EARLIER STONE AGE GEOARCHAEOLOGY OF THE NORTHERN KRUGER PARK

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A dissertation submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science.

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Declaration

I declare that this dissertation is my own, unaided work, except where otherwise acknowledged. It is being submitted for the degree of Master of Science in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

Signed this 26 day of October 2004

Ryan James Gibbon.

Abstract

The results of an extensive survey of the Northern Kruger Park reveals that Earlier Stone Age hominids utilised clasts from the Malonga Formation to make stone tools. Analysis of the survey data demonstrates that tools dropped on the landscape, through a combination of alluvial and colluvial processes, became engulfed within stream beds and outwash alluvial fans radiating from the Malonga Formation highlands. These tool-bearing deposits formed the resistant areas which occur as ridges and hills in the landscape today. The deposits accumulated under more arid climatic conditions than occur at present, with a reduction in vegetation cover. An Acheulean industry, preserved within the deposits, appears to belong to the Middle Acheulean period because it lacks the relatively more refined bifaces of the later Acheulean. The industry contains numerous prepared cores, including a few Victoria West-like cores. This Middle Acheulean interpretation is supported by geomorphological data. A distinct east-west change in tool concentrations is explained in terms of the distribution of the quality of the raw materials and the discard behaviour of the hominids. The area would have been a favourable location for hominid activity, with access to water, as well as to abundant food resources in the riverine habitat.

Preface

Northern Kruger Park Earlier Stone Age investigation forms part of the larger research programme being conducted by the University of the Witwatersrand, under the coordination of Dr K. Kuman. The programme is currently investigating the archaeology (predominantly Earlier Stone Age) of the Palaeo-Limpopo River Basin and associated tributaries. Until 2000, relatively little was known about the prehistory of the Limpopo River Basin before 3000 BP, with details about the Earlier Stone Age of the region limited to notes made during other survey work and visits. The programme began in August of 2000, with survey and excavation of the Earlier Stone Age archaeology of the Vhembe-Dongola National Park and surrounding farms (Figure 1.1), and it was expanded in 2002 to include investigation of Middle Stone Age occurrences in the western portion of the study area (Kuman 2001*b*, Kuman 2002, Kuman *et al.* in press). The portion of the Palaeo-Limpopo River under study lies between 22°00′ and 22°30′ South and extends from 29°00′ to 31°20′ East. The area stretches from Pontdrif in the west, to the Mozambique border in the east, a landscape that covers an east-west distance of approximately 240 kilometres. To date, research has been confined to the two ends of this landscape as these are the areas with the best noted archaeology, with full survey and study of the interlinking area still needed.

Research has revealed that within the Vhembe-Dongola National Park and surrounding farms, south of the modern Limpopo River near its confluence with the Shashe, gravels associated with an ancient aggrading terrace of the river attracted Earlier Stone Age occupations (Kuman *et al.* in press). Artefacts from late Earlier Stone Age occupations were deflated onto substrates of cemented Miocene terrace sediments and sandstone bedrock and today lie buried by fine, non-alluvial sands of Holocene age. Artefacts are eroding from these sands, which cap a three kilometre long escarpment forming the northern edge of the remnant terrace. Large-scale excavation, near to the edge of the escarpment, has exposed a rich artefact accumulation with parallels to the Sangoan, a final phase of the Earlier Stone Age. Test-pitting of the sand cover across ten square kilometres has been conducted along the escarpment and southwards in sediments that overlie both sandstone and calcrete. Buried artefacts are preserved throughout the sand covered area, but the more informative sites occur at deep sediment traps formed by hilly sandstone outcrops. This initial work has provided evidence that the Limpopo Basin has been occupied from about 300 000 years onwards.

Before this research programme virtually nothing was known about Earlier Stone Age occupation along the Limpopo River in South Africa. Vhembe-Dongola National Park and Northern Kruger Park research are concentrating on establishing and expanding the cultural record of the area. This is crucial as the area would have been sensitive to population movements during the Pleistocene. Riverine habitats would have been an ideal refuge for southern African populations, displaced during dry and cold periods in the Pleistocene. In both areas, research is focusing on understanding site formation and transformation which determines the extent to which one can interpret behaviour. The search for new primary context sites, and subsequent excavation, is crucial for expanding the limited data base on hominid behaviour of the Earlier Stone Age. The Northern Kruger Park investigation, focusing on understanding site context, can be used in conjunction with Vhembe-Dongola National Park research. Comparing and combining of data from both areas is essential in expanding the limited knowledge of this time period within southern Africa.

Acknowledgements

I wish to thank Johan Verhoef (SanParks) for his support and enthusiasm for this project. Thanks must also go to Heidi Hansen of the Cultural Resource Office (SanParks) for logistical support, and all the staff of the GIS lab in Skukuza who provided digital data on the research area. I would also like to thank the rangers from the Pafuri Ranger Station who kept me alive, even though we spent each day walking on elephant paths. Sincere thanks must also go to John Makamu who provided most of my field protection while surveying. I am indebted to Chris and Betty Morris, and Morne and Marelize Carelsen who became my family while away from home, and for their kindness and help.

I also wish to thank the Makuleke People for their help and goodwill in allowing me to conduct research on their land. The Makuleke Park is truly one of the most beautiful areas in the region and a gem just waiting to be discovered. Thanks must also go to the Makahane people who are working closely with the park to preserve cultural resources. I also wish to thank Prof. Partridge, whose visit to the region and subsequent discussions on the geomorphology proved very informative and were much appreciated. Thanks must also go to Dr Woodbourne (CSIR) for his input on landscape evolution. This research was supported by P.A.S.T (Palaeo-Anthropology Scientific Trust). Without this funding the project would not have been possible. Final thanks must also go to my supervisors for their support and help throughout. [1]

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- Dr K. Kuman (Senior Research Officer, School of Geography, Archaeology and Environmental Studies).
- Prof. B. Moon (Head of the School of Geography, Archaeology and Environmental Studies).

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Chapter 1

Introduction

Investigation was conducted into the Earlier Stone Age of the Northern Kruger Park, in the Limpopo and Levuvhu River basins (Figure 1.1). Iron Age survey work in the Northern Kruger Park by Eloff (1979), from the University of Pretoria, recorded several Stone Age occurrences. Mr J. Verhoef (Manager, Cultural Resource Management Conservation Services) of the South African National Parks also recorded a number of sites discovered during work in the park and during other archaeological survey work (Verhoef 1997). An initial visit to a number of these sites, undertaken with Mr Verhoef, indicated that Earlier Stone Age (ESA) tools were eroding out of clast-supported 'tool-bearing deposits'. Middle Stone Age (MSA) and Later Stone Age (LSA) sites and artefacts were preserved to a lesser degree.

The ESA record in southern Africa is rather restricted, not only because of the limited sedimentary contexts that preserve archaeological materials, but also due to the paucity of researchers in the field. New research is essential in order to expand the cultural record, so that knowledge about early humans is not based on only a few sites, from a few locations within southern Africa. Data from many sites, across the Limpopo Basin, prevents unfounded and speculative conclusions from being drawn about our early ancestors.

One of the key areas of research into the ESA concerns interpretations regarding hominid behaviour (Toth & Shick 1986, Schick 1987, Kroll 1994, Clark

