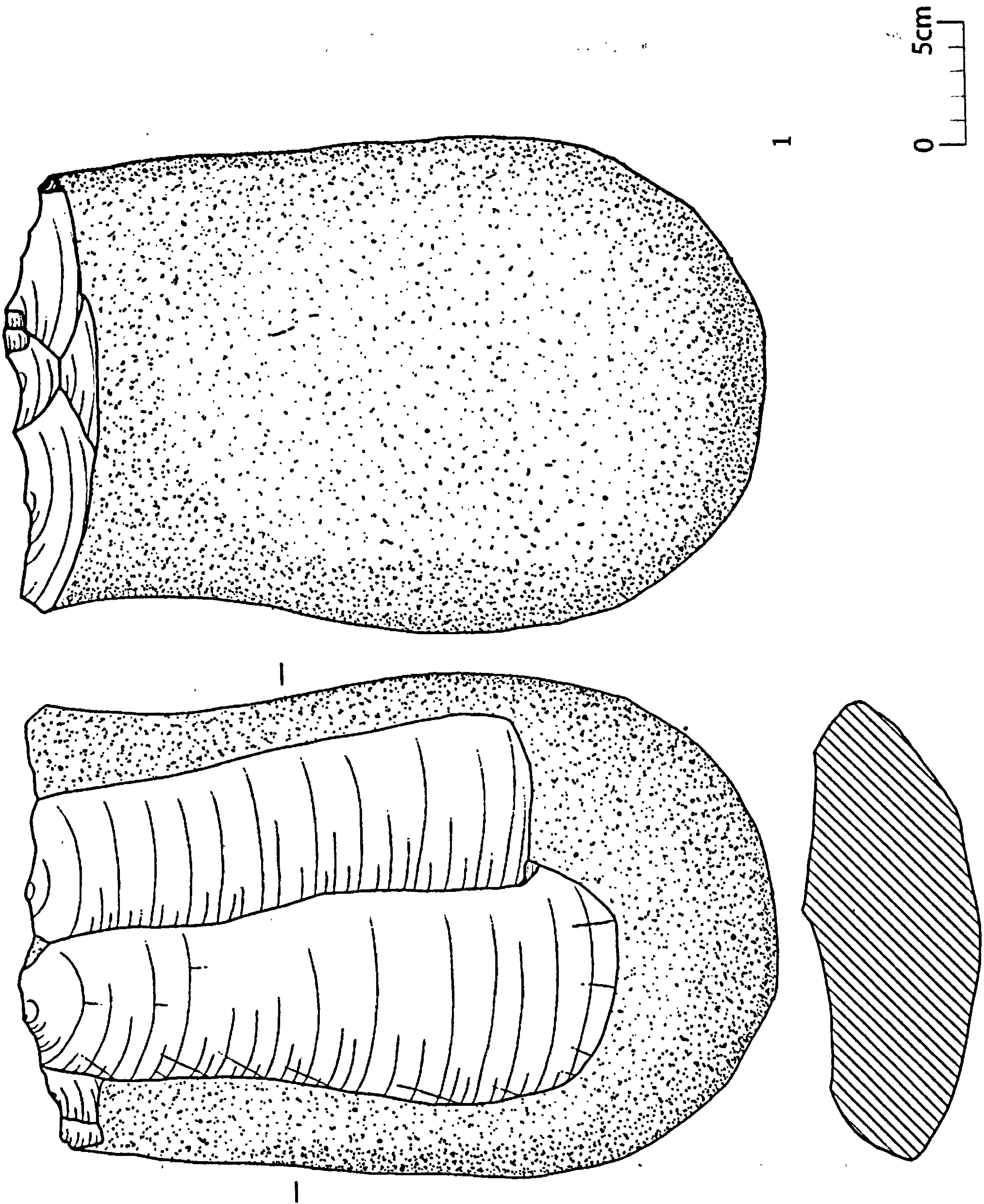


Fig.5.59 Tabular scraper cores collected at Qa Abu Tulayha type tabular scraper production sites.
1: JF0211.

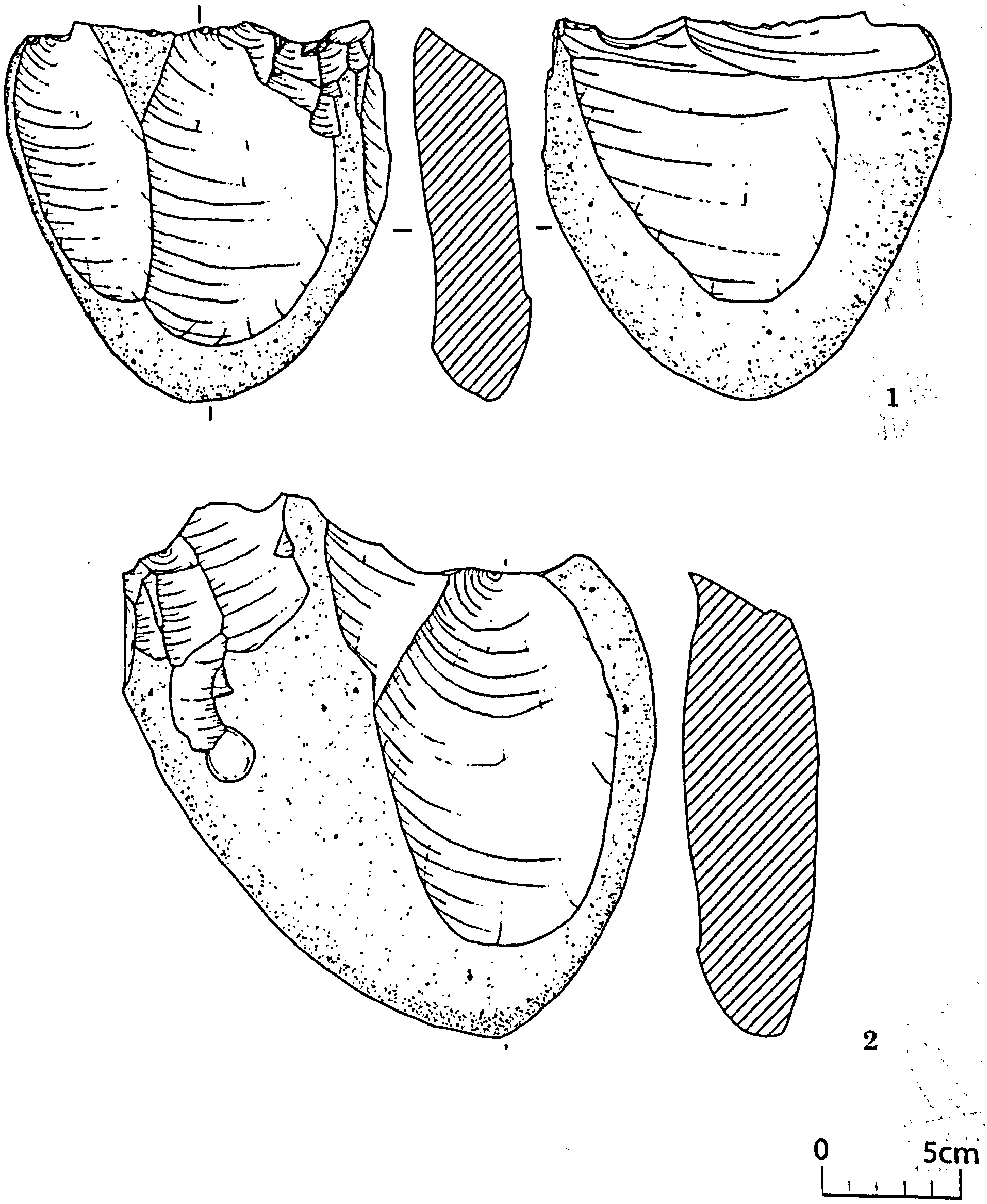


Fig.5.60 Tabular scraper cores collected at Qa Abu Tulayha type tabular scraper production sites. 1-2: JF0212.

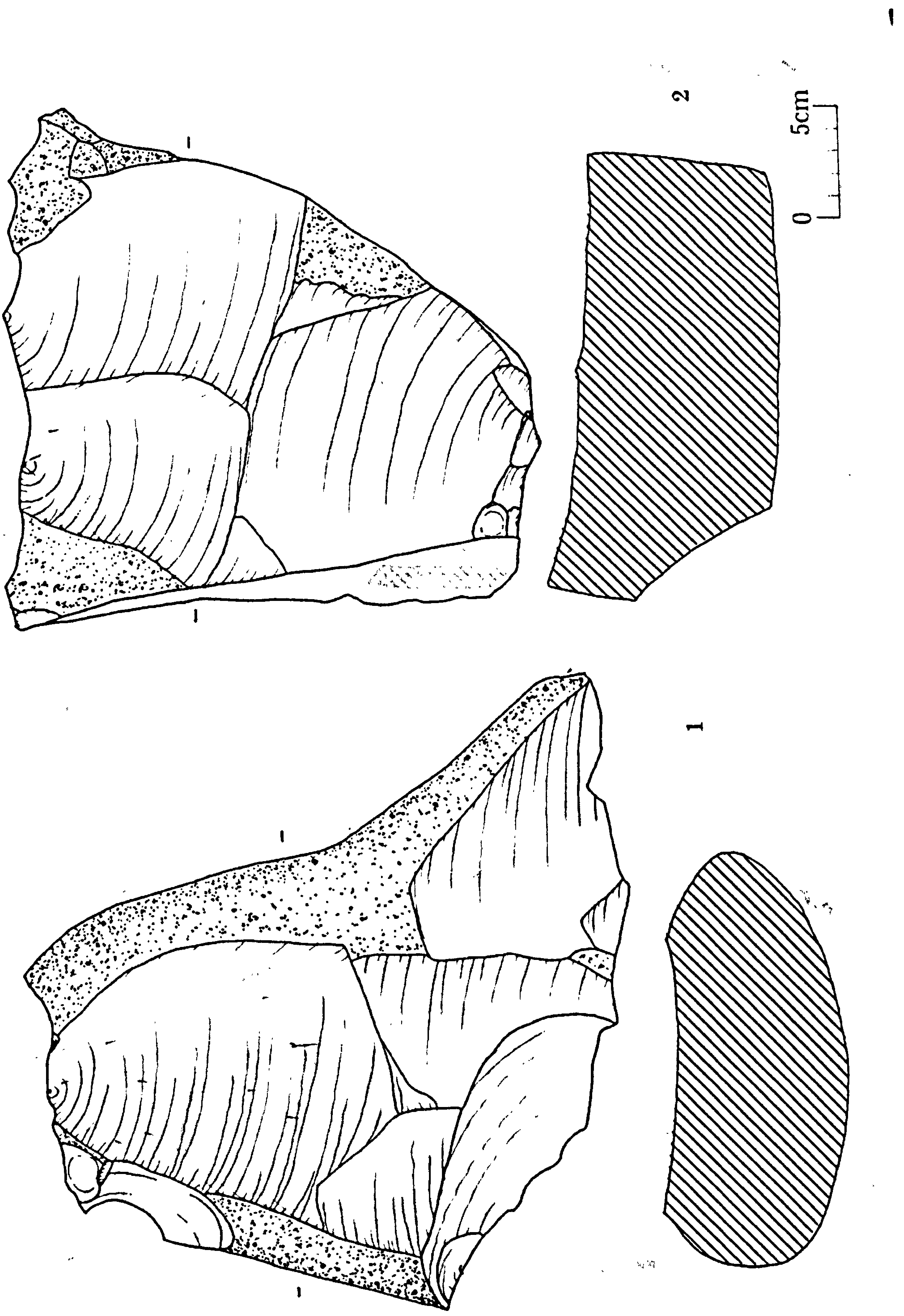


Fig.5.61 Tabular scraper cores collected at Qa Abu Tulayha type production sites.
1-2: JF0212.

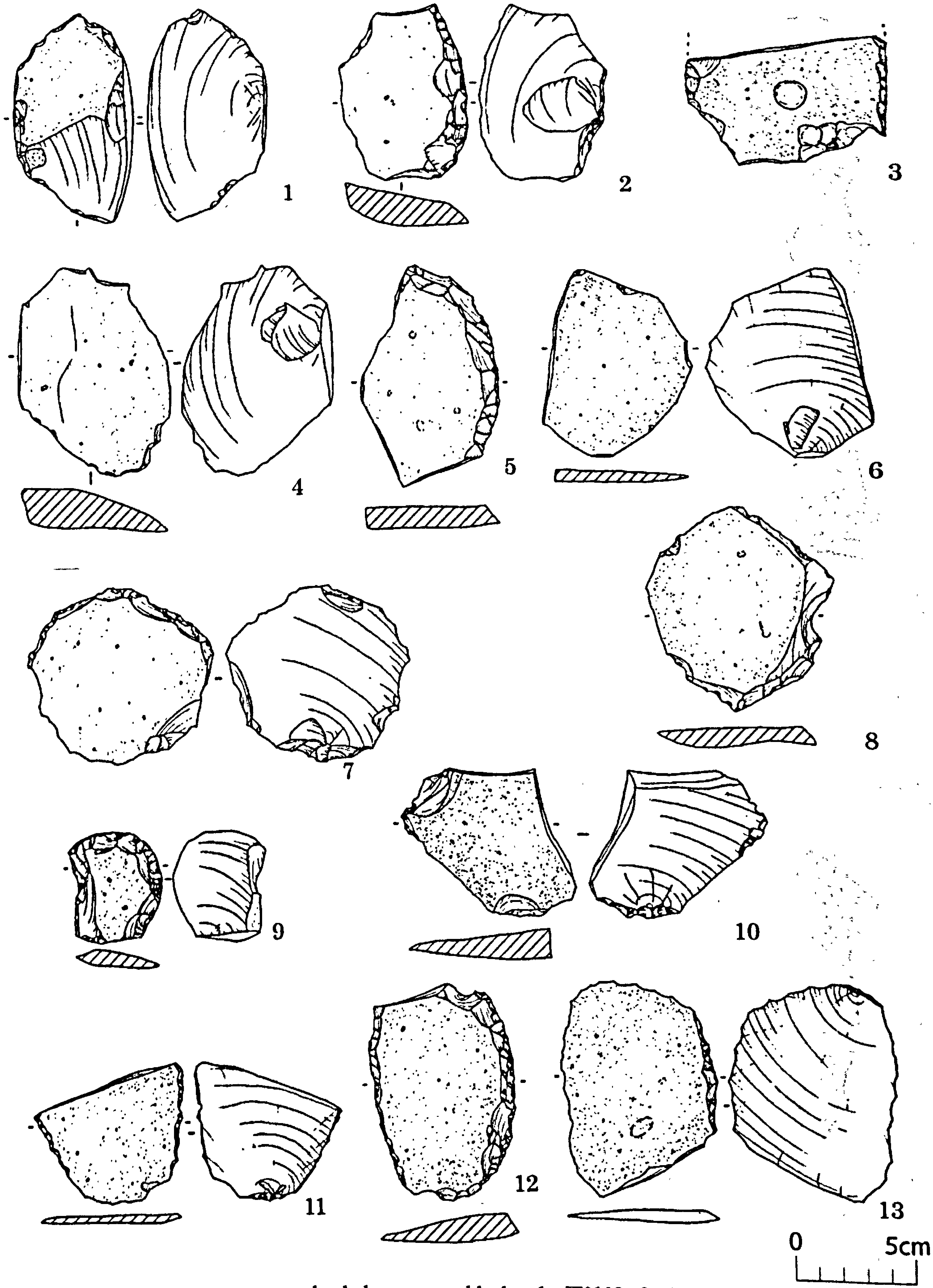


Fig.5.62 Tabular scrapers and tabular scraper blanks. 1: JF0102, 2, 4: JF0106, 3: JF0155, 5:JF0212, 6-7: JF0208, 8: JF0107, 9: JF0111, 10: JF0208, 11: JF9702, 12-13: JF9702.

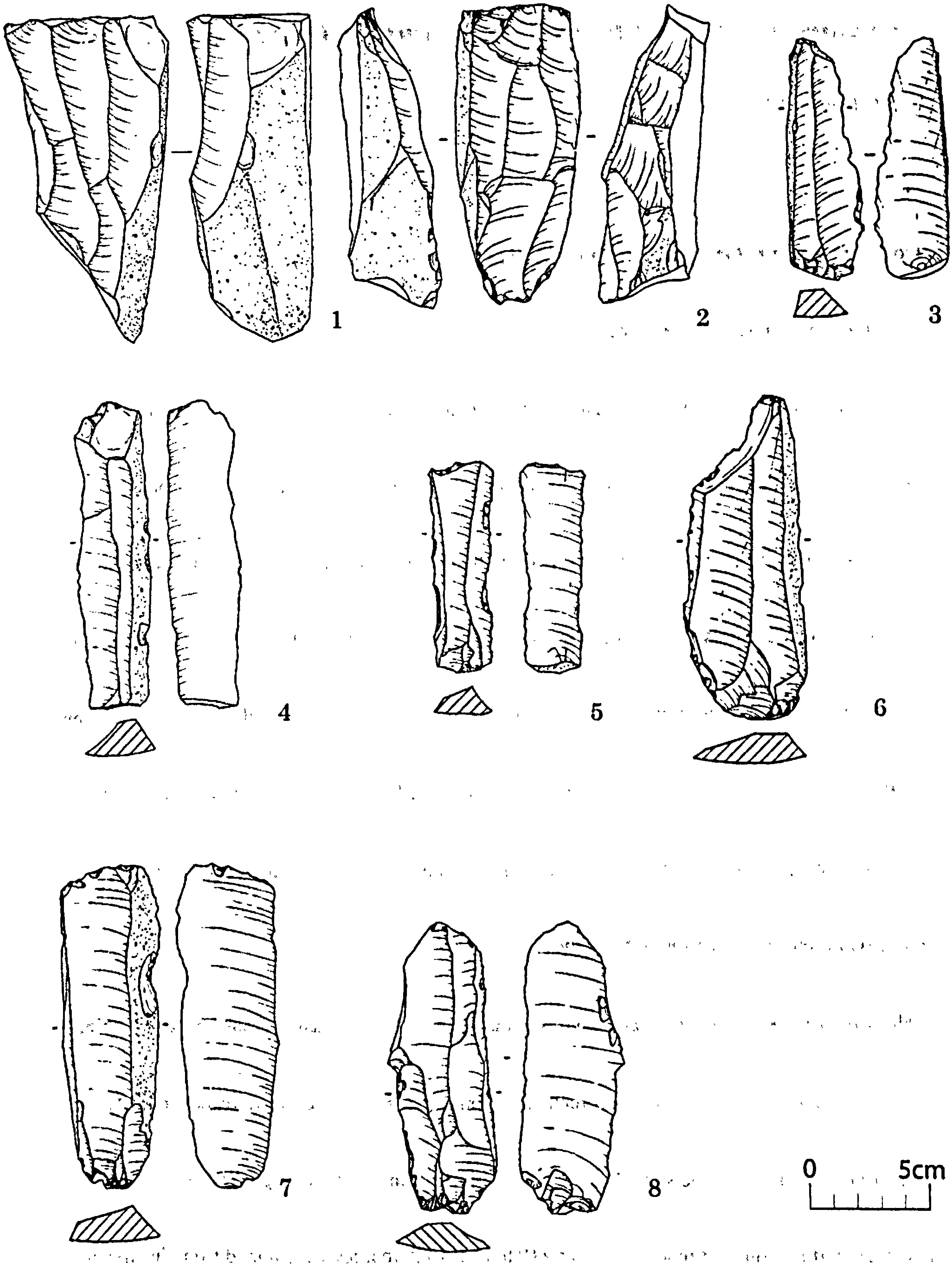


Fig.5.63 Jafr blades and Jafr blades cores.

1: JF0211, 2: JF0107, 3: JF0101, 4:JF0153, 5: JF0103, 6: JF0153, 7: JF0110, 8: JF0107.

Chapter 6 TABULAR SCRAPER PRODUCTION AT QA ABU TULAYHA

6.1 THE SITE OF QA ABU TULAYHA

6.1.1 The site of Qa Abu Tulayha

As discussed in Chapter 5, a number of Chalcolithic and Early Bronze Age tabular scraper production sites were located in the northwestern part of the Jafr Basin by the Japanese surveys (Abe and Fujii 2004). In total, 60 sites were discovered by Japanese surveys. Amazingly, nearly half of the discovered sites, 25 sites are tabular scraper production sites. 6 of 25 tabular scraper production sites are classified as Qa Abu Tulayha type tabular scraper production sites. Qa Abu Tulayha type sites are tabular scraper production sites with intensive flint mining. An American team also discovered three Qa Abu Tulayha type production sites in the northeast part of the basin (Quintero, Wilke and Rollefson 2002).

The size of Qa Abu Tulayha type tabular scraper production sites ranges from 2.3 ha to 0.15 ha. At every Qa Abu Tulayha type site, remains of intensive flint mines were discovered. At the largest Qa Abu Tulyha type site, JF0212, a flint mining trench whose length is over 700 m was discovered. It is estimated that as much as 410 tons of flint nodules were mined from this trench. Even at the smallest Qa Abu Tulayha type site, JF0216, two mining trenches whose length is about 50 m were discovered. 60 tons of flint nodules were extracted even at this site.

Great efforts were made in the acquirement of raw material at Qa Abu Tulayha type tabular scraper production sites. At these sites, very large flint nodules whose average size is bigger than human head size were extracted. As will be discussed below in detail, large end struck oval/elongated tabular scrapers were produced at Qa Abu Tulayha type sites. Mining large and fresh flint nodules were necessary to produce a certain amount of such large and long tabular scrapers. The site of Qa Abu Tulayha, the type site of Qa Abu Tulayha type tabular scraper production sites, will be explained in detail below.

The site of Qa Abu Tulayha (JF9503) is the type site of Qa Abu Tulayha type tabular scraper production sites. The site was discovered in 1995 and intensively excavated from 1997 to 2002 as a part of the Jafr Basin Prehistoric Project by S. Fujii at Kanazawa University in Japan (Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002c, Fujii 2003).

The site was named after a small playa, Qa Abu Tulayha in the northwestern area of the Jafr Basin. The site is situated on a low hill between Qa Abu Tulahya and Wadi ar-Ruwayshid (Fig.5.2, Fig.6.2).

The site consists of two parts: Qa Abu Tulayha East and Qa Abu Tulayha West (Fig.6.2, Fig.6.3). A modern road running between the Desert Highway and the village of al-Jafr passes through the site. The area above the road is designated Qa Abu Tulayha East and the area below the road is designated Qa Abu Tulayha West. Qa Abu Tulayha West was subject to intensive excavations while Qa Abu Tulayha East was only mapped briefly because Qa Abu Tulayha East was heavily damaged and totally erased by modern limestone quarrying soon after its discovery.

The site of Qa Abu Tulayha was occupied mainly in two periods: Late Neolithic and Early Bronze Age. The Late Neolithic occupation has no relationship with tabular scraper production. During the Late Neolithic period, about 30 rectangular structures were constructed (Fig.6.1). The rectangular structures run in lines. The average size of the rectangular structures is about 8 m by 7 m. Walls of the structures were made of two rows of limestone and flint upright slabs. The structures consist of one main large rectangular room and small subsidiary rooms. The structures are characterized by a scarcity of ecofacts and artifacts. Each structure has a cairn on the southeastern corner. The average diameter of the cairns is about 2 m. S. Fujii interpreted the rectangular structures as funerary buildings for the dead accompanying cairn tombs although no cairn yielded human bones or burial goods. S. Fujii dated the structures to the Late Neolithic on the basis of one radiocarbon sampe from a hearth from a rectangular structure, B.P.7060±50 (Calibrated 5991-5901 B.C) (Fujii 2001a, Fujii 2001b, Fujii 2002c).

The occupation during the Early Bronze Age was characterized by intensive tabular scraper production. Tabular scraper production at the site is dated to the Late Early Bronze Age I and Early Bronze Age II on the basis of two radiocarbon samples, B.P 4245±30 (NUTA2-2022) (Calibrated 2902-2765 BC) and B.P. 4540±70 (NUTA2-1978) (Calibrated 3362-3102 B.C). No structure yielded dateable pottery sherds.

At Qa Abu Tulayha, processes of tabular scraper production, core reduction and blank modification, were separated in two places: round structures and flint mining areas (Fig.6.64). While flint mining areas are located on the eastern and western slopes of the hill, round structures are located on the top of the hill (Fig.6.2, Fig.6.3).

In flint mining areas (W-01, W-02, W-09, W-03, W-05, W-06, Qa Abu Tulayha East), large flint nodules were intensively mined. Remains of flint mining pits can be still observed on the surface and extracted large flint nodules are scattered densely around the pits. Tabular scraper flakes (blanks) were also detached in the flint mining areas. A number of dense spreads of cores were recorded by the extraction pits. Several thousand tabular scraper cores in total are probably present in these mining areas at Qa Abu Tulayha. Among flint mining areas, W-06 mining area was selected and trenched in 2002 (Fujii 2003). The author directed the excavation.

Other areas with cores are also known on the west and east slopes (W-04, W-07, W-08, W-10). In these areas, flint bedrocks are exposed in places and small flint blocks, which were split naturally from the bedrocks, are available on the surface without mining. These small flint blocks on the surface were selected and used as raw material for tabular scraper production. However the density of tabular scraper cores is extremely low. Tabular scraper cores and associated debitage are scattered very thinly among the flint blocks. These areas yielded far fewer tabular scraper flakes than the flint mining areas. At Qa Abu Tulayha, most tabular scraper flakes (blanks) were detached in the flint mining areas rather than the areas with surface blocks.

From the flint mining areas and other areas with cores, tabular scraper blanks were transported to round structures on the top of the hill. There are four round structures on the top of the hill (Structure 01, Structure 03, Structure 07 and Structure 51). Every four structure was excavated. The excavations reveal that most tabular scraper flakes (blanks) were carried to Structure 01 and Structure 07 and retouched carefully inside and around these two round structures (Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002c, Fujii 2003).

At Qa Abu Tulayha, Jafr blades were also produced on a much smaller scale at Structure 1001 (Fujii 1999, Fujii 2002a). This structure is to the east of the hill. Jafr blade production and this structure will be described separately in Chapter 10.

The next sections will describe each structure, flint mining area and area with surface blocks in detail.

6.1.2 Flint mining areas at Qa Abu Tulayha

Several flint mining areas (W-01, W-02, W-03, W-05, W-06, W-09) were discovered at Qa Abu Tulayha West. Their length is usually from 30 m to 50 m. Other flint mining areas are also known at Qa Abu Tulayha East. Their length is longer and usually about 100 m (Fig.6.2).

As will be described later, I assume that larger flint mining areas at Qa Abu Tulayha East were probably formed by flint knappers at Structure 01 and smaller flint mining areas at Qa Abu Tulayha West (W-01, W-02, W-03, W-05, W-06, W-09) were probably formed by knappers at

Structure 07. However there is a possibility that there were other structures at Qa Abu Tulyha East because Qa Abu Tulayha East was heavily damaged by modern limestone quarrying.

Qa Abu Tulayha West, W-06 flint mining area

The W-06 flint mining area is situated on the western slope of the hill and about 250 m to the northwest of Structure 01 and Structure 07 (Fig.6.2, Fig.6.3, Fig.6.4, Fig.6.5, Fig.6.6).

A number of tabular scraper cores are densely present at the W-06 flint mining area (Fig.6.4). The size of W-06 mining area is about 55 m from east to west and 25 m from north to south. The mining area is not damaged by modern limestone quarrying. Therefore a small excavation was conducted in the summer of 2002 (Fujii 2003). I directed the excavation at the W-06 mining area.

Some patterns could be observed even before the excavation (Fig.6.4, Fig.6.5, Fig.6.6). The W-06 mining area is located on a gentle slope, which slopes down to the northwest (Fig.6.3). The W-06 mining area can be divided into three areas, the northern downhill, middle area and southern uphill (Fig.6.4). Tabular scraper cores are not evenly distributed over these three areas.

Only a small number of tabular scraper cores are scattered in the northern downhill. Instead of tabular scraper cores, several hundred flint chunks and nodules are densely distributed in the northern downhill. The total weight of the chunks and nodules are probably about 15 tons. The area was probably the dump area. As explained below, a large number of flint nodules were dug from underground in the middle area. Flint nodules and chunks inappropriate for tabular scraper production were probably dumped in the northern downhill with extracted chalk and sands.

Depressions can be seen in the middle area of the W-06 mining area. In this area, there are few tabular scraper cores and few flint nodules/chunks. These facts strongly suggest that flint nodules were probably dug from this area and the depressions are remains of ancient mining pits. To unveil the depressions, a small trench was opened in the middle of W-06 mining areas (Fig.6.4, Fig.6.7, Fig.6.8).

In this trench, four mining pits were discovered (Pitl, Pit2, Pit3, Pit4). Every pit is round or oblong. Two pits, Pit 1 and Pit 2, were excavated (Fig.6.7, Fig.6.8, Fig.6.9, Fig.6.10). Pit 1 is an oblong mining pit measuring 6 m in its long axis and 4 m in its short axis. Its depth is about 50 cm from the Early Bronze Age surface.

Chalk bedrock was exposed at the bottom of the pit. Some flint nodules still remain above the chalk bedrock (Fig.6.9, Fig.6.10). Before mining, a number of flint nodules were probably embedded in the chalk bedrock. These flint nodules must have been the target of flint mining.

The section of Pit 1 is noteworthy (Fig.6.7). The section shows that chalk bedrock was broken up and the shattered chalk was raked and dumped to the north with sands above the chalk bedrock. The shattered chalk and sands were probably dumped from pits to the northern down hill with inappropriate flint nodules but washed back to the pit from the north. Fills in the pit included a number of fragments of chalk.

One tabular scraper core was found at the bottom of the pit. This core may have been chipped to test the quality of flint during mining.

Pit 2 was found in the northwestern corner of the trench and was partly excavated. Pit 3 was found in the south of the trench and Pit 4 was revealed in the east of the trench. But these two pits were not excavated because of lack of time. The small trench reveals that several flint mining pits were dug to obtain flint nodules, which were embedded in chalk bedrock, in the middle area of W-06 mining area.

Depressions in the middle zone of W-06 flint mining area cover about 250 m^2. There are probably about 15 flint mining pits in the area. It is estimated that 125 m^3 of chalk was removed and 30 tons of large flint nodules were mined in total at W-06 flint mining area. The extracted flint nodules are usually large and bigger than human head size.

Tabular scraper cores are concentrated mainly in the southern uphill area (Fig.6.4, Fig.6.11, Fig.6.12, Fig.6.13). The knapping of tabular scraper flakes (blanks) was mainly conducted here. Over 30 tabular scraper core clusters were found in this area. The size of core clusters ranges from 2 m to 3 m and some core clusters are annular. The size is appropriate for one person to sit down and work inside (Fig.6.11, Fig.6.14). It is likely that one flint knapper sat down and knapped tabular scraper cores in a core cluster in one work episode.

Two core clusters, Unit A and Unit B, were excavated and all of the chipped stone artifacts were collected. However sieving was not conducted because the time was limited (Fig.6.4, Fig.6.14, Fig.6.15, Fig.6.16, Fig.6.17, Fig.6.18, Fig.6.19). The cluster of Unit A is about 2 m in diameter and annular (Fig.6.14, Fig.6.15, Fig.6.16). The cluster of Unit B is about 3 m in diameter and not annular (Fig.6.17, Fig.6.18, Fig.6.19).

The collection of Unit A includes 31 tabular scraper cores and the collection of Unit B includes 29 tabular scraper cores. Therefore each core cluster has about 30 tabular scraper cores. As discussed later, about 2.4 tabular scraper flakes were detached from each core. Hence each core cluster produced approximately (30×2.4=) 72 tabular scraper blanks. In the W-06 mining areas, 34 core clusters were identified. Therefore about (30×2.4×34=) 2448 tabular scraper flakes (blanks) were produced in the W-06 mining area. About 1000 tabular scraper cores are present in the southern uphill. As discussed later in detail, large symmetrical end struck blanks were the main products.

Although a large number of tabular scraper flakes (blanks) were detached in the W-06 mining area, only a small number of tabular scrapers were found. From the trench, only one tabular scraper was found. Furthermore the collections from Unit A and Unit B include only one tabular scraper. The collections do not include any typical by-products of retouching. It suggests that blank modification was not conducted at the mining area. Tabular scraper blanks were obviously transported from the mining area to the round structures, Structure 01 and Structure 07, on the hill.

As discussed above, the W-06 mining area can be divided into three areas, a dump area in the northern downhill, mining pits in the middle area and knapping area in the southern uphill. The same pattern can be observed at most Qa Abu Tulayha type tabular scraper production sites in the Jafr Basin (See Chapter 5, Quintero, Wilke and Rollefson 2002).

At W-06 flint mining area, great efforts were made to acquire raw material. Flint knappers mined 30 tons of large flint nodules and broke up 125 m^3 of hard chalk bedrock in total to acquire raw material for about 2500 tabular scraper blanks.

Qa Abu Tulayha West, W-01 flint mining area

The W-01 flint mining area is located on the eastern slope of the hill. The W-01 flint mining area measures 27 m in its NW-SE long axis and 20 m in its NE-SW short axis. The mining area is located on a gentle slope. Tabular scraper cores are distributed densely in this area. There are tabular scraper core clusters in the uphill of the W-01. Each cluster consists of dozens of tabular scraper cores. Several depressions, remains of flint mining pits, can be seen in the middle are. In the downhill, there are flint nodules. These nodules were probably dug from the pits. However they were probably inappropriate for knapping and discarded.

Qa Abu Tulayha West, W-02 flint mining area

The W-02 flint mining area is located on the eastern slope of the hill. The mining area measures 32 m in its NE-SW long axis and 18 m in its NW-SE short axis. Unfortunately the area is heavily damaged by modern limestone quarrying. The modern quarrying makes the configuration of the mining area unclear. Despite the damage, several tabular scraper core clusters and remains of flint mining pits can be still observed on the surface.

Qa Abu Tulayha West, W-03 flint mining area

The W-03 flint mining area measures 50 m in its NE-SW long axis and 24 m in its NW-SE short axis. The mining area is located on a gentle slope, which slopes down toward the southeast. Tabular scraper cores are scattered densely in the uphill of the area. Several tabular scraper core clusters are observed. Several depressions, remains of flint mining pits, are seen in the middle area. Flint nodules are densely concentrated in the downhill area.

Qa Abu Tulayha West, W-05 flint mining area

The W-05 flint mining area measures 34 m in its N-S long axis and 14 m in its E-W short axis. The mining area is heavily damaged by car tracks for the modern limestone quarry. The tracks make the configuration of the mining area unclear. Flint mining pits cannot be observed on the surface because of the heavy disturbance. However several tabular scraper core clusters were observed.

Qa Abu Tulayha West, W-09 flint mining area

The W-09 flint mining area measures 28 m in its NE-SW long axis and 24 m in its NW-SE short axis. The mining area is located on a gentle slope. Tabular scraper cores are densely distributed in the uphill. Several tabular scraper core clusters can be also observed. Each cluster consists of dozens of tabular scraper cores. The size of clusters is about 3 m in diameter. Several round depressions can be observed in the middle area. These depressions are remains of flint mining pits. Flint nodules, which do not show any tabular scraper flake removal, are spread around in the downhill area. These nodules were probably dug from the mining pits but were not utilized for tabular scraper production for some reason.

Qa Abu Tulayha East (Fig.6.20)

A line of flint mining areas was found on the eastern slope at Qa Abu Tulayha East. The flint mining areas at Qa Abu Tulayha East are much longer than those at Qa Abu Tulayha West. Their length is usually over 100 m and their width is about 30 m while the length of flint mining areas at Qa Abu Tulayha West ranges from 30 m to 50 m. The total length of the mining areas at Qa Abu Tulayha East is over 500 m. Tabular scraper cores and associated debitage are scattered in high density at the mining areas. It can be estimated that ten thousand tabular scraper cores are probably present and about 25,000 tabular scraper flakes (blanks) were produced at Qa Abu Tulayha East in total. A number of depressions, remains of flint mining pits, were also observed. However the areas were totally destroyed and erased by modern limestone quarrying before excavation and detailed recording. Only brief mapping was conducted at Qa Abu Tulayha East. Therefore detail information about the areas will never be known.

As discussed above, several flint mining areas (W-01, W-02, W-03, W-05, W-06, W-09, Qa Abu Tulayh East) were identified at Qa Abu Tulayha. At flint mining areas, flint mining and detachment of tabular scraper flakes (blanks) were conducted. On the basis of the excavation at W-06, it is estimated that there are about 13,000 tabular scraper cores in the mining areas in total and the areas probably yielded over 30,000 tabular scraper flakes (blanks). 350 tons of flint was probably mined in total at Qa Abu Tulayha.

6.1.3 Other areas with tabular scraper cores.

Qa Abu Tulayha West, W-04 area.

The W-04 area measures 90 m in its NE-SW long axis and 50 m in its NW-SE short axis. Small Flint blocks, which were naturally split from the exposed bedrock, cover the area and the small blocks were selected for tabular scraper production. Tabular scraper cores and associated debitage are scattered very thinly among the flint blocks. No flint mining pit was observed on the surface.

Qa Abu Tulayha West, W-07 area

The W-07 area measures 110 m in its long axis and 30 m in its short axis. The area is located on the western slope of the hill and covered by small flint blocks. The flint blocks on the surface were exploited for tabular scraper production without mining flint. Tabular scraper production at the area was obviously non-intensive and only a small number of tabular scraper cores are spread.

Qa Abu Tulayha West, W-08 area

The W-08 area measures 150 m in its N-S long axis and 50 m in its E-W short axis. The area is located in the southern edge of the site. Flint bedrock is exposed in some places and the area is covered by small flint blocks derived from the bedrock. Among the flint blocks, tabular scraper cores are spread out very thinly. The small flint blocks on the surface were used as raw material for tabular scraper production without mining flint.

Qa Abu Tulayha West, W-10 area

The W-10 area measures 46 m in its long axis and 20 m in its short axis. The area is located on the east slope of the hill and covered by small flint blocks, which were derived from exposed flint outcrops. These small flint blocks on the surface were selected as raw materials for tabular scraper production. Tabular scraper cores and associated debitage are scattered over the area but the density of cores is very low.

6.1.4 Round Structures

Four round structures are located on the top of the hill. Several cairns were attached to walls of the round structures although no cairns yield human bones. S. Fujii interpreted these structures as funerary buildings attached to the burial cairns (Fujii 2002c, Fujii 2003). However the structures were apparently used for tabular scraper production, especially blank modification. In fact, burial cairns were often attached to structures at the Early Bronze Age pastoral nomadic camp sites (Beit-Arieh 2003). Burials were not separated from living areas even in the Early Bronze Age in the arid areas.

Structure 07 (Fig.6.23, Fig.6.24)

Structure 07 is an oblong structure measuring 7m in its NW-SE long axis and 5 m in its NE-SW short axis (Fujii 2000). Several small cairns whose diameter is about 1m were attached to the structure. The structure consists of one row of undressed limestone slabs. The wall remains mostly as one course. However restoration after the excavation reveals that the original height of the wall was probably about 70cm (Fig.6.24). Although no postholes or post foundations were discovered inside the structure, I assume that an organic roof covered all of the structure.

An entrance is located in the southeast of the structure. The entrance faces to leeward. The width of the entrance is 70 cm and the entrance was flanked by two upright standing limestone slabs whose height is about 60 cm. On the opposite side of the entrance, there are three upright standing stones. The highest upright standing stone is about 80 cm. They were inserted into an earth bank. The structure consists of two rooms. The main room has two hearths: Hearth01 and Hearth02. The diameter of Hearth01 and Hearth02 is 30 cm and 50 cm respectively and their depth of the hearths is about 10 cm. Remains of tabular scraper production concentrated in this room. The other room is subsidiary and smaller. Cultural deposits inside the structure are very thin and their thickness is less than a few centimeters.

As discussed later in detail, a number of tabular scraper fragments (N=438) and tabular scraper flake fragments (N=972) were excavated inside and outside the structure along with associated debitage elements, hammer stones and anvil stones. It is noteworthy that most tabular scrapers and tabular scraper flakes from the structure (over 99%) are fragments (Table.6.48, Table.6.68). The density of tabular scraper fragments and tabular scraper flake fragments is very high in the structure. There are 73 tabular scraper fragments and 162 tabular scraper flake fragments per 25 ㎡ at Structure 07 . The sample also includes a number of by-products of blank modification

(Table.6.36). Chips, partially cortical flakes and cortical flakes in Fig.6.53: 6-10 are typical debitage elements at the structure and they were knapped off from tabular scraper blanks by retouching. Two pits, Pit1 and Pit2 were found outside the structure. Pit 1 is filled with chips. The debris of flint knapping was probably abandoned in the pit. In contrast, only a few tabular scraper cores were excavated.

It strongly suggests that the main activity at Structure 07 was blank modification. Most of the tabular scraper fragments and tabular scraper flake fragments were probably broken accidentally during blank modification and discarded inside and outside the Structure 07. Completed tabular scrapers (N=2) were rare at the structure. It hints that completed tabular scrapers were probably transported out from the structure.

No pottery, animal bones, grinding stones nor plant remains were found within the structure. Flint artifacts from Structure 07 include only a small number of other tools such as end scrapers, denticulates, notches and borers (Fig.6.56). They occupy only less than 4 % in tools. It suggests other activities were carried out only on a limited scale.

The structure 07 is dated to B.P. 4540±70 (NUTA2-1978) (Calibrated 3362-3102 B.C.) by one radiocarbon sample. The structure can be dated to the Late Early Bronze Age I .

Given the small size of the structure, about five people probably stayed in the structure. The scarcity of other artifacts except remains of tabular scraper blank modification suggests all of the people were probably engaged in flint knapping. Thin cultural deposits at the structure suggest that the knappers probably used the structure seasonally.

Structure 01 (Fig.6.21, Fig.6.22)

The plan of Structure 01 is irregular (Fujii 1998). Several cairns whose diameter is about 2 m were attached to the structure. The structure consists of several curvilinear walls. It measures 25 m in its east-west axis and 23 m in its north-west axis. The structure walls consist of one row of undressed limestone slabs. The walls remain mostly as one course. On the basis of fallen stones, it is estimated that the height of the original walls was low and probably less than 1m. There are upright standing stones in the west part of the structure. The height of upright standing stones is about 60 cm. Several partition walls were also discovered inside the structure. Although no post holes or post foundations were discovered, I assume that organic roofs probably covered several parts of the structure.

I also assume that Structure 01 was probably made up of unroofed courtyard and roofed rooms. There was probably an unroofed courtyard in the centre of the structure. 33 hearths were discovered in and around the structure. However, most of the hearths concentrated in the courtyard. Their size is from 50 cm to 100 cm and their depth is from 10 to 20 cm. Partition walls hint that the courtyard was probably surrounded by 5 or 6 roofed rooms (Fig.6.21). The diameter of the roofed rooms was probably about 5 m.

A number of tabular scraper fragments and tabular scraper flake fragments were excavated inside and outside the structure along with associated debitage elements, hammer stones and anvil stones. Most of the chipped stone artifacts were discovered in the courtyard. It suggests that knapping was conducted mainly in the unroofed courtyard. There is a possibility that the courtyard was also served as an animal pen although no animal dung layers were discovered at the courtyard.

Although flint artifacts from Structure 01 are not counted, Structure 01 yielded far more tabular scraper fragments and tabular scraper flake fragments than Structure 07. The density of tabular scraper fragments at the Structure 01 is extremely high. There are 185 tabular scraper fragments per 25 m². Furthermore the sample includes a number of byproducts of blank modification. But the sample includes only a few unbroken completed tabular scrapers. It suggests that the main activity at the structure was blank modification and the final products were exported out from the structure.

The structure is characterized by the scarcity of other artifacts. Only four small pottery sherds were collected (Fujii 1998). It is very difficult to date these sherds because of their smallness. Only a few animal bones were collected in the excavation. Their identification is also difficult because of their fragmentary nature. No grinding stones or charred plants were discovered.

The structure is dated to the Early Bronze Age II on the base of one radiocarbon date, B.P 4245±30 (NUTA2-2022) (Calibrated 2902-2765 BC).

Given that there are 5 or 6 roofed round rooms, the author assumes that over 20 people probably stayed in the structure and were engaged in flint knapping and flint mining. Many more knappers were probably engaged in tabular scraper production at Structure 01 than at Structure 07.

Flint mining areas discovered in Qa Abu Tulayha East are much bigger than flint mining areas in Qa Abu Tulayha West (Fig.6.2). Each flint mining area in Qa Abu Tulayha East is over 100 m in length and twice or three times longer than flint mining areas in Qa Abu Tulaya West (W-01, W-02, W-03, W-05, W-06 and W-09). Therefore the author speculates that these larger flint mining areas at Qa Abu Tulayha East were formed by flint knapper who stayed in Structure 01 while smaller flint mining areas in Qa Abu Tulayha West including W-06 was formed by knappers who stayed in Structure 07. However there is also a possibility that there were other structures at Qa Abu Tulayha East because Qa Abu Tulayha East was heavily damaged by modern limestone quarrying.

Thin cultural deposits at the structure suggest that the knappers probably visited the structure seasonally.

Structure 03 and Structure 51 (Fig.6.25, Fig.6.26)

Most tabular scraper blanks were transported from mining areas to Structure 07 and Structure 01. Blank modification was mainly conducted at these two structures.

However other structures, Structure 03 and Structure 51 were also discovered at the site. I assume that these two structures were probably seasonal nomadic camps rather than tabular scraper production loci.

Structure 03 is a round structure (Fig.6.25) (Fujii 1999). The structure was heavily damaged and only a part of its northern wall remains. The remains of the wall are about 3 m in length. The structure consists of one row of undressed limestone slabs. The wall remains mostly as one course. The original size of the structure was probably slightly larger than Structure 07. The author assumes that all of the structure was probably covered with a roof. One small cairn was constructed inside the structure. The diameter is about 2.5 cm. No pottery, animal bones, plant remains or grinding stones were found at the structure. No radiocarbon date was available from the structure.

Structure 51 is a oblong structure measuring 20 m×12 m (Fig.6.26) (Fujii 2002a). Several cairns were constructed along the structure. The wall of the structure consists of one row of limestone and flint slabs. The wall remains mostly as one course. The original wall was probably very low because of the small number of fallen stones. 9 hearths were found inside the structure. A few dozen pottery sherds were also collected, but these sherds were fragmentary and not diagnostic. No animal bones or grinding stones were discovered. Two radiocarbon dates were obtained from the structure: B.P.4330±60 (Calibrated 3056-2914 B.C) and B.P. 4360±30 (Calibrated 3015-2931 B.C.). The structure can be dated to the end of the Early Bronze Age I or beginning of Early Bronze Age II.

These structures yielded much fewer tabular scraper flake fragments and tabular scraper fragments than Structure 01 and Structure 07. Structure 03 yielded only 25 tabular scraper fragments and Structure 51 yielded only 9 tabular scraper fragments.

The density of tabular scraper fragments is also noteworthy. There are only 2.8 tabular scraper fragments per 25 ㎡ at Structure 03 and there are only 0.6 tabular scraper fragments per 25 ㎡ at Structure 51.

Furthermore stone tool assemblages from Structure 03 and 51 include a number of other tools such as hoes, borers, denticulates and scrapers. The proportion of tools other than tabular scrapers at Structure 03 and 51 is high and 47 % and 66 % respectively.

Therefore, Structure 03 and 51 were probably normal camp sites rather than tabular scraper production loci. Blank modification was not the main activity at those two structures.

The presence of structures (Structure 01 and Structure 07) associated with tabular scraper production at Qa Abu Tulayha suggests that flint knappers stayed at Qa Abu Tulayha for tabular scraper production for a longer time than at Gurta Siyyata type sites. As will be discussed in Chapter 7, structures associated with tabular scrapers production are not known at Gurta Siyyata type tabular scraper production sites.

I assume that Qa Abu Tulayha was formed in multiple episodes and one flint mining area was probably formed in one episode because flint mining areas are standardized in size. As already described, the size of flint mining areas at Qa Abu Tulayha West is about from 30 m to 50 m in length and the size of flint mining areas at Qa Abu Tulayha East is about 100 m in length. Flint knappers probably changed locations of flint mining at every visit. Therefore it is possible to estimate the length of each stay by calculating how many days it took to form one flint mining area.

I will calculate how many days it took to form W-06 here. As already described, W-06 was probably formed by flint knappers at Structure 07. Therefore about 5 knappers were probably engaged in stone tool production and flint mining. This calculation will go on the assumption that they worked 6 hours per a day.

As already discussed, 125 m^3 of chalk were broken up and 30 tons of flint nodules were mined at W-06. According to P.A. Jewell who undertook an experimental reconstruction of prehistoric earthwork in England, one person can break up 0.42 m^3 of bedrock chalk per hour using prehistoric tools (Jewell 1963). If another person rakes and carries shattered chalk to the dump area as his assistance, five people can dig 6.3 m^3 of bedrock chalk per a day using prehistoric tools (Jewell 1963). Therefore it is estimated that it took about (125÷6.3≒) 20 days to finish mining at W-06. At W-06, about 2500 tabular scraper blanks were knapped from the extracted flint nodules. On the basis of the author's experiments, it takes about 2 minutes to knap a blank from a flint nodule on hand. So if five knappers are engaged in blank detachment for 6 hours per a day, they can detach 900 blanks per a day. Therefore it is estimated that it took (2500÷900≒) 3 days to detach 2500 tabular scraper blanks from flint nodules on hand. In total, it took about (20+3=) 23 days to finish mining raw material and detachment of blanks. This calculation does not consider time of blank modification. Therefore a few days for blank modification should be added to 23 days.

If other assumptions are used, this result would change. But this simple calculation clearly shows that tabular scraper production at Qa Abu Tulayha type sites was a very intensive and time-energy consuming task. Each production episode was relatively long and probably spanned a few weeks.

Given this intensive nature of the production at Qa Abu Tulayha, it is no wonder that structures were constructed at the site for the production and staying.

I suppose that about 2000 tabular scrapers were produced at Structure 07 and about 5000 tabular scrapers were produced at Structure 01 in each visit.

6.2 TABULAR SCRAPER PRODUCTION AT QA ABU TULAYHA

6.2.1 Analyzed samples

This section will study flint artifacts from Qa Abu Tulayha. Two samples will be studied here. The first sample was collected from Unit A and Unit B, W-06 flint mining area. As already discussed, there are 34 tabular scraper core clusters at W-06 flint mining area. Unit A and Unit B are two of these clusters (Fig.6.4, Fig.6.14, Fig.6.17). The sample was collected without sieving. However much attention was focused on collection of even the smallest pieces.

The second sample was from Structure 07. The sample was collected with a 3 mm mesh dry sieving. Several 5 m by 5 m squares were set up for excavation of Structure 07 (Fig.6.23). Flint artifacts from Square b8, b9, b10, c8, c9 and c10 will be analyzed here.

These two samples represent different processes of tabular scraper production at Qa Abu Tulayha. The sample from Unit A and Unit B represents core reduction at flint mining areas. The sample includes a number of tabular scraper cores (Table.6.1). However it includes only one tabular scraper and a handful of tabular scraper flakes (Fig.6.46, Fig.6.47, Fig.6.48). Non-cortical flakes, partially cortical flakes and cortical flakes in the sample are usually by-products of platform preparation (e.g.Fig.6.48:7-9, Fig.6.64).

The sample from Structure 07 represents blank modification at round structures. The sample includes a number of tabular scraper flake fragments and tabular scraper fragments. But it includes only a few tabular scraper cores (Table.6.36). The sample also includes a number of by-products of retouching such as chips, small non-cortical flakes, small partially cortical flakes and small cortical flakes (Fig.6.53:6-10, Fig.6.64).

6.2.2 Raw material procurement

As already explained, large and fresh flint nodules were intensively extracted from quarry pits in the flint mining areas. The flint nodules are high quality Eocene flint. They are usually covered with white or orange cortex. However, they are not homogeneous in quality. Outer parts of the flint nodule just below its cortex are far finer than its central parts. While the central parts of the flint nodules are cream and coarser, outer parts are darker, usually brown or black and fine grained (Fig.6.63). This may have been the main reason why only outer zones of the tabular scraper cores were detached and dorsal surfaces of tabular scrapers are usually covered with cortex.

The shape of quarried flint nodules is usually nodular rather than tabular (Table.6.2, Fig.6.28, Fig.6.29, Fig.6.31-Fig.6.40, Fig.6.42, Fig.6.43, Fig.6.45). The size of tabular scraper cores hints at the original size of flint nodules. The average size of cores is about 25 cm×25 cm×10 cm (Table.6.3, Table.6.4, Fig.6.27-Fig.6.45). Given that the original size was reduced by core reduction, very large flint nodules were generally dug in flint mining areas. The average size of flint nodules was probably about 30 cm×30 cm×10 cm.

Large thermal flakes, which were naturally flaked from the nodules, were also used as raw material for tabular scraper cores (Fig.6.27, Fig.6.30, Fig.6.41, Fig.6.44).

The Jafr Basin is geographically characterized by flint pavement deserts. Flint blocks are usually available even on the surface all over most of the basin. However flint blocks available on the surface are generally small and tabular rather than nodular. They were also weathered and have internal fractures. It is hard to acquire a significant quality of large, fresh nodular flint without flint mining.

As explained later, large end struck oval/elongated tabular scrapers were produced at Qa Abu Tulayha (e.g.Fig.6.46:1, Fig.6.64). Large fresh nodular flint from underground is necessary to produce a certain amount of such large and long tabular scrapers. It is difficult to produce such tabular scrapers from small, weathered and tabular flint blocks available on the surface.

6.2.3 Core preparation

As already explained, tabular scraper flakes (blanks) were mainly detached from flint nodules at the flint mining areas. A number of tabular scraper cores are distributed densely in the flint mining areas. This was probably because most flint nodules are too heavy to transport to other places. Some tabular scraper cores from Unit A and Unit B weigh over 20 kg. A few tabular scraper cores were also excavated at Structure 07 (Table.6.36, Fig.6.56:1). But tabular scraper cores found at Structure 07 are generally smaller and lighter than cores from Unit A and Unit B (Table.6.40).

Core preparation of tabular scraper production is technologically simple but characterized by careful examination of convex surfaces of nodules and careful platform preparation (Fig.6.64).

Platforms were produced along peripheries of flint nodules. As explained later in detail, large and roughly symmetrical end struck tabular scraper flakes were usually detached from cores. The average size of the flakes is about 15 cm in length×10 cm in width. To get such symmetrical long flakes, knappers must have examined surfaces of flint nodules carefully to find convex parts of the nodules, along which shock waves of percussion would run, before setting up striking platforms at appropriate positions.

Furthermore platforms of tabular scraper cores are generally carefully faceted. Over 90 % of platforms of tabular scraper cores from Unit A and Unit B are faceted (Table.6.8). Tabular scrapers and tabular scrapers flakes from Unit A, Unit B and Structure 07 also show a high incidence of faceted platforms (butts) (Table.6.24, Table.6.57, Table.6.78). Every tabular scraper flake from Unit A and Unit B has a carefully facetted platform (butt). Over 90 % of tabular scrapers and tabular scraper flakes from Structure 07 show carefully facetted platforms. The sample from Unit A and Unit B includes a number of byproducts of the platform preparation (e.g.Fig.6.48:7-9, Fig.6.64). Partially cortical flakes in Fig.6.48: 7-8 and the cortical flake in Fig.6.48: 9 were typical byproducts of platform preparation.

Platform preparation by careful faceting probably had two goals. One goal is to isolate impact points. Isolation of impact points enables more accurate blank removal. A tabular scraper core in Fig.6.39 is a good example to show the isolation of impact point (Fig.6.39).

The other goal is to make the *angle de chasse* appropriate. Most of the *angle de chasse* of tabular scraper flakes and tabular scrapers from Unit A, Unit B and Structure 07 is slightly less than 90 degrees (Table.6.25, Table.6.58, Table.6.79, Fig.6.60, Fig.6.62). Making the *angle de chasse* slightly less than 90 degrees is necessary to produce long flakes. According to J. Whittaker, the closer the *angle de chasse* comes to 90 degrees, the longer the detached flake becomes (Whittaker 1994).

The high incidence of platform preparation by careful faceting is one of the main features at Qa Abu Tulayha Type tabular scraper production sites. As the next chapter will discuss, platform preparation by careful faceting is far less common at Gurta Siyyata type tabular scraper production sites.

6.2.4 Core reduction and core abandonment

Scars on tabular scraper cores from Unit A and Unit B show that large symmetrical end struck tabular scraper flakes were mainly produced at the flint mining areas. The scars are usually large and measure about 15 cm in length×10 cm in width on average (Table.6.11, Table.6.13, Table.6.14, Fig.6.27-Fig.6.45, Fig.6.64). Furthermore most scars (about 70 %) are roughly symmetrical.

The shapes of tabular scraper flakes excavated from Unit A, Unit B and Structure 07 also support this idea. Over 90 % of the tabular scraper flakes are broken (Table.6.15, Table.6.16, Table.6.48, Table.6.49). Most of the broken pieces are too fragmentary to know the original shapes (Table. 6.17, Table.6.51, e.g. Fig.6.48:2, 4, Fig.6.55:2, 4, 7, 9, 11). However original shapes sometimes can be estimated from broken pieces. Distal fragments and proximal fragments with expanding ends are probably fragments of side struck tabular scraper flakes (e.g.Fig.6.48:3). However most of the distal fragments and proximal fragments of tabular scraper flakes in the samples have symmetrical unexpanding ends. They are probably fragments of symmetrical end struck tabular scraper flakes (Fig.6.47, Fig.6.48:1, Fig.6.54:2-6, Fig.6.55:1, 3, 5, 8, 10). It supports the idea of that large symmetrical end struck tabular scraper flakes were the main products at flint mining area (Table.6.17, Table.6.31, Table.6.32, Table.6.33, Table.6.51, Table.6.59, Table.6.60, Table.6.60). The unbroken tabular scraper flake in Fig.6.54:1 is probably a typical flake produced at the flint mining areas.

As the next chapter will discuss, tabular scraper production at Gurta Siyyta type sites contrasts with production at Qa Abu Tulayha Type sites. At Gurta Siyyata type sites, smaller side struck tabular scraper flakes (7 cm in length×9 cm in width on average) were mainly detached.

On average, about 2.4 tabular scraper flakes were flaked from each core (Table.6.5). Platform preparation was conducted carefully almost every time a tabular scraper flake was removed. Some tabular scraper cores (about 25 % of cores) show tabular scraper removals both from upper faces and lower faces of nodules (Table.6.6, e.g. Fig.6.29, Fig.6.39).

Tabular scraper cores were usually abandoned when no more cortex was left on surfaces of cores after detaching several tabular scraper flakes (Fig.6.27-Fig.6.45). Only the cortical surfaces of tabular scraper cores were reduced. Furthermore tabular scrapers and tabular scraper flakes from Unit A, Unit B and Structure 07 show intentional retention of cortex on virtually all of the dorsal surfaces (Table.6.34, Table.6.66, Table.6.84). As already discussed, this is mainly because inner parts of the flint nodule are much coarser than outer parts of the flint nodule just below its cortical surfaces. Outer parts of the flint nodule just below its cortex are the finest in quality (Fig.6.63). Furthermore cortex of tabular scrapers may have some functions for gripping tabular scrapers or have some symbolic meanings.

Tabular scraper flakes were probably detached from cores by direct percussion with soft stone hammers such as flint and limestone. Patterns of hammer modes of tabular scraper flakes and tabular scrapers from Unit A, Unit B and Structure 07 were spread across mode I , II and III

(Table.6.28, Table.6.63, Table.6.82). According to M. Suzuki, A. Igarashi, K. Onuma, S. Kadowaki, S. Kunitake, Y. Sunada, Y. Nishiaki, T. Midoshima, T. Yamada and M. Yoshida, these patterns can be seen when flakes are detached by direct percussion with soft stone hammers (Suzuki, Igarashi, Onuma, Kadowaki, Kunitake, Sunada, Nishiaki, Midoshima, Yamada and Yoshida 2002). Patterns of bulbs, impact points, bulbar scars and lips also support the view (Table.6.26, Table.6.27, Table.6.64, Table.6.65, Table.6.80, Table.6.81). Bulbs are usually prominent and bulbar scars are often observed. But impact points and cones are not always clear. Lips are usually absent. These patterns imply that tabular scraper flakes were usually detached with soft stone hammers rather than hard stone hammers, antlers and woods.

Failures of detaching tabular scraper flakes sometimes happened. Overshots often happened accidentally (Table.6.12). 8.3 % of the cores from Unit A and Unit B show overshot removal of blanks. The cores from Unit A and Unit B show hinged termination also often occurred (Table.6.12). 43 % of the cores show hinged termination. Samples from Unit A, Unit B and Structure 07 also include a number of tabular scraper flakes with hinged termination (Table.6.12, Table.6.29, Table.6.62).

In total, 56 broken tabular scraper flakes were found at Unit A and Unit B, W-06 flint mining area (Fig.6.47, Fig.6.48). These broken tabular scraper flakes were probably discarded here intentionally. Some pieces were probably broken by post-depositional effects such as trampling by animals and humans in later periods. However most of the broken tabular scraper flakes were probably broken into pieces accidentally during flake detachment from cores.

6.2.4 Blank selection and transportation of blanks to the round structures

As already discussed, core reduction was done mainly at flint mining areas and blanks (tabular scraper flakes) were transported to two round structures, Structure 07 and Structure 01 (Fig.6.64).

Only one tabular scraper is included in samples from Unit A and Unit B, W-06 flint mining area (Fig.6.46:1). Furthermore tabular scrapers are truly rare all over the W-06 flint mining area. It strongly suggests blank modification was rarely conducted at the flint mining areas.

It is also noteworthy that the sample from Unit A and Unit B include only four pieces of unbroken tabular scraper flakes (Fig.6.46:2, 3). It hints that most tabular scraper flakes (blanks) detached from cores without breakage were transported to the round structures for blank modification. In contrast, a large proportion of unbroken tabular scraper flakes (blanks) were abandoned ungrudgingly before blank modification at Gurta Siyyata type sites (See Chapter 7).

Tabular scraper production at Qa Abu Tulayha included intensive flint mining and careful core preparation. Therefore to abandon blanks was a waste for knappers at Qa Abu Tulayha. Only a few unbroken blanks were discarded at W-06 at Qa Abu Tulayha.

These four unbroken tabular scraper flakes, which were discarded at Unit A and Unit B, are clearly small in size (Fig.6.57). The average size of tabular scraper flake scars on tabular scraper cores are 15 cm in length×10 cm in width. The size of discarded unbroken tabular scrapers at

Unit A and Unit B is 8.9 cm in length×9.7 cm in width on average (Table.6.19). Furthermore these four pieces have hinged termination and two pieces are side struck flakes (Table.6.33, Fig.6.46:2-3). These two flakes probably became side struck flakes accidentally during flake detachment.

6.2.5 Blank modification

Blank modification was mainly conducted at two round structures, Structure 01 and Structure 07. Most tabular scraper flakes and tabular scrapers from Structure 07 were broken. Over 99 % of tabular scrapers and tabular scraper flakes were broken pieces (Table.6.48, Table.6.49, Table.6.69, Table.6.70, Fig.6.49-Fig.6.55). Some pieces were broken by post-depositional effects such as trampling by people and animals in the later periods and strong sunlight. However most of the broken pieces were probably broken accidentally during blank modification (retouching) and discarded at Structure 07. The scarcity of unbroken completed tabular scrapers at the structure strongly suggests that finished unbroken tabular scrapers were transported to other places and not left at the Structure 07 (Fig.6.64).

Five unbroken tabular scraper flakes were included in the sample from Structure 07 (Table.6.48). These tabular scraper flakes were probably brought from flint mining areas but were not retouched at Structure 07. Among five flakes, four tabular scraper flakes were discarded probably because they are small and side struck flakes (Table.6.52, Table.6.61, Fig.6.59). The other tabular scraper flake in Fig.4.54:1 is a typical blank but discarded for unknown reasons.

Two largely unbroken tabular scrapers were excavated from Structure 07 (Table.6.68. Fig.6.49:1, 3). These two pieces are obviously defective products (Table.6.76, Fig.6.61). The tabular scraper in Fig.6.49.1 was probably an incomplete piece and discarded during blank modification. The knapper probably intended to make an end struck oval tabular scraper. However the tabular scraper was discarded probably because of hinged termination of the blank and accidental break of left distal end. A tabular scraper in Fig.6.49:3 was almost a complete piece. But the size is too small (Table.6.76, Fig.6.61). It was discarded at the Structure 07 because of its small size (Table.6.76, Fig.6.61).

Most of the tabular scrapers found at Structure 07 were broken and too fragmentary to estimate original shapes (Table.6.69, e.g.Fig.6.52:1-3, 5, 7, 9-11, Fig.6.53: 2-4). However reconstructable pieces (e.g.Fig.6.49:2, 4-8, Fig.6.50, Fig.6.51:1-6, 10, Fig.6.52: 6.8, Fig.6.53.1) imply that the main products at Structure 07 were large end struck oval/elongated tabular scrapers on symmetrical end struck tabular scraper flakes (Table.6.70, Table.6.72, Fig.6.64).

The original blanks (tabular scraper flakes) were already roughly symmetrical. Hence only simple blank modification was necessary.

The size of completed end struck oval/elongated tabular scarpers is unclear. But the average size is probably about 15 cm in length×10 cm in width. A tabular scraper from Unit A (Fig.6.46:1) is probably a good typical example.

Retouching was usually conducted only on the dorsal surfaces (Table.6.88). Only one piece shows retouching both on the ventral and dorsal surfaces (Fig.6.52:6). Bulbar thinning is also rare (Table.6.88). Only one tabular scraper show bulb thinning with invasive retouching (Fig.6.49:7). Bulbs of tabular scrapers were usually left without any retouching.

Shapes of retouch are usually scaled (77%) or semi-paralleled (23%) (Table.6.86). And short and semi-abrupt (from 30 degrees to 60 degrees) retouching is common (Table.6.85, Table.6.87).

Distal ends, left sides and right sides of tabular scraper flakes were usually retouched (Table.6.89, Table.6.90, Table.6.91). But striking platforms were usually left (Table.6.90). Retouching at proximal ends are rare and only a few striking platforms of tabular scrapers were totally removed by dorsal retouching (Fig.6.49.7).

Some marks were often incised on cortical surfaces of tabular scrapers excavated from sedentary settlements in the Mediterranean area (S.A. Rosen 1997). These marks are often interpreted to have had some symbolic meanings because several tabular scrapers excavated from ritual contexts such as temples have such incision marks. However no incision was observed on cortex of tabular scrapers excavated from Unit A, Unit B and Structure 07 (Table.6.18, Table.6.50, Table.6.71). As already pointed by S.A. Rosen (S.A. Rosen 1997), incision of marks on cortex was probably a tradition only in the Mediterranean area not in the arid area. Villagers and town dwellers incised marks after acquisition of tabular scrapers from desert areas to mark ownership or for other reasons such as symbolic meanings.

6.3 SUMMARY (Fig.6.64)

The landscape of the Jafr Basin is characterized by a high incidence of Chalcolithic/Early Bronze Age tabular scraper sites. 25 tabular scraper production sites were located by Japanese surveys. Of 25, 6 sites are classified into Qa Abu Tulayha type tabular scraper production sites.

Qa Abu Tulayha type sites are tabular scraper production sites with intensive flint mining. Their size ranges from 2.3 ha to 0.15 ha. At every site, remains of intensive flint mining were discovered. At the largest Qa Abu Tulyha type site, JF0212, one flint mining trench whose length is over 700 m was discovered. Over 400 tons of flint nodules were mined from this trench. Even at the smallest site, JF0216, two mining trenches whose length is about 50 m were discovered. 60 tons of flint nodules were extracted even at this smallest site in total

At these sites, great efforts were made for raw material acquirement. Large end struck oval/elongated tabular scrapers were the main products at Qa Abu Tulayha type tabular scraper production sites. To produce a certain amount of such large and long tabular scrapers, mining fresh and large flint nodules was necessary.

The site of Qa Abu Tulayha is the type site of Qa Abu Tulayha type tabular scraper production sites. The site was discovered in 1995 and intensively excavated from 1997 to 2002.

At Qa Abu Tulayha, tabular scraper production was separated into discrete operations at two places: flint mining areas and round structures. A number of remains of flint mining pits can be observed at flint mining areas. Large and fresh Eocene flint nodules were intensively mined at the areas. Extracted flint nodules are about 30 cm×30 cm×10 cm on average. Tabular scraper blanks were also detached from the nodules at the flint mining areas because the nodules are too heavy to transport. Around the flint mining pits, tabular scraper cores and other debitage are scattered very densely. Tabular scraper cores usually form circular clusters. Each core cluster consists of about 30 tabular scraper cores. The size of clusters is about 3 m in diameter and some clusters are annular. It is likely that one flint knapper sat down and detached tabular scraper cores in one cluster.

In total, about 350 tons of flint nodules were mined at the flint mining areas. It is estimated that about 13,000 tabular scraper cores are present and 30,000 tabular scrapers were produced in total at the site although the site of Qa Abu Tulayha was probably formed in multiple episodes.

At Qa Abu Tulayha, several round structures associated with tabular scraper production were discovered. At these structures, blank modification was done. The presence of structures at the site suggests that each knapping episode was probably long. It is estimated that each knapping episode probably spanned a few weeks. The author supposes that several thousand tabular scrapers were produced in each episode.

Tabular scraper production at Qa Abu Tulayha is technologically very simple but characterized by carefully knapping. Symmetrical large end struck blanks were detached from nodules. To detach such large and long blanks, knappers must have examined forms of flint nodules carefully to find convex parts, along which shock waves of percussion would run, before creating striking platforms. In addition, striking platforms of cores were usually prepared by careful faceting. The careful platform preparation had two goals. The first goal is to isolate impact points. Isolation of impact points enabled more accurate blank removal. The second goal is to make the *angle de chasse* slightly less than 90 degrees. Making the *angle de chasse* slightly less than 90 degrees was necessary to produce long blanks. Careful examination of forms of nodules and careful platform preparation were necessary to produce the symmetrical large and long blanks.

Cores were usually abandoned when no more cortex was left on their surfaces. This is probably because outer parts of flint nodules just below their cortex are the finest in quality. On average, 2.4 blanks were flaked from each core.

The blanks were modified into large end struck oval/elongated tabular scrapers. Their average size is probably 15 cm in length ×10 cm in width.

Tabular scraper production at Qa Abu Tulayha type sites was intensive and characterized by intensive flint mining and careful flint knapping.

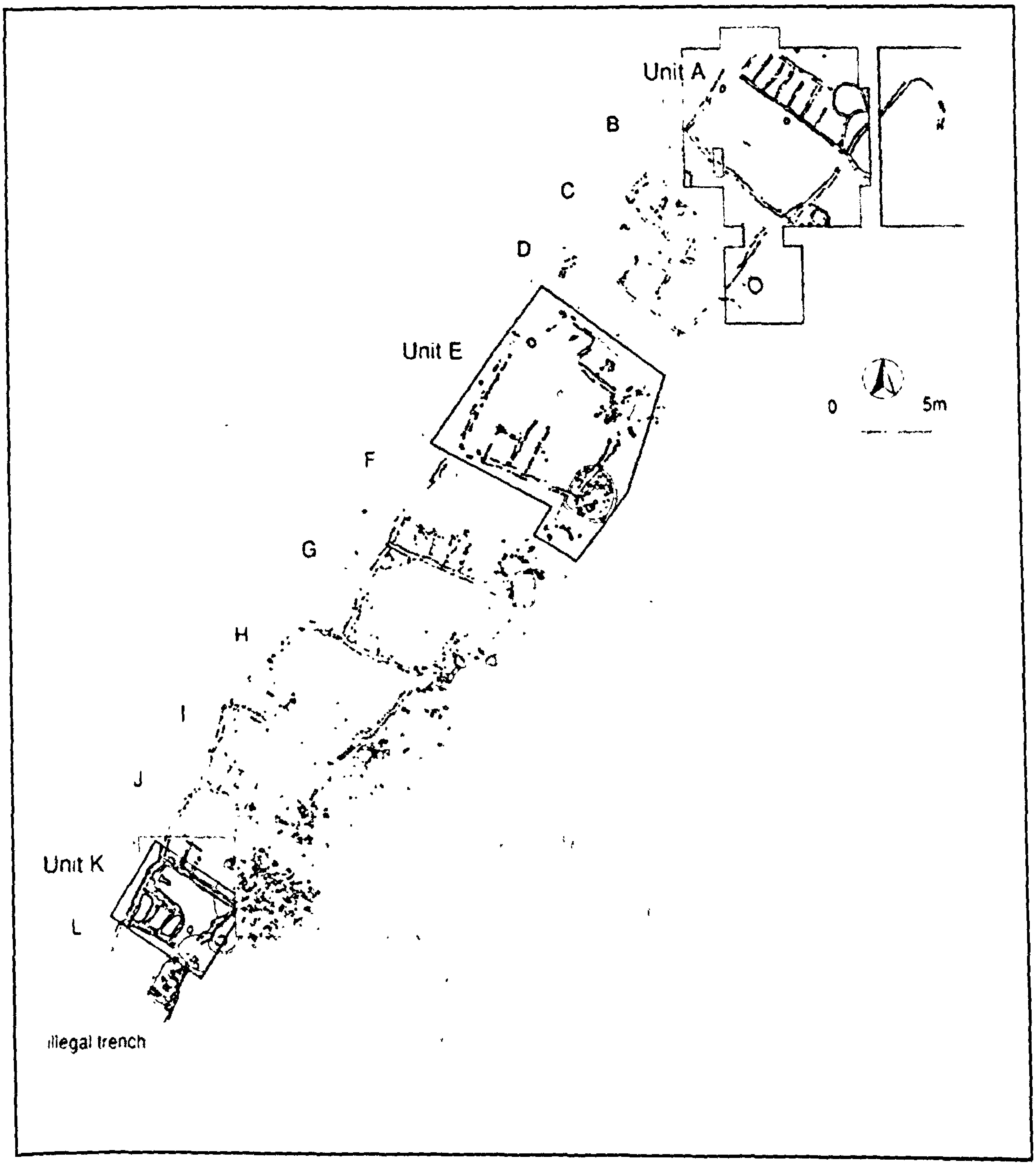


Fig.6.1 Late Neolithic rectangular structures at Qa Abu Tulayha (from Fujii 2002c).

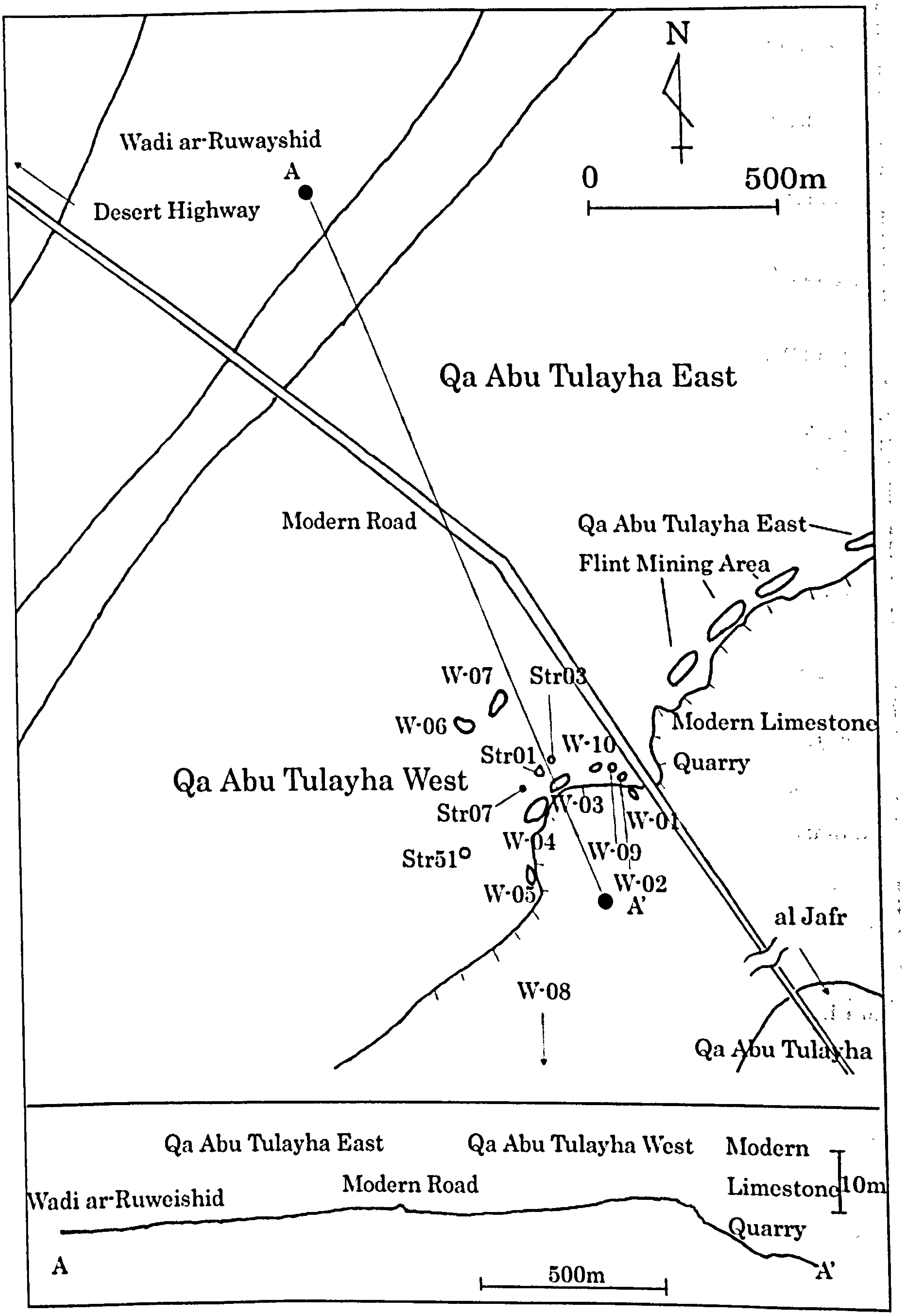


Fig.6.2 Site map of Qa Abu Tulayha in the Early Bronze Age (from Fujii 1998).

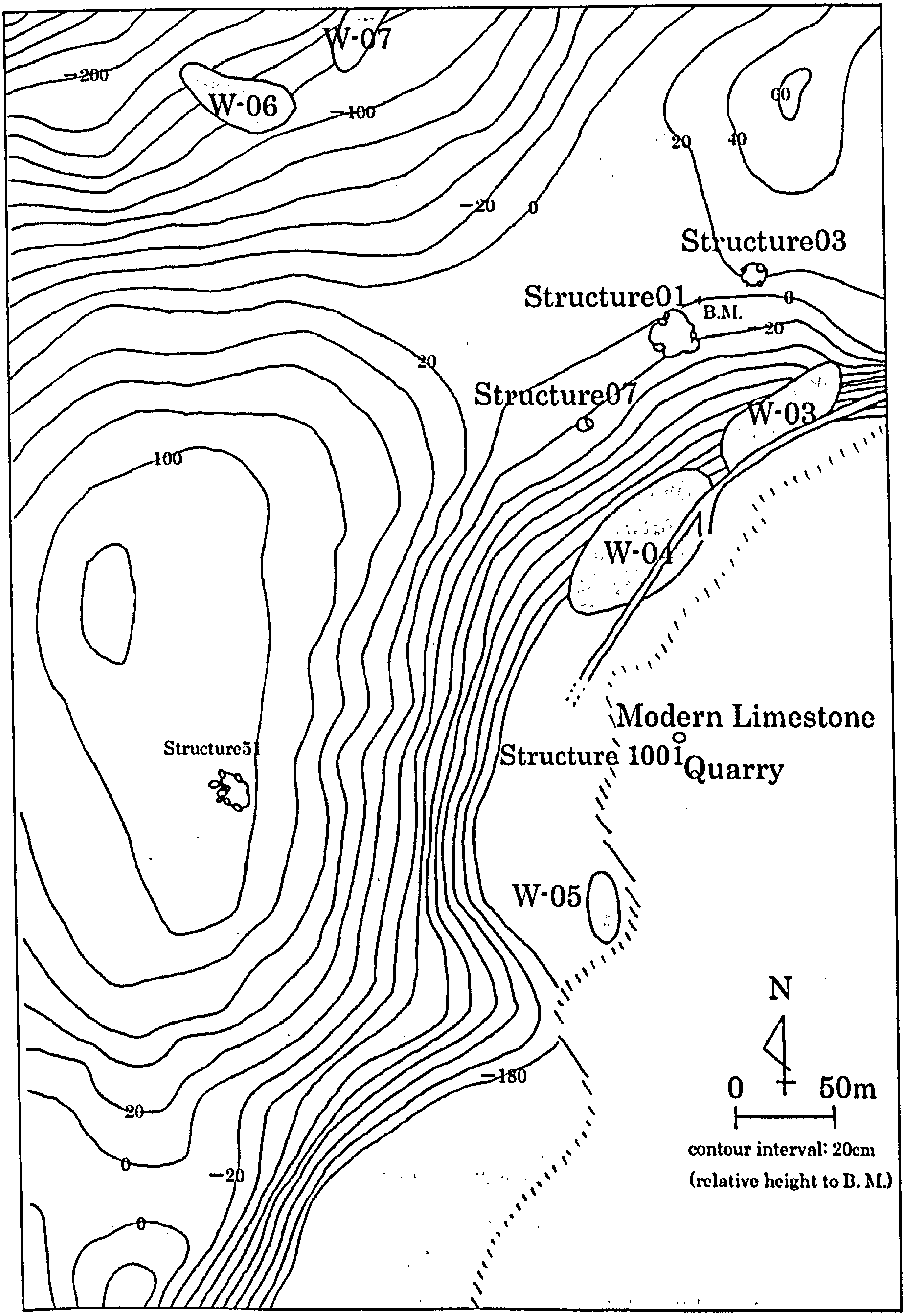


Fig.6.3 The site of Qa Abu Tulayha West in the Early Bronze Age (from Fujii 2003).

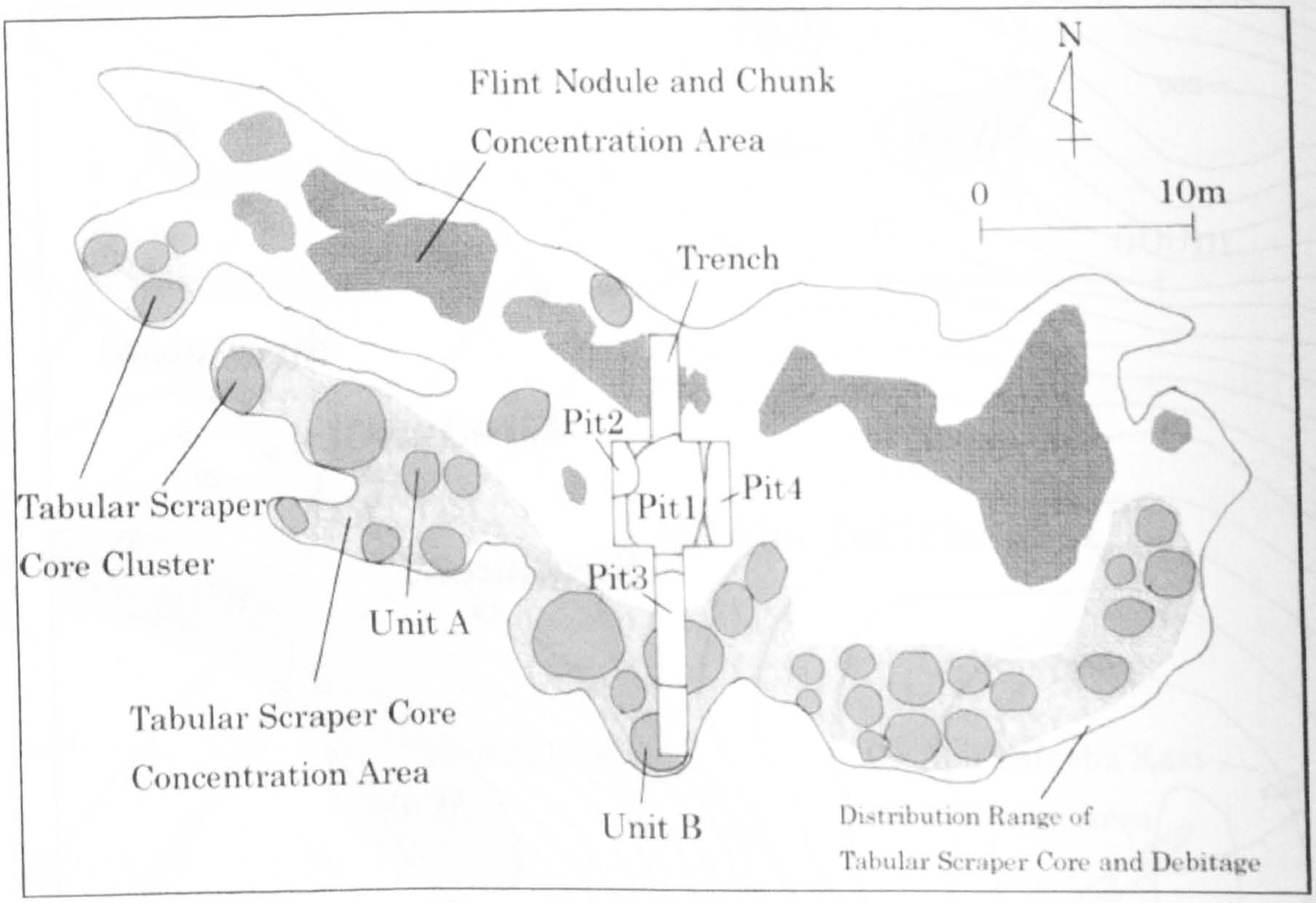


Fig.6.4 W-06 flint mining area at Qa Abu Tulayha West (From Fujii 2003).

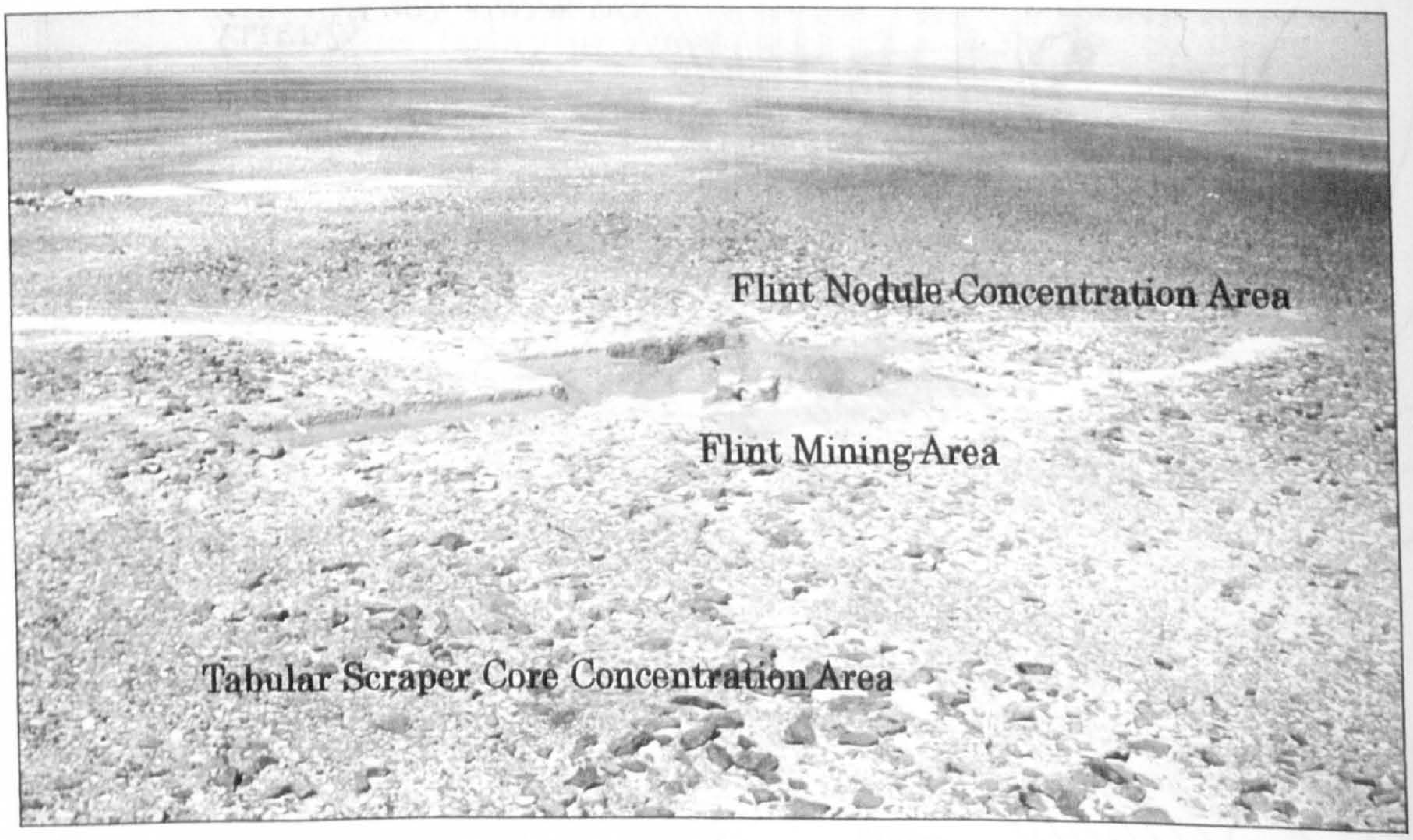


Fig.6.5 W-06 flint mining area from the southeast.

Fig.6.6 W-06 flint mining area from the west.

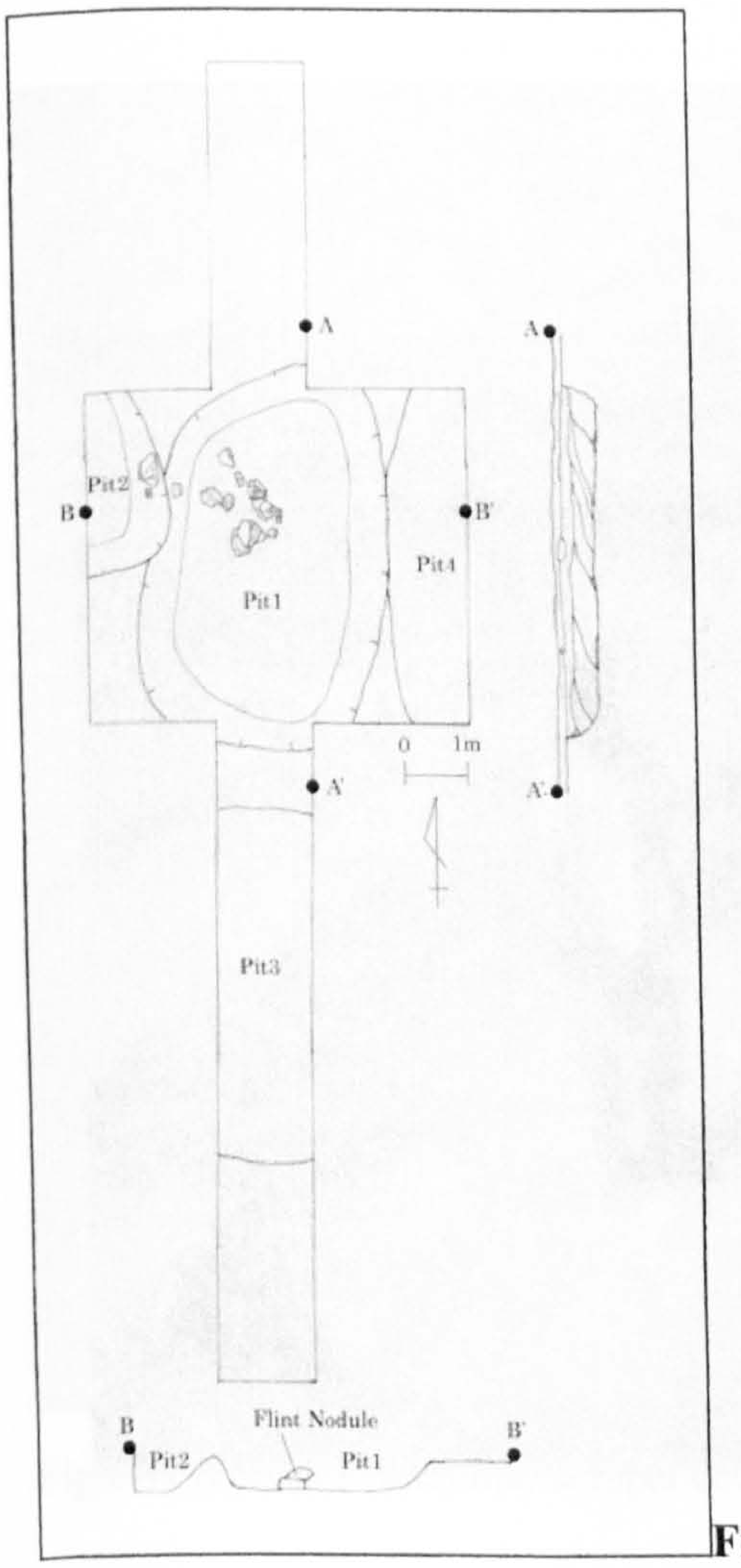


Fig.6.7 Trench at W-06 flint mining area.