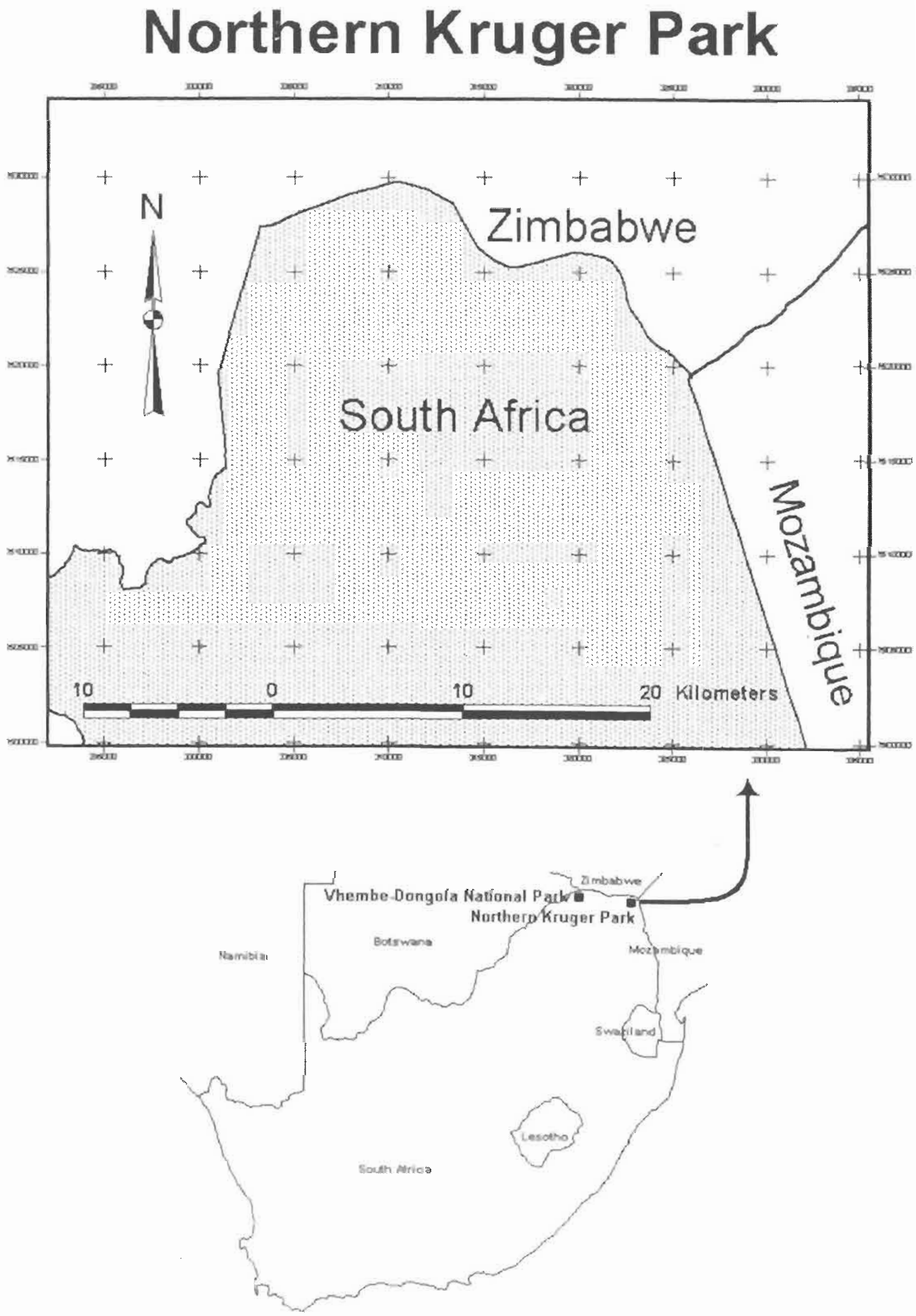


Figure 1.1: Northern Kruger Park study area, and map of South Africa showing the location of the Northern Kruger Park and Vhembe-Dongola National Park research areas.

1996, Kyara 1996, Tuffreau *et al.* 1997). It is of extreme interest to archaeologists to understand the development, complexity, and variation in social behaviour throughout the course of hominid evolution. Investigation of hominid behaviour must be considered within the broader cultural stratigraphy of the region. Investigation must thus also consider the technological time period within the ESA, and the technological signatures of the hominids. The cultural stratigraphy of southern Africa is poorly understood and often relies on extrapolation from eastern Africa, where stratified sites are dated by absolute means. Thus research in southern Africa must focus initially on understanding the archaeological deposits and artefacts place within the Stone Age, before consideration can be given to the activities of the hominids.

When investigating cultural remains from such a distant past, one must show caution when drawing conclusions about hominid behaviour, as the artefacts and their context may have been disturbed or changed since the tools were originally deposited. Understanding site formation processes is key to understanding ESA archaeological occurrences. Integral to understanding a site's formation is the contribution that both past and present geomorphological processes may have had on preserving, disturbing or rearranging cultural materials (Rapp 1987). As such, it is essential to study the landscape, past and present, in conjunction with the artefacts, to prevent speculative interpretations regarding hominid behaviour. If it is possible to identify the degree to which a site has been disturbed, and patterns produced by natural processes can be distinguished from those with a cultural origin, it is possible to draw important interpretations regarding hominid behaviour with confidence. This approach thus provides data on both the environment in which the hominids lived and carried out their daily activities, and on subsequent environmental changes which may have disturbed and altered the original cultural record. Understanding the hominid environment and its transformations over time is essential for comprehending hominid behaviour.

The Northern Kruger Park ESA research objectives are outlined below. Each of these objectives is integrally linked and cannot be considered alone

Site Formation Understanding ESA site formation is the first step in the investigation. Integral to understanding a site's formation is the contribution that both past and present geomorphological processes may have had on altering cultural remains.

Technology and Industry Investigation of the technology in terms of consistency across the landscape, time period within the ESA, and technological signatures of the hominids provides a basis from which behavioural statements can be made.

Hominid Behaviour The underlying objective of ESA research is to understand hominid behaviour throughout the course of hominid evolution. Once the site formation context has been established, patterns relating to hominid behaviour can be considered.

The Hominid Environment Understanding of the hominid environment is an essential backdrop for comprehending hominid behaviour.

After the initial assessment of the Stone Age archaeology in the Northern Kruger Park, a full survey of the area was carried out to determine all locations of artefacts and sites. The findings from the survey were then used as the basis from which to achieve an understanding of both cultural and natural factors which could explain the artefact localities. Any possible hominid behavioural influences on the locations of the artefacts, as well as present and ancient geomorphological processes which may have preserved or disturbed the tools from their original contexts, were investigated. Diagnostic stone tool types were used to differentiate between the Earlier, Middle and Later Stone Age occurrences (discussed in Chapter Four), as well as provide a relative chronology of the archaeology. Only then were patterns within the archaeology relating to hominid behaviour considered.

Northern Kruger Park research thus focuses on identifying patterns and relationships that can be attributed to hominid behaviour, within the broad cultural stratigraphy of the region, with crucial natural site formation and disturbance processes studied to prevent dubious behavioural interpretations. This approach thus provides data on the broad environmental and geographic setting in which the hominids lived and carried out their daily activities. It also provides comparable cultural and natural (eg. site formation) data that can be used to establish similarities and differences in ESA archaeological occurrences with the sites in the Vhembe-Dongola National Park area (Figure 1.1). Research is currently focusing on expanding the regions ESA cultural record through time and space. The regional approach also allows for comparisons to be made with archaeological occurrences on both regional and continental scales.

* * *

In order to achieve the research objectives, various research methods were employed both within the field and laboratory. Five months within the field proved essential for gaining an understanding of the landscape and associated archaeological materials. Laboratory analyses of the material collected from the Northern Kruger Park provided further data on both the archaeology and site formation processes.

Chapter 2

Research Methods

In this chapter the field and laboratory research methods employed are described. Five months of fieldwork primarily consisted of walking transects across the Northern Kruger Park, recording both artefact locations and landscape types (geomorphology). These data were continuously incorporated into a GIS (Geographic Information System). Large scale stereo-pair aerial photographs of the Northern Kruger Park, were used in conjunction with the GIS data obtained in the field, to map out the tool-bearing deposits. The mapping of the tool-bearing deposits allowed for a fuller understanding of landscape evolution.

Surface artefact collection provided artefact assemblage samples from various localities. Ten test pits were dug within various landscape localities to obtain *in situ* artefacts and to gain further understanding of the geomorphology. Laboratory work involved analyses of both the selected artefacts and excavated assemblages to achieve a greater understanding of the technology and industries within the context of the preservation history. Cataloguing and study of the artefacts provided data on the technology in terms of consistency across the landscape, time period, and technological signatures of the hominids.

2.1 Fieldwork

2.1.1 Survey

There are number of survey techniques that are considered standard in the field of archaeology (Hall 1996, Renfrew & Bahn 1996, Mithen *et al.* 2000). These include 'systematic sampling', in which a grid of equally spaced sample blocks are set up over the survey area, and each is searched. In a second technique called 'random sampling', the sample blocks within the survey area are determined by coordinates drawn from a table of random numbers, so that the numbers bear no relation to the factors determining the distribution of archaeological evidence, thus avoiding the major draw-back of systematic surveys. A third technique which takes into account the archaeologist's intuitive knowledge of the landscape is 'stratified random sampling'. With this technique the survey area is divided into zones which the archaeologist considers appropriate, such as habitat, topography or ecology (eg. an archaeologist may believe that archaeological materials will be found at certain heights within a landscape, as the artefacts are associated with ancient river terraces with fixed topographic positions). Random surveys are then conducted in each zone, combining the benefits of intuitive knowledge and randomness.

The above survey techniques are all sampling strategies and do not cover the whole landscape, and thus each strategy could potentially miss a crucial site. The only way to avoid such problems is to conduct surveys with a 100 percent coverage of the land-surface. Although this is the ideal and should be strived for when conducting landscape archaeology, it is not always possible due to time and monetary constraints. The archaeologist is seeking a strategy which will find the largest number of sites in the greatest possible area at the lowest possible cost. Sampson (1985, 25) with similar constraints developed a strategy with the guiding principle, *"learn what types of terrain yield the highest and lowest numbers of sites of all categories, and concentrate on the former terrain types while giving the latter a more cursory inspection"*. Sampson's daily survey tactics were to tighten the search path when the rate of site discovery increased, and to open it out whenever it decreased. This flexible survey technique allows for the accommodation of unexpected discoveries and changes in site distribution patterns. Although the technique does not recover every site, its effectiveness at recording 'real' site distributions can be tested against small 100 percent survey areas within the main study area.

Survey within the Northern Kruger Park involved walking transects across the study area. The survey differed from standard archaeological surveys (discussed above), in that it also included investigation of the landscape and not only the archaeology. A starting point was recorded, thereafter any change that was associated with geomorphology and landscape features with potential for understanding site formation and landscape evolution was recorded with a GPS (Global Positioning System), with full description and recording of the landscape between points across the transect. This continuous data set was used in interpreting the geomorphology and associated artefacts, and in the mapping of the Northern Kruger Park.

ESA artefact concentrations were recorded along the transects, with such areas described briefly in terms of their tool types, extent and condition. In terms of the survey it proved not to be necessary to cover 100 percent of the landscape as tools occur throughout the landscape in various concentration densities associated with 'tool-bearing deposits'. These 'tool-bearing deposits' are the result of hydrological processes (alluvial and colluvial wash) concentrating natural material (eg. rocks, pebbles, sand), as well as stone tools in certain areas. These concentrations have formed resistant areas which have survived erosional forces and now form features on the landscape. Thus there was no need for full landscape coverage, but rather the larger picture needed to be understood. Intensive survey was carried out in artefact rich 'tool-bearing deposits' areas, with the search path widened in less productive areas. Full discussion on the formation of the tool-bearing deposits follows in Chapter Three.

Transects cover all of the landscape types found within the Northern Kruger Park, dominated by basalt and sandstone, and are sufficient in number for detailed mapping. Certain areas needed greater amounts of coverage due to the complex geomorphology and numbers of stone tools, such as along the south-eastern region. Other areas consisted of a simpler landscape, such as the sandstone region in the west, which proved to have preserved little archaeological material.

2.1.2 Geographic Information Systems

An important tool in modern landscape archaeology, with its inherent need to understand past and present geomorphology, is the use of Geographical Information Systems (Verstappen 1977, Huxhold 1991, Bernhardsen 1999, Longley *et al.* 2001). A GIS helps in the constant development of the survey strategy, as well as the interpretation of geomorphological and archaeological data. A GIS is the most appropriate tool to help in recording, analysing, and interpreting spatial data (Custer *et al.* 1986, Kvamme 1990, Gaffney & Stancic 1996, Woodman 2000, Lake 2000). The strength of a GIS lies in its ability to be used as a spatial analysis tool, as well as in its instant updateable representation of spatial data, which one then has at hand to help in the development of the research and interpretation of the findings (Longley *et al.* 2001).

The GPS points and associated archaeological and geomorphological spatial data from the field, were continuously updated into the system and analysed on a daily basis. Digital Elevation Models (DEMs), topographic map data (eg. river systems), geological maps, aerial photographs, and satellite images formed the basis of the system, and were used to assist with the identification of topographic features that reflect past geomorphology. Spatial data were analysed to evaluate any relationships or patterns (natural or cultural) that may be apparent. This continuously updateable and analysed data source was integrated into the research strategy and guided research throughout. The use of GIS proved vital in achieving an understanding of the tool-bearing deposits and associated archaeology.

2.1.3 Surface Artefact Collection

A number of areas was selected to conduct surface artefact collection. This was based on geomorphological data (prominent tool-bearing deposit preservation) and artefact density. Surface collections were used to determine the range of material present, to establish if the artefacts were fairly consistent in industry or represented a mixture from various time periods. The surface collections are only selected samples of the tool types that occur at each locality and the region as a whole, and they are by no means a complete sample. They do, however, provide good data that can be used to make certain comparisons between the preserved tool-bearing deposits, as well as aid in an understanding of the types of tools (assemblage composition) and their place within the Stone Age.

2.1.4 Test Pits

Since surface collections are selective and never completely representative, test pits were dug into various tool-bearing deposits within the landscape. This provided unbiased samples to be used to evaluate the nature of the artefact concentrations more accurately. These *in situ* collections were useful for comparisons between the various artefact concentrations across the landscape and were used to consider issues such as artefact types and condition differences. A total of ten test pits was dug. Either a half by one metre or one by one metre proved the best size to dig into the hard consolidated tool-bearing deposits. The test pits provided further site formation and geomorphological data and helped in gaining an understanding of landscape evolution and the formation of the deposits.

In conjunction with the test pit data, a number of road and river cuttings and borrow pit sections were analysed to assess both the artefacts and geomorphology. Due to the large sizes of exposed sections through the landscape features, as well as the associated tools, these exposures proved to be invaluable in understanding the landscape.

2.2 Laboratory Work

2.2.1 Stereo-Pair Aerial Photograph Analysis

In conjunction with data from the GIS, large scale stereo-pair aerial photographs (1:30 000) of the area were used to identify the most important topographic features associated with the tool-bearing deposits. The photographs were used to produce a geomorphological map of these deposits. The map could then be used for interpretation and understanding of the archaeological and geomorphological history.

2.2.2 Stone Tool Analyses

Cataloguing and study of the artefacts provided data on the technology in terms of consistency across the landscape, time period, and technological signatures of the hominids, as well as site formation. Further discussion on these analyses follows in Chapter Four. The specific analyses conducted on the artefacts from the Northern Kruger Park are listed below.

Stone Tool Classification Artefacts were classified within modern classification schemes for the Stone Age (Clark & Kleindienst 1974).

Raw Material The types of raw materials from which the tools were made were recorded.

Artefact Condition Stone tools were classified according to weathering states and preservation influenced by fluvial processes.

Artefact Size Analysis The maximum length of the stone tools from all test pits was recorded and then used for a comparison with results from artefact flaking experiments that represent complete assemblages undisturbed (Schick 1986).

Cortex Data Cortex on stone tools was used to source the raw materials (manufactured from clasts or bedrock?).

* * *

In Chapter Three there is full discussion of the geomorphology of the Northern Kruger Park and the formation and preservation of the tool-bearing deposits. Understanding site formation is key to understanding ESA archaeological occurrences. As such, it is essential to study the landscape, past and present, in conjunction with the artefacts to prevent speculative interpretations regarding hominid behaviour from being formed.

Chapter 3

Geomorphology

3.1 Introduction

The tool-bearing deposits that preserve ESA stone tools in the Northern Kruger Park have formed due to unique, localised geomorphic conditions. The Malonga Formation, a dominant component of the geology, has provided the material necessary for their formation. These deposits form features on the modern landscape and constitute an important component of the geomorphological history of the region. The formation of these deposits needs to be understood within the broader macro-scale geomorphic, drainage, climatic, and geological evolution of the region and of southern Africa as a whole. Each of these related aspects is discussed below, followed by a model explaining the tool-bearing deposits formation and survival to the present day.

3.2 Macro-Scale Geomorphic Evolution

The macro-scale geomorphic evolution of southern Africa since the beginning of the Pliocene is relevant. Massive uplift of the eastern hinterland of southern Africa at the beginning of the Pliocene was accompanied by an increase in offshore sedimentation rates (Partridge & Maud 1987). Various lines of evidence, including the long profiles of rivers which are convex upward, and profiles of remnants of ancient surfaces (namely the African Surface) are similarly deformed, and gradients on the seaward side of the axis of maximum uplift are as high as 40 metres per kilometre, compared to gradients of one to three metres in areas of advanced planation unaffected by warping (Partridge & Maud 1987). In the Eastern Cape, Pliocene marine deposits have been raised to an elevation of 400 metres above present sea level, less than 20 kilometres from the coast, with Pliocene sea levels believed to be within 35 metres of the present (Partridge & Maud 2000, 14). These lines of evidence have been use to bracket the amplitude of the axis of maximum uplift between 700 and 900 metres, with lesser uplift in regions such as the south-eastern and western coast lines, where uplift amounted to 90 to 110 metres.

The effects of this uplift during the Pliocene included imparting a slight increase to the gradients of westward flowing rivers; eastward flowing rivers were significantly steepened, and this led to major gorge cutting and dissection. Similarly an increase in the relief along the eastern and southern parts of the Great Escarpment resulted through incision in the headwater reaches of most rivers (Partridge & Maud 2000, 14). The rejuvenation of some rivers was aided by warmer and more mesic conditions during the Pliocene, which resulted in weaker, unprotected lithologies achieving a considerable degree of planation through erosion (eg. eastern Lowveld of Mpumalanga). Consequently there was an increase in offshore sedimentation rates. The increased relief along large sections of the Great Escarpment produced rain shadow effects as the uplifted areas intercepted moisture advected from the Indian Ocean, thereby increasing the east-west climatic gradient across the sub-continent (Partridge & Maud 2000, 15). The effects of the uplift served to accentuate the effects of global cooling and aridification which accompanied the growth of high latitude ice-sheets between 3.0 and 2.6 million years ago (Partridge & Maud 2000, 15).

From 2.6 million years ago, geomorphic evidence in the form of river terraces along the major rivers attests to the influences of cyclical changes in climate (discussed below), as patterns of global atmospheric circulation responded to the waxing and waning of high latitude ice sheets (Partridge & Maud 2000, 15). The above summary relates to the broad geomorphic evolution of the subcontinent before and during the formation of the tool-bearing deposits. Local and regional geomorphic conditions and processes, viewed within this macro-scale framework, also need to be considered to understand the formation of the tool-bearing deposits.

3.3 Climate Evolution

Early Pliocene climate is characterised by warmer and more mesic conditions than prevailed during the Miocene (Partridge 1997*a*, Tyson & Partridge 2000). Rejuvenation of drainage networks from a number of regions, such as rivers in the Northern Cape and the Vaal River system, occurred during this period. Evidence from the hominid sites of Sterkfontein and Makapansgat, is said to indicate rich grassland and forest mosaics in the environs of the mid to late Pliocene, with a summer rainfall regime indicated (Tyson & Partridge 2000, 373). It must be remembered, however, that both of these sites are found in sheltered valley environments.