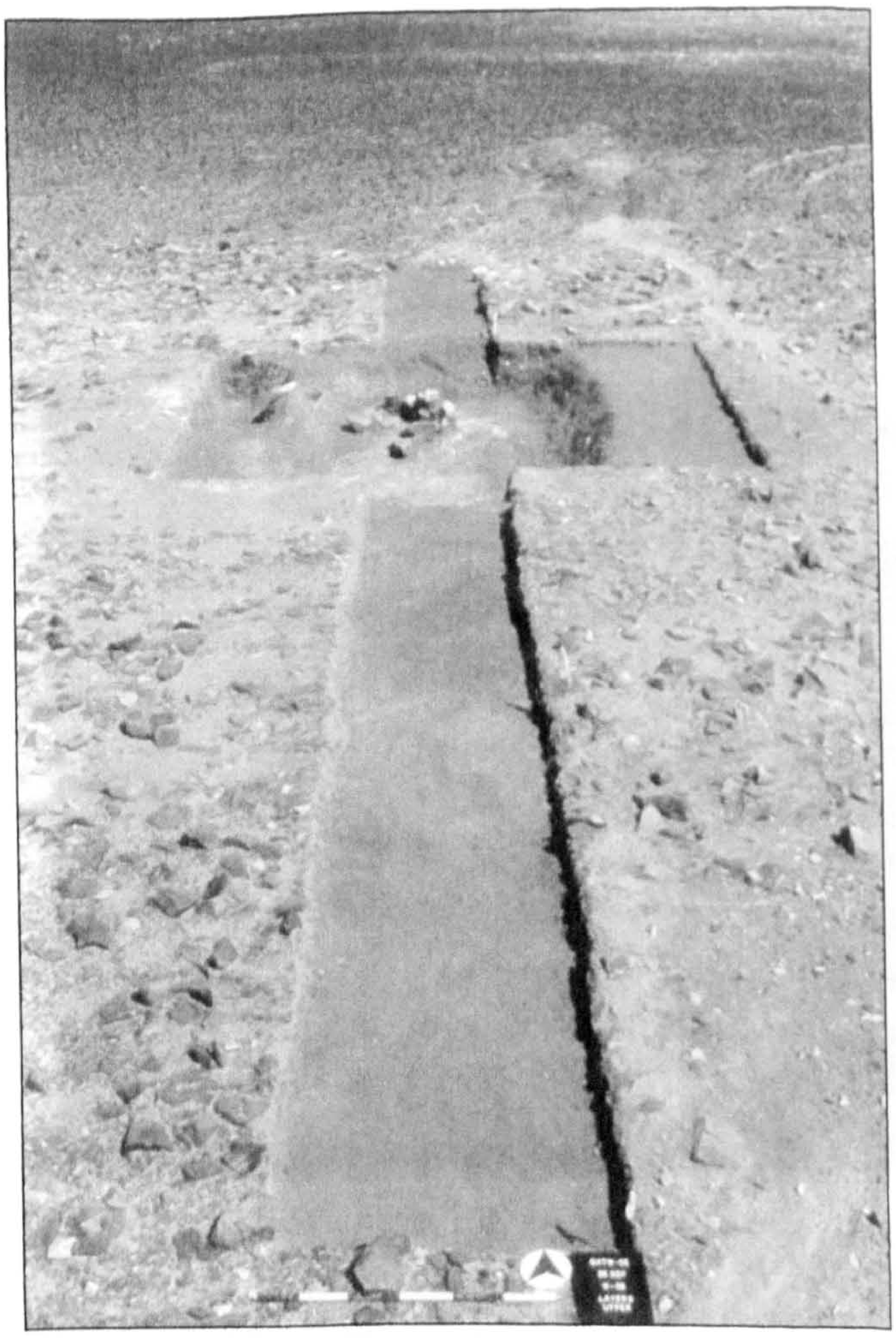


Fig 6.8 Trench at W-06 flint mining area.

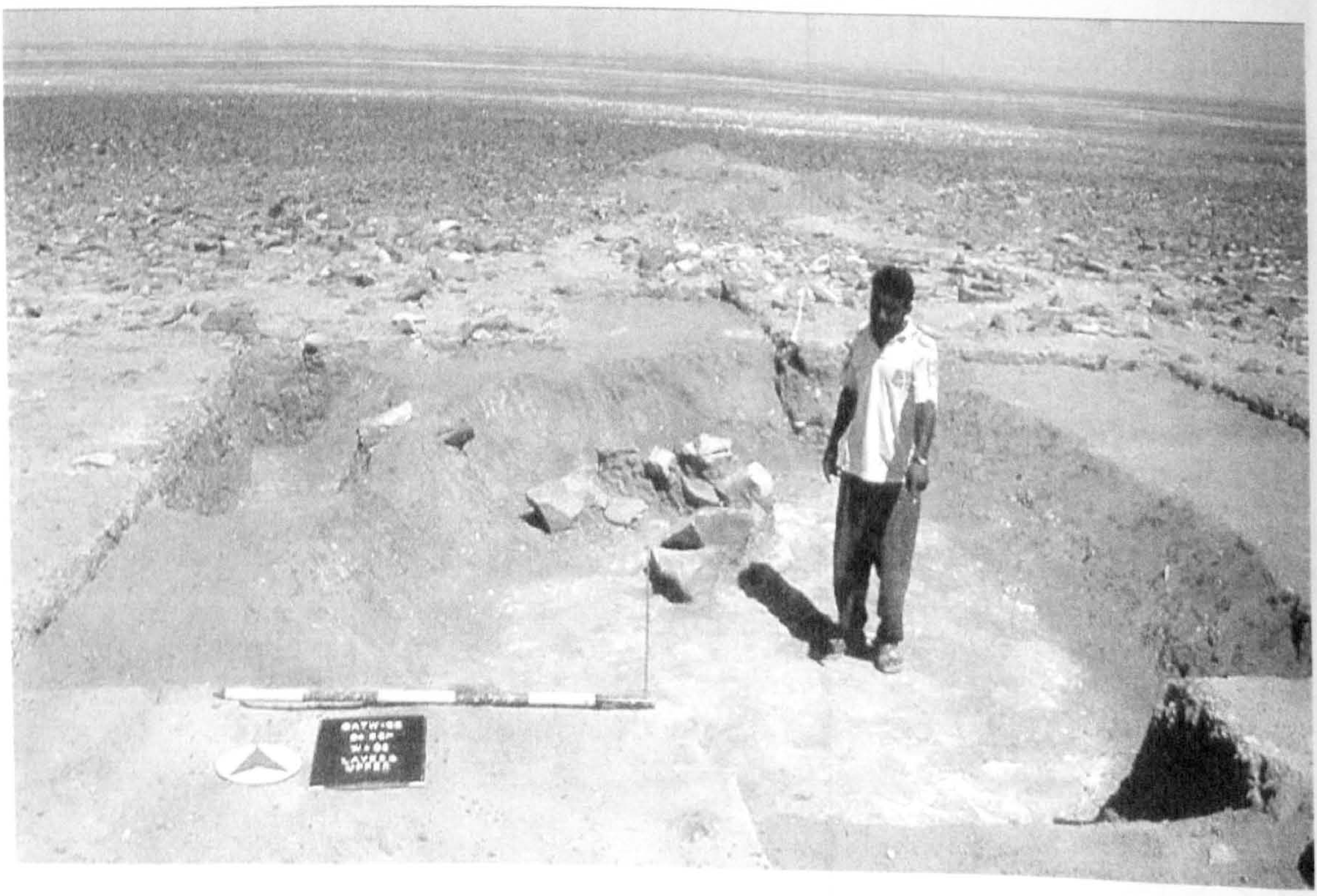


Fig.6.9 Pit1 and Pit2.

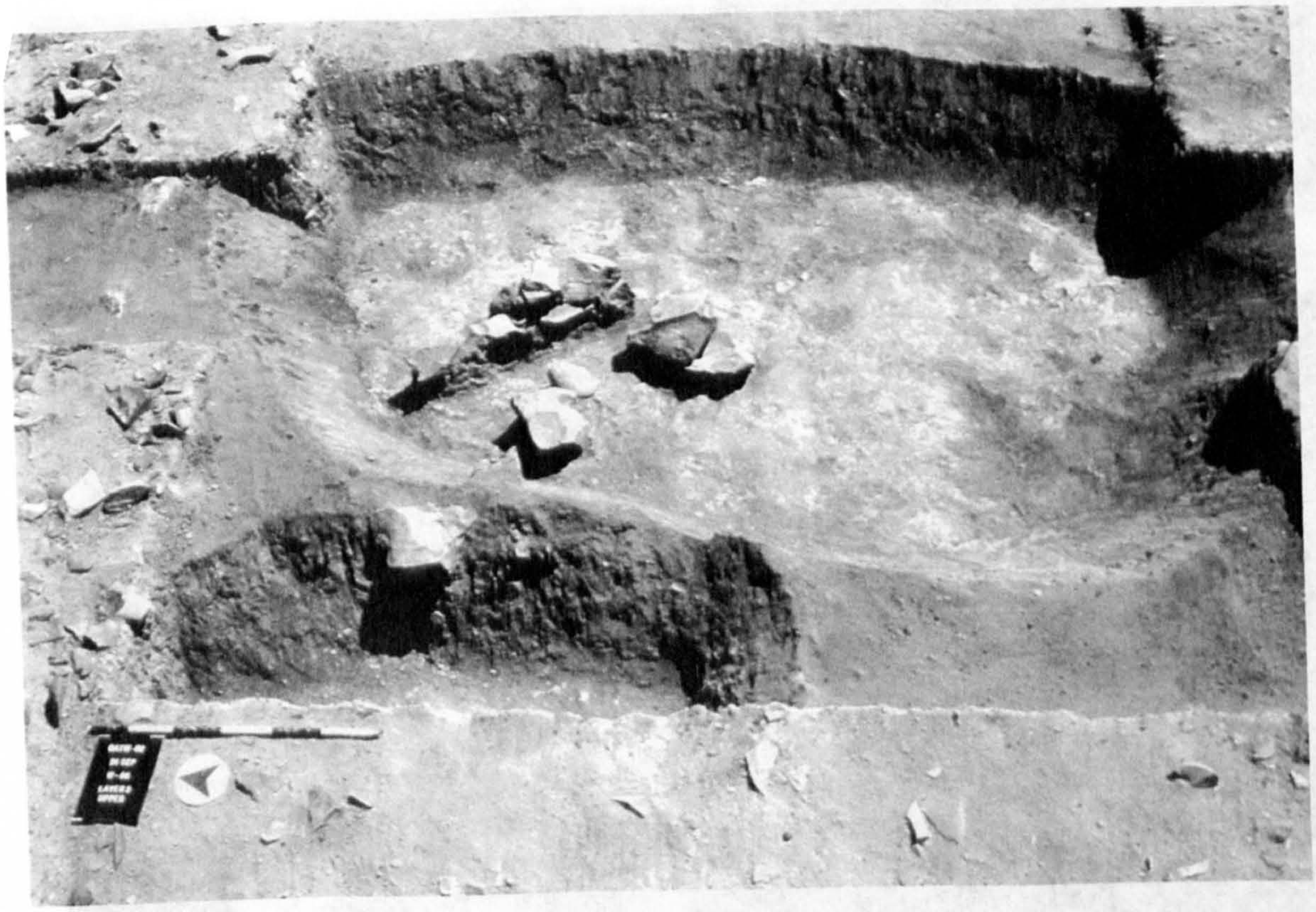


Fig.6.10 Pit1 and Pit2.

Fig.6.11 A cluster of tabular scraper cores.

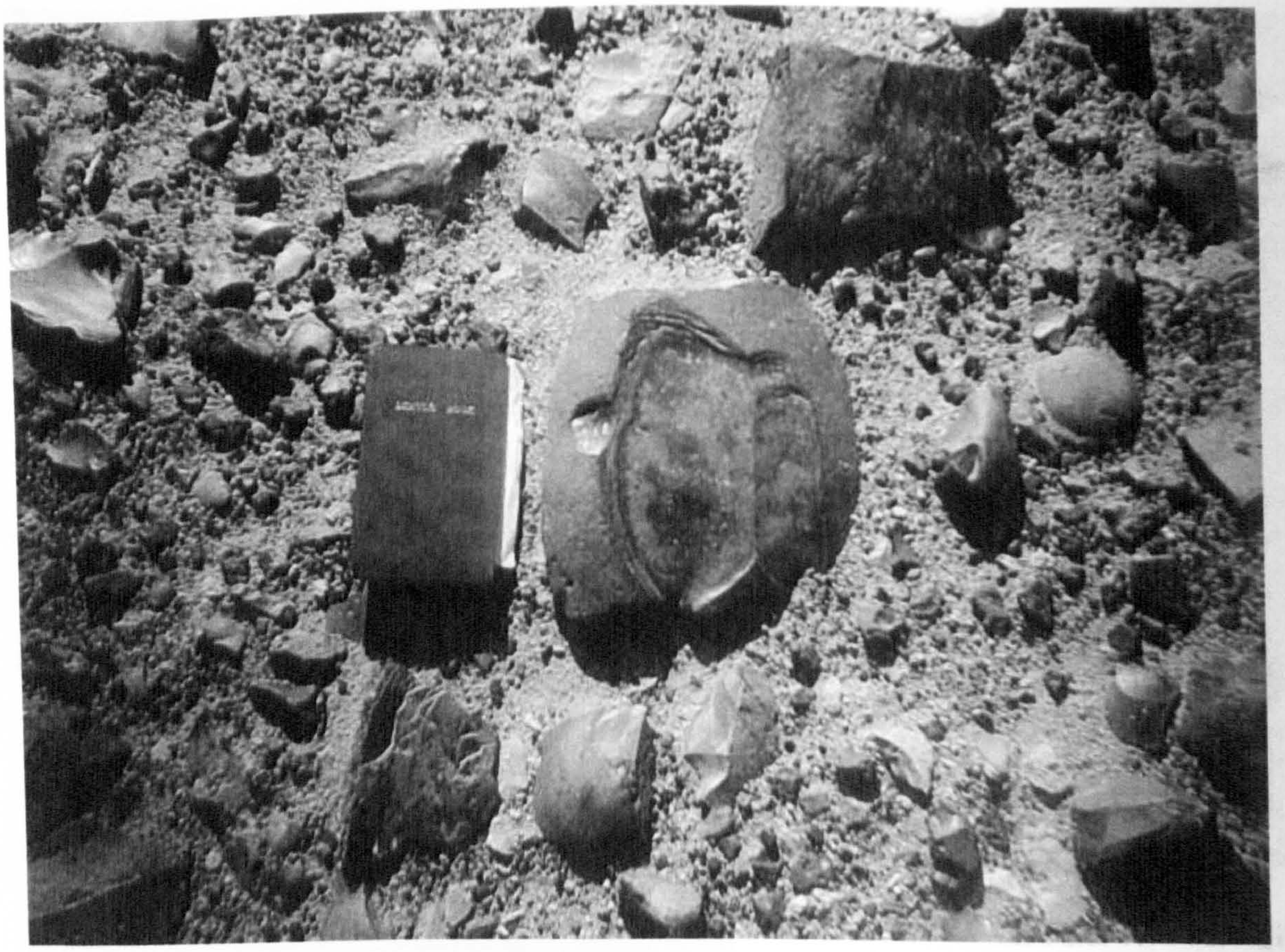


Fig.6.12 A tabular scraper core at W-06 flint mining area.

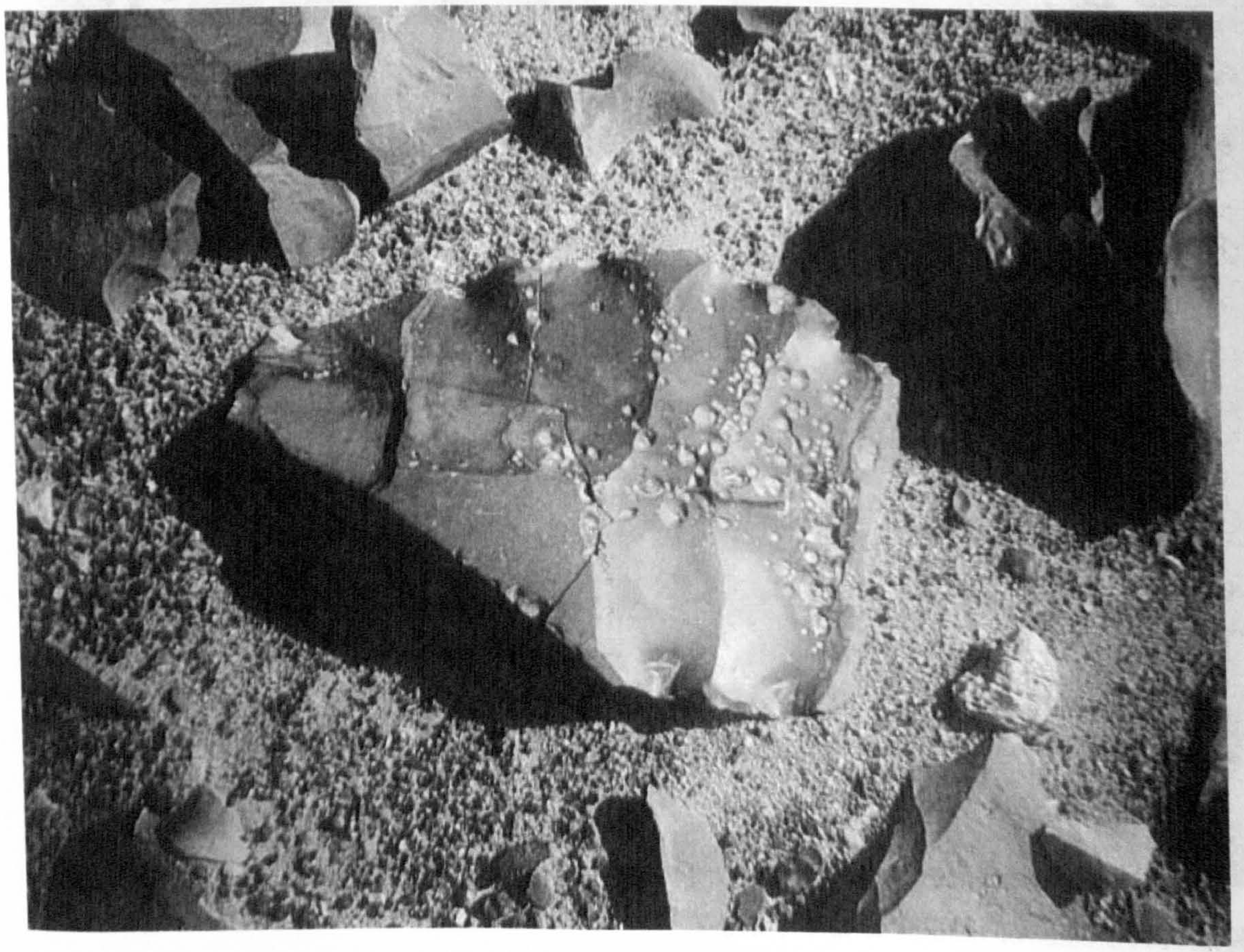


Fig.6.13 A tabular scraper core at W-06 flint mining area.

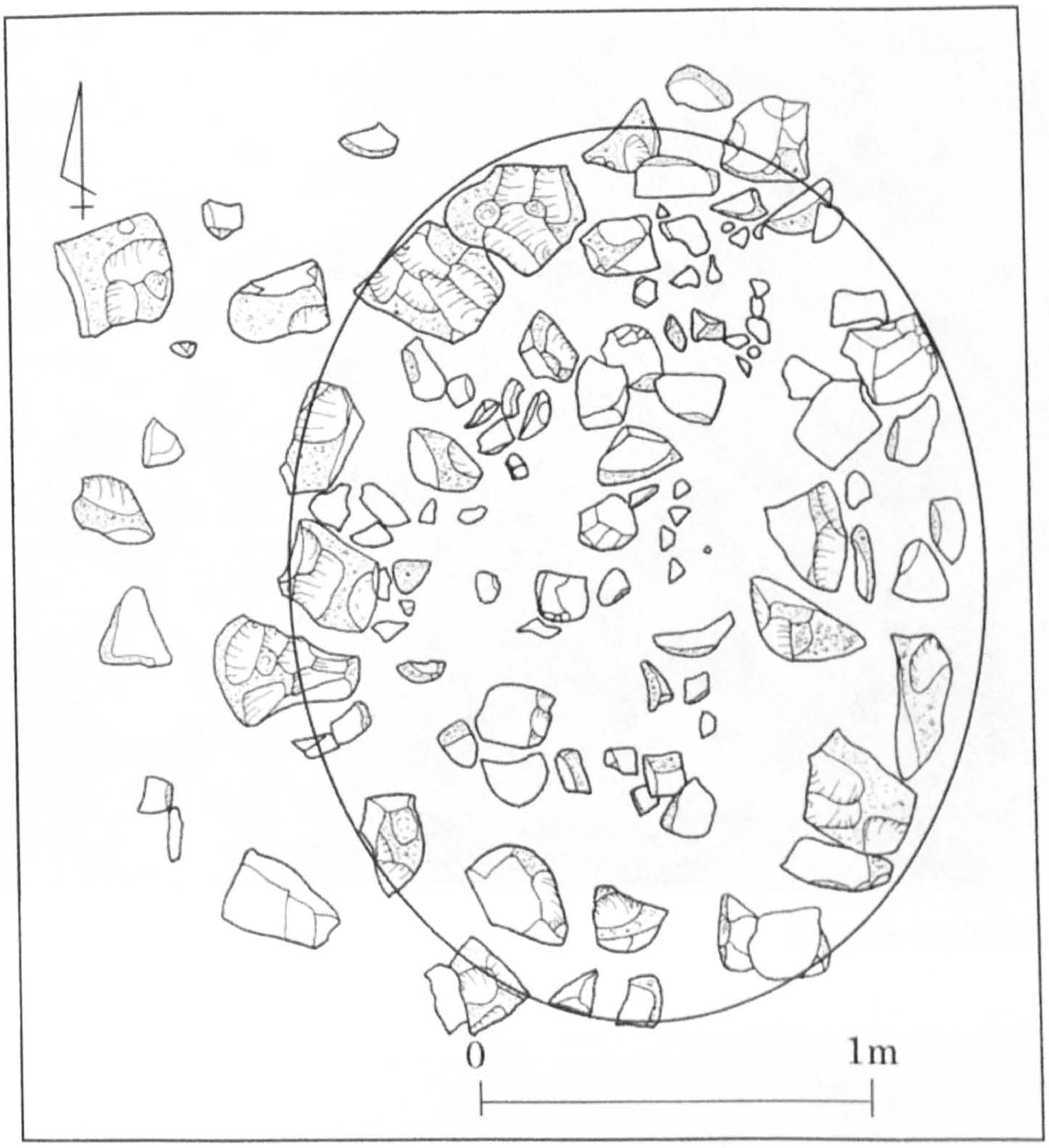


Fig 6.14 Unit A, a core cluster at W-06 flint mining area.

Fig.6.15 Unit A from the west.

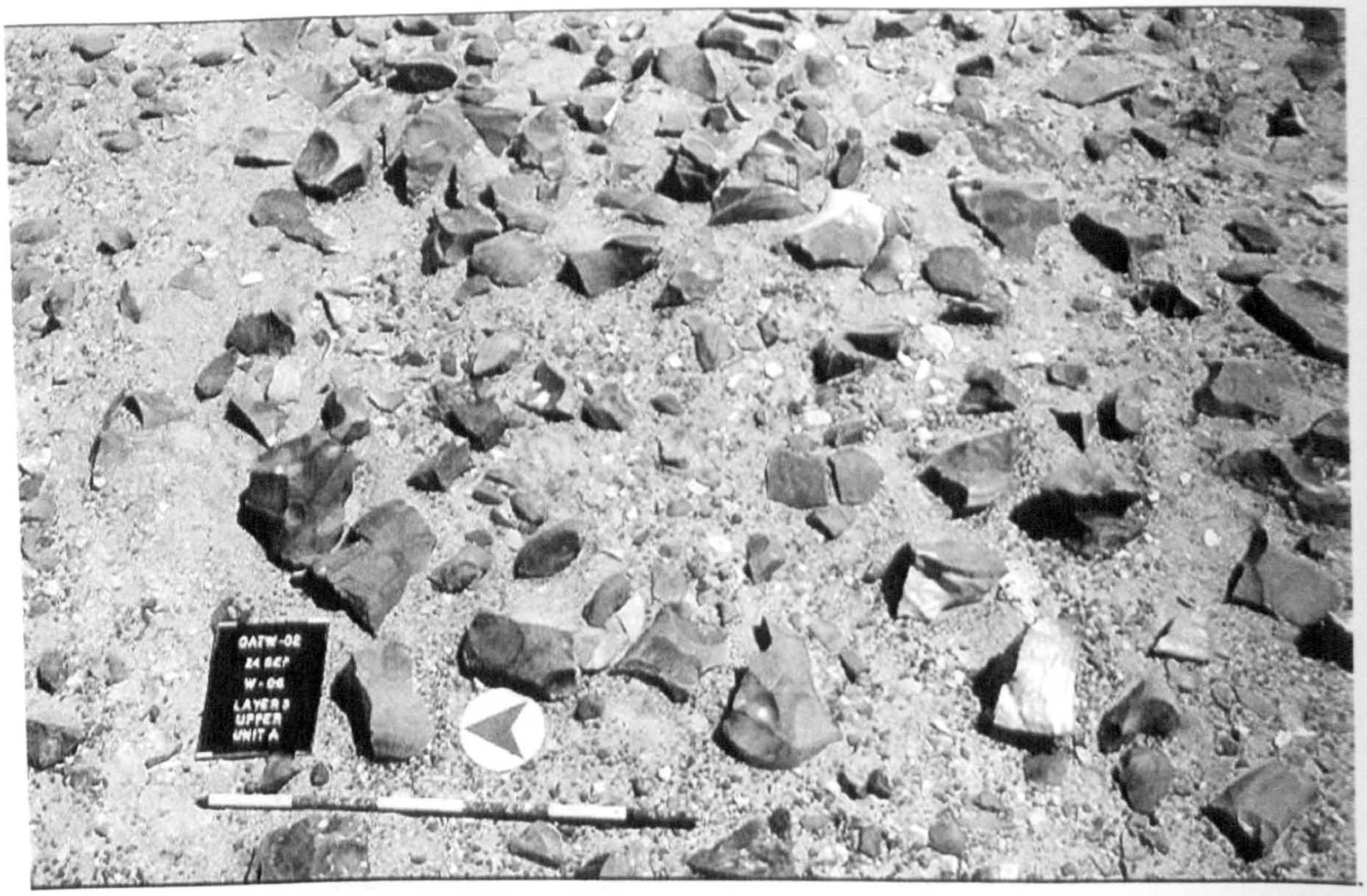


Fig.6.16 Unit A from the west.

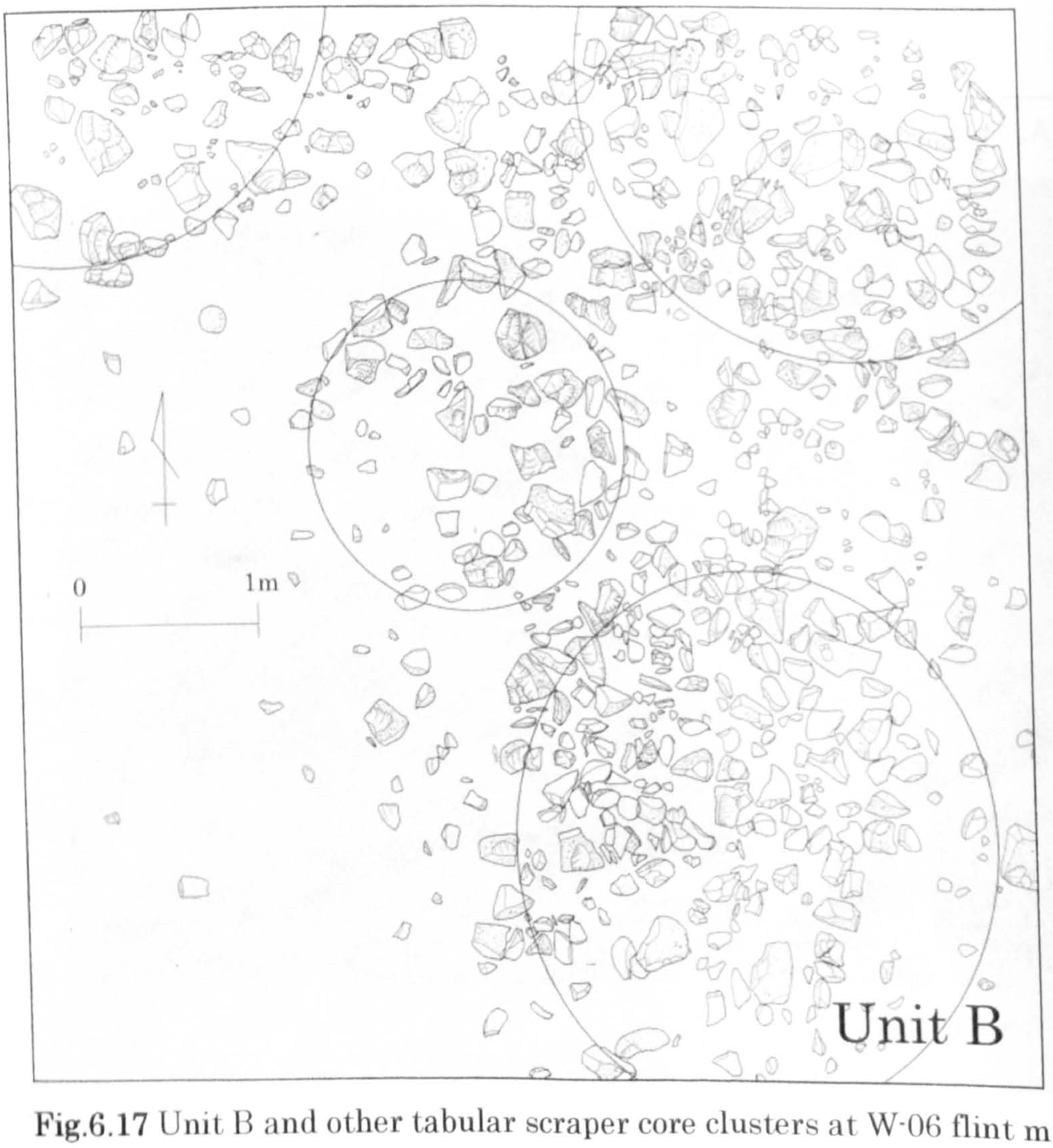


Fig.6.17 Unit B and other tabular scraper core clusters at W-06 flint mining area.

Fig.6.18 Unit B from the south.

Fig.6.19 Unit B from the south.

Fig.6.20 Flint mining area at Qa Abu Tulayha East.

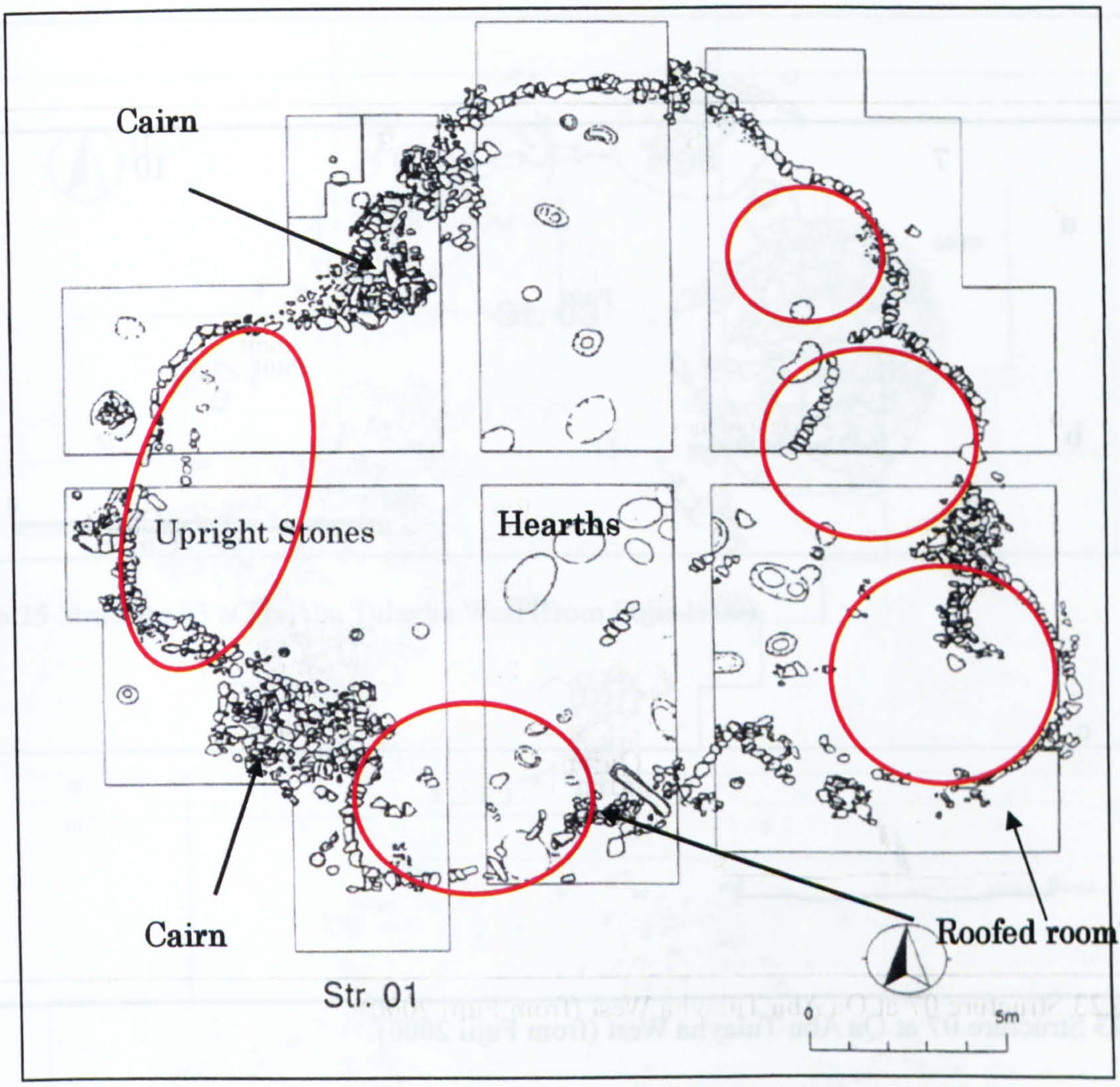


Fig.6.21 Structure 01(from Fujii 1998).

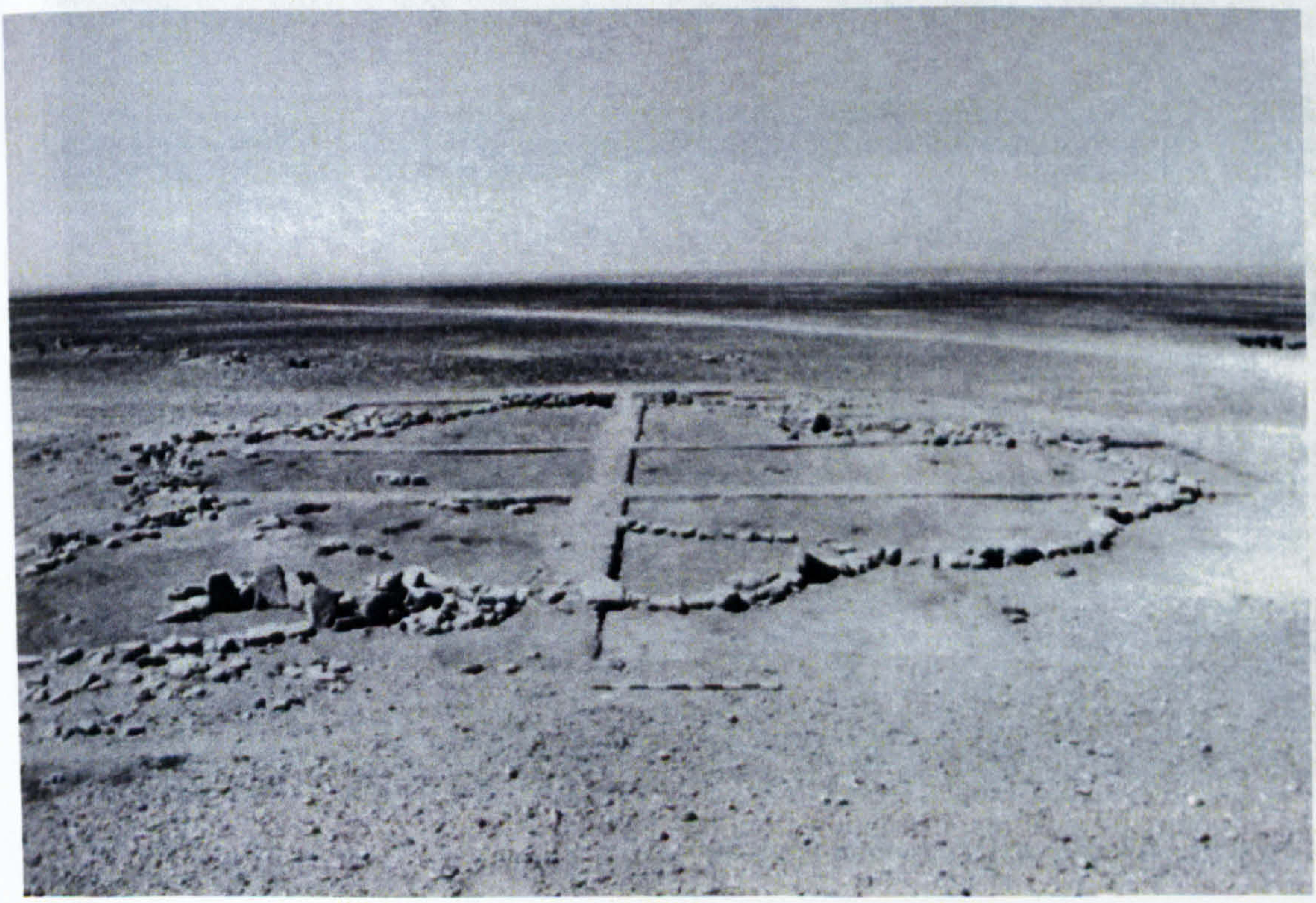


Fig.6.22 Structure 01 from the east (from Fujii 1998).

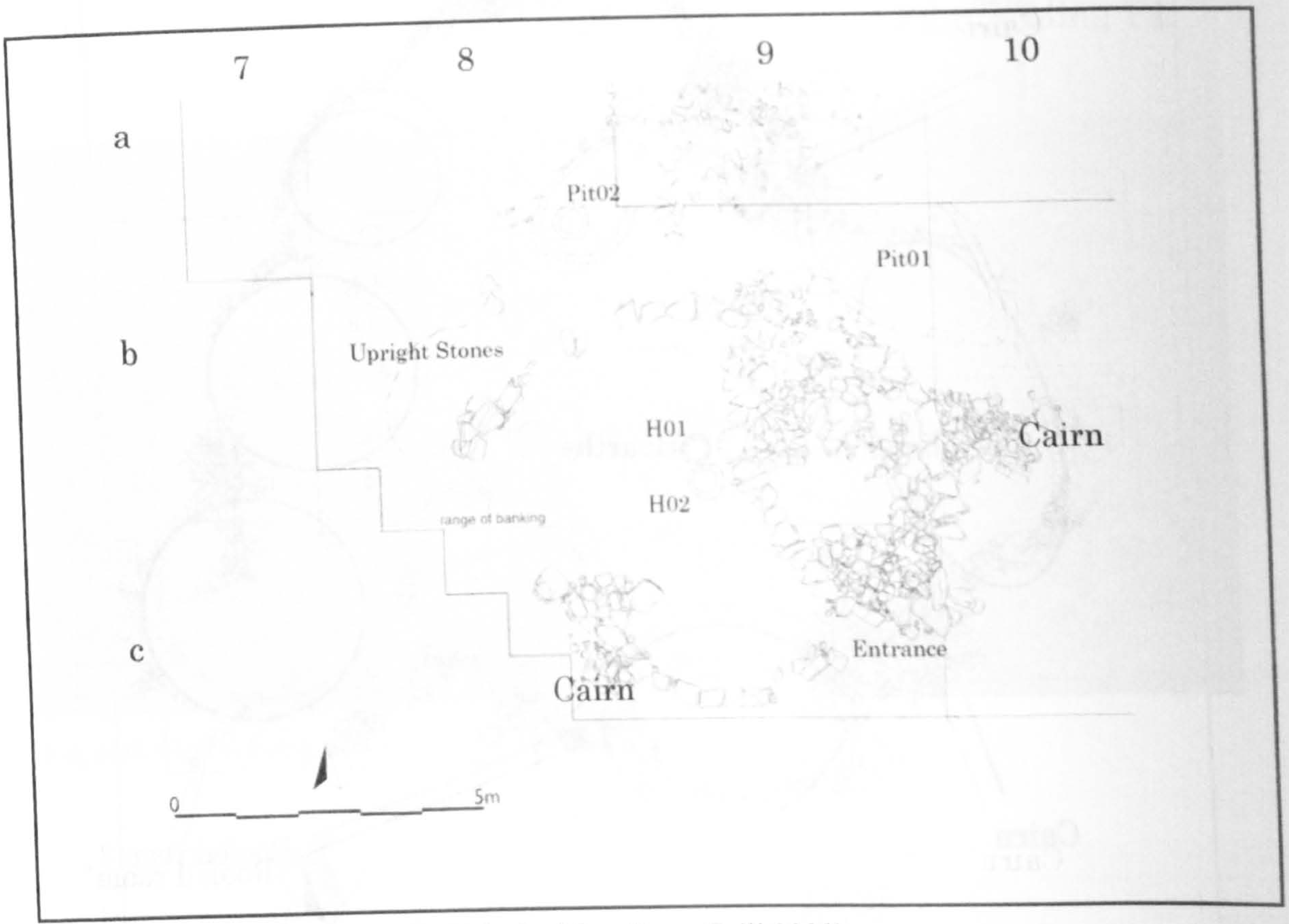


Fig.6.23 Structure 07 at Qa Abu Tulayha West (from Fujii 2000).

Fig.6.24 Structure 07 after reconstruction from the entrance.

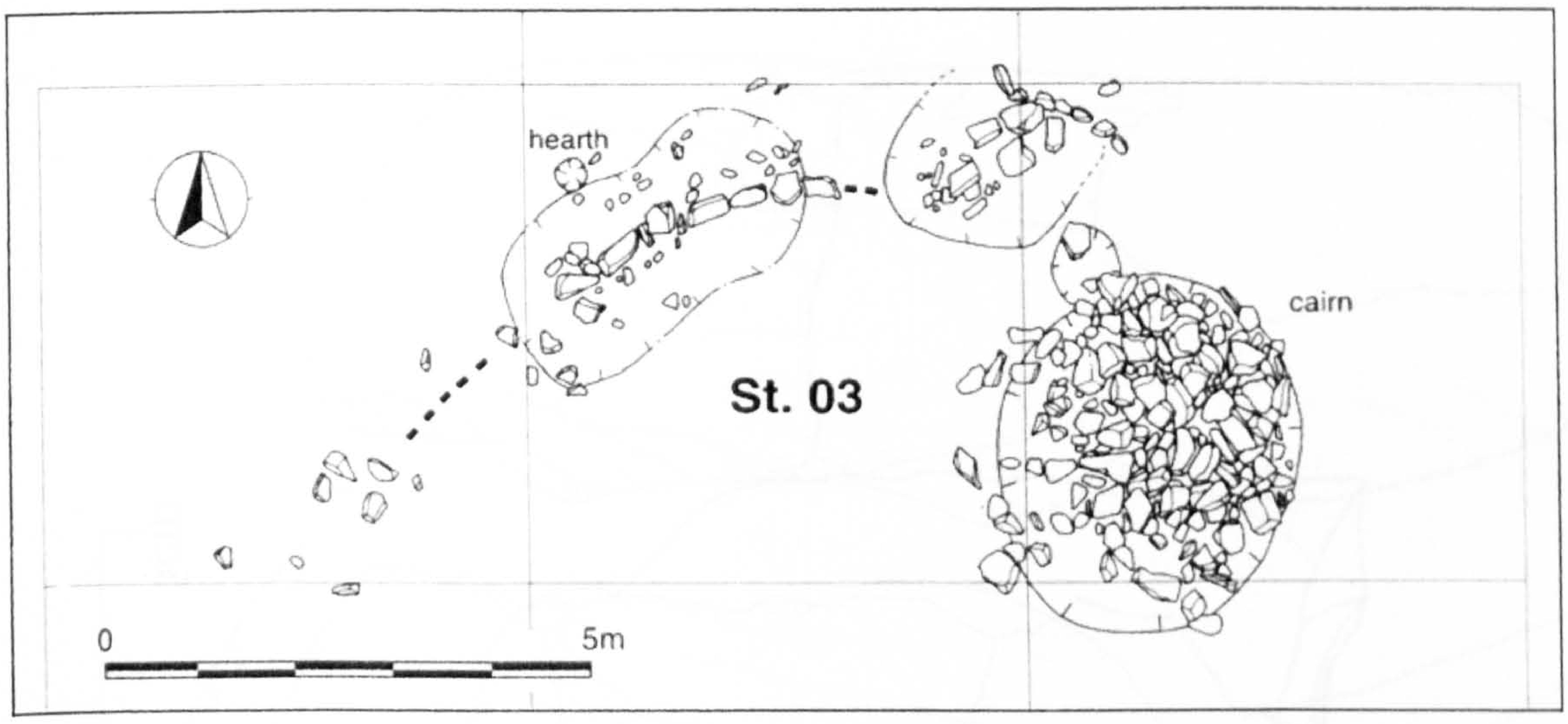


Fig.6.25 Structure 03 at Qa Abu Tulayha West (from Fujii 1999).

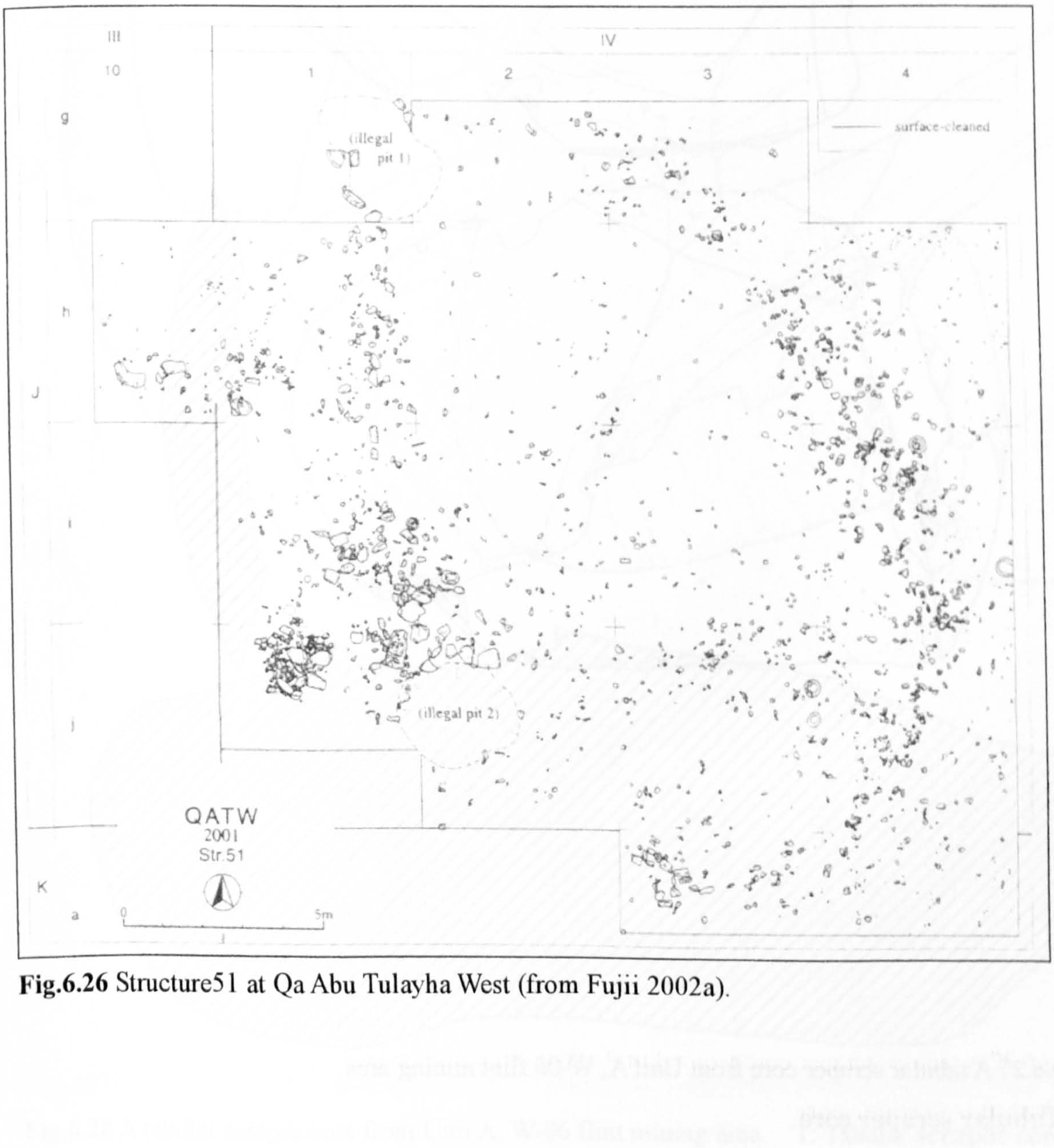


Fig.6.26 Structure51 at Qa Abu Tulayha West (from Fujii 2002a).

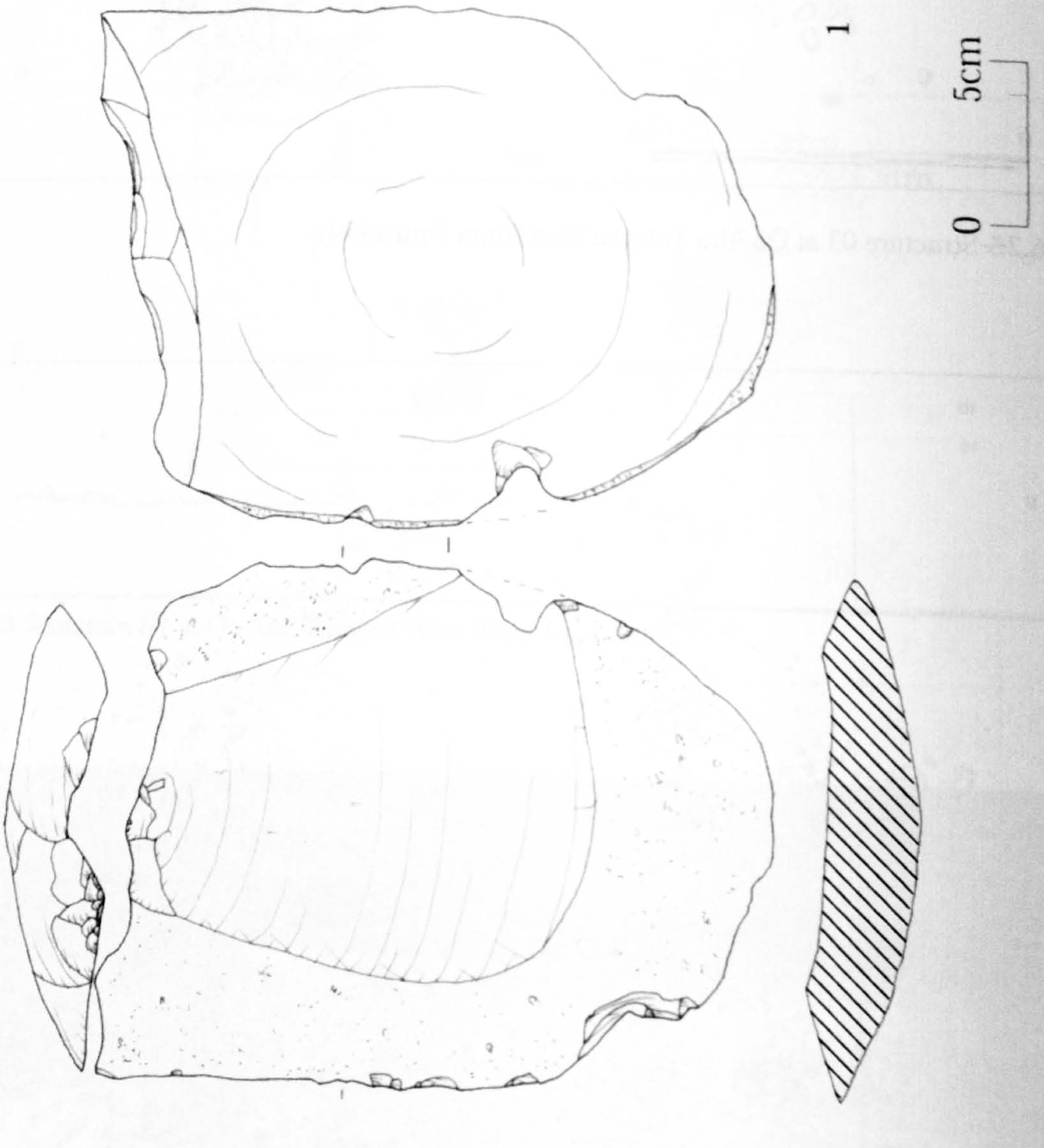


Fig.6.27 A tabular scraper core from Unit A, W-06 flint mining area.

1: Tabular scraper core.

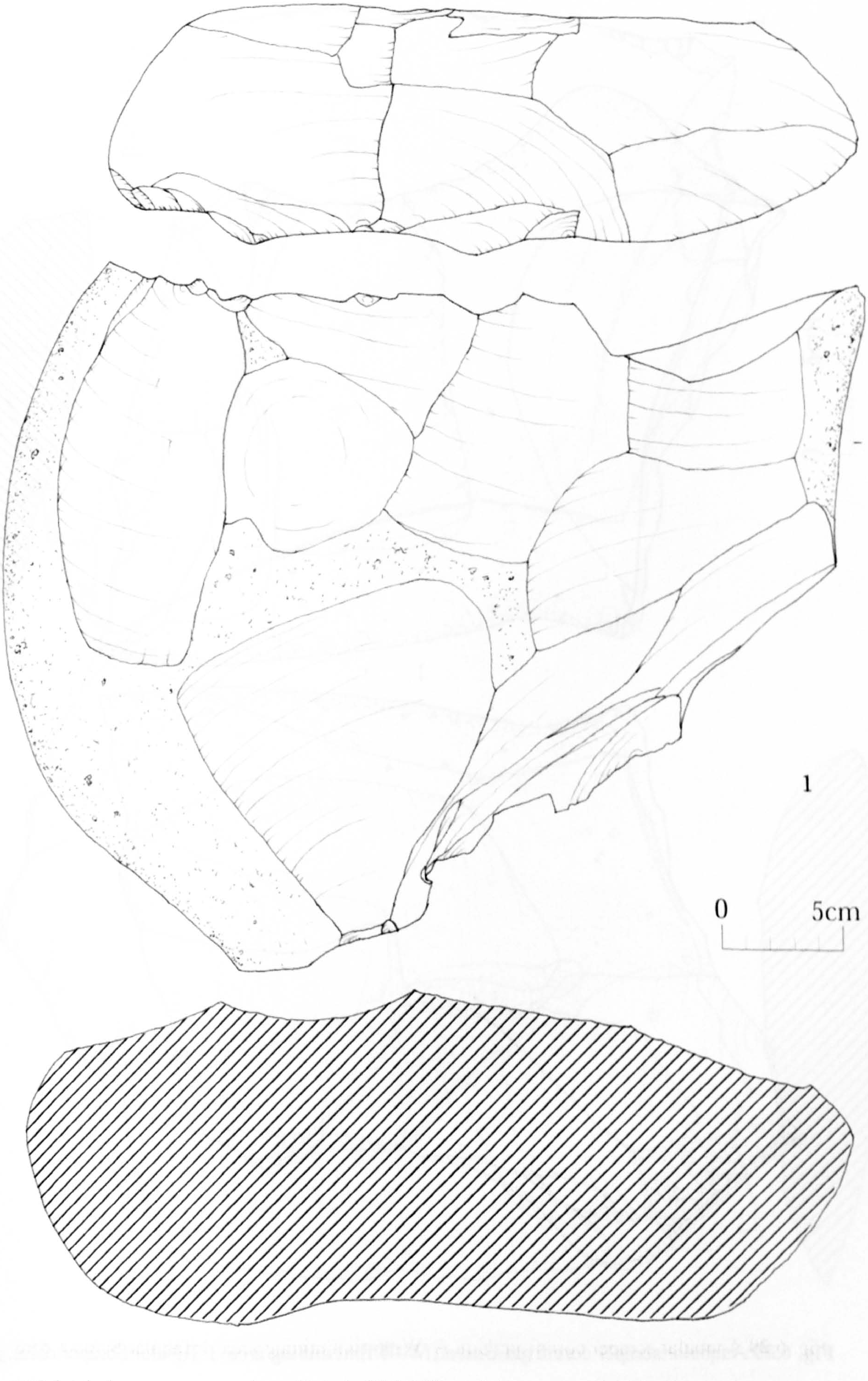


Fig.6.28 A tabular scraper core from Unit A, W-06 flint mining area. 1: Tabular scraper core.

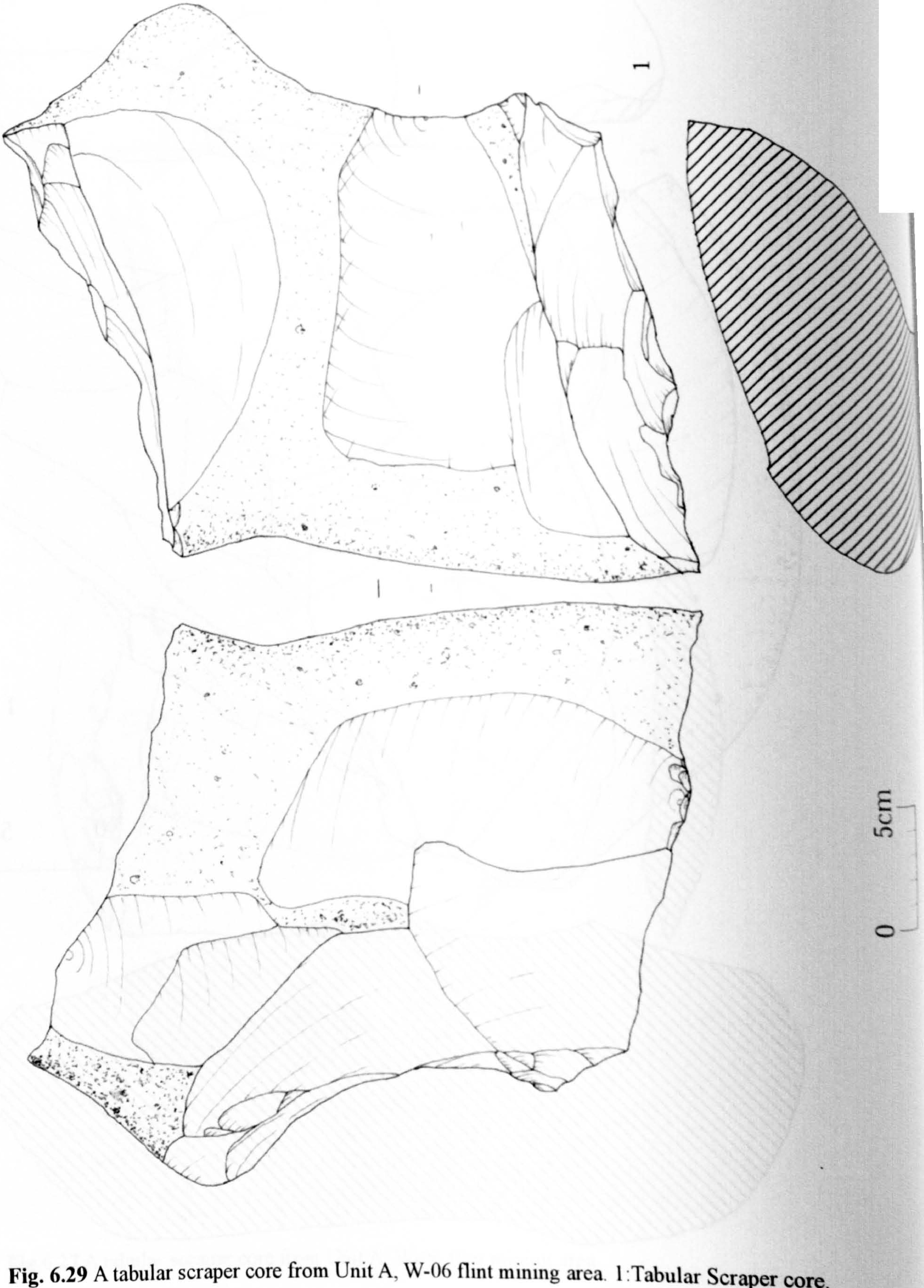


Fig. 6.29 A tabular scraper core from Unit A, W-06 flint mining area. 1:Tabular Scraper core.

Fig.6.30 A tabular scraper core from Unit A, W-06 flint mining area.1: Tabular scraper core.

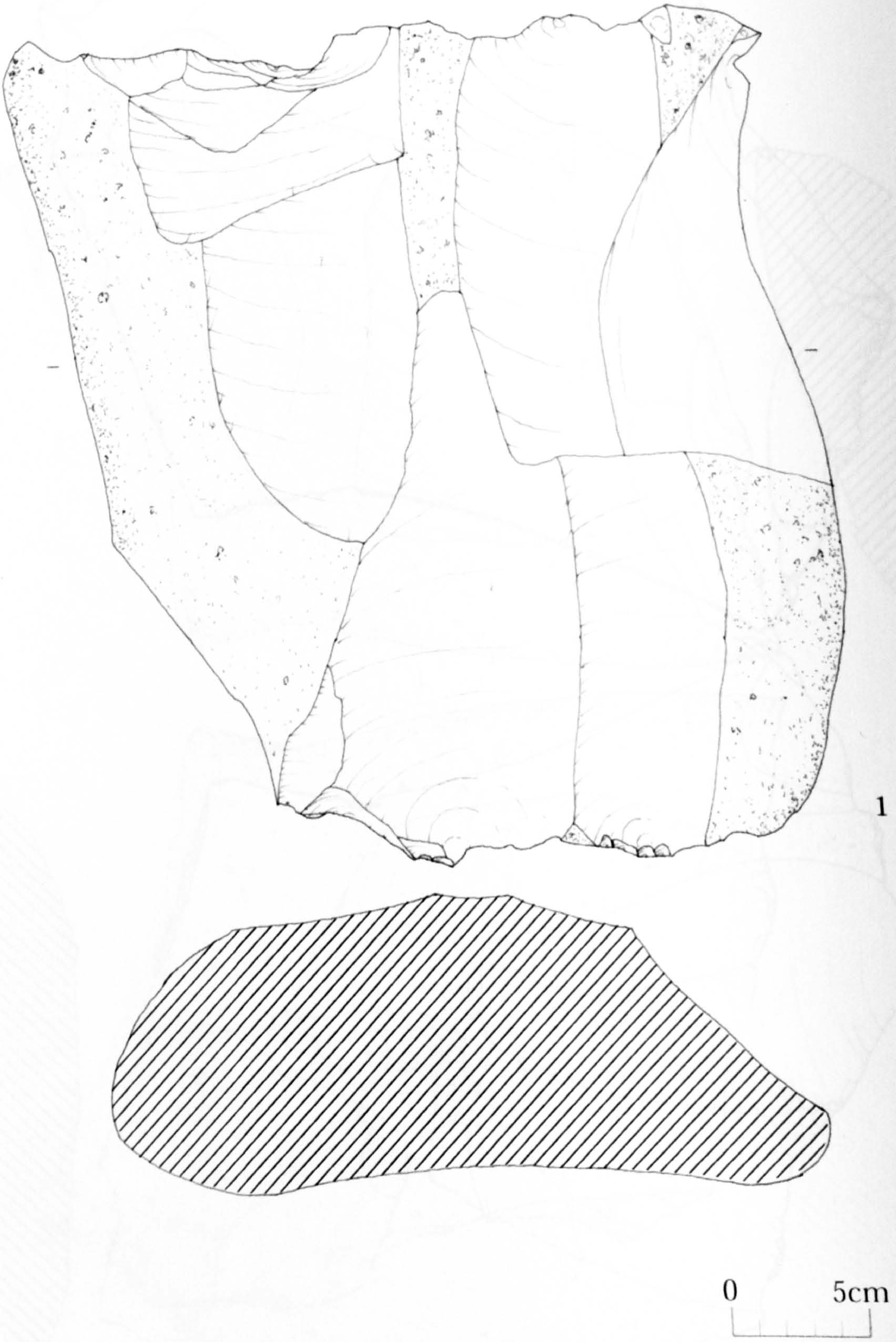


Fig.6.31.1 A tabular scraper core from Unit A, W-06 flint mining area.

1: Tabular scraper core.

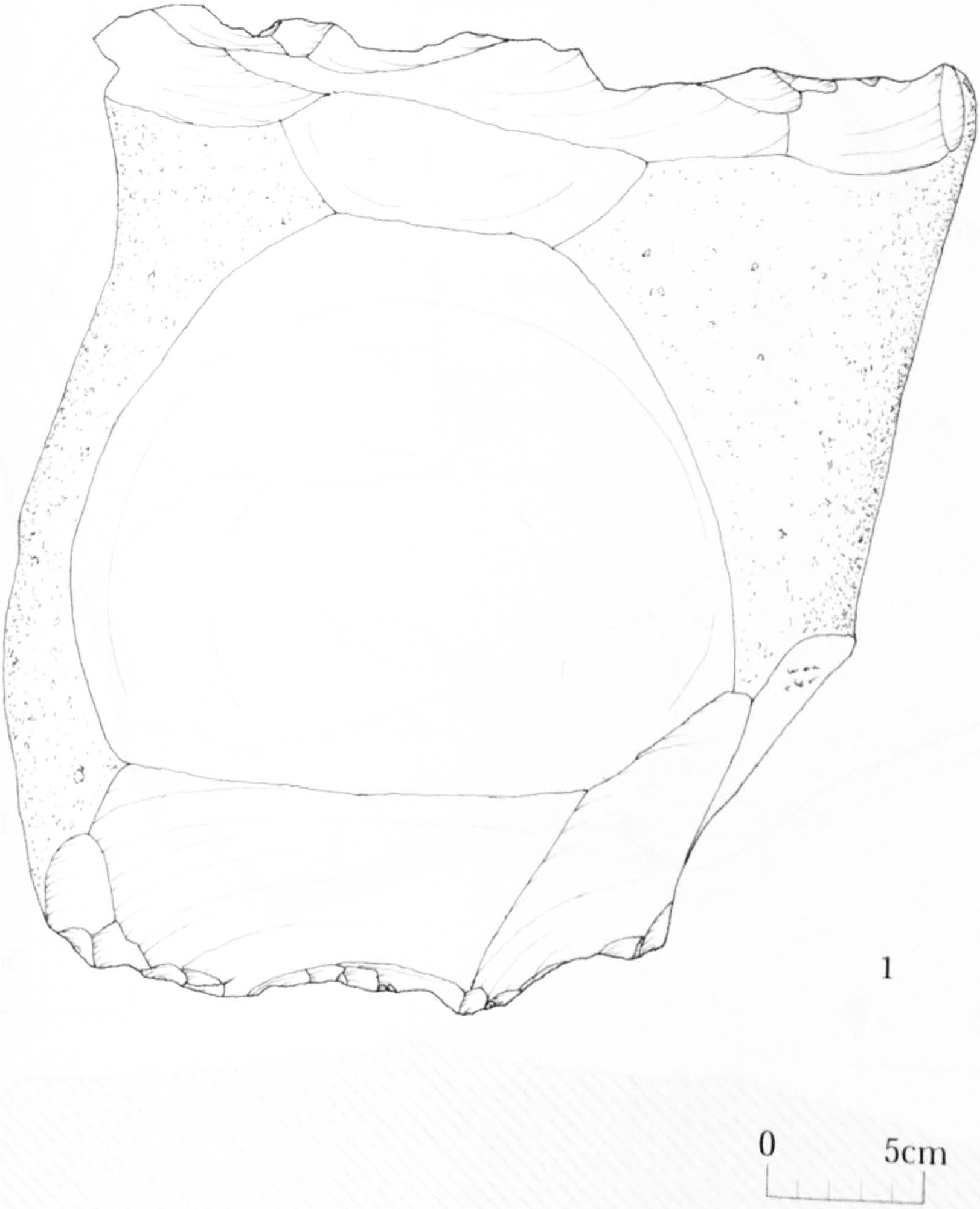


Fig.6.31.2 The reverse of the tabular scraper core in Fig.6.31.1. 1: Tabular scraper core.

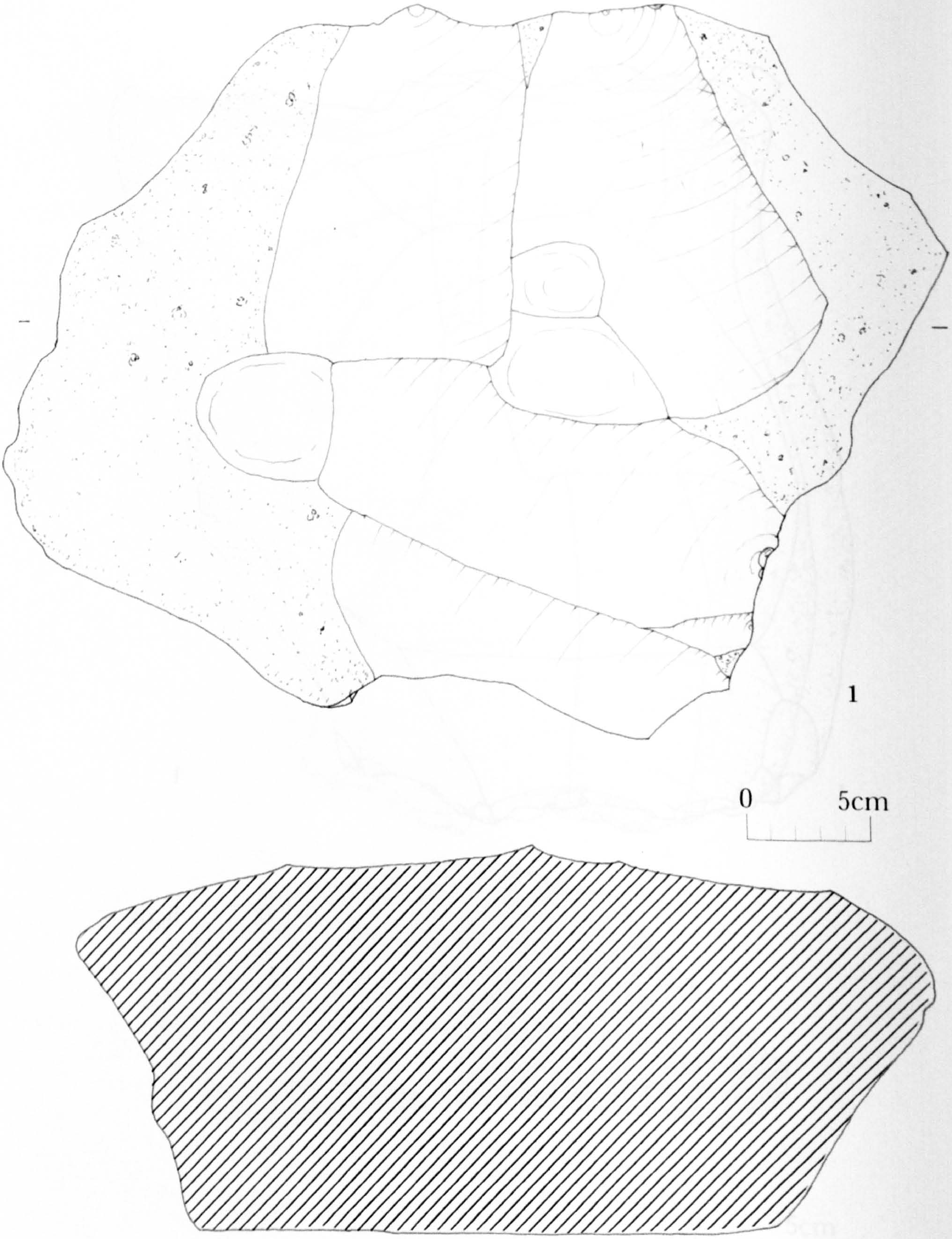


Fig.6.32.1 A tabular scraper core from Unit A, W-06 flint mining area. 1: Tabular scraper core.

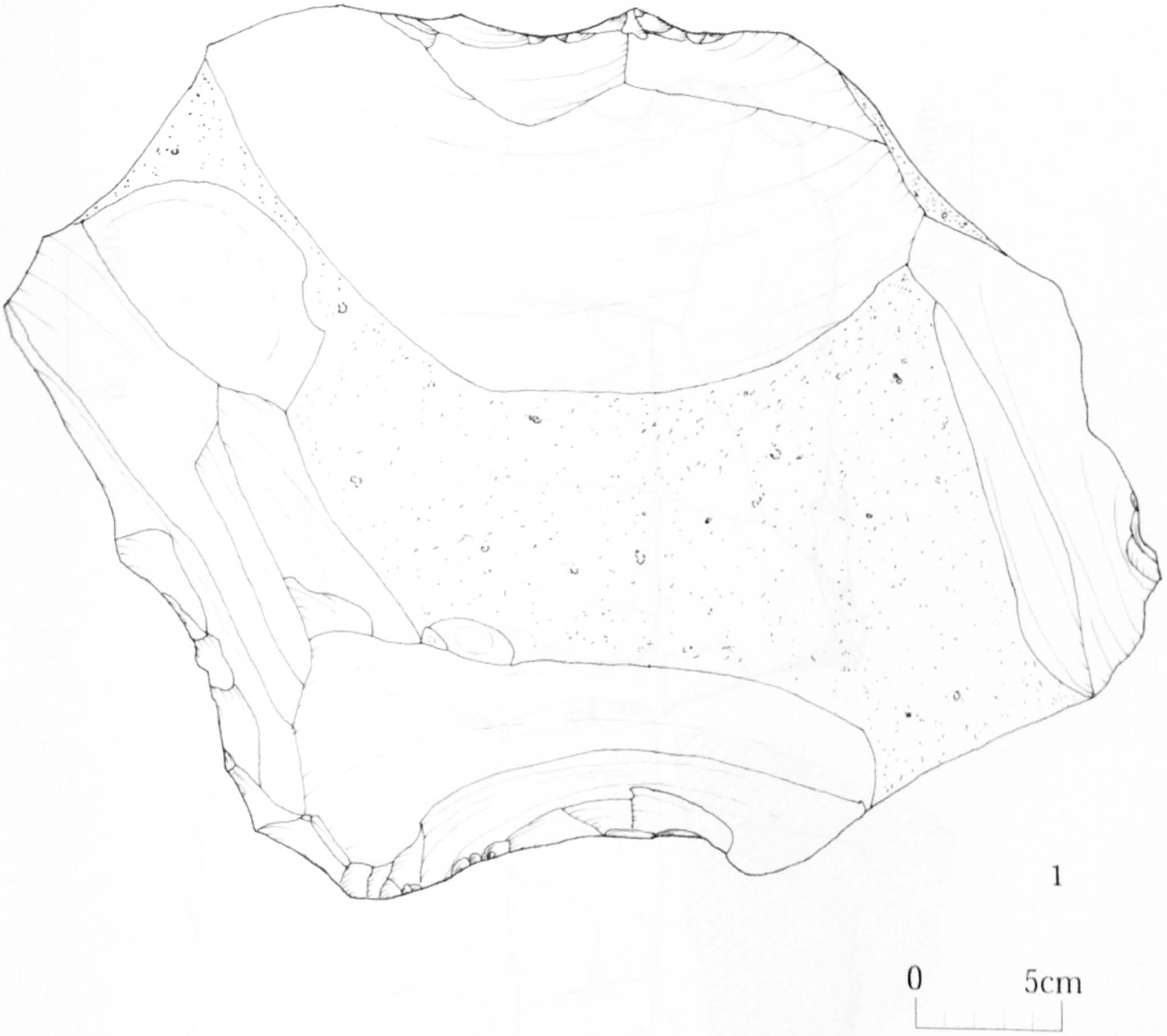


Fig.6.32.2 The reverse of the tabular scraper core in Fig.6.32-1. 1: Tabular scraper core.

Fig.6.33 A tabular scraper core from Unit A, W-06 flint mining area.

1: Tabular scraper core.

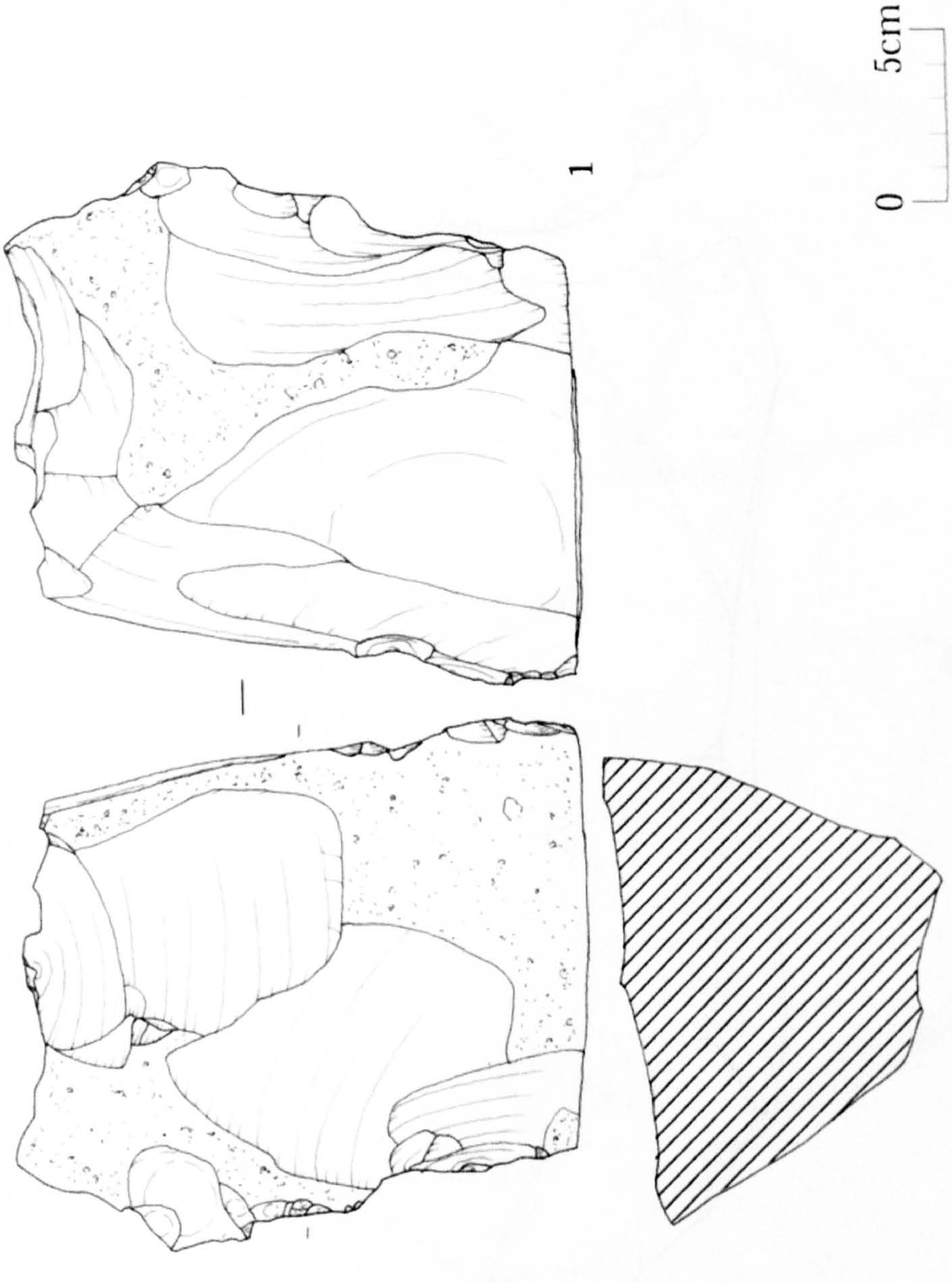


Fig.6.34 A tabular scraper core from Unit A, W-06 flint mining area.

1: Tabular scraper core.

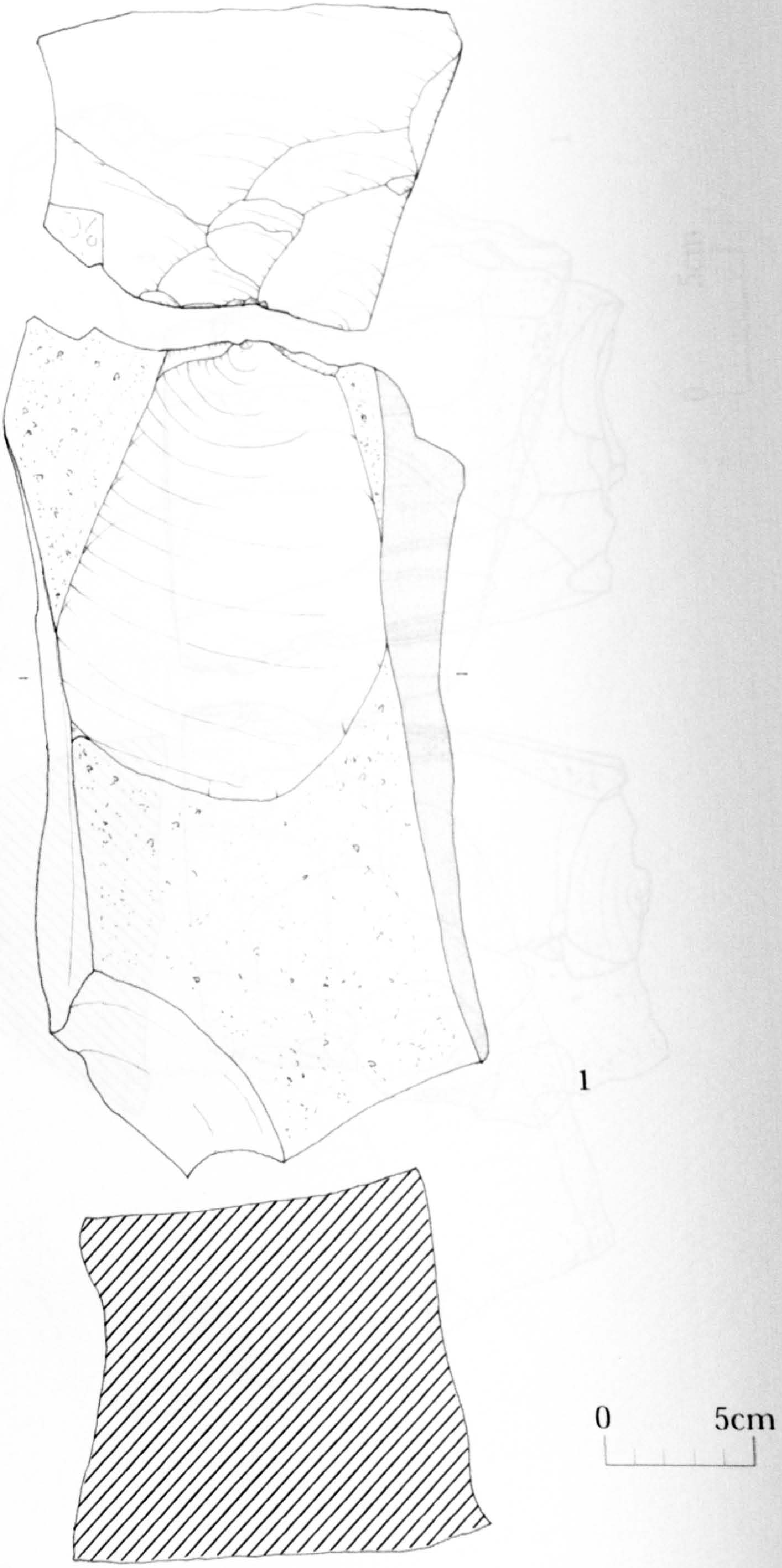


Fig.6.35 A tabular scraper core from Unit A, W-06 flint mining area. 1: Tabular scraper core.

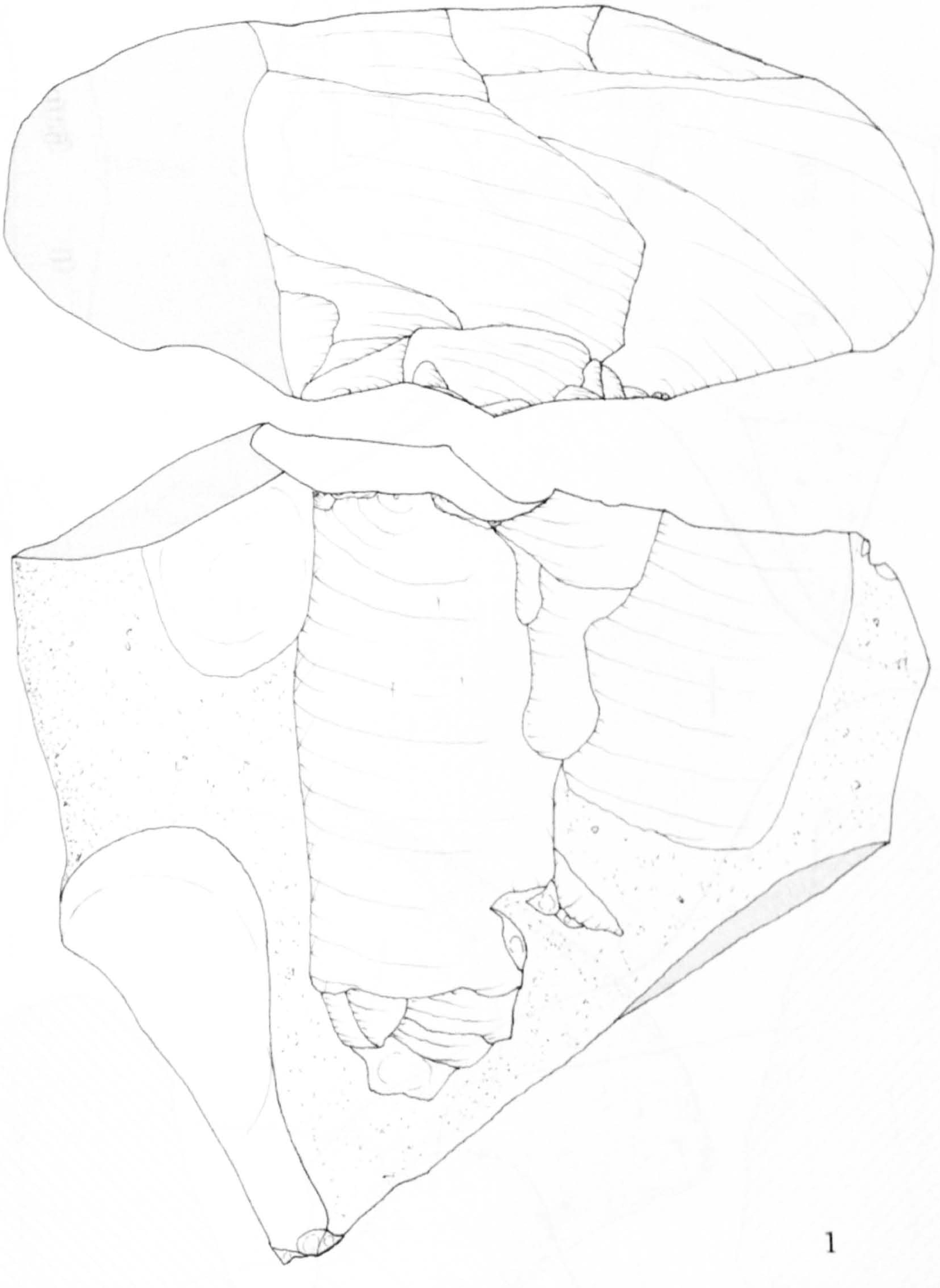


Fig.6.36 A tabular scraper core from Unit B, W-06 flint mining area.

1: Tabular scraper core.

Fig.6.37 A tabular scraper core from Unit B, W-06 flint mining area. 1: Tabular scraper core.

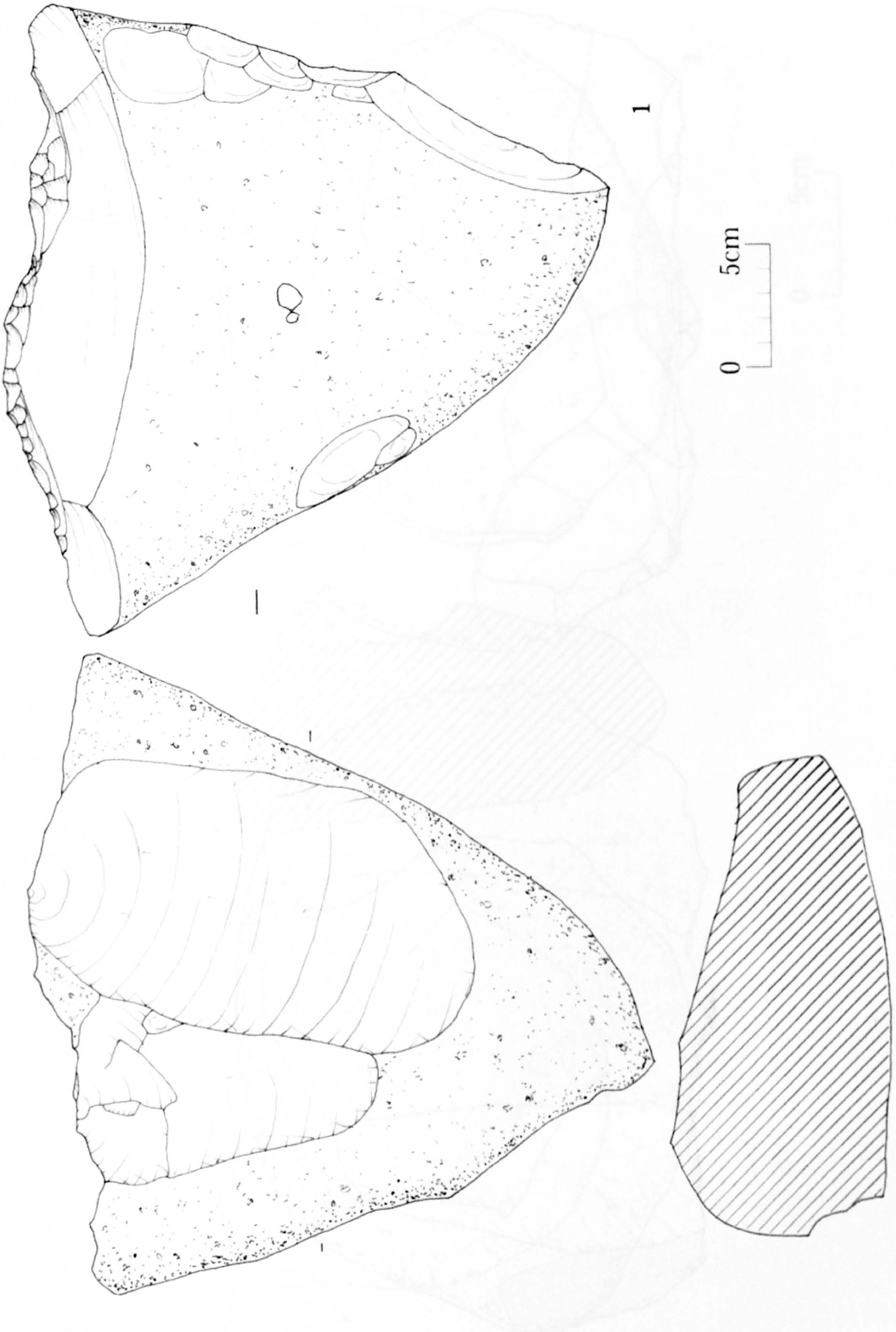


Fig.6.38 A tabular scraper core from Unit B, W-06 **flint mining area**.

1: Tabular scraper core.

Fig.6.39 A tabular scarper core from Unit B, W-06 flint mining area.

1: Tabular scraper core.

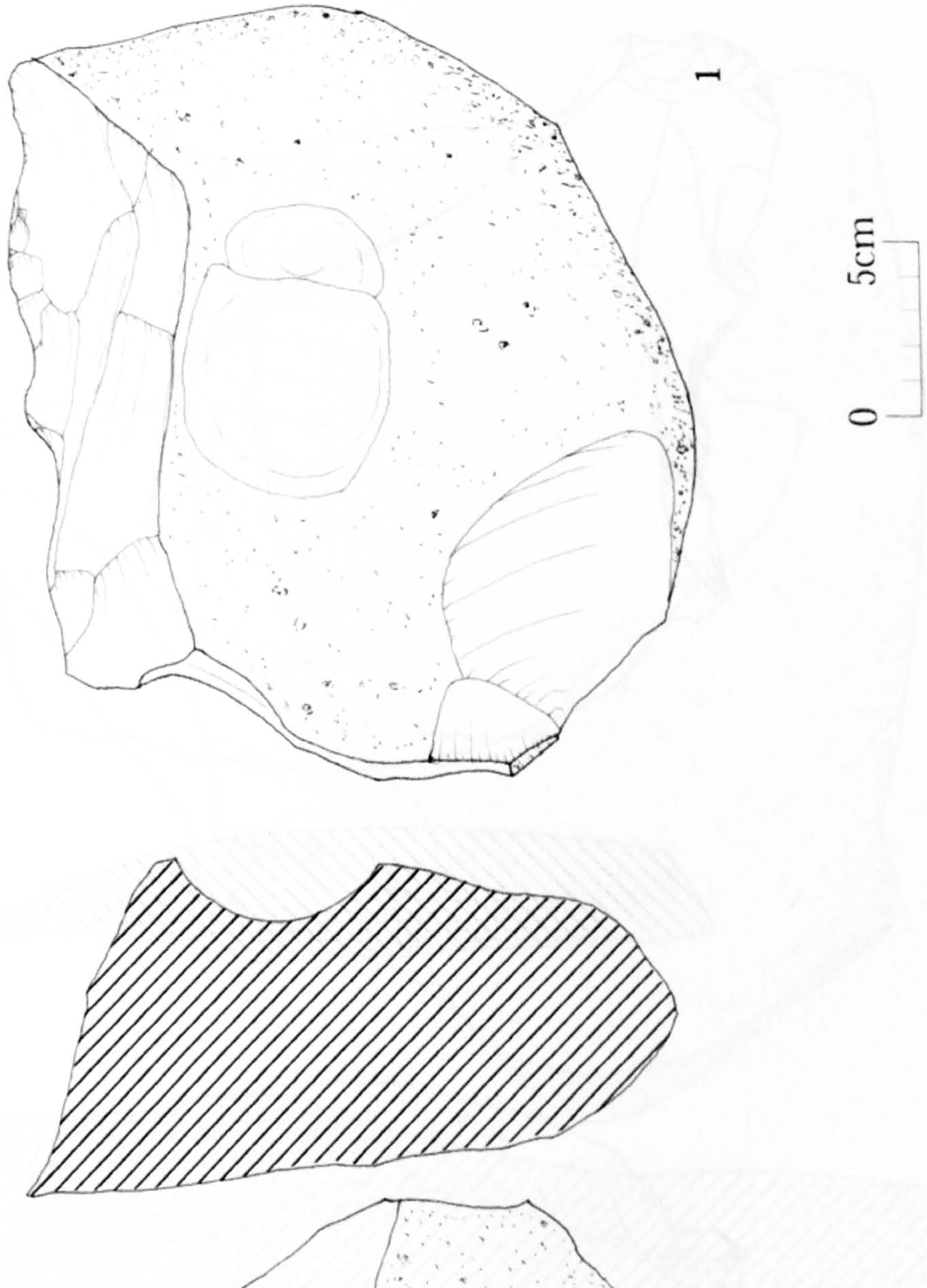


Fig.6.40 A tabular scraper core from Unit B, W-06 flint mining area. 1: Tabular scraper core.