Major climate change then occurred towards the end of the Pliocene. The Pliocene uplift in the eastern hinterland of southern Africa (discussed above) produced notable effects. The east-west precipitation gradient was strengthened through orographic interception of moisture advected from the Indian Ocean, especially areas next to the warm Agulhas current (Tyson & Partridge 2000, 373). Precipitation was concentrated on the windward side of the uplifted areas with rain-shadow effects to the west. At around the same time as uplift occurred (3.0 to 2.6 million years ago), a major interval of global cooling was initiated (deMenocal 1995). Global oceanic records indicate a significant period of cooling which culminated in the first major expansion of the northern hemisphere ice-sheets into the temperate latitudes (deMenocal 1995, Partridge 1997*a*). Middle and low latitude climates responded to the growth of the ice-sheets and on subsequent fluctuations in their size, in response to orbitally induced variations in receipts of incoming solar radiation (Partridge 1997*b*, 15). The uplift and global interval of climatic deterioration brought about major environmental responses, which included the aridification of large areas of sub-Saharan Africa, including the development of extensive dune systems. Fragmentation of environments and steep climatic gradients resulted.

There is very limited knowledge on the climates of the Pleistocene, with climate characterised by glacial and interglacial periods at high latitudes. Complex patterns superimposed on these glacial and interglacial periods included the effects of orbital precession, but were also strongly influenced by regional circulations of both the atmosphere and ocean (Tyson & Partridge 2000, 374). Ocean cores indicate that climate oscillated between glacial and interglacial periods with a quasi-periodicity of 100 000 years in response to Milankovitch forcing due to changes in the eccentricity of the earths orbit (Tyson & Partridge 2000). Global and local evidence points to greatest aridity during the cool glacial maxima during these cycles (Partridge 1997*b*, 16). Reliable climate data only exists for the time period following the ESA and thus no firm statements about exact Pleistocene climate can be made. It has been suggested, however, based on marine records, that there were major shifts to arid, open conditions in Africa at around 1.7 and one million years ago (deMenocal 1995).

3.4 Drainage Evolution

There has been very little research on the drainage evolution of the Limpopo River and its tributaries. Sediments of the palaeo-Limpopo River during Cretaceous times, west of the Mozambique border, are discussed in the geology section. In Mozambique there is a substantial aggradational delta which was formed when vast quantities of clastic sediments were disgorged into the Mozambique Basin (de Wit *et al.* 2000, 57). It is believed that this volume of sediment indicates the existence of a significantly larger palaeo-Limpopo basin during the late Jurassic and early Cretaceous, which may have included the Okavango system of northern Botswana and north eastern Namibia (Hartnady 1985). This palaeo-Limpopo may have had its headwaters in central Angola.

Miocene terrace deposits, associated with a very much reduced river, compared to Cretaceous drainage, occur on farms west of Musina (de Wit 1996). During the Plio-Pleistocene in the headwaters of the Limpopo River, on the edge of the Kalahari Basin in the Northern Province, the river has incised into the Post-African surface (de Wit *et al.* 2000, 68). Apart from this very limited research the drainage evolution of the Limpopo River since the Pliocene is poorly understood.

3.5 Geology

The geology of the Northern Kruger Park is dominated by Letaba Basalt, Clarens Sandstone, Malonga Formation sediments, and Quaternary deposits (Figure 3.1). Each of these components is discussed below. The geological structure of the area has proved to be critical for the formation and subsequent preservation of the tool-bearing deposits. The shale indicated on the geological map does not form part of the study area and is not discussed.

3.5.1 Karoo Rocks

The Karoo basin and associated Karoo deposits with a thickness of 7000 metres in certain areas, covered an inter-continental basin between the Cape Mountains and the Kalahari Craton, extending well beyond the present margins of southern Africa into adjoining areas of Gondwanaland (Partridge & Maud 2000, 3). This sedimentation culminated in extensive outpourings of basalt around 183 million years ago as rifting of the continents occurred. Both the Clarens Sandstone and Letaba Basalt form part of the Karoo Sequence.

3.5.1.1 Clarens Sandstone

This formation consists of fine grained, aeolian sandstone, which is said to be evidence of Late Triassic desiccation (Brink 1983, Visser 1989). Near the base, the rock is somewhat argillaceous, pinkish and in places deep red, but higher

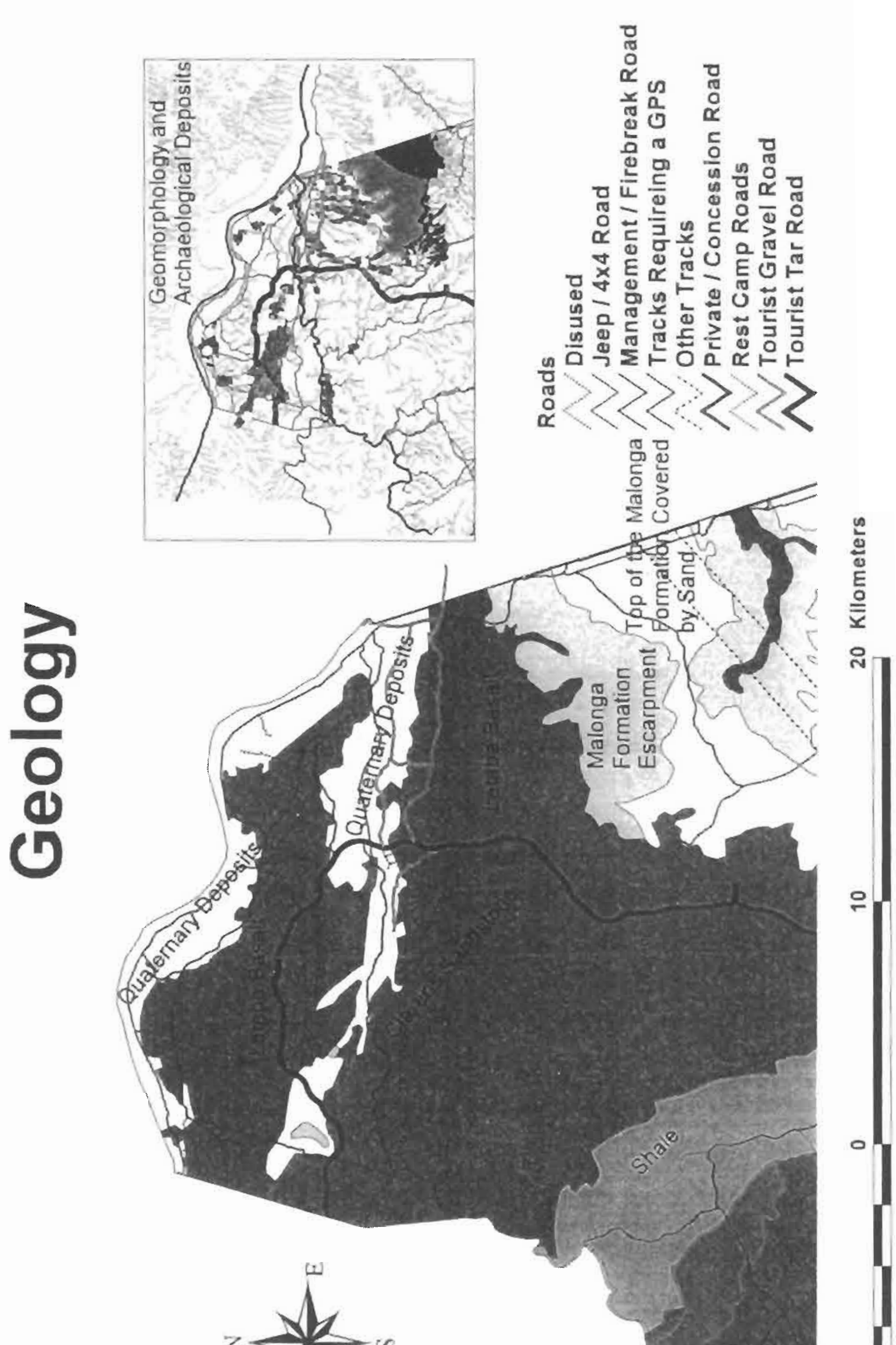


Figure 3.1: Geology of the Northern Kruger Park, based on the 1:250 000 geological map from the Council for Geoscience (1981). Geology and infrastructure data courtesy of the GIS Lab, Skukuza, Kruger National Park.

up it is white or yellowish (Visser 1989, 154). In certain regions, such as the Drakensberg, the outcrops are characterised by cliffs that hollow out at the base to form caves, which have been used extensively by humans for shelter throughout the ages (Truswell 1977). Thickness of these sediments also varies considerably. Fossils are rare from the formation; however, petrified wood, reptilian remains, and imprints of fish have been found in certain areas (Visser 1989, 154). These rocks were laid down during the Late Triassic and Early Jurassic (Bordy & Catuneanu 2002). Parts of the sandstone in the Northern Kruger Park have been metamorphosed into quartzite through contact with the Letaba Basalt outpouring discussed below.

3.5.1.2 Letaba Basalt

The Letaba Formation follows conformably on the Clarens Sandstone and forms part of the extensive outpourings of basalt around 183 million years ago (Brink 1983, Visser 1989). The formation occupies the relatively even, turf-covered terrain on the west side of the Lebombo Mountains. The formation consists of black, dark-grey, brownish and purplish basalt, and varies from dense to vesicular, with pipe amygdales developed at the base of individual flows (Visser 1989, 155). The thickness of these rocks amounts to at least 3600 metres. The basalt is crystalline and is therefore subject to both disintegration and decomposition, with the predominant form of weathering dependent on the environment (Brink 1983, 153). Where the Letaba Basalt is exposed on the surface to the atmosphere, the rocks disintegrate into a rather coarse-grained, irregularly shaped gravel. This process is often associated with strong development of calcrete.

3.5.2 Malonga Formation

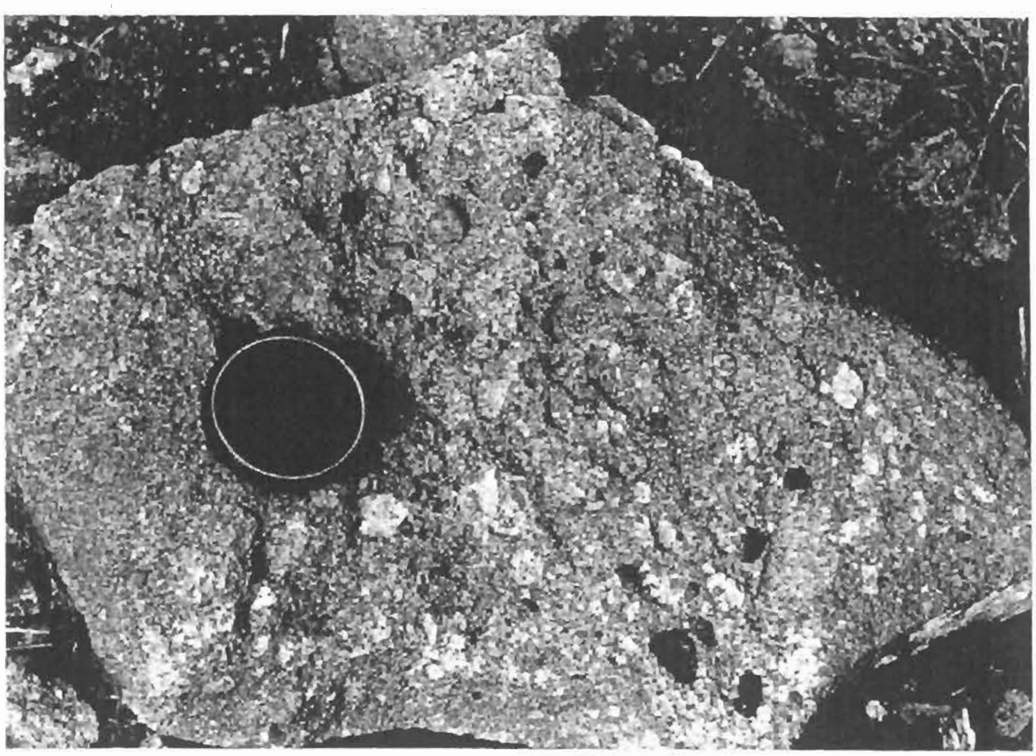
The post-Karoo age Malonga Formation rocks form a dominant component of the landscape in the Northern Kruger Park. The study by Botha and De Wit (1996) provides a good understanding of the nature of the formation. Previous research on these rocks, formally known as the Malvernia Formation, was limited in scope and lacked coherence between studies (Visser 1989). The latest research by Botha and De Wit (1996) draws together previous studies and expands understanding of these sedimentary rocks. The above authors work is summarised below.

These deposits are said to represent continental, taphrogenic sedimentation on the eastern margin of the newly formed African continent after the breakup of Gondwanaland. This sedimentation followed the eustatic uplift associated with the Karoo vulcanicity and the extensional tectonics and rifting along the continental margin and within the proto-Limpopo valley. The widespread occurrence of this system is believed to suggest the existence of a piedmont land-surface comprising coalesced alluvial fans and major fluvial channel and floodplain systems close to the continental margin during the Middle to Late Cretaceous.

The Malonga Formation is preserved in the far northeastern corner of South Africa, in the Gona-re-Zhou region of southeastern Zimbabwe, and along the Lebombo mountain foothills in western central Mozambique. Within these areas and within the Northern Kruger Park these deposits can be recognised by flat, sand covered plateau areas (Figure 3.2a). These plateaus occur at around 400 to 528 metres above sea level and are characterised by poorly defined drainage with linear, blind ephemeral streams and spherical pans. They are covered by unconsolidated sand and gravel deposits. High density dendritic tributary basins characterise the lower escarpments, with the flood plains of the major rivers (Limpopo and Levuvhu rivers in the Northern Kruger Park) defining a local base level at around 200 metres.

The Malonga Formation in the Northern Kruger Park can be sub-divided into an aggradational sequence of calcareous conglomerate, sandstone with intercalated red, mottled siltstone, and sandstone. The formation in the Northern Kruger Park area shows an eastward lithological change. Thin planar-bedded, unsorted pebbly sandstone conglomerate with thin matrix supported, pebble conglomerate, deposited by sheet flood action is found in the west. In the east

(a) South-east Malonga Formation plateau rising above the modern floodplain.



(b) Malonga Formation sedimentary rock structure.

Figure 3.2: Malonga Formation

thicker, upward-fining rocks comprising channel bound, clast-supported, rounded cobble to boulder size conglomerate and sandstone with well developed red palaeosol profiles in the upper, silty and fine-grained sandstone, deposited in fluvial channel and floodplain environments. occur. In the Northern Kruger Park there are also outcrops of red or grey calcareous marls and massive hardpan calcrete horizons. The clasts from the Malonga Formation consist of red and other quartzite (Soutpansberg Group), agate amygdales and basalt (Letaba Formation), vein quartz, granitoid, dolomite, jasper and banded iron formation. In Figure 3.2b an example of the sedimentary rock structure can be seen.

Overlying the calcareous Malonga rocks is a lateritic conglomerate formed by the decalcification of the parent material, releasing the clasts from the matrix. These clasts have then been cemented by a hard, ferruginous matrix. This is then overlain by a layer of unconsolidated clasts and sand cover up to six metres. The sand cover is discussed in the 'Quaternary Deposits' section. The escarpment of the Malonga Formation is covered by a veil of up to 12 metres in height of rounded pebbles, cobbles and boulders weathered from the calcareous parent rocks.

Botha and De Wit (1996) believe that the palaeo-environmental conditions during the accumulation of the Malonga Formation sediments were more arid than conditions inferred during the Upper Cretaceous in the region. The time period for accumulation can only be placed within the Middle to Late Cretaceous, with deposition ceasing during the Late Cretaceous with the formation of the thick silcrete layer associated with the 'Africa Surface'. Two surviving remnants of the Malonga Formation can be seen in Figures 3.1 and 3.3. The south-east remnant is far more extensive than the one in the north-west.

Throughout the Northern Kruger Park, away from the Malonga Formation proper and the tool-bearing deposits, there are small patches of Malonga pebbles, cobbles and boulders preserved from the original formation. These patches are found both on top of the gravely basalt, as well as in the sandstone areas where they have become incorporated in the sandstone sand, weathered from the parent material.

3.5.3 Quaternary Deposits

There are a number of areas that have been classified as Quaternary deposits (Figure 3.1). Fieldwork and recent research has allowed for the revision of some of the Quaternary deposit labels. Quaternary alluvial deposits along the Limpopo and Levuvhu rivers are not in need of adjustment. The floods in 2000 covered these areas with modern sediment. Undoubtedly there are older Quaternary deposits beneath the sediments on the floodplain, but these are beyond the scope of this investigation.

The Council for Geoscience has labelled the top of the Malonga Formation and associated high ground as Quaternary deposits. The work of Botha and De Wit (1996) provides a clearer understanding of these sediments. The top of the Malonga Formation is covered by a thick layer of unconsolidated red or yellow sand, which has previously been considered to be aeolian in origin (Botha & Wit 1996, 181). This thick sand cover thins around pans, drainage lines and along the escarpment. Botha and De Wits's (1996) investigation recorded red, yellow or grey, well to moderately-well drained, eutrophic soil profiles developed within the coarse sand with clay-rich smectic soils formed in shallow drainage lines. These authors believe that this unconsolidated sand cover is derived from the weathering of the calcareous Malonga Formation sediments and is not aeolian in origin (Botha & Wit 1996, 181).

3.6 Tool-Bearing Deposits

3.6.1 Formation

With an understanding of the geological and geomorphological history of the region and the Northern Kruger Park, focus is now given to an explanation of tool-bearing deposit formation and preservation within the local setting. Large areas of tool-bearing deposits have preserved within the Northern Kruger Park (Figure 3.3).

As discussed, survey within the Northern Kruger Park involved walking transects across the study area. A starting point was recorded, thereafter any change that was associated with geomorphology and landscape features was recorded with a GPS, with full description of the landscape between points across the transect. These data were then incorporated into the GIS. Digital Elevation Models (DEMs), topographic map data, geological maps, and satellite images, were used with the field data to assist with the identification of the tool-bearing deposits. In conjunction with data from the GIS, large scale stereo-pair aerial photographs (1:30 000) of the area were used to identify and then map the deposits. The GPS data and GIS were used to identify the location of the tool-bearing deposits on the stereo-pair aerial photographs. With these geomorphic features identified on the photographs, it was possible to map these prominent features on the landscape. The distribution of the tool-bearing deposits were then digitised from the stereo-pair aerial photographs and incorporated into the GIS. The GPS field data were then compared to the mapped tool-bearing deposit areas to evaluate map accuracy, with only minor adjustments needing to be made.