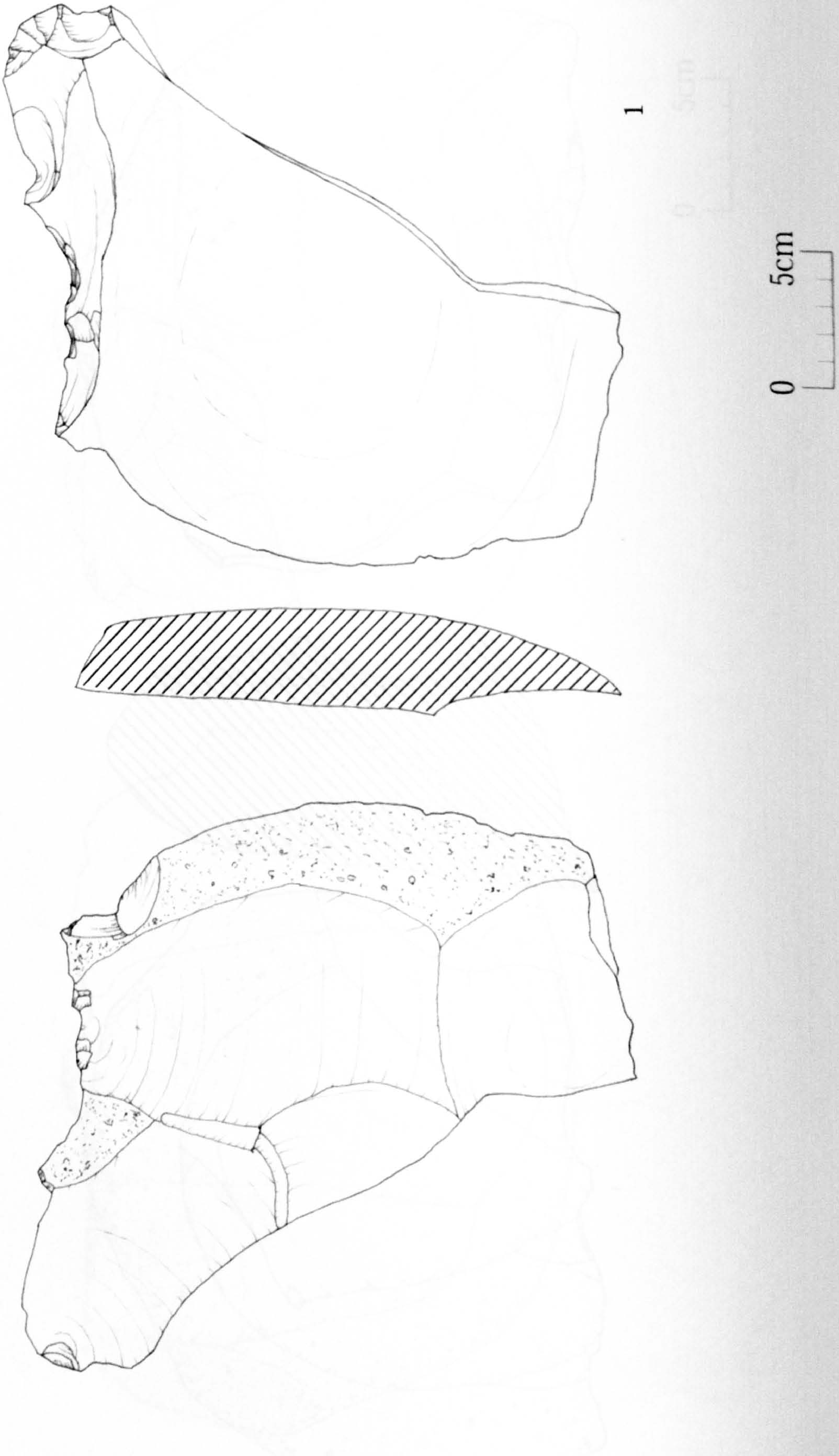


Fig.6.41 A tabular scraper core from Unit B, W-06 flint mining area.

1: Tabular scraper core.

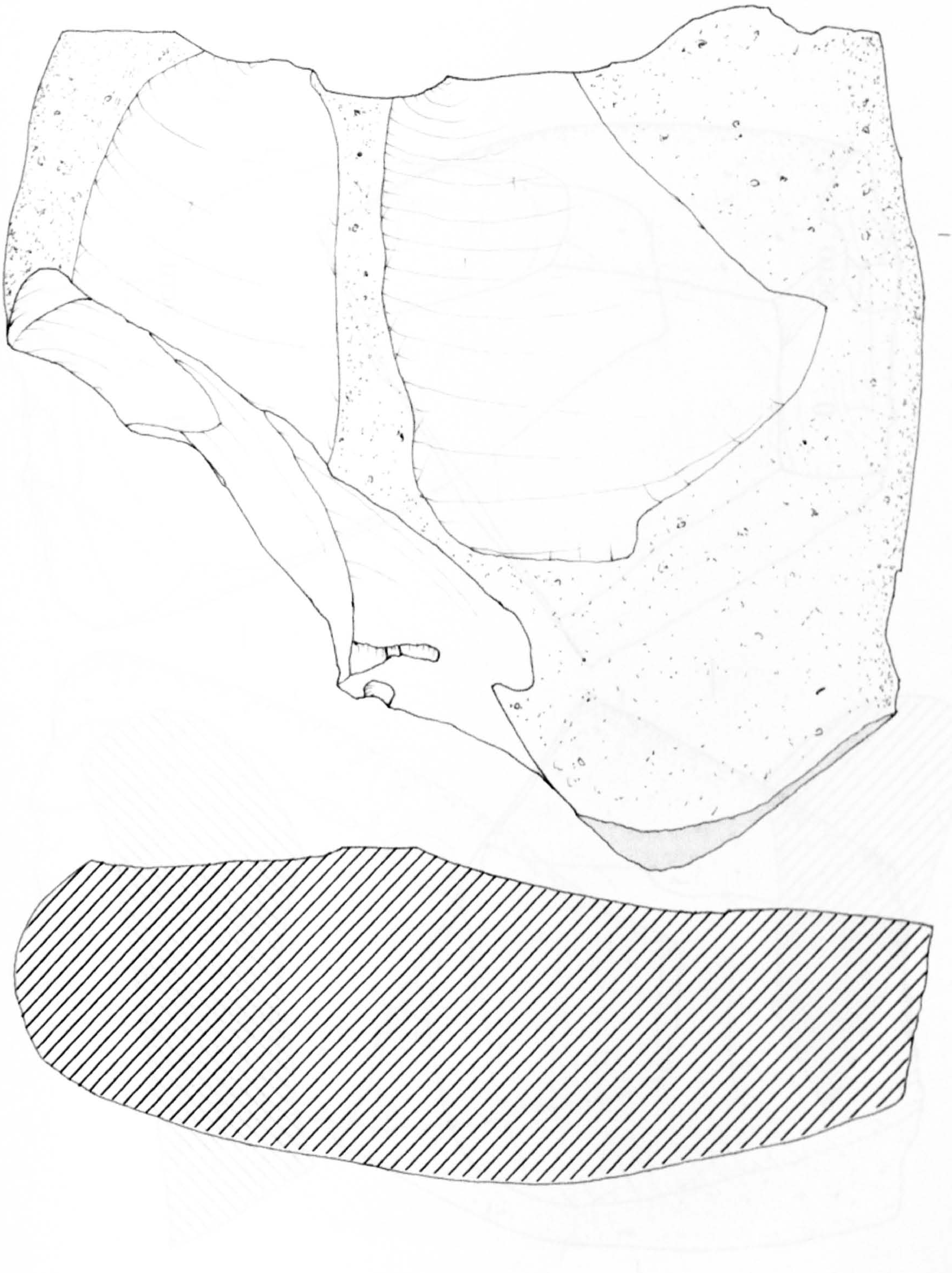


Fig.6.42 A tabular scraper core from Unit B, W-06 flint mining area.

1: Tabular scraper core.

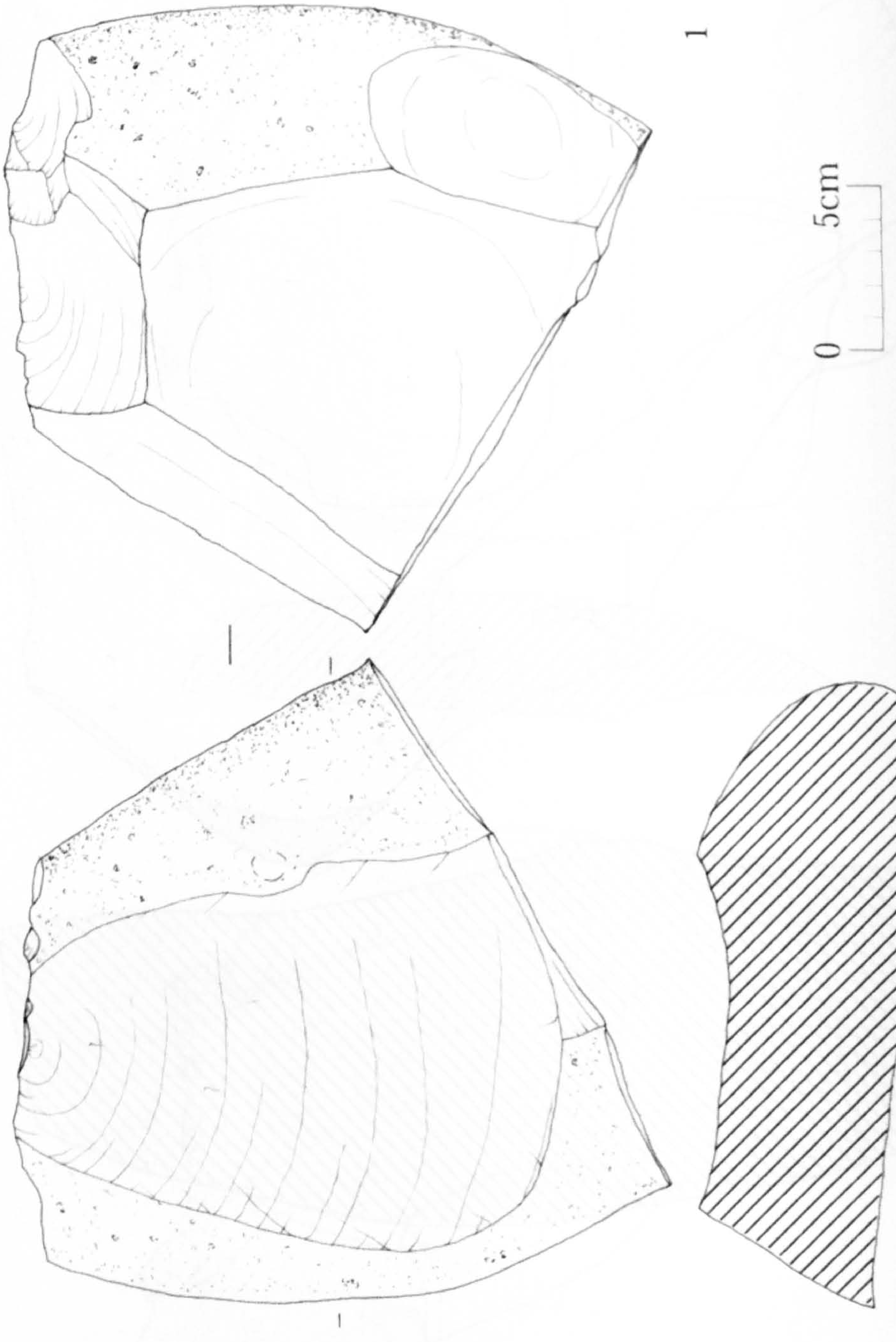


Fig.6.43 A tabular scraper core from Unit B, W-06 flint mining area.

1: Tabular scraper core.

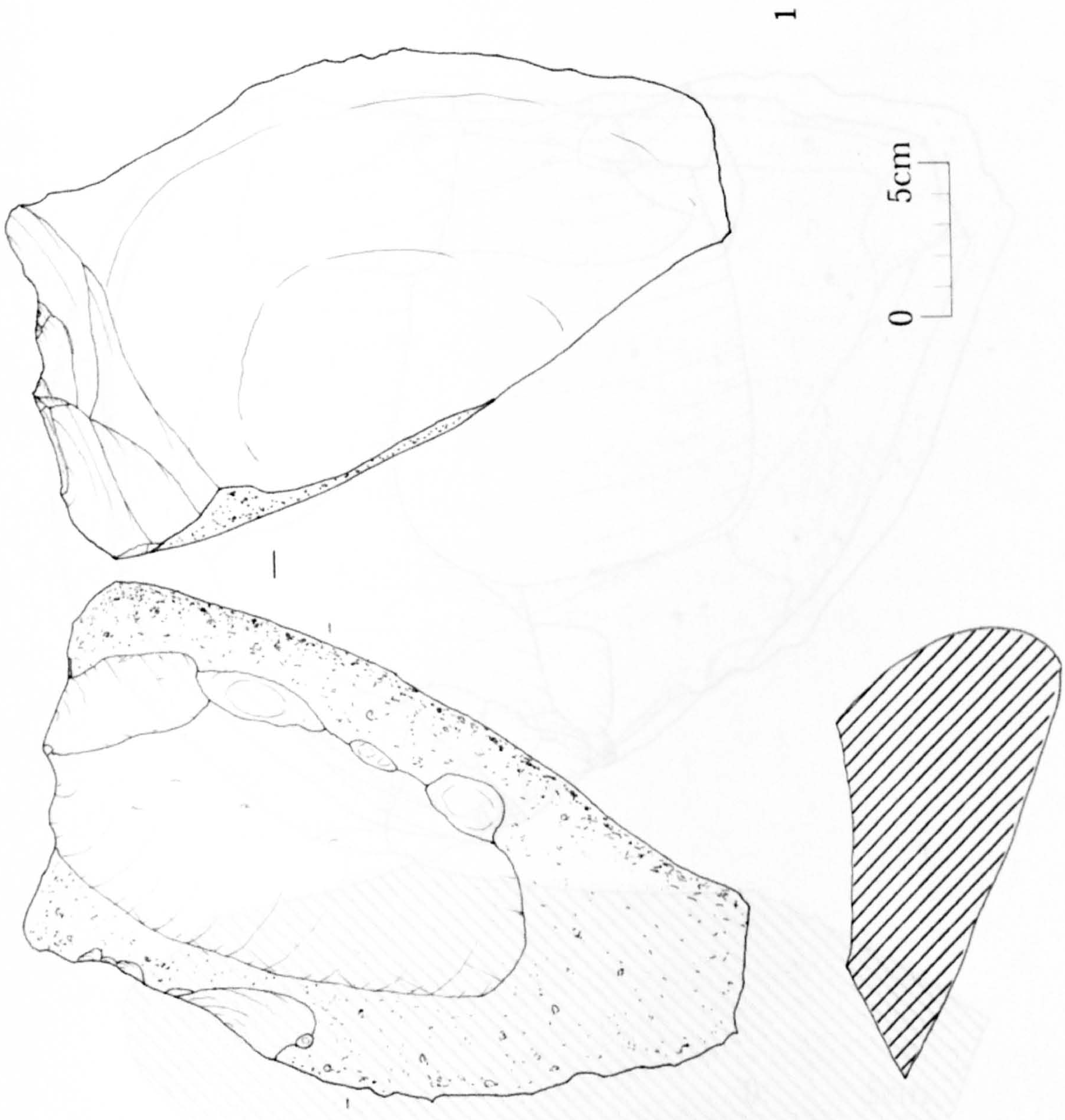


Fig.6.44 A tabular scraper core from Unit B, W-06 flint mining area.

1: Tabular scraper core

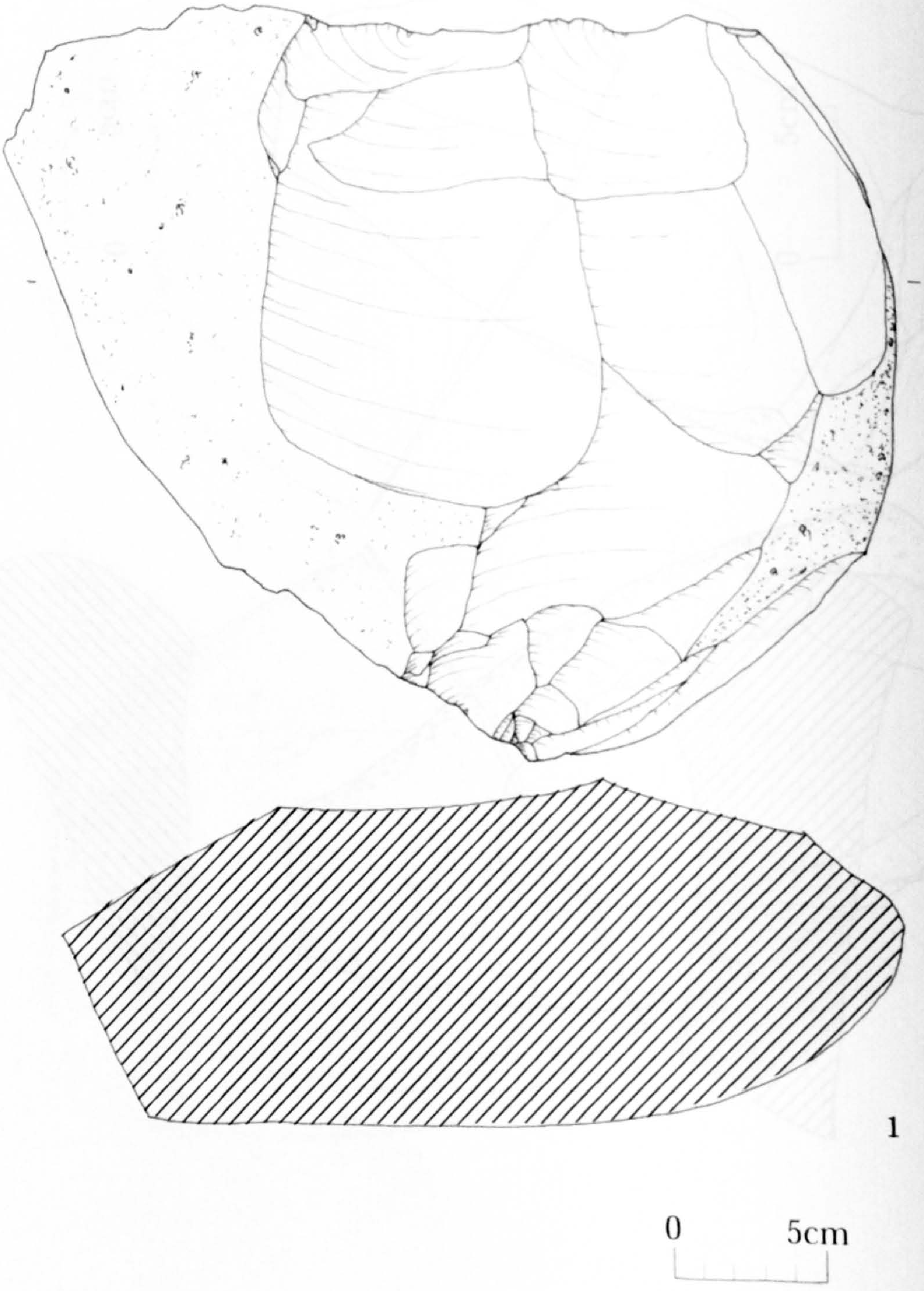


Fig.6.45.1 A tabular scraper core from Unit B, W-06 flint mining area.

1: Tabular scraper core

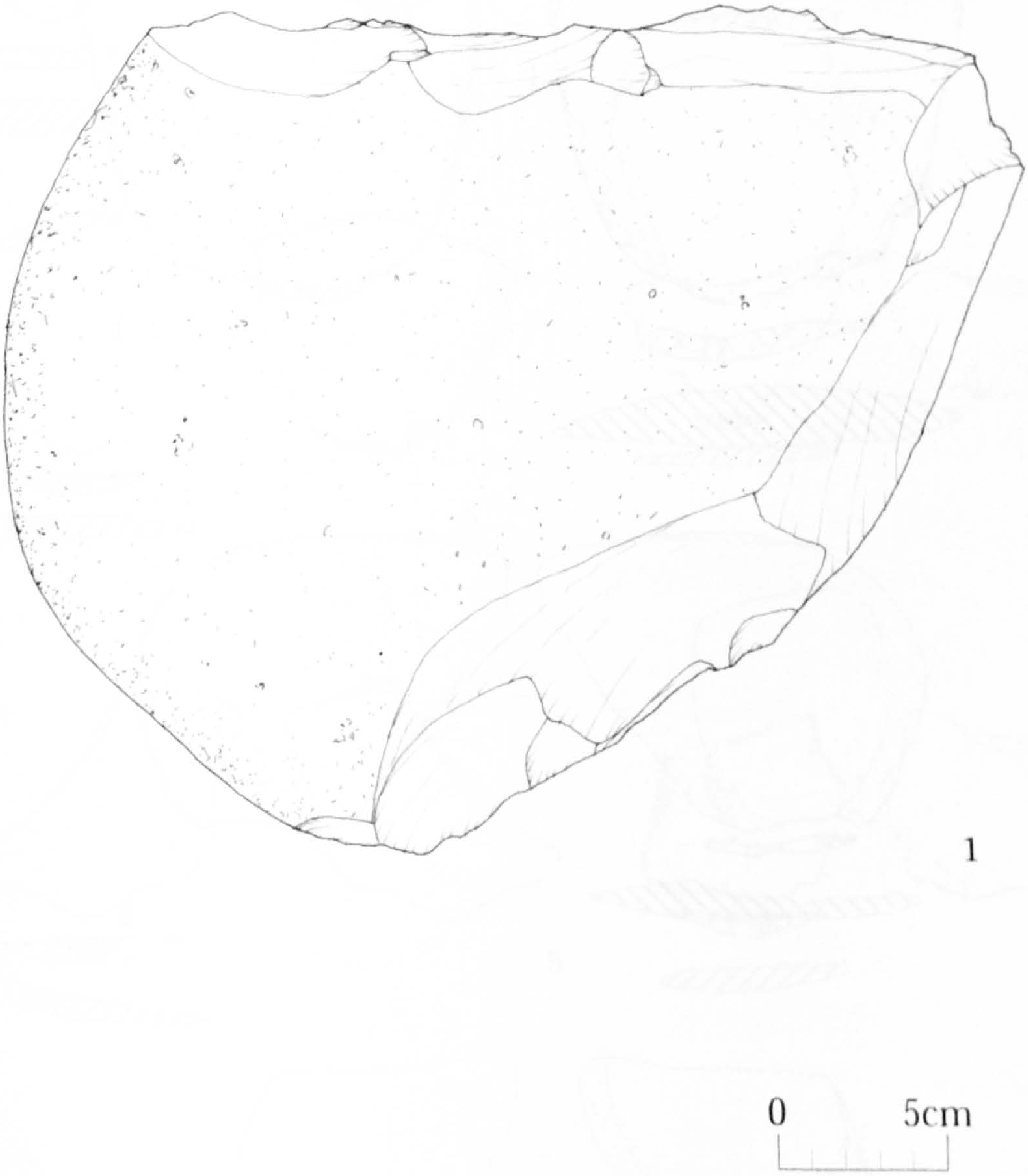


Fig.6.45.2 The reverse of the tabular scraper core in Fig.6.41.1.

1:Tabular scraper core.

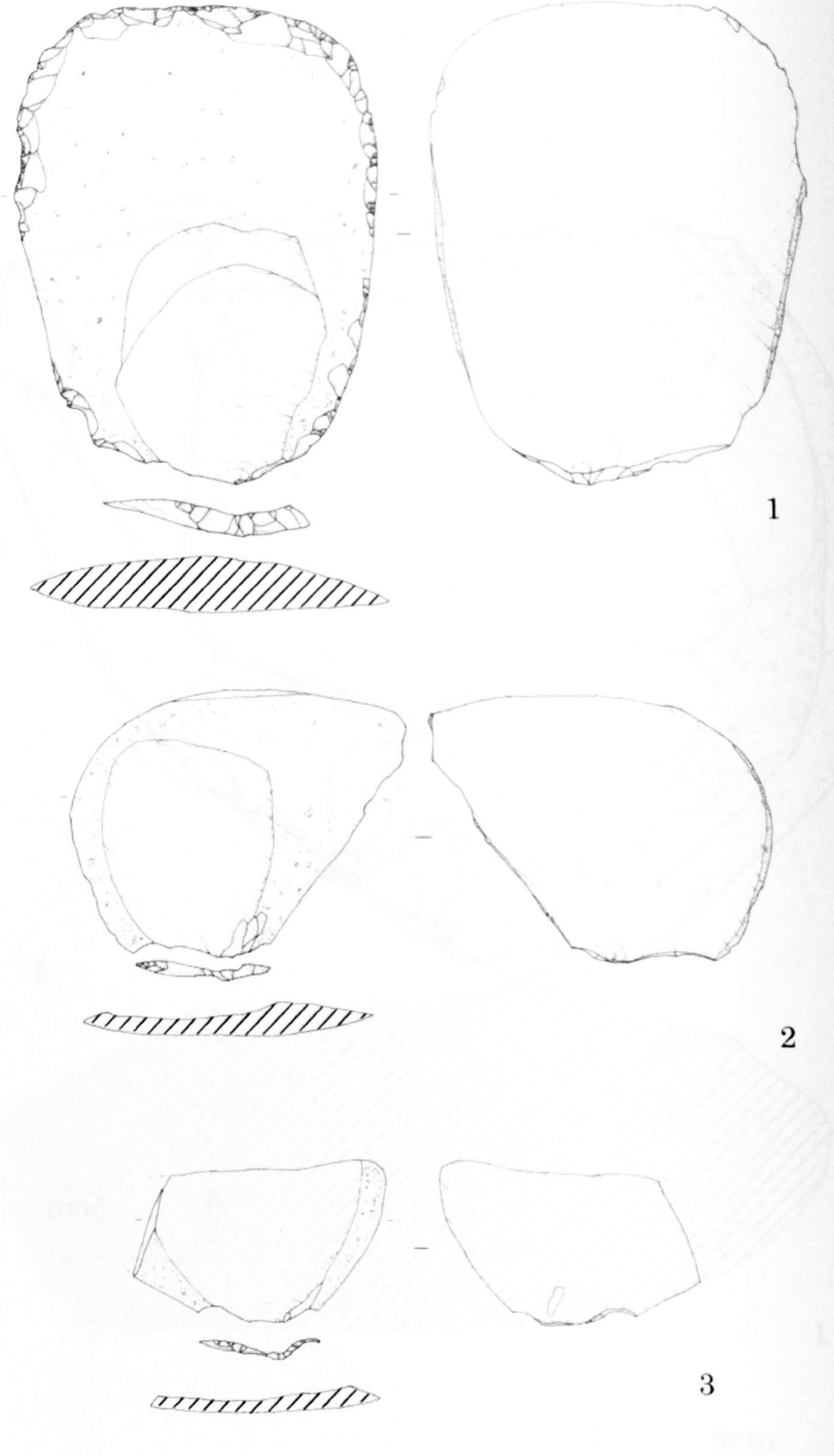


Fig.6.46 A tabular scraper and tabular scraper flakes from Unit A and B, W-06 flint mining area.
1: Tabular scraper, 2-3: Tabular scraper flakes.

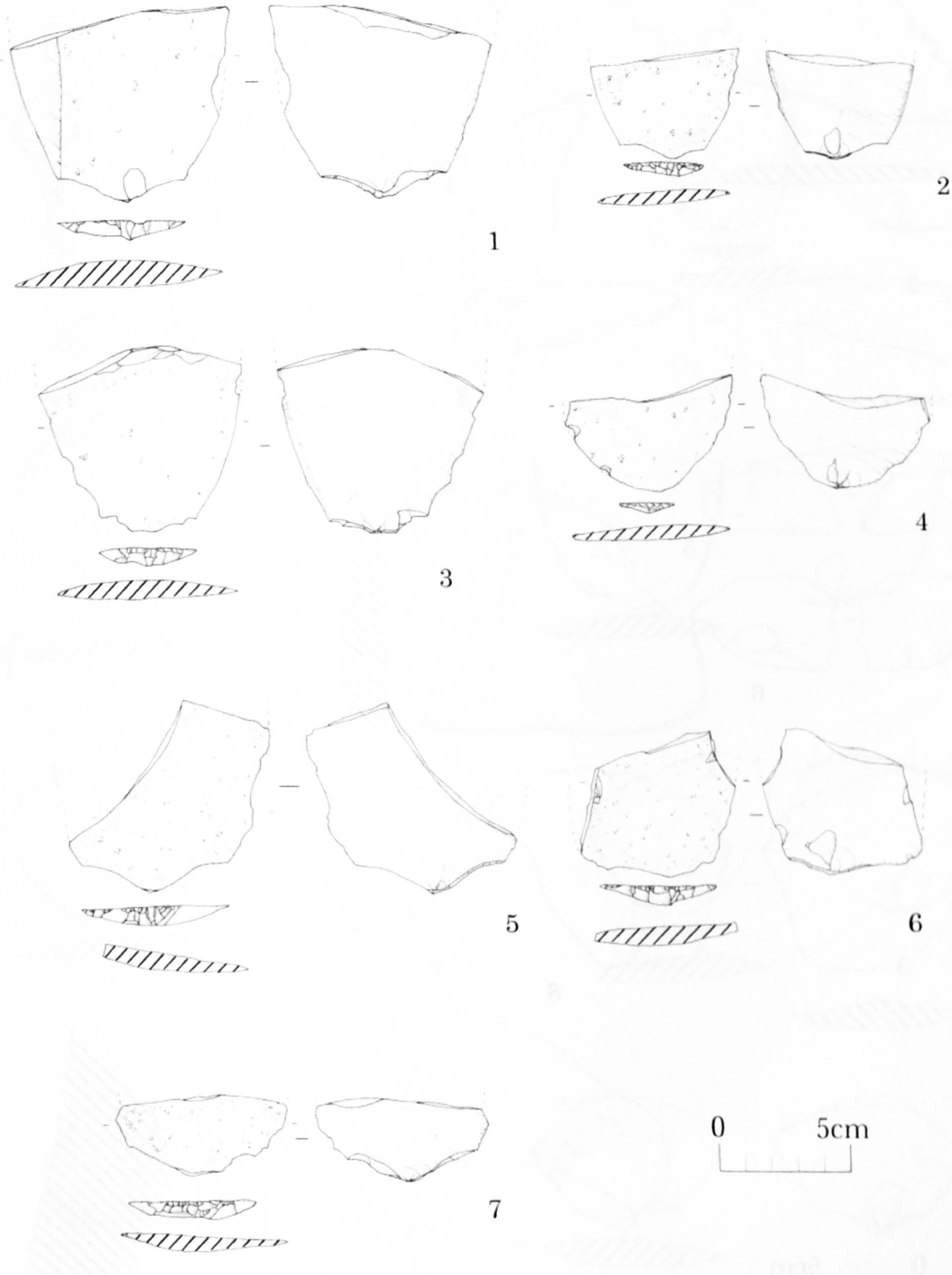


Fig.6.47 Tabular scraper flakes from Unit A and B, W-06 flint mining area.

1-7: Proximal fragments of tabular scraper flakes.

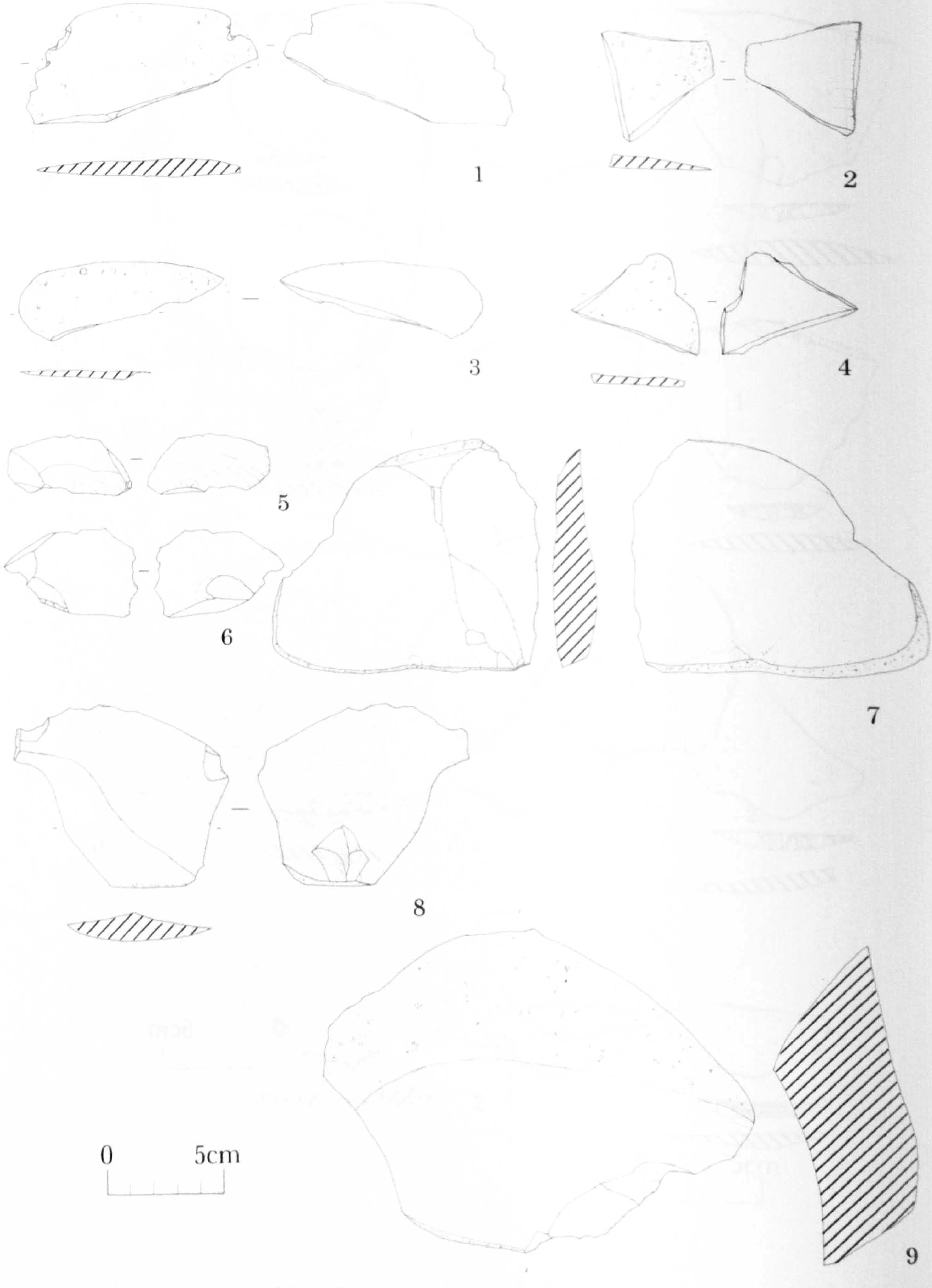


Fig.6.48 Tabular scraper flakes, flakes, partially cortical flakes and cortical flakes from Unit A and B.1-4: Tabular scraper fragments, 5-6: Flakes, 7-8: Partially cortical flakes, 9: Cortical flake.

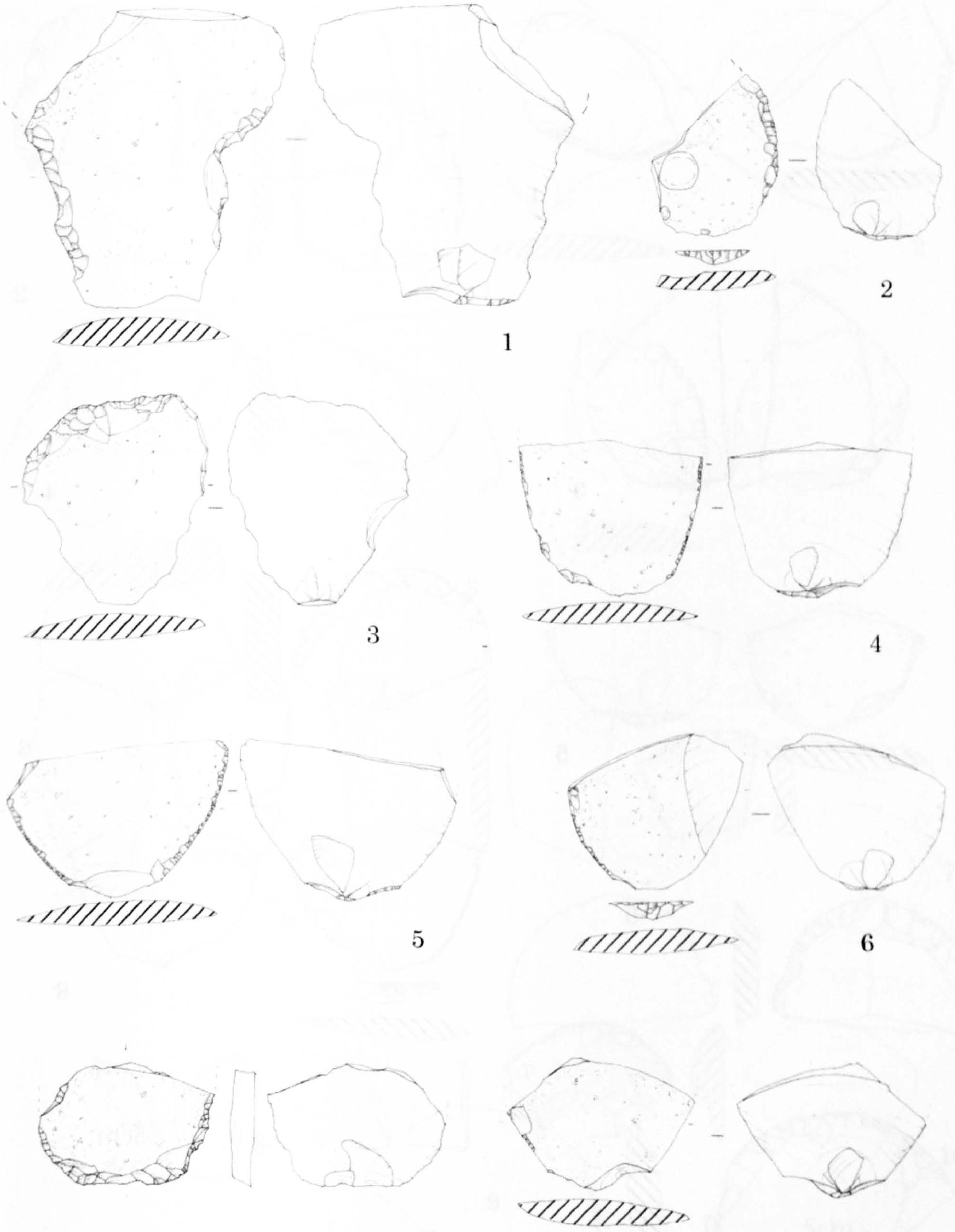


Fig.6.49 Tabular scrapers from Structure 07.

1, 3: Unbroken tabular scrapers, 2, 4-8: Proximal fragments of tabular scrapers

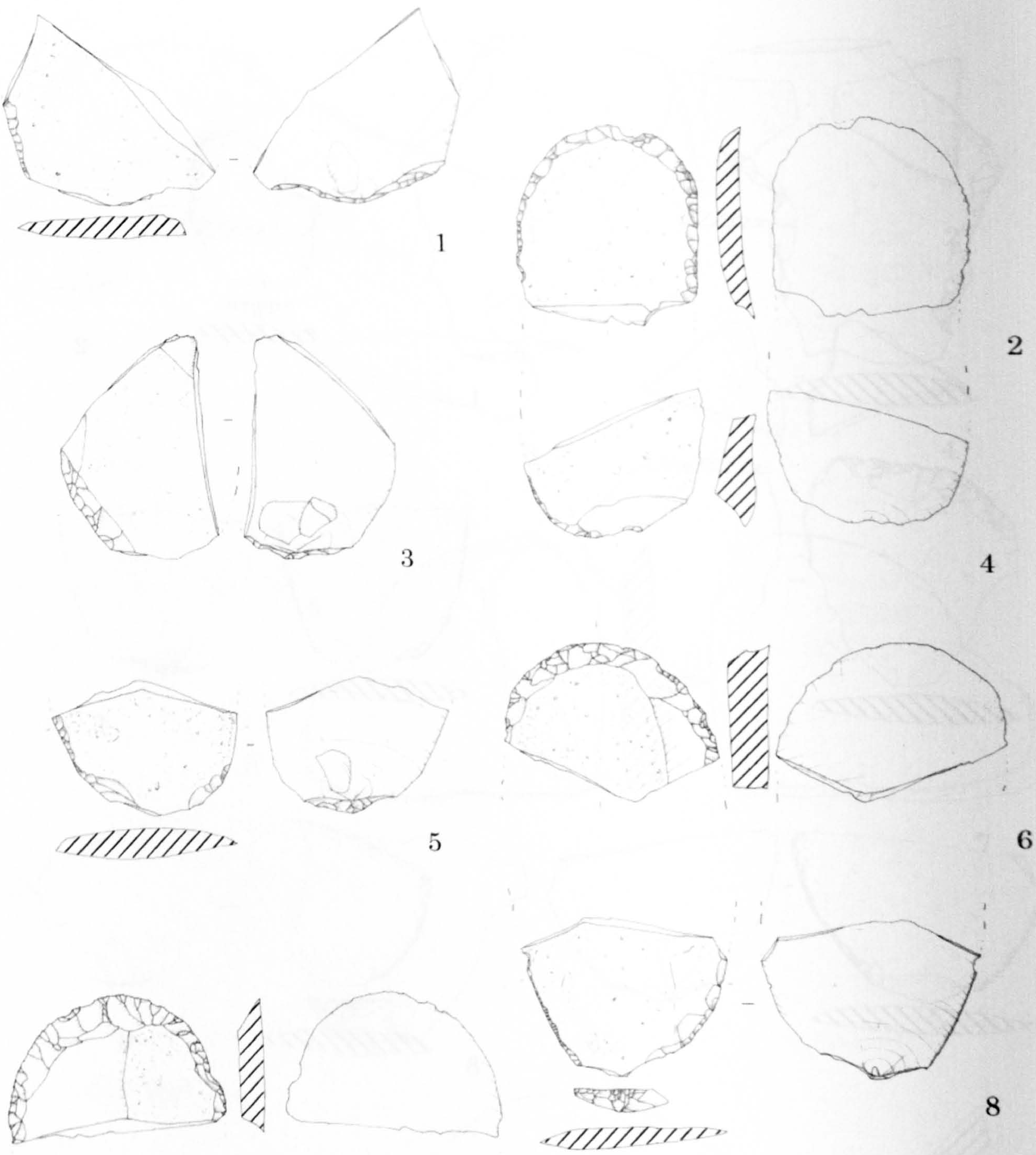


Fig.6.50 Tabular scrapers from Structure 07.

1,3,4,5,8: Proximal fragments of tabular scrapers, 2, 6, 7,9: Distal fragments of tabular scarpers.

Fig.6.51 Tabular scrapers from Structure 07.

1-10: Distal fragments of tabular scrapers.

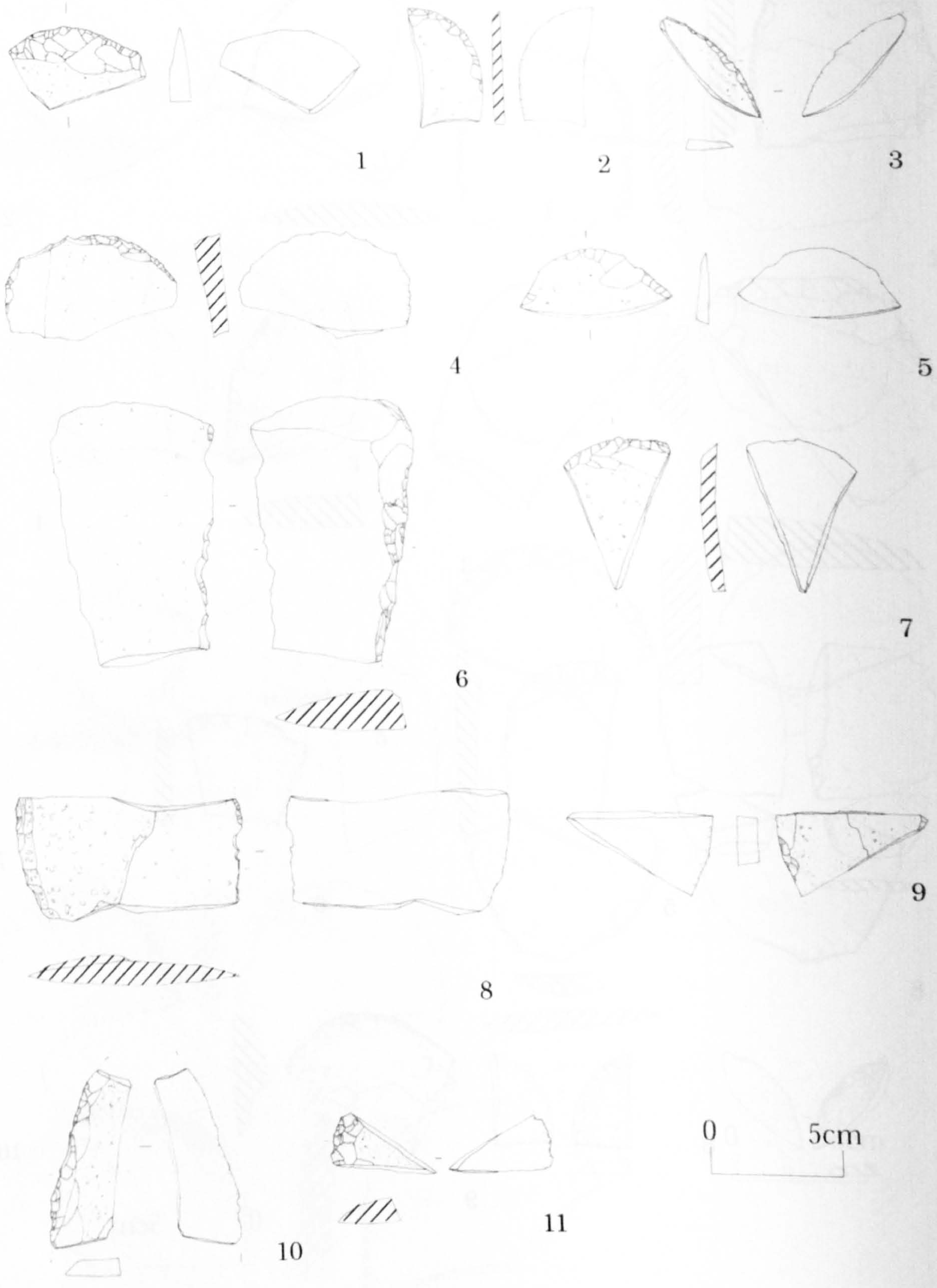


Fig.6.52 Tabular scrapers from Structure 07.

1-7: Distal fragments of tabular scrapers, 8-11: Other fragments of tabular scrapers.

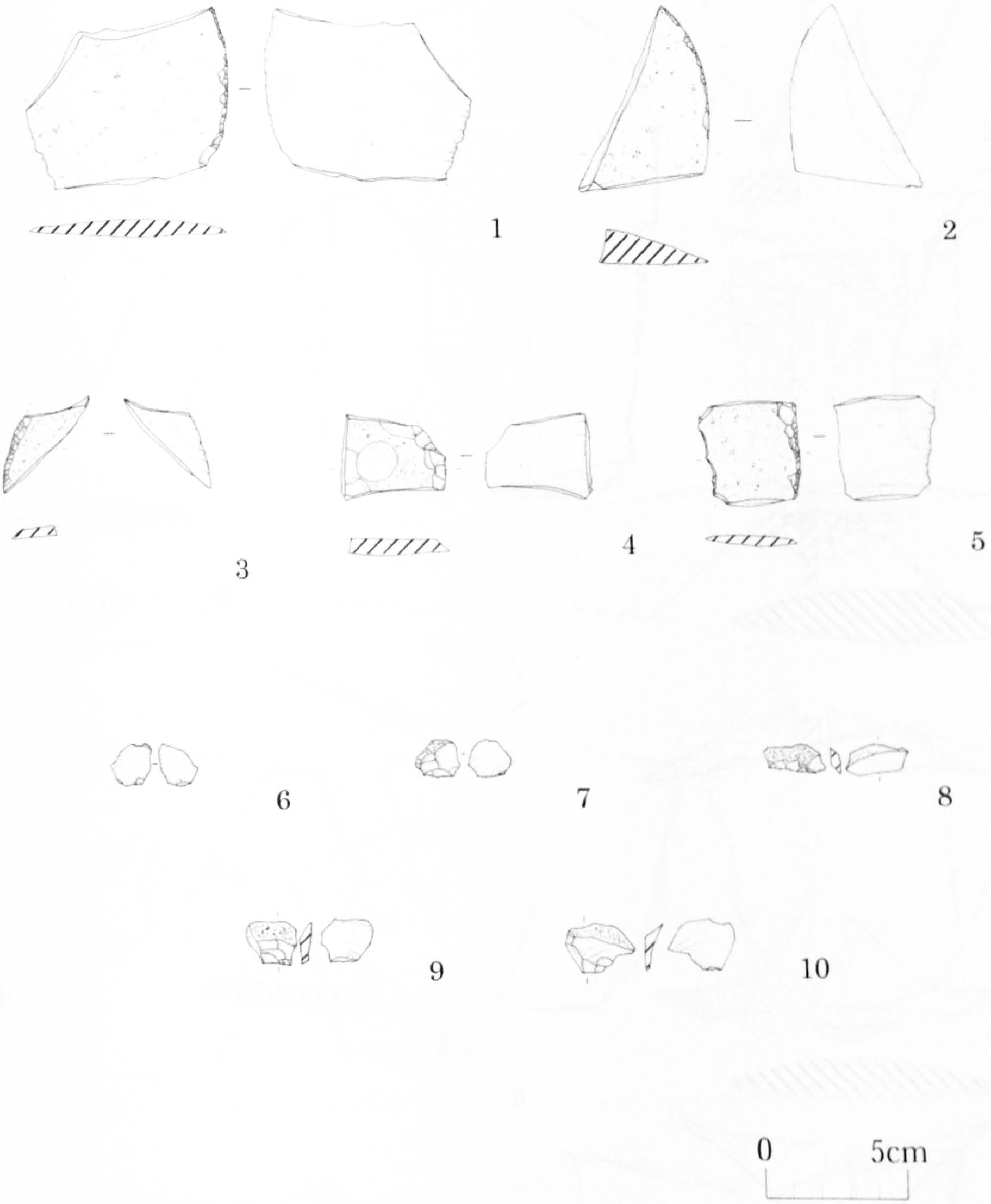


Fig.6.53 Tabular scrapers, chips, partially cortical flakes and cortical flakes from Structure 07.

1-5: Other fragments of tabular scrapers, 6, 7: Chips, 8, 9: Cortical flakes, 10: Partially cortical flakes.

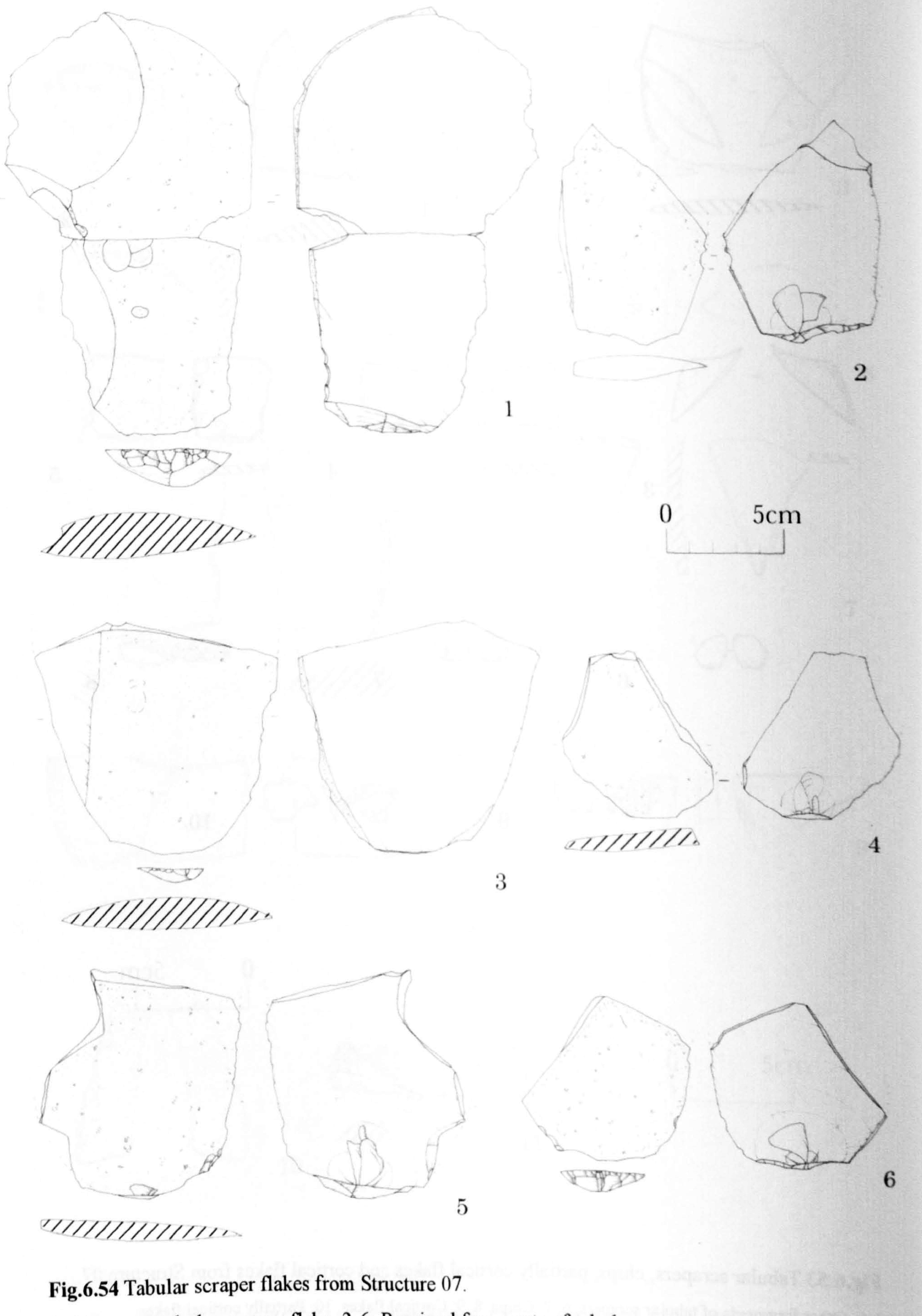


Fig.6.54 Tabular scraper flakes from Structure 07.

1: Unbroken tabular scraper flake, 2-6: Proximal fragments of tabular scraper flakes.

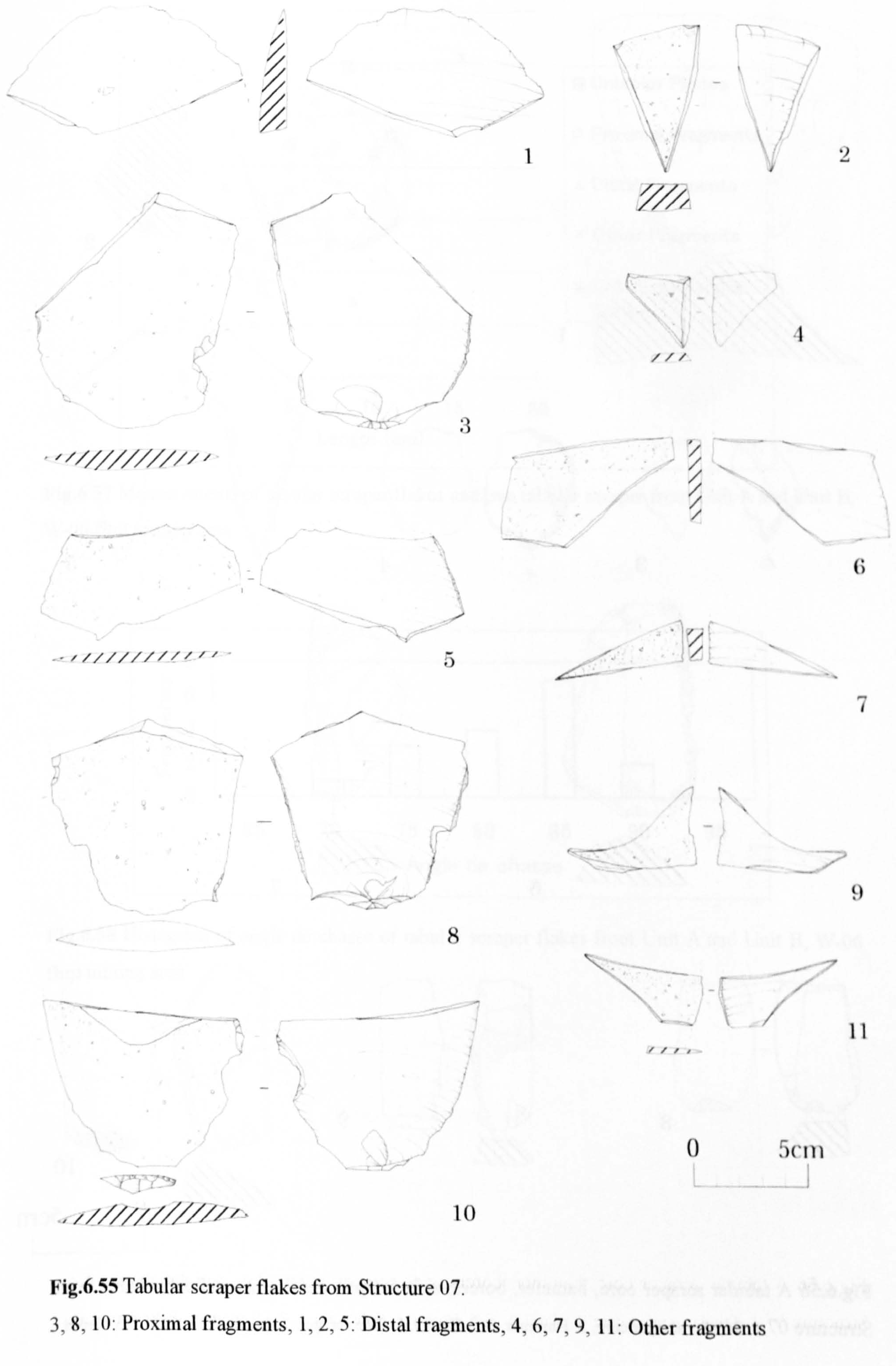


Fig.6.55 Tabular scraper flakes from Structure 07.

3, 8, 10: Proximal fragments, 1, 2, 5: Distal fragments, 4, 6, 7, 9, 11: Other fragments

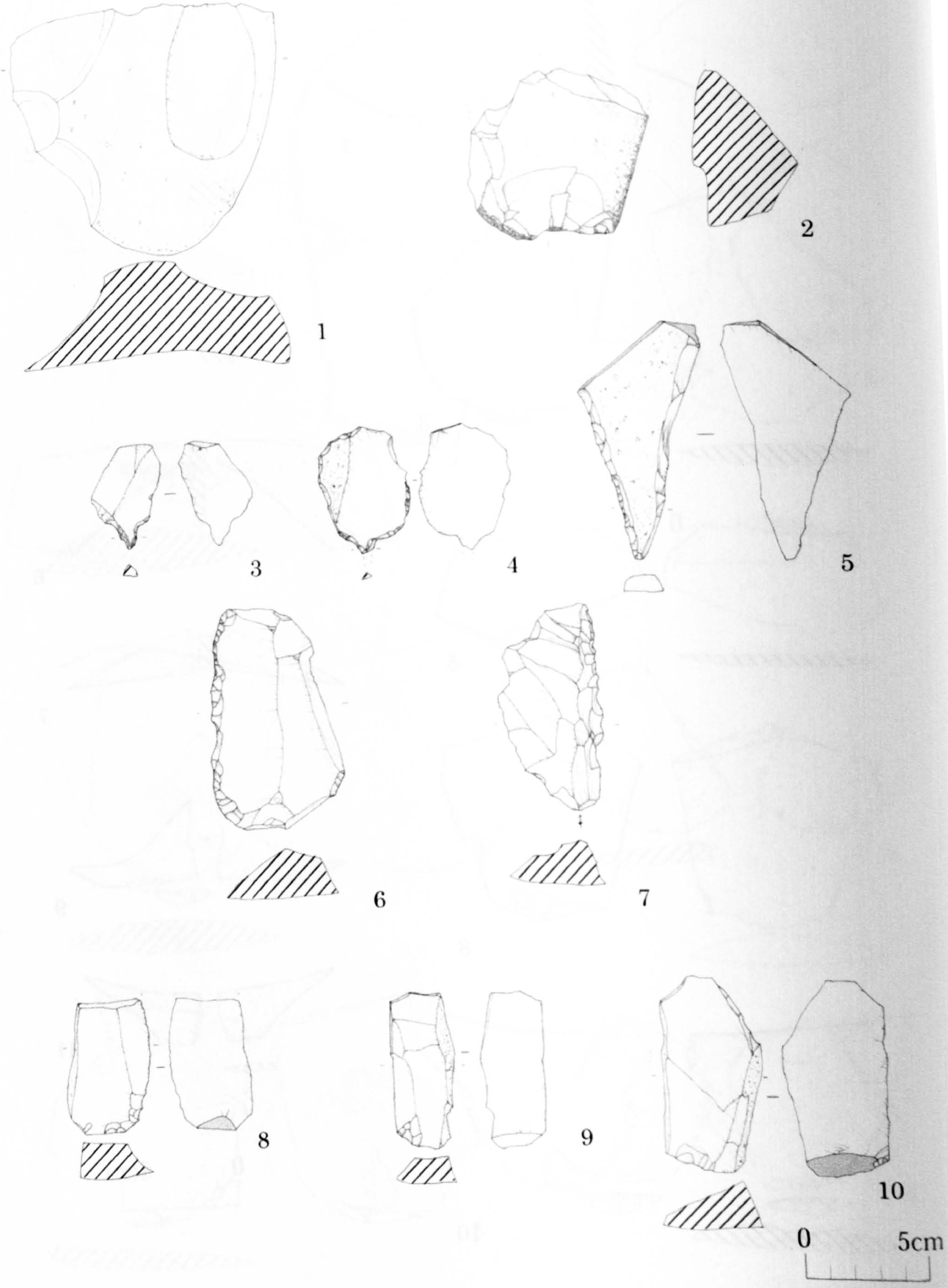


Fig.6.56 A tabular scraper core, hammer, borers, side scraper, denticulate and Jafr blades from Structure 07. 1: Tabular scraper core, 2: Hammer, 3-5: Borers, 6: Side scraper, 7: Denticulate, 8-10: Jafr blades.

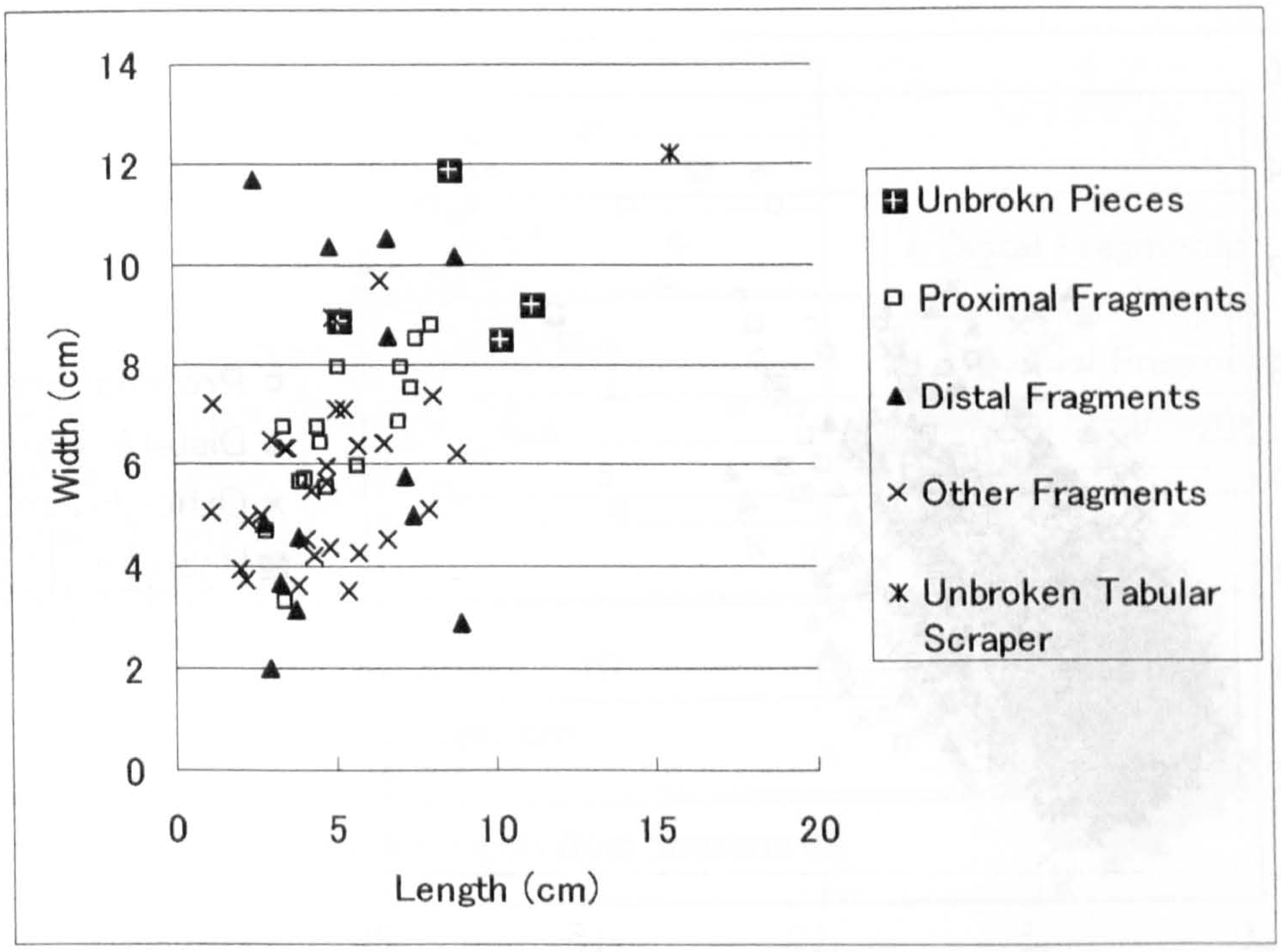


Fig.6.57 Measurements of tabular scraper flakes and one tabular scraper from Unit A and Unit B, W-06 flint mining area.

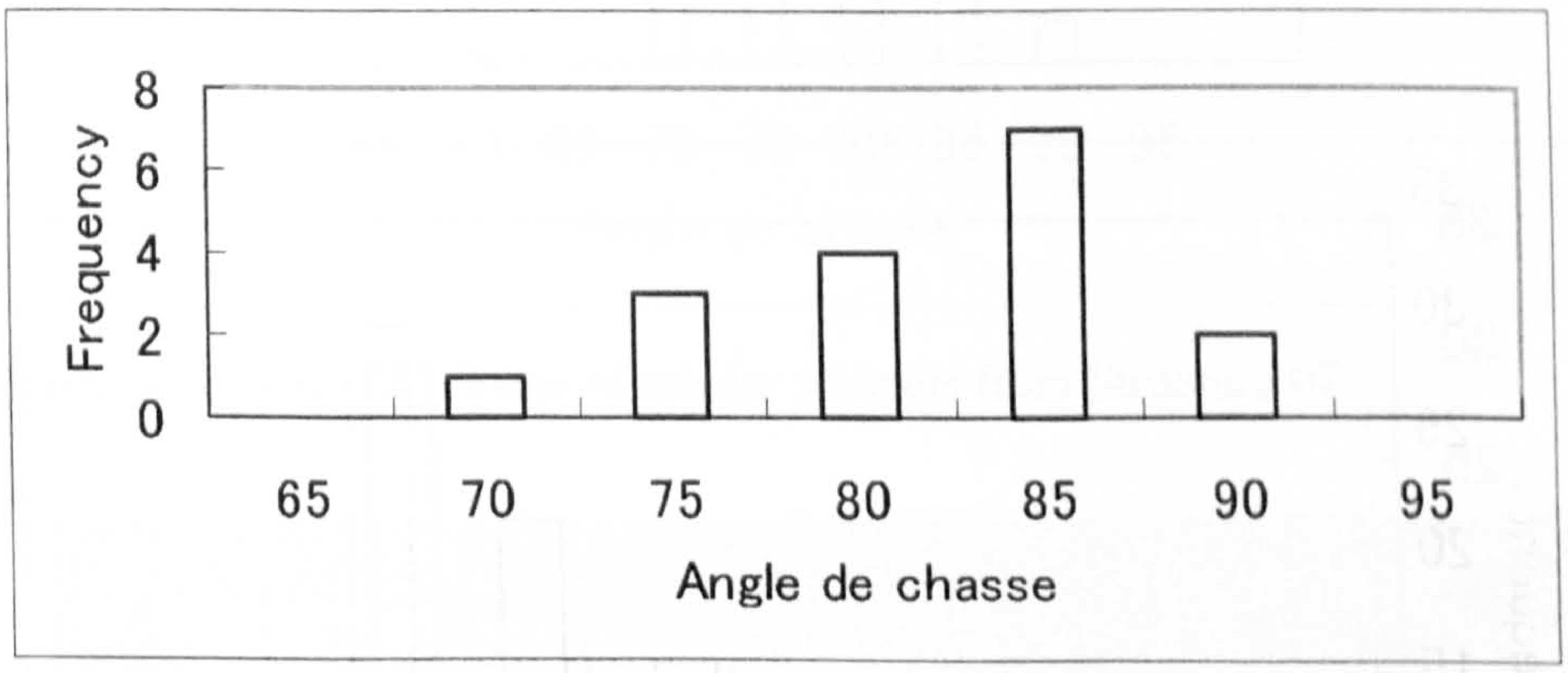


Fig.6.58 Histogram of angle de chasse of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

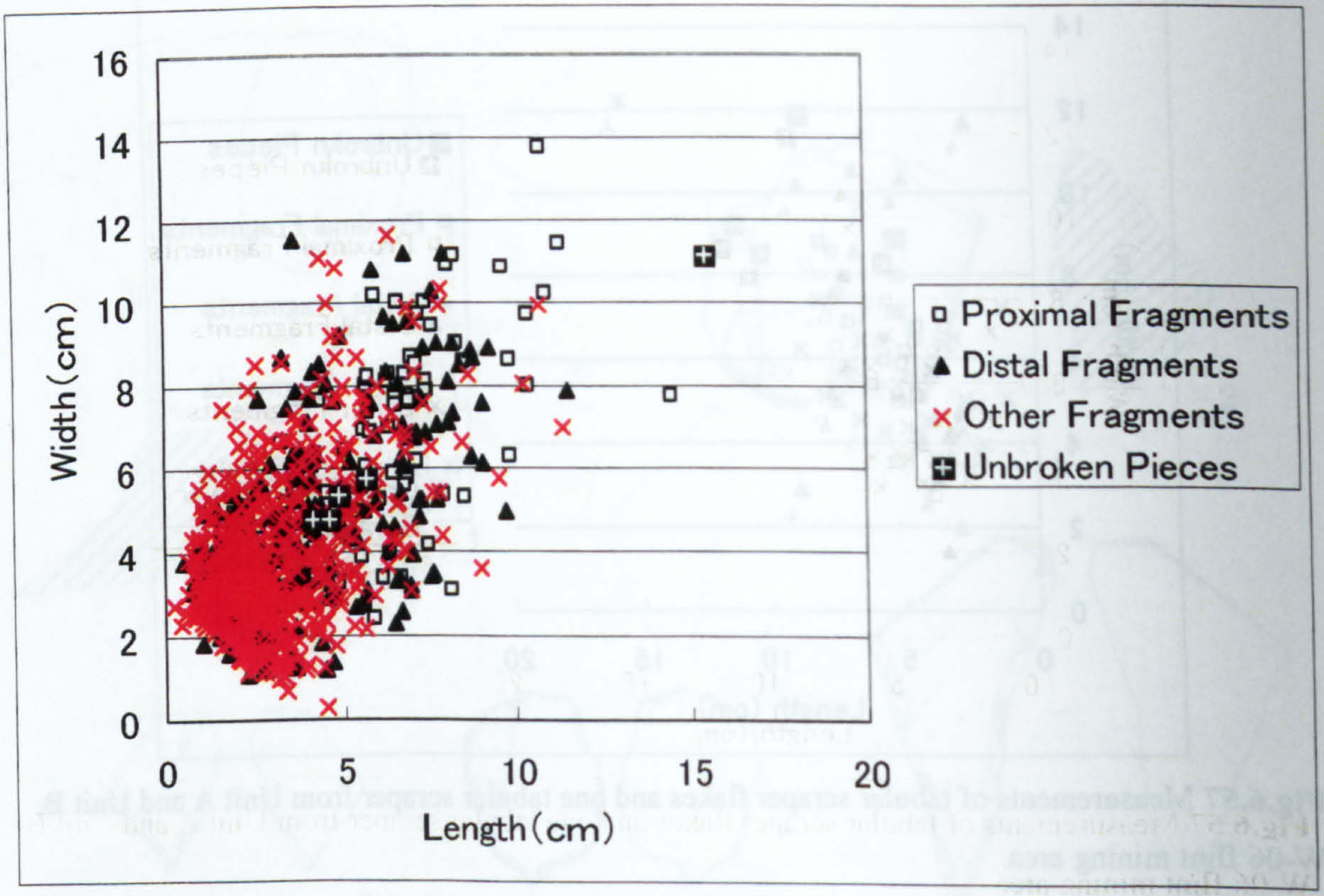


Fig.6.59 Measurements of tabular scraper flakes from Structure 07.

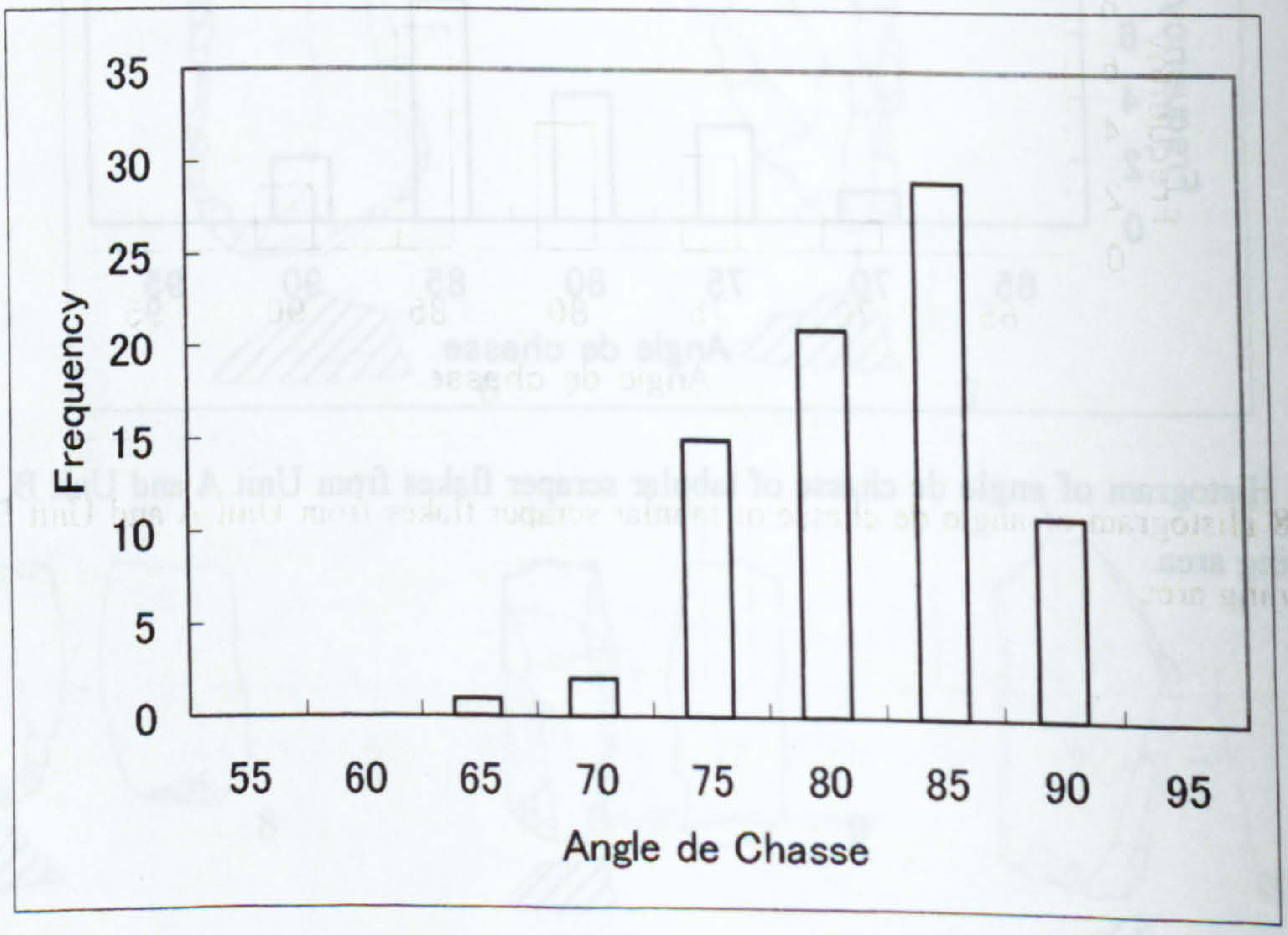


Fig.6.60 Histogram of angle de chasse of tabular scraper flakes.

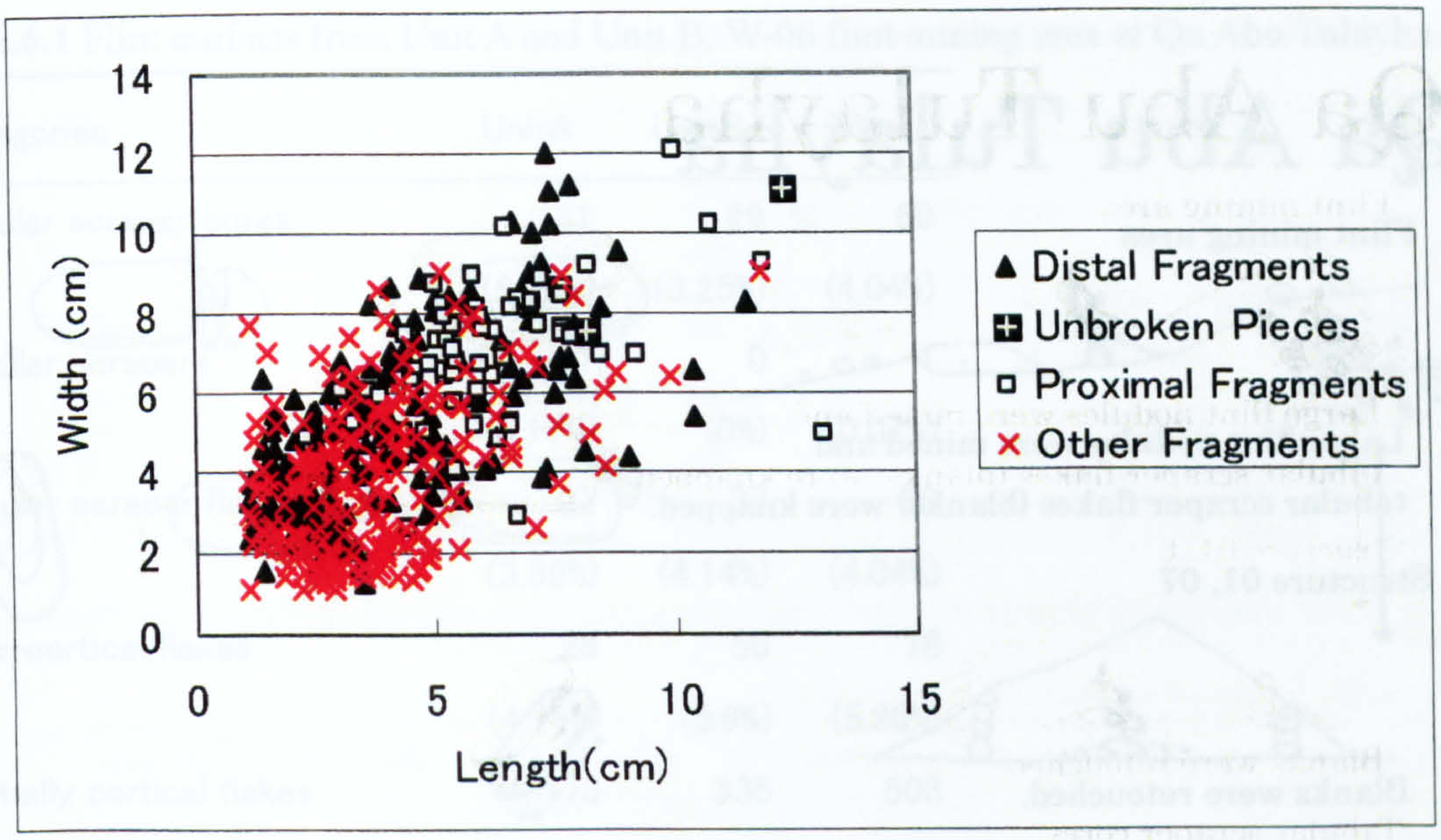


Fig.6.61 Measurements of tabular scrapers from Structure 07.

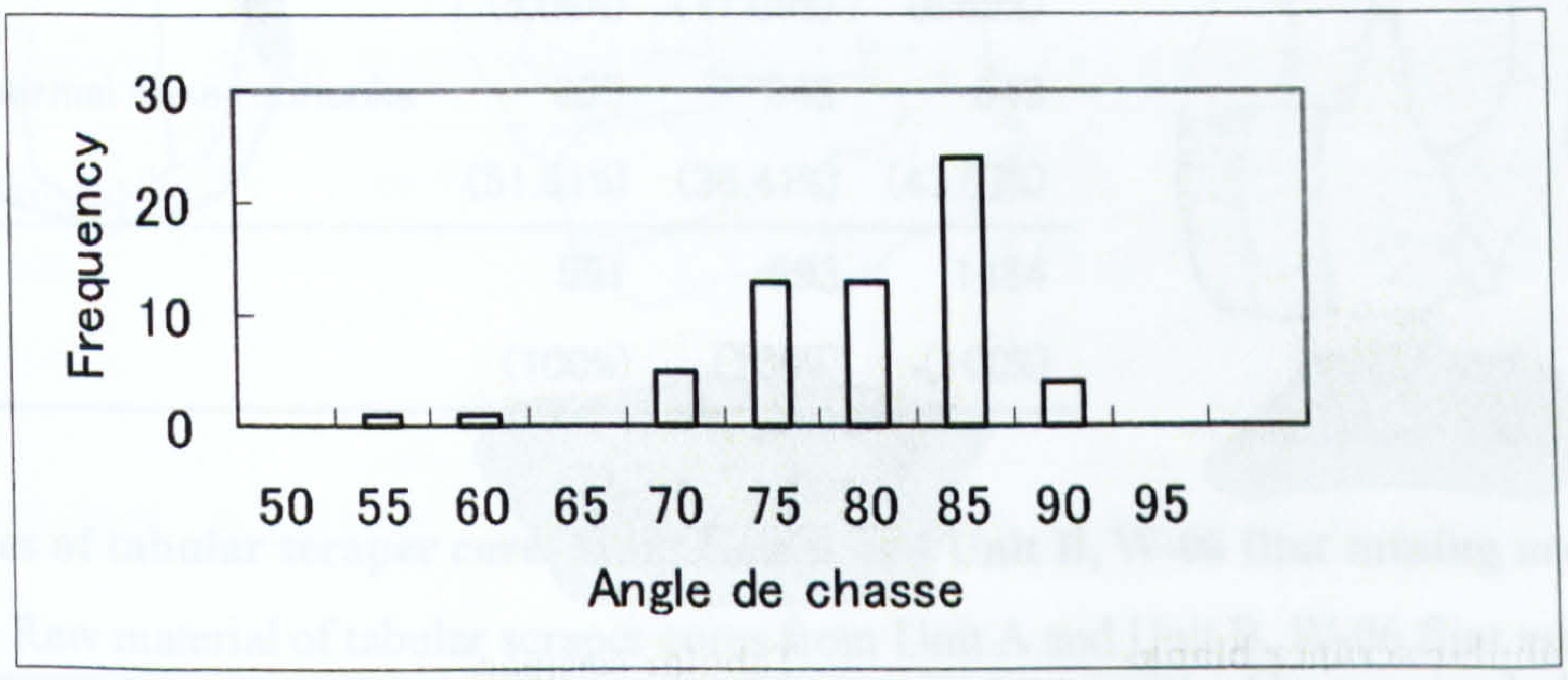


Fig.6.62 Histogram of angle de chasse of tabular scrapers from Structure 07.

Fig.6.63 Section of flint.

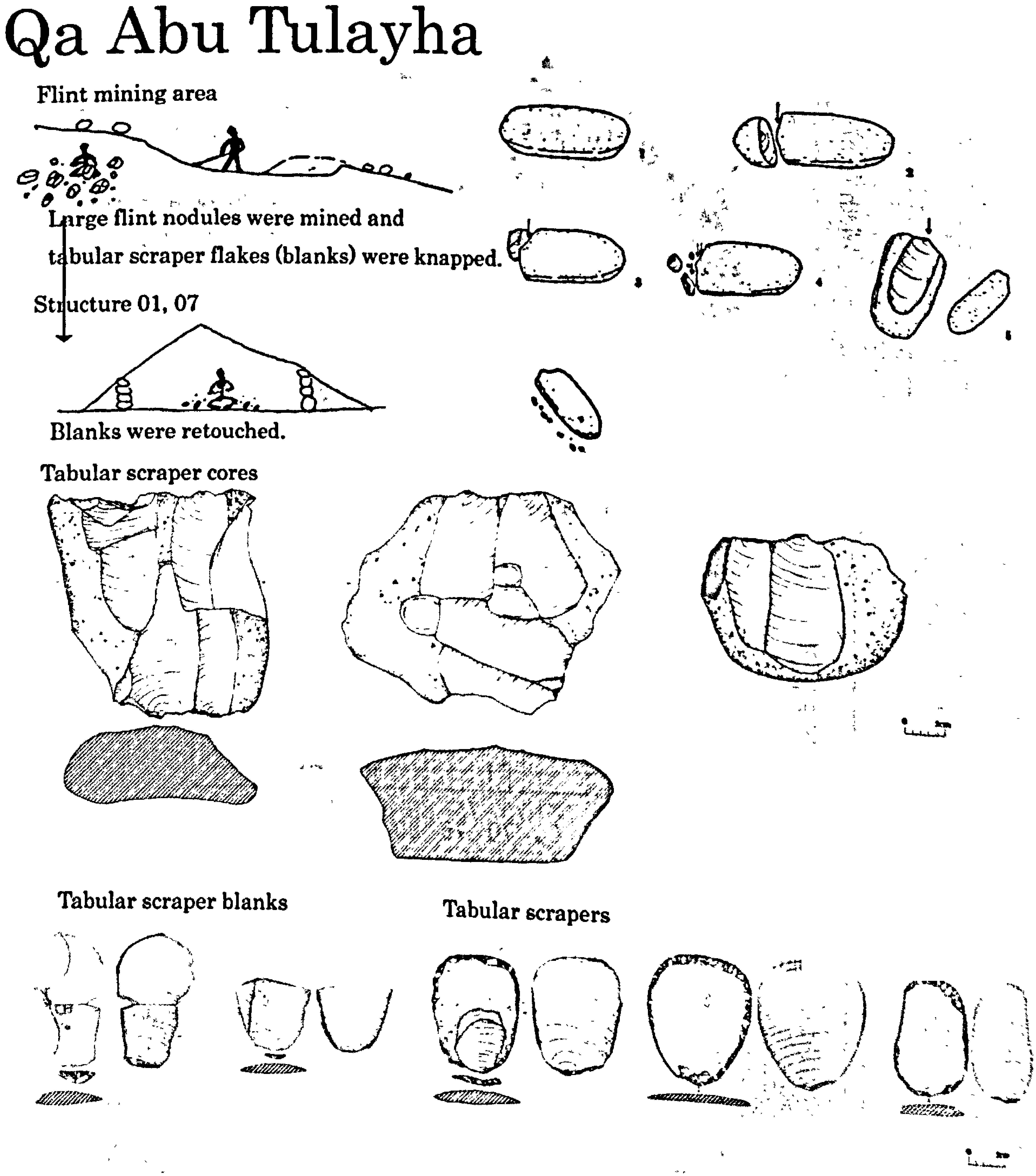


Fig.6.64 Tabular scraper production at Qa Abu Tulayha.
Two tabular scrapers (middle and right) on this figure are excavated from JF0208.

Table.6.1 Flint artifacts from Unit A and Unit B, W-06 flint mining area at Qa Abu Tulayha.

Categories	UnitA	UnitB	Total
Tabular scraper cores	31	29	60
	(5.25%)	(3.25%)	(4.04%)
Tabular scrapers	1	0	1
	(0.17%)	(0%)	(0.07%)
Tabular scraper flakes	23	37	60
	(3.89%)	(4.14%)	(4.04%)
Non-cortical flakes	28	50	78
	(4.74%)	(5.6%)	(5.26%)
Partially cortical flakes	173	335	508
	(29.27%)	(37.51%)	(34.23%)
Cortical flakes	30	99	129
	(5.08%)	(11.09%)	(8.69%)
Chips, Thermal flakes, Chunks	305	343	648
	(51.61%)	(38.41%)	(43.67%)
Total	591	893	1484
	(100%)	(100%)	(100%)

-Attributes of tabular scraper cores from Unit A and Unit B, W-06 flint mining area-

Table.6.2 Raw material of tabular scraper cores from Unit A and Unit B, W-06 flint mining area.

Raw material	Nodular flint	Tabular Flint	Thermal flake	Total
UnitA	24	0	7	31
UnitB	26	0	3	29
Total	50	0	10	60
%	83.33	0	16.67	100

Table.6.3 Measurements of tabular scraper cores from Unit A, W-06 flint mining area.

Measurements of tabular scraper cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	31	23.4	5.54	15.5	33.3	21.4
Width	31	24.106	6.525	12.1	35.5	24.7
Thickness	31	11.177	3.932	4.1	16.6	12.3
Length/Width	31	1	0.259	0.6	1.6	1
Width/Thickness	31	2.458	1.192	1.2	6	1.5

Table.6.4 Measurements of tabular scraper cores from Unit B, W-06 flint mining area.

Measurements of tabular scraper cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	29	24.424	6.133	13.3	35.5	24
Width	29	24.234	5.768	13.5	36.8	23.9
Thickness	29	10.955	2.818	4.4	15.8	11.1
Length/Width	29	1.045	0.337	0.5	1.9	1
Width/Thickness	29	2.328	0.706	1.3	4.4	2.2

Table.6.5 The number of tabular scraper blanks detached from tabular scraper cores from Unit A and B.

The number of blanks detached from cores	N	Mean	S.D.	Min.	Max.	Median
UnitA, W-06	31	2.61	1.783	1	7	2
UnitB, W-06	29	2.24	1.215	1	5	2

Table.6.6 Core types of tabular scraper cores from Unit A and Unit B, W-06 flint mining area.

Core types (%)	Uniface	Biface	Total
UnitA, W-06 (N=31)	67.74	32.26	100
UnitB, W-06 (N=29)	82.76	17.24	100

Table.6.7 Platform angle of tabular scraper cores from Unit A and Unit B, W-06 flint mining area.

Platform angle	N	Mean	S.D.	Min.	Max.	Median
UnitA, W-06	31	64.833	9.432	47	88	65
UnitB, W-06	29	65.621	8.069	48	78	66

Table.6.8 Platform types of tabular scraper cores from Unit A and Unit B, W-06 flint mining area.

Platform types (%)	Plain	Weathered	Faceted	Total
UnitA, W-06 (N=31)	3.23	3.23	93.54	100
UnitB, W-06 (N=29)	0	6.9	93.1	100

Table.6.9 The number of tabular scraper flake scars on the main flaking surfaces of tabular scraper cores from Unit A and Unit B, W-06 flint mining area.

The number of tabular scraper flake scars on the main flaking surfaces	N	Mean	S.D.	Min.	Max.	Median
UnitA, W-06	31	2.19	1.424	1	6	2
UnitB, W-06	29	2.07	1.067	1	4	2

Table.6.10 Scar patterns on the main flaking surfaces of tabular scraper cores from Unit A and B.

(%)	N	One Scar	Unidirectional	Bidirectional	Convergent	Centripetal	Others	Total
UnitA, W-06	31	45.16	6.45	9.68	9.68	22.58	6.45	100
UnitB, W-06	29	37.93	13.79	3.45	17.24	27.59	0	100

Table.6.11 Shapes of the main scars on the main flaking surface of tabular scraper cores from Unit A and Unit B, W-06 flint mining area.

Shapes of the main scars (%)	N	Symmetrical end struck	Asymmetrical end struck	Side struck	Total
UnitA, W-06	31	67.74	16.13	16.13	100
UnitB, W-06	29	75.86	6.9	17.24	100

Table.6.12 Termination of the main scars of tabular scraper cores from Unit A and UnitB.

Termination of the main scars (%)	N	Feather	Hinged	Overshot	Total
UnitA, W-06	31	35.48	54.84	9.68	100
UnitB, W-06	29	62.07	31.03	6.9	100

Table.6.13 Measurements of main scars on main flaking surfaces of tabular scraper cores from Unit A.

Measurements of the main scars (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	31	14.793	4.096	6.3	21.1	15.5
Width	31	10.207	2.081	5.8	14.3	10.4
Length/Width	31	1.5	0.484	0.7	2.5	1.4

Table.6.14 Measurements of main scars on main flaking surfaces of tabular scraper cores from Unit B.

Measurements of the main scars (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	29	15.366	3.33	8	21.5	15.5
Width	29	10.848	2.21	7	17.1	10.9
Length/Width	29	1.472	0.439	0.7	2.4	1.5

-Attributes of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area-

Table.6.15 Tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

	UnitA	UnitB	Total
Unbroken pieces	2	2	4
	(8.7%)	(5.41%)	(6.67%)
Proximal fragments	5	10	15
	(21.74%)	(27.03%)	(25%)
Distal fragments	6	7	13
	(26.09%)	(18.92%)	(21.67%)
Other fragments	10	18	28
	(43.48%)	(48.65%)	(46.67%)
Total	23	37	60
	(100%)	(100%)	(100%)

Table.6.16 Proportion of broken and unbroken pieces of tabular scraper flakes from Unit A and Unit B.

Broken and unbroken pieces (%)	Broken	Unbroken	Total
Tabular scraper flakes (N=60)	93.33	6.67	100

Table.6.17 Estimated shapes of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Shapes of tabular scraper flakes (%)	Symmetrical end struck	Asymmetrical end struck	Side struck	Unknown	Total
Tabular scraper flakes (N=60)	26.67	0	8.33	65	100

Table.6.18 The proportion of absence and presence of incisions on cortical surfaces of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Incisions (%)	Absent	Present	Total
Tabular scraper flakes (N=60)	100	0	100

Table.6.19 Measurements of unbroken tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	4	8.88	2.32	5.2	11.3	9.5
Width	4	9.645	1.329	8.5	11.9	9.1
Thickness	4	1.168	0.226	0.8	1.4	1.2
Length/Width	4	0.938	0.283	0.6	1.2	1
Width/Thickness	4	8.55	1.727	6	10.8	8.7

Table.6.20 Measurements of proximal fragments of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	15	5.365	1.684	2.9	8.2	4.8
Width	15	6.552	1.433	3.3	8.8	6.7
Thickness	15	1.104	0.306	0.8	2.1	1.1

Table.6.21 Measurements of distal fragments of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	13	5.407	2.28	2.6	9	4.9
Width	13	6.414	3.25	2	11.7	5
Thickness	13	0.858	0.247	0.5	1.3	0.8

Table.6.22 Measurements of other fragments of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	28	4.643	1.971	1.1	8.9	4.8
Width	28	5.689	1.517	3.5	9.7	5.6
Thickness	28	0.86	0.197	0.4	1.3	0.8

Table.6.23 Measurements of butts of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

	N	Mean	S.D.	Min.	Max.	Median
Butt width (cm)	18	4.506	0.922	2.5	6	4.6
Butt depth (cm)	18	1.009	0.375	0.6	2.1	0.9

Table.6.24 Butt type of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Butt types (%)	Cortex	Weathered	Plain	Faceted	Others	Total
Butt type (N=19)	0	0	0	100	0	100

Table.6.25 Measurements of angle de chasse and flaking angle of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Angle de chasse	18	79.412	4.827	70	88	82
Flaking angle	18	100.588	4.827	92	110	98

Table.6.26 Patterns of impact points, corns, bulbar scars and lips of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

(%)	Present	Absent	Unknown	Total
Impact point (N=19)	42.1	52.6	5.3	100
Corn (N=19)	42.1	52.6	5.3	100
Bulbar scar (N=19)	57.9	36.8	5.3	100
Lip (N=19)	26.3	68.4	5.3	100

Table.6.27 Patterns of bulbs of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

(%)	Prominent	Prominent weakly	Non-prominent	Unknown	Total
Bulb (N=19)	57.9	36.8	0	5.3	100

Table.6.28 Patterns of hammer modes of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

(%)	I	II	III	IV	V	Others	Total
Hammer mode (N=19)	36.8	26.3	26.3	0	0	10.5	100

Table.6.29 Termination of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

(%)	Feather	Hinged	Plunged	Total
Termination (N=17)	47.1	52.9	0	100

Table.6.30 Profile of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

(%)	Straight	Concave	Convex	Unknown	Total
Profile (N=60)	8.3	1.7	5	85	100

Table.6.31 Shapes of proximal fragments of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Shapes of proximal fragments (%)	Unexpanding	Expanding	Unknown	Total
Proximal fragments (N=15)	86.7	0	13.3	100

Table.6.32 Shapes of distal fragments of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Shapes of distal fragments (%)	Unexpanding	Expanding	Unknown	Total
Distal fragments (N=13)	23.1	23.1	53.8	100

Table.6.33 Shapes of unbroken tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Shapes of unbroken piece (%)	Symmetrical end struck	Asymmetrical end struck	Side struck	Unknown	Total
Unbroken pieces (N=4)	50	0	50	0	100

Table.6.34 Cortex patterns of tabular scraper flakes from Unit A and Unit B, W-06 flint mining area.

Cortex (%)	Total	Cortical	Partially cortical	Total
Unbroken pieces (N=4)	50	25	25	100
Proximal fragments (N=15)	80	20	0	100
Distal fragments (N=13)	69.2	30.8	0	100
Others (N=28)	89.3	7.1	3.6	100

-Attributes of a tabular scraper from Unit A and Unit B, W-06 flint mining area-

Table.6.35 Attributes of a tabular scraper from Unit A and Unit B, W-06 flint mining area.

Tabular scraper (N=1)	
Shape	End Struck Oval
Length (cm)	15.7
Width (cm)	12.2
Thickness (cm)	1.35
L/W	1.28
W/T	11.59
Butt Depth (cm)	1.8
Butt Width (cm)	7.5
Butt type	Faceted
Angle de chasse	84
Flaking angle	96

Table.6.36 Flint artifacts from Structure 07 at Qa Abu Tulayha West.

Categories	Number	%
Tabular scraper cores	10	0.04
Tabular scrapers	440	1.59
Tabular scraper flakes	977	3.52
Jafr blade cores	1	0
Blade cores	1	0
Flake core	6	0.02
Levallouis cores	1	0
Jafr blades	17	0.06
Non-cortical flakes	329	1.19
Partially cortical flakes	605	2.18
Cortical flakes	387	1.4
End scraper	1	0
Denticulate	2	0.01
Side scrapers	3	0.01
Borers	4	0.01
Notches	1	0
Hammers	7	0.03
Chips	24099	86.92
Thermal flakes and Chunks	835	3.01
Total	27726	100

- **Attributes of tabular scraper cores from Structure 07-**

Table.6.37 Raw material of tabular scraper cores from Structure 07.

Raw material	Nodular flint	Tabular Flint	Thermal flake	Total
Str07(N=10)	6	3	1	10
%	60	30	10	100

Table.6.38 Core types of tabular scraper cores from Structure 07.

Core types	Uniface	Biface	Total
Str o7 (N=10)	10	0	10
%	100	0	100

Table.6.39 The number of tabular scraper flakes detached from tabular scraper cores from Structure 07.

The number of blanks detached from cores	N	Mean	S.D.	Min.	Max.	Median
Str07	10	1.9	0.7	1	3	2

Table.6.40 Measurements of tabular scraper cores from Structure 07.

Measurements of tabular scraper cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	10	14.633	4.953	10.5	26	12.1
Width	10	16.285	6.101	9.5	26.7	16.3
Thickness	10	6.334	2.518	3.7	11.16	6.3
Length/Width	10	1.193	0.523	0.6	2.38	1
Width/Thickness	10	3.043	1.219	0.9	4.8	2.6

Table.6.41 Platform angle of tabular scraper cores from Structure07.

Platform angle	N	Mean	S.D.	Min.	Max.	Median
Str07	10	69.6	9.902	52	84	73.5

Table.6.42 Platform types of tabular scraper cores from Structure 07.

Platform types (%)	Plain	Weathered	Faceted	Total
Str07(N=10)	30	20	50	100

Table.6.43 The number of tabular scraper flake scars on the main surfaces of tabular scraper cores from Structure 07.

The number of scars on the main flaking surfaces	N	Mean	S.D.	Min.	Max.	Median
Str07	10	1.9	0.7	1	3	2

Table.6.44 Scar patterns of the main flaking surfaces of tabular scraper cores from Structure 07.

Scar patterns of the main flaking surfaces (%)	N	One Scar	Unidirectional	Bidirectional	Convergent	Centripetal	Others	Total
Str07	10	30	20	10	10	30	0	100

Table.6.45 Shapes of the main scars of tabular scraper cores from Structure 07.

Shapes of the main scars (%)	N	Symmetrical end struck	Asymmetrical end struck	Side struck	Total
Str07	10	20	30	50	100

Table.6.46 Termination of the main scar of tabular scraper cores from Structure 07.

Termination of the main scars (%)	N	Feather	Hinged	Overshot	Total
Str07	10	40	60	0	100

Table.6.47 Measurements of the mains scars of tabular scraper cores from Structure 07.

Measurements of the main scars (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	10	6.407	2.469	3.4	12.6	6
Width	10	6.433	1.766	3.4	10	5.4
Length/Width	10	1.068	0.455	0.56	1.87	0.9

-Attributes of tabular scraper flakes from Structure 07-

Table.6.48 Tabular scraper flakes from Structure 07.

	Str07
Unbroken pieces	5 (0.5%)
Proximal fragments	80 (8.2%)
Distal fragments	281 (28.8%)
Other fragments	611 (62.5%)
Total	977 (100%)

Table.6.49 The proportion of broken and unbroken pieces of tabular scraper flakes from Structure 07.

Broken (%)	Broken	Unbroken	Total
Tabular scraper flakes (N=977)	99.5	0.5	100

Table.6.50 The proportion of absence and presence of incisions on the cortical surface of tabular scraper flakes.

Incisions (%)	Absent	Present	Total
Tabular scraper flakes (N=977)	100	0	100

Table.6.51 Estimated original shapes of tabular scraper flakes from Structure 07.

Shapes of flakes (%)	Symmetrical end struck	Asymmetrical end struck	Side struck	Unknown	Total
Tabular scraper flakes (N=977)	6.9	0	0.9	92.2	100

Table.6.52 Measurements of unbroken tabular scraper flakes from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	5	7.004	4.281	4.2	15.5	4.9
Width	5	6.36	2.396	4.8	11.1	5.4
Thickness	5	0.986	0.589	0.5	2.2	0.8
Length/Width	5	1.024	0.192	0.9	1.4	1
Width/Thickness	5	7.228	1.989	5.2	11	6.8

Table.6.53 Measurements of proximal fragments of tabular scraper flakes from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	80	6.405	2.332	1.7	14.5	6.5
Width	80	6.753	2.36	2.4	13.7	6.8
Thickness	80	1.261	0.38	0.6	2.9	1.2

Table.6.54 Measurements of distal fragments of tabular scraper flakes from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	281	3.746	2.096	0.6	11.6	3.1
Width	281	4.276	2.147	1.1	11.5	3.7
Thickness	281	0.644	0.356	0.1	2	0.5

Table.6.55 Measurements of other fragments of tabular scraper flakes from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	611	2.992	1.671	0.3	11.4	2.6
Width	611	3.833	1.774	0.3	11.7	3.4
Thickness	611	0.671	0.307	0.2	2.3	0.6

Table.6.56 Measurements of butts of tabular scraper flakes from Structure 07.

	N	Mean	S.D.	Min.	Max.	Median
Butt width (cm)	62	4.58	1.605	0.5	8.3	4.6
Butt depth (cm)	62	1.1	0.357	0.2	1.9	1

Table.6.57 Butt types of tabular scraper flakes from Structure 07.

Butt types (%)	Cortex	Weathered	Plain	Faceted	Others	Total
Butt type (N=85)	0	1.2	2.4	95.3	1.2	100

Table.6.58 Measurements of angle de chasse and flaking angle from Structure 07.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Angle de chasse	80	80.1	4.811	64	88	81
Flaking angle	80	99.8	4.807	92	116	98

Table.6.59 Shapes of proximal fragments of tabular scraper flakes from Structure 07.

Shapes of proximal fragments (%)	Unexpanding	Expanding	Unknown	Total
Proximal fragments (N=80)	43.8	0	56.2	100

Table.6.60 Shapes of distal fragments of tabular scraper flakes from Structure 07.

Shape of distal fragments (%)	Unexpanding	Expanding	Unknown	Total
Distal fragments (N=281)	17.1	2.5	80.4	100

Table.6.61 Shapes of unbroken tabular scraper flakes from Structure 07.

Shapes of unbroken tabular scrapers (%)	Symmetrical end struck	Asymmetric al end struck	Side struck	Unknown	Total
Unbroken pieces (N=5)	20	0	80	0	100

Table.6.62 Termination of tabular scraper flakes from Structure 07.

(%)	Feather	Hinged	Plunged	Unknown	Total
Termination (N=286)	57.7	35.7	0.3	6.3	100

Table.6.63 Patterns of hammer modes of tabular scraper flakes from Structure 07.

(%)	I	II	III	IV	V	Others	Total
Hammer mode (N=85)	27.1	36.5	25.9	2.4	0	8.2	100

Table.6.64 Patterns of impact points, corns, bulbar scars, and lips of tabular scraper flakes from Structure 07.

(%)	Present	Absent	Unknown	Total
Impact point (N=85)	32.9	57.6	9.4	100
Corn (N=85)	28.2	62.4	9.4	100
Bulbar scar (N=85)	63.5	27.1	9.4	100
Lip (N=85)	29.4	61.2	9.4	100

Table.6.65 Patterns of bulbs of tabular scraper flakes from Structure 07.

(%)	Prominent	Prominent weakly	Non-prominent	Unknown	Total
Bulb (N=85)	81.2	7.1	2.4	9.4	100

Table.6.66 Cortex of tabular scraper flakes from Structure 07.

Cortex (%)	Total	Cortical	Partially cortical	Total
Unbroken pieces (N=5)	40	60	0	100
Proximal fragments (N=80)	87.5	12.5	0	100
Distal fragments (N=281)	92.2	5.7	2.1	100
Others (N=611)	94.8	3.4	1.8	100

Table.6.67 Termination of tabular scraper flakes from Structure 07.

(%)	Straight	Concave	Convex	Unknown	Total
Profile (N=977)	2.9	0	0.3	96.8	100

- Attribute of tabular scrapers from Structure 07-

Table.6.68 Tabular scrapers from Structure 07.

	Str07
Unbroken pieces	2
	(0.5%)
Proximal fragments	68
	(15.5%)
Distal fragments	169
	(38.4%)
Other fragments	201
	(45.7%)
Total	440

Table.6.69 The proportion of broken and unbroken pieces of tabular scrapers from Structure 07.

Broken (%)	Broken	Unbroken	Total
Tabular scrapers (N=440)	99.5	0.5	100

Table.6.70 Estimated shapes of original blanks of tabular scrapers from Structure 07.

Shapes of original blanks (%)	Symmetrical end struck	Asymmetrical end struck	Side struck	Unknown	Total
Tabular scrapers (N=440)	20.2	0.5	1.1	78.2	100

Table.6.71 The proportion of the absence and presence of incisions on the main surfaces of tabular scrapers from Structure 07.

Incisions (%)	Absent	Present	Total
Tabular scrapers (N=440)	100	0	100

Table.6.72 Estimated shapes of tabular scrapers.

Shapes of tabular scrapers (%)	Side struck fan	Side struck oval	Round	End struck oval	End struck oval or Elongated	Elongated	Others	Unknown	Total
Tabular scrapers (N=440)	1.1	0.2	0.2	0.2	20.5	0	0.7	77	100

Table.6.73 Measurements of proximal fragments of tabular scrapers from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	68	6.065	1.959	2.3	13.1	5.9
Width	68	6.928	1.7	2.6	12.1	7
Thickness	68	1.329	0.36	0.6	2.3	1.3

Table.6.74 Measurements of distal fragments of tabular scrapers from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	167	4.068	2.231	1.1	11.5	3.5
Width	167	5.136	2.179	1.3	12	4.6
Thickness	167	0.808	0.3843	0.2	2	0.7

Table.6.75 Measurements of other fragments of tabular scrapers from Structure 07.

Measurements (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	201	3.632	1.787	1.1	11.8	3.3
Width	201	3.863	1.915	1.1	9	3.7
Thickness	201	0.732	0.309	0.2	2.1	0.7

Table.6.76 Measurements of two unbroken tabular scrapers from Structure 07.

Length	Width	Thickness	L/W	W/T
12.3	11.1	1.6	1.1	7.2
8.2	7.6	0.9	1.1	8

Table.6.77 Measurements of butts of tabular scrapers from Structure 07.

	N	Mean	S.D.	Min.	Max.	Median
Butt width (cm)	54	4.506	1.539	0.5	8.4	4.3
Butt depth (cm)	54	1.186	0.428	0.4	2.7	1.1

Table.6.78 Butt types of tabular scrapers from Structure 07.

Butt types (%)	Cortex	Weathered	Plain	Faceted	Others	Total
Butt type (N=70)	0	0	2.9	90	7.1	100

Table.6.79 Measurements of angle de chasse and flaking angle of tabular scrapers from Structure 07.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Angle de chasse	61	78.21	6.4	54	88	80
Flaking angle	61	101.787	6.4	92	126	100

Table.6.80 Patterns of impact points, corns, bulbar scars and lips of tabular scrapers from Structure 07.

(%)	Present	Absent	Unknown	Total
Impact point (N=70)	21.4	58.6	20	100
Corn (N=70)	20	60	20	100
Bulbar scar (N=70)	54.3	25.7	20	100
Lip (N=70)	25.7	54.3	20	100

Table.6.81 Patterns of bulbs of tabular scrapers from Structure 07.

(%)	Prominent	Prominent weakly	Non-prominent	Unknown	Total
Bulb (N=70)	71.4	4.3	2.9	20	100

Table.6.82 Patterns of hammer modes of tabular scrapers from Structure 07.

(%)	I	II	III	IV	V	Others	Total
Hammer mode (N=70)	20	30	25.7	4.3	0	20	100

Table.6.83 Profile of tabular scrapers from Structure 07.

(%)	Straight	Concave	Convex	Unknown	Total
Profile (N=440)	3.9	0.5	0.9	94.8	100

Table.6.84 Cortex of tabular scrapers from Structure 07.

Cortex (%)	Total	Cortical	Partially cortical	Total
Unbroken pieces (N=2)	100	0	0	100
Proximal fragments (N=68)	89.7	5.9	4.4	100
Distal fragments (N=169)	94.1	3	3	100
Others (N=201)	96	2.5	1.5	100

Table.6.85 Retouch angle of tabular scrapers from Structure 07.

(%)	Low	Semi Abrupt	Abrupt	Total
Retouch angle (N=440)	3	84	13	100

Table.6.86 Shapes of retouch of tabular scrapers from Structure 07.

(%)	Scaled	Stepped	Parallel	Semi Parallel	Total
Shapes of retouch (N=440)	76.8	0	0	23.2	100

Table.6.87 Degree of retouch of tabular scrapers from Structure 07.

(%)	Short	Long	Invasive	Unknown	Total
Degree of retouch (N=440)	98.2	0.2	0	1.6	100

Table.6.88 Positions of retouch.

(%)	Dorsal	Dorsal and Bulb thinning	Dorsal and Ventral	Dorsal, Bulb thinning and Ventral	Total
Positions of retouch (N=440)	99.6	0.2	0.2	0	100

Table.6.89 Retouch locations on dorsal surfaces of unbroken tabular scrapers (N=2) from Structure 07.

(%)	Left and Right	Distal	Total
Retouch locations on dorsal surfaces	50	50	100

Table.6.90 Retouch locations on dorsal surfaces of proximal fragments of tabular scrapers (N=68).

(%)	Left	Right	L and R	Proximal	P and L	P and R	P, L and R	Unknown	Total
Retouch locations on dorsal surface	14.7	13.2	50	1.5	1.5	0	2.9	16.2	100

Table.6.91 Retouch locations on dorsal surfaces of distal fragments of tabular scrapers (N=440).

(%)	Left	Right	L and R	Distal	D and L	D and R	D, L and R	Unknown	Total
Retouch locations on dorsal surfaces	0.6	3	3.6	1.8	1.2	2.4	7.1	80.1	100

Chapter 7 TABULAR SCRAPER PRODUCTION AT GURTA SIYYATA TYPE SITES

7.1 GURTA SIYYATA TYPE SITES

7.1.1 Gurta Siyyata type sites

As already discussed in Chapter 5, the landscape of the Jafr Basin is characterized by a high incidence of tabular scraper production sites. In total, 60 sites were discovered in the northwestern part of the basin by Japanese surveys. Amazingly, nearly a half of the discovered sites, 25 sites are tabular scraper production sites: 19 of 25 tabular scraper production sites are classified as Gurta Siyyata type tabular scraper production sites.

An American team also discovered a number of tabular scraper production sites in the northeastern part of the Jafr Basin (Quintero, Wilke and Rollefson 2002). They recorded 114 sites in total. Of the 114, 79 sites are tabular scraper production sites. 65 of the 79 tabular scraper production sites can be classified into Gurta Siyyata type tabular scraper production sites.

Gurta Siyyata type production sites are named after a prominent rock hill, Gurta Siyyata in the northwestern area of the Jafr Basin where one tabular scraper production site, JF110, was discovered (Fig.5.22).

Gurta Siyyata type sites are tabular scraper production sites using small flint blocks collected on the surface as raw material instead of mined large flint nodules. At the sites, limited efforts were made to acquire raw material. No flint mines were discovered at the sites. The sites are usually located in geologically dissected areas such as escarpments of tablelands, slopes of hills and valley walls. At the sites, Eocene flint veins in limestone bedrocks were exposed, weathered and naturally shattered into small blocks. These small flint blocks usually cover the land surface at Gurta Siyyata type sites. They are usually small and only slightly bigger than the fist size. These flint blocks on the surface were selected as raw material for tabular scraper production. Small side struck fan shaped tabular scrapers were produced from the small flint blocks at Gurta Siyyata type sites. Their average size is about 7 cm in length ×9 cm in width. A certain amount of large and long oval/elongated tabular scrapers could not be produced without flint mining.

Flint knappers probably knapped tabular scrapers on the spot where they found appropriate flint blocks. They did not bring appropriate flint blocks to one location to knap them together. Therefore remains of tabular scraper production are dispersed very widely but very thinly among the natural flint blocks on the surface at the sites. The density of tabular scraper cores is usually very low at the sites. Tabular scraper core clusters are rarely found. There are less than 0.5 tabular scraper cores per 1 m^2 one average at sites.

As already mentioned, the Japanese team discovered 19 Gurta Siyyata tabular scraper production sites. The size of these Gurta Siyyata type tabular scraper production sites vary from 25 ha to 0.2 ha. Three sites are larger than 10 ha. 2 sites are less than 10 ha and more than 5 ha. 7 sites are less than 5 ha and more than 1ha. 6 sites are less than 1 ha in size. The size of one site is unknown.

As already discussed, the American team also discovered 65 Gurta Siyyata type tabular scraper production site (Quintero, Wilke and Rollefson 2002). Of these 65, one site is larger than 5 ha. 20 sites are less than 5 ha and more than 1 ha. 44 sites are less than 1 ha in size.

In short, 84 Gurta Siyyata type production sites are known in the Jafr Basin in total from the surveyed areas. Most of the Gurta Siyyata tabular scraper production sites (about 60%, N=50) are small and less than 1 ha in size.

At large Gurta Siyyata type sites, remains of tabular scraper production sometimes cover one hill or one valley. The size of JF0101, the largest Gurta Siyyata type site, reaches about 25 ha (Fig.5.9, Fig.5.10, Fig.5.11). It is estimated that over several tens of thousands of tabular scraper cores are present at the site.

However no structures associated with tabular scraper production were discovered at Gurta Siyyata type sites by the Japanese surveys. This fact suggests that each knapping episode was probably too short to construct a structure for staying and production. Each episode probably spanned only a few days at longest. Even the largest Gurta Siyyata type site over 25 ha was probably formed by multiple repeated short knapping episodes over many years.

In the next sections, two Gurta Siyyata type sites, JF0106 and JF0153, will be described in detail.

7.1.2 The site of JF0106

The site is a small sized Gurta Siyyata tabular scraper production site located on a low hill (Fig.7.1, Fig.7.2). Four limestone cairns were discovered on the top of the hill. Their diameter ranges from 1 m to 4 m. Although their exact date is unknown without excavations, it is likely that they are not Chalcolithic/Early Bronze Age cairns because they have no typological similarities with the Chalcolithic/Early Bronze Age cairns excavated at JF0204, JF0206 and JF0208.

The site is covered with small natural flint blocks (Fig.7.3). Their average size is about 10 cm×10 cm×5 cm. Exposed flint beds were weathered for a long time and naturally shattered into these flint blocks. Flint beds are still observable in places (Fig.7.4). These flint blocks on the surface were picked up and used for tabular scraper production (Fig.7.5, Fig.7.6). No flint mines were discovered at the site. The site produced small side struck fan shaped tabular scrapers. Remains of tabular scraper production such as tabular scraper cores and debitage were spread very sparsely and widely among the flint blocks. The size of the site is about 150 m×100 m (Fig.7.1).

In the spring of 2005, one square measuring 4 m×4 m was set up at an area where tabular scraper cores were present most densely at the site (Fig.7.7). Every tabular scraper core, tabular scraper flake and tabular scraper in the square was collected by me.

The collected sample includes only 14 tabular scraper cores. Even at the most dense area, there are only 0.9 tabular scraper cores per 1 m². Therefore there are probably less than 0.5 tabular scraper cores per 1 ㎡ on a sitewide average.

It is estimated that there are at most (0.5×15000 ㎡=) 7500 tabular scraper cores at the site. As explained later, 1.6 tabular scraper flakes (blanks) were knapped from one core at the site on average. Therefore (7500×1.6=) 12000 tabular scraper flakes (blanks) were produced in total at the site. But 35 % of blanks were discarded at the site without any modification. Hence (12000×0.65=)7800 tabular scrapers were produced at JF0106.

No structures associated with tabular scraper production were discovered at the site. Therefore it probably suggests that each knapping episode was so short that knappers did not construct any structures for staying and production. Each knapping episode probably spanned a few days at longest and the site was probably formed in multiple short episodes.

7.1.3 The site of JF0153

The site is a middle sized Gurta Siyyata type site on a low hill called Tausu Abu Tulayha (Fig.7.8, Fig.7.9). Its size is about 6 ha. The hill is covered with small flint blocks, which were originated from flint beds in the limestone bedrock (Fig.7.12). The flint beds are still observable on slopes of the hill. The flint beds were exposed, weathered and naturally shattered into the small flint blocks. The size of the flint blocks on the surface is usually slightly larger than the human fist size. The flint blocks on the surface were picked up and used as raw material for tabular scraper production without flint mining. No flint mines were discovered at the site. Small side struck tabular scraper blanks (flakes) were knapped from the flint blocks and small side struck fan shaped tabular scrapers were produced on the blanks at the site. While large and long oval/elongated tabular scrapers were produced at Qa Abu Tulayha type sites, it was impossible to produce a certain amount of such large and long tabular scrapers without mining large flint nodules. Tabular scraper cores are spread very thinly but widely among the flint blocks all over the hill (Fig.7.12, Fig.7.13, Fig.7.14, Fig.7.15). The size of distribution of tabular scraper cores is about 300 m×200 m.

On the top of the hill, four cairns are present (Fig.7.10). The cairns consist of large flint blocks. Such large flint blocks are rarely found on the hill. Dozens of Thamudic inscriptions were incised on these flint blocks (Fig.7.11). The cairns may have been signposts along a road in the historical period.

In the spring of 2005, one square measuring 4 m×4 m was set up at an area where tabular scraper cores are present most densely on the southern slope of the hill (Fig.7.16, Fig.7.17). Every tabular scraper core, tabular scraper flake and tabular scraper in the square was collected by me.

The collected sample includes only 8 tabular scraper cores. It show that there are only 0.5 tabular scraper cores per 1 m^2 even at the most dense area. There are probably less than 0.25 tabular scraper cores per 1 m^2 on a sitewide average. As will be discussed later, 1.1 tabular scrapers blanks were knapped from one core on average at the site.

Therefore it is estimated that (60000 m^2×0.25=) 15000 tabular scraper cores are present at the site and about (60000×0.25×1.1=) 16500 tabular scraper blanks were produced at the site in total.

It is noteworthy that the density of tabular scraper cores at JF0153 is lower than at JF0106.Larger sites tend to show lower density of tabular scraper cores.

The site was probably formed in multiple episodes rather than in one episode. The absence of structures at the site supports this view. The site was probably frequently visited by knappers and formed over many years. In each visit, knappers probably stayed only a few days at longest.

Lastly labor intensiveness at Gurta Siyyata type sites and at Qa Abu Tulayha type sites will be compared using data from this site. A simple calculation will be done on the assumption that five knappers were engaged in tabular scraper production for 6 hours per a day.

On the basis of my experiments, it takes about 3 minutes to collect an appropriate flint block on the surface and knap one blank from the block. Therefore one flint knapper can produce 20 tabular scraper blanks per one hour. Five knappers can produce 600 tabular scraper blanks per day.

Therefore it is estimated that it took about (16500÷600=) 27.5 days in total to produce 16500 tabular scraper blanks and form the site of JF0153. This calculation does not include time of blank modification. Therefore a few days for blank modification should be added to 27.5 days.

As already discussed in Chapter 6, in total 30 tons of flint nodules and 125 m^3 of chalk were mined to produce 2500 tabular scarper blanks at Qa Abu Tulayha. Therefore to produce 16500 tabular scraper blanks from mined large flint nodules, it is necessary to mine 200 tons of flint nodules and 825 m³ of chalk.

According to P.A. Jewell who undertook an experimental reconstruction of prehistoric earthwork in England, one people can break up 0.42 m³ of bedrock chalk per hour using prehistoric tools (Jewell 1963). If another person rakes and dumps shattered as his assistance, five people can dig 6.3 m³ of bedrock chalk per a day using prehistoric tools (Jewell 1963).

Therefore it is estimated that it took (825÷6.3=)131 days to mine the raw material for 16500 tabular scraper blanks. On the basis of the author's experiments, it takes about 2 minutes to knap a blank from a flint nodule on hand. So if five knappers are engaged in blank detachment for 6 hours per a day, they can detach 900 blanks per a day. Therefore it is estimated that it took (16500÷900=) 18 days to detach 16500 tabular scraper blanks from the flint nodules on hand. In total, it probably took about (131+18=) 149 days to produce the same number of blanks at Qa Abu Tulayha type sites. This calculation does not include time of blank modification. Therefore a few days for blank modification should be added to 149 days.

This simple calculation clearly shows that only limited efforts were made for tabular scraper production at Gurta Siyyata type sites. Tabular scraper production with intensive flint mining at Qa Abu Tulayha type sites is about (149÷27.5=) 5.4 times more labor intensive than the production at Gurta Siyyata type sites.

Given this non-intensive nature of the production at Gurta Siyyata type sites, it is no wonder that no structures were constructed at the site for the production and staying.

The next section will examine tabular scraper production at Gurta Siyyata type site technologically through the *Chaîne opératoire* approach.

7.2 TABULAR SCRAPER PRODUCTION AT GURTA SIYYATA TIPE SITES

7.2.1. Analyzed samples

Three samples will be analyzed together in this section (Table.7.1). The first sample is 39 tabular scraper cores collected from 12 Gurta Siyyata type sites during surveys (Fig.5.53, Fig.5.54, Fig.5.55, Fig.5.56, Fig.5.57, Fig.5.58). During surveys, three or four typical tabular scraper cores were collected from each Gurta Siyyata type site randomly.

The second sample was collected at JF0106 (Fig.7.18, Fig.7.19, Fig.7.22). As already explained, one square measuring 4 m×4 m was set up at the site in 2005 (Fig.7.7). All tabular scraper cores, tabular scraper flakes and tabular scrapers in the square were collected. Other debitage was not collected because of the limited time. The sample includes 14 tabular scraper cores, 2 tabular scrapers and 9 tabular scraper flakes.

The third sample was from JF0153 (Fig.7.20, Fig.7.21; Fig.67.23). One square measuring 4 m×4 m was set up at the site and all tabular scraper cores, tabular scrapers and tabular scraper flakes in the square were collected. Other debitage was not collected. The sample includes 8 tabular scraper cores, 2 tabular scrapers and 18 tabular scraper flakes.

7.2.2 Raw material procurement

Flint mining was not conducted at Gurta Siyyata type sites. Instead of mined large flint nodules, flint blocks on the surface were used as raw material for tabular scraper production at the sites (Fig.7.25).

The quality of the flint blocks available on the surface is the same as the mined flint nodules. They are high quality Eocene flint. They are usually covered with white or orange cortex. However, they are not homogeneous in quality. Outer parts of the flint nodule just below its cortex are far finer than its central parts. While the central parts of the flint nodules are cream and coarser, outer parts are darker, usually brown or black and fine grained (Fig.6.63). This may have been the main reason why only outer zones of the tabular scraper cores were detached and dorsal surfaces of tabular scrapers are usually covered with cortex.

However, the flint blocks available on the surface are inferior to the mined flint nodules in several points. The flint blocks on the surface are usually small and only slightly larger than the human fist size. Large flint blocks are rarely found on the surface. It is supported by the size of tabular scraper cores at Gurta Siyyata type sites. Tabular scraper cores at Gurta Siyyata type sites are much smaller than tabular scraper cores at Qa Abu Tulayha type sites. While the average size of cores at Qa Abu Tulayha type sites is about 24 cm ×24 cm×11 cm, the average size of cores is about 13×16×6 cm at Gurta Siyyata type sites (Fig.5.53, Fig.5.54, Fig.5.55, Fig.5.56, Fig.5.57,

Fig.5.58, Fig.7.18, Fig.7.19, Fig.7.20, Fig.7.21, Table.7.3, Table.7.4, Table.7.5).

Furthermore the flint blocks available on the surface are usually tabular rather than nodular while mined large flint nodules are usually nodular (Table.7.2). The flint blocks were also weathered and usually have internal fractures while mined large flint nodules are usually fresh.

As already explained in Chapter 6, large and long blanks were knapped from the large, fresh mined flint nodules and large end struck oval/elongated tabular scrapers were produced on the blanks at Qa'Abu Tulayha type sites (Fig.6.64). Their average size is about 15 cm in length×10 cm in width.

However the small size, tabular shape and internal fractures of Gurta Siyyata type surface raw material make it difficult to produce such large end struck oval/elongated tabular scrapers. The small size and internal fractures prevent detachment of large blanks. The tabular shape of raw material makes it difficult to produce long (end struck) blanks. The flint blocks available on the surface are only suitable for detaching small side struck blanks. As explained later, small side struck fan shaped tabular scrapers whose average size is about 7 cm in length×9 cm in width were the main products at Gurta Siyyata type sites (Fig.7.22:1, Fig.7.23:1, Fig.7.25).

At Gurta Siyyata type tabular scraper production sites, limited efforts were made for raw material acquirement. Because of the limited efforts, large and long tabular scrapers could not be produced.

7.2.3 Core preparation

As already explained in Chapter 6, tabular scraper production at Qa Abu Tulayha type sites is characterized by careful examination of the mined nodules and careful platform preparation before blank removal. To produce large and long blanks, flint knappers had to examine surfaces of the nodules carefully to find their convex parts, along which shock waves of percussion would run, before making platforms. Careful platform preparation was also necessary to produce the large and long tabular scraper blanks. In fact, over 90 % of the tabular scraper cores, tabular scraper flakes and tabular scrapers from Qa Abu Tulayha have carefully faceted platforms. The careful platform preparation probably had two goals. The first goal is to isolate impact points for accuracy of the next blank removal. The second goal is to make the appropriate *angle de chasse,* slightly less than 90 degrees. According to J. Whittaker, the closer the *angle de chasse* comes to 90 degrees, the longer the detached flake becomes (Whittaker 1994).

However, careful nodule examination and careful platform preparation were not necessary to detach the small side struck flakes (blanks) at Gurta Siyyata type sites (Fig.7.25). Flat surfaces of tabular flint blocks usually do not have any convex parts, along which shock waves of percussion would run. Therefore the tabular flint blocks are suitable only for production of side struck flakes.

The small side struck blanks can be produced very easily even without isolating impact points and making the *angle de chasse* the appropriate angle.

At Gurta Siyyata type sites, simple plain platforms and naturally weathered platforms without any platform preparation are more common (Table.7.9, Table.7.25). For example, no tabular scraper flakes collected at JF0106 have a faceted platform. Cores in the three samples show a high incidence of plain and weathered platforms. In particular, over 92 % of the cores from JF0106 have plain or weathered platforms. Especially the high incidence of naturally weathered platforms is noteworthy. Natural flat weathered surfaces of flint blocks were often used directly as platforms without any platform preparation (e.g. Fig.7.20, Fig.7.21:2, Fig.7.23:3,4, Fig.7.25). These facts strongly hint at less careful nature of core preparation at Gurta Siyyata type sites.

Angle de chasse of tabular scraper flakes from Gurta Siyyata type sites is also suggestive. The *angle de chasse* of tabular scraper flakes from JF0106 and JF0153 disperses between 60°and 90°(Fig.7.24). It strongly suggests that to make the *angle de chasse* appropriate was not an important process at Gurta Siyyata type sites.

7.2.4 Core reduction and core abandonment

Scars on tabular scraper cores from Gurta Siyyata type sites show that small side struck tabular scraper flakes (blanks) were flaked at Gurta Siyyata type sites (Fig.5.53, Fig.5.54, Fig.5.55, Fig.5.56, Fig.5.57, Fig.5.58, Fig.7.18, Fig.7.19, Fig.7.20, Fig.7.21, Table.7.12). The average size of scars is about 7 cm in length×9 cm in width on average (Table.7.14, Table.7.15, Table.7.16) and most scars are scars of side struck flakes (Table.7.12). For example, over 90 % of scars on cores collected at JF0106 are scars of side struck flakes.

Tabular scraper flakes in the samples from JF0106 and JF0153 also support this view. Most of the tabular scraper flakes are small side struck flakes (Table.7.19, Table.7.21, Table.7.22, Table.7.34, Table.6.35, Table.6.36, Fig.6.22, Fig.6.23). Nearly 70% of the tabular scraper flakes are side struck flakes and their average size is 7.42 cm in length×7.75 cm in width at JF0106 and 7.28 in length×9.6 in width at JF0153.

As already discussed, the small size, internal fractures and tabular shape of the raw material limited to the production of small side struck flakes (blanks).

Tabular scraper cores were usually abandoned after detaching a few tabular scraper flakes (Table.7.6). Only cortical skins of tabular scraper cores were reduced. As already explained, this is probably because the outer parts of flint just below cortex are the finest in quality.

On average, about 1.8 tabular scraper flakes were detached from each core. The number is smaller than the average number at Qa Abu Tulayha type sites (about 2.4 flakes from one core). The small flint blocks collected on the surface can yield only a smaller number of appropriate sized tabular scraper flakes. Some of the tabular scraper cores show tabular scraper removals both from the upper face and lower face of flint blocks (Table.7.7).

Tabular scraper flakes were probably detached from cores by direct percussion with soft stone hammers such as flint and limestone. Hammer modes of tabular scraper flakes in the samples were spread across categories of mode Ⅰ, Ⅱ and Ⅲ (Table.7.31). This pattern is related to direct percussion with soft stone hammers (Suzuki, Igarashi, Onuma, Kadowaki, Kunitake, Sunada, Nishiaki, Midoshima, Yamada and Yoshida 2002).

Failures of detaching tabular scraper flakes often happened. The samples show a much higher incidence of hinged termination than the sample at Qa Abu Tulayha. While 43 % of the cores have hinged termination at Qa Abu Tuayha, about 70 % of tabular scraper cores in the three samples from Gurta Siyyata type sites show hinged termination (Table.7.13, e.g.Fig.7.18). Tabular shape of the flint blocks and less careful platform preparation are probably the main reasons for the high incidence.

Samples from JF0106 and JF0153 also include several broken tabular scraper flakes (Table.7.18, e.g.Fig.7.22.5-6). While 11 % of tabular scraper blanks collected at JF 0106 were broken, 39 % of tabular scraper blanks were broken at JF0153. They were probably broken accidentally during flake detachment from cores and abandoned on the spot although some pieces may have been broken by post depositional effects.

7.2.4 Blank selection

Samples from JF0106 and JF0153 include a number of unbroken tabular scraper flakes (blanks) (Table.7.1, Table.7.17, Table.7.18). They were probably abandoned before blank modification for several reasons such as their small size, irregular shapes, curved profiles and hinged termination.

The size was probably an important factor of blank selection. Tabular scrapers in the samples are larger than the abandoned blanks without modification (Table.7.21, Table.7.22, Table.7.39). While the average size of the unbroken tabular scraper flakes is about 7.3 cm in length×8.8 cm, the average size of tabular scrapers is about 9.3 cm in length×12.1 cm in width. There is a possibility that large blanks were selected. However the samples include only three tabular scrapers. The number is too small to judge.

Hinged termination was probably another important factor for abandonment of blanks. Every tabular scraper in the sample was made on blanks with feather termination. Blanks with feather termination were probably selected (Fig.7.22:1, Fig.7.23:1, Table.7.39).

The sample from JF0106 includes 14 tabular scraper cores and 8 unbroken tabular scraper flakes. Judging by the number of scars on cores, it is estimated that 23 tabular scraper flakes were detached from these cores in total. 8 of 23 tabular scraper flakes (about 35 %) were abandoned without any modification. The sample from JF 0153 includes 8 tabular scraper cores and 11 tabular scraper flakes. It is estimated that 9 tabular scraper flakes were detached from these cores in total. But 11 tabular scraper flakes were discarded before modification. In the sample, the number of discarded unbroken tabular scraper flakes (N=11) exceeds the estimated number of detached tabular scraper flakes (N=9). This non-conformity is probably from small sample size or post depositional effects.

However these facts strongly suggest that a large proportion of blanks were abandoned before modification at Gurta Siyyata type sites. In contrast, unbroken tabular scraper flakes without modification are rarely found at Qa Abu Tulayha.

Tabular scraper production at Gurta Siyyata type sites is less labor intensive. Only limited efforts were made for raw material acquirement. And blanks were knapped off from cores with less careful core preparation. Flint knappers abandoned most of the blanks before modification. But for knappers, to discard a large proportion of blanks was not a waste because they made only minimum efforts to produce them.

7.2.5 Blank modification

Two unbroken tabular scrapers are included in the sample from JF106 and the sample from JF0153 includes one unbroken tabular scraper (Fig.7.22:1; Fig.7.23:1, Fig.7.25, Table.7.39). The reason why these three unbroken tabular scrapers were left is unclear. But they clearly show that the main products at Gurta Siyyata type sites were small side struck fan shaped tabular scrapers on small side struck tabular scraper flakes. Their average size is about 9.3 cm in length×12.1 cm in width. (But the number of tabular scrapers in the sample is too small. Given the size of scars on cores, the average size of tabular scrapers at Gurta Siyyata type sites was smaller and probably about 7cm in length×9cm in width). They were transverse scrapers and have their main edges at their distal ends. The edges are usually semi abruptly or abruptly retouched.

The blanks were shaped to the tabular scrapers by short retouching on dorsal surfaces. Shapes of retouch are semi-parallel or scaled. Striking platforms and bulbs were not removed by retouching.

No incision was observed on cortical surfaces of tabular scraper flakes and tabular scrapers from Gurta Siyyata type sites.

7.3. SUMMARY

19 of 25 tabular scraper production sites discovered by Japanese surveys are classified into Gurta Siyyata type sites. Gurta Siyyata type sites are tabular scraper production sites using small flint blocks on the surface as raw material instead of large mined flint nodules (Fig.7.25). At the sites, only limited efforts were made for raw material acquirement. Because of the absence of intensive flint mining, the production at Gurta Siyyata type sites needed only one fifth of the labor (days) of the production at Qa Abu Tulayha type sites to produce the same number of blanks.

Gurta Siyyata type sites vary in size. The size ranges from 25 ha to 0.2 ha. These sites are usually very extensive. Tabular scraper cores and tabular scraper flakes are dispersed widely but very thinly at the sites. There are less than 0.5 tabular scraper cores per 1 m^2 on average. The largest site probably yielded 125000 tabular scraper cores while the smallest site yielded 1000 tabular scraper cores. But Gurta Siyyata type sites were probably formed in multiple episodes. The absence of structures associated with tabular scraper production at the sites hints that each knapping episode was probably short and the sites were frequently visited over many years. Each knapping episode probably spanned only a few days at longest. Because of short staying, structures were not built. Given the less intensiveness of the production, it is no wonder that no structures were discovered at the sites.

Flint blocks on the surface are usually small, weathered and have internal fractures. Small side struck tabular scraper flakes (blanks) and small side struck tabular scrapers were produced from the flint blocks at Gurta Siyyata type sites. Without the mined large and fresh nodules, a certain amount of large end struck oval/elongated tabular scarpers could not be produced.

Tabular scraper production at Gurta Siyyata type sites is also characterized by less careful flint knapping. Carefully prepared platforms by faceting was less common at Gurta Siyyata type sites than at Qa Abu Tulayha type sites. Instead, simple plain platforms and naturally weathered platforms without any platform preparation are more common at Gurta Siyyata type sites. Careful platform preparation was not necessary to produce the small side struck blanks.

On average, 1.8 blanks were knapped from one core. Blank detachment at Gurta Siyyata type sites is characterized by a high incidence of failures. The samples show a very high incidence of hinged termination. Tabular shapes of the flint blocks and less careful platform preparation are probably the main reasons for it. Blanks were also often broken accidentally during flake detachment.

At the sites, a large proportion of tabular scraper flakes (blanks) were abandoned ungrudgingly before blank modification. Tabular scraper production at the sites did not include intensive flint mining or careful core preparation. Therefore to abandon a large proportion of blanks was not a waste for knappers. The knappers modified only a small number of appropriate tabular scraper flakes (blanks) into small side struck fan shaped tabular scrapers.

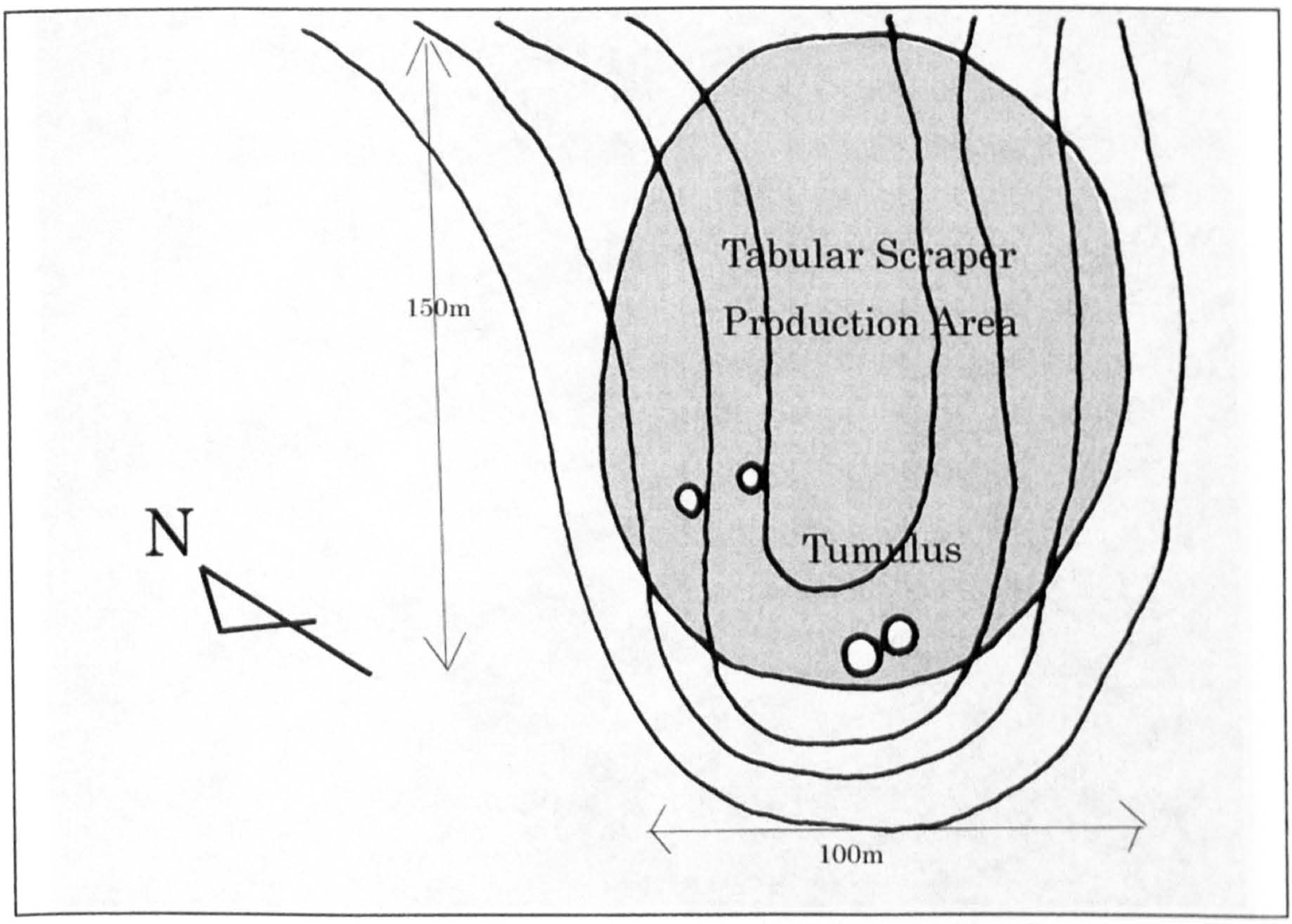


Fig.7.1 Sketch map of JF 0106.

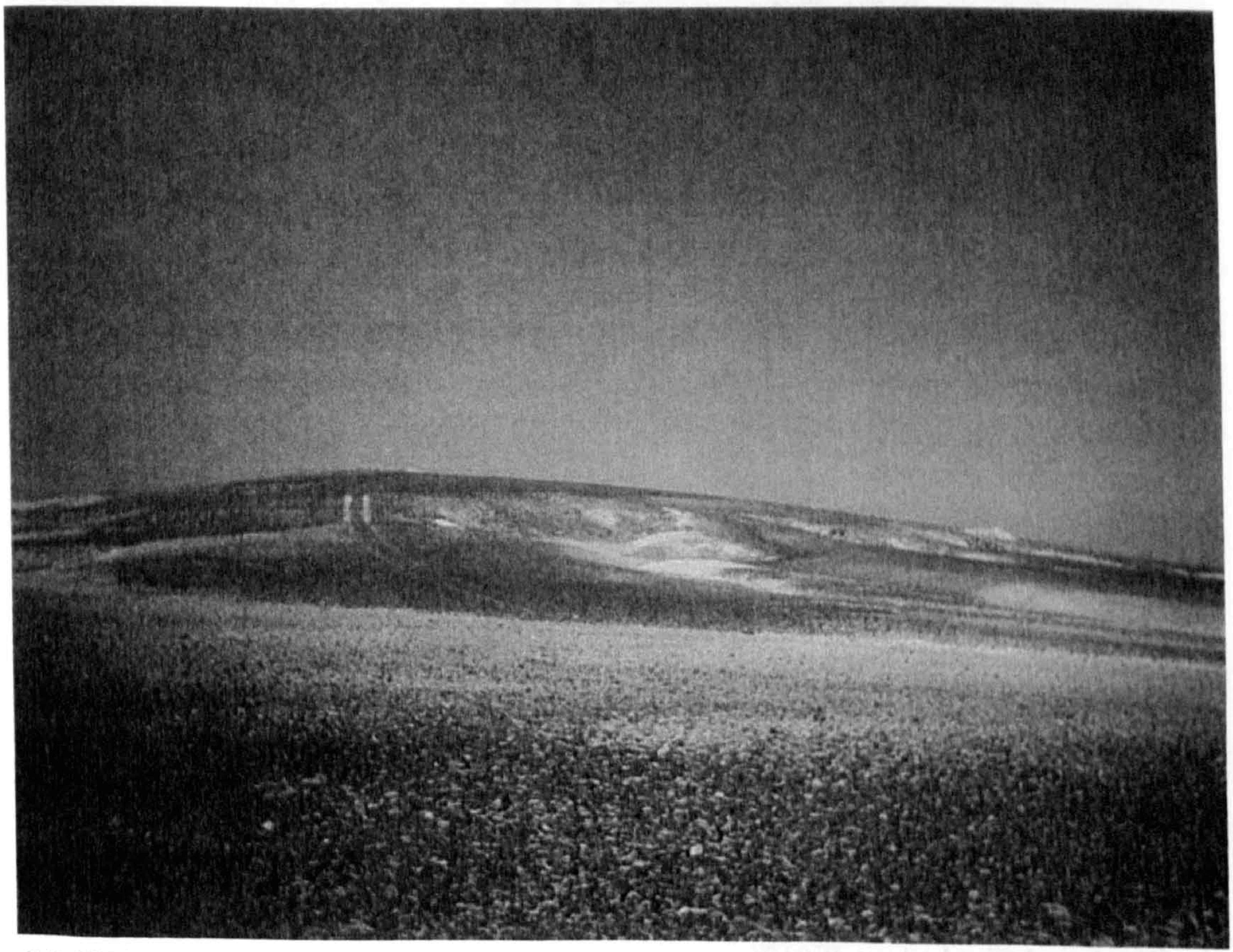


Fig.7.2 JF0106 from the south.

Fig.7.3 Dispersed flint blocks and tabular scraper cores at JF0106.

Fig.7.4 Weathered flint beds at JF0106.

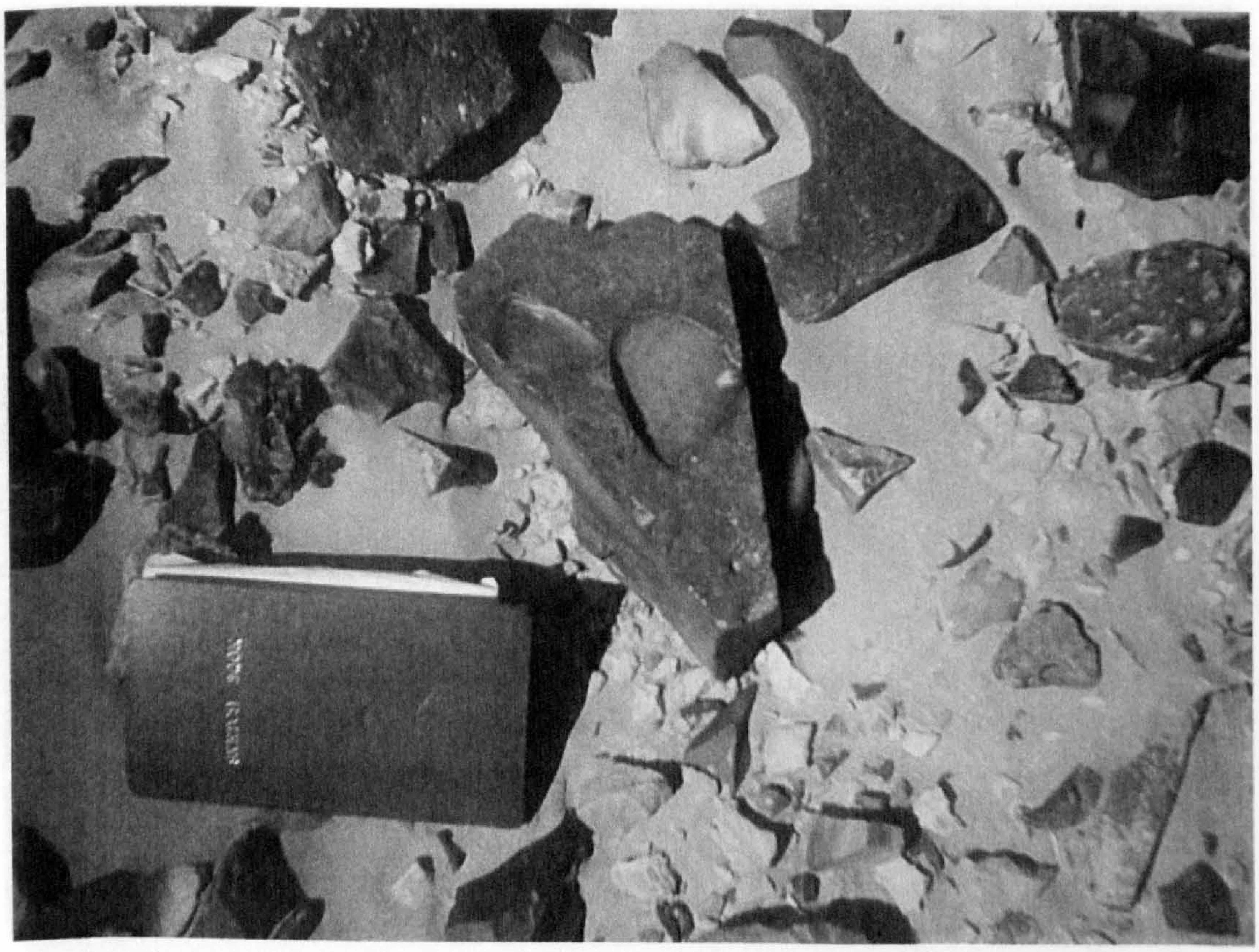


Fig.7.5 A typical tabular scarper core at JF0106.

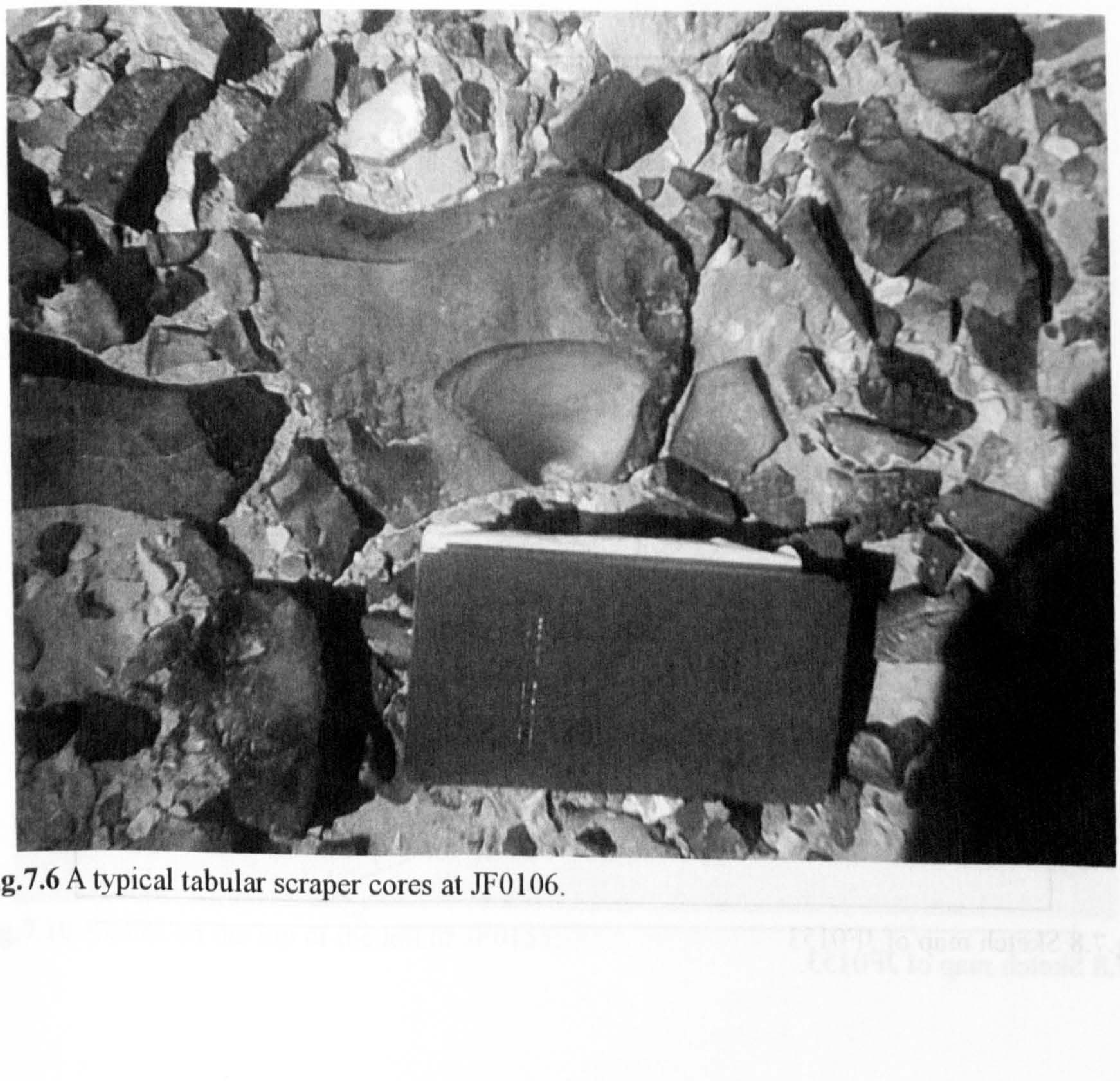


Fig.7.6 A typical tabular scraper cores at JF0106.

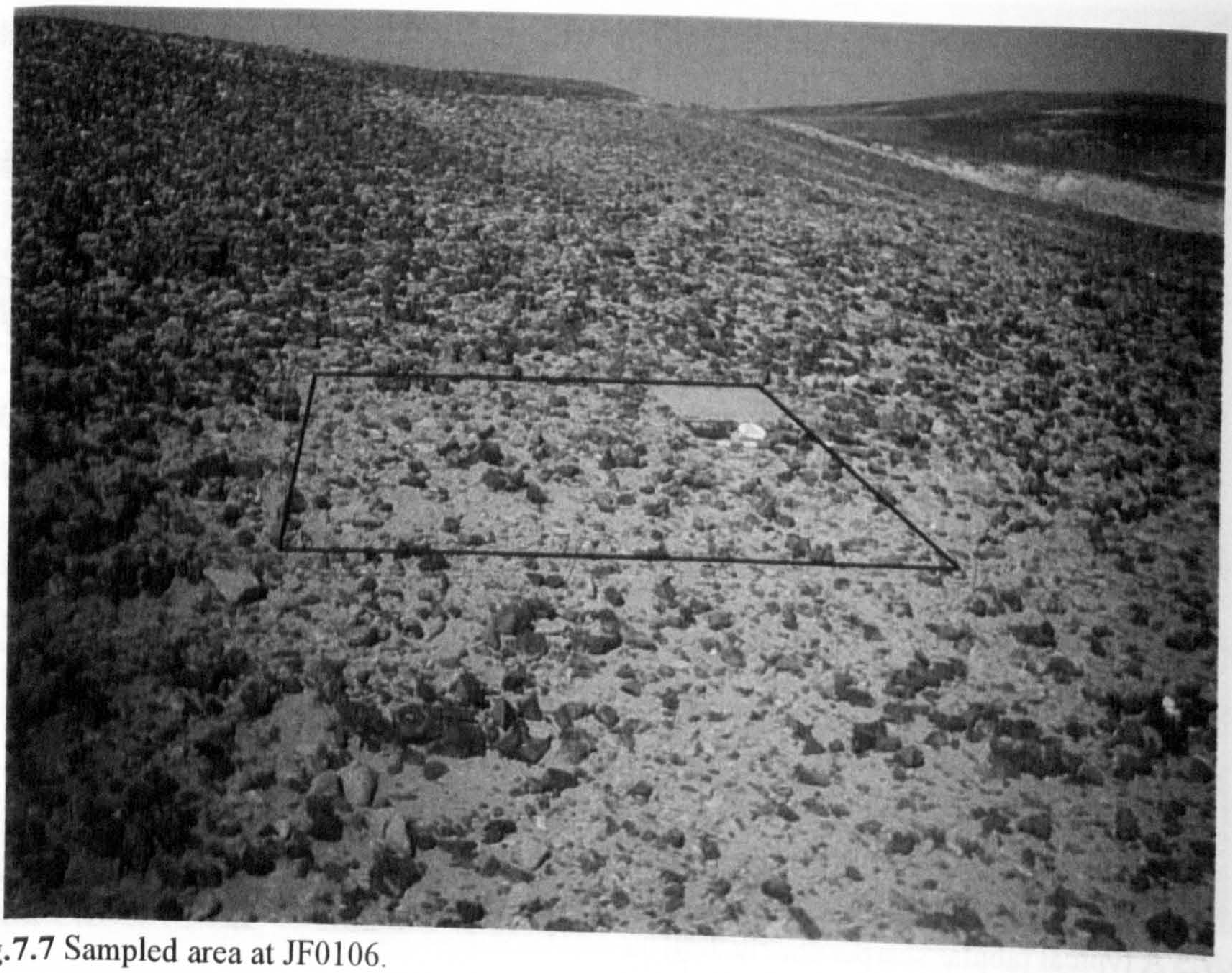


Fig.7.7 Sampled area at JF0106.

Fig.7.8 Sketch map of JF0153.

Fig.7.9 JF0153 from the southeast.

Fig.7.10 A cairn on the top of the hill of JF0153.

Fig.7.11 Thamudic inscription on a cairn at JF0153.

Fig.7.12 Dispersed flint blocks and tabular scraper cores at JF0153.

Fig.7.13 A typical tabular scraper core at JF0153.

Fig.7.14 A typical tabular scraper core at JF0153.

Fig.7.15 A typical tabular scraper core at JF0153.

Fig.7.16 Sampled area at JF0153 (from the south).

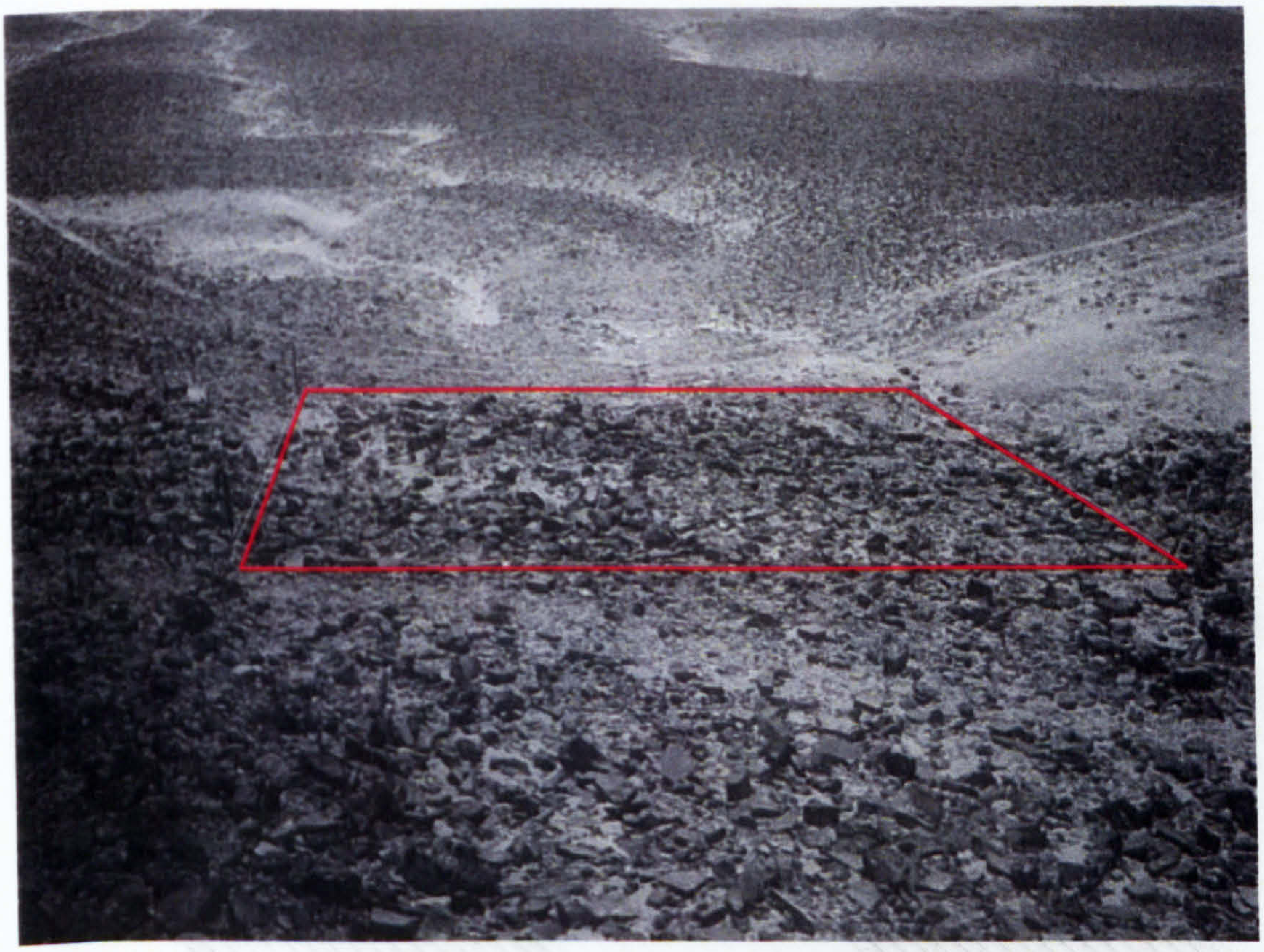


Fig.7.17 Sampled area at JF0153 (from the north).

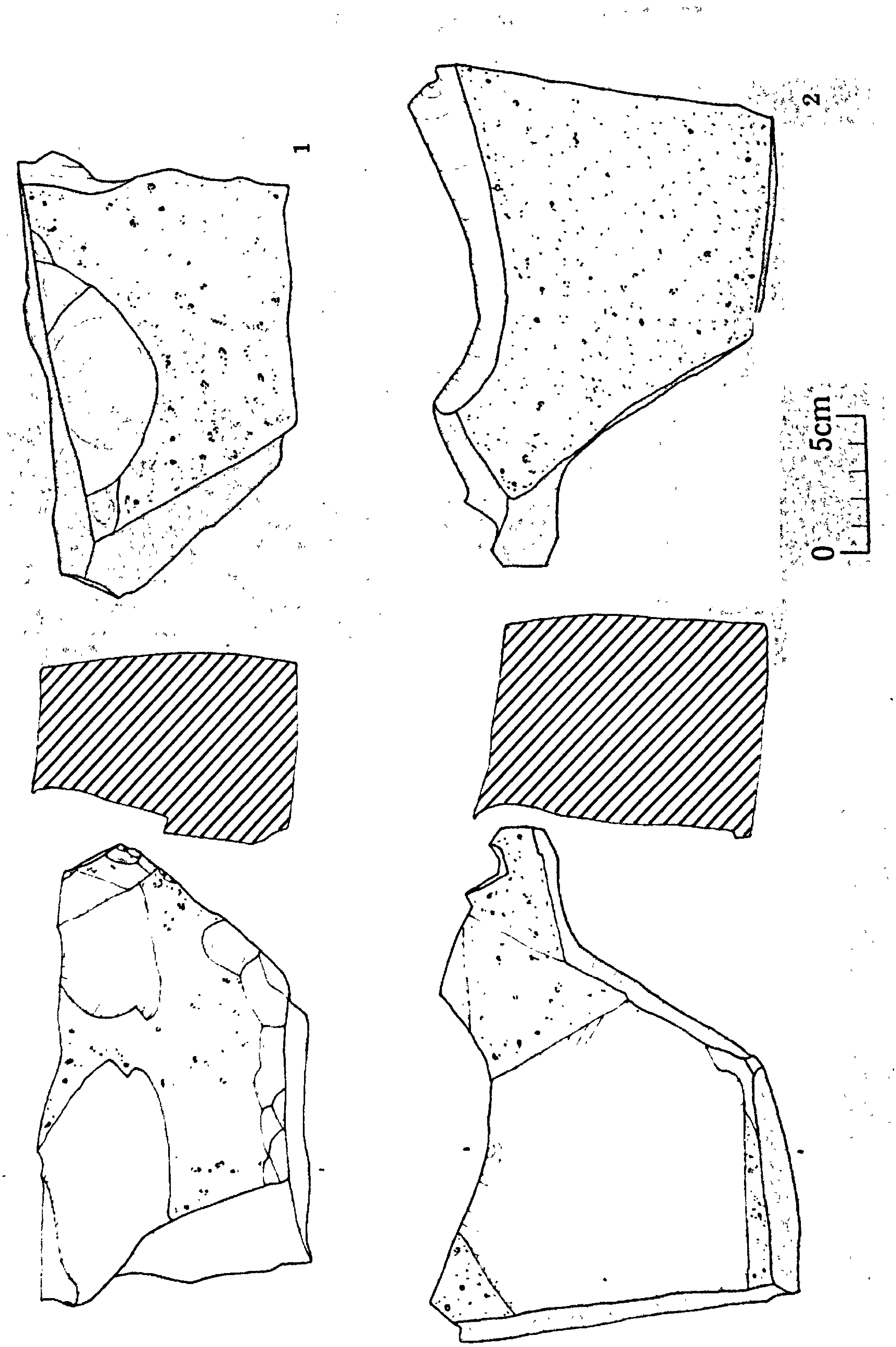


Fig.7.18 Tabular scraper cores from JF0106 (Screen represents natural flat weathered surfaces).
1-2: Tabular scraper cores.

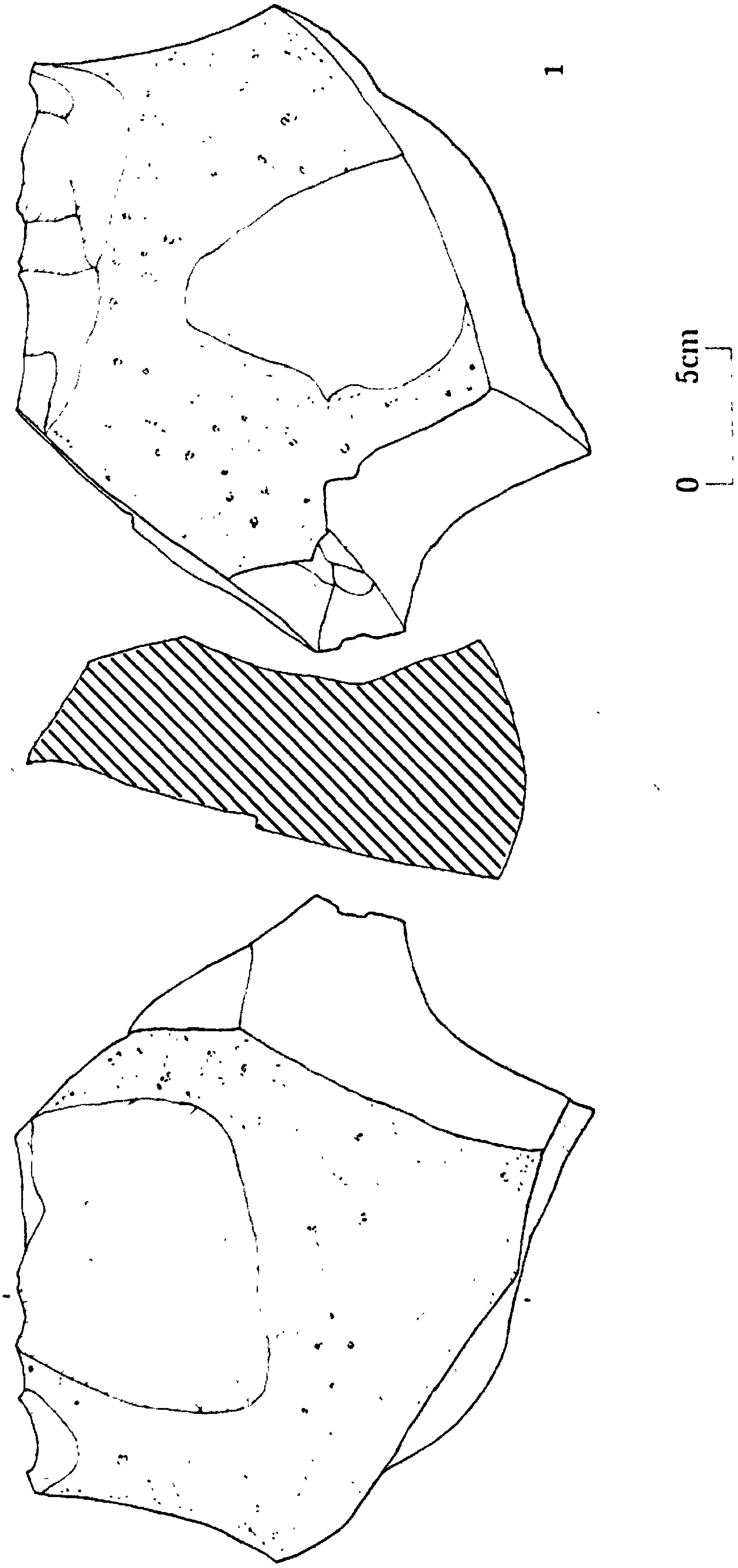


Fig.7.19 A tabular scraper core from JF0106.

1: Tabular scraper core.

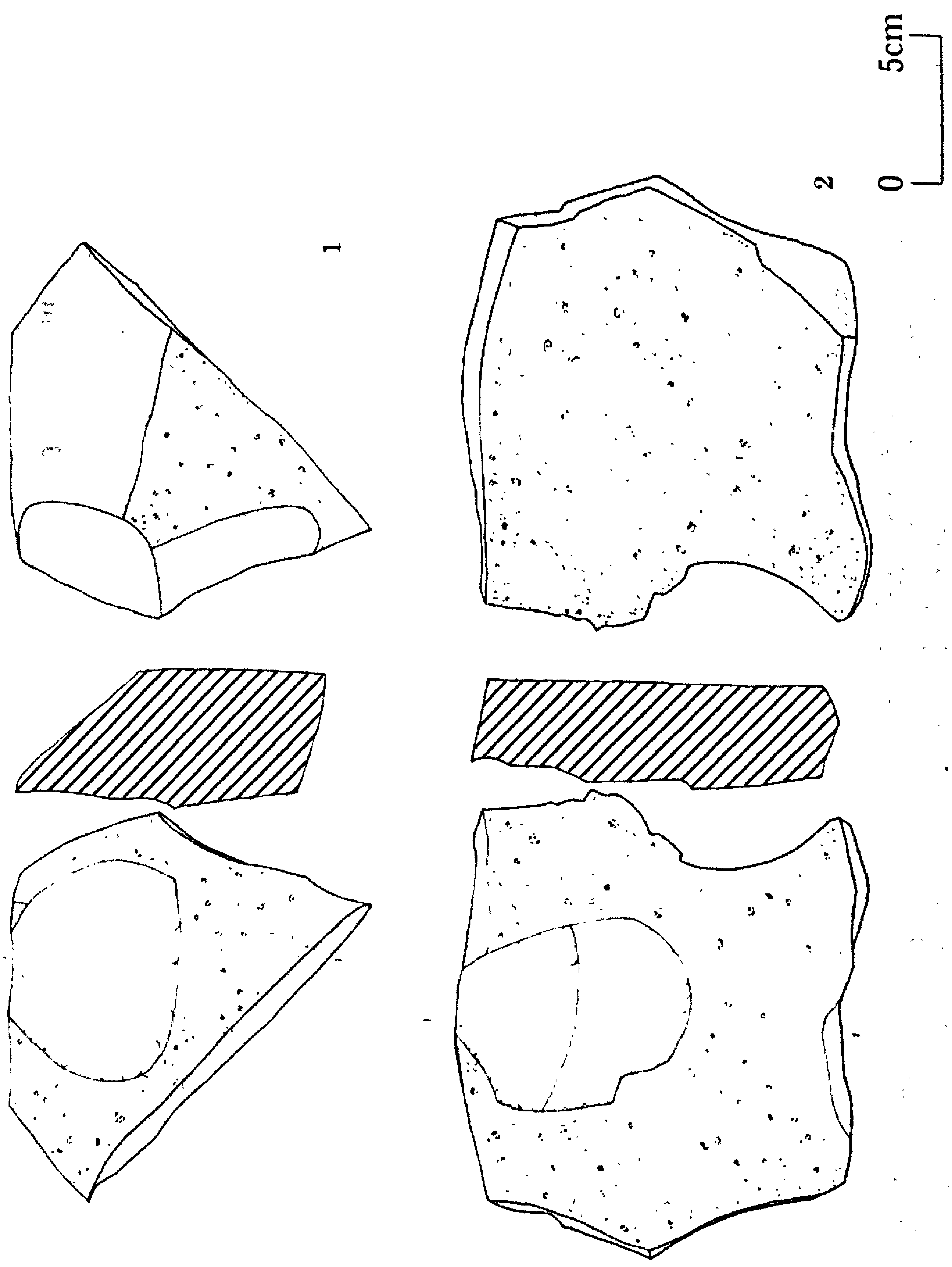


Fig.7.20 Tabular scraper cores from JF0153.

1-2: Tabular scraper cores.

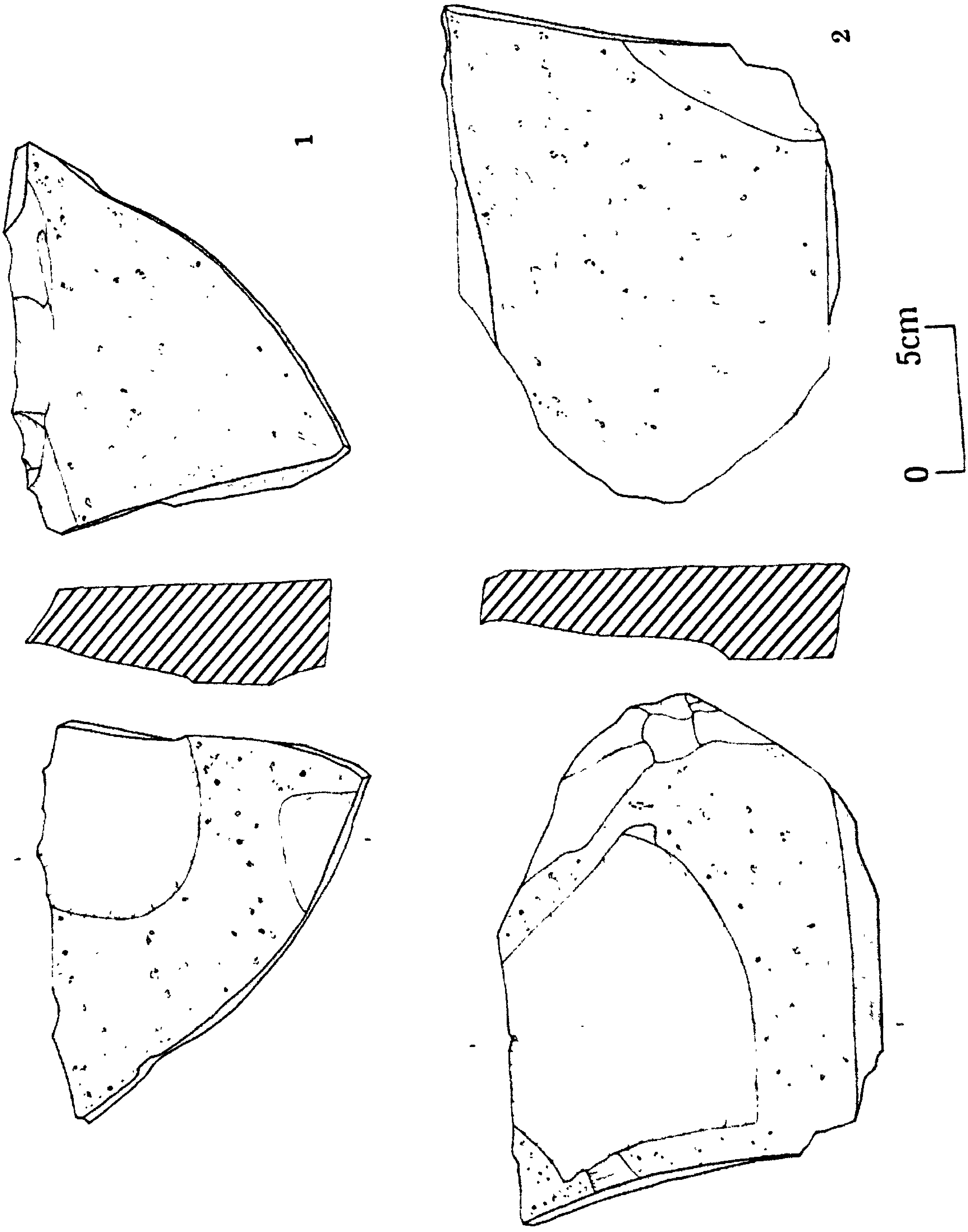


Fig.7.21 Tabular scraper cores from JF0153.

1-2: Tabular scraper cores.

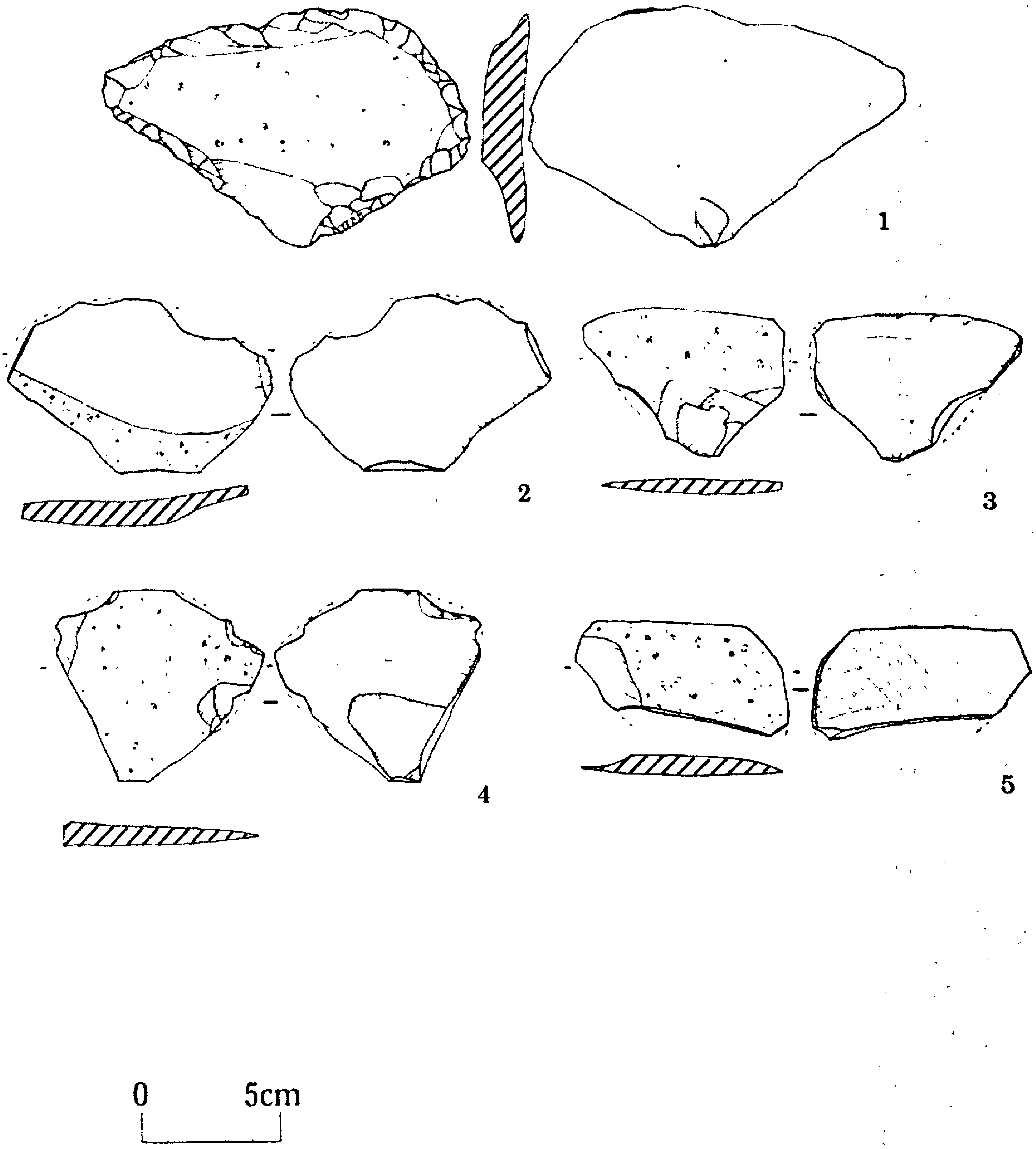


Fig.7.22 A tabular scraper and tabular scraper flakes from JF0106.
1: Tabular scraper, 2-5: Tabular scraper flakes.

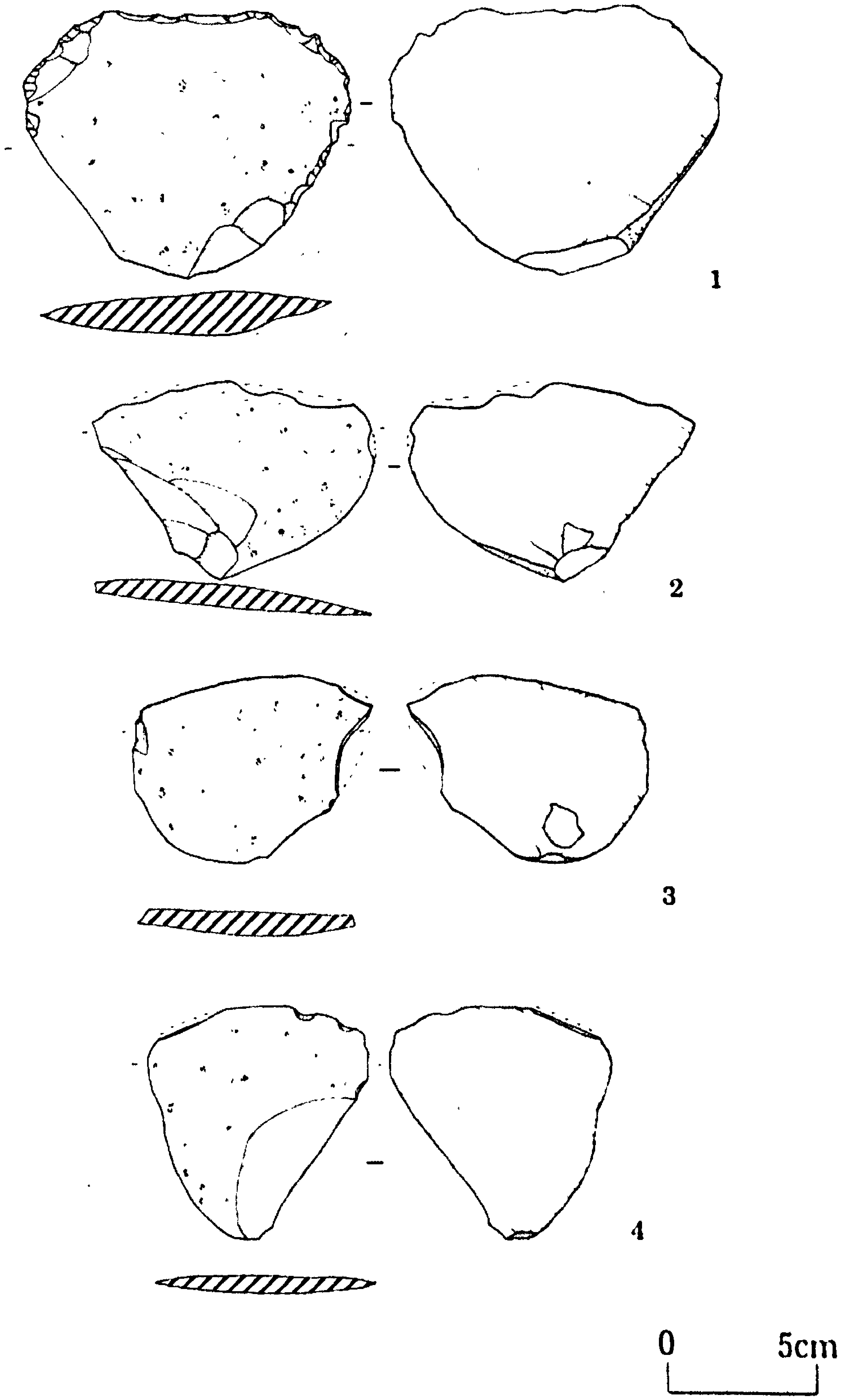


Fig.7.23 A tabular scraper and tabular scraper flakes from JF0153.

1: Tabular scraper, 2-4: Tabular scraper flakes.