Botha and De Wit (1996, 181) describe the redistribution of the derived gravel weathered from the calcareous Malonga Formation, accumulating through colluvial and alluvial action at the base of the Malonga escarpment. These authors believe that ongoing incision of the land-surface by tributaries of the major rivers has created raised gravel covered terraces. This landscape model is very simplified and does not account for all aspects of tool-bearing deposit formation and preservation.

The action of colluvial and alluvial processes was the dominant formation agent of the tool-bearing deposits. Outwash alluvial fans and streams radiating from the surrounding highlands of the Malonga Formation preserved the ESA tools. Fluvial activity concentrated sediment, pebbles, cobbles, boulders and artefacts along hydrological lines. Localised colluvial processes also contributed,

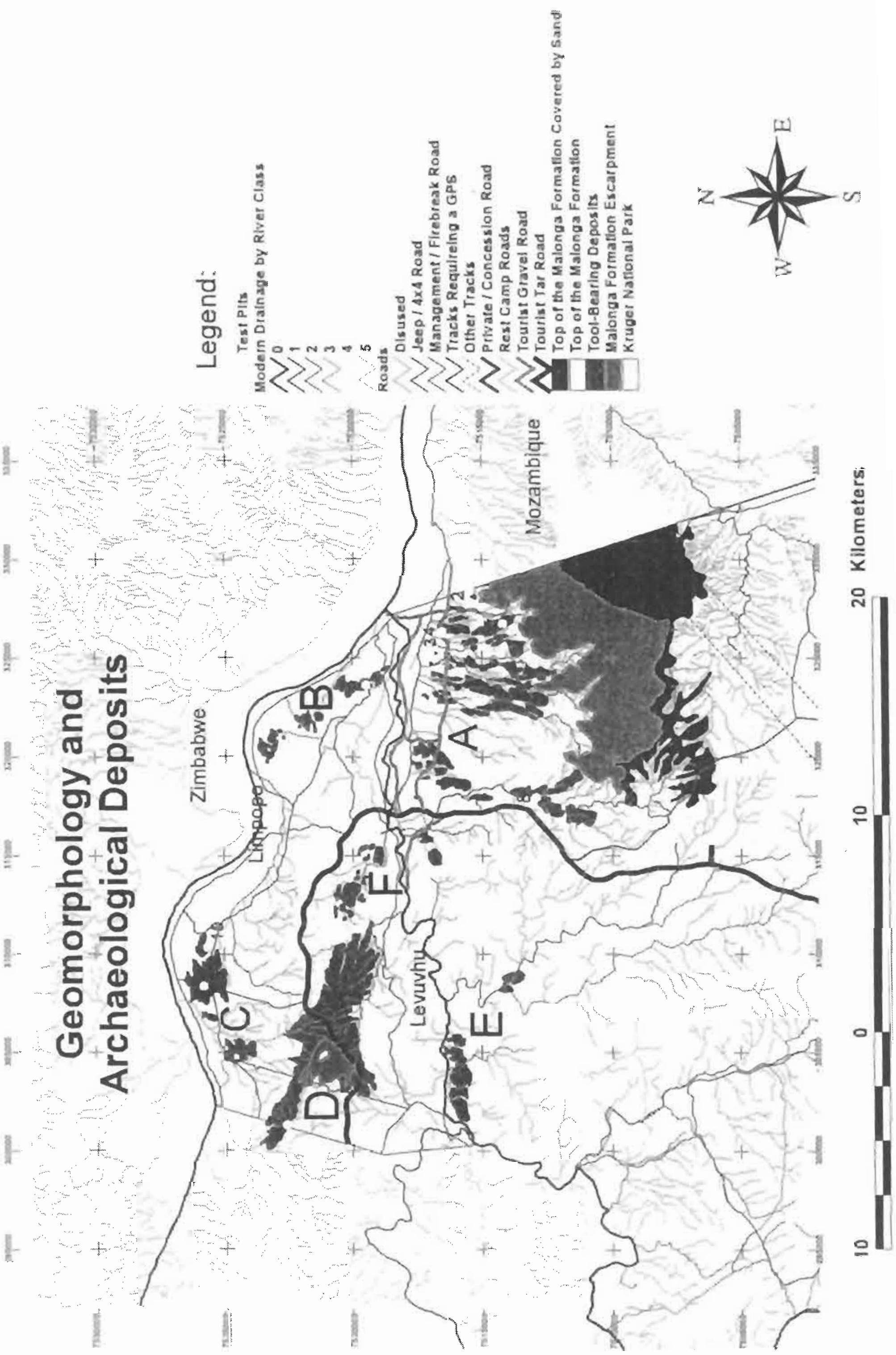


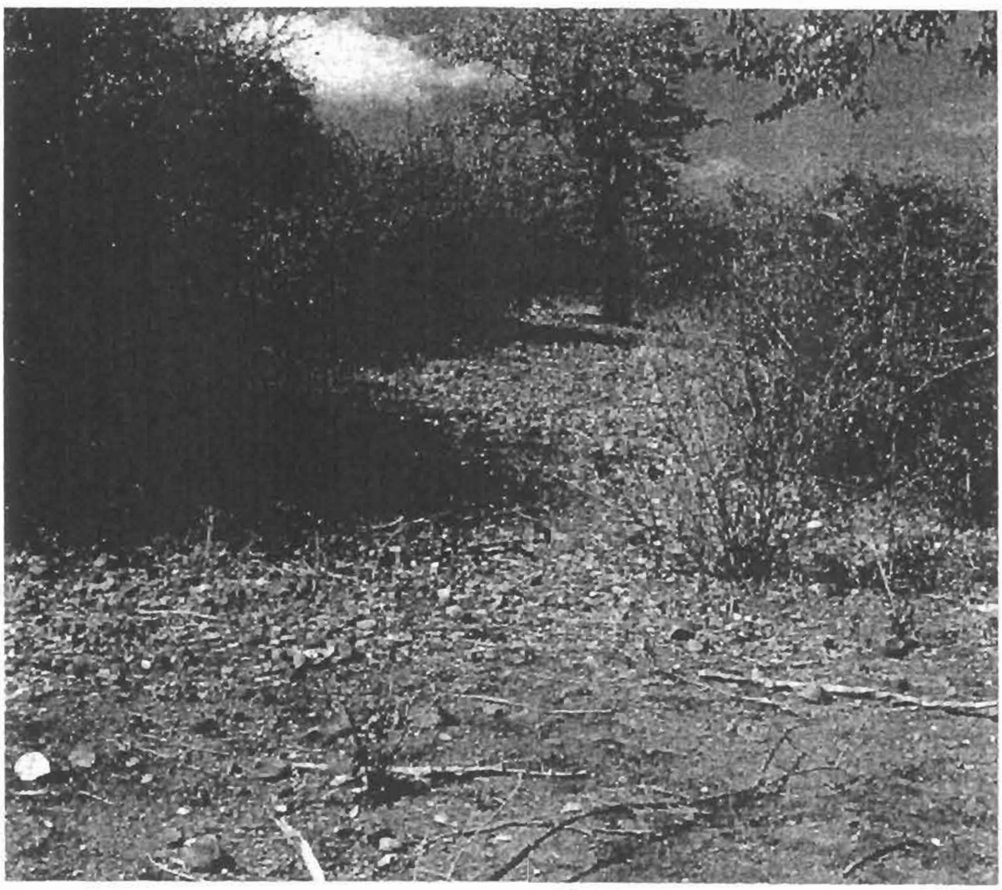
Figure 3.3: Northern Kruger Park showing the dominant geomorphology and associated archaeological deposits. Letters **A** to **F** indicate the different areas with tool-bearing deposits discussed in the text. Test pits are numbered from 1 to 10. Drainage and infrastructure data courtesy of the GIS Lab, Skukuza, Kruger National Park.

with materials washed into streams along the edge of the retreating escarpments. Streams thus became filled with the Malonga clasts and stone tools. These alluvial and colluvial deposits then formed the resistant areas which occur as ridges and hills (height = 2 - 30 metres) on the landscape today that contain the stone tools (Figure 3.4). These features represent a local inversion of the topography, with the streams beds of the past now forming ridges on the landscape today.

In relation to the tool-bearing deposit formation model outlined above, it is important to note that there is variation in the clast materials and sizes eroding out of the various remnants of the Malonga Formation in the Northern Kruger Park. In the south-east, the Malonga Formation remnant contains clasts that range in size from small pebbles to boulder size, with clasts dominated by red quartzites and other quartzites. The smaller northern remnant of the Malonga Formation has clast sizes which are much reduced when compared to the clasts from the south-east, with quartz becoming a prominent component. Quartzites still dominate the northern remnant, but there is a notable reduction in the amount of red quartzite. The Malonga Formation in the Northern Kruger Park and surrounding areas shows an eastward lithological change due to different depositional environments, with this clearly evidenced by the difference in clasts from the two remnants (Figures 3.5 and 3.6). This difference has been used to source the point of origin of the clasts from the various tool-bearing deposits and has proved valuable in understanding the formation of the tool-bearing deposits.

The tool-bearing deposits within the Northern Kruger Park can be separated into six areas as defined by their dominant geomorphic processes (Figure 3.3). These consist of the tool-bearing deposits predominantly to the east of the main road and south of the Levuvhu River (**A**: test pits one to five and eight); tool-bearing deposits to the east of the north-south main road and north of the Levuvhu River (**B**: test pit nine); deposits in the far north of the Northern Kruger Park along the Limpopo River (**C**: test pits six and ten); deposits radiating from the small remnant of the Malonga Formation to the north of the Levuvhu River (**D**: test pit seven); deposits to the west of the main road and

(a)



(b)

Figure 3.4: Tool-bearing deposit ridges.