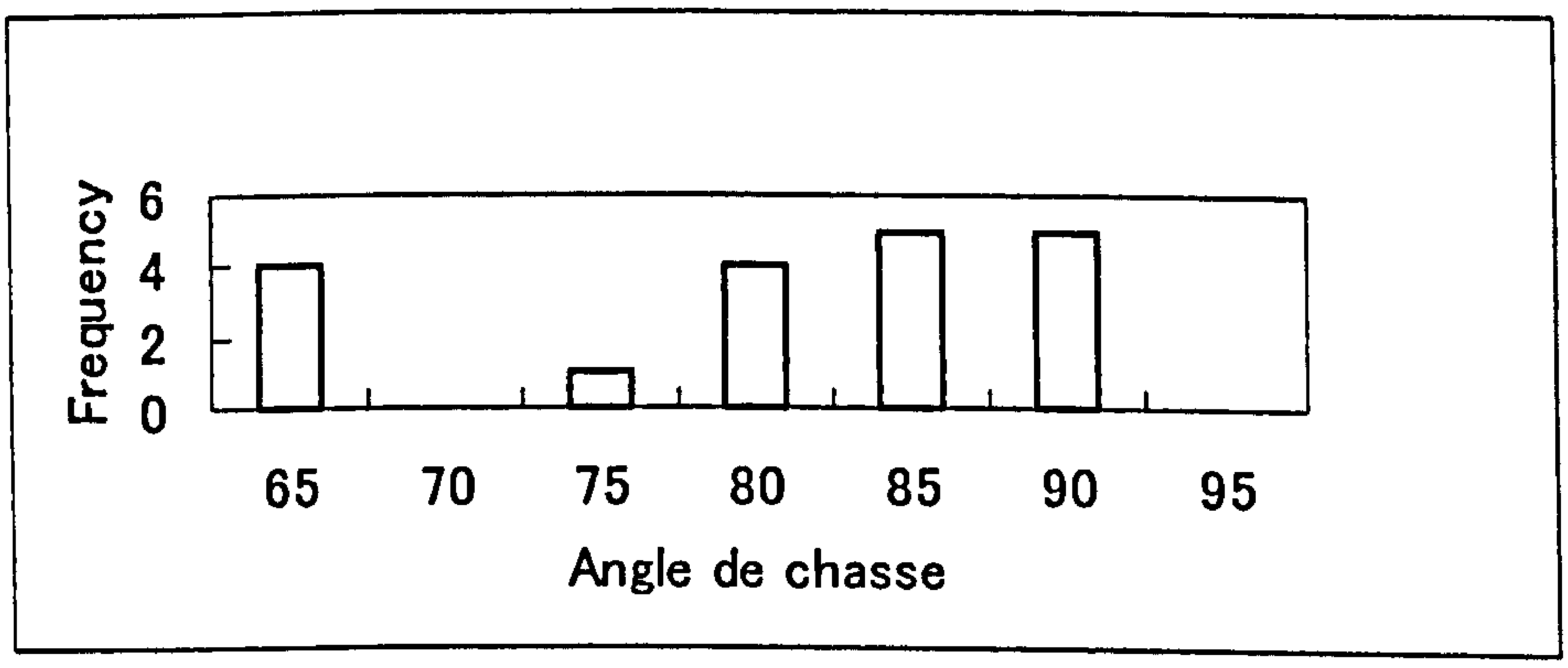
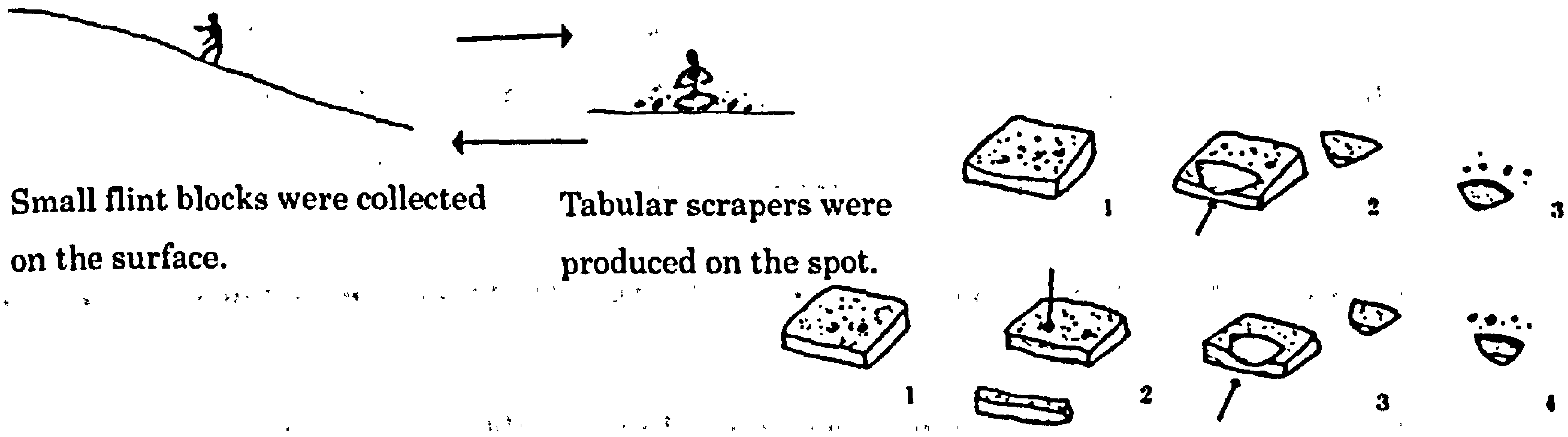


Fig.7.24 Histogram of angle de chasse of tabular scraper flakes from JF0106 and JF0153.

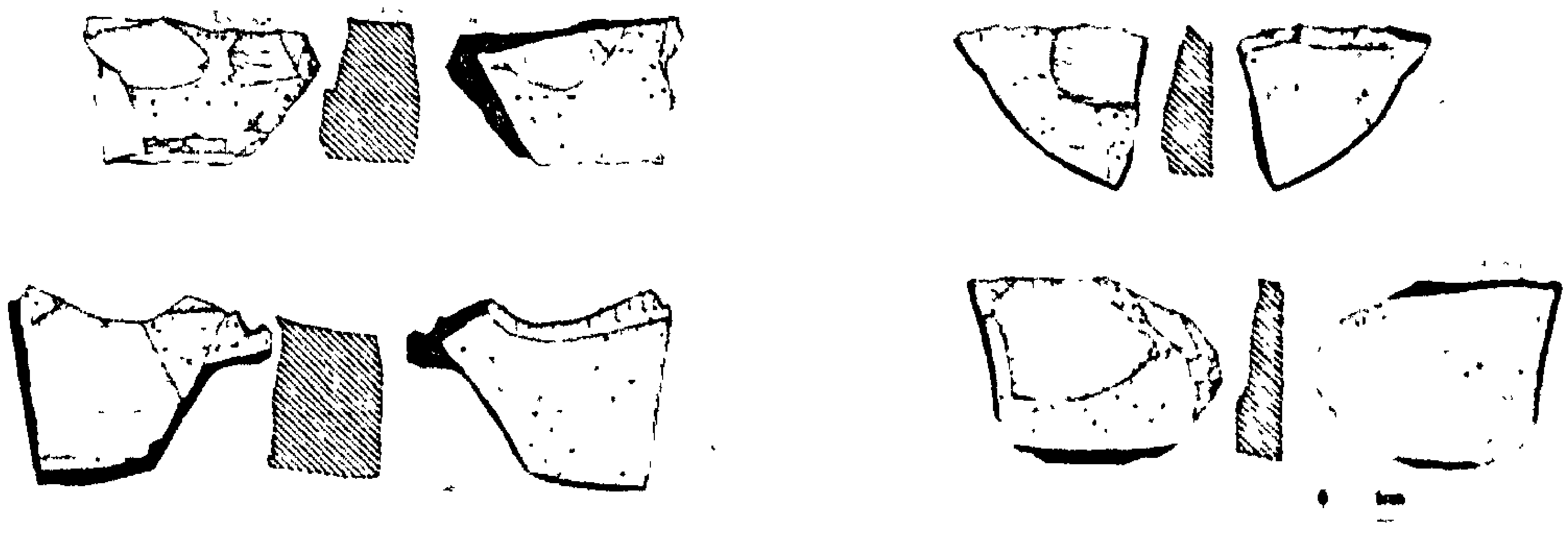
Gurta Siyyata type



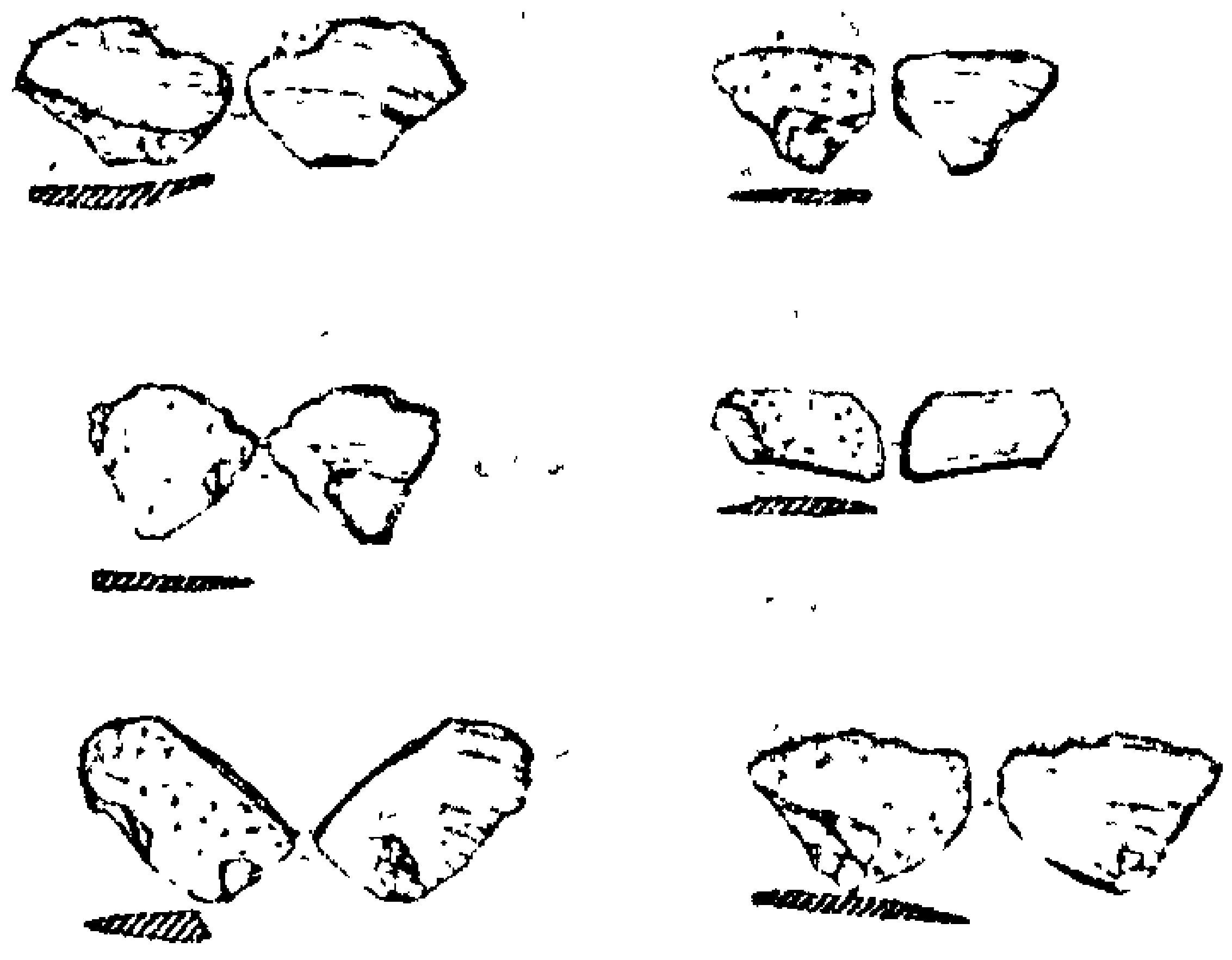
Small flint blocks were collected on the surface.

Tabular scrapers were produced on the spot.

Tabular scraper cores



Tabular scraper flakes (blanks)



Tabular scrapers

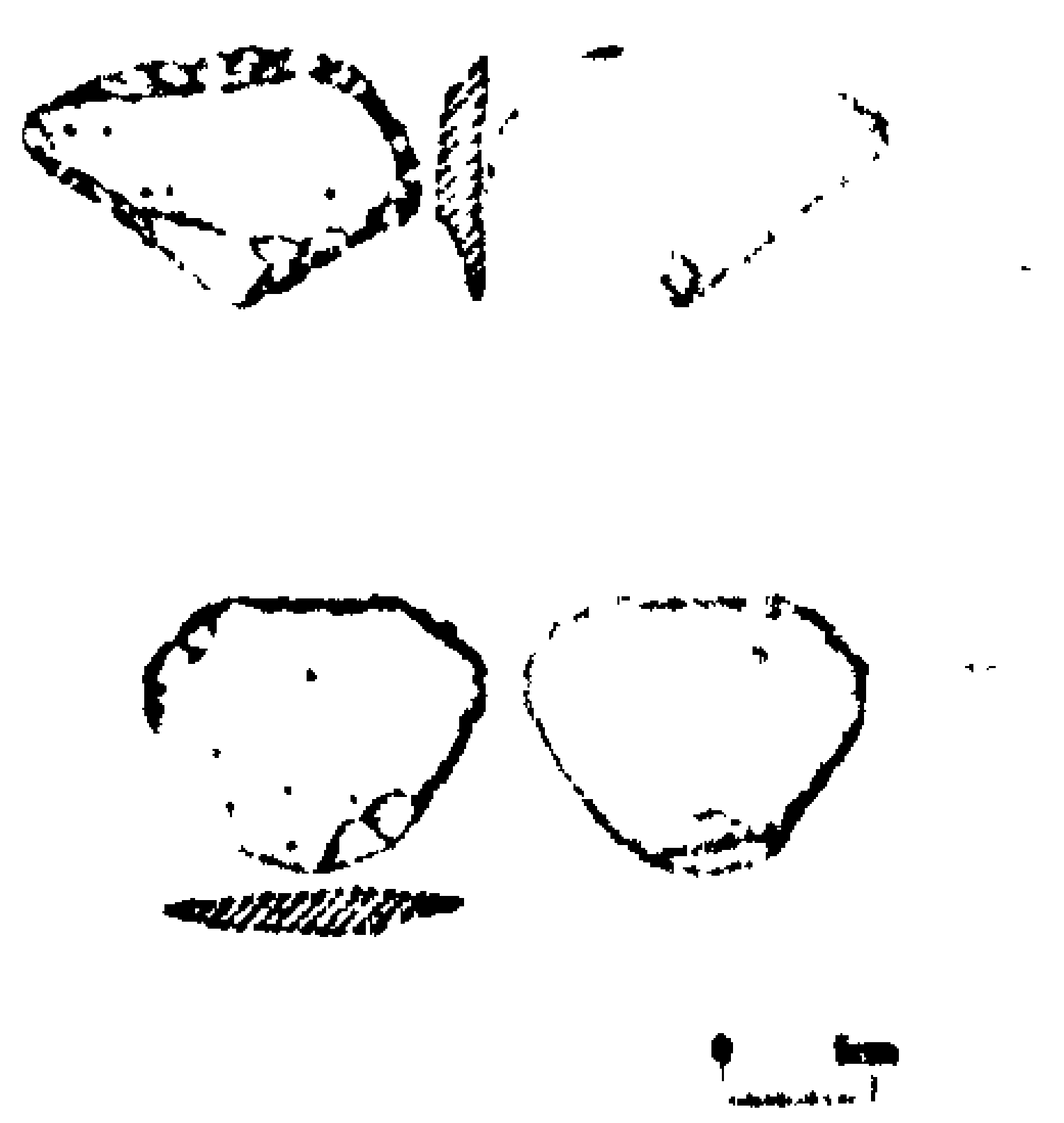


Fig.7.25 Tabular scraper production at Gurta Siyyata type sites.

Table.7.1 Flint artifacts from JF0106, JF0153 and other Gurta Siyyata type sites.

Categories	Gurta Siyyata type sites	JF0106	JF0153	Total
Tabular scraper cores	39	14	8	61
Tabular scrapers	0	2	2	4
Tabular scraper flakes	0	9	18	27
Total	39	25	28	92

-Attributes of tabular scraper cores from JF0106, JF0153 and other Gurta Siyyata type sites-

Table.7.2 Raw material of tabular scraper cores from JF0106, JF0153 and other Gurta Siyyata type sites.

Raw material	Nodular	Tabular	Thermal flake	Total
Gurta Siyyata type sites	20	19	0	39
JF0106	7	7	0	14
JF0153	2	6	0	8
Total	29	32	0	61
%	47.54	52.46	0	100

Table.7.3 Measurements of tabular scraper cores from other Gurta Siyyata type sites.

Measurements of tabular scraper cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	39	13.244	2.927	7.9	20.6	12.5
Width	39	16.203	3.31	9.9	24.5	16.2
Thickness	39	5.923	2.522	2.1	13.9	5.3
Length/Width	39	0.849	0.252	0.5	1.5	0.8
Width/Thickness	39	3.092	1.081	1.1	6.2	3.2

Table.7.4 Measurements of tabular scraper cores from JF0106.

Measurements of tabular scraper cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	14	12.733	2.72	9.9	19.6	12.1
Width	14	16.716	3.557	9.6	22.3	17.6
Thickness	14	8.015	1.985	5.4	13.7	7.4
Length/Width	14	1.476	1.962	0.6	8.4	0.9
Width/Thickness	14	1.982	0.651	0.3	2.8	2.2

Table.7.5 Measurements of tabular scraper cores from JF0153.

Measurements of tabular scraper cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	8	11.229	1.943	7.9	14	11.7
Width	8	15.831	2.391	12.2	19.7	15.6
Thickness	8	5.256	2.465	2.3	9.3	4.4
Length/Width	8	2.106	1.636	0.5	4.6	1.2
Width/Thickness	8	3.663	1.523	1.6	5.9	3.8

Table.7.6 The number of tabular scraper blanks detached from tabular scraper cores.

The number of blanks detached from cores	N	Mean	S.D.	Min.	Max.	Median
Gurta Siyyata type sites	39	1.92	1.692	1	8	1
JF0106	14	1.643	0.972	1	4	1
JF0153	8	1.125	0.331	1	2	1

Table.7.7 Core types of tabular scraper cores.

Core types (%)	Uniface	Biface	Total
Gurta Siyyata type sites (N=39)	87.18	12.82	100
JF0106 (N=14)	71.43	28.57	100
JF0153 (N=8)	100	0	100

Table.7.8 Platform angle of tabular scraper cores.

Platform Angle	N	Mean	S.D.	Min.	Max.	Median
Gurta Siyyata type sites	39	72.658	8.622	54	88	74
JF0106	13	80.846	12.672	66	116	78
JF0153	8	75.625	7.777	62	86	77.5

Table.7.9 Platform types of tabular scraper cores.

Platform types (%)	Plain	Weathered	Faceted	Total
Gurta Siyyata type sites (N=39)	20.51	25.64	53.85	100
JF0106 (N=13)	23.08	69.23	7.69	100
JF0153 (N=8)	37.5	25	37.5	100

Table.7.10 The number of tabular scraper flakes on the main flaking surfaces of tabular scraper cores.

The number of scars on the main flaking surface	N	Mean	S.D.	Min.	Max.	Median
Gurta Siyyata type sites	39	1.56	1.165	1	7	1
JF0106	14	1.357	0.61	1	3	1
JF0153	8	1.125	0.331	1	2	1

Table.7.11 Scar patterns on the main flaking surfaces of tabular scraper cores.

Scar pattern of the main flaking surface(%)	N	One Scar	Unidirectional	Bidirectional	Convergent	Centripetal	Others	Total
Gurta Siyyata sites	39	66.67	7.69	5.13	7.69	12.82	0	100
JF0106	14	71.43	14.29	7.14	0	0	7.14	100
JF0153	8	87.5	12.5	0	0	0	0	100

Table.7.12 Shapes of the main scars on the main flaking surfaces of tabular scraper cores.

Shape of the main scar (%)	N	Symmetrical end struck	Asymmetrical end struck	Side struck	Total
Gurta Siyyata type sites	39	10.26	20.51	69.23	100
JF0106	12	0	8.33	91.67	100
JF0153	8	12.5	0	87.5	100

Table.7.13 Termination of the main scars of tabular scraper cores.

Termination of the main scar (%)	N	Feather	Hinged	Overshot	Total
Gurta Siyyata types sites	39	38.46	61.54	0	100
JF0106	14	21.43	78.57	0	100
JF0153	8	12.5	87.5	0	100

Table.7.14 Measurements of main scars of tabular scraper cores from Gurta Siyyata type sites.

Measurements of the main scars (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	39	8.382	1.746	5.2	13.5	8.4
Width	39	8.913	1.844	5.9	13.1	9.1
Length/Width	39	0.964	0.235	0.5	1.7	0.9

Table.7.15 Measurements of main scars of tabular scraper cores from JF0106.

Measurements of the main scars (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	12	7.753	1.98	5	11.4	8.1
Width	12	9.642	1.951	6.33	13.2	9.9
Length/Width	12	0.8	0.124	0.53	1.03	0.8

Table.7.16 Measurements of main scars of tabular scraper cores from JF0153.

Measurements of the main scars (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	8	6.274	1.423	3.9	8.6	6.1
Width	8	8.054	1.957	5.2	11.8	8
Length/Width	8	0.809	0.211	0.6	1.3	0.8

-Attributes of tabular scraper flakes from JF0106 and JF0153-

Table.7.17 Tabular scraper flakes from JF0106 and JF0153.

	JF106	JF0153	Total
Unbroken pieces	8	11	19
Proximal fragments	0	1	1
Distal fragments	1	5	6
Other fragments	0	1	1
Total	9	18	27

Table.7.18 The proportion of broken and unbroken pieces of tabular scraper flakes from JF0106 and JF0153.

Broken and unbroken pieces (%)	Broken	Unbroken	Total
JF0106 (N=9)	11.11	88.89	100
JF0153 (N=18)	38.89	61.11	100

Table.7.19 Estimated shapes of tabular scraper flakes from JF0106 and JF0153.

Shape of tabular scraper flake (%)	Symmetrical end struck	Asymmetrical end struck	Side Struck	Unknown	Total
JF0106 (N=9)	11.11	11.11	66.67	11.11	100
JF0153 (N=18)	0	5.56	66.67	27.78	100

Table.7.20 Incisions on cortical surfaces of tabular scraper flakes from JF0106 and JF0153.

Incision (%)	Absent	Present	Total
JF0106 (N=9)	100	0	100
JF0153 (N=18)	100	0	100

Table.7.21 Measurements of unbroken tabular scraper flakes from JF0106.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Length	8	7.42	1.645	5.5	10.9	7.3
Width	8	7.75	1.496	5.9	10.2	7.4
Thickness	8	1.283	0.296	0.9	1.9	1.3
Length/Width	8	1.005	0.364	0.7	1.9	0.9
Width/Thickness	8	6.233	1.344	4.5	8.3	6.1

Table.7.22 Measurements of unbroken tabular scraper flakes from JF0153.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Length	10	7.284	0.879	6.1	8.9	7.3
Width	10	9.612	1.814	6.2	12.3	9.5
Thickness	10	1.722	0.503	1	2.7	1.6
Length/Width	10	0.776	0.249	0.5	1.4	0.7
Width/Thickness	10	5.881	1.443	3.8	8.7	5.6

Table.7.23 Measurements of butts of tabular scraper flakes from JF0106.

	N	Mean	S.D.	Min.	Max.	Median
Butt width (cm)	8	2.053	0.817	0.9	3.6	1.9
Butt depth (cm)	8	0.719	0.329	0.2	1.2	0.7

Table.7.24 Measurements of butts of tabular scraper flakes from JF0153.

	N	Mean	S.D.	Min.	Max.	Median
Butt width (cm)	11	3.65	2.241	1.3	8.2	2.8
Butt depth (cm)	11	1.161	0.525	0.4	2.1	1.1

Table.7.25 Butt types of tabular scraper flakes from JF0106 and JF0153.

Butt types (%)	Cortex	Weathered	Plain	Faceted	Others	Total
JF106 (N=8)	0	50	50	0	0	100
JF0153 (N=12)	0	33.33	41.67	25	0	100

Table.7.26 Measurements of angle de chasse and flaking angle of tabular scraper flakes from JF0106.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Angle de chasse	7	82.286	2.914	78	86	82
Flaking angle	7	97.714	2.914	94	102	98

Table.7.27 Measurements of angle de chasse and flaking angle of tabular scraper flakes from JF0153.

Measurements	N	Mean	S.D.	Min.	Max.	Median
Angle de chasse	12	74.917	11.758	54	88	79
Flaking angle	12	105.083	11.758	92	126	101

Table.7.28 Patterns of impact points, corns, bulbar scars and lips of tabular scraper flakes from JF0106.

(%)	Present	Absent	Unknown	Total
Impact point (N=8)	37.5	62.5	0	100
Corn (N=8)	37.5	62.5	0	100
Bulbar scar (N=8)	50	50	0	100
Lip (N=8)	50	50	0	100

Table.7.29 Patterns of impact points, corns, bulbar scars and lips of tabular scraper flakes from JF0153.

(%)	Present	Absent	Unknown	Total
Impact point (N=12)	50	50	0	100
Corn (N=12)	41.67	58.33	0	100
Bulbar scar (N=12)	58.33	41.67	0	100
Lip (N=12)	33.33	66.67	0	100

Table.7.30 Patterns of bulbs of tabular scraper flakes from JF0106 and JF0153.

	Prominent	Prominent weakly	Non-prominent	Unknown	Total
JF0106 (N=8)	100	0	0	0	100
JF0153 (N=12)	100	0	0	0	100

Table.7.31 Patterns of hammer modes of tabular scraper flakes from JF0106 and JF0153.

Hammer mode (%)	I	II	III	IV	V	Others	Total
JF0106 (N=8)	25	12.5	62.5	0	0	0	100
JF0153 (N=12)	41.67	16.67	41.67	0	0	0	100

Table.7.32 Termination of tabular scraper flakes from JF0106 and JF0153.

Termination (%)	Feather	Hinged	Plunged	Total
JF0106 (N=9)	33.33	55.56	11.11	100
JF0153 (N=16)	43.75	43.75	12.5	100

Table.7.33 Profile of tabular scraper flakes from JF0106 and JF0153.

Profile (%)	Straight	Concave	Convex	Unknown	Total
JF0106 (N=9)	88.89	0	0	11.11	100
JF0153 (N=18)	33.33	5.56	22.22	38.89	100

Table.7.34 Shapes of unbroken tabular scraper flakes from JF0106 and JF0153.

Shapes of unbroken pieces (%)	Symmetrical end struck	Asymmetrical end struck	Side struck	Unknown	Total
JF0106 (N=8)	12.5	12.5	75	0	100
JF0153 (N=11)	0	9.1	90.9	0	100

Table.7.35 Shapes of proximal fragments of tabular scraper flakes from JF0106 and JF0153.

Shapes of proximal fragments (%)	Unexpanding	Expanding	Unknown	Total
JF0153 (N=1)	100	0	0	100

Table.7.36 Shapes of distal fragments of tabular scraper flakes from JF106 and JF1053.

Shape of distal fragments (%)	Unexpanding	Expanding	Unknown	Total
JF0106 (N=1)	0	100	0	100
JF0153 (N=5)	40	60	0	100

Table.7.37 Cortex patterns of tabular scraper flakes from JF0106

JF0106	Total	Cortical	Partially Cortical	Total
Unbroken piece (N=8)	50	37.5	12.5	100
Distal fragments (N=1)	0	100	0	100

Table.7.38 Cortex patterns of tabular scraper flakes from JF0153.

JF0153	Total	Cortical	Partially Cortical	Total
Unbroken piece (N=11)	36.36	54.54	9.09	100
Proximal fragments (N=1)	100	0	0	100
Distal fragments (N=5)	60	40	0	100
Others (N=1)	100	0	0	100

-Attributes of tabular scrapers from JF0106 and JF0153-

Table.7.39 Attributes of four tabular scrapers from JF0106 and JF0153

Tabular Scrapers (N=4)	1	2	3	4
Figures	fig.6.22:1	–	fig.6.23:1	–
Sites	JF0106	JF0106	JF0153	JF0153
Broken	Unbroken	Unbroken	Unbroken	Broken
Shape	Side struck Fan	Side struck fan	Side struck fan	Unknown
Incision	Absent	Absent	Absent	Absent
Length (cm)	8.6	9.8	9.5	9.1
Width (cm)	13.6	11.3	11.5	9.5
Thickness (cm)	1.5	2.8	2.5	2.9
L/W	0.6	0.9	0.8	–
W/T	8.9	4.1	4.7	–
Butt depth	0.6	5.8	2.4	8.3
Butt width	0.5	2.8	3.8	2.3
Butt type	Weathered	Plain	Plain	Weathered
Angle de Chasse	78	72	64	84
Flaking Angle	102	108	116	96
Profile	Convex	Convex	Straight	–
Termination	Feather	Feather	Feather	Feather
Cortex	Total	Partially	Total	Total
Retouch angle	Semi-abrupt	Abrupt	Abrupt	Semi-abrupt
Shapes of retouch	Scaled	Scaled	Semi-parallel	Scaled
Degree of retouch	Short	Short	Short	Short
Positions of retouch	Dorsal	Dorsal	Dorsal	Dorsal
Locations of retouch	Distal,Left, Right,Proximal	Distal	Distal, Right	–

Chapter 8 TABULAR SCRAPER PRODUCTION, DISTRIBUTION AND CONSUMPTION IN THE CHALCOLITHIC AND EARLY BRONE AGE OUTSIDE THE JAFR BASIN

8.1. INTRODUCTION

While previous chapters discussed tabular scraper production sites in the Jafr Basin, Southern Jordan, this chapter will investigate tabular scraper production, distribution and consumption in the Southern Levant more widely. Firstly tabular scraper production sites in other areas will be reviewed. Secondly tabular scraper consumption sites in the Southern Levant will be examined. Then Chalcolithic and Early Bronze Age tabular scraper consumption sites in Southern Jordan will be discussed in detail separately.

This investigation will be helpful in answering several important questions about tabular scraper production in the Jafr Basin in particular 'who was engaged in tabular scraper production in the Jafr Basin?'; 'when did non-intensive tabular scraper production at Gurta Siyyata type sites start?'; 'when did intensive tabular scraper production with flint mining at Qa Abu Tulayha type sites begin?'; 'which areas imported tabular scrapers from the Jafr Basin?' in the next chapter.

8.2. TABULAR SCRAPER PRODUCTION SITES IN OTHER AREAS

Tabular scraper production sites are also known in the Sinai, Negev and East Jordan (Fig.8.1) (Baird 2001a, Carter 2001, S.A. Rosen 1997, Wasse and Rollefson 2005). However, most of the production sites were reported only briefly. Information about these sites such as the site size, intensity of production and their main products is very limited.

B. Kozloff noted the presence of a number of tabular scraper production sites in Wadi Gera and Wadi Themila on Gebel Egma in the Sinai (Kozloff 1972/73). However, no details of these production sites are reported.

Several tabular scraper production sites are also known in the Negev, which includes Har Qeren 15, Givat Barnea, Har Safun and Quseima (S.A. Rosen 1983b, S.A. Rosen 1997). Har Qeren 15 was excavated and reported in detail by S.A. Rosen and N. Goring-Morris (S.A. Rosen 1997, S.A. Rosen and Goring-Morris in press). Har Qeren 15 is a small less labour intensive tabular scraper production sites without flint mining. The site is very similar in nature to small Gurta Siyyata type production sites in the Jafr Basin. Its size is less than 0.2 ha. Only a few dozen tabular scraper cores are present at the site. Tabular scraper production debris are scattered in low density at the site. There are only about 0.16 tabular scraper cores per 1 m². Eocene flint blocks, which were available from exposed outcrops on the surface, were used as raw material for tabular scraper production. The average size of tabular scraper cores at the site (14.4 cm×19.3 cm×9.2 cm) is slightly bigger than cores at JF0106, one of the Gurta Siyyata type sites in the Jafr Basin (12.7cm×16.7 cm×8 cm). Like Gurta Siyyata type sites in the Jafr Basin, careful platform preparation by faceting before blank removal was not common at the site. According to excavators, only 12 % of the tabular scraper cores show platform preparation by faceting (Fig.8.2:1). Plain platforms and probably weathered platforms are more common. Scars on tabular scraper cores hint that small side struck cortical flakes were typically flaked from cores (Fig.8.2:1). Judging from the published illustrations, the average size of the detached side struck cortical flakes was about 7 cm in length×11 cm in width. Information about the main products at the site is limited. However, given the scars on cores and less careful platform preparation at the site, it is likely that small side struck tabular scrapers were the main products at the site. One large end struck oval tabular scraper with a carefully faceted platform, whose size is 17 cm×12 cm×1.6 cm, was also reported from the site (Fig.8.2:2). It suggests that such large and long tabular scrapers could be produced occasionally even using flint blocks from the surface. However, mining fresh large nodules and careful knapping would have been necessary to produce a certain amount of such large and long tabular scrapers.

Several tabular scraper production sites are also known in East Jordan (Fig.8.1). One small Gurta Siyyata type tabular scraper production sites whose size is about 1 ha was discovered in Bayir by the Japanese surveys (See Chapter 5). The site of JF0126 is located on the east bank of Wadi Bayir. Tabular scraper production debris is scattered in low density over an area of 50 m×250 m. Small flint blocks on the surface were used as raw material. There are only less than

0.5 tabular scraper cores per 1 m^2. It is estimated that about 5000 tabular scraper cores are present at the site. The site was probably formed in multiple episodes. Small side struck fan shaped tabular scrapers, whose average size is about 7 cm (in length)×9 cm (in width), were the main products at the site.

Other tabular scraper production sites were also discovered recently in Wadi ar Ruwayshid in East Jordan (Carter 2001). However, information in them is very limited.

D. Baird also reported one tabular scraper production site in al-Jilat. According to D. Baird, tabular scraper cores are extensively scattered at the site. This site is probably a less intensive tabular scraper production site without flint mining. Flint blocks on the surface were selected as raw material (Baird 2001a). However, information about the site is still limited.

A few tabular scraper production sites were also discovered in Wadi Hudruj near the border between Jordan and Saudi Arabia in East Jordan (Wasse and Rollefson 2005). The site of Wadi Hudruj 7 is probably an intermediate type between Qa Abu Tulayha type and Gurta Siyyata type. At the site, large flint nodules were available on the surface even without flint mining. These large nodules from the surface were used as raw material for tabular scraper production. Some cores reach 50 cm in length. Tabular scraper production debris is concentrated in considerably density. Cores form a few core clusters at the site. However, the amount of large flint nodules available from the surface was limited at the site. Only about 100 tabular scraper cores were present at the site while at even the smallest Qa Abu Tulayha tabular scraper production site, JF0216, about 2000 tabular scraper cores are present. Flint mining was necessary to acquire a significant quantity of large fresh nodules. There is no information about the final products at the site. However, given the large size of cores, there is a possibility that large end struck oval/elongated tabular scarpers were produced at the site in far smaller scale than at Qa Abu Tulayha type sites in the Jafr Basin.

Wadi Judhayat Hudruj 2 is a small less intensive tabular scraper production site without flint mines. Its size is about 40 m×40 m. Tabular scraper cores are scattered in low density at the site. Small flint blocks on the surface were used as raw material for tabular scraper production. Several tabular scraper cores were also collected at Wadi Hudruj 3. Wadi Judhayat Hurduj 2 and Wadi Hudruj 3 are similar in nature to small Gurta Siyyata type production sites in the Jafr Basin. They probably produced small side struck fan shaped tabular scrapers using small flint blocks on the surface like Gurta Siyyata type sites in the Jafr Basin.

As described above, tabular scraper production sites discovered in the Sinai, Negev and East Jordan are similar in nature to Gurta Siyyata type production sites in the Jafr Basin. At these sites, flint blocks from the surface were used as raw material for tabular scraper production. Only limited efforts were made to acquire raw material at these sites. Currently intensive tabular scraper production sites with flint mines are known only in the Jafr Basin. However, given the small number of archaeological projects and surveys in the Sinai, Negev and East Jordan, future surveys would discover tabular scraper production sites with intensive flint mining in these areas.

Tabular scraper production sites in the Southern Levant are usually located in Eocene flint sources (Fig.8.1). Eocene flint is the highest quality flint in the Southern Levant and restricted in its distribution. This flint is the most preferred as raw material for tabular scraper production. However, some tabular scraper production sites such as JF0126 (Bayir) and Jilat are located in Late Cretaceous flint sources. Late Cretaceous flint is somewhat inferior to Eocene flint in quality but the second best flint in the Southern Levant. This second class flint was sometimes used as raw material for tabular scraper production.

It is noteworthy that no tabular scraper production sites are known in the Mediterranean area although several Eocene flint sources, which are suitable for tabular scraper production, are present in this area. Large Eocene flint nodules are available in the Shephela, Samaria, northern Galilee and Gilead (S.A. Rosen 1997) (Fig.8.1). In fact, some of these sources in the Mediterranean area were used by specialized knappers for Canaanean blade production in the Early Bronze Age (S.A. Rosen 1997).

8.3. TABULAR SCRAPER CONSUMPTION SITES IN THE SOUTHERN LEVANT

8.3.1. Tabular scraper consumption sites in the Southern Levant during the Pottery Neolithic

Tabular scrapers had already appeared in the Yarmukian period. However, tabular scrapers were extremely rare in Yarmukian sedentary farming settlements. Only a few sites such as Shaar Hagolan and Jebel Abu Thawwab have yielded a few dubious tabular scrapers. They may be scrapers on normal thick cortical flakes (Fig.8.3:1-3) (S.A. Rosen 1997, Stekelis 1972, Wada 2001). They are round and end struck oval tabular scrapers. They are usually small, less than 9 cm in length. However their small number hinders generalization. Bifacial scrapers/knives made on cortical thin tabular flint are more commonly used in Pottery Neolithic sedentary farming settlements. They are often called 'proto-tabular scrapers' or 'tile knives' and may be the precursors of tabular scrapers (Gopher 1995).

In contrast, tabular scrapers are often found in pastoral nomadic camp sites in the steppes and deserts of eastern Jordan in the Yarmukian period (Late Neolithic). In particular, those of Qasr Burqu 27 and Dhuweila were reported in detail (McCartney 1992, McCartney and Betts 1998) (Fig.8.3:4-8). It is noteworthy that the proportion of tabular scrapers in retouched stone tools was very low even at these sites. While tabular scrapers usually account for nearly 20% of retouched tools at desert sites during the Chalcolithic and Early Bronze Age, they make up only 2% at Qasr Burqu 27 and Dhuweila (Table.8.1). Small side struck fan shaped tabular scrapers were the most common type at these sites. Their average size is about 7.5 cm in length ×8.6 cm in width. They usually have plain or weathered platforms rather than carefully faceted platforms (Fig.8.3:7-8). Their main transverse edges were formed at distal ends with dorsal retouch (Fig,8.3:4,7,8). Bulb removal with ventral invasive retouch cannot be observed. Interestingly some tabular scrapers from Dhuweila were made on thermal flakes (Fig.8.3:5-6). The thermal flakes were probably flaked by natural process such as strong heat and selected as blanks. Interestingly even tabular scrapers on thermal flakes were retouched into fan shapes. Scrapers/knives made on cortical thin tabular flint are also common in these pastoral nomadic camp sites.

8.3.2. Tabular scraper consumption sites in the Southern Levant during the Chalcolithic

Tabular scrapers became more common during the Chalcolithic. In particular, tabular scrapers increased radically in pastoral nomadic camp sites in deserts. Tabular scrapers are over 20% of retouched stone tools in pastoral nomadic camp sites such as Timnian sites, Jebel el Jill and Jebel Queisa in Wadi Hisma in Southern Jordan (Table.8.1, Fig.8.4) (Henry 1995).

Most Chalcolithic sedentary farming settlements in the Mediterranean zone also yield tabular scrapers. However, the proportion of tabular scrapers in retouched tools at these sites was still very low, usually less than 3% (Table.8.1, Fig.8.4).

Tabular scrapers were over 5% of retouched tools at Arad, Ghassul, Qatif, Site B and Site A and over 10% at Abu Snesleh (Epstein 1984, Kerner, Bernbeck, Lamprichs and Lehmann 1992, Koeppel 1940, Lehmann, Lamprichs, Kerner and Bernbeck 1991, Roshwalb 1981, Schick 1978,). But these values are problematic. At Arad, the total sample size (N=14) is small. Furthermore the recovery technique at Arad was rudimentary and only diagnostic tools were selectively collected without sieving (Schick 1978). These factors probably overestimate the actual proportion of tabular scrapers. According to R. Koeppel, tabular scrapers are about 9.7 % of retouched tools at Ghassul (Koeppel 1940). But this value had the same problem as Arad. Recent new excavations at Ghassul do not provide any data concerning percentages of retouched tools. The data from Qatif, Site B, Site A and Abu Snesleh are also problematic because these sites are not typical Chalcolithic sedentary farming villages. The first three sites (and Site M, Site D) are small temporary camp sites without permanent structures (Epstein 1984, Roshwalb 1981). Because of specialized activities at these camps, tabular scrapers occur more frequently than at Chalcolithic sedentary farming villages. Abu Snesleh is a small hamlet (0.3ha) on the fringe of steppe. It is often argued that animal herding was more important than cultivation at the site (Bourke 2001, Lehmann, Lamprichs, Kerner and Bernbeck 1991, Kerner, Bernbeck, Lamprichs and Lehmann 1992).

Therefore tabular scrapers are usually less than 3 % of retouched tools at typical Chalcolithic sedentary farming settlements. Only at a few sites such as Tel Tsaf and Tel Fendi, tabular scrapers occur at over 5% (Table.8.1, Fig.8.4) (Blackham, Fisher and Lasby 1997, Blackham, Fisher and Lasby 1998, Gopher 1988/89).

Chalcolithic tabular scrapers were usually excavated from domestic contexts. It is generally accepted that tabular scrapers were probably multi-purpose knives for butchering, hideworking, wool shearing and so on (Henry 1995, S.A. Rosen 1997). It is noteworthy that some tabular scrapers from Abu Hamid and Ghassul have sickle gloss along their edges (Dollufus and Kafafi

1989). This suggests that tabular scrapers were often used as reaping knives at sedentary farming villages.

Some Chalcolithic tabular scrapers were excavated from mortuary and ritual contexts. One tabular scraper was excavated from a burial at Shiqmim (Levy and Rosen 1987). The other tabular scraper was discovered under one ossuary at the ossuary cave of Horvat Castra (Van den Brink et al 2004). They were probably burial goods. Several tabular scrapers were also excavated from the temple of Gilat (Levy 2006). They were probably used as ritual sacrifice knives.

Chalcolithic tabular scrapers were typically made on side struck blanks. The author analyzed 107 Chalcolithic tabular scrapers using published illustration from site reports (Table.8.2, Table.8.3, Fig.8.5, Fig.8.6). About 60% of the Chalcolithic tabular scrapers were made on side struck blanks. They include side struck fan shaped tabular scrapers (Fig.8.8.2), side struck lentoid tabular scrapers (Fig.8.8.1), side struck crescent tabular scrapers (Fig.8.10:1-2) and side struck oval tabular scrapers (Fig.8.8.3). They usually have transverse main edges at their distal ends (Fig.8.8:1-3). Only 30 % of tabular scrapers were made on end struck blanks (Fig.8.5). In addition, even tabular scrapers made on end struck blanks conform to tabular scrapers made on side struck blanks morphologically (Fig.8.8:4-6). For example, fan scrapers made on end struck blanks (end struck fan shaped tabular scrapers) (Fig.8.8.5) from Ghassul have their main edges along one sides and they are fan shaped (Koeppel 1940, Henessy 1989). They apparently conform to side struck fan shaped tabular scrapers (Fig.8.8.2). At Golan sites, crescent or lentoid shaped tabular scrapers made on end struck blanks (end struck crescent and lentoid shaped tabular scrapers) (Fig.8.8.4) cannot be distinguished from side struck crescent or lentoid tabular scrapers (Fig.8.8.1) (Noy 1998). End struck oval tabular scrapers from Gilat (end struck oval type II tabular scrapers on Fig.8.6) (Fig.8.8.6) are different from normal end struck oval tabular scrapers on Fig.8.9, Fig.8.18, Fig.8.19, and Fig.8.20 (Rowan 2006). They have their main retouched edges along one sides and the ventral faces of the opposite sides were thinned with invasive retouch. These tabular scrapers conform to the shapes of side struck oval tabular scrapers (Fig.8.8.3). These end struck tabular scrapers (end struck fan, end struck lentoid, end struck crescent and end struck oval II on Fig.8.6 and Fig.8.7) suggest that side struck tabular scrapers were the basic forms in the Chalcolithic and end struck blanks were often retouched imitating side struck tabular scrapers (Fig.8.8).

Besides these end struck tabular scrapers conforming to side struck tabular scrapers, only a small number of end struck oval and elongated tabular scrapers are known from the Chalcolithic sites (Fig.8.6, Fig.8.9). They form only 17% of the analyzed samples. In particular, large end struck oval and elongated tabular scrapers exceeding 12 cm in length are very rare (Fig.8.7). Only Shiqmim yielded two large end struck elongated tabular scrapers over 12 cm in length (Fig.8.9:1-2) (Levy and S.A. Rosen 1987).

Chalcolithic tabular scrapers also show strong regional variation. This thesis will take several major sites as examples to explore regional variation.

- Tabular scrapers at Golan sites.

Tabular scrapers from Golan sites have very distinctive forms (Noy 1998). They are usually crescent or lentoid shaped (Fig.8.10). Non-local high quality Eocene flint was used as raw material. Both crescent and lentoid shaped tabular scrapers are usually made on side struck blanks. Their average size is about 6.6 cm in length ×10.5 cm in width. It is noteworthy that non-cortical blanks rather than cortical blanks were preferred (Fig.8.10: 1, 2, 4, 5) although some are also made on cortical blanks. Crescent shaped tabular scrapers have curved distal ends and slightly curved or nearly straight proximal ends (Fig.8.10:1, 2) while lentoid shaped tabular scrapers have curved proximal ends (Fig.7.8: 3-5). Both crescent and lentoid shaped tabular scrapers are bilaterally symmetrical and have sharp angles along both sides. Bulbs were usually removed with ventral invasive retouch. Some tabular scrapers were drilled in the centre (Fig.8.10: 5).

Morphologically similar tabular scrapers are known from other sites (Fig.8.11). Abu Hamid, Delhamiya, Munhata and Byblos yielded tabular scrapers identical to the Golan types (Gopher 1989, Dunand 1973, Dollufus and Kafafi 1989, Stekelis 1967). Horbat Castra and Neve Ur yielded morphologically similar tabular scrapers to Golan crescent shaped tabular scrapers (Fig.8.11) (Perrot, Zoriand Reich 1967, Van den Vrink 2004, Horwitz, Khalaily, Liphschitz and Nagar 2004).

Golan type tabular scrapers are distributed mainly in Northern Israel, Northern Jordan and Lebanon, from Abu Hamid in the south to Byblos in the north (Fig.8.4). However, currently, no tabular scrapers production centres of Golan type tabular scrapers are known in the Southern Levant. Future research would discover them probably in northeastern Jordan.

- Ghassul type tabular scrapers

Ghassul type tabular scrapers are classical 'fan scrapers' (Hennessy 1969, Hennessy 1989, Koeppel 1940) (Fig.8.8:2.5, Fig.8.12). Fan shaped tabular scrapers are the main type of tabular scrapers at Ghassul. Their average size is about 6.5 cm in length ×9.2 cm in width (Koeppel 1940). They were usually transverse scrapers and made on small side struck cortical blanks. They were formed roughly into fan shapes with dorsal retouch. Bulbs and striking platforms were usually left intact. Morphologically similar tabular scrapers are known from Umm Qatafa, Tell Wadi Feinan and Wadi Hisma Timnian sites (Henry 1995, Najjar 1992, Najjar, Abu Dayya, Suleiman, Weisgerber and Hauptmann 1990, Neuville 1934, Perrot 1992).

As will be described in Chapter 9, these tabular scrapers are very similar to the main products at Gurta Siyyata type sites in the Jafr Basin in their size and morphology.

- Tabular scrapers from Gilat

Tabular scrapers from Northern Negev Chalcolithic sites show strong morphological variation even within the Northern Negev. This variation may be due partially to chronological differences between sites. Tabular scrapers from Gilat are reported by Y. M. Rowan (Fig.8.13) (Rowan

2006). According to Rowan, fan shaped tabular scrapers are rare at the site. Side struck oval tabular scrapers are the most common type at the site (Fig.8.13:2,3). The average size is about 6.3 cm in length ×7.1 cm width. Small side struck cortical blanks were usually preferred as blanks. They usually have transverse main edges at their distal ends. Bulbs were usually removed with ventral thinning retouch (Fig.8.13: 1, 2, 3).

- Tabular scrapers from Site A, Nahal Besor

Chalcolithic assemblages from Nahal Besor (Wadi Ghazzeh) sites were also reported in detail by A. Roshwalb (Roshwalb 1981). Site A yielded distinctive tabular scrapers. Unlike Gilat, fan shaped tabular scrapers are common at the site. Their average size is about 8.8 cm in length and 9.5 cm in width. Three types of fan shaped tabular scrapers are known from the site. The main type (N=16) are fan shaped tabular scrapers on side struck blanks (Fig.8.13:4). Unlike fan shaped tabular scrapers from Ghassul, they are bilaterally symmetrical and their bulbs and striking platforms were often removed with ventral invasive retouch and proximal dorsal retouch. They have their transverse main edges at their distal ends. The second type (N=11) are fan shaped tabular scrapers made on end struck blanks (Fig.8.13:5). They usually have their main edges along one side. They apparently imitated the first type. The third type (N=4) are bifacial fan shaped tabular scrapers. They were retouched with bifacial invasive retouch into fan shapes.

Tabular scrapers from other Northern Negev sites such as Shiqmim, Horvat Beter and Grar were also reported (Gilead,, Hershman and Marder 1995, Levy and S. A. Rosen 1987, S.A.

Rosen 1987, S.A. Rosen and Eldar 1993). Although the small number of tabular scrapers from each site hinders generalization, they also show regional variation within the Negev. For example, Shiqmim yielded two large end struck elongated tabular scrapers exceeding 12 cm in length (Fig.8.9:1, 2). As already discussed, this type of tabular scarpers is extremely rare in the Chalcolithic.

8.3.3. Tabular scraper consumption sites in the Southern Levant during the Early Bronze Age

The proportion of tabular scrapers in retouched tools did not change at pastoral nomadic camp sites from the Chalcolithic to the Early Bronze Age. Tabular scrapers are from 20 to 30 % of retouched tools at Nahal Mitnan, Har Horsha and Ramat Matred in the Negev (Table.8.1, Fig.8.4, Fig.8.14) (Haiman 1994, S.A. Rosen 1991, S.A. Rosen 1993).

In contrast to steppe and desert sites, the number of tabular scrapers increased radically in sedentary settlements in the Early Bronze Age (Table.8.1, Fig.8.4, Fig.8.14).

The high proportion of tabular scrapers at En Besor (15%), Yarmuth (16%), Arad (27%) and Tell el Handaquq (30%) is problematic. The actual values must be much lower. At En Besor, Yarmuth and Arad, recovery techniques were rudimentary and only the major diagnostic tools were probably collected without sieving (Gophna and Friedmann 1995, S.A. Rosen 1988b, Schick 1978). The total sample size of stone tools from Tell el Handaquq is only ten (Mabry et al 1996). Therefore the high proportion there may be caused by the small sample.

However even sites, where sieving was conducted and every artifact was carefully collected, show high proportion of tabular scrapers. The percentage of tabular scrapers among retouched tools is about 10 % at Tel Teo, 12% at Tel Beth Yerah, 9% at Tel Get Hefer and 9% at Tel Iktanu (Bankirer 2006, Bankier and Marder 2003, Gopher and S.A. Rosen 2001, McCartney 1996). The proportion of tabular scrapers among retouched tools in the Early Bronze Age is three or four times larger than the Chalcolithic. It is interesting that tabular scrapers increased in farming villages and towns in the Early Bronze Age while they increased in steppe/desert sites in the preceding Chalcolithic.

Most Early Bronze Age tabular scrapers were excavated from domestic contexts. Tabular scrapers are presemued to have been used as multipurpose knives in domestic contexts. However some tabular scrapers were discovered from mortuary contexts. At JF0208 in the Jafr Basin, several tabular scrapers were excavated from Early Bronze Age cairns (See Chapter 5). They were probably deposited as burial goods. Tabular scrapers were also discovered in ritual contexts. Tabular scrapers were recovered from temples at Megiddo and Bab edh Dhra. An open air shrine in the Uvda Valley, Negev also yielded a tabular scraper. Tabular scrapers were probably used as sacrifice knives in ritual contexts.

The most important characteristic of the Early Bronze Age tabular scrapers is that most tabular scrapers were made on end struck blanks. The author analyzed 233 Early Bronze Age tabular scrapers using illustrations from site reports (Table.8.2). Over 70 % of EB tabular scrapers were made on end struck blanks (Fig.8.5). Furthermore it is noteworthy that end struck tabular scrapers such as end struck lentoid, end struck crescent and end struck oval type II, which probably imitated side struck tabular scrapers, also disappeared (Fig.8.6). Fig.8.16 and Fig.8.17 clearly show that these changes occurred all over the Southern Levant. End struck tabular scrapers became more important than side struck tabular scrapers in the Early Bronze Age.

While end struck oval and elongated tabular scrapers were uncommon during the Chalcolithic, they became the main types of tabular scrapers in the Early Bronze Age (Fig.8.6, Fig.8.15, Fig.8.17). Furthermore it is noteworthy that large end struck oval and elongated tabular scrapers over 12 cm in length became common all over the Southern Levant during the Early Bronze Age. A number of sites such as Hujayrat al Ghuzlan, Tall al Magass, Fidan 4, En Besor, Sabra North (one of Petra EB sites), Horbat Hani, Jebel Abu Thawwab, Tell Abu Kharaz, Tell Get Hefer and Jawa yielded large end struck oval and elongated tabular scrapers over 12 cm in length (Fig.8.15, Fig.8.18, Fig.8.19) (Bankier and Marder 2003, Betts 1991, Gophna and Friedmann 1995, Hering 2002a, Herling 2002b, Khalaily 2003, Libder and Genz 2000, Linder, Hubner and Genz 2001, Wada 2001). Broken end struck oval and elongated tabular scrapers from other sites such as Lower Horbat Illin, Ashqelon Afiridar and Tell Erani were probably over 12 cm in length before breakage (Fig.8.20) (Gal 2004, Kempinski and Gilead 1991, Marder, Braun and Milevski 1995, S.A. Rosen 1988c).

While Chalcolithic side struck tabular scrapers show morphological regional variation, this regional variation disappeared in the Early Bronze Age. The Early Bronze Age end struck oval and elongated tabular scrapers were almost the same morphologically at every site. They were retouched with dorsal retouch. Retouch is usually short and scaled or semi-parallel. These tabular scrapers are usually bilaterally symmetrical (Fig.8.18, Fig.8.19, Fig.8.20). They usually have platforms intact. Bulb thinning with ventral invasive retouch is rarely observed.

Early Bronze Age sites also yield side struck tabular scrapers (Fig.8.5, Fig.8.6, Fig.8.15, Fig.8.16, Fig.8.17, Fig.8.21). However, the Chalcolithic Golan type and Negev type side struck tabular scrapers disappeared in the Early Bronze Age. Ghassul type side struck fan shaped tabular scrapers became typical side struck tabular scrapers at Early Bronze Age sites in the Southern Levant. They were shaped roughly into fans with dorsal retouch. They have their transverse main edges at their distal ends. The retouch is usually short and semi parallel or scaled. Their platforms were usually left intact. Bulb thinning by ventral invasive retouch is rarely observed.

It is also noteworthy that Early Bronze Age tabular scrapers were more frequently broken and reused as other tools such as borers than Chalcolithic tabular scrapers (Fig.8.22).

Incised marks are often observed on the cortex of Early Bronze Age tabular scrapers while no Chalcolthic tabular scrapers have incised marks on their cortex. Tabular scrapers with incised marks are known from several sedentary settlements such as Jawa, Qiryat 'Aya, Tell esh Shuna North, Abu Kharaz, Jericho, Lower Horbat Illin, Yarmuth, Bab edh Dhra and Umm Saysaban (one of Petra EB sites). Given that no incised marks are observed in tabular scraper production sites in the Jafr Basin, it is likely that the marks were incised after acquisition by villagers at the sedentary settlements.

8.4. TABULAR SCRAPER CONSUMPTION SITES IN SOUTHERN JORDAN

Unlike other regions, the Chalcolithic period in Southern Jordan remains unknown because of limited excavations. Southern Jordanian Chalcolithic stone tool assemblages are reported only from Wadi Hisma sites and Tell Wadi Faynan (Fig.8.23, Fig.8.24).

Several Timnian sites in Wadi Hisma such as Jebel el Jill and Jebel Queisa were excavated by D. Henry (Henry 1985, Henry 1995). Timnian sites are characterized by pit-houses and animal pens. These sites are interpreted as pastoral nomadic camp sites. Tabular scrapers are one of the major tools in Timnian sites and usually occur as over 20% in retouched tools (Table.8.1). Tabular scrapers from several Timnian sites were published altogether in one illustration without any context information by D. Henry (Henry 1995: 364) (Fig.8.23: 7-13). Radiocarbon data from the Timnian sites show that the Timnian sites spanned the Early Chalcolithic to the Early Bronze Age. Therefore the illustration probably includes some Early Bronze Age tabular scrapers along with Chalcolithic tabular scrapers. Small side struck fan shaped tabular scrapers are typical tabular scrapers at these sites (Fig.8.23: 8-11). Small cortical side struck blanks were preferred.

They were retouched with dorsal retouch. They have their main transverse edges at their distal ends (Fig.8.23: 8-11). No tabular scraper core is reported from these sites.

Tell Wadi Faynan (Feinan) is a Chalcolithic village located in the Faynan region. Three layers were identified at the site: the Roman, Late Chalcolithic (Ghassulian) and Middle Chalcolithic (Qatifian) (Gopher 1999, Najjar, Abu Dayya, Suleiman, Weisgerber and Hauptman 1990, Najjar 1992). Several tabular scrapers from surface collections and excavation were reported by the excavators (Fig.8.23:1-6, Fig.8.25). Non quantitative data for stone tools was reported. Like Timnian sites in the Wadi Hisma, small side struck fan shaped tabular scrapers are common (Fig.8.23:1, 2, 5, 6, Fig.8.24:2), although one non-cortical tabular scraper is exceptionally large and has a distinctive form (Fig.8.24:3). Small cortical side struck blanks were preferred. The fan shaped tabular scrapers have their main transverse edges at their distal ends. They were retouched with dorsal retouch. Retouch is usually short and its shape is semi-parallel or scaled. Bulb thinning is not observed. Striking platforms and bulbs were left intact. No tabular scraper core is reported from the site.

Currently the data from Chalcolithic tabular scrapers in Southern Jordan is limited. However it is likely that small side struck fan shaped tabular scrapers were the main tabular scraper type. They are usually small (Fig.8.20), their average size is about 5cm in length×7.5 cm in width (Table.8.5).

In contrast to the Chalcolithic, tabular scrapers were reported in detail from several Early

Bronze Age sites in Southern Jordan.

Fidan 4 is a small farming village in Wadi Fidan (Adams 1999). The site is dated to the Early EB I and Late EB I . Five radiocarbon dates were published by the excavators (Adams and Genz 1995): 3610-3375calBC (HD-16380), 3615-3380calBC (HD-16327), 3610-3365calBC (HD-13776), 3360-3165calBC (HD-16379), 3255-2920calBC (HD-16378). No quantitative data on stone tools was published. However, according to R. Adams, tabular scrapers form a high proportion of retouched tools. Tabular scrapers excavated from Fidan 4 are apparently different from Chalcolithic tabular scrapers. End struck oval and elongated tabular scrapers were typical tabular scrapers at the site (Fig.8.26:1, 2, 3, 4, 5, 7, 8) although fan shaped tabular scrapers were also reported (Fig.8.26:6). Furthermore the appearance of large oval and elongated tabular scrapers at the site is noteworthy. For example, the size of tabular scraper on Fig.8.26.4 is 17.2 cm in length×5.2 cm in width. Tabular scrapers from the site are usually retouched with dorsal retouch. Retouch is usually short and its shape is scaled or semi-parallel. Bulb thinning is not observed. They usually have carefully faceted platforms. No tabular scraper cores are reported from the site.

Hujayrat al Ghuazlan and Tall al Magass are small village sites located near Aqaba (Khalil, Eichmann and Schmidt 2003, Herling 2002a, Herling 2002b). They are dated to the transitional phase between the Late Chalcolithic and Early Bronze Age I . Radiocarbon dates show that they were occupied between 3900 BC and 3500 BC. No quantitative data on stone tools was published. Like Fidan 4, these sites yielded a number of large end struck oval and elongated tabular scrapers (Fig.8.27:1. 2, 9) along with small side struck fan shaped tabular scrapers (Fig.8.27:8, 11). Tabular scrapers were usually retouched with dorsal retouching. Bulbs and striking platforms were usually left intact. Tabular scrapers usually have carefully faceted platforms. It is noteworthy that several tabular scraper blanks were also discovered at Hujayrat al Ghuzlan. However no tabular scraper core is reported from the sites.

The site of Bab edh Dhra is located on the Jordanian side of the Dead Sea. During Late EB I, Bab edh Dhra was still a small farming village. But it developed into a fortified center in the Early Bronze Age II/III. The stone tool assemblage from the site was reported by. M. A. McConaughy (Fig.8.28) (McConaughy 2003). Tabular scrapers are about 7 % of retouched tools. The sample includes both side struck fan shaped tabular scrapers (Fig.8.28: 5, 6) and large end struck oval/elongated tabular scrapers (Fig.8.28: 1-4). They were usually retouched with dorsal retouch. They usually have carefully faceted platforms. Bulb thinning is rarely observed. Bulbs and striking platforms were usually left intact.

The author analyzed 16 Chalcolithic tabular scrapers and 112 Early Bronze Age tabular scrapers from Southern Jordanian sites using published illustrations from site reports (Table.8.1). The Chalcolithic tabular scrapers are from Tell Wadi Feinan and Wadi Hisma and the Early Bronze tabular scrapers are from Fidan 4, Hujayrat al Ghuzlan, Tall al Magass, Bab edh Dhra, Petra EB sites (Umm Saysaban, Jabal Shudayfah, Sabra North, As Sadeh) and Wadi Faynan 100.

Fig.8.29 and Fig.8.30 clearly shows that Chalcolithic small fan shaped tabular scrapers on side struck blanks were replaced by end struck oval and elongated tabular scrapers in the Early Bronze Age. Nearly 80 % of Early Bronze Age tabular scrapers were made on end struck blanks and over 70 % of Early Bronze Age tabular scrapers are end struck oval and elongated tabular scrapers. Fig.8.25 shows measurements of unbroken tabular scrapers. It also shows the shift from small side struck fan shaped tabular scrapers to large end struck oval and elongated tabular scrapers in the Early Bronze Age. The appearance of large end struck oval and elongated tabular scrapers in the Early Bronze Age sites is noteworthy (Fig,8.25).

8.5. SUMMARY

This chapter examined tabular scraper production and consumption in the Southern Levant more widely. The summary of this chapter will be listed below.

Other tabular scraper production sites in the Southern Levant

- Other tabular scraper production sites are known in the Negev, Sinai and East Jordan. However information about these sites is very limited.
- Currently tabular scraper production sites in other areas are similar in nature to Gurta Siyyata type sites in the Jafr Basin. They used flint blocks from the surface as raw material. However, future archaeological surveys will probably locate tabular scraper production sites with intensive flint mines in other areas.

- Tabular scraper production sites are usually located in Eocene flint sources. Some tabular scraper production sites are located in Late Cretaceous flint sources.
- No tabular scraper production sites are known in the Mediterranean area although the area has Eocene flint sources which suitable for tabular scraper production.

This chapter revealed various changes in tabular scraper consumption sites from the Late Neolithic to the Early Bronze Age in the Southern Levant and Southern Jordan. The main changes are listed below.

Changes from the Late Neolithic to the Early Bronze Age in the Southern Levant

- Tabular scrapers increased radically in pastoral nomadic camp sites in steppes and deserts during the Chalcolithic.
- Tabular scrapers increased radically in sedentary farming settlements during the Early Bronze Age (from Early Bronze Age I).
- During the Chalcolithic, side struck tabular scrapers are typical tabular scrapers. However end struck oval and elongated tabular scrapers predominate in the Early Bronze Age.
- Large end struck oval and elongated tabular scrapers over 12 cm in length appeared all over the Southern Levant in the Early Bronze Age while they were very rare in the Chalcolithic.
- In the Chalcolithic, regional variation in tabular scrapers is notable but this variation disappeared in the Early Bronze Age.

Changes from the Chalcolithic to the Early Bronze Age in Southern Jordan

- While Chalcolithic tabular scrapers in Southern Jordan are characterized by small side struck fan shaped tabular scrapers, end struck oval and elongated tabular scrapers became typical tabular scrapers in the Early Bronze Age.
- Large end struck oval and elongated tabular scrapers appeared in the Early Bronze Age sites in Southern Jordan.

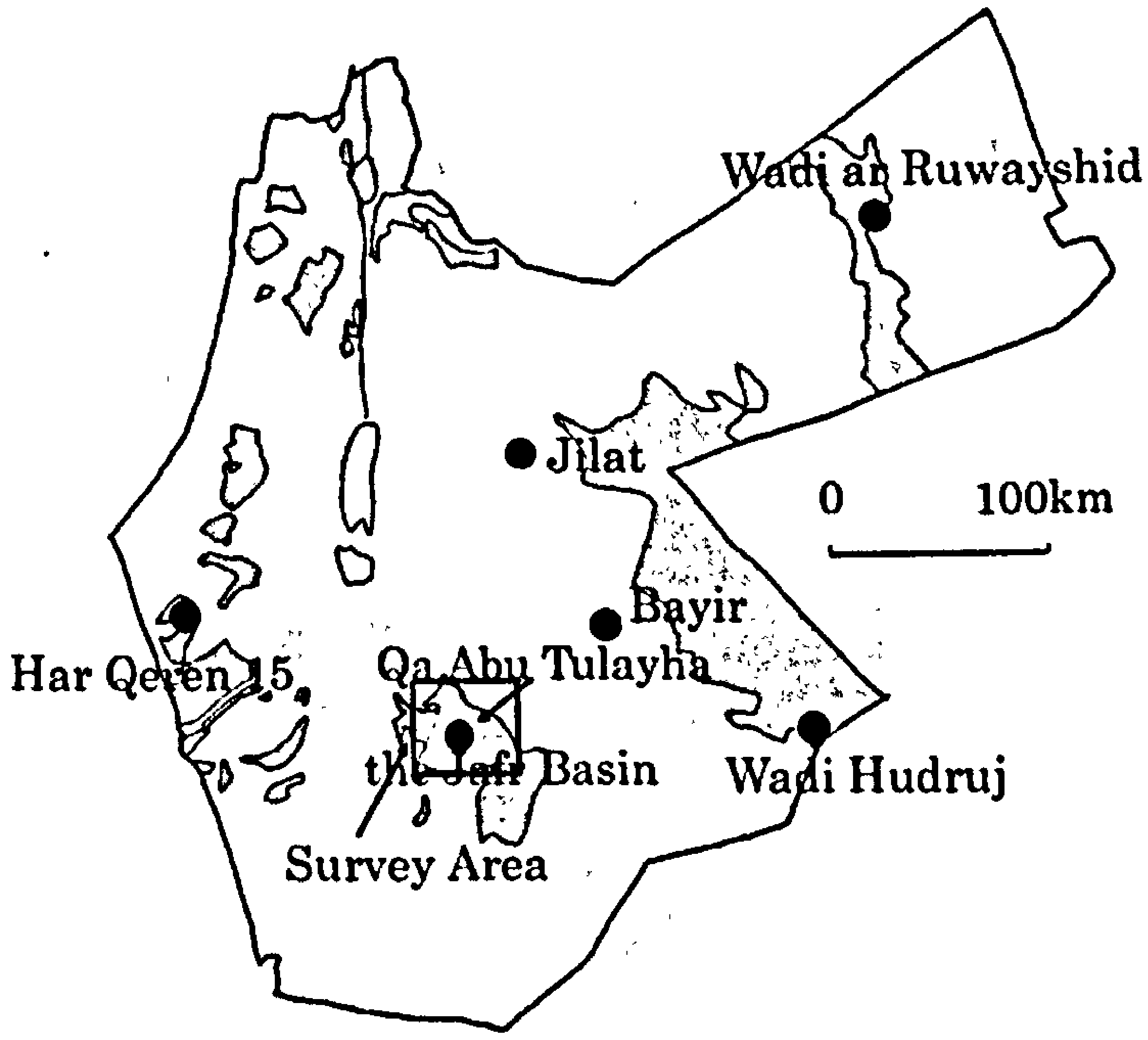


Fig.8.1 Eocene flint sources and tabular scraper production sites in the Southern Levant.

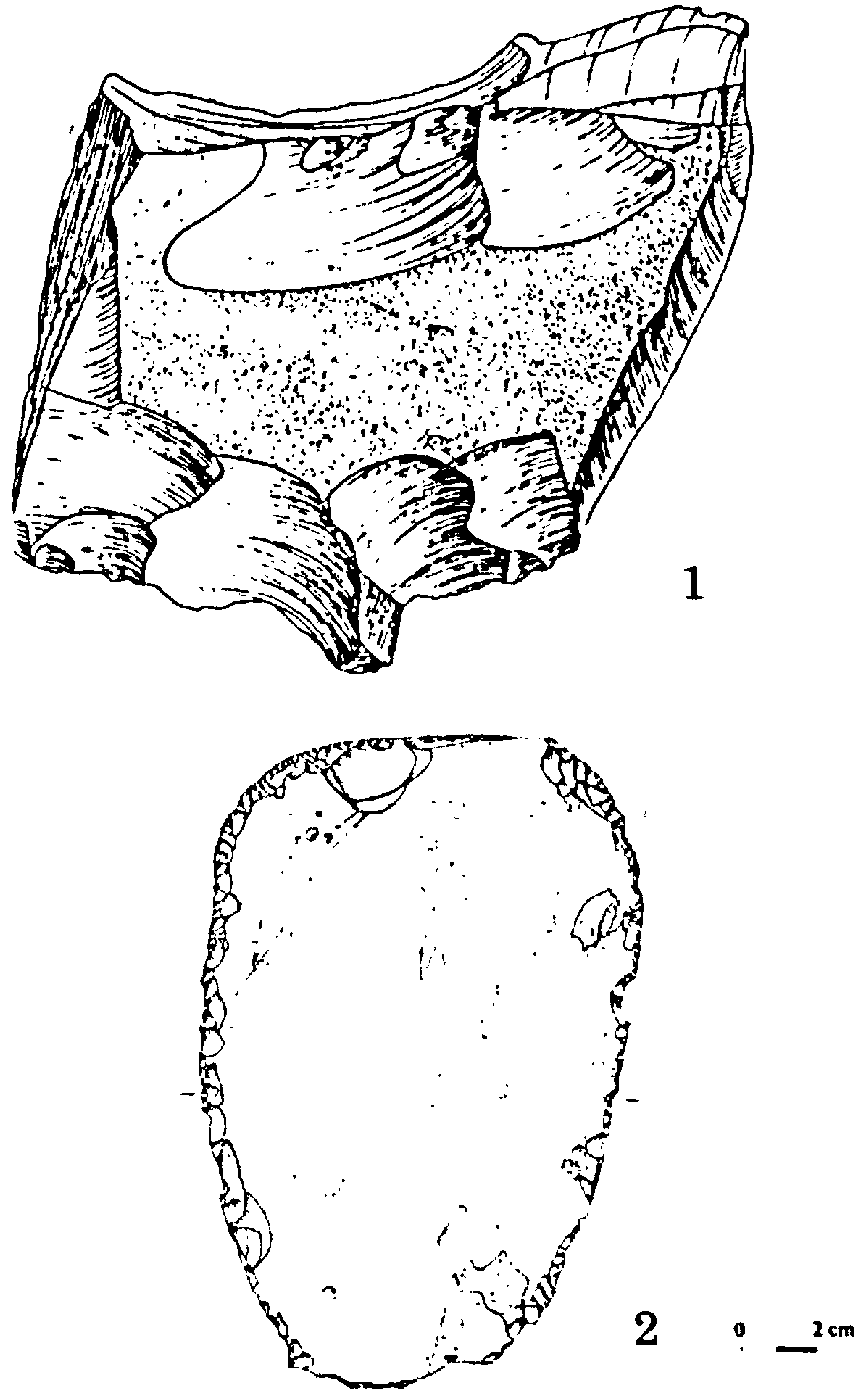


Fig.8.2 Tabular scraper core and tabular scraper from Har Qeren 15 (from S.A. Rosen 1997).

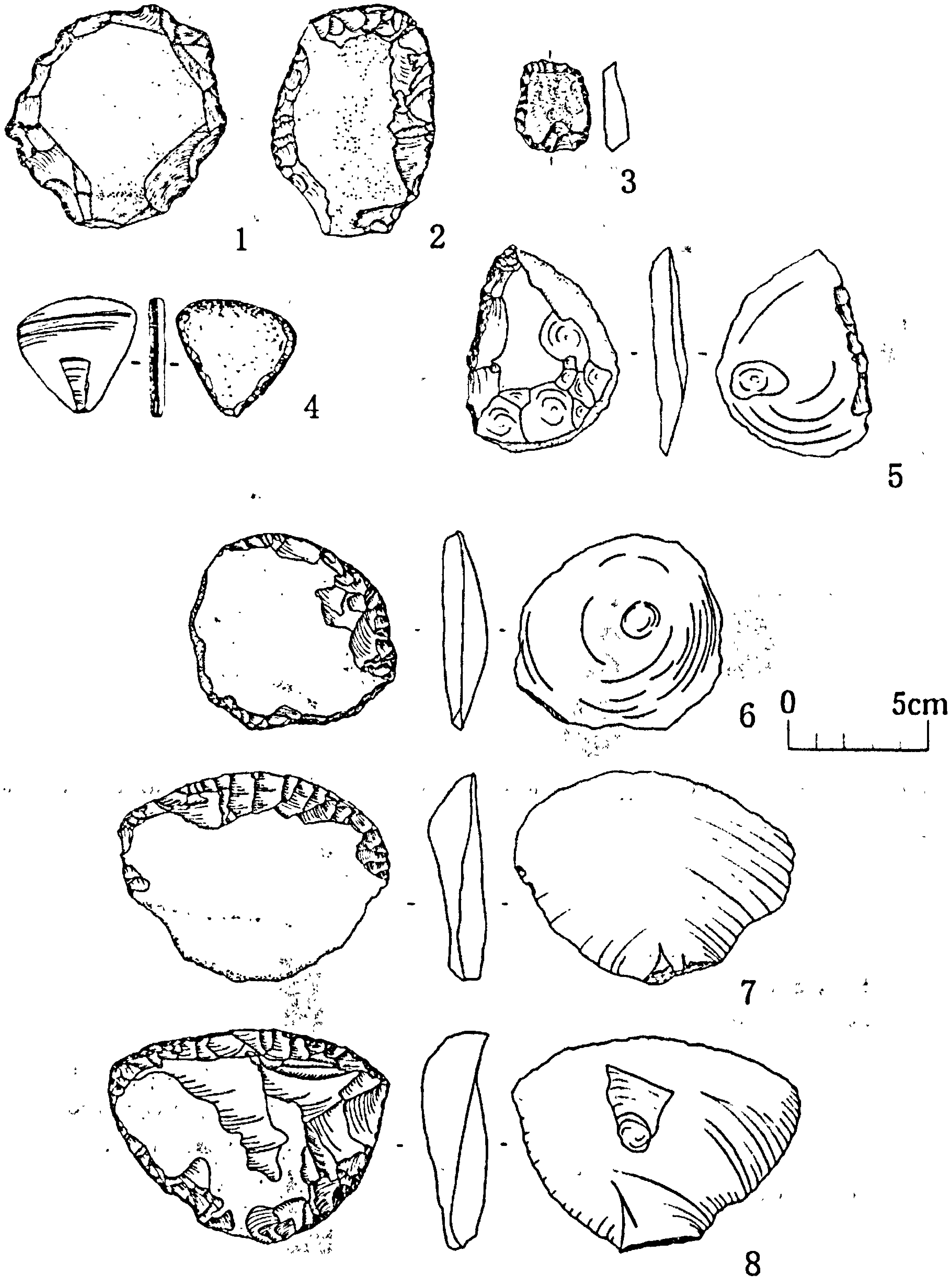


Fig.8.3 Tabular scrapers from the Pottery Neolithic sites.

1-2: Shaar Hagolan (Stekelis 1972), 3: Jebel Abu Thawwab (Wada 2001), 4: Qasr Burqu 27 (McCartney 1992), 6-8: Dhuweila (McCartney and Betts 1998).

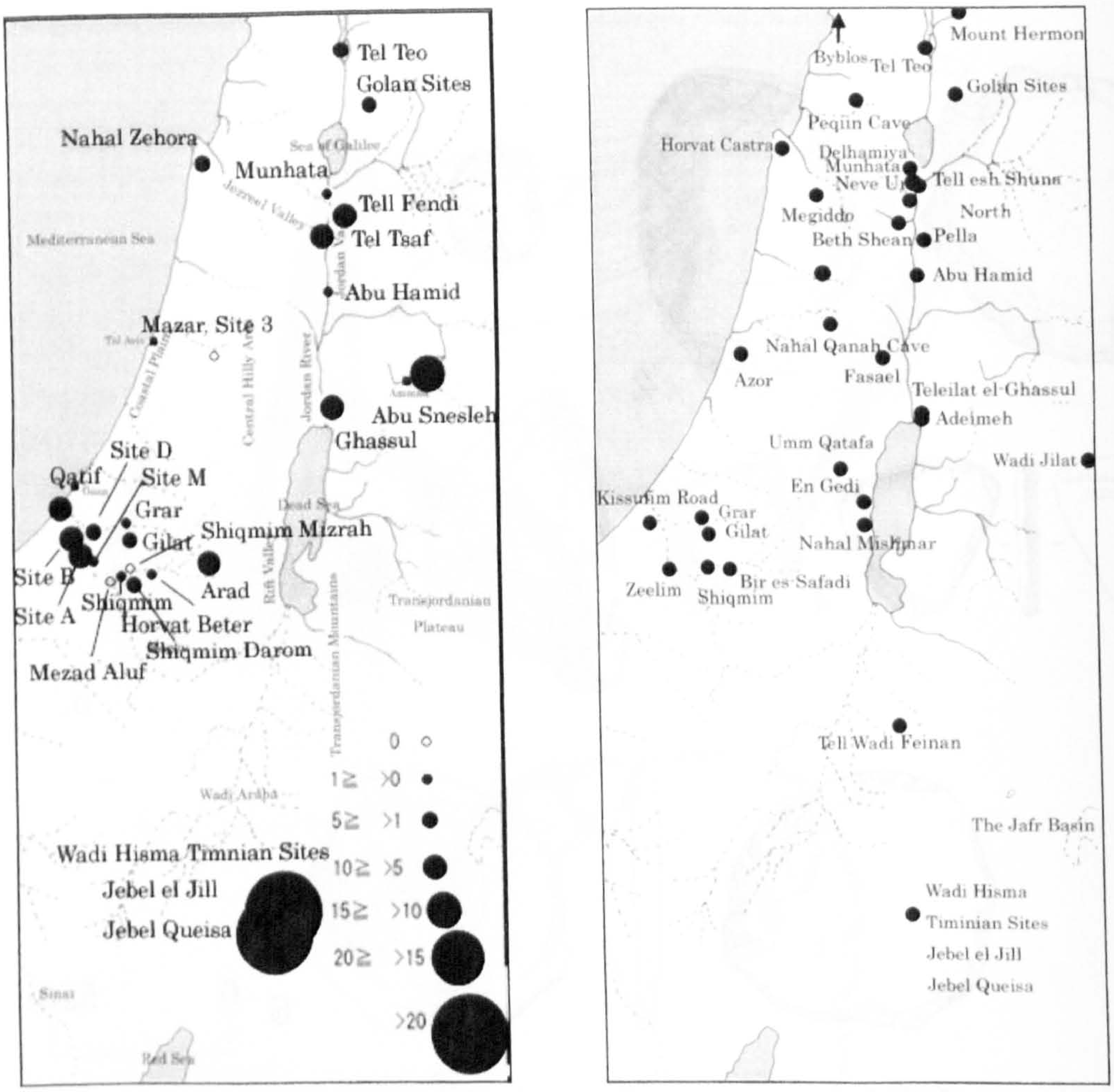


Fig.8.4 Percentages of tabular scrapers in stone tools in the Chalcolithic and major Chalcolithic sites.

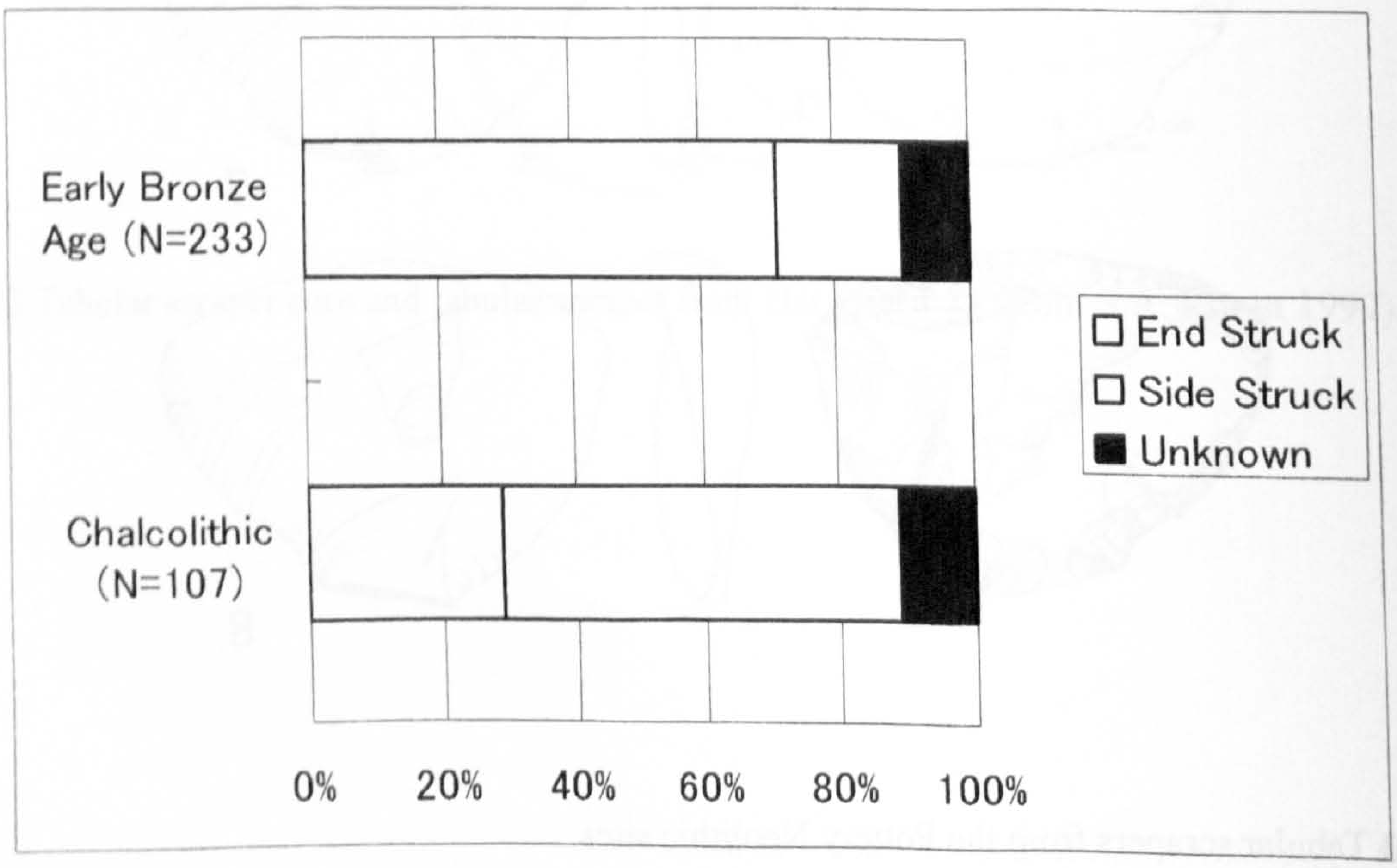


Fig.8.5 Shapes of original blanks of tabular scrapers from the Chalcolithic and Early Bronze Age sites in the Southern Levant.

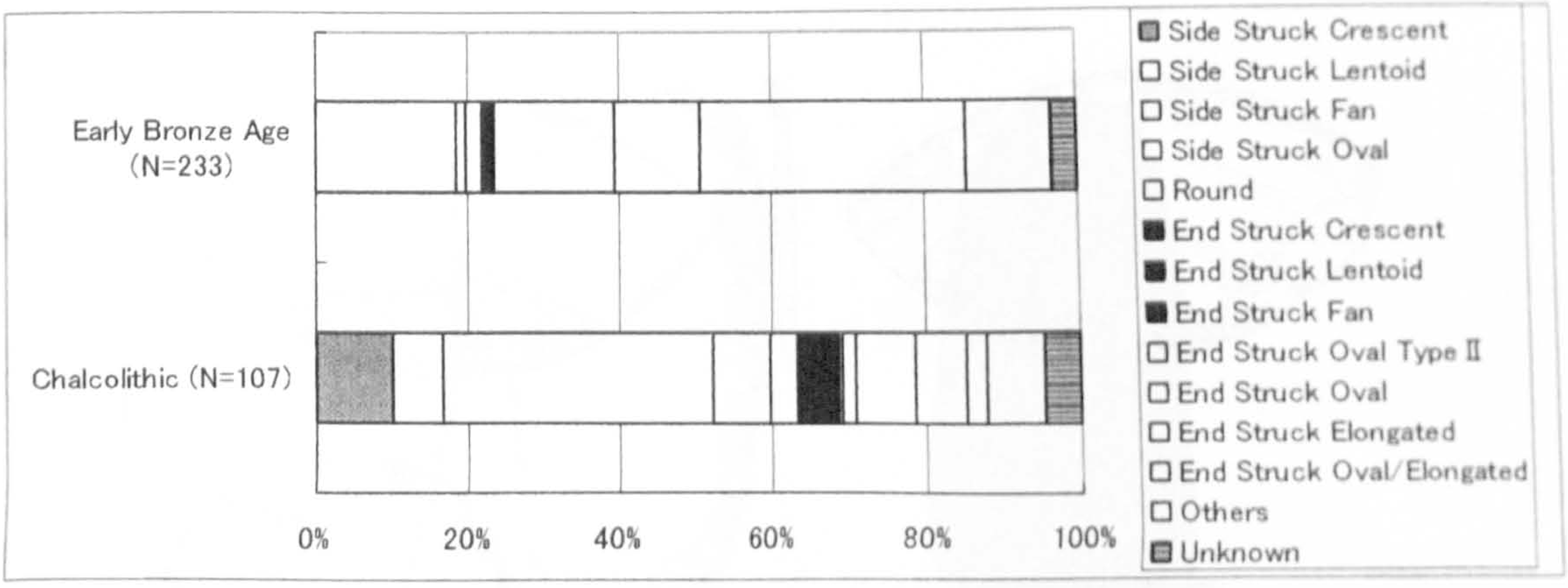


Fig.8.6 Shapes of tabular scrapers from the Chalcolithic and Early Bronze Age sites in the Southern Levant.

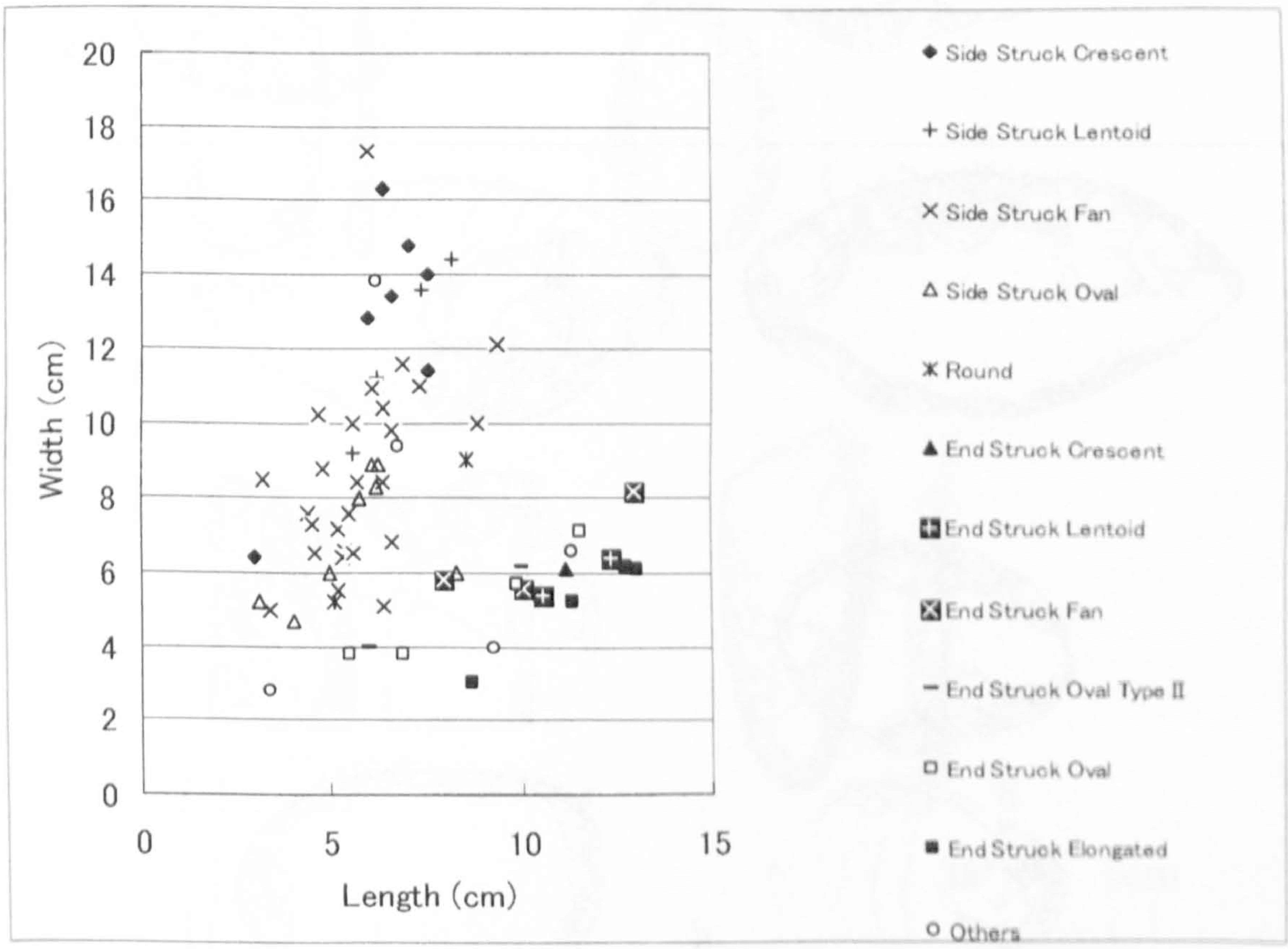


Fig.8.7 Measurements of unbroken Chalcolithic tabular scrapers from the Southern Levant.

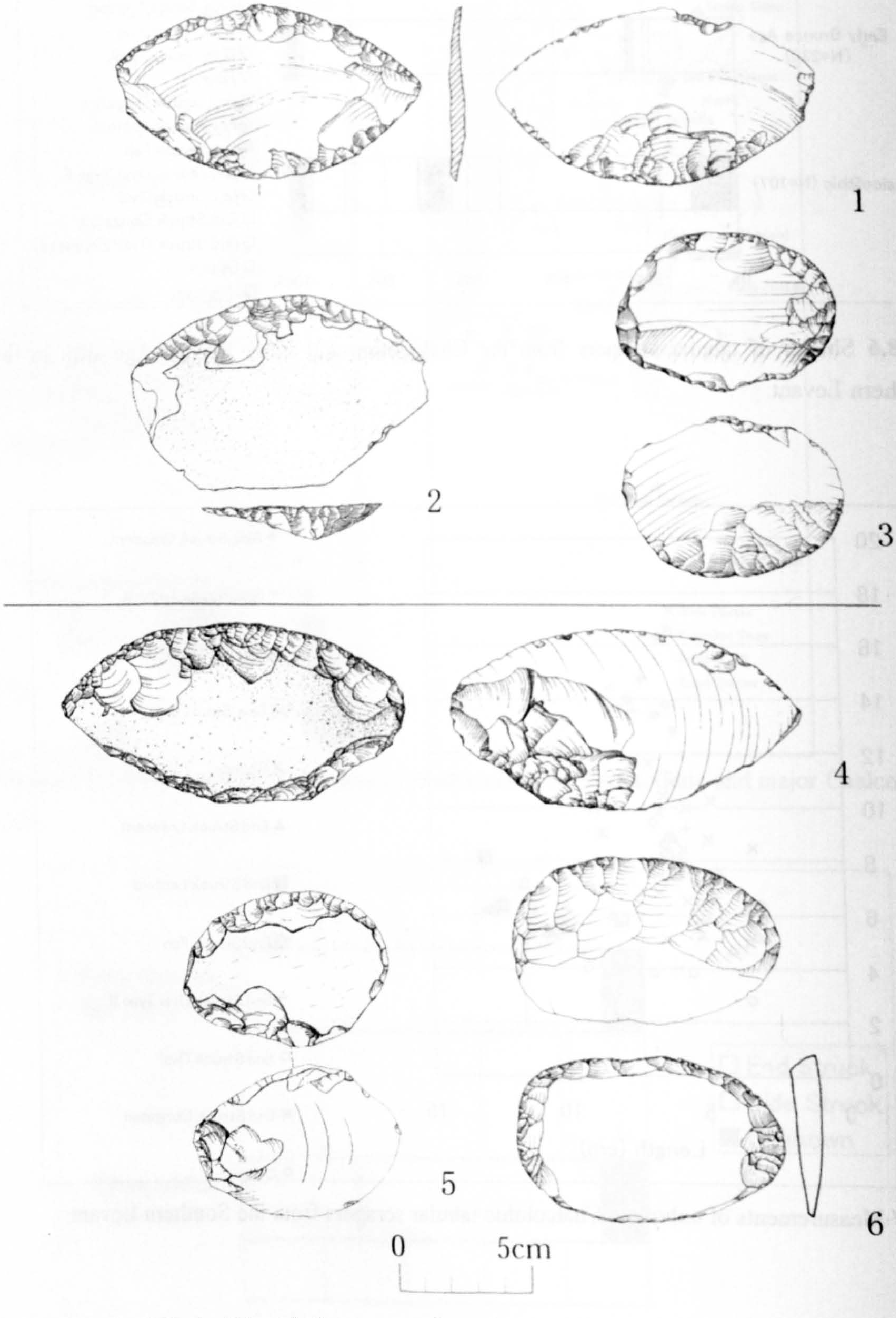


Fig.8.8 Typical Chalcolithc tabular scrapers from the Southen Levant.

1-3: Tabular scrapers on side struck blanks.

1: Side struck lentoid (Noy 1998), 2: Side struck fan (Koeppel 1940), 3: Side struck oval (Rowan 2006)

4-6: Tabular scrapers on end struck blanks.

4: End struck lentoid (Noy 1998), 5: End struck fan(Koeppel 1940) , 6: End struck oval (Type II) (Rowan 2006).

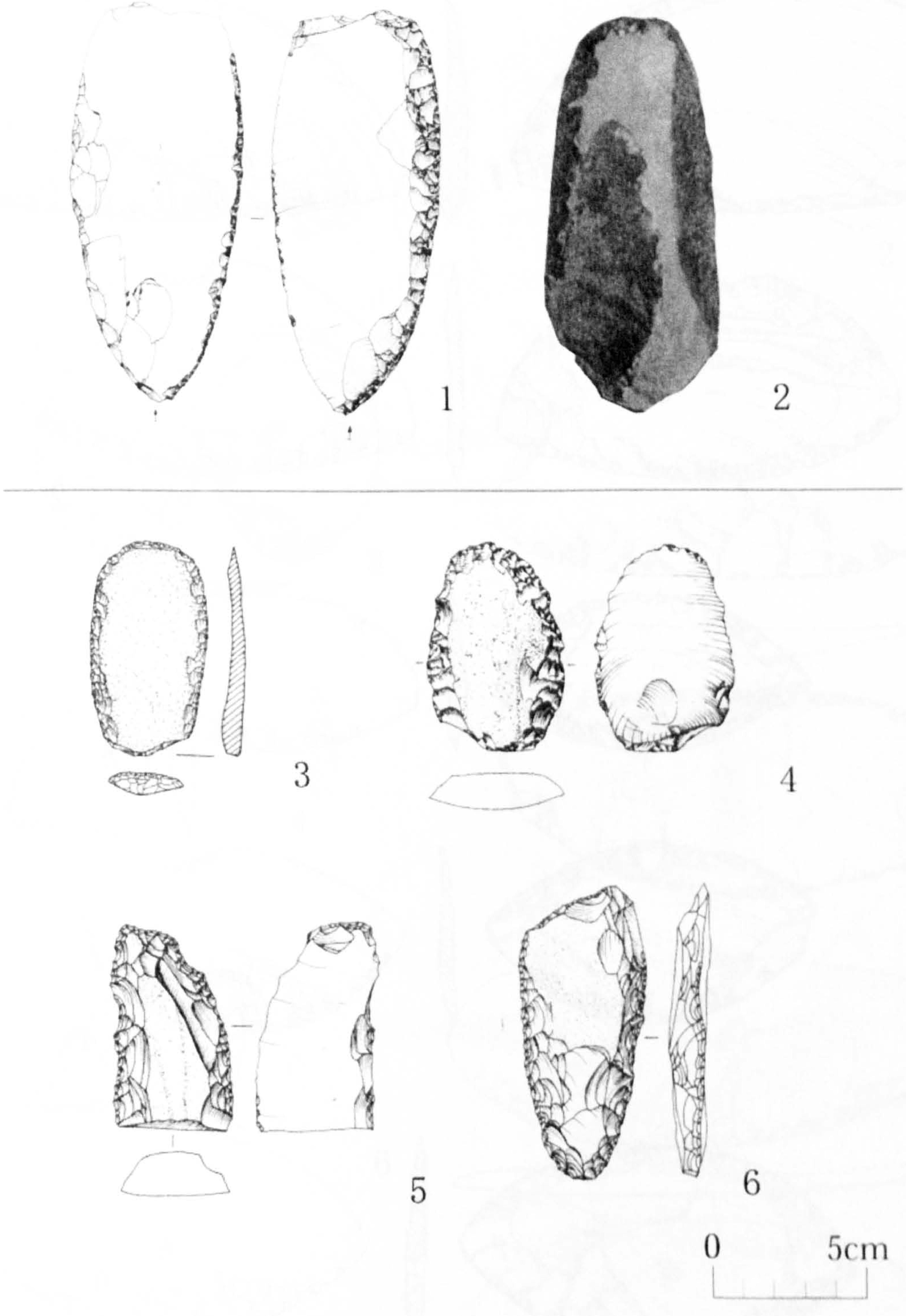


Fig.8.9 End struck oval and elongated tabular scrapers from the Chalcolithic sites.
1-2: Shiqmim (Levy and Rosen 1987), 3: Golan Sites (Noy 1998), 4: Tell Wadi Feinan (Najjar et al 1990, Najjar 1992), 5-6: Tel Tsaf (Gopher 1988/89).

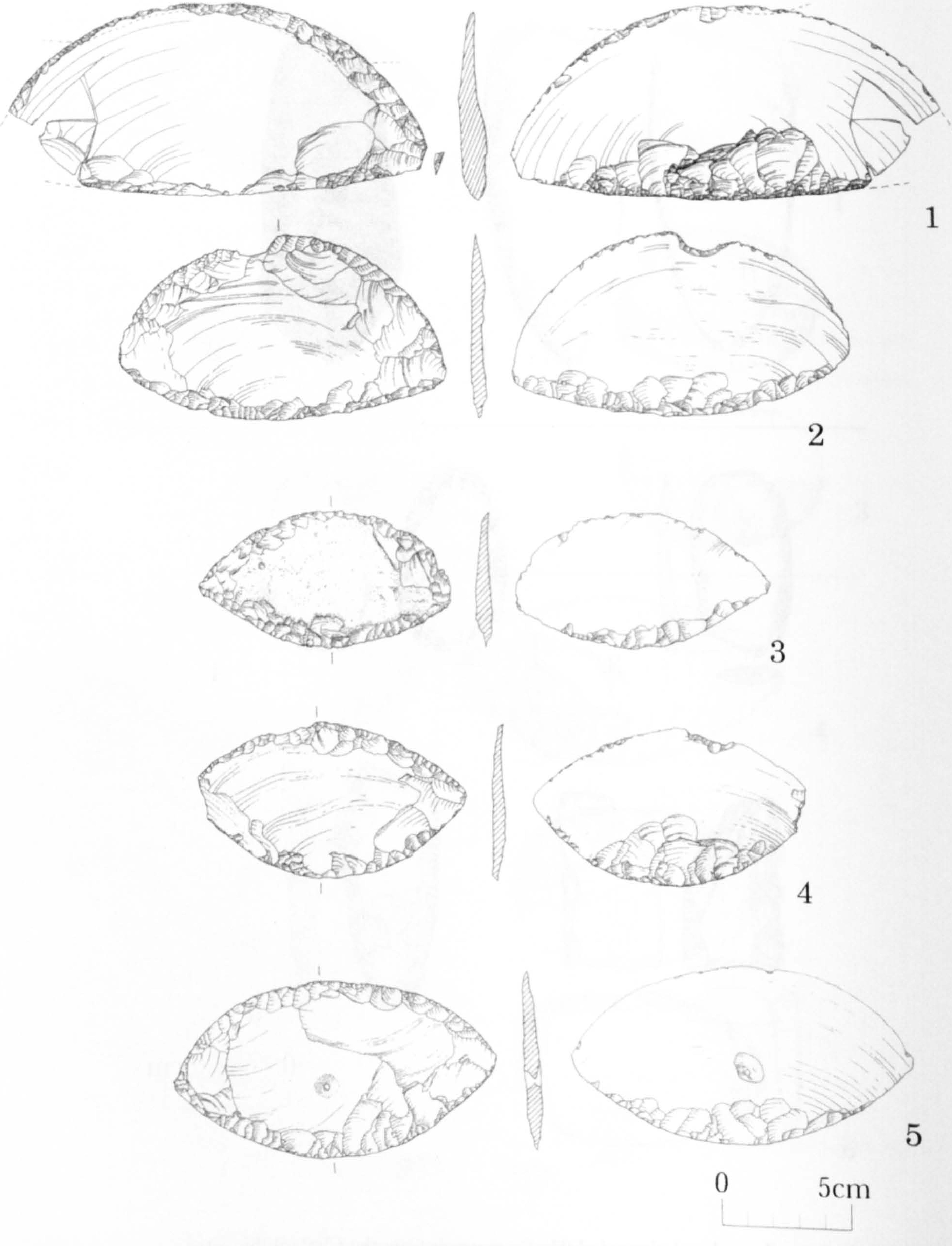


Fig.8.10 Tabular scrapers from Golan Chalcolithic sites (from Noy 1998).

1-2: Crescent shaped tabular scrapers.

3-5: Lentoid shaped tabular scrapers.

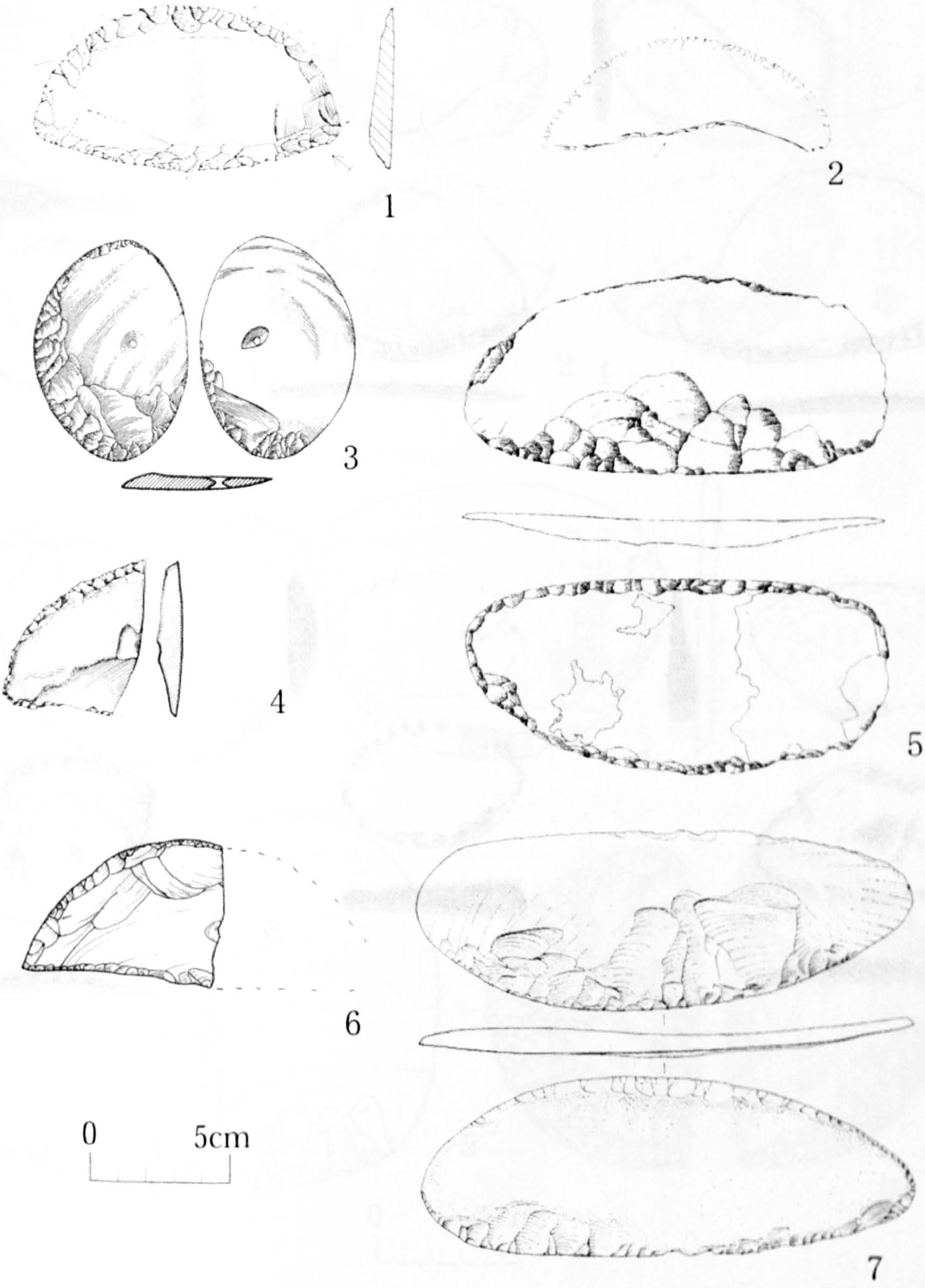


Fig.8.11 Golan type tabular scrapers from other sites.

1-2: Abu Hamid (Dollufus and Kafafi 1998), 3: Byblos (Dunand 1973), 4: Munhata (Gopher 1989), 5: Horbat Castra (Van den Brink, Horwitz, Khalaily, Liphschitz, Mienis, and Nagar 2004), 6: Delhamiya (Stekelis 1967), 7: Neve Ur (Perrot, Zori and Reich 1967).

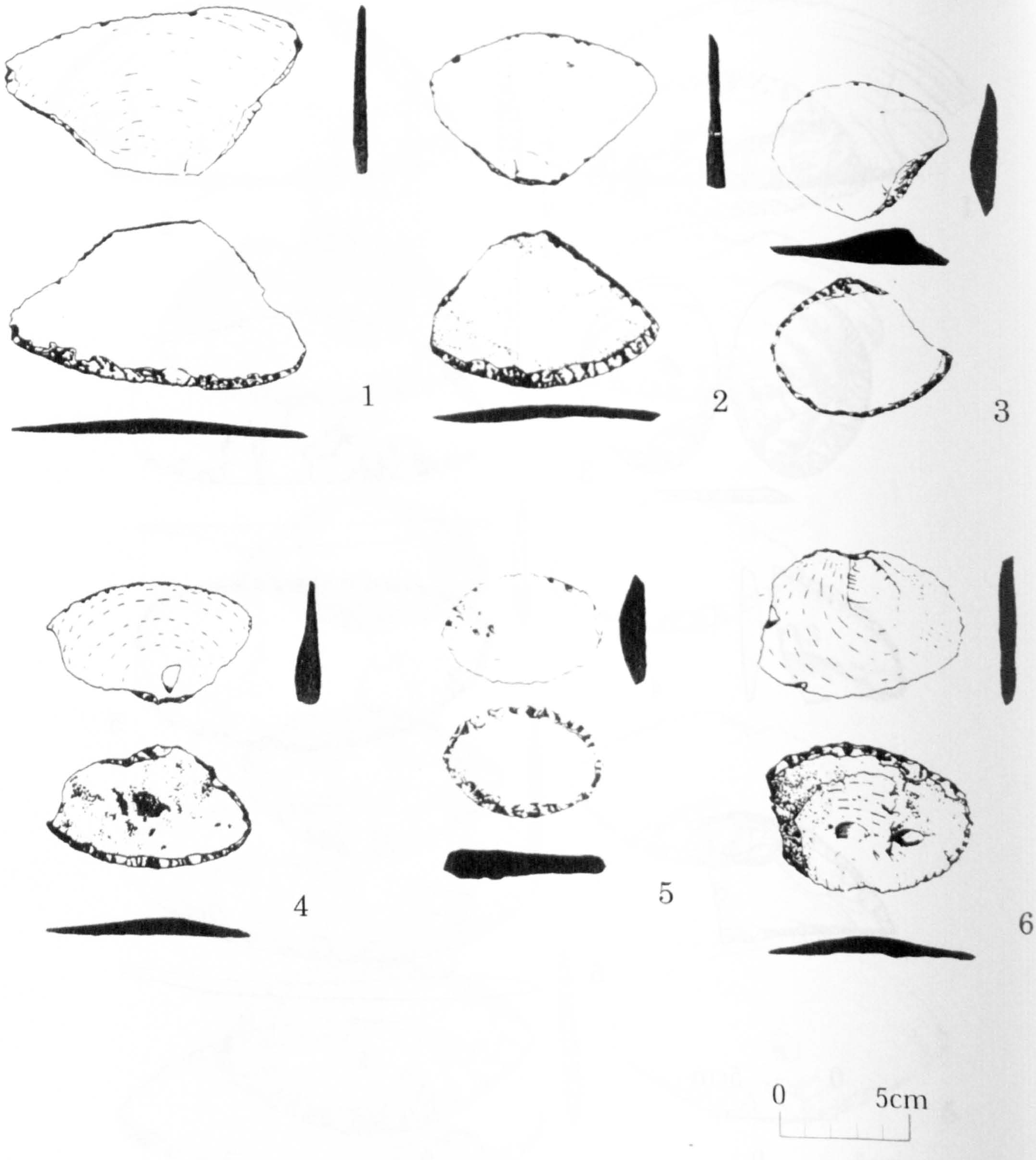


Fig.8.12 Tabular scrapers from Ghassul (Hennessy 1989).

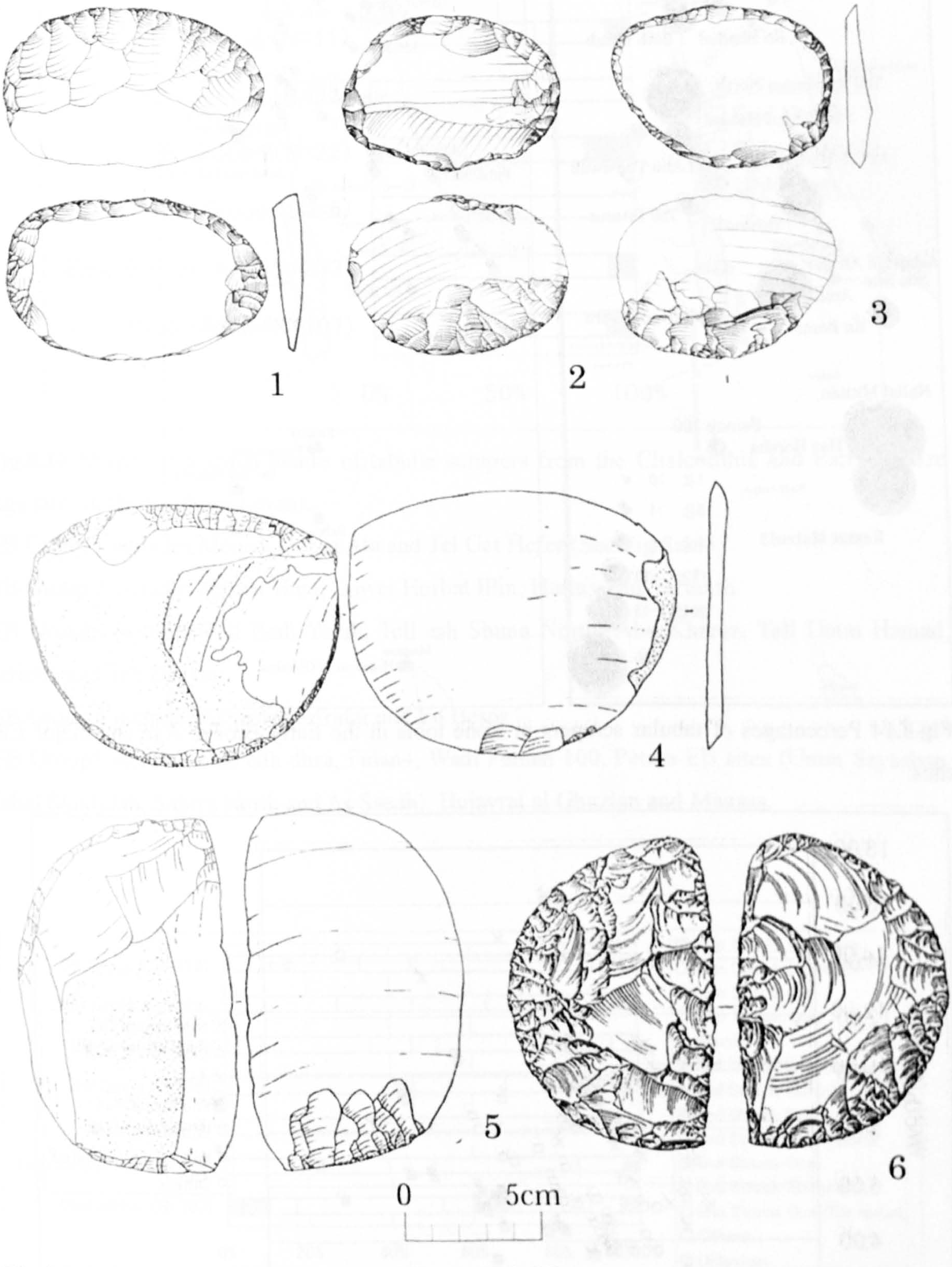


Fig.8.13 Tabular scrapers from Gilat and Site A, Nahal Besor.

1-3: Tabular scrapers from Gilat (Rowan 2006).

4-6: Tabulae scrapers from Site A, Nahal Besor (Roshwalb 1981).

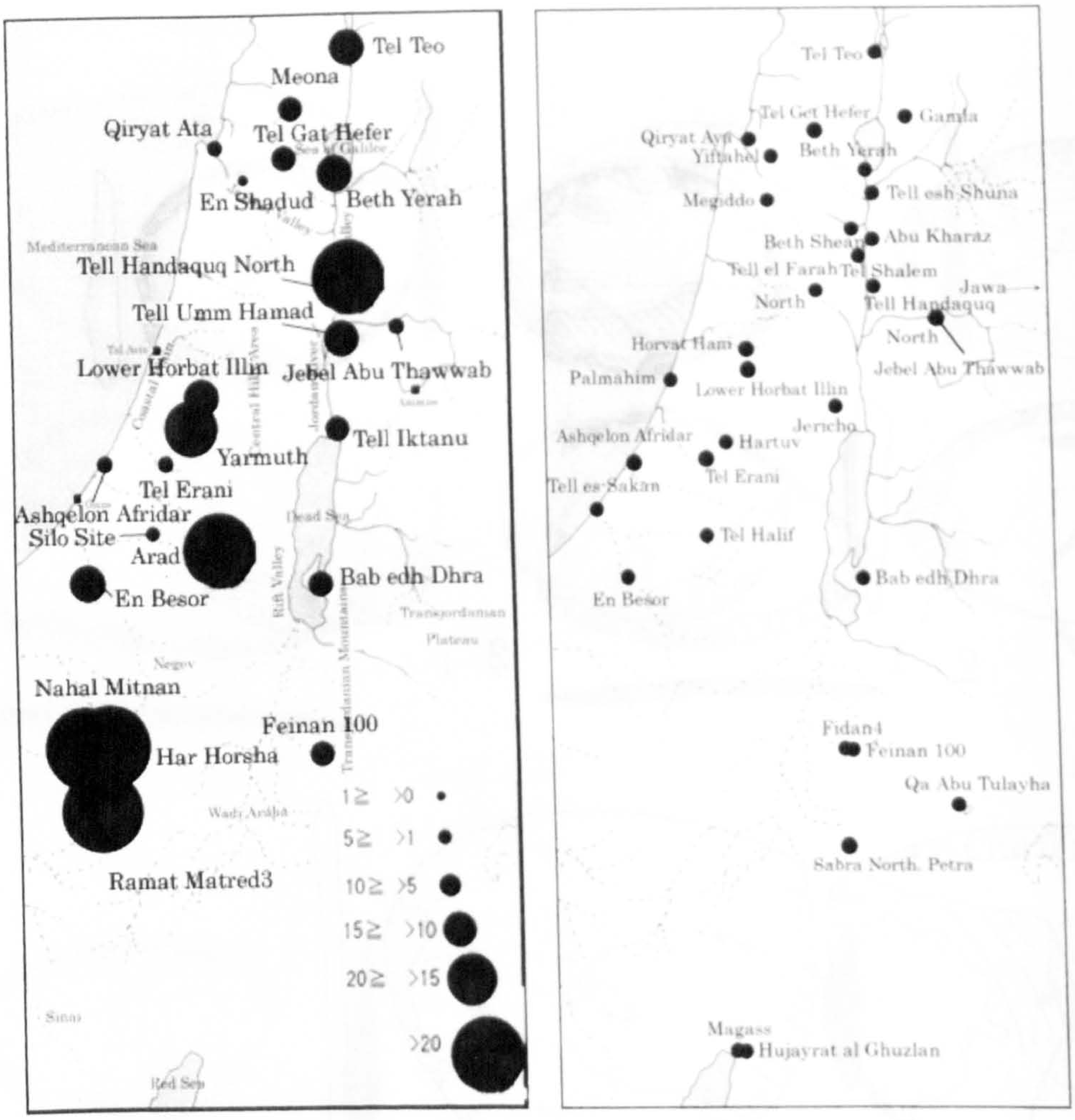


Fig.8.14 Percentages of tabular scrapers in stone tools in the Early Bronze Age and major EB sites.

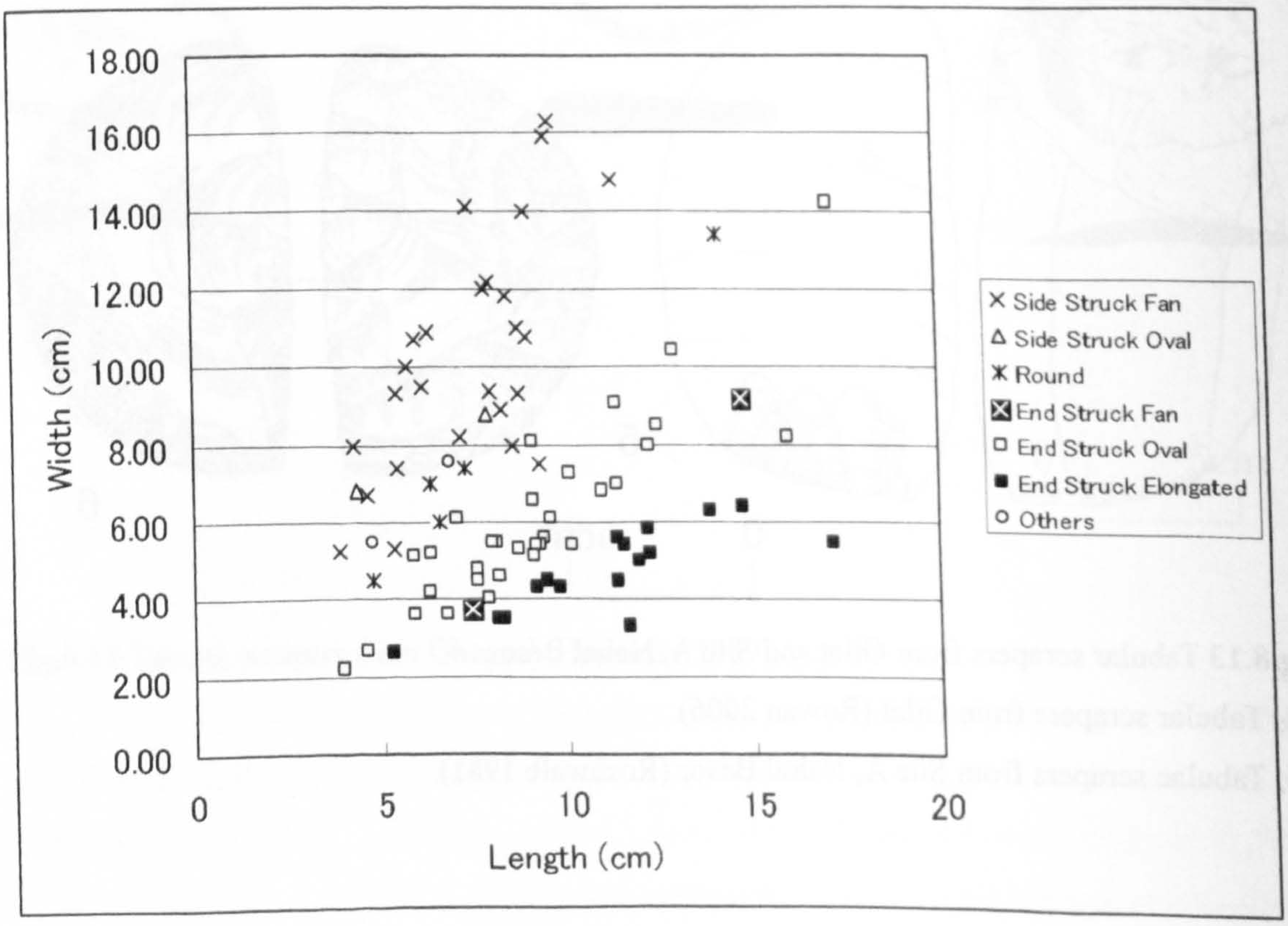


Fig.8.15 Measurements of unbroken Early Bronze Age tabular scrapers.

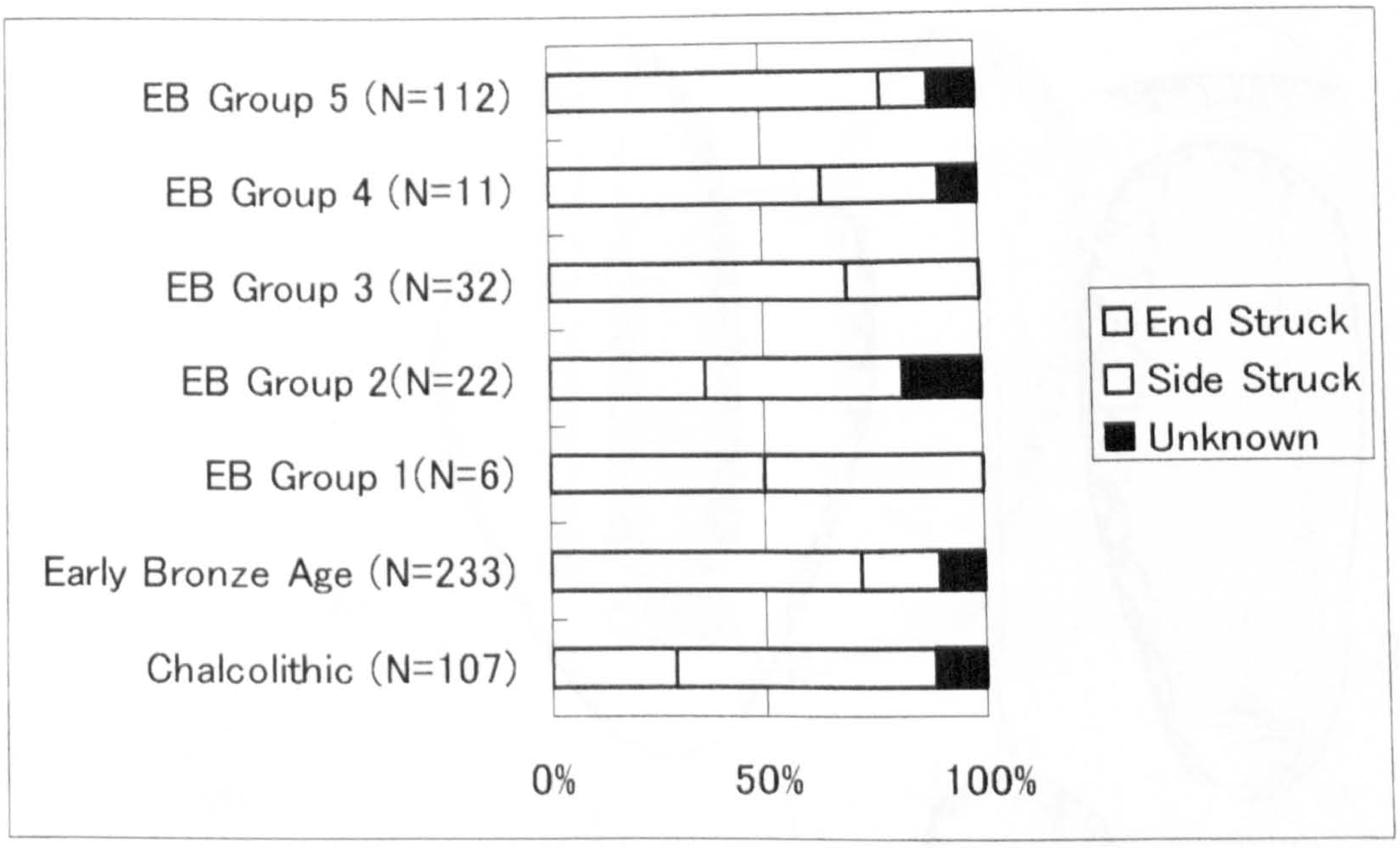


Fig.8.16 Shapes of original blanks of tabular scrapers from the Chalcolithic and Early Bronze Age sites in the Southern Levant.

EB Group 1 includes Meone, Qiryat Ata and Tel Get Hefer (See Fig.8.14).

EB Group 2 includes Horbat Hani, Lower Horbat Illin, Hartuv and Yarmuth.

EB Group3 includes Tell Beth Yerah, Tell esh Shuna North, Abu Kharaz, Tell Umm Hamad, Jericho and Tell Ikutanu.

EB Group 4 includes Ashqelon Afridar and En Besor.

EB Group5 includes Bab edh dhra, Fidan4, Wadi Feinan 100, Petera EB sites (Umm Saysaban, Jabal Shudyfah, Sabrra North and As Saedh), Hujayrat al Ghuzlan and Magass.

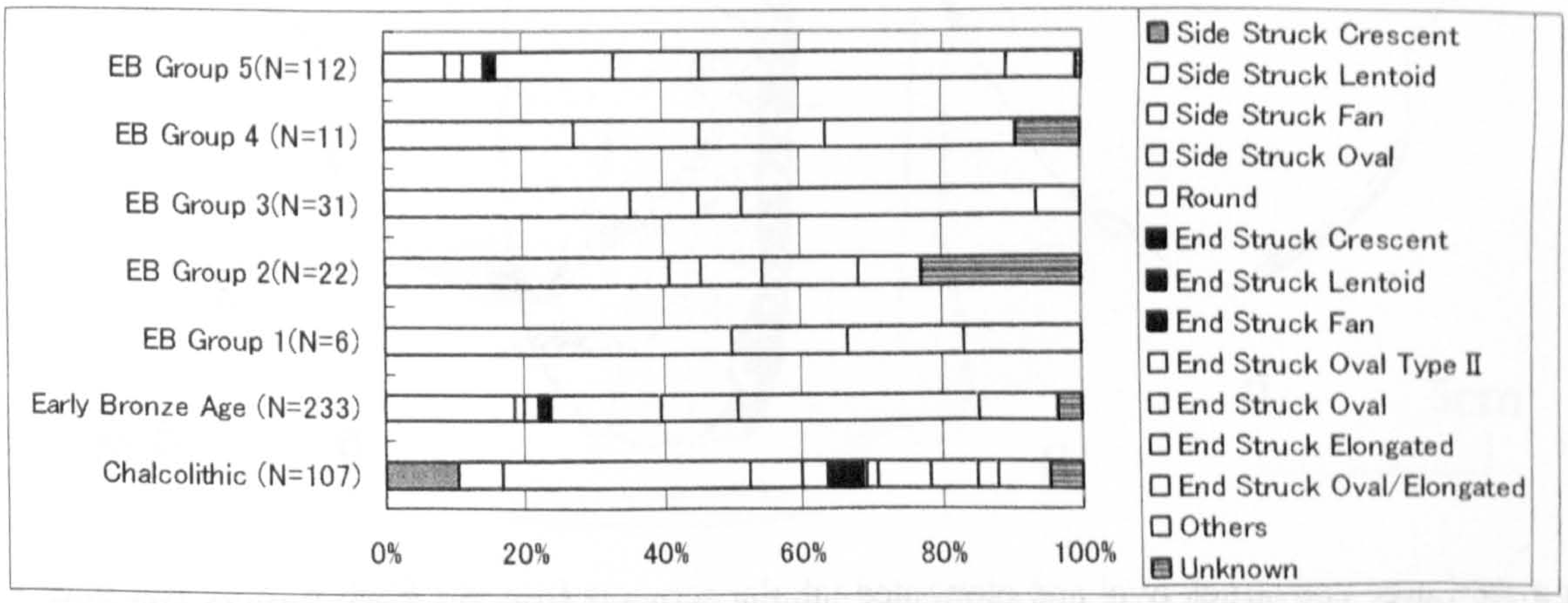


Fig.8.17 Shapes of tabular scrapers from the Chalcolithic and Early Bronze Age sites in the Southern Levant.

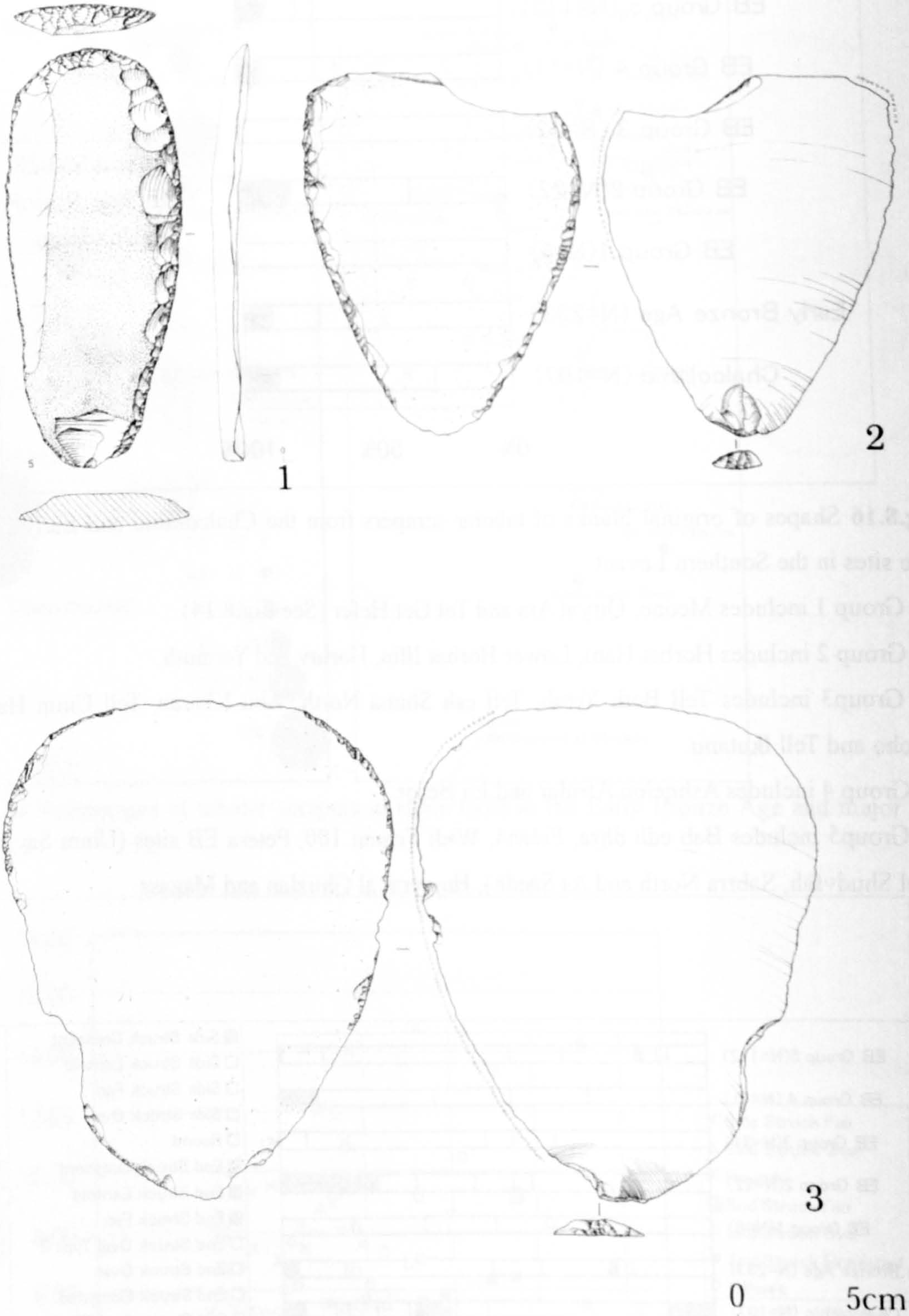


Fig.8.18 Large end struck oval and elongated tabular scrapers from the Early Bronze Age sites. 1: Horbat Hani (Khalaily 2003), 2-3: Jawa (Betts 1991).

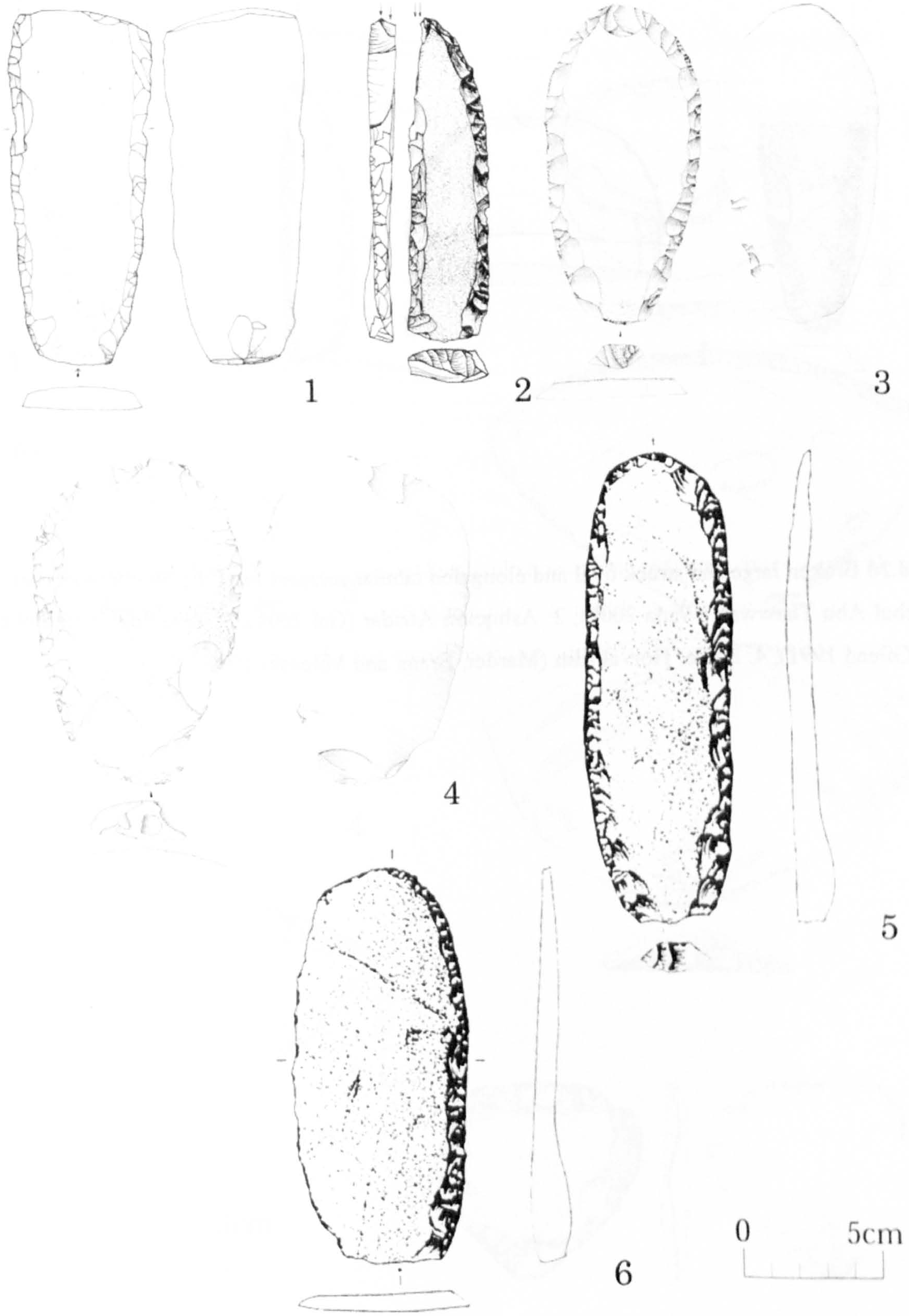


Fig.8.19 Large end struck oval and elongated tabular scrapers from the Early Bronze Age sites. 1: Abu Kharaz, 2: Jebel Abu Thawwab (Wada 2001), 3: Hujayrat al Ghuzlan (Herling 2002a), 4: Tall al Magass (Herling 2002b), 5-6: Fidan 4 (Adams 1999).

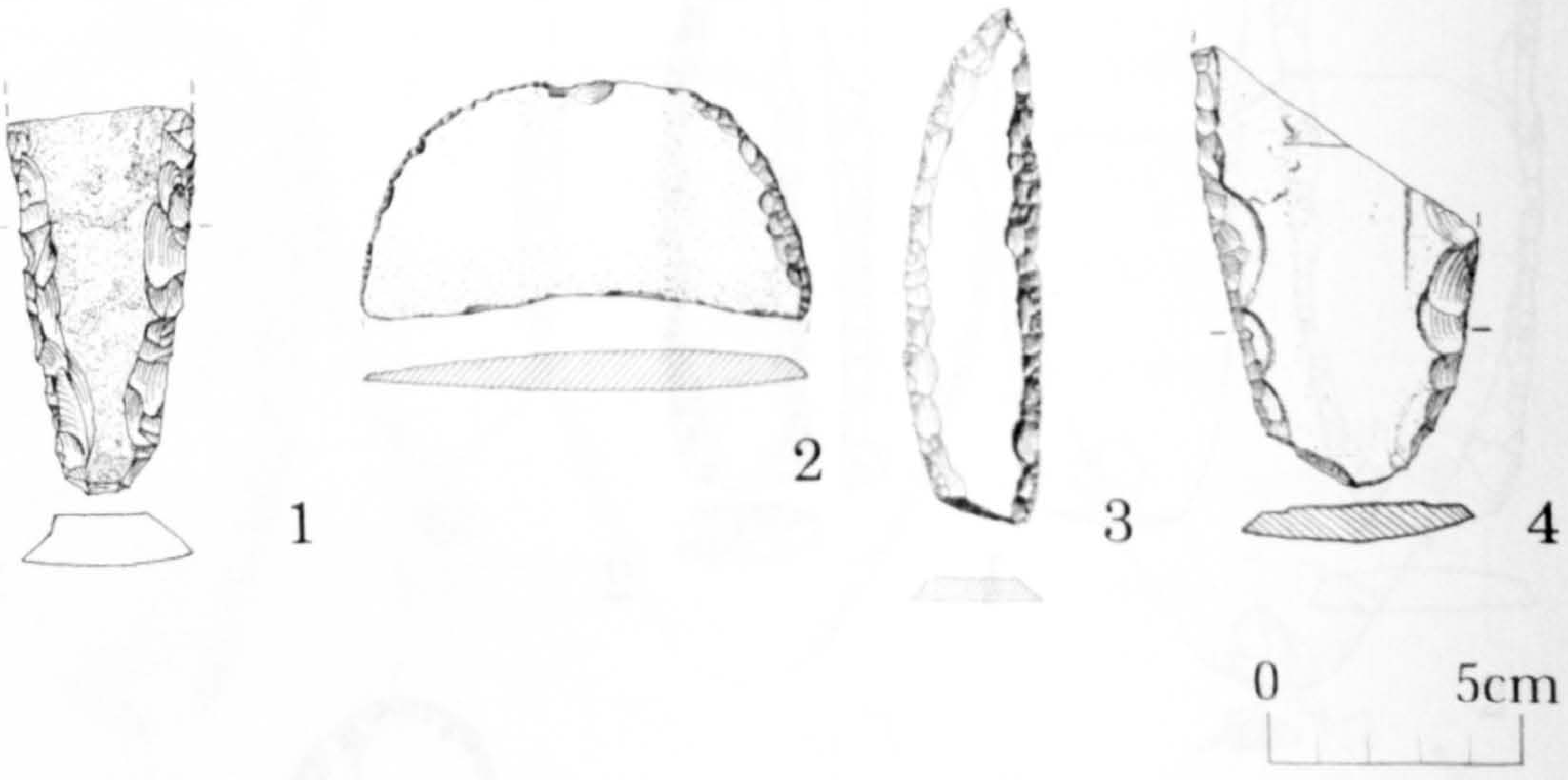


Fig.8.20 Broken large end struck oval and elongated tabular scrapers from the Southern Levant. 1: Jebel Abu Thawwab (Wada 2001), 2: Ashqelon Afridar (Gal 2004), 3: Tel Erani (Kempinski and Gilead 1991), 4: Lower Horvat Illin (Marder, Braun and Milevski 1995).

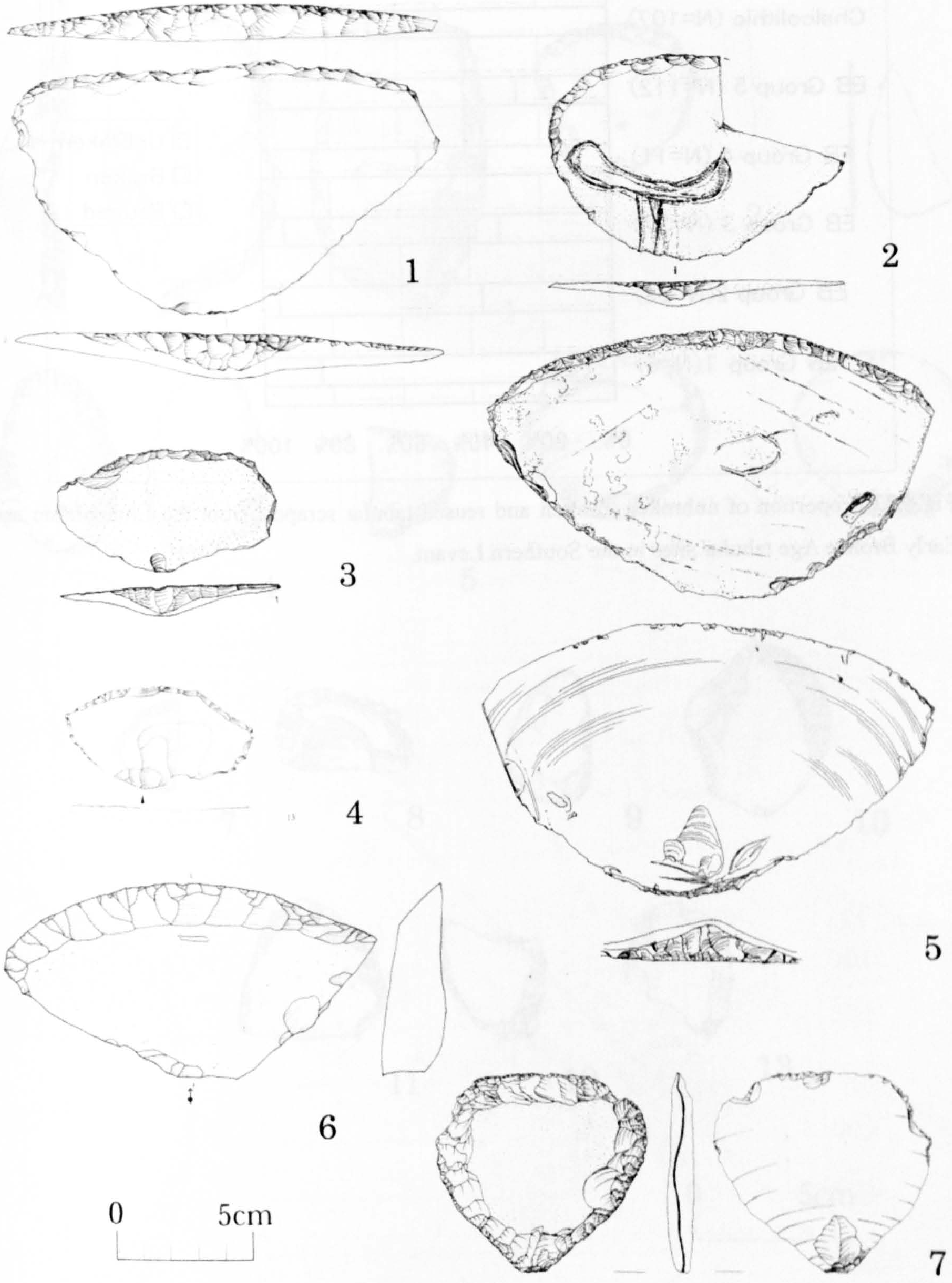


Fig.8.21 Side struck fan shaped tabular scrapers from the Early Bronze Age sites in the Southern Levant.

1: Tel Beth Yerah (Bankirer 2006), 2-3: Lower Horbat Illin (Marder, Braun and Milevski 1995), 4: Hujayrat al Ghuzlan (Herling 2002), 5: Jericho (Crowfoot Payne 1983), 6: Abu Kharaz, 7: Ashqelon Afridar (Gal et al 2004).

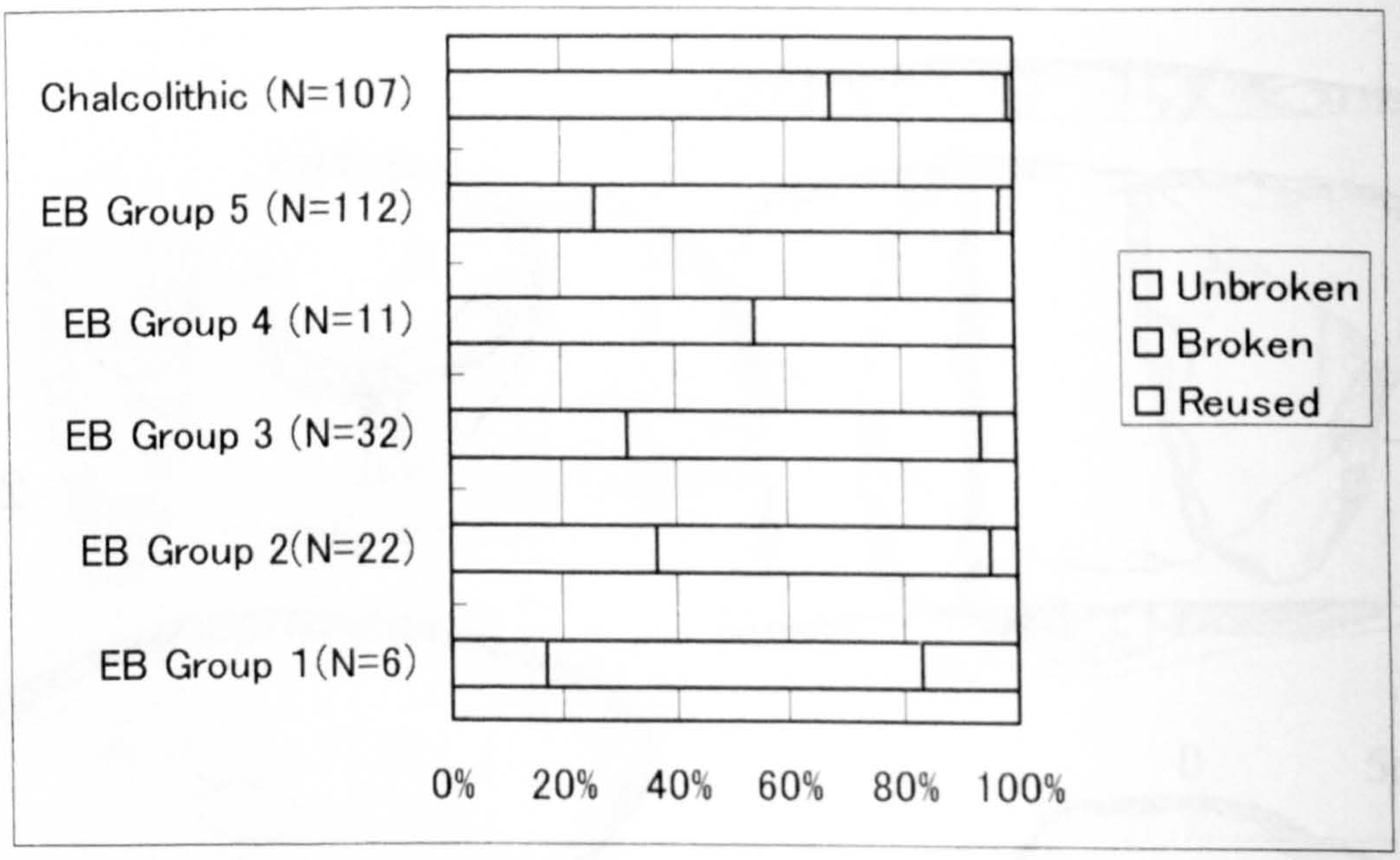


Fig.8.22 Proportion of unbroken, broken and reused tabular scrapers from the Chalcolithic and Early Bronze Age tabular sites in the Southern Levant.

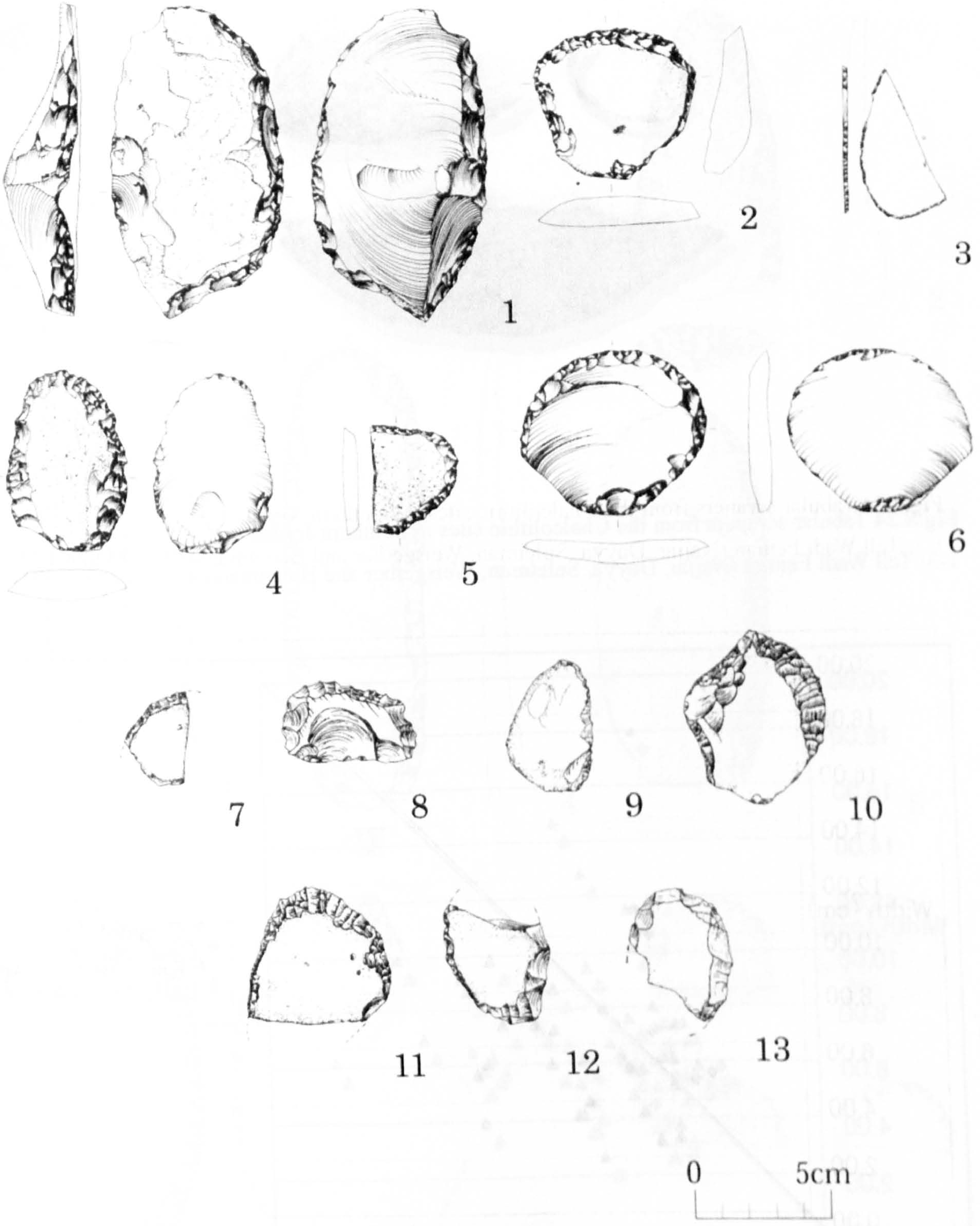


Fig.8.23 Tabular scrapers from the Chalcolithic sites in Southern Jordan.

1-6: Tell Wadi Feinan (Najjar, Dayya, Suleiman, Weisgerber and Hauptmann 1990, Najjar 1992)

7-13: Wadi Hisma Timinian sites (Henry 1995).

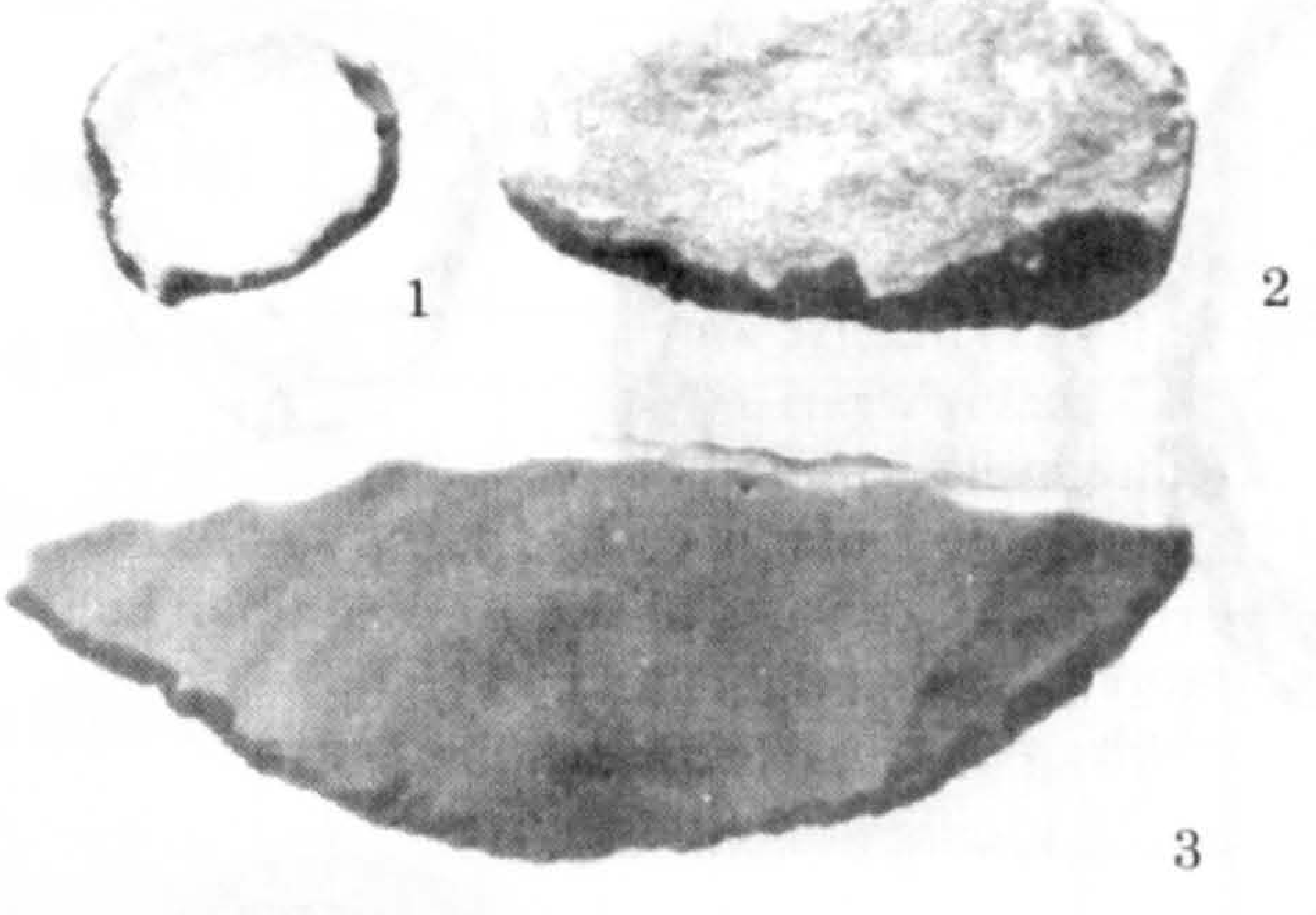


Fig.8.24 Tabular scrapers from the Chalcolithic sites in Southern Jordan.

1-3: Tell Wadi Feinan (Najjar, Dayya, Suleiman, Weisgerber and Hauptmann 1990, Majjar 1992)

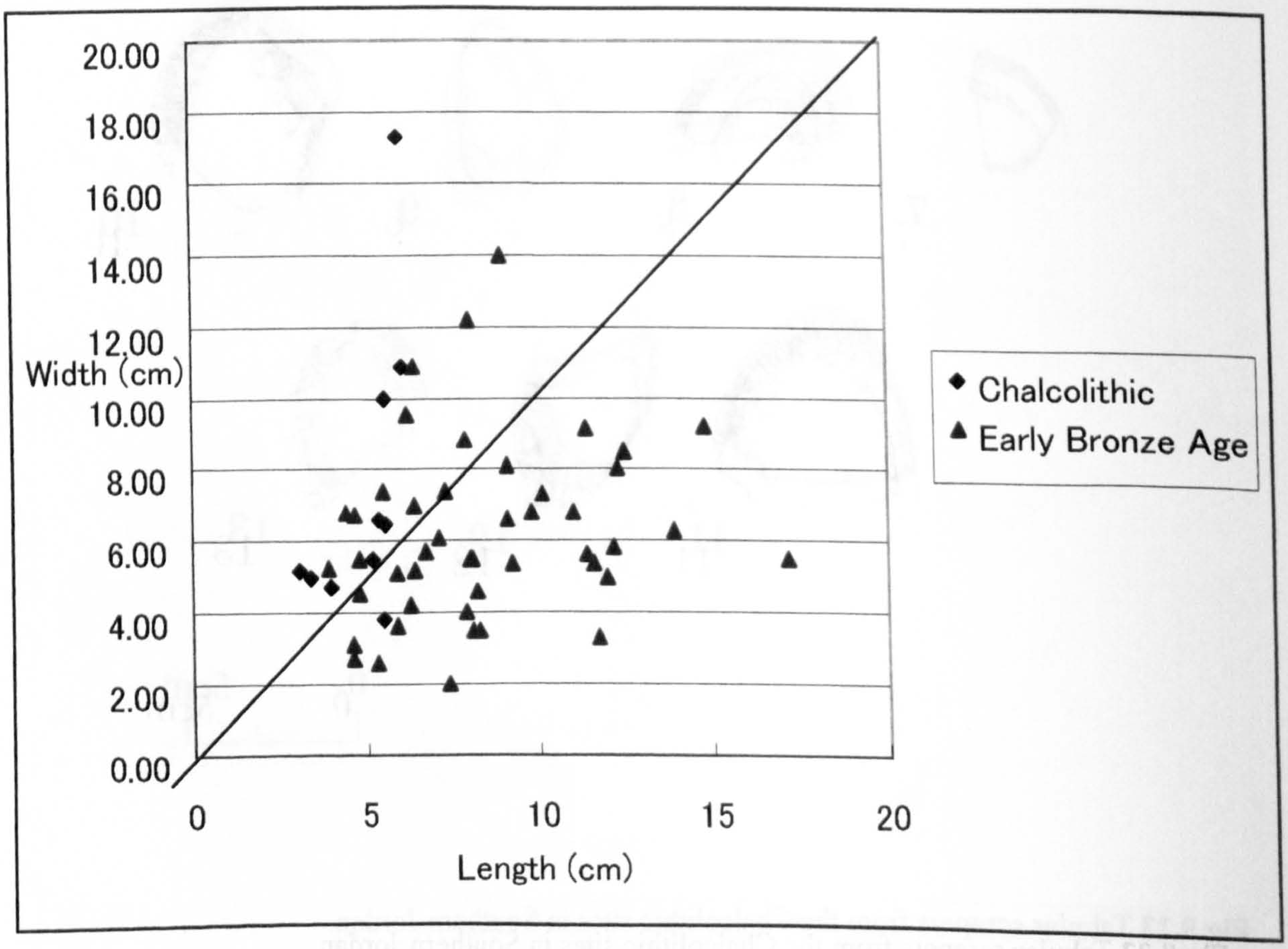


Fig.8.25 Measurements of tabular scrapers from the Chalcolithic and Early Bronze Age sites in Southern Jordan.

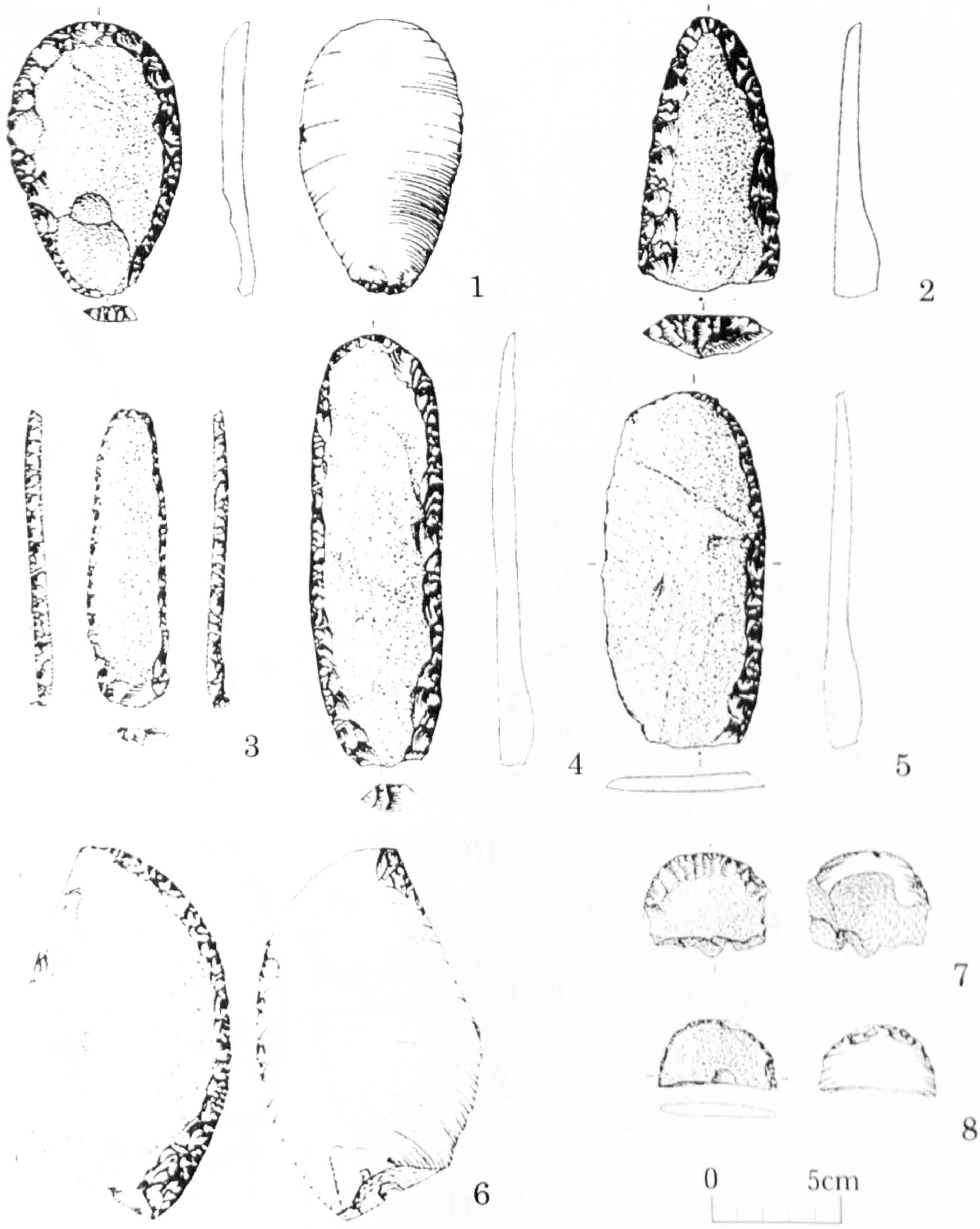


Fig.8.26 Tabular scrapers from Fidan 4 (Adams 1999).

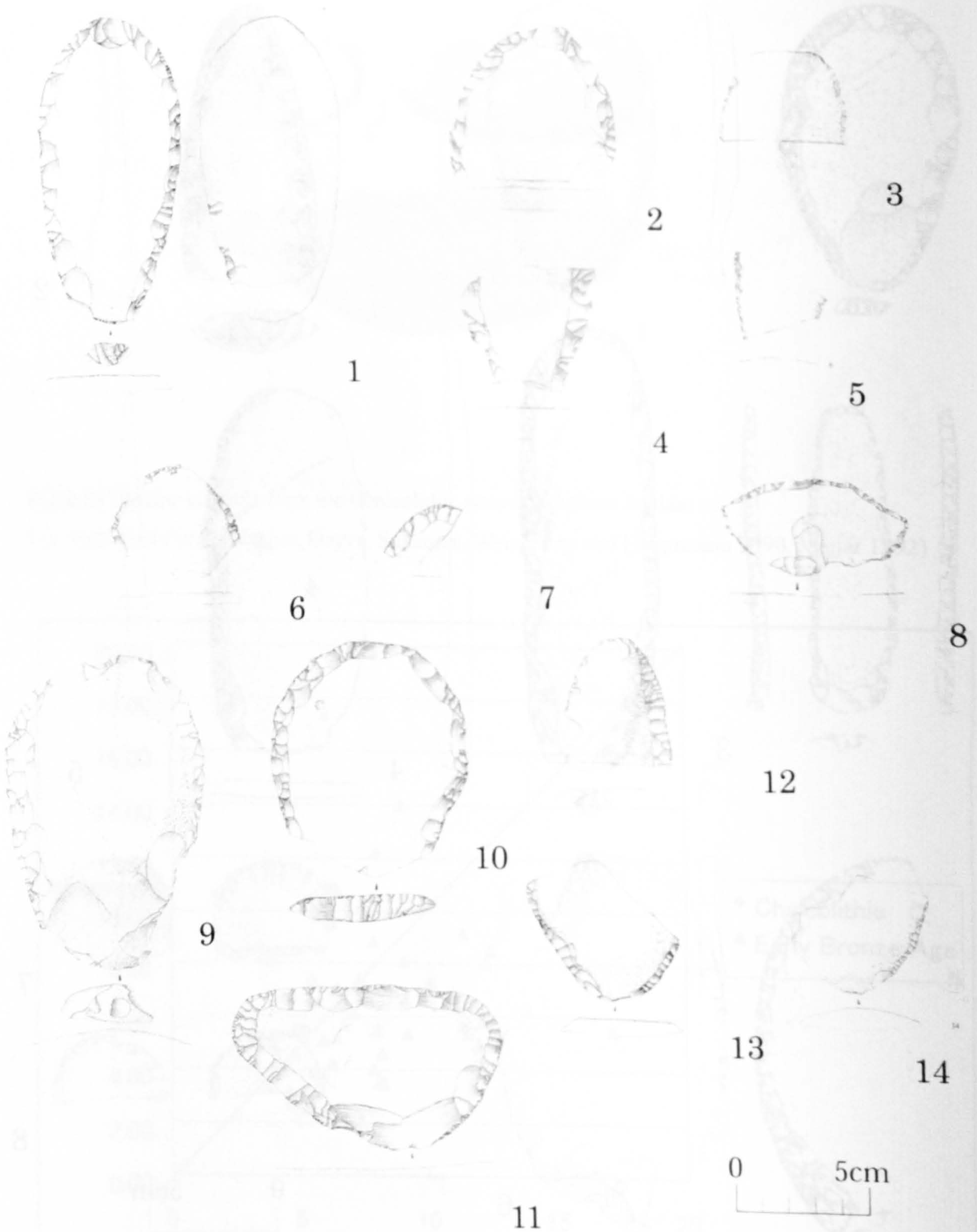


Fig.8.27 Tabular scrapers from Hujayrat al-Ghuzlan and Magass.
1-8: Tabular scrapers from Hujayrat al-Ghuzlan (Hering 2002a).
9-14 : Tabular scrapers from Magass (Hering 2002b).

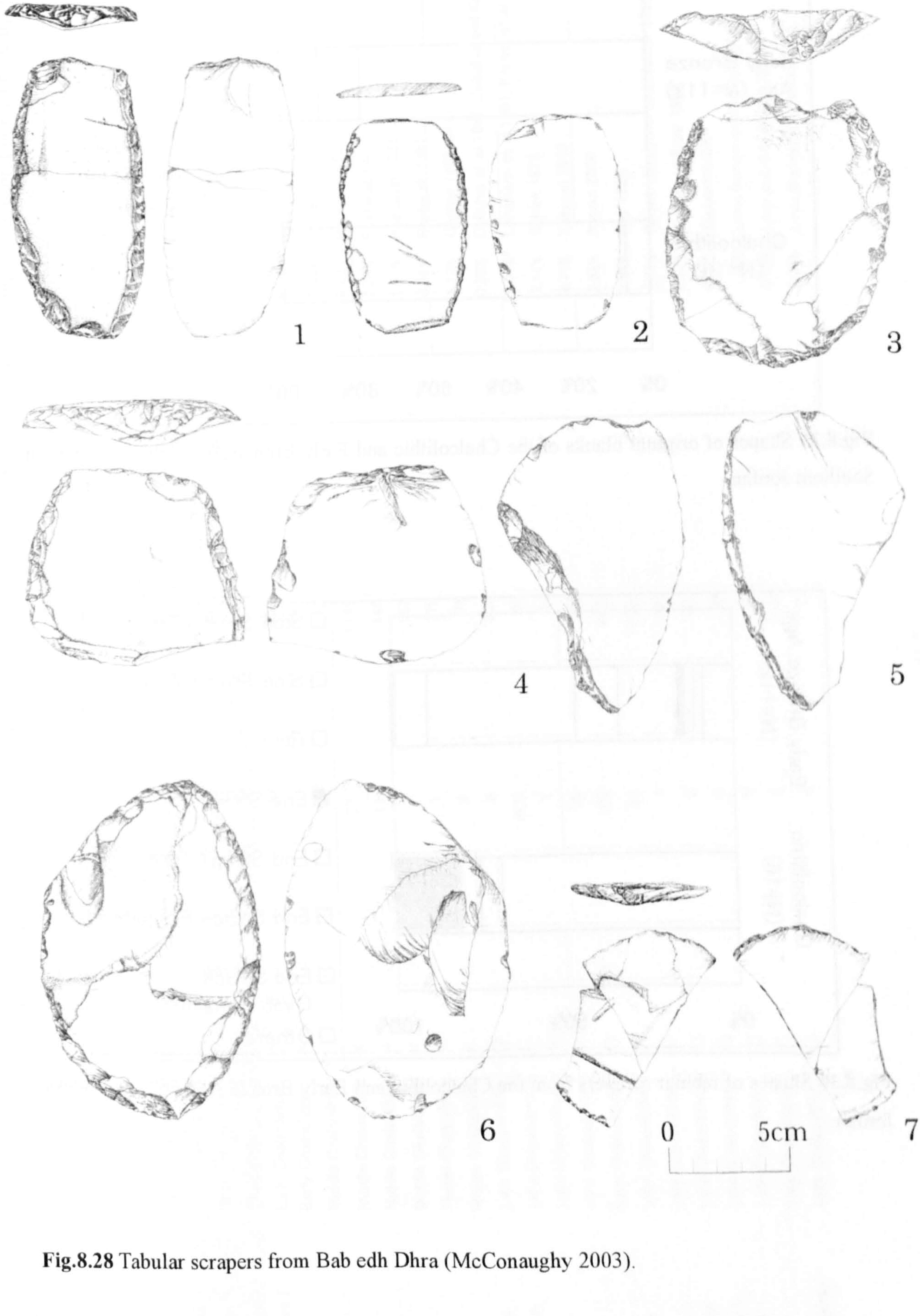


Fig.8.28 Tabular scrapers from Bab edh Dhra (McConaughy 2003).

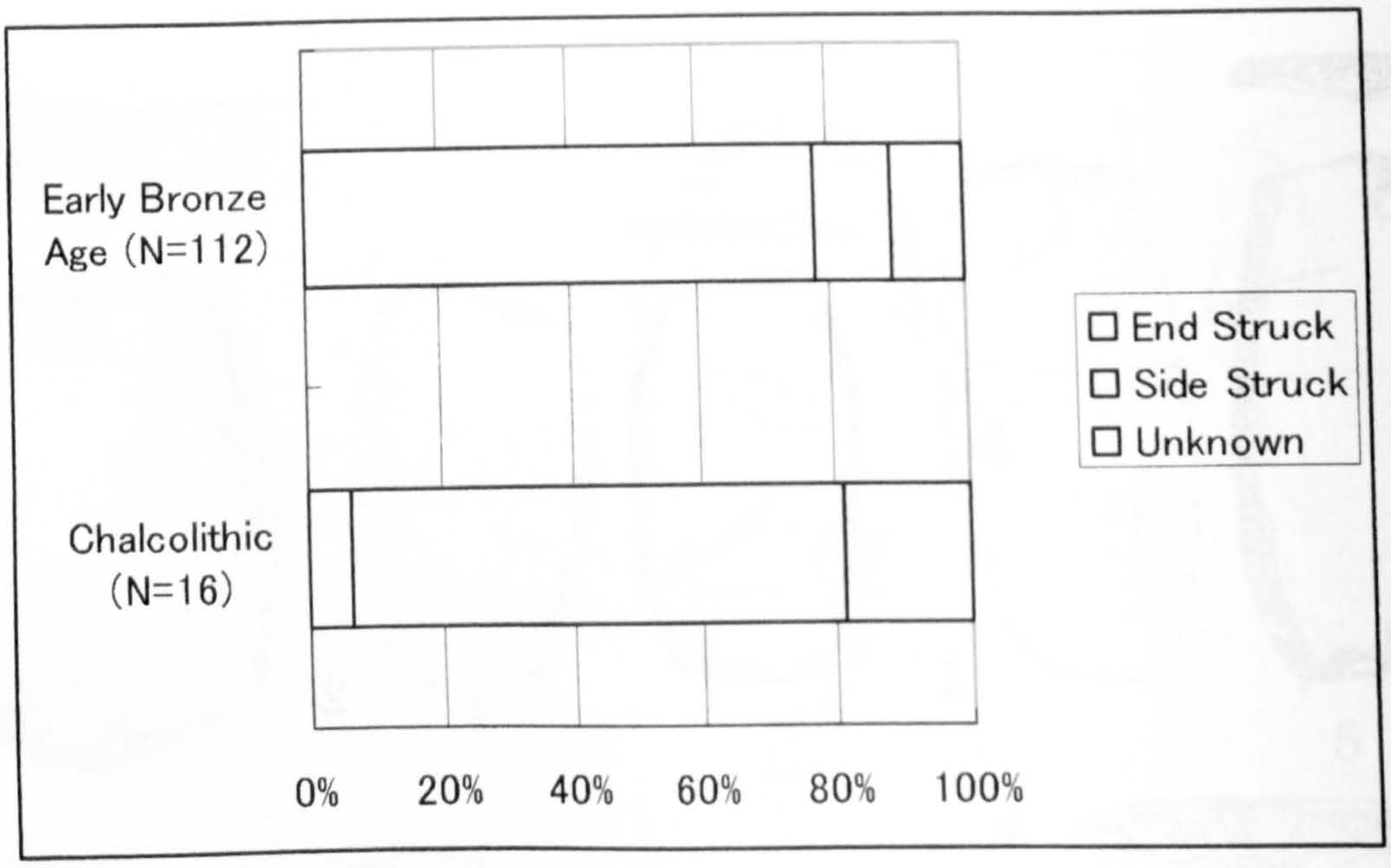


Fig.8.29 Shapes of original blanks of the Chalcolithic and Early Bronze Age tabular scrapers in Southern Jordan.

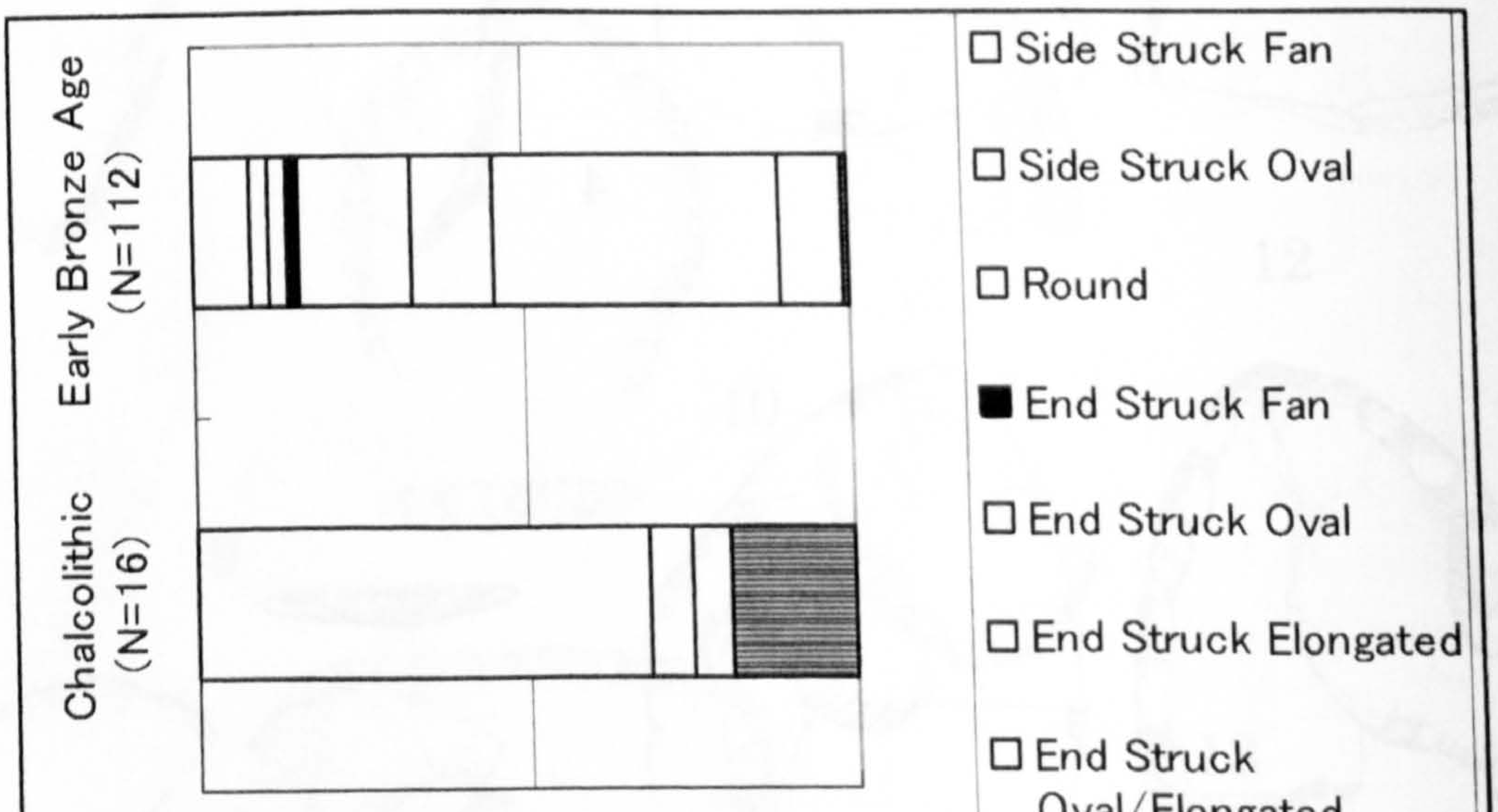


Fig.8.30 Shapes of tabular scrapers from the Chalcolthic and Early Bronze Age sites in Southern Jordan.

Table.8.1 Percentage of tabular scrapers in retouched tools during the Chalcolithic and Early Bronze Age. (Sites in gray lines are pastoral nomadic camp sites in arid areas).

Site	Period	*Sieving	Number of tabular scrapers	Number of retouched tools	Percentage of tabular scrapers in retouched tools	Reference
Dhuweila	Late Neolithic	○	37	2019	1.83%	McCartney and Betts 1998
Qasr Burqu27	Late Neolithic	○	7	353	1.98%	McCartney 1992
Jebel el Jill	Chalcolithic	○	16(?)	55	29.10%	Henry 1995
Jebel Queisa	Chalcolithic	○	7(?)	35	20%	Henry 1995
Nahal Zehora I	Early Chalcolithic	○	3	261	1.15%	Gopher and Orelle 1990
Munhata	Early Chalcolithic	×	2	440	0.45%	Gopher 1989
Qatif	Middle Chalcolithic	?	6	79	7.59%	Epstein 1984
Site A	Middle Chalcolithic	×	77	1144	6.70%	Roshwalb 1981
Site B	Middle Chalcolithic	×	11	149	7.38%	Roshwalb1981
Site D	Middle Chalcolithic	×	3	157	1.91%	Roshwalb 1981
Site M	Middle Chalcolithic	×	1	278	0.36%	Roshwalb 1981
Tel Tsaf	Middle Chalcolithic	×	4	78	5.13%	Gopher 1988/89
Abu Hamid	Late Chalcolthic	○	3	323	0.93%	Dollufus et al 1986, Dollufus and Kafafi 1989
Abu Snesleh	Late Chalcolithic	?	6(?)	58	10.34%	Lehamann et al 1991, Kerner et al 1992
Arad	Late Chalcolithic	×	1	14	7.14%	Schick 1978
Ghassul	Late Chalcolithic	×	30	309	9.71%	Koeppel 1940
Gilat	Late Chalcolithic	○	108	4128	2.62%	Rowan 2006
Golan Sites	Late Chalcolithic	×	46	1357	3.39%	Noy 1998
Grar	Late Chalcolithic	○	7	695	1.01%	Gilead, Hershman and Marder 1995
Horvat Beter	Late Chalcolithic	○	2	382	0.52%	Rosen and Eldar 1993
Mazar, Site 3	Late Chalcolithic	○	0	94	0.00%	Zbenovich 2001
Mezad Aluf	Late Chalcolithic	○	0	50	0%	Levy, Burton and Rowan 2006
Shiqmim	Late Chalcolithic	○	8	5939	0.13%	Levy and S.A. Rosen 1987
Shiqmim Darom	Late Chalcolithic	○	2	74	2.70%	Levy, Burton and Rowan 2006

Shiqmim Mizrah	Late Chalcolithic	○	0	24	0%	Levy, Burton and Rowan 2006
Tell Fendi	Late Chalcolithic	○	3	57	5.26%	Blackham et al 1997, Blackham et al 1998
Tel Teo	Late Chalcolithic	○	3	149	2.01%	Gopher and S.A. Rosen 2001
Ashqelon Afridar	EB Ⅰ	△	12	410	2.93%	Gal et al 2004
En Shadud	EB Ⅰ	×	2	399	0.50%	Rosen 1985
Feinan 100	Eb Ⅰ	?	25	390	6.41%	Moloney 2004
Hartuv	EB Ⅰ	?	3	156	1.92%	Rosen 1996
Jebel Abu Thawwab	EB1	?	2	98	2.04%	Wada 2001
Lower Horbat Illin	EB Ⅰ	×	44	415	10.60%	Marder, Braun and Milevski 1995
Silo Site	EB Ⅰ	○	58	2222	2.61%	Levy et al 1997
Tel Erani	EB Ⅰ	○	10	238	4.20%	Kempinski and Gilead 1991, S.A. Rosen 1988c
Tell Iktanu	EB Ⅰ	○	5	56	8.93%	McCartney 1996
Tel Teo	EB Ⅰ	○	7	69	10.14%	Gopher and S.A. Rosen 2001
Arad	EB Ⅰ / Ⅱ	×	64	240	26.67%	Schick 1978
En Besor	EB Ⅰ / Ⅱ	×	12	82	14.63%	Gophna and Friedmann 1995
Meona	EB Ⅰ / Ⅱ	?	3	37	8.11%	Marder 1996
Qiryat Ata	EB Ⅰ / Ⅱ	○	17	515	3.30%	Bankirer 2003
Tel Get Hefer	EB Ⅱ / Ⅲ	○	3	34	8.82%	Bankirer and Marder 2003
Tell el Handaquq North	EB Ⅰ / Ⅱ	○	3	10	30%	Mabry et al 1996
Tell Umm Hamad	EB Ⅰ / Ⅱ	×	8	62	12.90%	Betts 1992
Har Horsha	**EB Ⅱ**	○	**23**	**78**	**29.49%**	**Rosen 1991**
Nahal Mitnan	**EB Ⅱ**	○	**22**	**74**	**29.73%**	**Rosen 1993**
Ramat Matred 3	**EB Ⅱ**	?	**71**	**346**	**20.52%**	**Haiman1994**
Bab edh Dhra	EB Ⅱ / Ⅲ	×	31	460	6.74%	McConaughy 2003
Tel Beth Yerah	EB Ⅰ / Ⅱ / Ⅲ	○	18	152	11.84%	Bankirer 2006
Yarmuth	EB Ⅰ / Ⅱ / Ⅲ	×	20	126	15.87%	Rosen 1988

*×means that artifacts were collected without sieving. ○ means that artifacts were collected with sieving.