Figure 3.5: Top of a tool-bearing deposit ridge near the south-east Malonga Formation remnant. Clasts range in size from small pebbles to boulder size, with clasts dominated by red quartzites and other quartzites.

south of the Levuvhu River (**E**); and deposits between the east-west section of the main road and the Levuvhu River, just separate from the deposits radiating from the small remnant of the Malonga Formation (**F**). Each of these areas is discussed separately within the broader tool-bearing deposit formation model outlined above. A schematic cross-section through the Northern Kruger Park landscape depicts the relationship between the various topographic features that dominate the area (Figure 3.7).

- Area **A** tool-bearing deposits cover a large area of the Northern Kruger Park, just to the north of the largest surviving remnant of the Malonga Formation. Their formation can be attributed predominantly to stream processes, but small alluvial fan processes may have played a lesser role. The tool-bearing deposits radiate from the Malonga Formation in a manner similar to modern drainage, and they are thus considered to be ancient stream bed deposits, rather than outwash fan deposits. Supporting evidence for streams comes from the fact that these deposits run up to,

(a) Clast sizes are much reduced when compared to the clasts from the south-east remnant, with quartz becoming a prominent component. Quartzites still dominate, but there is a notable reduction in the amount of red quartzite.

(b) Sand covered tool-bearing deposit ridge.

Figure 3.6: Tool-bearing deposit ridges near the north-west Malonga Formation remnant.

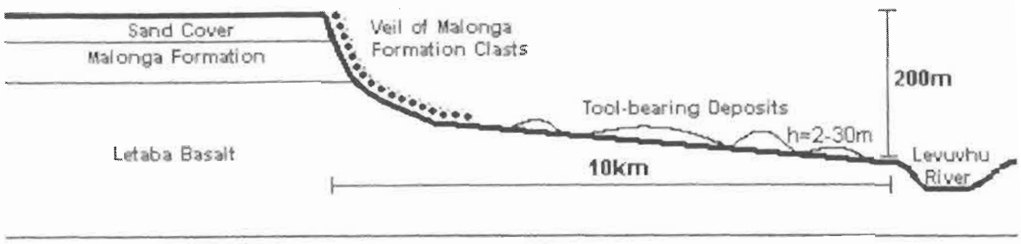


Figure 3.7: Schematic cross-section through the Northern Kruger Park landscape.

and then around, dykes seen on the aerial photographs, just as modern drainage does around these resistant obstructions. The large region in the middle of area **A** that does not contain tool-bearing deposits is dominated by dykes, and thus these more resistant rocks imparted an important structural control on the ancient drainage, confining hydrological lines to the weaker lithologies (basalt).

- Area **B** deposits, due to their isolated preservation, could be remnants of either an outwash alluvial fan or of stream deposits. Their point of origin may have been eroded away by the Limpopo and Levuvhu rivers. The clasts that make up the deposits appear to be the same type as those of area **A** and thus could represent the same streams radiating from the Malonga Formation in the south, with the deposits in the middle eroded away by the Levuvhu River. An exact date for the formation of the Levuvhu River is unfortunately not available to clarify the matter.

- Area **C** deposits are similarly difficult to attribute to either stream or fan deposits. Their point of origin can be attributed to the northern remnant of the Malonga Formation. The clasts that comprise these deposits are the same type as those of deposits **D**. Due to the fact that the shape of these deposits does not display stream characteristics, it appears that they could be the distal reaches of an alluvial outwash fan from the nearby Malonga remnant, that has subsequently been separated through erosion.

- Area D deposits clearly indicate an outwash alluvial fan, with colluvial and alluvial processes distributing material in a radial fashion.

- Area E probably represents stream deposits, due to their linear nature. These stream deposits have preserved at isolated locations and represent the last remaining remnants of streams that drained larger remnants of the Malonga Formation that have subsequently been eroded away.

- Area F deposits probably represent the distal reaches of the deposits D described above. They have, however, become separated through the action of faulting. In support of this the clasts that comprise these deposits are the same type as those of deposits D, indicating the same point of origin.

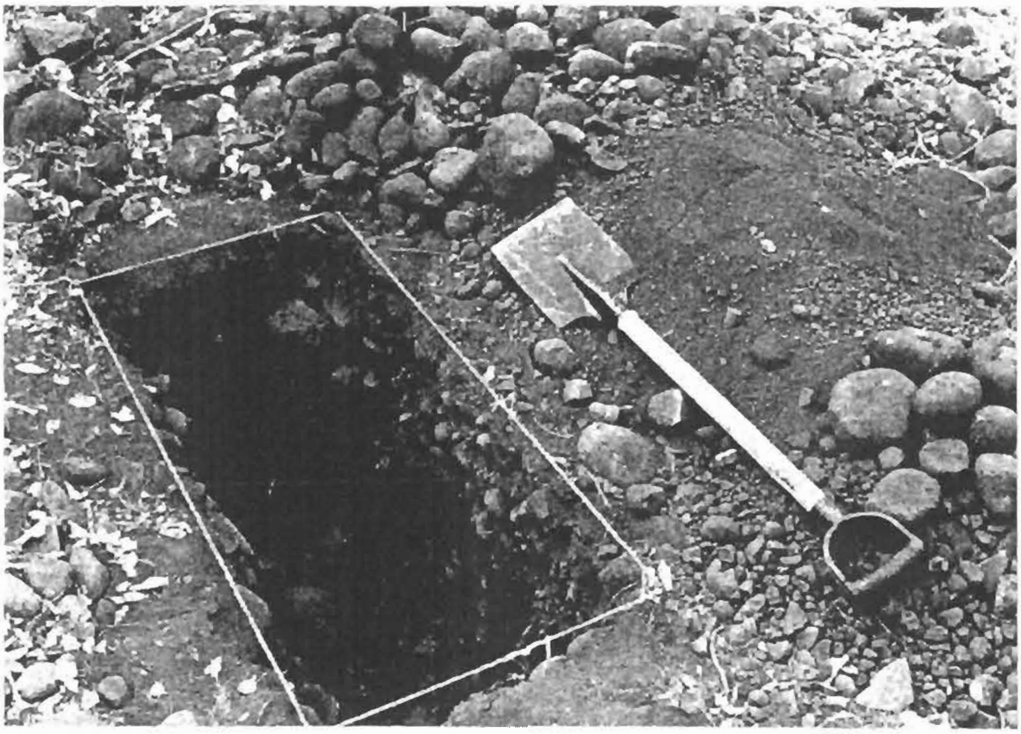
3.6.2 Supporting Evidence

Support for the tool-bearing deposit formation model, apart from spatial distribution of the deposits, includes:

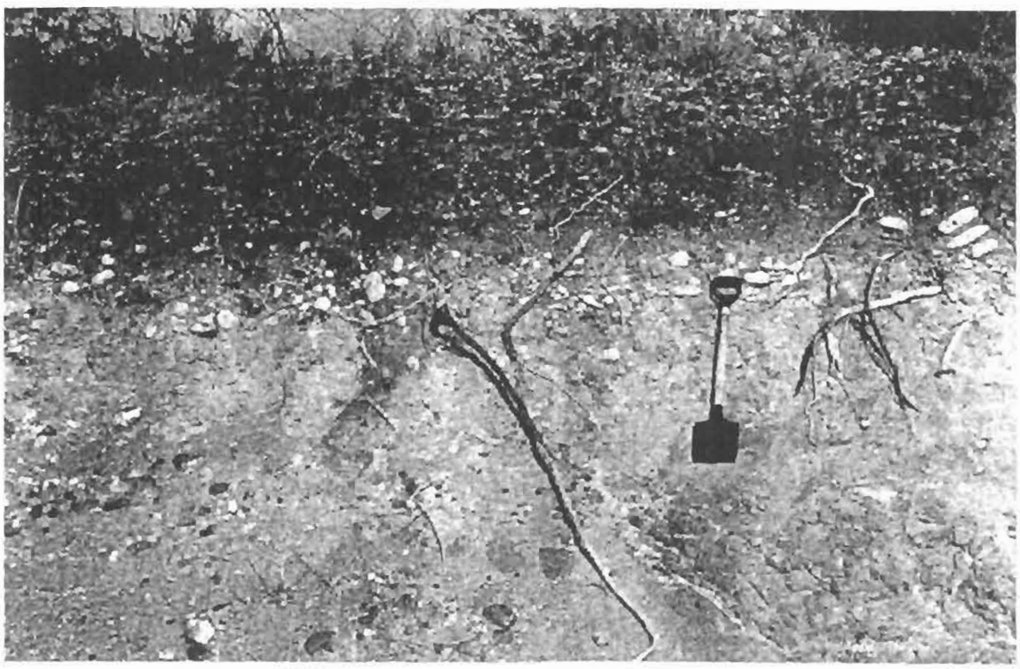
- Several of the deposits are preserved from around ten metres above current base level all the way to the base of the Malonga Formation escarpments. These deposits follow the same gradients as modern drainage lines and are thus interpreted as ancient stream bed deposits, radiating from the Malonga Formation (Figure 3.3).