Table.8.2 Analyzed site list.

Site	Period	The number of tabular scrapers	Reference
Ein el Jarba	Early Chalcolithic	1	Kaplan 1969
Munhata	Early Chalcolithic	2	Gopher 1989
Nahal Zehora I	Early Chalcolithic	1	Gopher and Orrelle 1990
Tel Teo	Early Chalcolithic	1	Gopher and Rosen 2001
Qatif	Middle Chalcolithic	1	Epstein 1984
Tel Tsaf	Middle Chalcolithic	4	Gopher 1988/89
Site A	Middle Chalcolithic	4	Roshwalb 1981
Site B	Middle Chalcolithic	1	Roshwalb 1981
Site M	Middle Chalcolithic	1	Roshwalb 1981
Tell Wadi Feinan	Middle/Late Chalcolithic	8	Najjar et al 1990, Najjar1992
Abu Hamid	Late Chalcolithic	2	Dollufus and Kafafi 1989
Abu Snesleh	Late Chalcolithic	4	Lehmann et al 1991, Kerner et al 1992
Arad	Late Chalcolithic	1	Schick 1978
Delhamiya	Late Chalcolithic	3	Stekelis 1967
Ghassul	Late Chalcolithic	22	Henessey 1989, Koeppel1940, 7 pieces were checked by the author.
Gilat	Late Chalcolithic	8	Rowan 2006
Golan	Late Chalcolithic	18	Noy 1998
Grar	Late Chalcolithic	4	Gilead, Hershman and Marder 1995
Horvat Beter	Late Chalcolithic	3	S.A. Rosen and Eldar 1993, Yeivin 1959
Horvat Castra	Late Chalcolithic	1	Van den Brink et al 2004
Neve Ur	Late Chalcolithic	1	Perrot, Zori and Reich 1967
Shiqmim	Late Chalcolithic	7	Levy and Rosen 1987
Tel Teo	Late Chalcolithic	1	Gopher and Rosen 2001
Umm Qatafa	Late Chalcolithic	1	Neuville 1934, Perrot 1992
Wadi Hisma Timnian sites	Chalcolithic	7	Henry 1995
En Besor	Early Bronze Age I	3	Gophna and Friedmann 1995

Fidan4	Early Bronze Age Ⅰ	8	Adams 1999
Hartuv	Early Bronze Age Ⅰ	1	S.A. Rosen 1996
Horbat Hani	Early Bronze Age Ⅰ	1	Khalaily 2003
Hujayrat al Ghuzlan	Early Bronze Age Ⅰ	34	Herling 2002a
Jawa	Early Bronze Age Ⅰ	27	Betts 1991
Jebel Abu Thawwab	Early Bronze Age Ⅰ	4	Wada 2001
Lower Horvat Illin	Early Bronze Age Ⅰ	12	Marder, Braun and Milevski 1995
Tall al Magass	Early Bronze Age Ⅰ	39	Herling 2002b
Tell esh Shuna North	Early Bronze Age Ⅰ	5	Checked by the author
Tell Iktanu	Early Bronze Age Ⅰ	2	McCartney 1996
Tell Teo	Early Bronze Age Ⅰ	1	Gopher and S.A. Rosen 2001
Wadi Faynan 100	Early Bronze Age Ⅰ	3	Moloney 2004, Wright et al 1998
Meona	Early Bronze Age Ⅰ / Ⅱ	2	Marder 1996
Qiryat Ata	Early Bronze Age Ⅰ / Ⅱ	3	Bankirer 2003
Tell Abu Kharaz	Early Bronze Age Ⅰ / Ⅱ	15	Checked by the author
Tell Umm Hamad	Early Bronze Age Ⅰ / Ⅱ	4	Betts 1992
Tel Bet Yerah	Early Bronze Age Ⅰ / Ⅱ / Ⅲ	2	Bankirer 2006
Yarmuth	Early Bronze Age Ⅰ / Ⅱ / Ⅲ	8	S.A. Rosen 1988b
Jericho	Early Bronze Age Ⅰ / Ⅱ / Ⅲ	4	Payne 1983
En Besor	Early Bronze Age Ⅱ	3	Gophna and Friedmann 1995
Har Horsha	Early Bronze Age Ⅱ	10	S.A. Rosen 1991
Nahal Mitnan	Early Bronze Age Ⅱ	7	S.A. Rosen 1993
Petra EB sites	Early Bronze Age Ⅱ / Ⅲ	16	Linder and Genz 2000, Linder, Hubner and Genz 2001
Bab edh Dhra	Early Bronze Age Ⅱ / Ⅲ	13	McConaughy 2003
Tell Gat Hefer	Early Bronze Age Ⅱ / Ⅲ	1	Bankirer and Marder 2003

Table.8.3 Measurements of tabular scrapers from the Chalcolithic sites in the Southern Levant.

Measurements of tabular scrapers (cm)	N	Mean	S.D.	Min.	Max.	Median.
Length	71	6.88	2.37	3	13.1	6.35
Width	71	8.18	3.219	2.8	17.3	7.32
Thickness	47	1.04	0.476	0.4	2.7	0.9
L/W	71	0.97	0.526	0.3	2.9	0.7
W/T	47	9.41	5.682	2.5	23.3	7.5

Table.8.4 Measurements of tabular scrapers from the Early Bronze Age sites in the Southern Levant.

Measurements of tabular scrapers (cm)	N	Mean	S.D.	Min.	Max.	Median.
Length	90	8.76	2.95	3.9	17.2	8.4
Width	90	7.15	3.212	2	16.3	6.2
Thickness	74	1.32	0.559	0.4	2.8	1.3
L/W	90	1.45	0.692	0.5	3.6	1.4
W/T	74	5.71	2.449	2	15.5	5.2

Table.8.5 Measurements of tabular scrapers from the Chalcolithic sites in the Southern Jordan.

Measurements of tabular scrapers (cm)	N	Mean	S.D.	Min.	Max.	Median.
Length	10	4.99	1.027	3.1	6.1	5.5
Width	10	7.55	3.908	3.8	17.3	6
Thickness	4	1.53	0.715	0.9	2.7	1.25
L/W	10	0.76	0.254	0.3	1.3	0.75
W/T	4	4.68	1.462	3.7	7.2	3.9

Table.8.6 Measurements of tabular scrapers from the Early Bronze Age sites in the Southern Jordan.

Measurements of tabular scrapers (cm)	N	Mean	S.D.	Min.	Max.	Median.
Length	46	8.42	3.04	3.9	17.2	8
Width	46	6.21	2.456	2	14	5.65
Thickness	46	1.34	0.602	0.4	2.8	1.25
L/W	46	1.55	0.747	0.6	3.6	1.5
W/T	46	5.12	1.896	2	9	4.6

Chapter 9 TABULAR SCRAPER PRODUCTION IN THE JAFR BASIN, SOUTHERN JORDAN

9.1. INTRODUCTION

Chapter 5 revealed that the Chalcolithic/Early Bronze Age landscape of the Jafr Basin is characterized by a number of tabular scraper (and Jafr blade) production sites. Kanazawa University discovered 60 sites in total in the survey area. Of 60, 25 sites are Chalcolithic and Early Bronze Age tabular scraper production sites. The tabular scraper production sites can be classified into two types: Qa Abu Tulayha type and Gurta Siyyata type.

As already discussed in Chapters 6 and 7, these two types of tabular scraper production sites are totally different in several points. Their characteristics are listed below.

Gurta Siyyata type tabular scraper production sites

- Small flint blocks from the surface were selected as raw material without flint mining.
- Tabular scraper production debris are scattered in low density at these sites.
- Small side struck fan shaped tabular scrapers were the main products. Their average size was probably about 7 cm in length×9 cm in width (Fig.7.22:1, Fig.7.23:1)
- Knapping was less carefully executed than at Qa Abu Tulayha type sites.
- Tabular scraper production at Gurta Siyyata type sites was less labour intensive.
- No structures associated with tabular scraper production were discovered at these sites. It hints

that each production episode was probably short and spanned a few days at most.

Qa Abu Tulayha type tabular scraper production sites

- Large flint nodules were intensively mined.
- Remains of tabular scraper production are concentrated in considerable density around flint mines.
- Large end struck oval/elongated tabular scrapers were produced. Their average size was probably about 15 cm ×10 cm in width (Fig.6.46:1, Fig.6.64)
- Knapping was careful. It was characterized by careful platform creation and platform preparation.
- Tabular scraper production at Qa Abu Tulayha type sites was labour intensive. The production at Qa Abu Tulayha type sites was five times more labour intensive than the production at Gurta Siyyata type sites to produce the same number of blanks.
- Structures associated with tabular scraper production were discovered at Qa Abu Tulayha. Given the intensity of production at Qa Abu Tulayha type sites, it is no surprise that structures were constructed for occupation during the production. The structures hint that each production episode was probably relatively lengthy. It is estimated that each production episode spanned several weeks at Qa Abu Tulayha.

This chapter will discuss several important issues concerning tabular scraper production in the Jafr basin in relation to the more evidence for production, distribution and consumption from other parts of the Southern Levant reviewed in Chapter 8. The questions include 'To which periods are the two types of tabular scraper production sites to be dated?', 'Which areas imported tabular scrapers from the Jafr Basin? ', 'Who produced tabular scrapers in the Jafr Basin?', 'Who were tabular scrapers produced for?', and 'How was tabular scraper production organized?'.

9.2. CHRONOLOGY OF TABULAR SCRAPER PRODUCTION SITES

It is very difficult to date tabular scraper production sites because they rarely yield diagnostic pottery. Only Qa Abu Tulayha, the type site of Qa Abu Tulayha type production sites, is securely dated to the Late EB I and EB II by two radiocarbon data: B.P. 4540±70 (NUTA2-1978) (Calibrated 3362-3102 B.C), B.P 4245±30 (NUTA2-2022) (Calibrated 2902-2765 BC).

However the typology of tabular scrapers excavated from sedentary settlements in Southern Jordan gives further indications of dates. As will be discussed in the next section, tabular scraper production sites in the Jafr Basin probably supplied tabular scrapers mainly to Southern Jordan rather than to all over the Southern Levant.

As discussed in Chapter 8, Chalcolithic villages such as Tell Wadi Faynan and Chalcolithic pastoral nomadic camp sites such as Timnian sites yield small side struck fan shaped tabular scrapers (Fig.8.23, Fig.8.24). These tabular scrapers were probably imported from Gurta Siyyata type production sites because they were typologically similar to the main products at Gurta

Siyyata type sites.

These tabular scrapers were fan shaped and made on small side struck cortical blanks (Fig.8.23, Fig.8.24). They were shaped by dorsal retouching and have their main transverse edges at their distal ends. Their platforms and bulbs were usually left without removal. Their average size is 5 cm in length ×7.6 cm in width. They are smaller than products at Gurta Siyyata type production sites (Fig.9.1, Fig.9.2). However this is probably because of reduction through use. It is noteworthy that no large end struck oval/elongated tabular scrapers are known from Chalcolithic sites in Southern Jordan. Large end struck oval/elongated tabular scrapers were very rare generally in the Southern Levant in the Chalcolithic.

Meanwhile Early Bronze Age villages and centres in Southern Jordan such as Fidan 4 (Early EB I and Late EB I), Hujayrat al Ghuzlan (EarlyEB I), Tall al Magass (Early EB I) and Bab edh Dhra (EB II / III) yield both large end struck oval/elongated tabular scrapers and small side struck fan shaped tabular scrapers (See Chapter 8, Fig.8.26, Fig.8.27, Fig.8.28). These settlements probably imported tabular scrapers from Gurta Siyyata type sites and Qa Abu Tulayha type production sites. The large end struck oval/elongated tabular scrapers are typologically similar to the main products at Qa Abu Tulayha Type sites.

The large end struck oval/elongated tabular scrapers were oval or elongated and made on very large end struck cortical flakes. Some tabular scrapers are over 17 cm in length (Fig.8.26:4). They were shaped by dorsal retouching and usually have very carefully faceted platforms. Bulbs were rarely thinned by invasive ventral retouching.

Tabular scrapers from Early Bronze Age sites in Southern Jordan were usually heavily reduced in size through use. Their average size is 8.4 cm in length and 6.2 cm in width, much smaller than products at Qa Abu Tulayha (Fig.9.1, Fig.9.2).

It is also noteworthy that large end struck oval/elongated tabular scrapers became very common not only in Southern Jordan, but also all over the Southern Levant in the Early Bronze Age (See Chapter 8).

These facts strongly suggest that Gurta Siyyata type tabular scraper production sites can be dated both to the Chalcolithic and the Early Bronze Age while Qa Abu Tulayha type production sites can be dated to the Early Bronze Age (from Early EB I to EBIII). There is also a possibility that tabular scraper production at Gurta Siyyata type sites dated back to the Late Neolithic because tabular scrapers had already appeared in the Late Neolithic in a limited number (See Chapter 8).

9.3. WHICH AREAS IMPORTED TABULAR SCRAPERS FROM THE JAFR BASIN?

This section will discuss the question of the areas which imported tabular scrapers from the Jafr Basin. Several geochemical techniques such as neutron activation analysis and X-ray fluorescence analysis have been developed recently to identify sources of chipped stone raw materials. However these techniques are usually suitable for identifying igneous rocks such as obsidian and sanukite. Methods for identifying flint sources are still poorly developed (Odell 2004). Furthermore raw material observation with the naked eye or with microscopes is also problematic for identifying the origin of tabular scrapers. For example, tabular scrapers made in Eastern Jordan are difficult to distinguish from tabular scrapers made in the Jafr Basin by direct observation because the raw materials are almost identical.

However this author suggests that the Jafr Basin was probably the source of tabular scrapers found in Southern Jordan. Tabular scrapers in other parts of the Southern Levant were produced in other areas. There are several pieces of evidence to support this view.

Firstly other tabular scraper production sites are also known in the Sinai, Negev and East Jordan although they are reported only briefly (Fig.8.1) (Baird 2001, Carter 2001, S.A. Rosen 1997, Wasse and Rollefson 2005). At the moment, tabular scraper production sites with intensive flint mines are known only in the Jafr Basin. However, this is probably because of the small number of archaeological surveys and projects in other arid areas. Future surveys will probably locate tabular scraper production sites with flint mines in the Sinai, Negev and East Jordan. Given the presence of multiple sources over the Southern Levant, it is likely that each tabular scraper source distributed their products to neighbouring regions. The Jafr Basin producers probably supplied tabular scrapers mainly to Southern Jordan.

The typology of tabular scrapers is also suggestive. As discussed in Chapter 8, Chalcolithic tabular scrapers in the Southern Levant show strong regional typological variation. This regional variation hints that each tabular scraper source produced distinctive tabular scrapers and covered only a small region. Tabular scrapers excavated from the Chalcolithic sites in Northern Jordan, Northern Israel and the Northern Negev are different techno-typologically from products produced at Gurta Siyyata type production sites in the Jafr Basin. In contrast, tabular scrapers from the Chalcolithic sites in Southern Jordan such as Wadi Hisma Timnian sites and Tell Wadi Feinan show techno-typological similarities to the products at Gurta Siyyata type production sites. It strongly suggests that the Gurta Siyyata type production sites in the Jafr Basin distributed their products mainly to Southern Jordan in the Chalcolithic.

This regional variation disappeared in the Early Bronze Age. As already discussed in Chapter 8, large end struck oval/elongated tabular scrapers, which are morphologically similar to products produced at Qa Abu Tulayha type production sites in the Jafr Basin, appeared all over the Southern Levant. The author supposes that other tabular scraper sources in the Negev, Sinai and Eastern Jordan also started intensive flint mining and produced identical tabular scrapers in the Early Bronze Age. This might have been caused by increased contacts or transmission of ideas between tabular scraper producers.

At the moment, tabular scraper production sites with intensive flint mines are known only in the Jafr Basin and the possibility that tabular scraper production in the Jafr Basin surpassed production in other sources and enlarged distribution in the Early Bronze Age can not be completely denied. Future surveys and detailed research in other sources is necessary to answer this question.

The number of tabular scrapers produced at Qa Abu Tulayha is also suggestive. Given that 2000 tabular scrapers were produced at Structure 07 and 5000 tabular scrapers were produced at Structure 01 at Qa Abu Tulayha per year, it is unlikely that the Jafr Basin supplied tabular scrapers to all over the Southern Levant (see chapter 6). If one person had consumed one tabular scraper per year, the site of Qa Abu Tulyha could have supplied tabular scrapers to only several villages.

Percentages of tabular scrapers in stone tool assemblages are also informative (Fig.8.4, Fig.8.14). If the Jafr Basin had been the only major tabular scraper production source in the Southern Levant, percentages of tabular scrapers would probably be lower at sites which are far from the Jafr Basin. However, such patterns cannot be seen both in the Chalcolithic and Early Bronze Age (Fig.8.4 and Fig.8.14). It suggests the presence of multiple tabular scraper sources in the Southern Levant.

9.4. WHO PRODUCED TABULAR SCRAPERS IN THE JAFR BASIN?

This section will discuss who was involved in production of tabular scrapers in the Jafr basin and other sources. This is clearly a key question. Several scenarios are possible and may have changed through time.

① The first scenario is that local pastoral nomads embedded tabular scraper production into their seasonal movements. Like modern Bedouins, they probably moved down to the Jafr Basin in rainy seasons (winter and spring) to pasture their animals although the climate in the Chalcolithic and Early Bronze Age was somewhat more humid than today (See Chapter 1). In this scenario, they would also be engaged in tabular scraper production utilizing the high quality Eocene flint in the Jafr Basin. When they returned to the western mountains at the end of the rainy seasons, they transported tabular scrapers to sedentary settlements in the west. They probably exchanged tabular scrapers, their animals, wool and dairy products for cereals, foods, pottery, metal tools and daily items. This type of production can be called 'community specialization'. C.L. Costin defined 'community specialization' as "autonomous individual or household-based production units, aggregated within a single community, producing for unrestricted regional consumption" (Costin 1991).

② The second scenario is that groups of miners and knappers from sedentary settlements in the more humid areas attracted by the high quality Eocene flint in the Jafr basin made special expeditions to exploit the flint sources. Several farming villages such as Tell Wadi Feinan, Fidan 4, Wadi Faynan 100, Barqa el Hetiye and Khirbet Hamra Ifdan and fortified centers such as Bab edh Dhra, Numeira, Mudawwara and Lejjun are actually known in the Transjordanian mountains and Wadi Arabah to the west of the Jafr Basin.(e.g. Chesson, Makarewicz, Kuijt and Whiting 2005, Miller 1991). In this model, the knappers would visit the Jafr Basin and engage in tabular scraper production seasonally. They brought the final products back to their settlements for use and exchange.

③ The third scenario is that mobile specialists perhaps like modern Gypsies were engaged in tabular scraper production. In this model, they would exchange tabular scrapers with sedentary settlements and pastoral nomads.

Each scenario is inherently plausible and many ethnographic parallels to each scenario can be found very easily. Furthermore combinations of these scenarios are also possible. However, on current evidence, the author suggests the first scenario is the most likely. There are several pieces of evidence.

Firstly tabular scraper production sites are known only in steppe/desert areas such as the Sinai, Negev, East Jordan and the Jafr Basin (Baird 2001, Carter 2001, S.A. Rosen 1997, Wasse and Rollefson 2005). However other high quality Eocene flint sources, which are suitable for tabular scraper production, are also present in the Mediterranean area (Fig.8.1). Large Eocene flint nodules are available in the Shephela, Samaria, northern Galilee and Gilead (S.A. Rosen 1997). But tabular scraper production sites are not present in the Mediterranean area. If flint knappers had been sent from sedentary settlements in the Mediterranean area or mobile specialists had produced tabular scrapers, they would also have used flint sources in the Mediterranean area which were close to their settlements. In fact, specialized Early Bronze Age knappers used many of these sources but for Canaanean blade production. It strongly suggests that pastoral nomads in steppes and deserts were engaged in tabular scraper production.

Secondly tabular scraper production sites are often present in relatively remote deserts. The Japanese team found one tabular scraper production site in Bayir (JF0126). Moreover A. Wasse and G. Rollefson recently discovered several tabular scraper production sites even in Wadi Hudruj, which is located near the border between Saudi Arabia and Jordan (Wasse and Rollefson 2005) (Fig.8.1). These sites are about 200 km to the east of the Mediterranean area. If flint knappers had been sent from sedentary settlements in the Mediterranean areas or mobile specialists had been engaged in tabular scraper production to supply mainly to the sedentary settlements, tabular scraper production sites would have been located in the western fringe of deserts and steppes. It was not necessary for knappers from the west to travel so far into the remote arid zone to knap tabular scrapers. It was obviously hard and dangerous for knappers to access remote deserts without in-depth knowledge about such areas.

Thirdly tabular scrapers were more common at pastoral nomadic camp sites in the arid zone sites than at the sedentary settlements in the moister zone. As discussed in Chapter 8, tabular scrapers are usually a high proportion (usually over 20 %) in stone tools (retouched tools) at pastoral nomadic camp sites (Fig.8.4, Fig.8.14). Tabular scrapers were more common tools in pastoral nomadic groups in the arid zone.

9.5. WHO WERE TABULAR SCRAPERS PRODUCED FOR?

This section will discuss for whom tabular scrapers were produced. As discussed in Chapter 7, tabular scrapers are usually less than 3 % of stone tools (retouched tools) at Chalcolithic sedentary settlements while they represent 20% to 30% of stone tools at Chacolithic pastoral nomadic camp sites in the arid areas (Fig.8.4, Fig.8.14). This strongly suggests that in Chalcolithic pastoral nomads in steppes and deserts produced tabular scrapers mainly for their own consumption and only a limited number of tabular scrapers were supplied to sedentary settlements from tabular scraper production centres in steppes and deserts. Tabular scraper production was still a minor industry for pastoral nomads.

However, in the Early Bronze Age, percentages of tabular scrapers in stone tools increased radically at sedentary settlements while their proportions did not change at pastoral nomadic camp sites (Fig.8.4, Fig.8.14) (See Chapter 8). The average percentage of tabular scrapers at Early Bronze Age sedentary settlements is about 9.5 %, about three times higher than the Chalcolithic average percentage.

The increase of tabular scrapers at sedentary settlements probably suggests that more tabular scrapers were supplied to sedentary settlements from tabular scraper production centres in the arid areas. The level of tabular scraper production at production centres probably increased in the Early Bronze Age. Tabular scraper production became an important industry of pastoral nomads for exchange in the Early Bronze Age.

9.6. SUMMARY: HOW WAS TABULAR SCRAPER PRODUCTION ORGANIZED?

Tabular scraper production was probably community specialization by pastoral nomads in the Jafr Basin. Local pastoral nomads in the Jafr Basin probably started tabular scraper production in the Chalcolithic (or the Late Neolithic) (Gurta Siyyata type sites). Chalcolithic tabular scraper production was still less intensive. Intensive flint mining was not carried out. Only limited efforts were made for raw material acquirement. Small flint blocks available on the surface were used as raw material. Chalcolithic tabular scraper production was technologically very simple and less careful. Small side struck fan shaped tabular scrapers were produced at Chalcolithic tabular scraper production sites. Each production episode was short, probably spanned a few days at most. Tabular scrapers were probably produced mainly for their own consumption by the pastoral nomads and only a limited number of tabular scrapers were exported into sedentary settlements. Tabular scraper production was still a minor industry for pastoral nomads. They probably followed west-east seasonal movements like the modern Bedouins. They probably occupied the Jafr Basin during rainy seasons for grazing animals. When they returned to the western mountains at the beginning of the arid seasons, they transported limited numbers of tabular scrapers to sedentary settlements. The author supposes that most groups of pastoral nomads in the Jafr Basin were engaged in this small scale tabular scraper production in the Chalcolithic because producing small side struck fan shaped tabular scrapers was technologically very simple and the raw material was available on the surface with limited efforts. It is also supported by a high incidence of Gurta Siyyata type sites in the Jafr Basin.

However, tabular scraper production in the Jafr Basin radically changed in the Early Bronze Age. Qa Abu Tulayha type production sites appeared. Tabular scraper production was intensified with the introduction of intensive flint mines to produce large end struck oval/elongated tabular scrapers. These large tabular scrapers were probably superior to small side struck fan shaped tabular scrapers in quality as multipurpose knives. Each production episode at Qa Abu Tulayha type sites was relatively lengthy, probably spanning several weeks. The level of tabular scraper production also increased. More tabular scrapers were exported to sedentary settlements. Tabular scraper production became a very important industry for pastoral nomads in the Jafr Basin for exchange. The author supposes that limited groups of pastoral nomads in the Jafr Basin specialized in this intensive tabular scraper production for exchange because producing large end struck oval/elongated tabular scrapers were technologically somewhat difficult and requires a certain degree of training and great efforts were necessary to get raw material. Furthermore the number of Qa Abu Tulayha type sites is much fewer than that of Gurta Siyyata type sites. Other groups also continued less intensive tabular scraper production at Gurta Siyyata type sites.

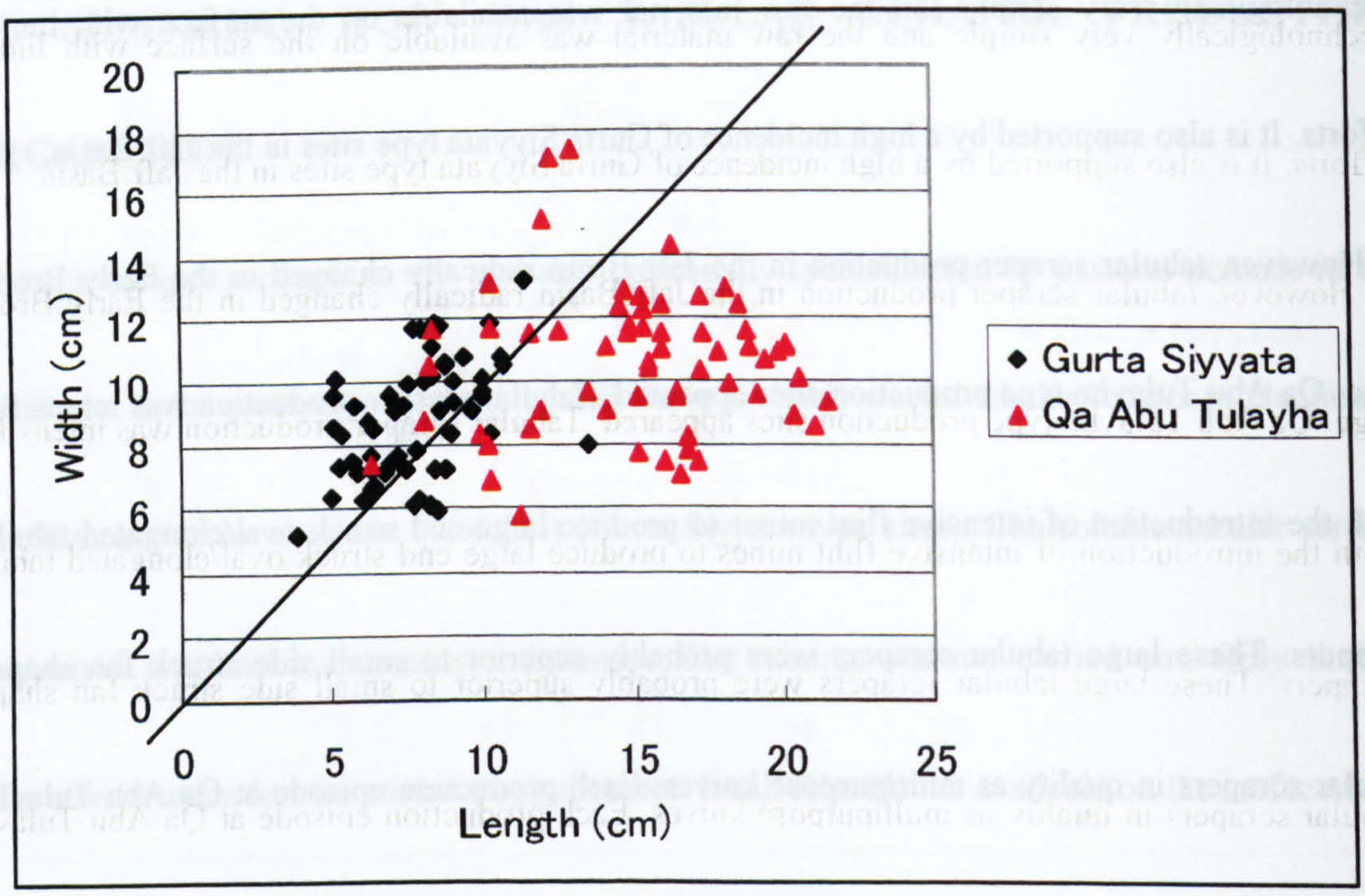


Fig.9.1 Measurements of the main scars on tabular scraper cores from Gurta Siyyata type sites and Qa Abu Tulayha.

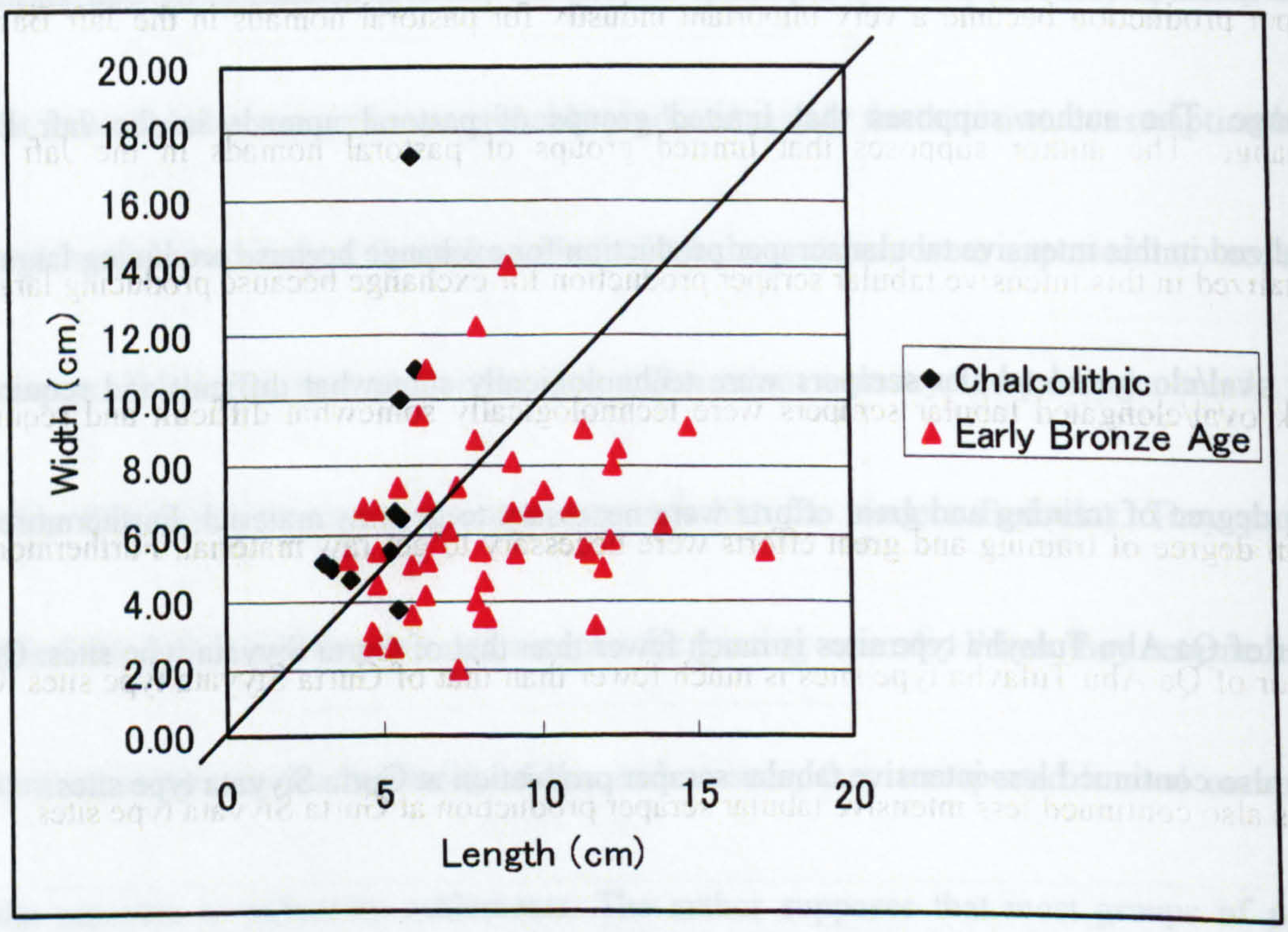


Fig.9.2 Measurements of tabular scrapers from the Chalcolithic and Early Bronze Age sites in Southern Jordan.

CHAPTER 10 A STUDY OF JAFR BLADE PRODUCTION IN THE JAFR BASIN

10.1 RESEARCH HISTORY IN RELATION TO JAFR BLADES

Jafr blades are very large, thick and robust blades (Fig.10.1). The Jafr blade is usually characterized by a large flat plain or natural weathered platform, unidirectional scars (sometimes bidirectional scars) on the dorsal surface, non prismatic configuration, and large size. Their average width is about 3 cm and their length when they are complete sometimes reaches over 15 cm. High quality Eocene flint was used as raw material.

Jafr blades are

mainly distributed in the Jafr Basin. The blades were first reported by R. Huckriede and G. Wiesemann (Fig.10.1) (Huckriede and Wiesemann 1968). During their geological surveys in the Jafr Basin, they found a distinctive blade industry, which is characterized by these robust blades. This blade industry was named 'Matakhian' by them. The name 'Matakhian' is derived from Qa al-Matakh, a small seasonal lake in the Jafr Basin. They dated these blades to the Middle Palaeolithic. However their dating is incorrect as described below.

Following their report, Jafr blades were not studied for a number of decades. It was in the 1990s that archaeological research restarted in the Jafr Basin and discussion of the blades resumed.

Kanazawa University in Japan started archaeological research in the northwestern part of the Jafr Basin in 1995 (Abe and Fujii 2004, Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002 c, Fujii 2003, Fujii 2004a, Fujii 2004b, Fujii 2005a, Fujii 2005b, Fujii 2006a, Fujii 2006b, Fujii and Abe in press). An American team also surveyed the northeastern area of the basin in 1997 and 1999 (Quintero and Wilke 1998a, Quintero and Wilke 1999b, Quintero, Wilke and Rollefson 2002). The results of their projects resemble each other. Both teams discovered a number of tabular scraper production sites in the basin. Almost half of the recorded sites in the basin are tabular scraper production sites (See Chapter 5).

Interestingly Jafr blade production loci were also discovered at most tabular scraper production sites (Table.10.1). The Japanese team discovered 25 tabular scraper production sites in the northwestern area of the Jafr Basin. Of 25 tabular scraper production sites, 20 have Jafr blade production loci.

An important contribution of the recent archaeological research was the re-dating of Jafr blades. The first scholar who re-dated the Jafr blade industry to the post-Palaeolithic was S. Fujii (Fujii 1999, Fujii 2000, Fujii 2002a). He suggests that Jafr blades should be dated to the post-Palaeolithic on the basis of several pieces of evidence from the site of Qa Abu Tulayha. In addition, the term 'Jafr blade' is now used instead of 'Matakhian' by scholars (Fujii 1999, Fujii 2000, Fujii 2002a, Quintero, Wilke and Rollefson 2002).

The main evidence for the re-dating by S. Fujii was the following.

1. Several Jafr blades and Jafr blade cores were excavated from Structure 07 at Qa Abu Tulayha. As already mentioned in Chapter 6, this structure is dated to the Late Early Bronze Age I by one radiocarbon date.

2. One tabular scraper core excavated from Structure 07 was re-used as a Jafr blade core (Fig.10.2). It strongly suggests that the Jafr blade core cannot be dated to the Palaeolithic because tabular scrapers are common tools in the Chalcolithic and Early Bronze Age.

3. The extent of patination on Jafr blades is almost the same as patination on tabular scrapers.

L. Quintero, P. Wilke and G Rollefson also support Fujii's view (Quintero, Wilke and Rollefson 2002). Moreover D. Henry denied the Palaeolithic dating of Jafr blades (Matakhian) from the point of view of technological attributes (Henry1998). It is also noteworthy that stone tool assemblages at several Early Bronze Age sedentary settlements in Southern Jordan such as Bab edh Dhra and Wadi Faynan 100 include several blades, which are techno-morphologically similar to Jafr blades (McConaughy 1979, McConaughy 1980, McConaughy 2003, Moloney 2004) (Fig.10.3).

Jafr blades were usually produced at Gurta Siyyata type tabular scraper production sites rather than at Qa Abu Tulayha type tabular scraper production sites (Table.10.1). Given that Gurta Siyyata type tabular scraper production sites can be dated to the Chalcolithic and Early Bronze Age (See Chapter 9), this blade industry should be dated to the Chalcolithic and Early Bronze

Age.

Currently few technological studies have been done on Jafr blades. S. Fujii briefly reported the basic technological characteristics of Jafr blades from Qa Abu Tulayha (Abe 2002, Fujii 1999, Fujii 2000, Fujii 2002a). L. Quintero, P. Wilke and G Rollefson also briefly compared Jafr blades with other blades from PPNB and Early Bronze Age contexts (Quintero, Wilke and Rollefson 2002).

Therefore one of the main goals in this chapter is to explore technological characteristics of Jafr blade production in detail through the *Chaîne opèratoire* approach. The following sections will introduce Jafr blade production sites discovered by Japanese surveys and analyze a sample from Structure 1001 at Qa Abu Tulayha.

10.2 JAFR BLADE PRODUCTION SITES IN THE JAFR BASIN

Jafr blade production was common at most tabular scraper production sites (Table.10.1). The Japanese team discovered 25 tabular scraper production sites in the surveyed area. Of 25, 20 tabular scraper production sites have Jafr blade production loci.

It is noteworthy that Jafr blade production was more common at Gurta Siyyata type tabular scraper production sites than at Qa Abu Tulayha type tabular scraper production sites. 17 of 19 Gurta Siyyata type sites (90% of the sites) produced Jafr blades with small side struck fan shaped tabular scrapers. A large number of Jafr blade cores and Jafr blades are present at these sites.

Gurta Siyyata type tabular scraper production sites vary in size. The size ranges from 25 ha to 0.2 ha. The small flint blocks on the surface were usually used as raw material for tabular scraper and Jafr blade production. Jafr blade cores and Jafr blades are dispersed widely but in very low density among the natural flint blocks on the surface along with remains of tabular scraper production.

At JF0106, a middle sized Gurta Siyyata tabular scraper production site, one square measuring 4 m×4 m was set up in an area where Jafr blade cores were scattered most densely. The area includes 6 Jafr blade cores and 10 Jafr blades. There are only 0.4 Jafr blade cores per 1 ㎡. At JF0153, another square measuring 4 m×4 m was set up in an area where Jafr blades cores were concentrated most densely. The area includes 3 Jafr blade cores and 7 Jafr blades. There are only 0.2 Jafr blade cores per 1 ㎡. On the basis of these data, it is estimated that there are probably less than 0.1 Jafr blade cores per 1 ㎡ on average at Gurta Siyyata type sites.

The largest Gurta Siyyata type sites probably contained (250000×0.1=) 25000 Jafr blade cores and the smallest Gurta Siyyata type sites probably contained (2000×0.1=) 200 Jafr blade cores. However, as already described in Chapter 7, no structures associated with stone tool production were discovered at Gurta Siyyata type sites. The absence of structures suggests that each knapping episode at Gurta Siyyata type sites was probably short and even the largest production site over 25 ha was formed in multiple short knapping episodes over many years.

In contrast with Gurta Siyyata type sites, Jafr blade cores are extremely rare at Qa Abu Tulayha type sites (Table.10.1). Of 6 Qa Abu Tulayha type sites, only 3 sites contained Jafr blade cores. In addition, the number of Jafr blade cores at these sites is extremely limited. At Qa Abu Tulayha, one Jafr blade production locus, Structure 1001, was discovered. However, only 13 Jafr blade cores were collected around the structure.

Most Jafr blades were produced at Gurta Siyyata type sites. This is because small tabular flint blocks available on the surface are more suitable for Jafr blade production than the quarried large flint nodules. Mining large flint nodules was not necessary for Jafr blade production.

The next section will explore Jafr blade production technologically, analyzing a sample from Structure 1001 at Qa Abu Tulayha.

10.3 JAFR BLADE PRODUCTION AT STRUCTURE 1001, QA ABU TULAYHA.

10.3.1 Structure 1001 at Qa Abu Tulayha and the analyzed sample.

Intensive tabular scraper production at Qa Abu Tulayha has already been discussed in Chapter 6. Along with tabular scraper production, Jafr blades were also produced on a far smaller scale at Qa Abu Tulayha. A small Jafr blade production locus, Structure 1001, was discovered on the eastern slope of the hill where the site is located, in 1998 (Fig.6.3, Fig.10.4).

This oblong structure was visible on the surface even before excavation. Jafr blades and Jafr blade cores were spread inside and outside the structure. The structure measures about 2 m by 3 m. The wall was made of a single row of undressed limestone and flint blocks. Some blocks were put in an upright position.The height of the preserved wall is very low, only about 20 cm. Given that only a few blocks were scattered around the structure, the original wall was possibly only slightly higher than the preserved wall. The construction technique of the structure is very similar to the tabular scraper production structures, Structure 01 and Structure 07.

However, before excavation, Structure 1001 was heavily damaged by local limestone quarrying activities between 1998 and 1999. The structure was deeply buried under a pile of limestone debris from the quarrying. In 2002, the limestone debris was removed and a rescue excavation was conducted (Fujii 1999, Fujii 2000, Fujii 2002a). Unfortunately most of the structure had been erased and its configuration was unclear. During the excavation, no sieving was conducted because of limited time. The structure yielded only chipped stone artifacts. No animal bones, grinding stones or plant remains were discovered. But the presence of several tools such as tabular scrapers, side scrapers, bifaces and burins in the structure suggests that other activities were also carried out along with small scale Jafr blade production in the structure (Fig.10.8).

The author assumes that the whole structure was probably roofed with organic materials although no postholes were discovered. No hearths were discovered. This may be because of disturbance by the modern quarrying.

The chipped stone sample analyzed in this chapter was from the surface collection in 1998 and from the excavation in 2002 of Structure 1001. The total number of sample is 155 (Table.10.2). The sample is small because of the damage by the limestone quarrying and lack of sieving.

The sample includes a few Middle Palaeolithic stone artifacts: a Levallois core and Levallois flake (Table.10.2, Table.10.3, Fig.10.7:1). It also includes artifacts related to tabular scraper production (Table.10.2, Table.10.3, Fig.10.7:2, 3, Fig.10.8). But most of the collection was derived from Jafr blade production (Table.10.3).

The method of analysis is based mainly on that developed by Y. Nishiaki for the Naviform cores from Douara cave II in Syria (Nishiaki 1992, Nishiaki 2000a). The next sections will discuss the Jafr blade production technology following the knapping sequence from raw material procurement to tool use.

10.3.2 Raw material procurement

Eocene flint beds were exposed in places around the structure. The flint beds were weathered and naturally shattered into small flint blocks. These small flint blocks cover the land surface around the structure. Their size is usually slightly larger than that of a human fist. Like Gurta Siyyata type tabular scraper production sites, the flint blocks on the surface were selected as raw material for Jafr blade production. The flint blocks are very high quality Eocene flint. However the flint is not homogeneous in quality. Outer parts below the cortex are brown or black coloured and fine in quality. However the inner parts of the flint are cream coloured and coarser in quality.

For Jafr blade production, tabular flint blocks (usually about 6 cm in thickness) were preferred as raw material (Fig.10.5, Fig.10.9, Table.10.4). Both sides of tabular flint blocks are usually covered with cortex. Tabular shaped flint blocks are suitable for blade production.

Mined large flint nodules were never used for Jafr blade production. Flint mining was not necessary for Jafr blade production.

10.3.3 Core preparation

Jafr blade production did not include any complicated core preparation (Fig.10.9). Bifaces were not prepared as preforms because the original forms of tabular blocks are already suitable for blade production without any core preparation.

One striking platform was usually created by removing a single platform spall. The main goal of creating the striking platform was to make the platform angle appropriate (usually about 75 degrees).

Jafr blade cores are most frequently unidirectional cores with only one single platform (Fig.10.5, Table.10.7, Table.10.12). The collection also includes opposed platform cores with two platforms (Fig.10.5:5-7). However, these cores probably represent the later stages of core reduction as will be explained below.

Plain platforms created by detaching a single platform spall are the most common platform type (Table.10.11). Natural weathered surfaces of the flint blocks were also often used as platforms without any platform spall removal (Fig.10.5:1, 5). 46 % of the cores have a weathered platform. 15 % of the Jafr blades have a weathered butt (Table.10.21, Fig.10.6:9). Tabular flint blocks with naturally appropriate platform angles were probably selected.

The Jafr blade production is very simple production taking advantage of the natural form of tabular flint blocks. Because of the original tabular shape, to make bifaces as preforms was unnecessary. Even the creation of striking platforms by removing spalls was not always necessary.

10.3.4 Core reduction

Firstly the primary blade was flaked from the working surface (Fig.10.9). The collection from Structure 1001 includes a few crested pieces (N=2) (Fig.10.6:13). However, to make crests for primary blades was rare. Cortical primary blades with a natural ridge in the centre are more common (N=7) (Fig.10.6:12, Fig.10.9). Natural ridges of the tabular flint blocks were used as guide lines for removing cortical primary blades. After removing the primary blade, the second blade was detached following the scar of the primary blade. Then a series of blades were continuously detached following the scars of previously detached blades.

Jafr blades were probably detached by direct percussion with soft stone hammers such as flint and limestone. Hammer modes of the blades were spread across categories of mode I , II and III (Table.10.17). According to Japanese archaeologists, the pattern on Table.10.17 is related to direct percussion with soft stone hammers (Suzuki, Igarashi, Onuma, Kadowaki, Kunitake, Sunada, Nishiaki, Midoshima, Yamada and Yoshida 2002).

Indeed the sample includes several flint hammers (Fig.10.7:4, 5). In addition, 2 Jafr blade cores have battered signs. The cores were probably reused as hammers (Table.10.5).

Jafr blade production was very simple blade production. Blades are usually thick and non prismatic. They have large plain or weathered butts. The average size of their butts is about 1.8 cm×0.9 cm (Table.10.18, Table.10.19. Table.10.20). In addition, most blades were detached without any platform preparation. Only 40 % of the blades show overhang removal by facting or abrasion on their dorsal surfaces (Table.10.22).

Jafr blade cores can be divided into the following types although the collection does not include Type II -a probably because of the small sample size.

Type I -a (N=9): Jafr blade cores with one platform and one flaking (working) surface (Fig.10.5:1-4).

Type I -b (N=3): Jafr blade cores with two opposed platforms and one flaking surface (Fig.10.5:5-6).

Type II -a (N=0): Jafr blade cores with one platform and two working surfaces.

Type II -b (N=1): Jafr blade core with two opposed platforms and two flaking surfaces (Fig.10.5:7).

These core types probably represent different stages of core reduction sequences (Fig.10.9). Type I -a cores must be the most basic while other types are reduced cores in more advanced stages of core reduction sequences.

This is supported by the size of cores, the shapes of scars and termination patterns on the main flaking surfaces of cores and the scar patterns of the dorsal surfaces on blades.

Type I -a cores vary in size from large to small cores while other core types are medium sized (Fig.10.11). It suggests that Type I -a cores represent several stages from initial to final stage of the reduction sequences. The type I -a cores were probably the basic forms through the sequences. The other cores are middle sized. It suggests that the other types of cores are cores in advanced stages of reduction.

The shapes of scars and termination patterns on the main flaking surfaces of cores are also suggestive (Fig.10.12, Fig.10.13). Flake scars are more common on the main flaking surfaces of non Type I -a cores. Moreover hinged terminations are always seen on non Type I -a cores. These facts suggest that non type I -a cores are more reduced and exhausted than the Type I -a cores.

The scar patterns of the dorsal surfaces of blades are also important. In the sample, unidirectional blades are more common than bidirectional blades (Table.10.23). About 70% of the blades are unidirectional blades.

Unidirectional cores with one platform and one main flaking surface (Type I -a) represent the basic form of Jafr blade production. Other core types are probably the result of core exhaustion and/or mistake correction (Fig.10.9).

Blades in the sample can be divided into the following five types on the basis of butt morphology and cortex (Table.10.15).

Cortical blades (N=12): Blades whose dorsal surface is half or more than half covered with cortex or weathered surface *(Fig.10.6: 12).*

L type blades (N=19): Partially cortical or non-cortical blades with a butt intersecting the long axis at an obtuse angle (Fig.10.6: 1-3).

M type blades (N=13): Partially cortical or non-cortical blades with a butt intersecting the long axis at nearly right angle (Fig.9.6: 4-8).

R type blades (N=21): Partially cortical or non-cortical blades with a butt intersecting the long axis at an acute angle (Fig.10.6: 9-11).

Other blades (N=17): Partially cortical or non-cortical blades without a butt. They can not be classified into any of the above classes because of the lack of butt.

L type blades, M type blades and R type blades were probably detached from different parts of Jafr blade cores (Fig.10.10). As shown by Y. Nishiaki, who analyzed the Naviform blade method at Douara II, Syria, L type blades were probably detached from left sides of Jafr blade cores. M type blades were probably flaked from middle parts of cores and R type blades were from right sides of cores.

This is strongly supported by position of cortex on blades (Fig.10.14, Table.10.16). Cortex on L type blades is usually along the left side of blades, and cortex on R type blades is usually along the right side. M type blades have no cortex or have cortex along both sides.

As will be discussed later, M type blades are more carefully detached than other blades. M type blades are probably the main products of Jafr blade production.

10.3.5 Core maintenance

The collection includes a number of blades with hinged terminations or plunged terminations (Table.10.25). Nearly 40 % of the blades have plunged or hinged terminations. Furthermore scars with hinge terminations can often be seen on the main surfaces of Jafr blade cores (Table.10.14).

This high incidence of knapping failures, hinging and plunging, was probably caused by the imprecise nature of the Jafr blade production.

The growth of hinge termination scars on the main surfaces prevents the further smooth detaching of blades and requires core maintenance. Several methods of core maintenance were observed in the sample.

The collection includes one core tablet. Hinged parts of cores can be removed by detaching core tablets. Some plunged blades were also detached intentionally for removing hinged parts.

Transforming unidirectional cores into bidirectional cores by making another platform is another method of maintenance (Fig.10.5: 5-7). It is very easy to remove developed hinged termination scars by blows from the opposite platform. Indeed the collection includes several bidirectional cores (Type I - b , II -b cores) and bidirectional blades. To abandon the flaking surface and make another flaking surface on the back of the core is also another method. Indeed the sample includes one core with two flaking surfaces (Fig,9.10:7).

10.3.6. Core abandonment

Cores were abandoned after core exhaustion or flaking failures. Battering signs on several cores imply that some cores were reused as hammerstones after core abandonment (Table.10.5).

10.3.7. Blade selection

The assemblage from Structure 1001 includes only 6 tools: one bifacial tool, one tabular scraper, one side scraper, one end scraper, one burin, and one truncated piece (Fig.10.8, Table.10.2). Although the burin, side scraper and end scraper were made on Jafr blades, the paucity of tools in the sample suggests that most of the detached blades were brought out and used at other places.

As mentioned earlier, Jafr blades can be divided into 5 types: cortical blades, L type blades, M type blades, R type blades and other blades. Cortical blades were probably byproducts because most dorsal surfaces of the blades are covered with cortex. They were not suitable for use and not good blanks for tools.

It is noteworthy that M type blades were more carefully detached than R and L type blades. M type blades were probably the main products of the Jafr blade production. Characteristics of M type blades are listed below.

- M type blades are thinner than R and L type blades (Fig.10.19, Fig.10.20, Fig.10.21, Table.10.18, Table.10.19, Table.10.20). The average thickness of M type blades is about 1.2 cm while the average thickness of L and R type blades is about 1.8 cm and 1.4 cm respectively.

(T-test does not show any significant differences in thickness between these three types of blades. This is probably because of the small number of these blades). As will be mentioned later, Jafr blades were probably used as sickle elements and hafted into sickles. Thin M type blades were more suitable for hafting and probably preferred as sickle elements. In addition, thin blades usually have sharper edges than thick blades.

- The width of M type blades is more uniform and focuses on 3 cm (the average width is 3.15cm) (Fig.10.16, Fig.10.17, Fig.10.18, Table.10.18, Table.10.19, Table.10.20). Sickles were usually composite tools and many sickle elements were inserted to the hafts of sickles. Dulled elements were often replaced with new elements. Therefore uniform width was necessary for hafting and replacement of sickle elements. Therefore M type blades are more suitable as sickle elements than other blades.

- Most M type blades (nearly 70 %) are non-cortical blades while most of the R and L type blades (85 % and100 % respectively) retain cortex (Fig.10.14, Table.10.16). Non-cortical blades were probably preferred.

- M type blades were usually flaked after careful overhang removal by dorsal faceting or abrasion. Most M type blades (about 77 %) show overhang removal while most R type blades and L type blades (67b% and 79 % respectively) were flaked without overhang removal (Fig.10.22, Table.10.22). It suggests that M type blades were more carefully detached than other blades.

- M type blades (N=13) are fewer than R type blades (N=21) and L type blades (L=19) in number. Although the sample size is small, it hints that more M type blades were exported from Structure 1001 than other blades. Moreover most other blades, which are not classified into these three types because of the lack of proximal ends, have cortex along their left or right side. Judging from the position of cortex, most other blades were perhaps fragments of R type and L type blades rather than fragments of M type blades (Fig.10.15). This fact also emphasizes the paucity of M type blades at Structure 1001.

- Some M type blades show paralleled edges and prismatic configuration and have trapezoidal cross section (Fig.10.6: 5, 7) while R type and L type blades are usually irregular shaped.

On these grounds, it can be concluded that R type and L type blades were probably byproducts of Jafr blade production. They were probably detached mainly for peeling cortex and making ridges for M type blade detachment. M type blades were probably the main desired products and exported from the knapping station, Structure 1001.

The Jafr blade production is very simple blade production taking advantage of the natural form of tabular flint blocks. Bifaces were not produced as preforms before blade removal. Natural weathered surfaces were often used as platforms without creating any platforms. Jafr blades were thick and non-prismatic. They have large butts. Most blades were detached without any platform preparation. M-type blades detached carefully from middle parts of cores were the main products of Jafr blade production.

10.4 JAFR BLADES AND SEDENTARY FARMING SETTLEMENTS TO THE WEST OF THE JAFR BASIN

It is likely that most pastoral nomads in the Jafr Basin during the Chalcolithic and Early Bronze Age were engaged in Jafr blade production. Jafr blades were probably produced at the individual level. There are several pieces of evidence to support this idea. Firstly Gurta Siyyata type tabular scraper production sites where a large number of Jafr blades were produced are very common all over the Jafr basin. The Japanese and American team discovered 84 Gurta Siyyata type sites in the Jafr Basin in total (See Chapter 7). Secondly raw material of Jafr blade production could be available on the surface with limited efforts. Thirdly the Jafr blade production is technologically very simple. It does not require a significant degree of knowledge or experience to produce Jafr blades.

Most Jafr blades were probably produced for their own consumption by pastoral nomads in the Jafr basin. They were used as blanks for other tools such as side scrapers, end scrapers and burins (Fig.10.8). As in the sedentary farming settlements, which will be discussed below, it is likely that Jafr blades (M type blades) were also used as sickle elements to harvest wild plants in steppes and deserts.

Given the close relationship between tabular scrapers and Jafr blades, some Jafr blades, especially M type blades, were probably distributed to sedentary settlements. In fact, several

Early Bronze Age sedentary settlements in Southern Jordan yield sickle blades which are very similar to M type Jafr blades both technologically and morphologically.

Bab edh Dhra is an Early Bronze Age fortified settlement on the eastern side of the Dead Sea. M. McConaughy reported on the flint artifacts from the site (McConaughy 1980, McConaughy 2003). According to M. McConaughy, three varieties of sickle blades were excavated from EB II / III contexts at the site: backed sickle blades, Canaanean sickle blades and Mersin-like sickle blades.

The majority of sickle blades at Bab edh Dhra are backed sickle blades. Two types of backed sickle blades, backed/bitruncated sickle blades (Fig.10.23:6,7) and arched backed sickle blades (Fig.10.23:8,9), are known. They were made on small non-prismatic blades with triangular cross section. The blades were narrow and their width is usually less than 2 cm (Fig.10.23:5-9). They were produced at Bab edh Dhra using local coarse flint wadi cobbles. Backed sickle blades were typical sickle blades at sedentary farming settlements to the west of the Jafr basin. They are known at Bab edh Dhra and Numeira on the east side of the Dead Sea, Fidan 4 and Tall al-Magass in Wadi Araba, the Uvda Valley in the Negev and Minsahlat in the Transjordanian Plateau (Fig.10.24) (Avner 1998, Baird 2001a, Chesson, Makarewicz, Kuijt and Whiting 2005, Herling 2002a, Herling 2002b). To produce backed sickle blades were technologically very simple. According to S.A. Rosen, they were produced at the household level on site using local coarse flint (S.A. Rosen 1997).

Limited numbers of Canaanean sickle blades were also excavated at Bab edh Dhra (Fig.10.23:1-4). Given that non-local high quality Eocene flint was used as raw material and no Cannaanean cores were discovered at the site, Canaanean blades were imported from other sites. Because Canaanean blades were much more common in the north area of the Southern Levant, Bab edh Dhra probably imported them from the north (Fig.10.24). Canaanean blades are large prismatic blades. Their width is usually over 2 cm and their length when they are complete sometimes reaches over 20 cm. Canaanean blades are usually thin and have symmetrical trapezoid cross section. Mined large and fresh flint nodules were used as raw material. Canaanean blades were probably knapped from cores by indirect percussion with a punch or pressure flaking with special devices such as levers. Canaanean blade production requires a certain degree of knowledge and training. According to S.A. Rosen, they were probably produced by specialists at limited sites.

The third type of sickle blade at Bab edh Dhra is called 'Mersin-like blades'. They were used as sickle elements without any modification. M. McConaughy did not report fully on the techno-typological attributes of the blades. However, several figures published in his reports clearly show that Mersin-like blades were very similar techno-morphologically to M type Jafr blades. In addition, flint of similar texture and colour was used for Jafr blades and Mersin-like blades (Fig.10.3).

Mersin-like blades and Jafr M type blades share common techno-morphological characteristics.

Mesrsin-like blades are large, unidirectional blades. They are much wider than backed sickle blades and Canaanean blades. Their width is over 3 cm. Mersin-like blades have a trapezoidal cross section but characterized by a non-prismatic configuration. They also have large plain platforms (Fig.10.3).

Given that Bab edh Dhra is only 90 km to the northwest of Qa Abu Tulayha and no cores of Mersin-like blades were discovered at the site, it is highly possible that the site imported Jafr blades (Mersin-like blades) with tabular scrapers from pastoral nomads in the Jafr Basin.

Inhabitants at Bab edh Dhra probably imported two types of sickle blades, Canaanean blades from the north and Jafr blades from the Jafr basin while they also produced the majority of sickle blades, backed sickle blades, by themselves on site.

An Early Bronze Age I site, Wadi Faynan 100, also yielded large blades, which resemble Jafr blades (Fig.10.3) (Moloney 2004). Future research would discover Jafr blades at other sedentary farming settlements in Southern Jordan.

Pastoral nomads in the Jafr basin probably supplied M type Jafr blades to sedentary farming settlements to the west. Jafr blades were used as sickle elements and possibly as threshing teeth at these sites. However, currently many important questions about Jafr blades such as 'how many Jafr blades were supplied to the sedentary farming settlements?' and 'were there any temporal changes in Jafr blade production like intensification of tabular scraper production in the beginning of Early Bronze Age?' are unclear. Future excavations and detailed research on stone tools from sedentary settlements in Southern Jordan would answer these questions.

10.5 SUMMARY

Jafr blades are large, thick and robust blades. The blade is generally characterized by a large plain or natural weathered platform, unidirectional scars (sometimes bidirectional scars) on the dorsal surface, non-prismatic configuration, and large size. Their width is usually about 3 cm and their length sometimes reaches over 15 cm. Eocene high quality flint was used as raw material. The blades used to be dated to the Palaeolithic. However recent studies dated the blades securely to the Chalcolithic and Early Bronze Age.

Jafr blade production loci were discovered at most tabular scraper production sites in the Jafr basin. However, most Jafr blades were produced at Gurta Siyyata type tabular scraper production sites. A large number of Jafr blade cores and Jafr blades are present at most Gurta Siyyata type sites. Small flint blocks on the surface were collected and used as raw material for Jafr blade production. Flint mining was not conducted for Jafr blade production.

The Jafr blade production is very simple blade production taking advantage of the natural form of flint blocks, which were collected on the surface. Bifaces were not produced as preforms before blade removal. Natural weathered surfaces were often used as platforms without creating any platforms. Most detached blades were thick and non-prismatic. They were detached without any platform preparation.

The main desired products of Jafr blade production were M type blades, which were knapped from the middle parts of the cores. M type blades are thin and have sharp edges. They are usually non-cortical and have uniform width. Their width is usually about 3 cm. They were more carefully detached than other blades. They usually show overhang removal by careful faceting or abrasion on dorsal surfaces. Furthermore some M type blades are parallel sided, prismatic and have trapezoidal cross sections.

Jafr blades were probably produced at the individual level. Most pastoral nomads in the Jafr basin in the Chalcolithic and Early Bronze Age were engaged in the production. Most Jafr blades were probably used for their own consumption by pastoral nomads in the Jafr basin.

However some Jafr blades (M type blades) were exported to sedentary settlements to the west of the Jafr Basin with tabular scrapers. In fact, some Early Bronze Age sites such as Bab edh Dhra and Wadi Faynan 100 yielded distinctive blades which resemble Jafr blades techno-typologically. M type blades were used as sickle elements and threshing teeth at these sedentary settlements.

But, currently many important questions about Jafr blades such as 'how many Jafr blades were supplied to the sedentary farming settlements?' and 'were there any temporal changes in Jafr blade production like intensification of tabular scraper production in the beginning of Early Bronze Age?' are not clear. Future excavations and detailed research on stone tools from sedentary settlements in Southern Jordan would answer these questions.

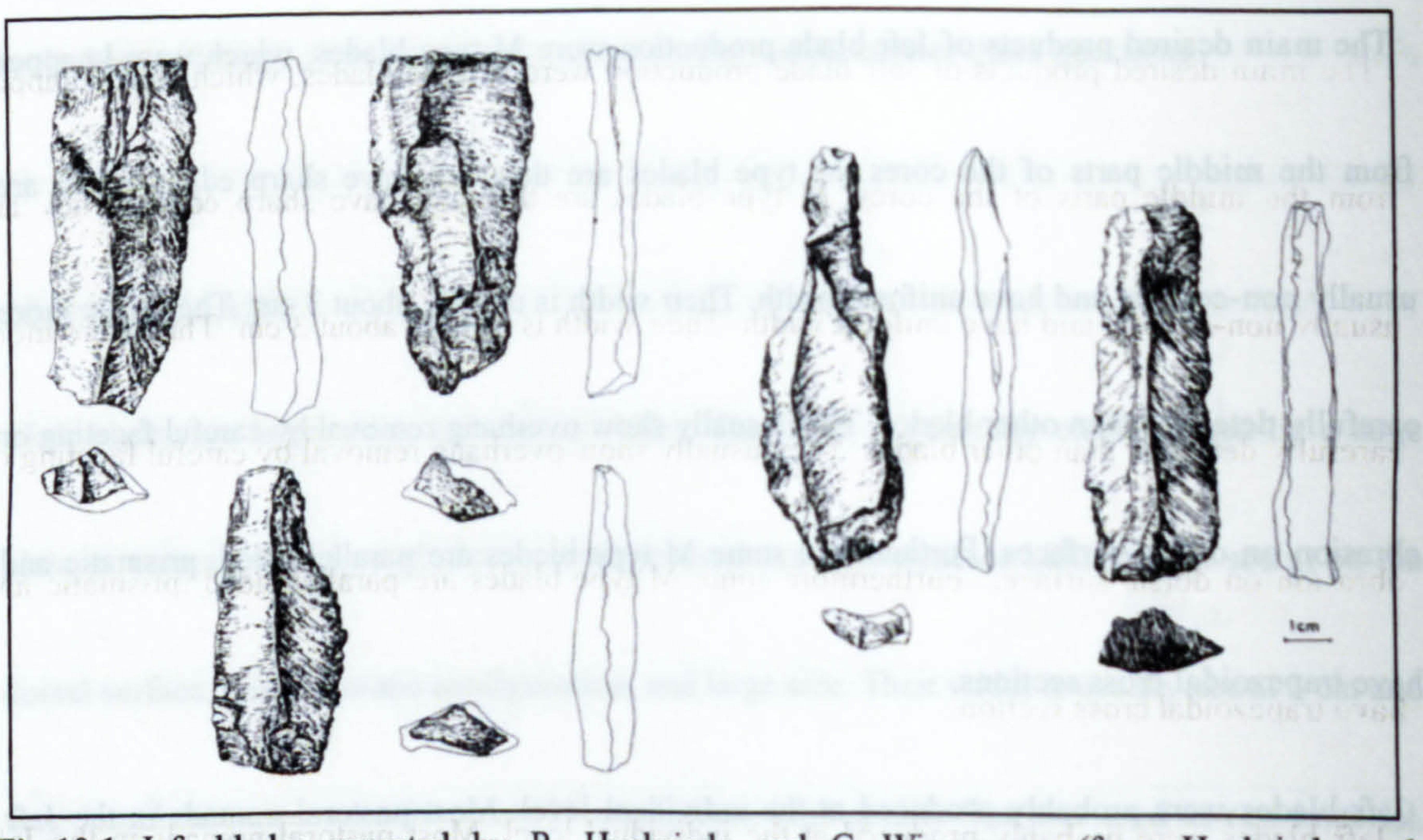


Fig.10.1 Jafr blades reported by R. Huckriede and G. Wiesemann (from Huckriede and Wiesemann 1968).

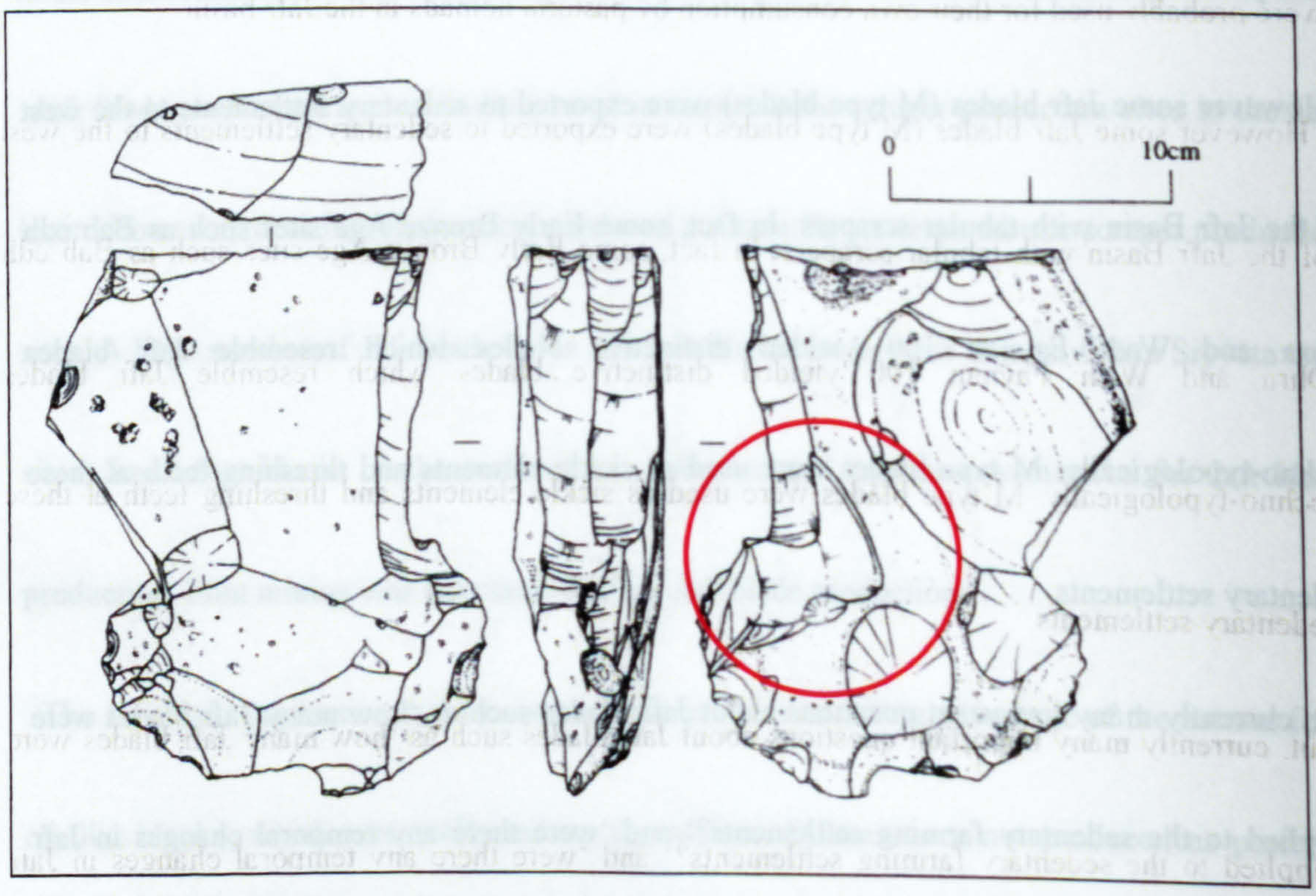


Fig.10.2 Jafr blade core reused as a tabular scraper core (from Fujii 2000).
The circle shows where a Jafr blade scar cuts a tabular scraper flake removal scar.

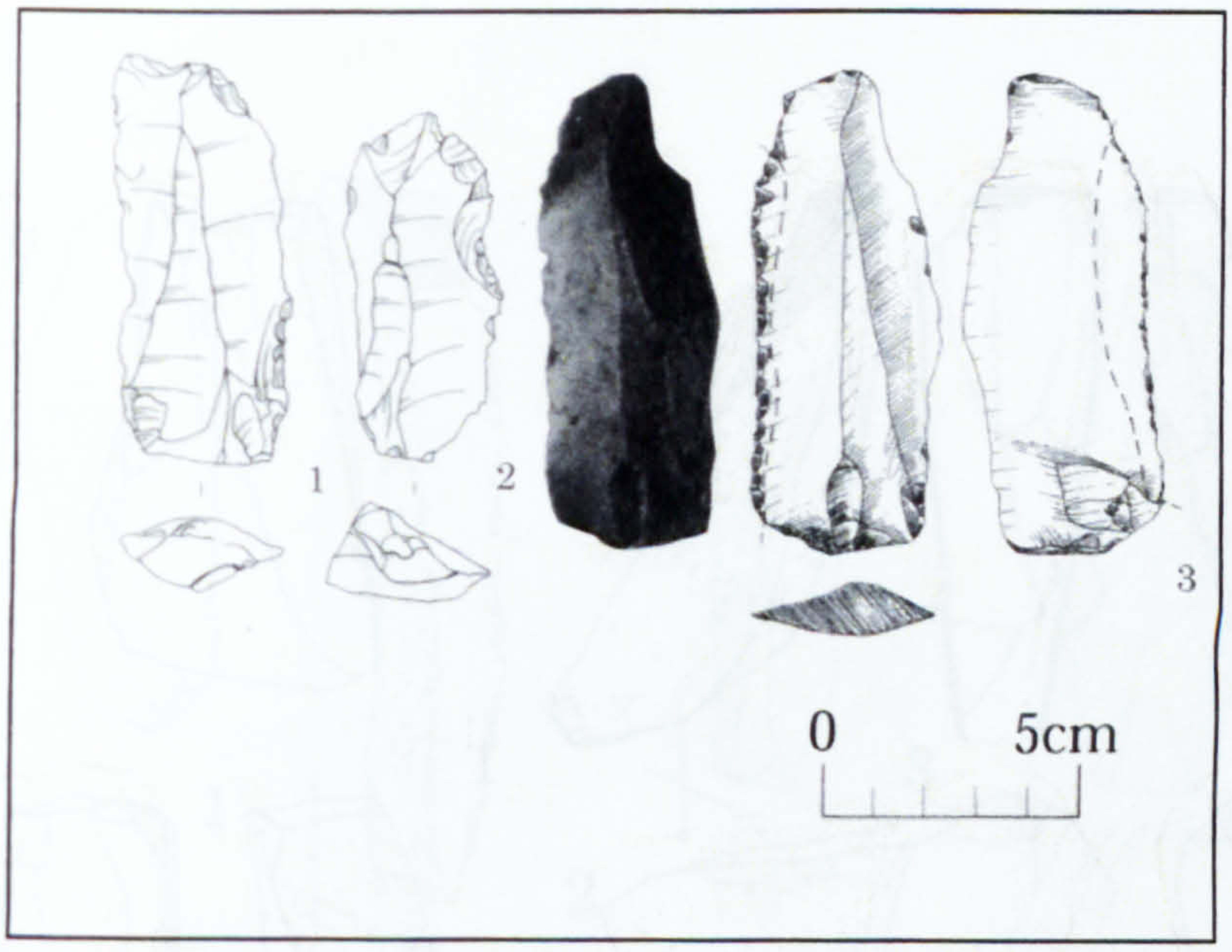


Fig.10.3 Jafr blades from Early Bronze Age sedentary settlements in Southern Jordan.
1-2: Wadi Faynan 100 (from Moloney 2004), 3: Bab edh Dhra (from MacConaughy 1980, 2003)

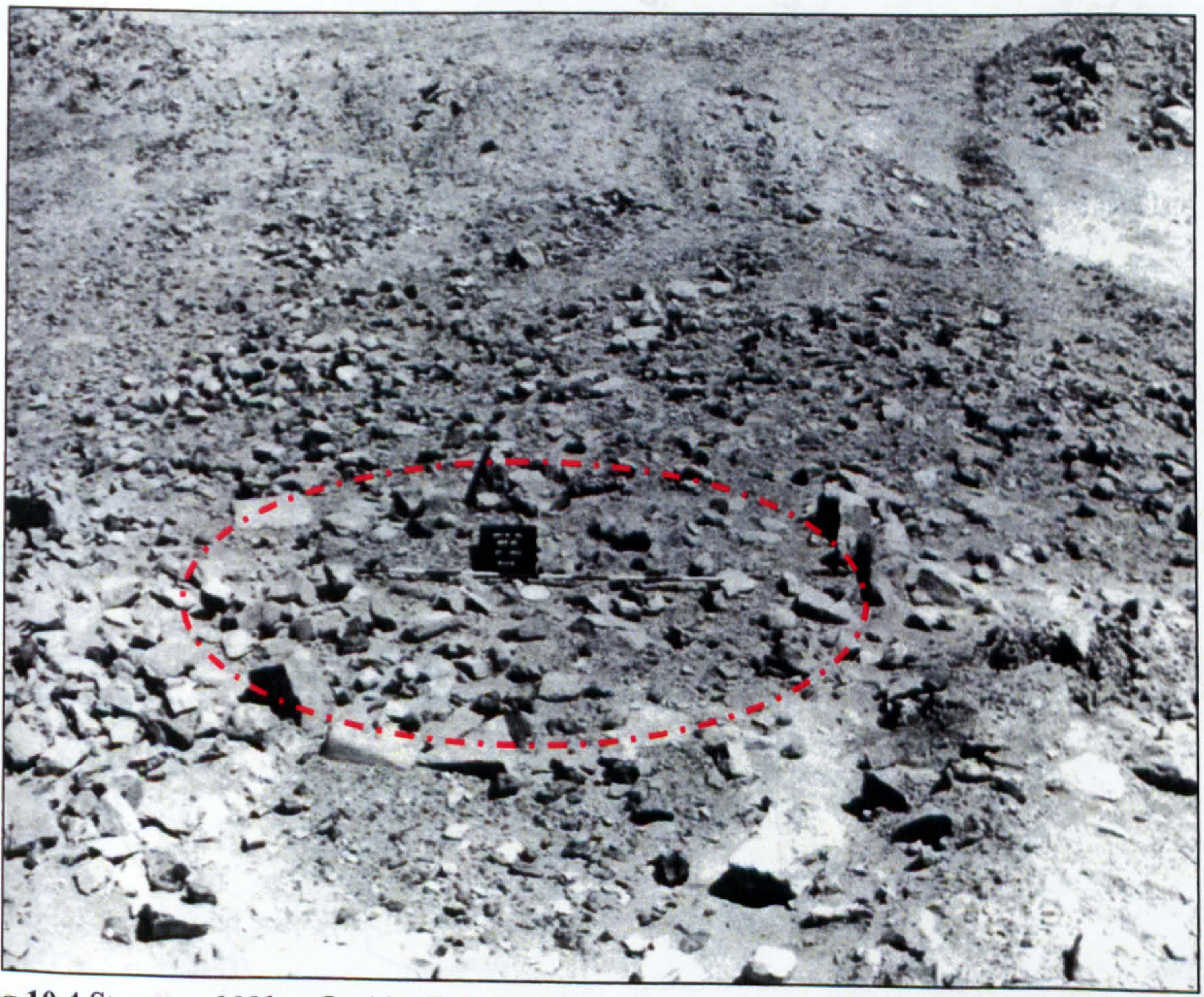


Fig.10.4 Structure 1001 at Qa Abu Tulayha before destruction by modern limestone quarrying.

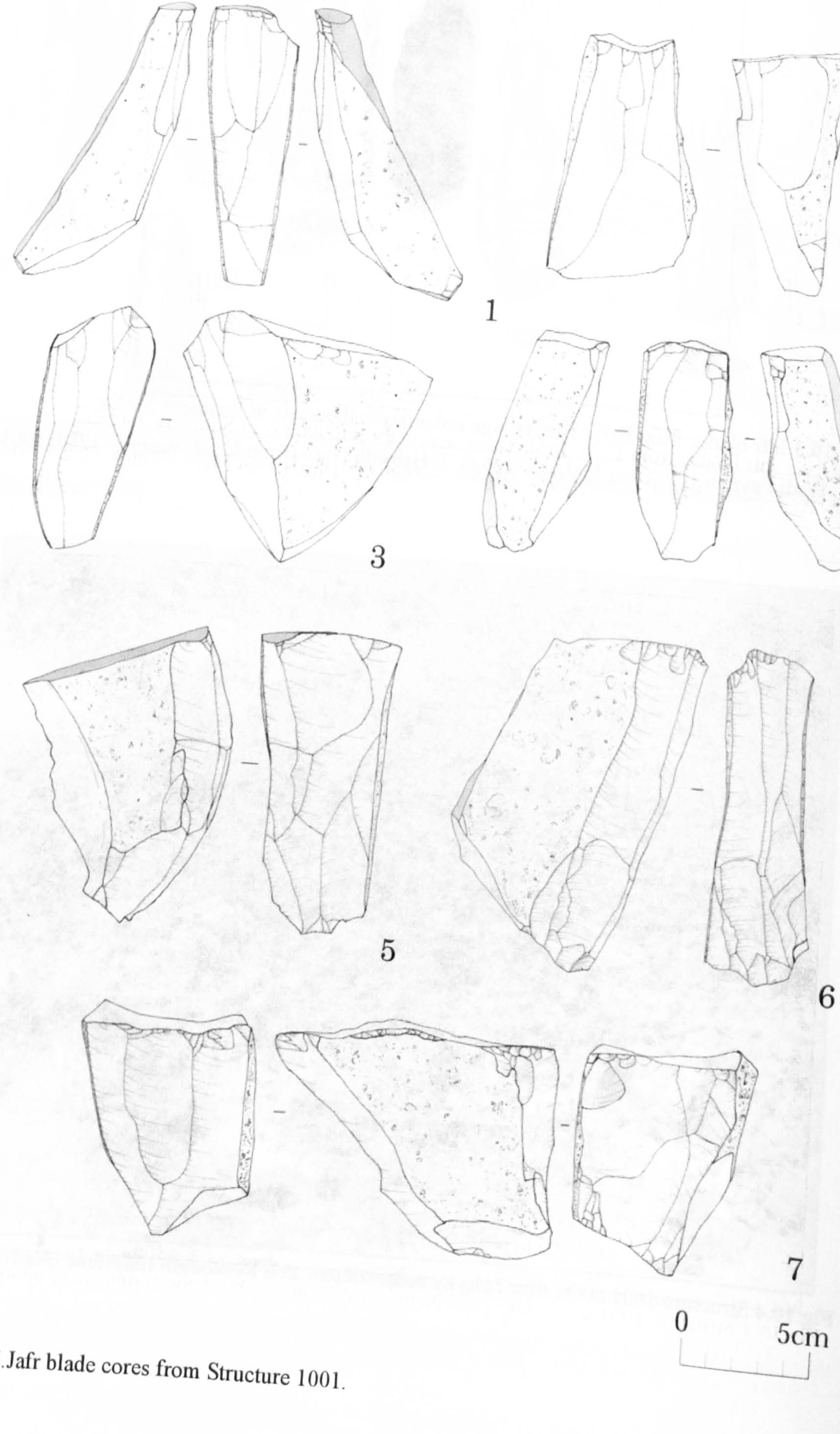


Fig.10.5.Jafr blade cores from Structure 1001.

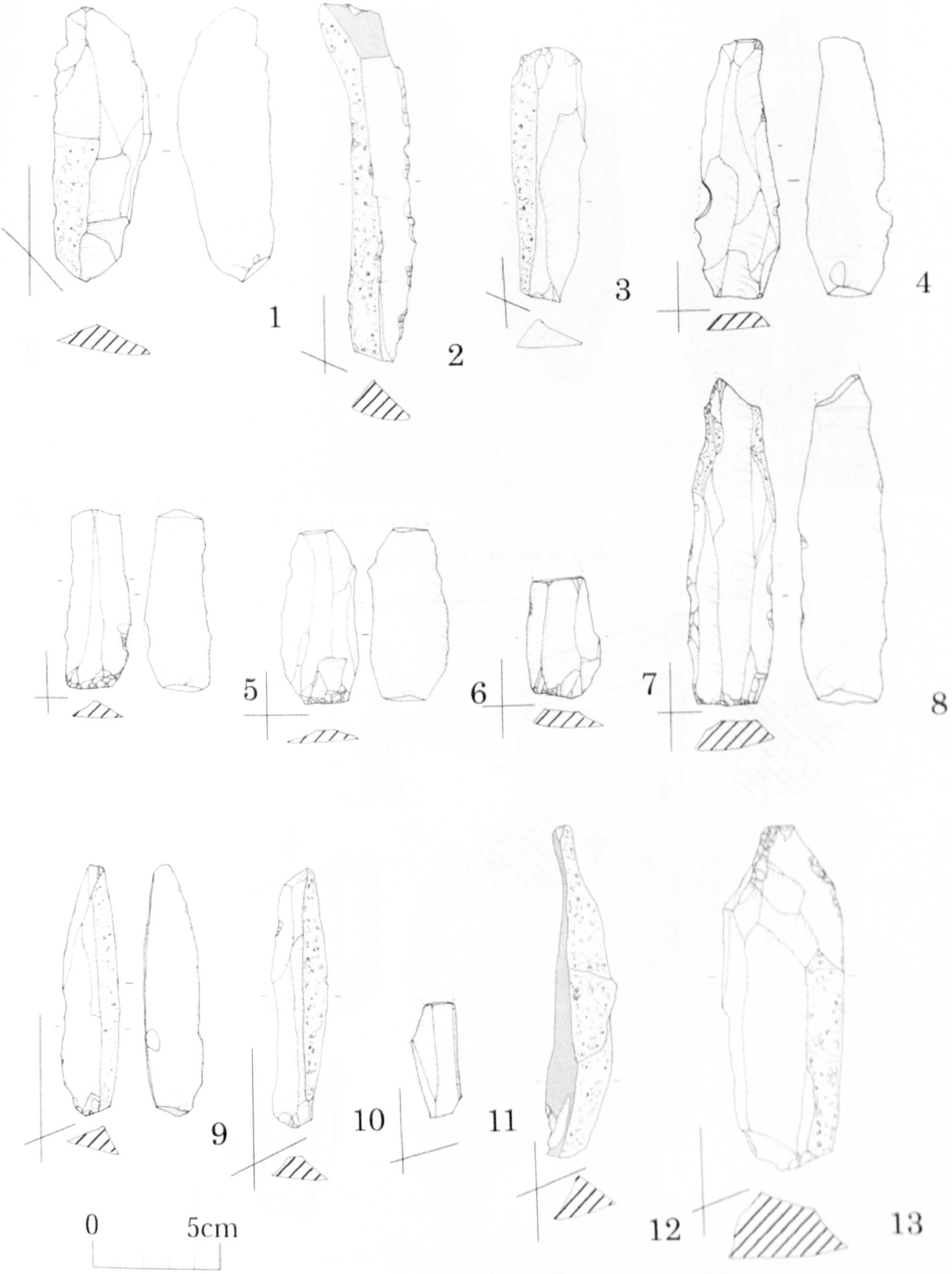


Fig.10.6 Jafr blades from Structure 1001.

1-3: L type blades, 4-8: M type blades, 9-11: R type blades, 12: Cortical blades, 13: Crested piece.

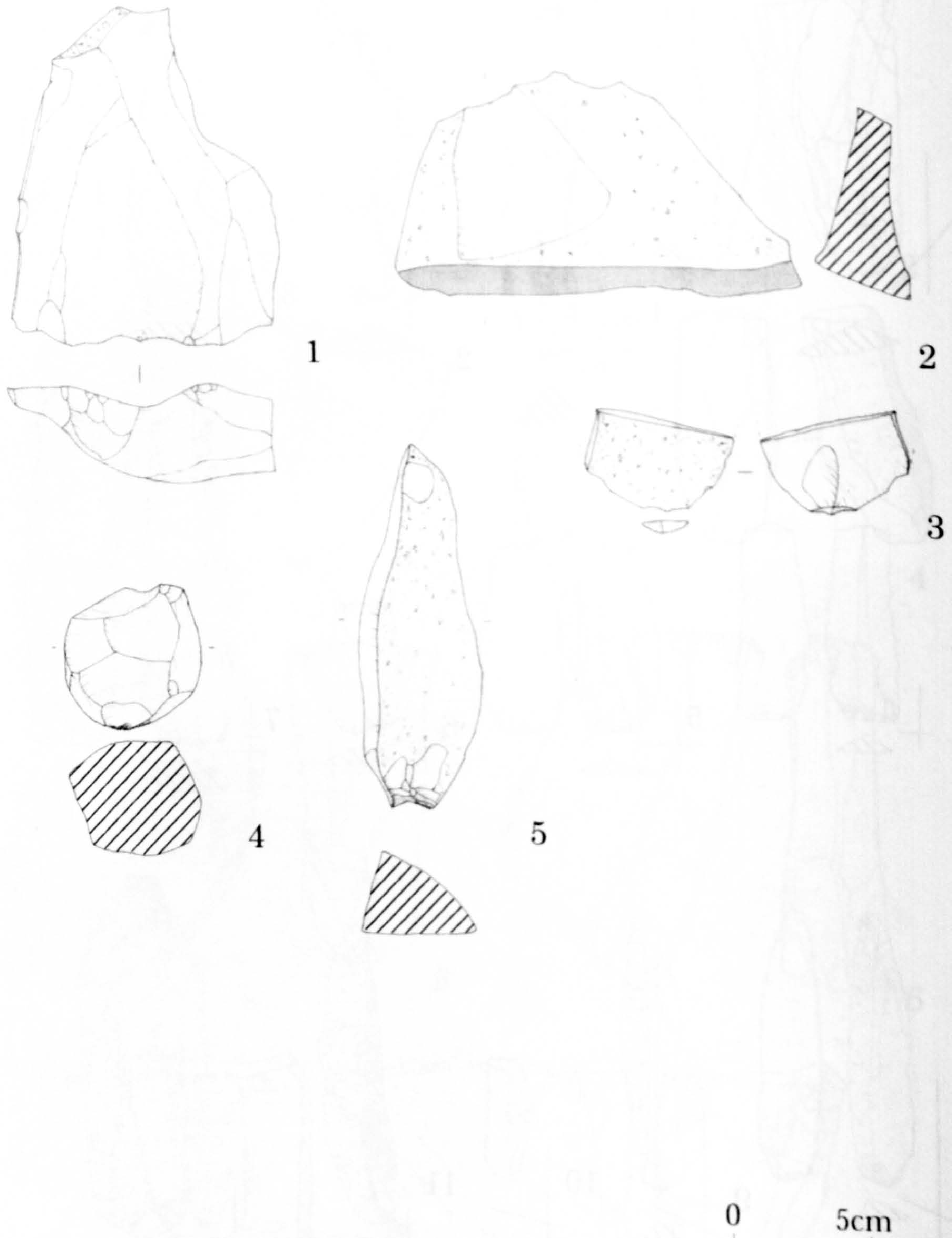


Fig.10.7 Various flint artifacts from Structure 1001.

1: Levallois core, 2: Tabular scraper core, 3: Tabular scraper flake, 4, 5: Hammer stones.

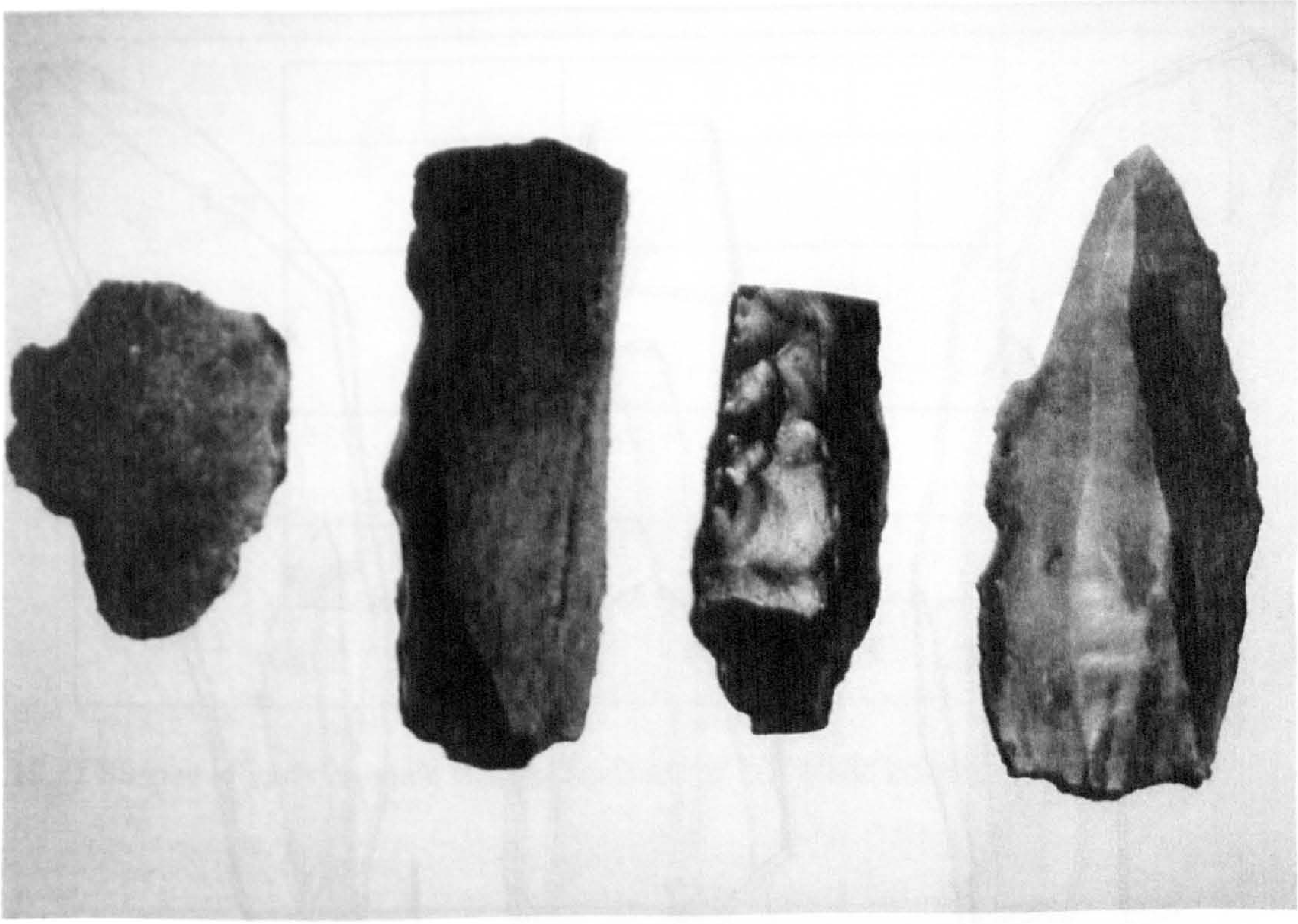


Fig.10.8 Various tools from Structure 1001.

Tabular scraper, side scraper, biface and burin (from left to right).

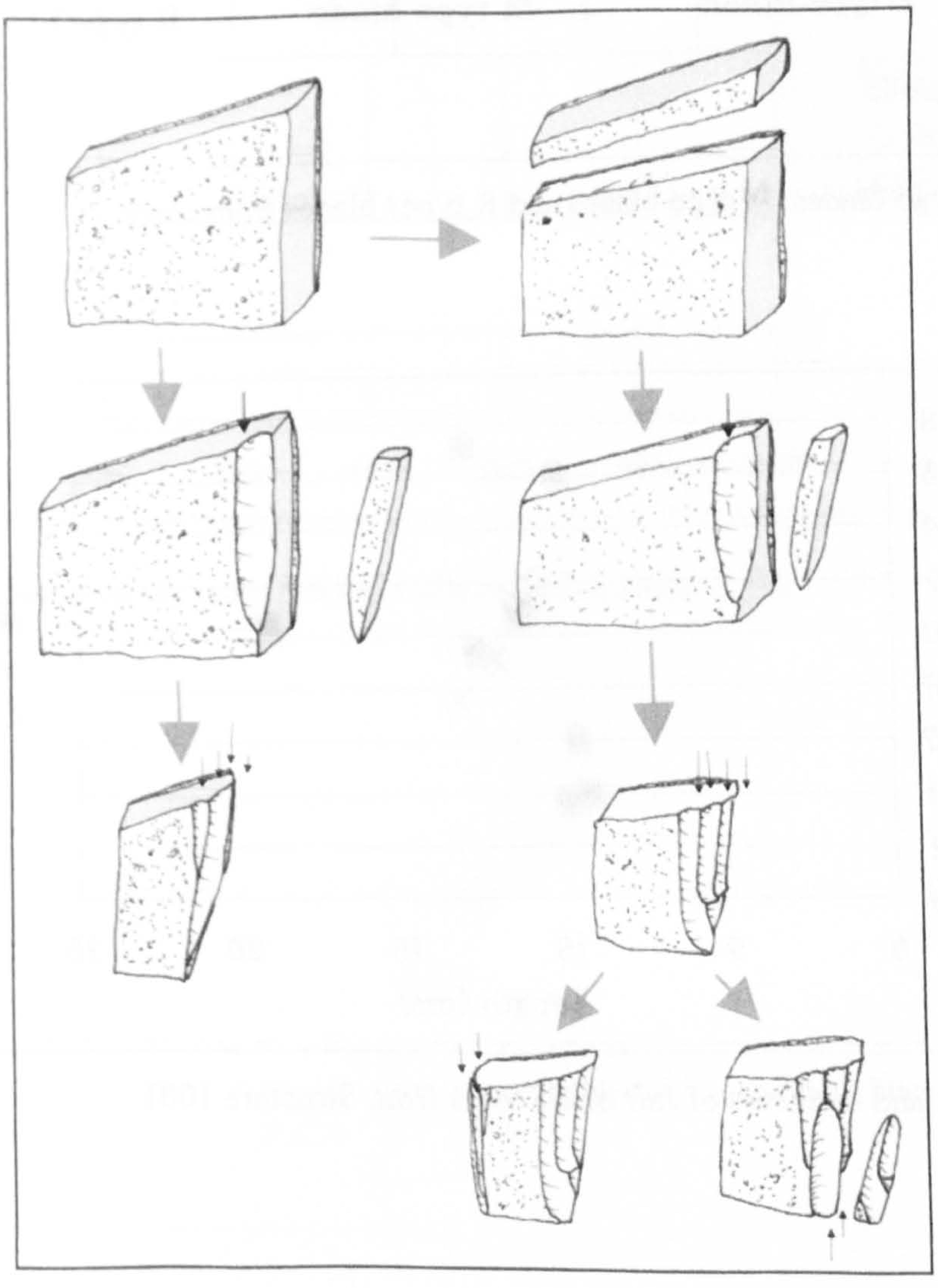


Fig.10.9 Reduction sequence of Jafr blade cores.

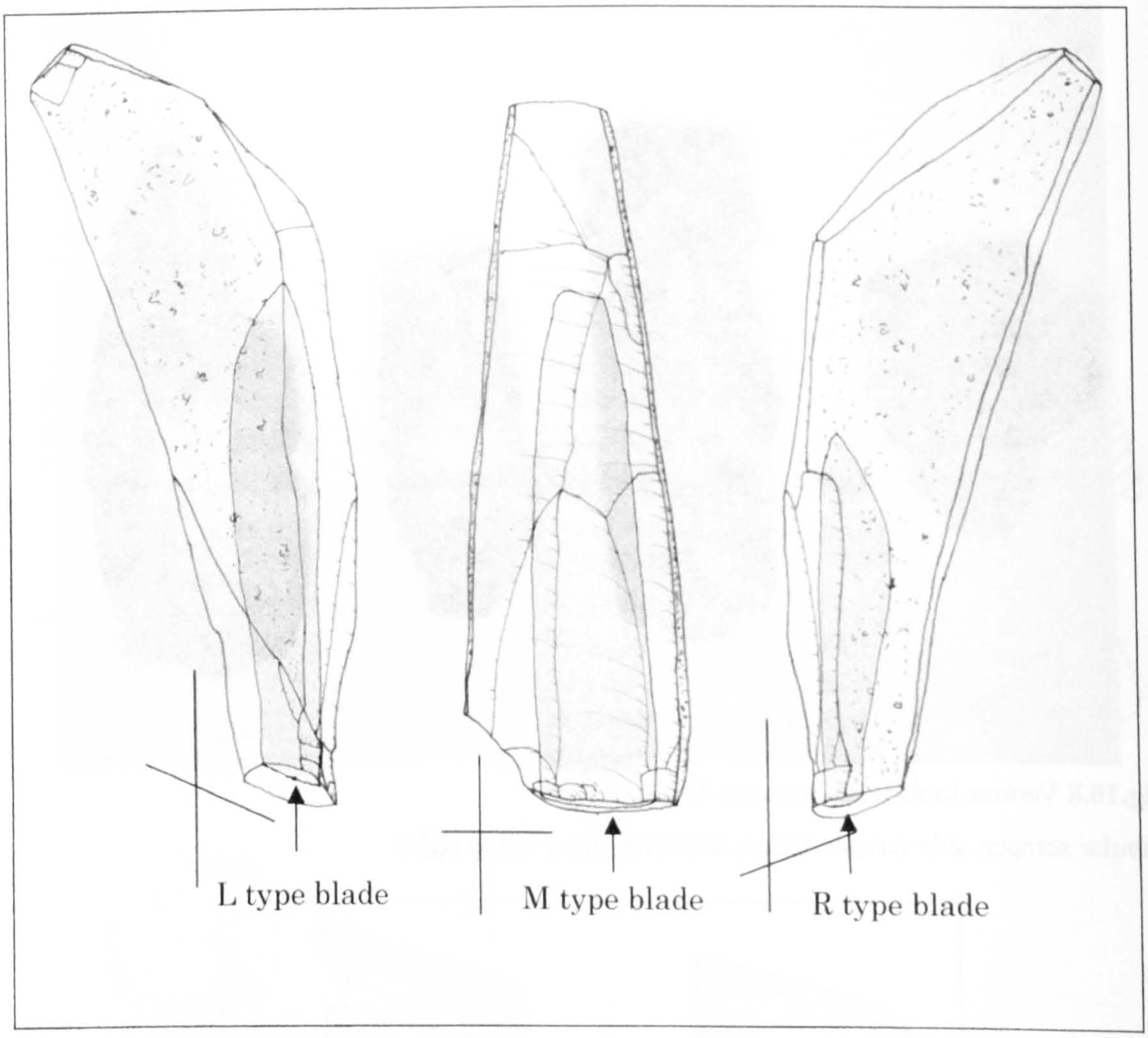


Fig.10.10 L type blades, M type blades and R types blades from cores.

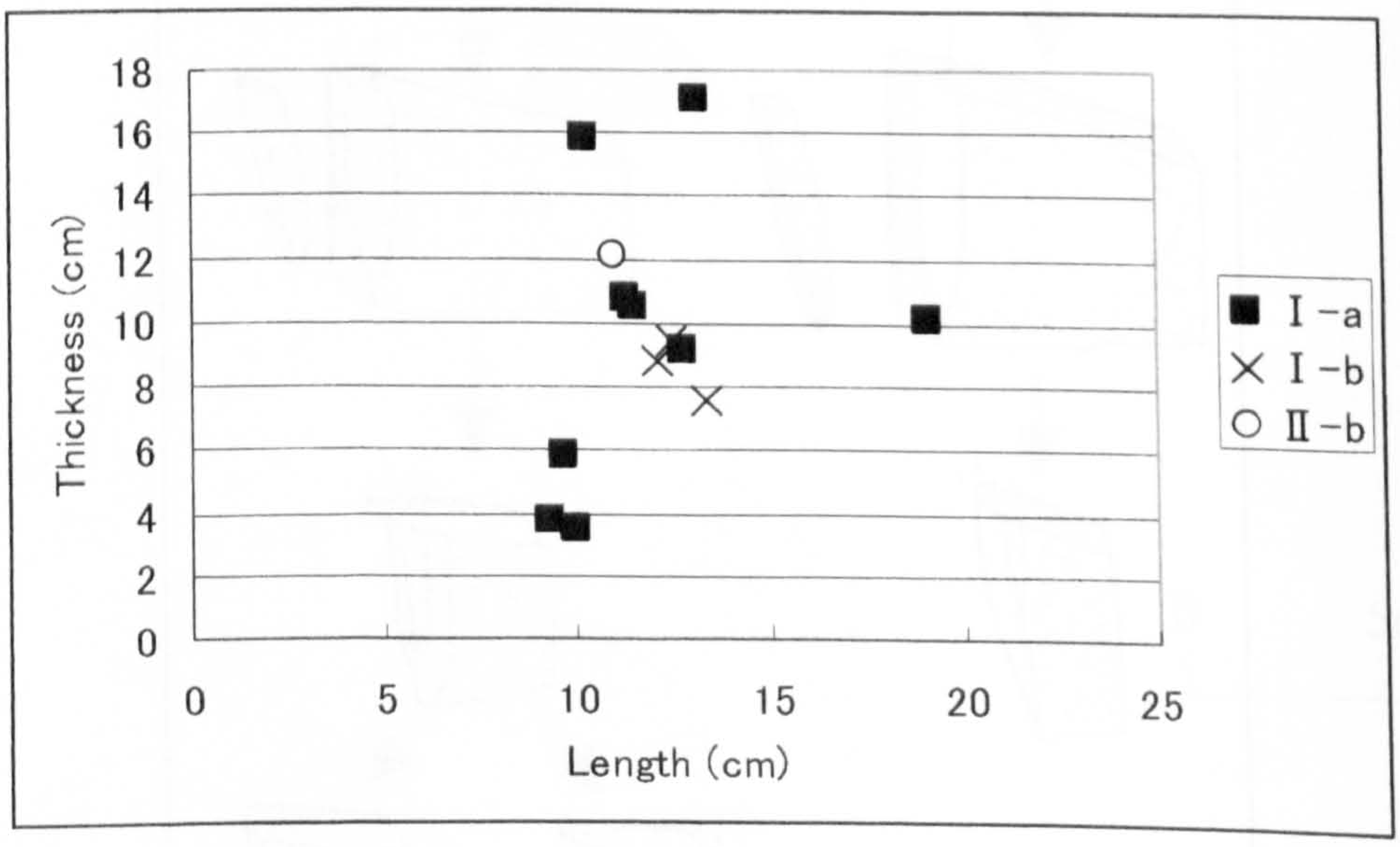


Fig.10.11 Length and thickness of Jafr blade cores from Structure 1001.

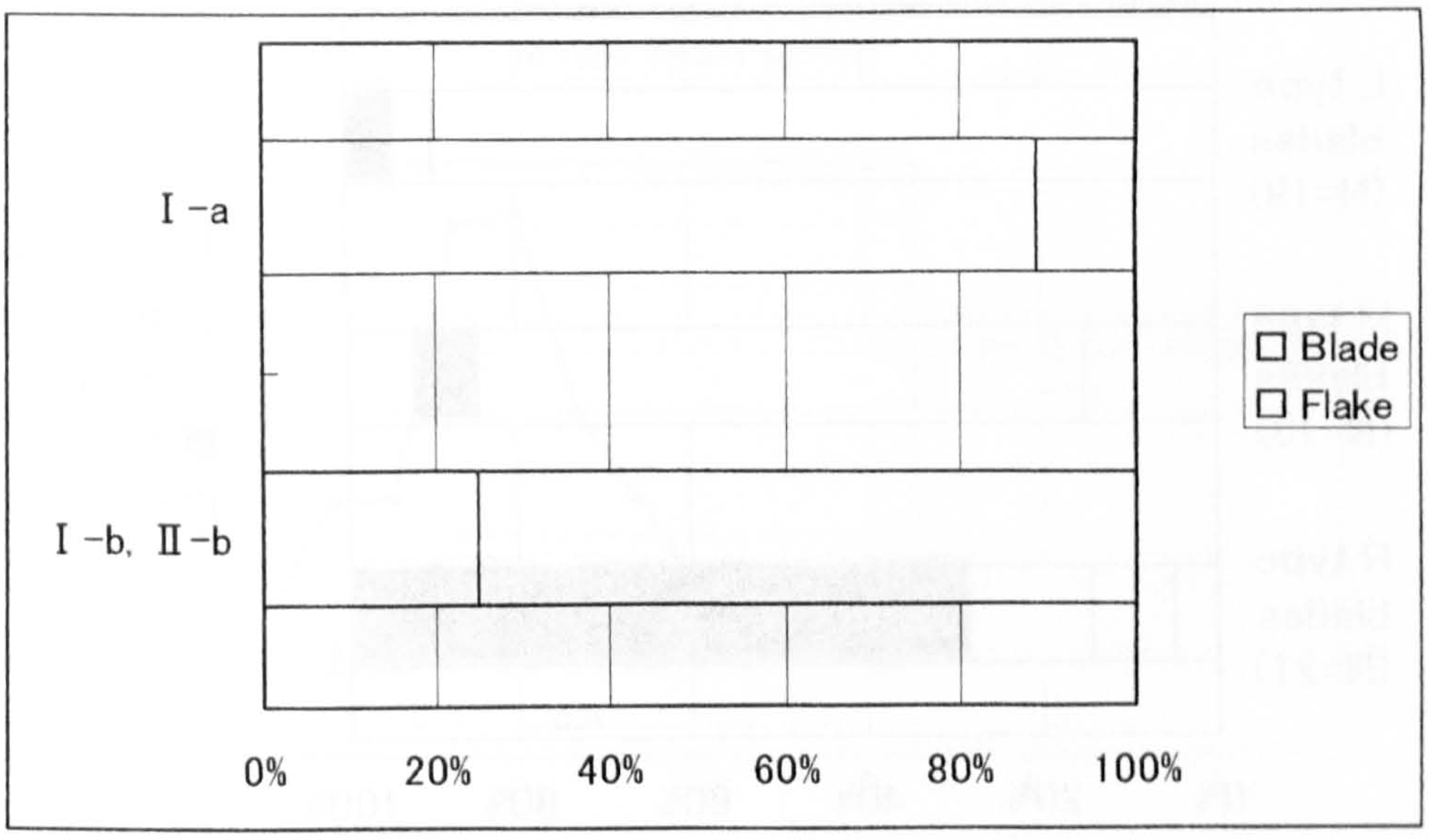


Fig.10.12 Shapes of scars on main flaking surfaces of Jafr blade cores.

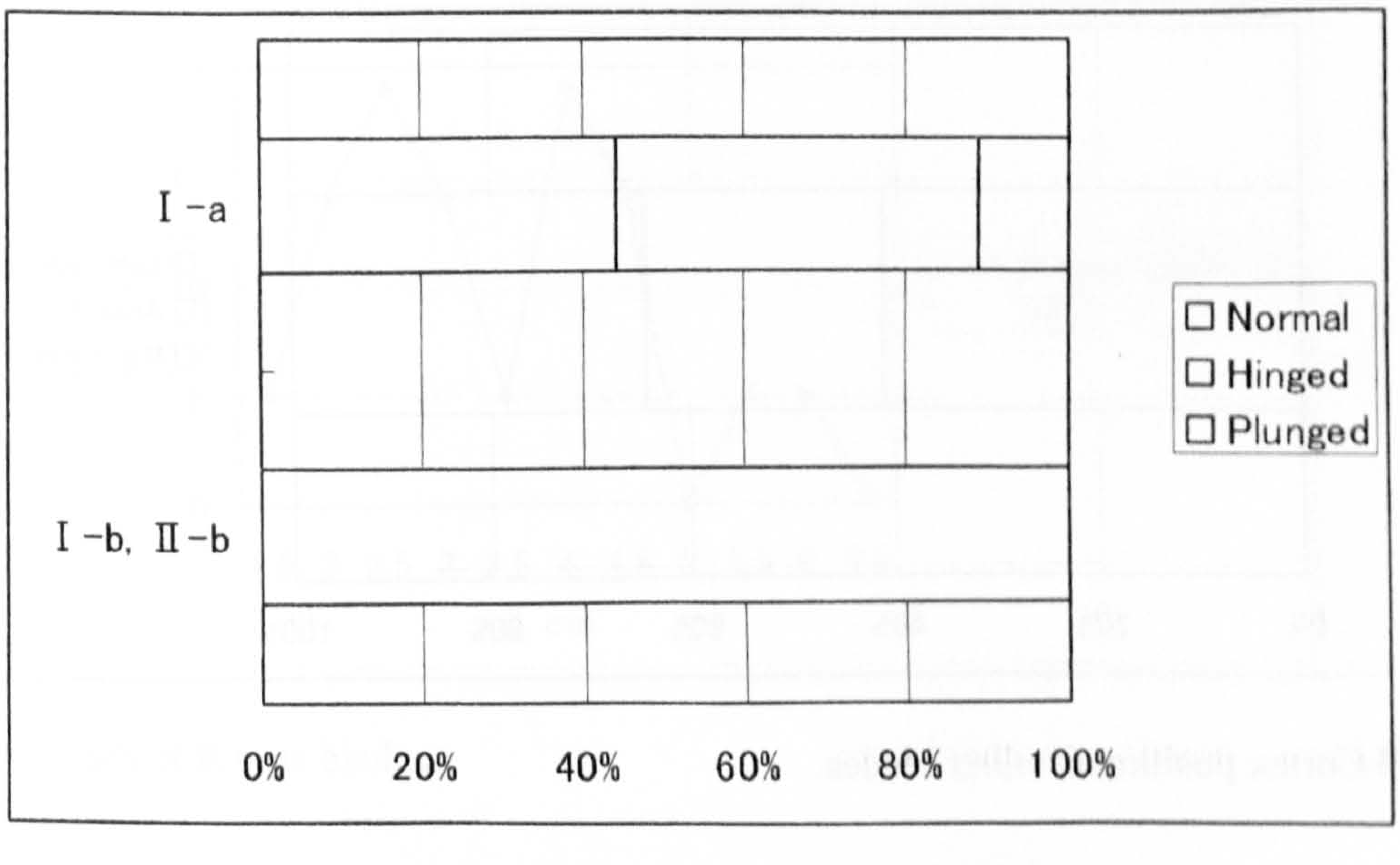


Fig.10.13 Termination on the main flaking surfaces of Jafr blade cores.

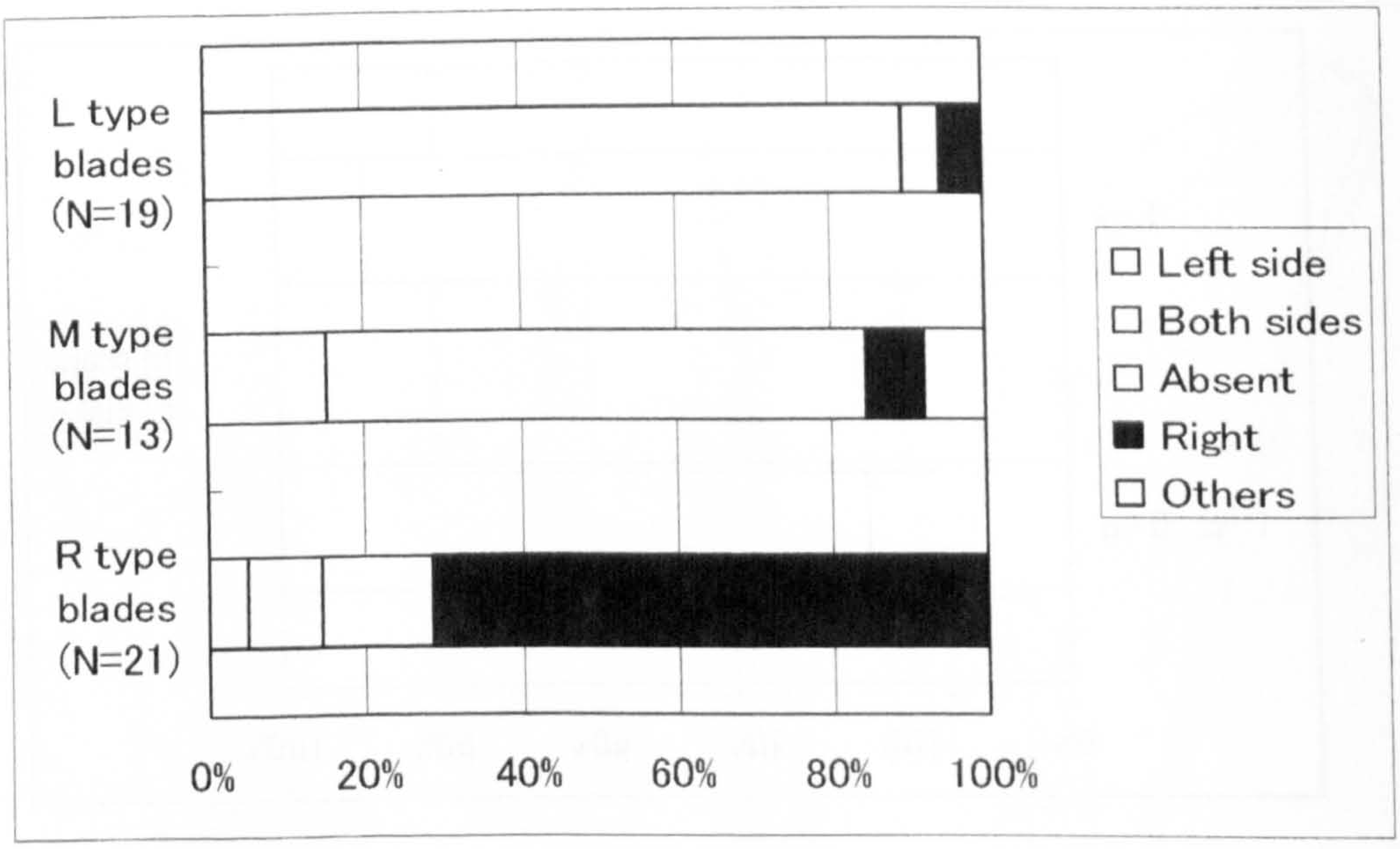


Fig.10.14 Cortex position of Jafr blades.

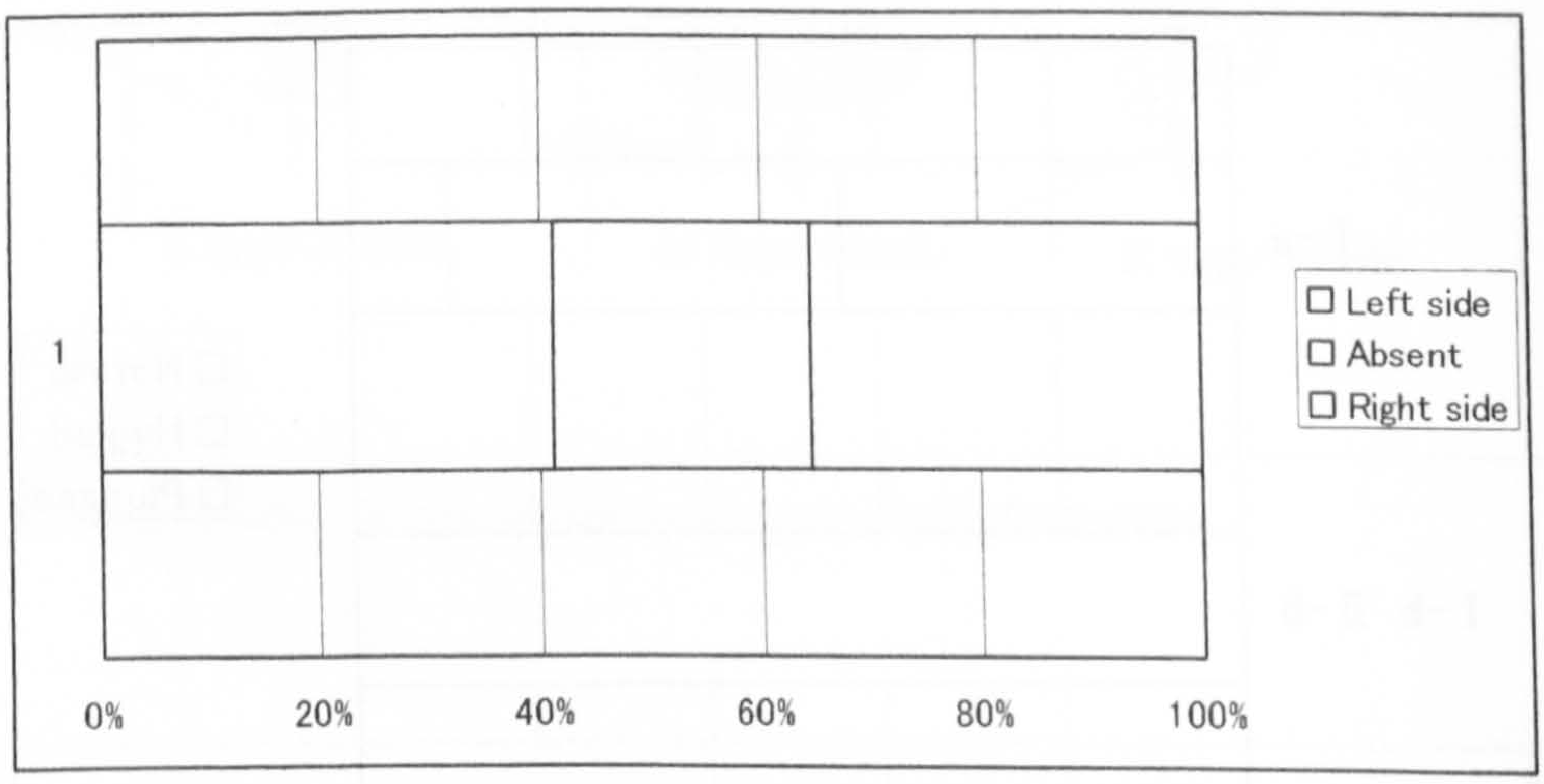


Fig.10.15 Cortex position of other blades.

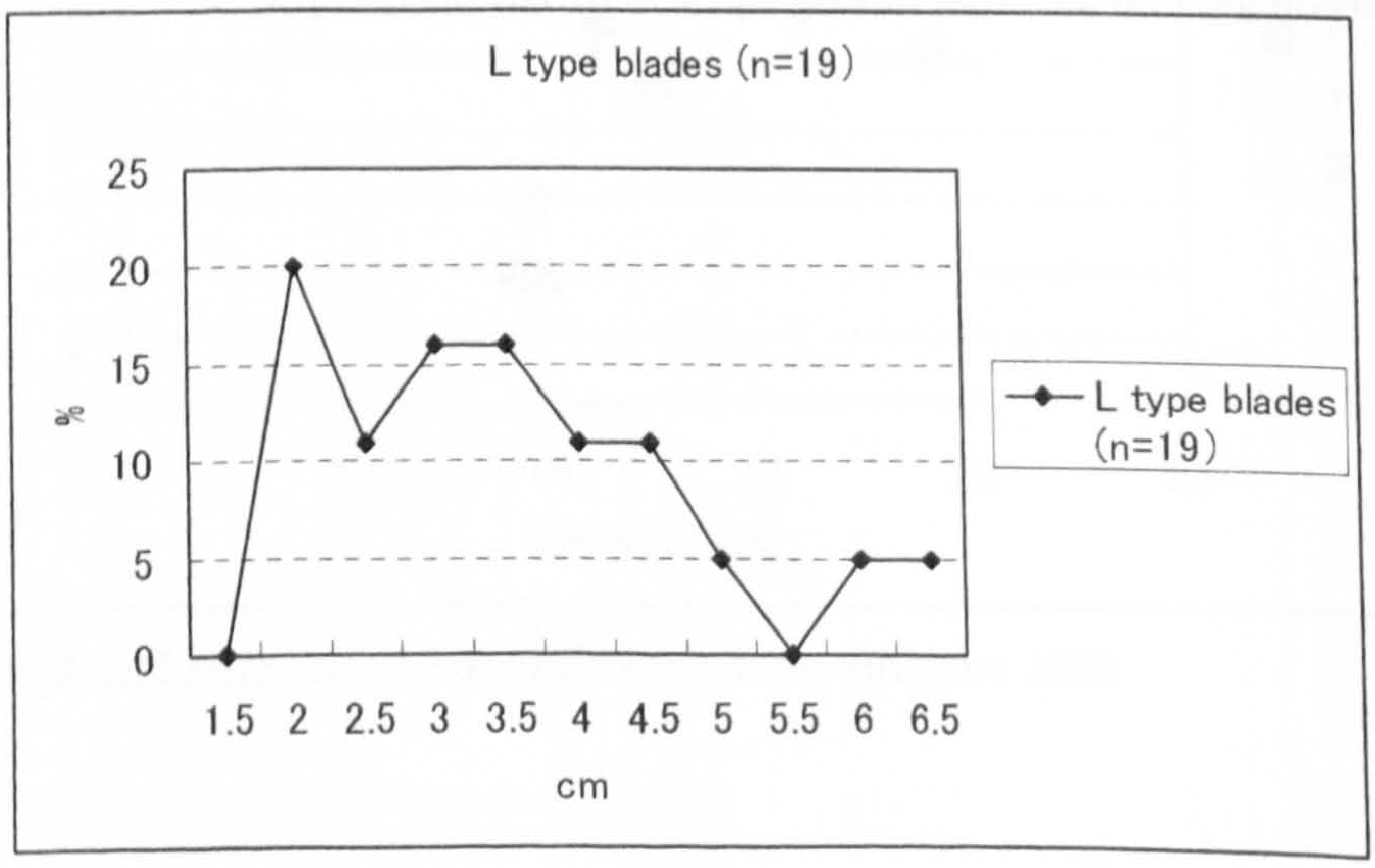


Fig.10.16 Width of L type blades.

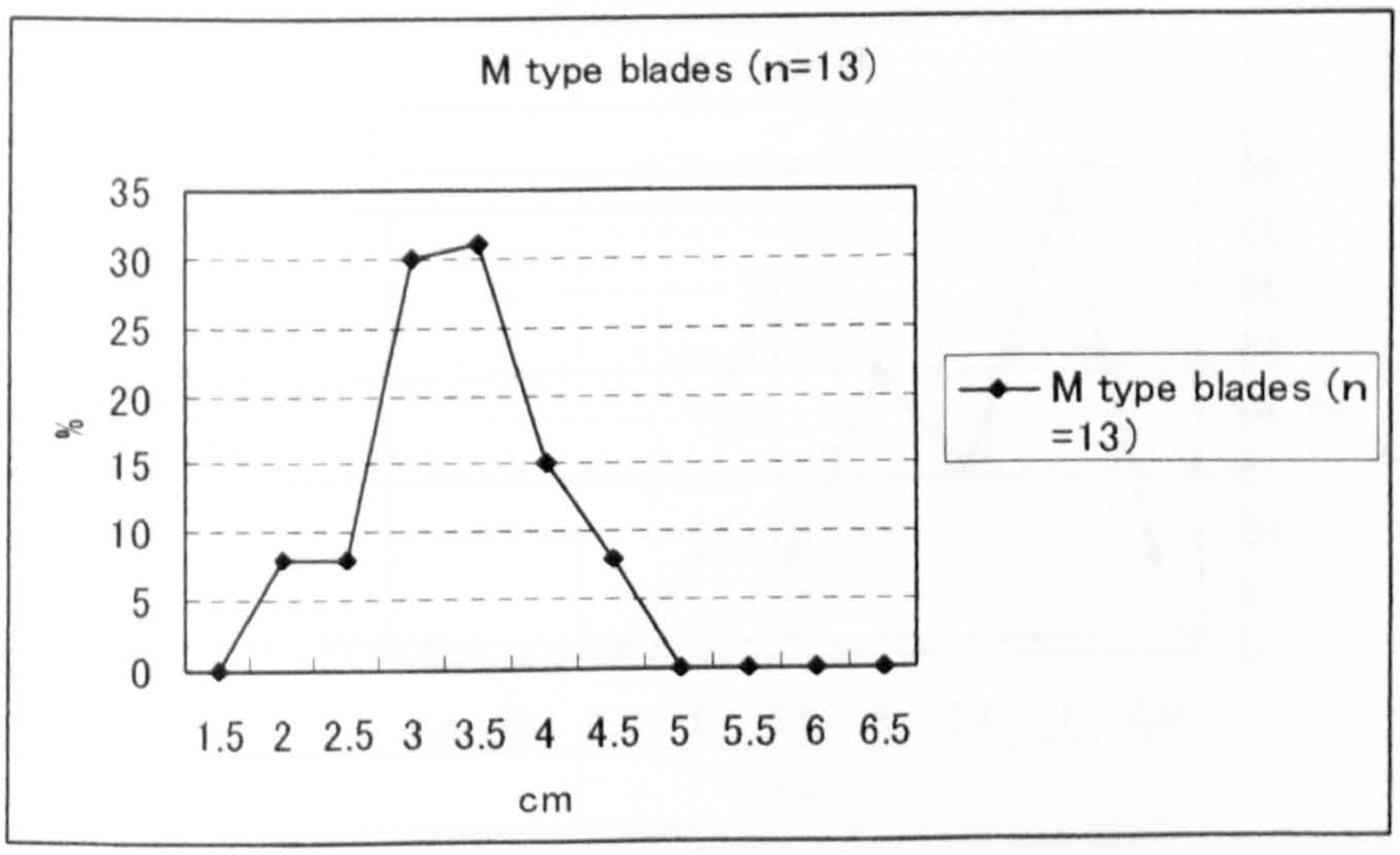


Fig.10.17 Width of M type blades.

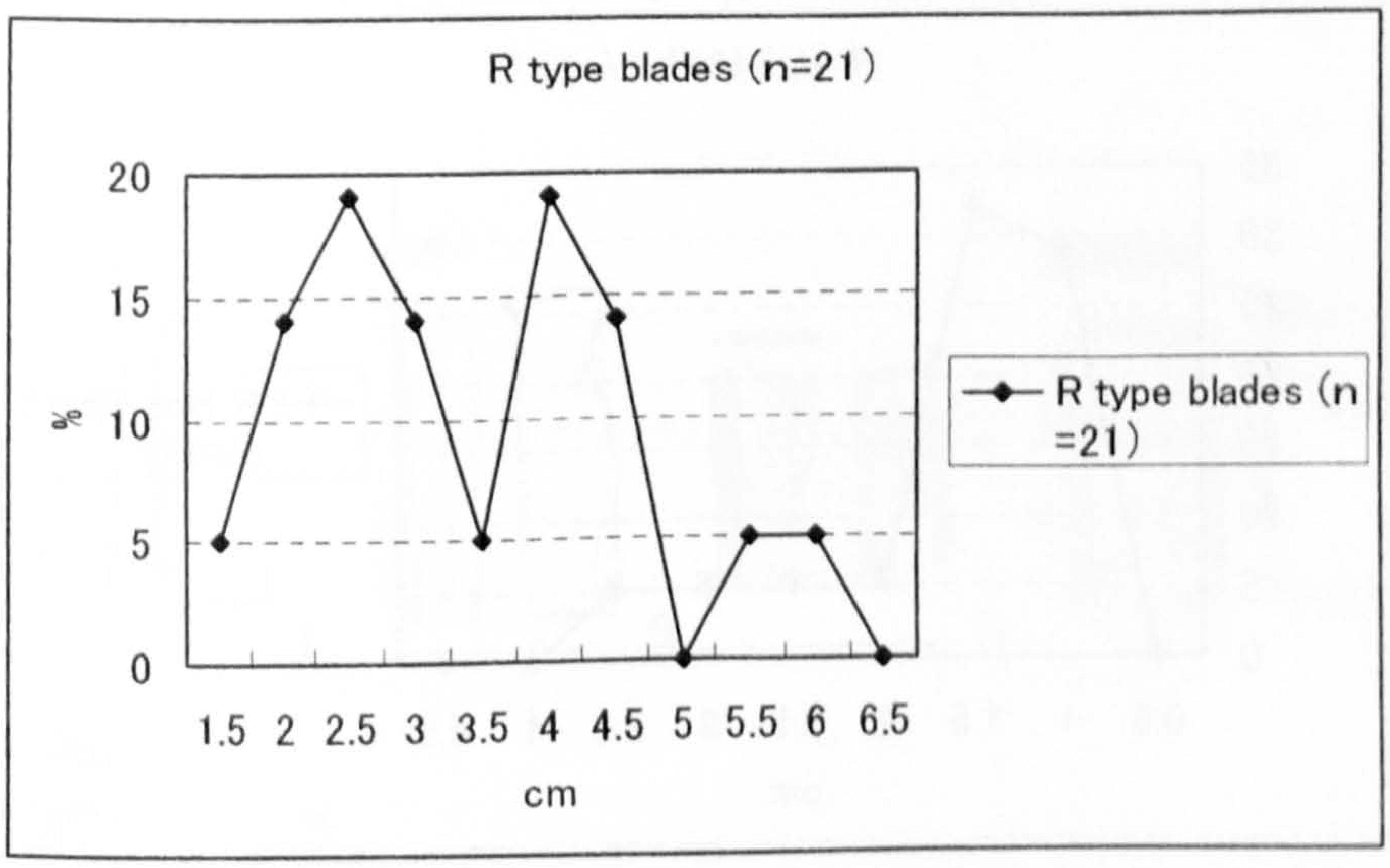


Fig.10.18 Width of R type blades.

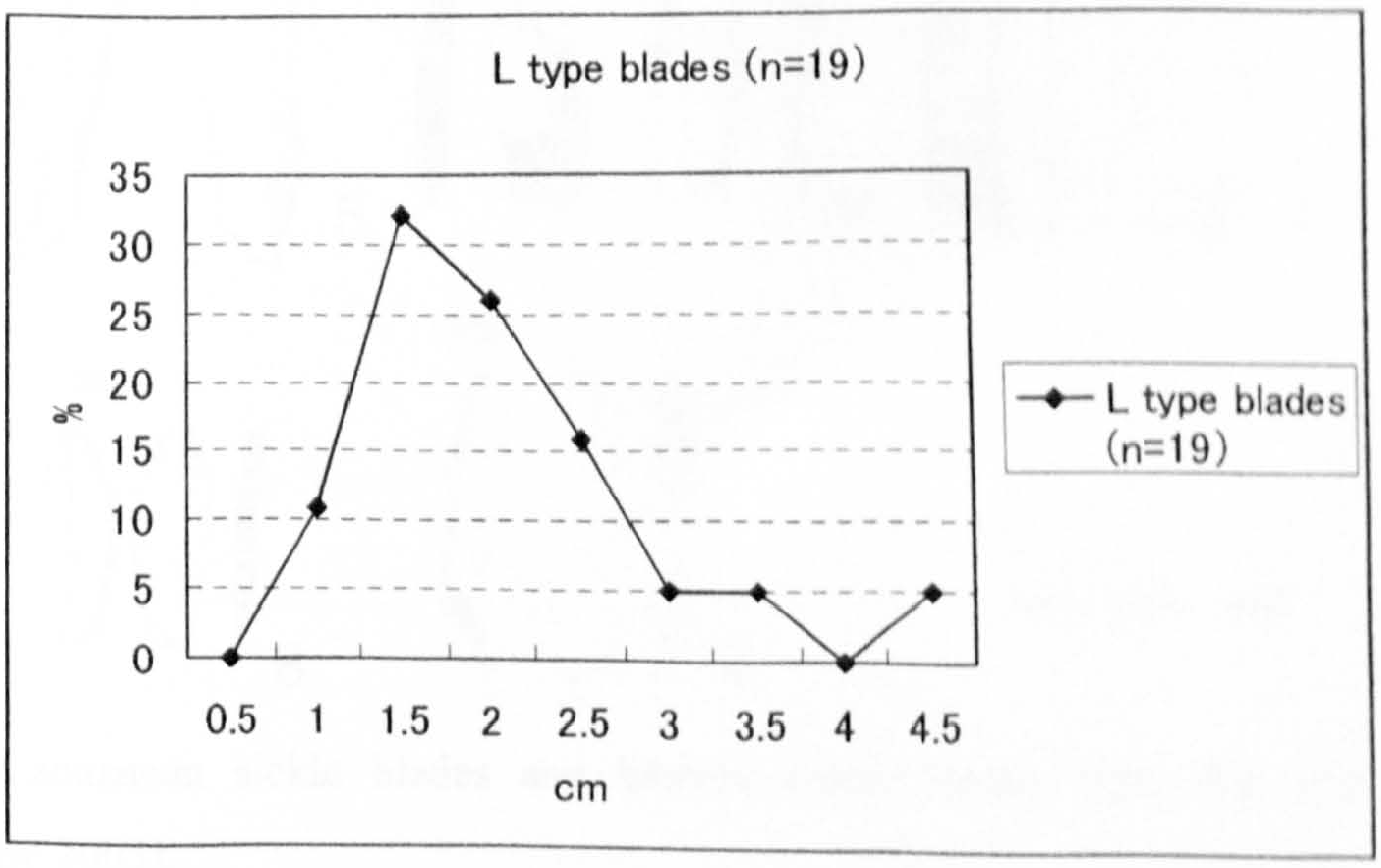


Fig.10.19 Thickness of L type blades.

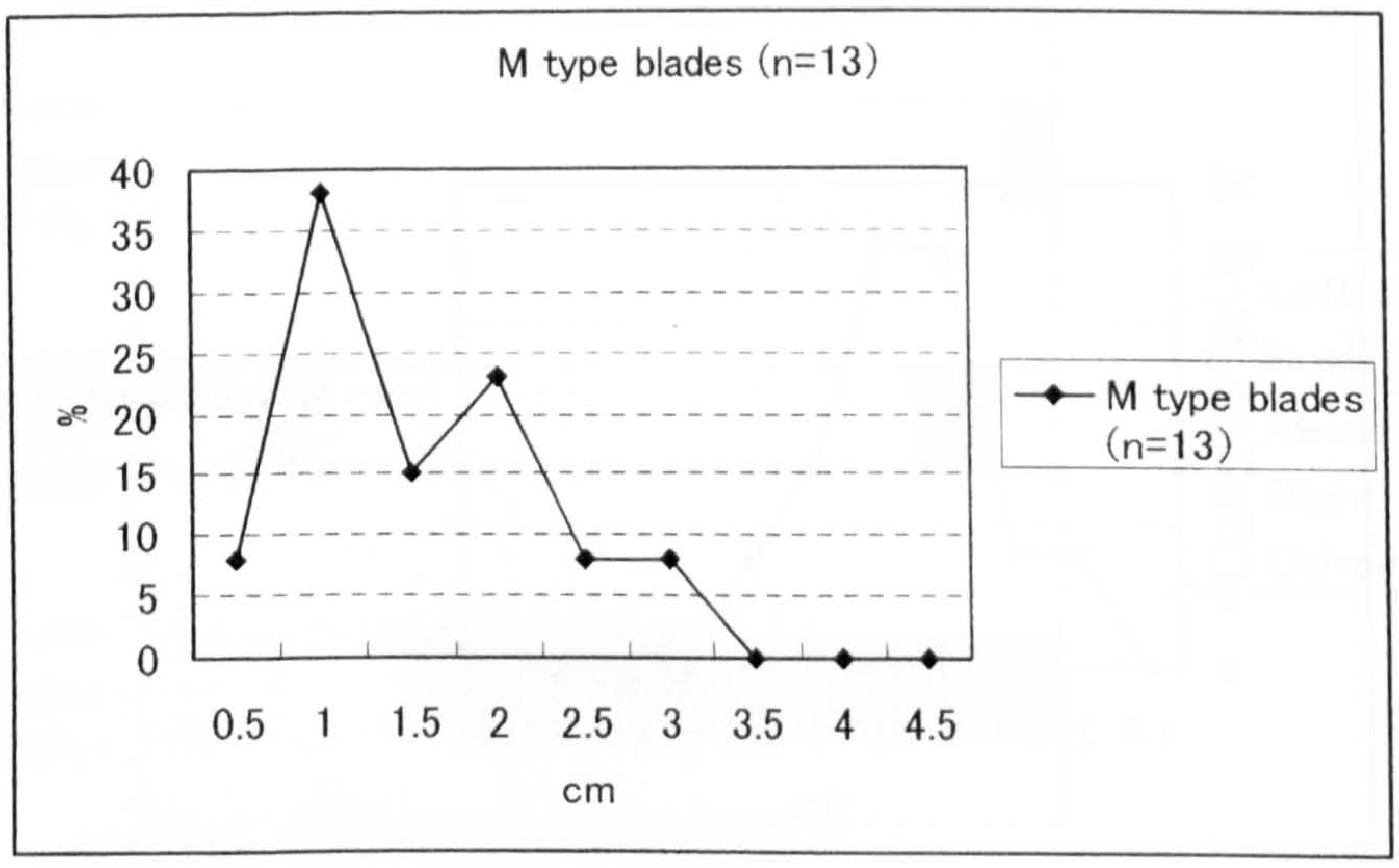


Fig.10.20 Thickness of M type blades.

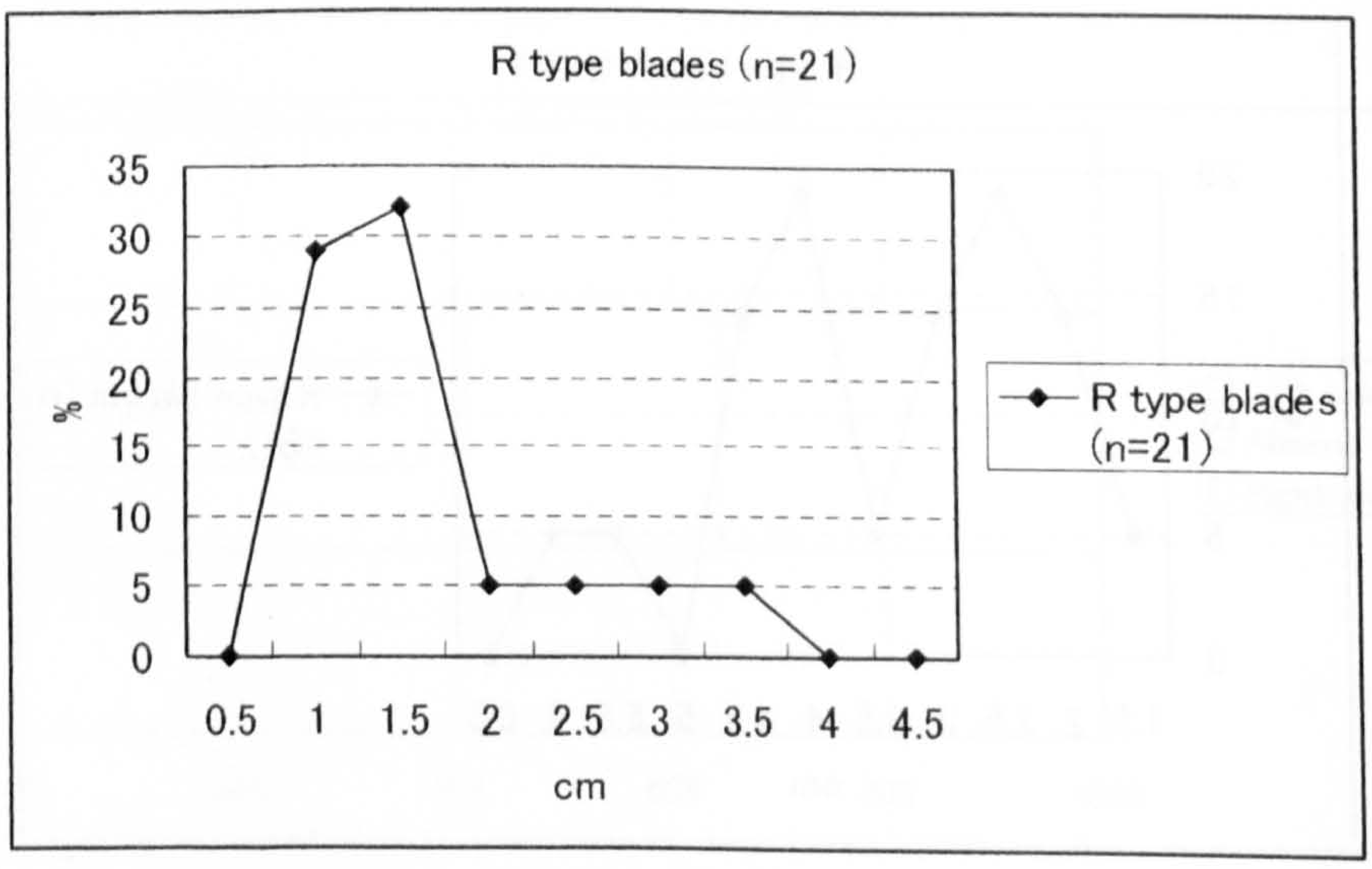


Fig.10.21 Thickness of R type blades.

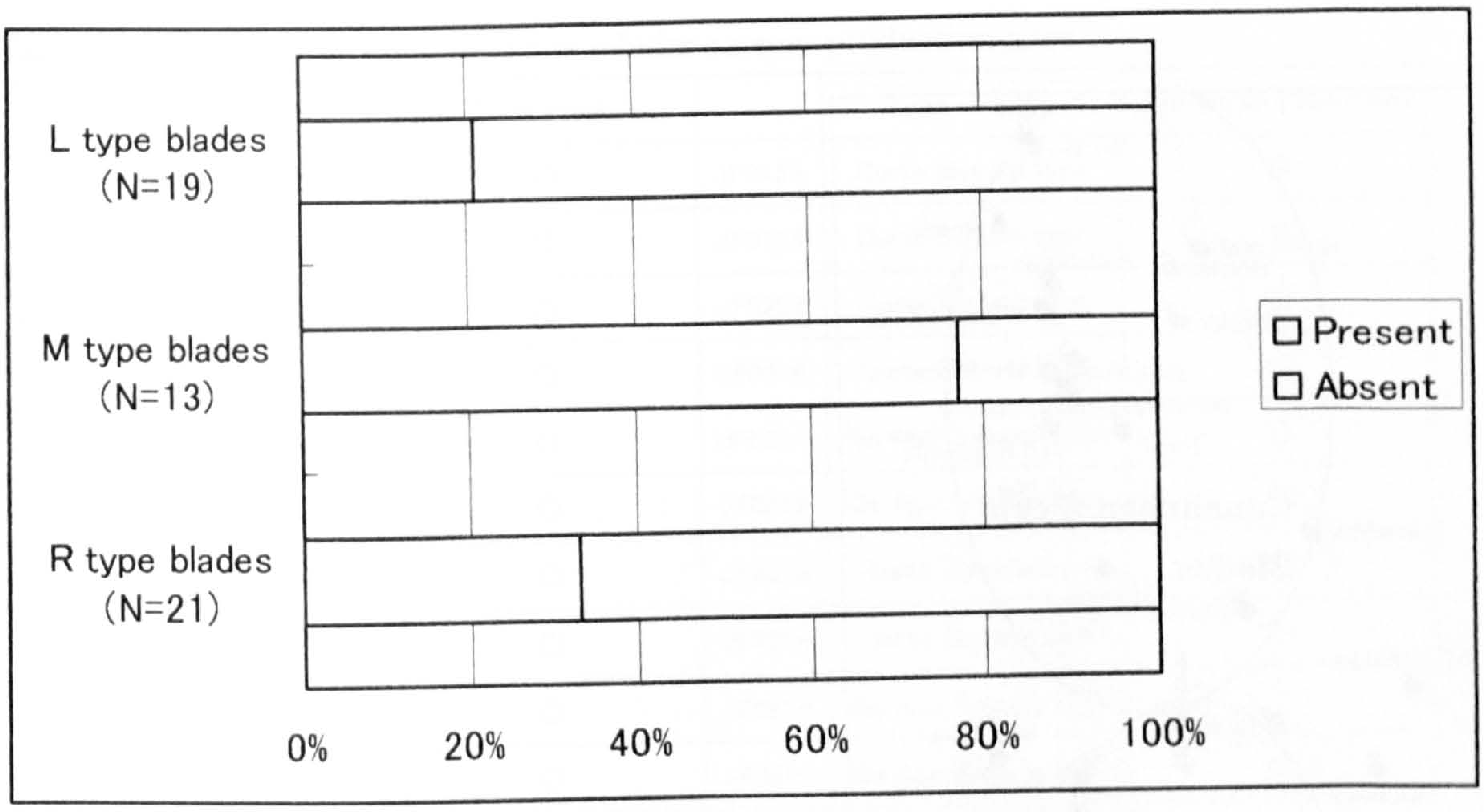


Fig.10.22 Overhang removal on Jafr blades.

Fig.10.23 Canaanean sickle blades and backed sickle blades from Bab edh Dhra (from McConaughy 2003).

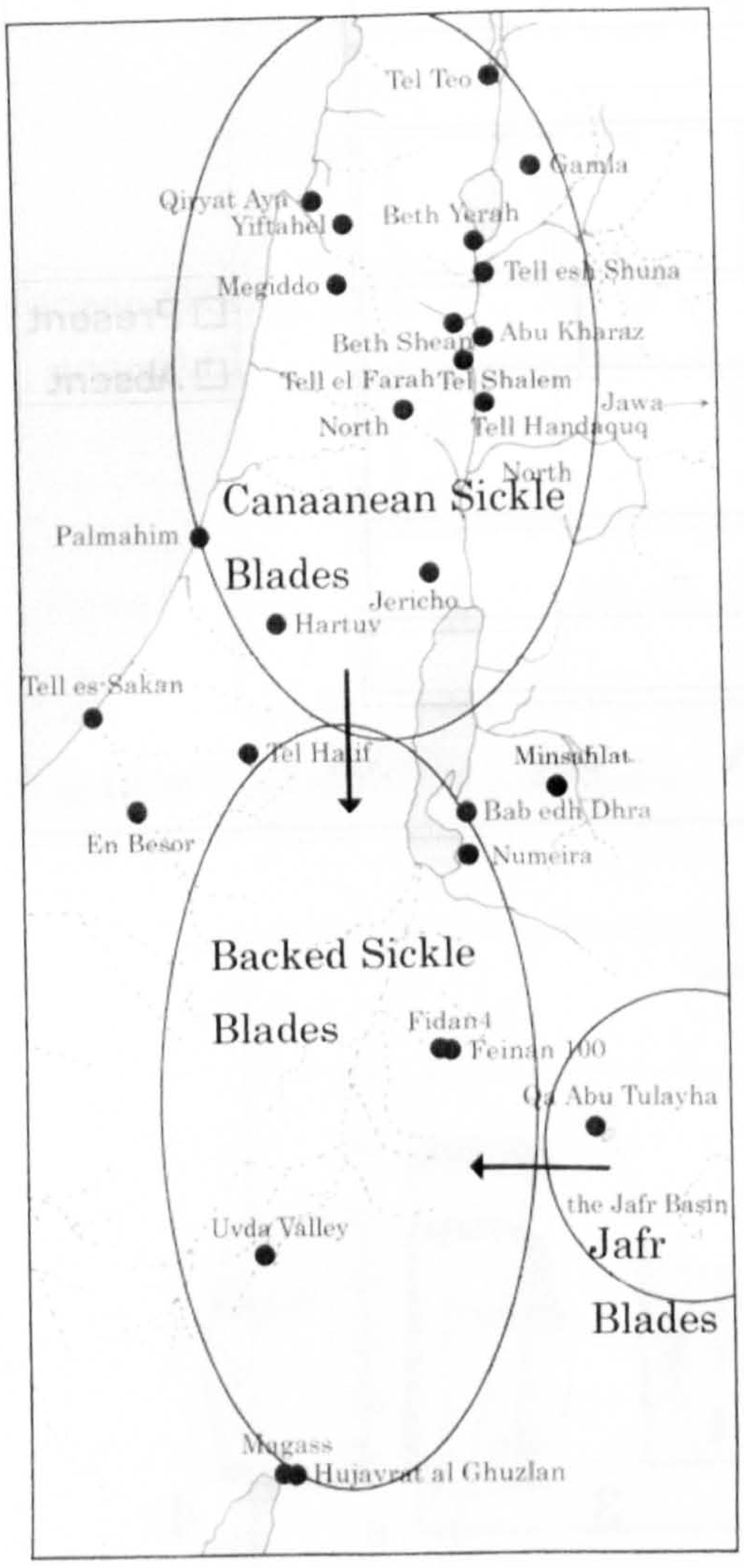


Fig.10.24 Sickle blades in the Southern Levant

Table.10.1 Jafr blade production loci at tabular scraper production sites.

	Type of Sites	Jafr Blade Production		Type of Sites	Jafr Blade Production
JF9503	Qa Abu Tulayha type	○	JF0153	Gurta Siyyata type	○
JF9801	Gurta Siyyata type	○	JF0155	Gurta Siyyata type	?
JF0101	Gurta Siyyata type	○	JF0209	Gurta Siyyata type	○
JF0102	Gurta Siyyata type	○	JF0210	Gurta Siyyata type	○
JF0103	Gurta Siyyata type	○	JF0211	Qa Abu Tulayha type	○
JF0105	Gurta Siyyata type	○	JF0212	Qa Abu Tulayha type	?
JF0106	Gurta Siyyata type	○	JF0213	Gurta Siyyata type	○
JF0107	Gurta Siyyata type	○	JF0214	Gurta Siyyata type	○
JF0109	Gurta Siyyata type	○	JF0215	Qa Abu Tulayha type	?
JF0110	Gurta Siyyata type	○	JF0216	Qa Abu Tulayha type	○
JF0124	Gurta Siyyata type	○	JF0217	Qa Abu Tulayha type	?
JF0126	Gurta Siyyata type	?			
JF0151	Gurta Siyyata type	○			
JF0152	Gurta Siyyata type	○			

Table.10.2 Flint artifacts from Structure 1001.

Categories	No	%
Cores	21	13.55
Core trimming pieces	3	1.94
Cortical flakes	6	3.87
Partially cortical flakes	11	7.09
Non-cortical Flakes	1	0.65
Levallois flakes	1	0.65
Tabular scraper flakes	1	0.65
Cortical blades	12	7.74
Partially cortical blades	55	35.48
Non-cortical blades	15	9.68
Tools	6	3.87
Hammers	5	3.23
Chips, thermal Flakes and chunks	6	3.87
Unworked flint blocks	12	7.74
Total	155	100

Table.10.3 Cores from Structure 1001.

Types		No	%
Jafr blade cores		13	61.9
	Ⅰ-a	9	
	Ⅰ-b	3	
	Ⅱ-a	0	
	Ⅱ-b	1	
Tabular scraper cores		3	14.29
Levallois cores		1	4.76
Non Jafr blade cores		1	4.76
Flake cores		2	9.52
Semi chipped cores		1	4.76
Total		21	100

Table.10.4 Raw material of Jafr blade cores.

Raw material (N=13)	Nodular	Tabular	Total
Jafr blade cores	0	13	13

Table.10.5 Battered signs on Jafr blade cores.

Battered signs (N=13)	Present	Absent	Total
Jafr blade cores	2	11	13

Table.10.6 The number of flaking surfaces on Jafr blade cores.

The number of flaking surfaces (N=13)	One	Two	Total
Jafr blade cores	12	1	13

Table.10.7 The number of platforms on Jafr blade cores.

The number of strinking platforms (N=13)	One	Two	Total
Jafr blade cores	9	4	13

Table.10.8 Measurements of Jafr blade cores.

Measurements of Jafr blade cores (cm)	N	Mean	S.D	Min.	Max.	Median
Length	13	12.006	2.517	9.3	19.1	11.5
Width	13	5.911	1.726	3.8	8.9	5.4
Thickness	13	9.606	4.015	3.5	17.1	9.4
L/W	13	2.16	0.584	1.3	3.3	2.23
W/T	13	0.694	0.258	0.3	1.1	0.61
Platform angle	13	74.615	4.857	62	80	75

Table.10.9 Measurements of Type Ⅰ-a Jafr blade cores.

Measurements of Type Ⅰ-a cores(cm)	N	Mean	S.D.	Min.	Max.	Median
Length	9	11.902	3.016	9.3	19.1	11.3
Width	9	6.03	1.988	3.8	9.9	5.3
Thickness	9	10.418	4.77	3.5	17.1	10.2

Table.10.10 Measurements of Type Ⅰ-b and Ⅱ-b Jafr blade cores.

Measurements of Type Ⅰ-b, Ⅱ-b cores (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	4	12.24	0.986	11	13.4	12.3
Width	4	5.643	1.115	4.2	6.5	6.0
Thickness	4	9.51	1.949	7.6	12.2	9.1

Table.10.11 Platforms of Jafr blade cores.

Platforms of Jafr blade cores	Plain	Weathered	Cortex	Total
Jafr blade cores : Type Ⅰ-a	5	4	0	9
Jafr blade cores : Type Ⅰ-b	1	2	0	3
Jafr blade cores : Type Ⅱ-a	0	0	0	0
Jafr blade cores : Type Ⅱ-b	1	0	0	1
Total	7	6	0	13
%	53.85	46.15	0	100

Table.10.12 Scar patterns on main flaking surfaces.

Scar patterns on main flaking surfaces	Unidirectional	Bidirectional	Total
Jafr blade cores	9	4	13

Table.10.13 Shapes of scars on the main flaking surfaces.

Shapes of scars on the main flaking surface	Blade	Flake	Total
Jafr blade cores : Type Ⅰ-a	8	1	9
Jafr blade cores : Type Ⅰ-b	1	2	3
Jafr blade cores : Type Ⅱ-a	0	0	0
Jafr blade cores : Type Ⅱ-b	0	1	1
Total	9	4	13
%	69.23	30.77	100

Table.10.14 Termination of scars on main flaking surfaces of Jafr blade cores.

Termination of the main flaking surface	Normal	Hinged	Overshot (Plunged)	Total
Jafr blade cores : Type Ⅰ-a	4	4	1	9
Jafr blade cores : Type Ⅰ-b	0	3	0	3
Jafr blade cores : Type Ⅱ-a	0	0	0	0
Jafr blade cores : Type Ⅱ-b	0	1	0	1
Total	4	8	1	13
%	30.77	61.54	7.79	100

Table.10.15 Types of Jafr blades from Structure 1001.

Types	No	%
Cortical blades	12	14.63
Type L blades	19	23.17
Type M blades	13	15.85
Type R blades	21	25.61
Other blades	17	20.73
Total	82	100

Table.10.16 The position of cortex on Jafr blades.

Cortex position (%)	Distal	Left	Right	Left and Right	Proximal	Mid.	Absent	Total
L type blades (N=19)	0	89.47	5.26	5.26	0	0	0	100
M type blades (N=13)	7.69	0	7.69	15.38	0	0	69.23	100
R type blades (N=21)	0	4.76	71.43	9.52	0	0	14.29	100
Total (N=53)	1.89	33.96	32.08	9.43	0	0	22.64	100

Table.10.17 Hammer modes on Jafr blades.

Hammer mode (%)	I	Ⅱ	Ⅲ	Ⅳ	Others	Total
L type blades (N=19)	31.58	21.05	31.58	5.26	10.53	100
M type blades (N=13)	7.69	61.54	15.38	7.69	7.69	100
R type blades (N=21)	14.29	47.62	19.05	9.52	9.52	100
Total (N=53)	18.87	41.51	22.64	7.55	9.43	100

Table.10.18 Measurements of L type blades.

Measurements of L type blades (cm)	N	Mean	S.D.	Min.	Max.	Mideain
Length	16	10.29	2.35	5.86	14.51	10.69
Width	19	3.34	1.285	1.91	6.41	3.16
Thickness	19	1.76	0.857	0.51	4.03	1.52
Butt width	18	1.92	1.25	0.38	4.99	1.78
Butt depth	18	0.9	0.676	0.15	2.49	0.71

Table.10.19 Measurements of M type Jafr blades.

Measurements of M type blades (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	4	10.39	2.308	7.4	13	10.6
Width	13	3.19	0.656	2.0	4.3	3.2
Thickness	13	1.28	0.66	0.5	2.7	1.0
Butt width	11	1.82	0.643	0.5	2.9	1.8
Butt depth	11	1	0.475	0.5	1.9	0.8

Table.10.20 Measurements of R type blades.

Measurements of R type blades (cm)	N	Mean	S.D.	Min.	Max.	Median
Length	15	9.17	2.403	5.6	14.9	9.1
Width	21	3.11	1.179	1.4	5.6	3
Thickness	21	1.4	0.68	0.6	3	1.3
Butt width	21	1.75	1.036	0.8	5	1.5
Butt depth	21	0.87	0.604	0.2	2.1	0.6

Table.10.21 Butt types.

Butt types (%)	Plain	Thinned	Small	Faceted	Dihedral	Weathered	Cortex	Others	Total
L type blades (N=19)	52.63	5.26	5.26	0	0	26.32	5.26	5.26	100
M type blades (N=13)	84.62	7.69	0	0	0	0	0	7.69	100
R type blades (N=21)	71.43	4.76	0	4.76	0	14.29	4.76	0	100
Total (N=53)	67.92	5.66	1.89	1.89	0	15.09	3.77	3.77	100

Table.10.22 Overhang removal on Jafr blades.

Overhang removal (%)	Faceted	Abrasion	Absent	Total
L type blades (N=19)	21.05	0	78.95	100
M type blades (N=13)	69.23	7.69	23.08	100
R type blades (N=21)	33.33	0	66.67	100
Total (N=53)	37.74	1.89	60.38	100

Table.10.23 Scar patterns on Jafr blades.

Dorsal scar patterns (%)	Unidirectional	Bidirectional	Others	Total
L type blades (N=16)	56.25	18.75	25	100
M type blades (N=4)	100	0	0	100
R type blades (N=15)	73.33	26.67	0	100
Total (N=35)	68.57	20	11.44	100

Table.10.24 Distal shapes of Jafr blades.

Distal Shape (%)	Asymmetric Right	Asymmetric Left	Symmetric Square	Symmetric Round	Symmetric Point	Total
L type blades (N=16)	25	31.25	25	0	18.75	100
M type blades (N=4)	25	25	50	0	0	100
R type blades (N=15)	26.67	0	26.67	40	6.67	100
Total (N=35)	25.71	17.14	28.57	2.86	25.71	100

Table.10.25 Termination of Jafr blades.

Termination (%)	Feather	Plunged	Hinged	Total
L type blades (N=16)	68.75	12.5	18.75	100
M type blades (N=4)	50	25	25	100
R type blades (N=15)	60	33.33	6.67	100
Total (N=35)	62.86	22.86	14.29	100

Table.10.26 Profile of Jafr blades.

Profile	Straight	Convex	Concave	Total
L type blades (N=16)	68.75	6.25	25	100
M type blades (N=4)	50	25	25	100
R type blades (N=15)	66.67	13.33	20	100
Total (N=35)	65.71	11.43	22.86	100

Chapter 11 CONCLUSIONS: THE DEVELOPMENT OF URBANISM AND PASTORAL NOMADS IN THE SOUTHERN LEVANT

11.1 THE DEVELOPMENT OF URBANISM IN THE SOUTHERN LEVANT

'The development of urbanism' has been one of the most important topics in archaeology since V.G Childe's seminal works (Childe 1950). As in other parts of the world, many researchers have tackled this topic in Southern Levant (See Chapter 2.3 for more details). As a result, there has been much debate about the nature and pace of development of urbanism in the Southern Levant.

In the Southern Levant, large sedentary settlements over 10 ha had appeared and site hierarchies had developed by the Late Chalcolithic (4500BC～38/3700BC). Although these settlements had no fortification systems, it is argued that public buildings such as temples and granaries were already constructed at some major sites (Bourke 2002, Levy 1995) (See Chapter 2.3).

In the EB I (38/3700BC～31/3000BC), some large and middle sized settlements became fortified for the first time. In particular, Megiddo is noteworthy. The size of Megiddo reached over 50 ha and the site was characterized by massive monumental public buildings such as temples (and possibly fortifications) (See Chapter 2.3). Most of the large fortified settlements in this period are located in the Jordan Valley. Therefore the Jordan Valley has been suggested as 'the cradle of urbanization' in the Southern Levant (Paz 2002) (See Chapter 2.3).

In the EB II / III (31/3000BC～2400/2300BC), a number of large fortified settlements appeared all over the Southern Levant. Their size is usually between 10 ha and 20 ha. These settlements usually have dense and compact residential areas, public buildings and installations such as bastions, temples, granaries and cisterns. Furthermore a massive complex over 6000 m², which was probably a palace, was recently discovered at Tell Yarmuth (Miroschedji 1999) (See Chapter 2.3). These features of the settlements strongly suggest that urban societies developed in the Early Bronze Age and that these societies are characterized by city states controlled by palace based elites (e.g. Ben-Tor 1992, Finkelstein 1995, Mazar 1992).

Along with these settlement developments, agricultural technologies, social stratification, long distance trade and craft specialization also developed in the Chalcolithic and Early Bronze Age (e.g. Adams 2002, Greenberg and Porat 1996) (See Chapter 2.3).

There has been much debate about the appearance of urban societies in the Southern Levant. However at the moment most studies about 'the development of urbanism' still focus on fortified urban settlements and large villages. Studies of possible transformations of pastoral nomads in these crucial periods are limited.

11.2 PASTORAL NOMADS AND TOWNS

Ethnographic studies have revealed that the modern pastoral nomads in the Near East strongly depend on towns and markets (See Chapter 2.4 for more details). Their animal management is focused on products intended to supply markets in towns. They consume only between 10 % and 20% of their animals themselves (Jabbur 1995, Marx 1992). Furthermore pastoral nomads export many desert products such as salt, precious stones, medical herbs, truffles and falcons to markets. Meanwhile they acquire most living necessities and luxuries such as cereals, foods, vegetables, sugar, coffee, tobacco, weapons and clothes from markets (Marx 1992). Modern pastoral nomads can not exist without towns (Marx 1992).

According to M. Rowton, this close relationship between pastoral nomads and urban communities represent one of major features throughout the Near Eastern history (Rowton 1974). In the Near East including the Southern Levant, pastoral lands and agricultural lands are closely interwoven. Seasonal grazing lands visited by pastoral nomads are often located in sedentary zones and encircled by urban settlements. As a result, pastoral nomads in the Near East have had close economic and political contacts with farming population and urban communities historically. Interaction between pastoral nomads and sedentary population in the Near East is much closer than that in other regions such as Central Asia.

Therefore it is easy to imagine that the initial appearance of urban communities in the Early Bronze Age in the Southern Levant may have had a great impact on pastoral nomads.

In addition, the arid areas of the Southern Levant are rich in a variety of natural resources. All major copper sources in the Southern Levant, that is the Southern Sinai, Timna and Feinan, are located in the arid areas. The two major salt sources, the Dead Sea and Azraq, are also located in the arid areas. The arid areas in the Southern Levant also yield turquoise (the Southern Sinai), bitumen (the Dead Sea) and high quality Eocene flint (the Sinai, Negev, Jafr Basin, East Jordan). These resources were probably desired by Early Bronze Age fortified urban settlements. Pastoral nomads in the arid areas may have played vital roles in distributing these resources to the urban settlements.

However, currently archaeologists in the Southern Levant have little explored the role of pastoral nomads in these crucial periods (S.A. Rosen 2002, S.A. Rosen 2003). Most excavations still focus on major sedentary settlements.

The main goal of this thesis is to discuss whether the transformation of pastoral nomads can be observed and related to the development of complex societies and urbanism and what might have been the role of pastoral nomads in relation to the first urban communities in the Early Bronze Age. Archaeological data from the Jafr Basin, Southern Jordan serve as the primary data in this thesis.

11.3. ARCHAEOLOGICAL SURVEYS IN THE JAFR BASIN, SOUTHERN JORDAN

The Jafr Basin is the largest inland basin in Jordan (See Chapter 5.2 for more details). It covers about 15000 k m^2 in Southern Jordan. The elevation is relatively high ranging from 850 m in its centre to 1200 m on its western fringe. The mean annual precipitation in the basin is less than

100 mm and vegetation is extremely scarce. Most parts of the basin belong to the Saharo-Arabian desert. The basin is covered with flint pavement desert, *Hammada*. Only a few perennial water sources such as the Jafr Oasis are known in the basin. Therefore the basin has been seasonally occupied by pastoral nomads in the recent past. In the dry seasons, they usually stay on the fringe of humid sedentary areas to the west. In the rainy seasons when water pools and pasture appear, they visit the basin with their animals for grazing.

In contrast with other arid areas such as the Negev, Sinai and East Jordan, the Jafr Basin had been sparsely investigated archaeologically. Before 1970, a few researchers conducted archaeological surveys in the basin (Field 1960, Huckriede and Wiesemeann 1968, Rhotert 1938). After their research, the basin had been almost ignored for a few decades.

It is in the 1990's when intensive archaeological research started in the Jafr Basin (See Chapter 5.2). In 1995, S. Fujii at Kanazawa University started an archaeological project and has conducted excavations at many sites from the Palaeolithic to the Islamic period (Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002 c, Fujii 2003, Fujii 2004a, Fujii 2004b, Fujii 2005a, Fujii 2005b, Fujii 2006a, Fujii 2006b, Fujii and Abe in press). I have participated in this project since 2001. In 1997 and 1999, an American team also surveyed the northeastern part of the basin (Quintero, Wilke and Rollefson 2002).

Kanazawa University has surveyed the northwestern part of the basin since 1995 (Abe and Fujii 2004, Fujii 1996, Fujii 2002b, Fujii and Abe in press). By 2002, the surveyed area covered about

2500 k m² and 60 sites ranging from the Palaeolithic to Islamic period had been discovered.

The surveys revealed that the Jafr Basin was probably occupied by pastoral nomads in the Chalcolithic and Early Bronze Age although it was wetter than today during these periods (A.M. Rsen 2007. See Chapter 2.2). The Kanazawa University team discovered 3 Chalcolithic/Early Bronze Age habitation sites. Given the low intensity of the surveys, many more habitation sites are probably present in the surveyed area. Habitation sites are usually characterized by several enclosures and small rooms attached to them (See Chapter 5). Enclosures are usually round and over 10 m in diameter. They were constructed of medium and large fieldstones standing several courses high. Given that similar structures are used as animal pens by modern pastoral nomads, the enclosures were probably animal pens. Small rooms are usually circular and about 5 m in diameter and were probably served as dwellings. At these sites, sediments are very shallow and limited numbers of artifacts are scattered. Although excavations were not conducted at these sites, these facts strongly suggest that these habitation sites were small seasonal pastoral nomadic camp sites. They were probably occupied for days, weeks or months, sometimes repeatedly rather than years like Mediterranean villages. Currently no Chalcolithic/Early Bronze Age sedentary farming villages are known in the basin (See Chapter 5.3).

The most important discovery by the surveys is the large number of Chalcolithic/Early Bronze Age 'tabular' scraper production sites (See Chapter 5). Of a total of 60 sites, 25 are Chalcolithic/Early Bronze Age tabular scraper production sites. The same pattern was confirmed in the northeastern part of the basin by the American team. They discovered 114 sites in total. Of 114 sites, 79 are Chalcolithic and Early Bronze Age tabular scraper production sites. These facts strongly suggest that a large stone tool production industry producing tabular scrapers developed in the Jafr Basin.

Tabular scrapers are knives/scrapers made on thin, flat and cortical flakes (See Chapter 3.3). They are typical tools of the Chalcolithic and Early Bronze Age in the Southern Levant. Micro-wear analyses and contextual studies show that they were multi purpose knives used for hide working, butchering and wool shearing. High quality Eocene flint, not local to most sites, was used as raw material for tabular scrapers while local flint was usually used as raw material for other stone tools. Moreover most sites have no traces of tabular scraper production on site although they yield tabular scrapers. On the basis of these facts, S.A. Rosen suggests that tabular scrapers were produced by limited groups in restricted areas (S.A. Rosen 1997).

The discovery of a number of tabular scraper production sites in the Jafr Basin strongly supports Rosen's idea. The Jafr Basin was apparently one of the major sources of tabular scrapers in the Southern Levant. In fact, the basin is one of the biggest and best Eocene flint sources in the Southern Levant.

The author assumes that the Jafr basin probably supplied tabular scrapers mainly to Southern Jordan rather than to all over the Southern Levant (See Chapter 9.3 for more details). There are several pieces of evidence to support this idea. Firstly other tabular scraper production sites are also known in the Sinai, Negev and East Jordan although they are only briefly reported (Baird 2001a, S.A. Rosen 1997). Secondly tabular scrapers in the Southern Levant, especially during the Chalcolithic, show regional typological variation. This regional variation hints that each tabular scraper source produced distinctive tabular scrapers and supplied them to neighbouring regions. Percentages of tabular scrapers in stone tool assemblages are also informative. If the Jafr Basin had been the only major tabular scraper production source in the Southern Levant, percentages of tabular scrapers would probably be lower at sites which are far from the Jafr Basin. However, such patterns cannot be seen both in the Chalcolithic and Early Bronze Age.

The author also assumes that pastoral nomads in the arid areas were probably engaged in tabular scraper production (See Chapter 9.4). There are several pieces of evidence to support this idea. Firstly tabular scraper production sites are known only in steppe/desert areas such as the Sinai, Negev, East Jordan and the Jafr Basin although other Eocene flint sources, which are suitable for tabular scraper production, are also present in the Mediterranean area (Baird 2001, Carter 2001, S.A. Rosen 1997, Wasse and Rollefson 2005). Secondly some tabular scraper production sites are located in relatively remote deserts. A. Wasse and G. Rollefson recently discovered several tabular scraper production sites even in Wadi Hudruj, which is about 200 km to the east of the Mediterranean area (Wasse and Rollefson 2005). Thirdly tabular scrapers were more common at pastoral nomadic camp sites in the arid zone sites than at the sedentary settlements in the moister zone.

Jafr blades were also produced with tabular scrapers at most tabular scraper production sites in the Jafr Basin. Of 25 tabular scraper production sites, 20 have Jafr blade production loci (See Chapter 5 and Chapter 10.2).

Jafr blades are very large, thick and robust blades (Fig.10.1). The Jafr blade is usually characterized by a large flat plain or natural weathered platform, unidirectional scars (sometimes bidirectional scars) on the dorsal surface, non-prismatic configuration, and large size. Their average width is about 3 cm and their length when they are complete sometimes reaches over 15 cm. Eocene flint was used as raw material.

The blades were dated to the Palaeolithic (Huckriede and Wiesemann 1968). However recent studies clearly show that the blades can be securely dated to the Chalcolithic and Early Bronze Age (Fujii 1999, Fujii 2002a). Jafr blades were probably exported with tabular scrapers from the Jafr Basin to sedentary settlements. In fact, some Early Bronze Age sites in Southern Jordan such as Bab edh Dhra and Wadi Faynan 100 yielded blades which are techno-typologically similar to Jafr blades. They were used as sickle elements or threshing teeth at these settlements (See Chapter 10).

The next section will discuss developments of stone tool production in the Jafr Basin from the Chalcolithic to the Early Bronze Age.

11.4. STONE TOOL PRODUCTION IN THE JAFR BASIN IN THE

CHALCOLITHIC

The Jafr Basin yields high quality Eocene flint. Tabular scraper and Jafr blade production were probably community specialization by local pastoral nomads in the Jafr Basin utilizing the flint source. C.L. Costin defined 'community specialization' as "autonomous individual or household-based production units, aggregated within a single community, producing for unrestricted regional consumption" (Costin 1991).

In the Chalcolithic, local pastoral nomads in the basin started production of tabular scrapers and Jafr blades. However, the Chalcolithic stone tool production was not intensive.

Tabular scraper production sites can be divided into two types: tabular scraper production sites without flint mining (Gurta Siyyata type) and tabular scraper production sites with intensive flint mining (Qa Abu Tulayha type) (See Chapter 5).

Of 25 tabular scraper production sites, 19 are classified into Gurta Siyyata type and 6 are classified into Qa Abu Tulayha type tabular scraper production sites.

It is very difficult to date tabular scraper production sites because they rarely yield diagnostic pottery. However the typology of tabular scrapers excavated from sedentary settlements in Southern Jordan gives further indications of dates because tabular scraper production sites in the Jafr Basin probably supplied tabular scrapers to Southern Jordan.

Small side struck fan shaped tabular scrapers were the main products at Gurta Siyyata type sites while large end struck oval/elongated tabular scrapers were the main products at Qa Abu

Tulayha type sites.

Chalcolithic villages and pastoral nomadic camp sites in Southern Jordan yield small side struck fan shaped tabular scrapers. In contrast, large end struck oval/elongated tabular scrapers were common at Early Bronze Age villages and fortified settlements in Southern Jordan although these settlements also yield a limited numbers of small side struck fan shaped tabular scrapers (See Chapter 9.2).

Therefore Gurta Siyyata type sites can be dated to the Chalcolithic and Early Bronze Age and Qa Abu Tulayha type sites can be dated to the Early Bronze Age (See Chapter 9.2).

In the Chalcolithic, only Gurta Siyyata type tabular scraper production sites were present. Tabular scraper production at Gurta Siyyata type sites is less labour intensive production without flint mines (See Chapter 7). Small flint blocks on the surface were collected as raw material instead of quarried large flint nodules. Only limited effort was put into raw material procurement at Gurta Siyyata type sites (See Chapter 7).

Gurta Siyyata type production sites are usually located on geologically dissected locales such as the slopes of valleys and hills. In these places, exposed flint beds were weathered and naturally fragmented into small flint blocks. The land surface at the sites is covered with small flint blocks. These flint blocks were used as raw material. Flint knappers produced tabular scrapers on the spot where they found appropriate flint blocks on the surface. They did not bring these flint blocks to one location to knap them together. Therefore remains of tabular scraper production are scattered widely but in very low density at the sites. The average density of tabular scraper cores is from 0.25 to 0.5 per 1 m^2. This suggests rather expedient use of material.

The size of Gurta Siyyata type production sites ranges from 0.2 ha to 25 ha. At large sites, the evidence of tabular scraper production can cover a complete hillside or valley slope although the density is very low. However, to date, no structures have been associated with tabular scraper production at Gurta Siyyata type sites (See Chapter 5). Each knapping episode was probably too short to make it worthwhile to construct a stone structure for residence purposes. Such episodes possibly spanned only a few days at most. Even large Gurta Siyyata type sites over 25 ha were probably formed by multiple short knapping episodes over many years.

Flint blocks on the surface at Gurta Siyyata type sites are usually small and have internal fractures as a result of weathering. In addition, the blocks are usually tabular rather than nodular. Therefore only small side struck blanks could be knapped from the flint blocks. Small side struck fan shaped tabular scraper on the blanks were the main products at the sites. Their average size was only about 7 cm in length×9 cm in width. Knapping at Gurta Siyyata type sites was less careful than at Qa Abu Tulayha type sites and characterized by rough platform preparation.

Chalcolithic tabular scraper production in the Jafr Basin was low intensity and without flint mining. Tabular scrapers were produced by pastoral nomads for their own consumption to a significant degree. In the Chalcolithic, tabular scrapers were 20 % to 30 % of stone tools at pastoral nomadic camp sites in steppes and deserts. In contrast, tabular scrapers were still rare and usually less than 3 % of stone tools at Chalcolithic sedentary settlements (Chapter 9.5). This evidence strongly suggests that only a modest number of tabular scrapers were supplied to sedentary settlements from tabular scraper production centres in the arid areas in the Chalcolithic. Tabular scraper production was still a minor and low intensity industry for pastoral nomads in the Jafr Basin.

Most Gurta Siyyata type tabular scraper production sites also produced a number of Jafr blades (See Chapter 5 and Chapter 10). Of 19 Gurta Siyyata type sites, 17 produced Jafr blades with tabular scrapers. Like tabular scrapers, the small flint blocks on the surface were used as raw material for Jafr blade production. Remains of Jafr blade production are also dispersed widely but in very low density alongside remains of tabular scraper production. The average density of Jafr blade cores is only 0.1 per 1 m^2.

Information about Jafr blades during the Chalcolithic is still very limited. However it is likely that the pastoral nomads in the Jafr basin produced the Jafr blades for their own consumption to a siginificant degree and only a limited number of Jafr blades were distributed to the sedentary settlements like tabular scrapers. Currently, no Chalcolithic sedentary settlements have yielded Jafr blades.

This author supposes that most groups of pastoral nomads in the Jafr Basin were engaged in this small scale tabular scraper production and Jafr blade production in the Chalcolithic because Chalcolithic tabular scraper production and Jafr blade production were technologically very simple and raw material was acquired from the surface with limited efforts. It is also supported by a high incidence of Gurta Siyyata type sites in the Jafr Basin.

11.5. STONE TOOL PRODUCTION IN THE JAFR BASIN IN THE EARLY BRONZE AGE

Stone tool production in the Jafr Basin changed radically in the Early Bronze Age (See Chapter 6 and Chapter 9). Tabular scraper production was intensified with introduction of flint mining. Currently 6 Qa Abu Tulayha type tabular scraper production sites are known in the surveyed area (See Chapter 5). Their size ranges from 2.3 ha to 0.15 ha. At every site, remains of substantial flint mining were discovered. At the largest Qa Abu Tulayha type site, JF0212, a flint mining trench whose length is over 700m was discovered. Over 400 tons of flint nodules were mined from this trench. Even at the smallest site, JF0216, two mining trenches whose length is about 50 m were discovered. 60 tons of flint nodules were extracted from these trenches. Great efforts were made to acquire suitable raw material. It is estimated that tabular scraper production at Qa Abu Tulayha type sites is about 5.5 times more labor intensive than the production at Gurta Siyyata type sites in order to produce the same number of blanks (See Chapter 7.1).

Quarried flint nodules were usually large and fresh. Their average size is about 30 cm×30 cm×10 cm. At Qa Abu Tulayha type sites, large end struck oval/elongated tabular scrapers were the main products of knapping these nodules. The average size of these tabular scrapers is about

15 cm in length×10 cm in width. Mining large and fresh flint nodules was necessary to produce a reasonable quantity of such large and long tabular scrapers.

Around flint mining trenches/pits, extracted flint nodules, limestone, and chalk were abandoned. Furthermore tabular scraper blanks were also detached from the nodules around the flint mining trenches/pits because the nodules were heavy. Tabular scraper cores and debitage are scattered in great density around the trenches/pits. The density of tabular scraper cores is extremely high. There are 10 tabular scraper cores per 1 ㎡ on average. Tabular scraper cores usually form circular clusters. Each core cluster consists of about 30 tabular scraper cores. The size of clusters is about 3 m in diameter and some clusters are annular. It is likely that one flint knapper sat down and detached tabular scraper cores in one cluster in one work episode.

At Qa Abu Tulayha (JF09503), two stone structures associated with tabular scraper production, Structure 01 and Structure 07, were discovered (See Chapter 6.1) (Fujii 1996, Fujii 1998, Fujii 1999, Fujii 2000, Fujii 2001a, Fujii 2001b, Fujii 2002a, Fujii 2002b, Fujii 2002 c, Fujii 2003). Given the size of these structures, about 5 knappers probably stayed at Structure 07 and over 20 knappers probably stayed at Structure 01. These structures suggest that periods of knapping and extraction were probably longer than at Gurta Siyyata type sites. Each mining and knapping phase was probably long enough to make it worthwhile to construct the stone structures for residence purposes. It is estimated that each mining and knapping phase at these structures probably spanned several weeks at Qa Abu Tulayha (See Chapter 6.1). The author assumes that the group who stayed at Structure 07 probably mined 30 tons of flint nodules and produced 2000 tabular scrapers in each phase and the group who stayed at Structure 01 probably mined over 70 tons of flint nodules and produced about 5000 tabular scrapers in each phase.

Tabular scraper production in the Jafr Basin was intensified with the introduction of flint mining in the Early Bronze Age. The pastoral nomads in the Jafr Basin probably intensified tabular scraper production for exchange. Large end struck oval/elongated tabular scrapers were preferred as high quality knives at sedentary settlements. In the Chalcolithic, tabular scrapers are less than 3 % of stone tools in sedentary settlements. However the average percentage of tabular scrapers in stone tools increased to about 9.5 % at sedentary settlements in the Early Bronze Age (See Chapter 8 and Chapter 9.5). Given that the significant number of large sedentary communities in the Early Bronze Age, this fact strongly suggests that more tabular scrapers were exported to sedentary communities from tabular scraper production centres in the arid areas in the Early Bronze Age. The amount of tabular scraper production probably increased in the Jafr Basin to supply sedentary settlements in the west. Stone tool production became a very important industry in the Jafr Basin.

The author supposes that limited groups of pastoral nomads in the Jafr Basin specialized in this intensive tabular scraper production for exchange because great efforts were necessary to get raw material. In addition, producing large end struck oval/elongated tabular scrapers was technologically somewhat difficult and requires training. Furthermore the number of Qa Abu

Tulayha type sites is much fewer than that of Gurta Siyyata type sites.

Other groups of pastoral nomads in the Jafr Basin also continued less intensive tabular scraper production and Jafr blade production at Gurta Siyyata type sites in the Early Bronze Age. Small fan shaped tabular scrapers were continuously produced at Gurta Siyyata type sites. Jafr blades were also continuously produced mainly at Gurta Siyyata type sites. It is noteworthy that several sedentary settlements such as Wadi Feinan 100 and Bab edh Dhra yielded sickle elements which resemble Jafr blades techno-morphologically (See Chapter 10). Some Jafr blades were probably exported from the Jafr Basin with tabular scrapers to sedentary settlements.

11.6. INTENSIFICATION OF STONE TOOL PRODUCTION IN THE JAFR BASIN AND THE DEVELOPMENT OF URBANISM

The intensification of stone tool production in the Jafr Basin in the Early Bronze Age was probably caused by 'the development of urbanism'.

As a part of the development of large fortified urban settlements in the Early Bronze Age, many economic changes can be suggested. Each region of the Southern Levant seems to have intensified production of specialized products (See Chapter 2). Greater regional interaction and economic integration are suggested.

For example, settlements in the highlands seem to have intensified olive cultivation in the Early Bronze Age although the beginning of olive cultivation dated back to the Chalcolothic.

Studies of pollen cores from the Lake Galilee clearly show that olive trees increased radically in the Early Bronze Age in the landscape around the lake (Fall, Falconer and Line 2002). In addition, the number of settlements in the highlands increased in the Early Bronze Age (Philip 2001).

The area around Mount Hermon is unsuitable for agriculture. Inhabitants in this area intensified and specialized in the production of Metallic ware to compensate for the lack of agricultural products. Most sedentary settlements in a 100km radius from Mount Hermon imported most daily pottery from the area (Greenberg and Porat 1996).

The appearance of Canaanean blades in the Early Bronze Age is also noteworthy. Canaanean blades were mass-produced in limited production centres near Mediterranean Eocene flint sources. A large amount of the blades were distributed from these centres intra and inter regionally (S.A. Rosen 1997).

In the Early Bronze Age, households became more dependent on foods and utilitarian goods produced by specialized producers in other regions.

The pastoral nomads in the Jafr Basin were probably caught up in these processes. In the Early Bronze Age, they specialized in intensified stone tool production exploiting high quality Eocene flint sources in the basin. This production was for consumption by sedentary communities in Southern Jordan.

It is likely that in the Early Bronze Age the arid areas were economically integrated with the moister zones to a greater degree than before. Pastoral nomads in other arid areas were also influenced by the development of urbanism and exploited desert raw materials more intensively in the Early Bronze Age (See Chapter 2).

The Camel site is a small pastoral nomadic camp site in the Central Negev (S.A. Rosen 2002, S.A. Rosen 2003). This camp site is located near metamorphosed and ferruginous sandstone sources. Grinding stone production loci exploiting the sandstone sources was discovered at the site. A number of roughouts, broken products and debitage were excavated.

Arad is an Early Bronze Age fortified urban settlement located in the southern fringe of the Judean hill. According to S.A. Rosen, most grinding stones at Arad were made on the Central Negev metamorphized or ferruginous sandstone. Furthermore no production loci of grinding stones were discovered at Arad although about 20 % of the site has been excavated to date. Therefore S. A. Rosen suggests that Arad imported the grinding stones from pastoral nomads in the Central Negev (S.A. Rosen 2002, S.A. Rosen 2003).

Several pastoral nomadic camp sites such as Sheikh Awad and Nabi Salah are known near copper mines, Wadi Riqita in the Southern Sinai (Beit-Arieh 2003). The presence of crucibles, copper slag, moulds and copper tools at the sites suggests that copper production was conducted on site on a modest scale along with animal herding. Petrographic studies show that these sites imported pottery such as storage jars from the Arad area. Therefore it is likely that the pastoral nomads in the South Sinai were engaged in copper production and exchanged copper tools to

Arad. Through the exchange, they probably acquired pottery, cereals and other daily commodities from Arad (Stager 1992).

11.7. CONCLUSION

In the Early Bronze Age, pastoral nomads in the Jafr Basin intensified stone tool production for exchange with sedentary settlements. They exploited high quality Eocene flint more intensively than in previous periods. Pastoral nomads in other arid areas also exploited desert resources more intensively in the Early Bronze Age. Pastoral nomads in the Central Negev exploited high quality sandstone sources and pastoral nomads in the South Sinai exploited copper mines for towns. It is also likely that some pastoral nomadic groups intensified animal management to supply sheep/goats, wool, cheese and milk to urban communities. G. Philip suggests that the fortified settlement of Khirbet az-Zaraqun probably acquired mature female goats from pastoral nomads in steppes and deserts on the ground of faunal remains from the site (Philip 1999).

The development of urbanism in the Early Bronze Age clearly had great impact on pastoral nomads in steppes and deserts. It is likely that the arid areas were economically integrated with the mositer zones to a greater degree in the Early Bronze Age than before. The development of urbanisim probably made pastoral nomads more market and town oriented. In the Early Bronze Age, a variety of desert products were distributed to sedentary settlements by pastoral nomads.

Meanwhile, Early Bronze Age pastoral nomads probably became more dependent for living necessities and luxuries such as cereals, foods, vegetables and clothes on markets in urban communities.

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