- Tools are found throughout the thickness of all deposits. This is evidenced from the ten test pits dug in various localities (Figure 3.8a), as well as from road and river cuttings and borrow pits (Figure 3.9). Holes dug into the deposits by animals (ant bears), and the uprooting of trees by elephants, also clearly indicate that all of the deposits contain tools within and not only on the surface of these features.

- Imbrication or dip of clasts, seen in a road cutting near Test Pit One, indicates fluvial stream action radiating from the Malonga Formation in



(a) Test pit five - resistant, clast-supported deposit with artefacts continuing to the basalt bedrock.



(b) Road cutting near test pit one showing imbrication of elongated clasts in an upstream direction. A clast-supported layer overlies a sediment layer, followed by decaying basalt bedrock. All layers are partially calcified.

Figure 3.8: Tool-bearing deposit stratigraphy

(a) Thin layer of tool-bearing deposit, overlying decaying, calcified basalt bedrock.

(b) River cutting showing a thick tool-bearing deposit layer overlying decaying, calcified basalt bedrock.

Figure 3.9: Tool-bearing deposit stratigraphy

a northerly direction, towards the Limpopo River (Figure 3.8b).

- Stone tool condition, based on the state of artefact abrasion and rounding, indicates fluvial action. This aspect is discussed further in Chapter Four.
- Artefact size analysis included measuring the maximum length of the stone tools that were preserved within the deposits. These data were then used for a comparison with results from experimentally created complete artefact assemblages. The results indicated that the smaller flake sizes had been winnowed away by fluvial processes. This aspect is discussed in Chapter Four.
- Surface collections and test pit artefacts were used to determine the range of material present, to establish if the artefacts are fairly consistent in industry or represent a mixture from various time periods. This analysis demonstrates a fairly consistent industry during the formation of the tool-bearing deposits, indicating one dominant agent of accumulation.

Botha and De Wit's (1996, 181) landscape evolution model describes the redistribution of the derived gravel weathered from the calcareous Malonga Formation, accumulating through colluvial and alluvial action at the base of the Malonga escarpment. Subsequently through on-going incision of the land-surface, streams have created raised gravel covered terraces (namely the tool-bearing deposits). This model was in need of revision as it did not account for the very rounded and abraded condition of the artefacts, which indicates more substantial movement by fluvial processes than the small-scale processes proposed by Botha and De Wit. The revised model gains support from various lines of evidence which include the imbrication of elongated clasts, the artefact size analysis (fluvial winnowing), and the fact that the tools are found throughout the thickness of the deposits. These findings indicate more substantial hydrological activity and transport of clasts and artefacts, not accounted for by the previous model.

3.6.3 Characteristics and Preservation

Hominids were utilising the eroding clasts from the Malonga Formation to make stone tools. Once used, the tools were dropped on the landscape, and subsequently through a combination of alluvial and colluvial processes they became engulfed with Malonga clasts within stream beds and outwash alluvial fans radiating from the highlands. Along the Malonga Formation escarpments and for varying distances from its base (10-100 metres), there are no ESA tools on, or within, the clast deposits. This finding can be accounted for by the erosional retreat of the escarpments since the formation of the tool-bearing deposits. Only occasional Middle and Later Stone age artefacts are found in these areas. This finding emphasises the point that both Malonga Formation escarpments and tool-bearing deposits are part of a changing continuum.

In understanding why the tool-bearing deposits have been able to survive to the present, forming features on the landscape, one must consider their structure. These deposits are clast-supported and in instances moderately calcified (Figure 3.8b). Tool-bearing deposits vary in thickness from a few centimetres to several metres, depending on their state of erosion (Figure 3.9). There is a fine sediment component, with the surface of these features sometimes almost covered by sand and soil (Figure 3.6b), but as soon as one starts to excavate below this layer it becomes evident that all are clast-supported near the surface. There are a few road cuttings (Figure 3.8b) where a layer of clasts can be seen overlying a sediment layer engulfing a limited number of matrix-supported clasts.

The clast-supported deposits could represent instances where:

- the finer sediments have been washed away in the stream beds, leaving the larger clasts,
- there were only large clasts available at the time the streams and fans were forming deposits, or,
- gravel accumulations formed in stream beds and outwash fans through alluvial or colluvial processes.

The sediment layers in the deposits could represent instances where:

- the source of material was fine sediments,
- alluvial or colluvial action was limited and unable to transport the large clasts, or,
- the fine sediments were not washed away, but accumulated, such as in low velocity areas in stream beds.

Where clast-supported deposits developed, they have formed a resistant capping which has survived against erosion and now forms ridges and hills. Calcification of these deposits provided further resistance. The clast-supported deposits are far more resistant than the surrounding decaying, gravely basalt bedrock which forms the low areas between these features. The tool-bearing deposits dominate the basalt landscape with limited deposits in the more resistant sandstone areas (Figure 3.1). Similar deposits may be found in the sandstone areas, but they do not form prominent topographic features and may have become engulfed within the sandstone sand that has resulted from the weathering of the parent rocks.

As discussed, throughout the Northern Kruger Park, away from the Malonga Formation proper and the tool-bearing deposits, there are small patches of Malonga pebbles, cobbles and boulders that have preserved from times when the formation would have covered larger areas than at present. These patches are found both on top of the gravely basalt, as well as in the sandstone areas where they have become incorporated in the sand weathered from the sandstone parent material. These small patches of clasts have also been utilised for raw materials throughout the ages, and searching at any such patch usually reveals a few flakes on the surface. No excavation of these occurrences has been undertaken to date. There are also large areas of the Northern Kruger Park where the tool-bearing deposits have been eroded away and now only scatters of clasts preserve on small basalt hills and ridges

3.6.4 Climatic Indicator

In terms of the environmental and climatic conditions necessary for the formation of the tool-bearing deposits, one can look at the modern drainage and associated deposits for analogues. The modern ephemeral drainage is insufficient to produce stream bed deposits of a similar nature. Modern stream deposits are dominated by fine sediments (sand and small pebbles) with only the occasional clast-supported gravel bar. The modern Levuvhu River, however, has permanent flow and higher energy. It contains large sections of clast-supported gravel bed deposits, as well as smaller gravel bars, along stretches near to remnants of the Malonga Formation. These deposits are virtually indistinguishable from the stream bed tool-bearing deposits, dominated by pebbles, cobbles and boulders. The modern Levuvhu River has sufficient energy to collect, transport and then deposit the same clast sizes as preserved within the tool-bearing deposits. In contrast, the modern ephemeral drainage, even during heavy thunderstorms, does not have the energy to achieve this. This finding points to different environmental and climatic conditions during the formation of the tool-bearing deposits than occur at the present.

There are two climatic regimes that could potentially account for the formation of the deposits:

1. Climatic conditions that were wetter than present (increased rainfall), producing high energy permanent and semi-permanent streams radiating from the Malonga Formation, with clast-supported stream bed deposits.
2. Climatic conditions with greater runoff than present producing clast-supported stream bed deposits. This may include increased thunderstorm and flood action. This would occur in a drier climate than present, with reduced vegetation cover allowing for greater runoff, and also the easier mobilisation of unprotected clasts to be incorporated in the stream bed deposits.

As the Malonga Formation remnants are fairly small in size, with their catchments insufficient to support semi-permanent to permanent streams in the mode of the current Levuvhu River, the second climatic regime is supported. It is thus proposed that the tool-bearing deposits accumulated during periods of drier climatic conditions than present with a reduction in vegetation cover. Discussion has focused on the specific formation of the tool-bearing deposits, but it must be remembered that this formation is part of the continuous transformation of the landscape. It is not implied that the formation of these clast-supported tool-bearing deposits occurred during only one dry stable climatic period. Similarly, the stone tools incorporated within the deposits did not have to be dropped on the landscape at the same time the deposits were forming, but could have been dropped previously, and then subsequently become incorporated into the deposit.

3.7 Middle Stone Age Evidence

Middle Stone Age tools are found throughout the Northern Kruger Park in the form of redistributed scatters. The classification of sites as MSA is based on diagnostic tool types, with this aspect discussed in the section 'Artefact Types For The Middle Stone Age' in Chapter Four. These sites are found predominately on the basalt areas but also occur in the sandstone regions. They are more difficult to identify in the sandstone areas due to the sand covering which encases surface artefacts and hides such sites. MSA tools occur as redistributed material both on basalt hills and ridges, and in hydrological lines radiating from these high areas. These tools lie directly on the decaying bedrock and are subject to redistribution by present hydrological processes. An example of one such site can be seen where material has been washed (most likely) from the nearby basalt hill (Figure 3.10). Although the MSA sites represent redistributed material, there does seem to be a preference for high ground locations, with most basalt hills containing artefacts. MSA sites abound in the Northern Kruger Park, with some sites containing thousands of artefacts. This attests to substantial occupation of the area during this time period.

Figure 3.10: Middle Stone Age site

* * *

With an understanding of the formation of the tool-bearing deposits containing the ESA materials established within the Northern Kruger Park, consideration can be given to the archaeological materials to learn more about the ESA phase represented and about hominid behaviour. If one is able to identify the degree to which a site has been disturbed and can separate out patterns produced by natural processes from those with a cultural origin, one can then begin to draw the important interpretations regarding hominid behaviour with a degree of confidence.

Chapter 4

Archaeology

4.1 Introduction

ESA research focuses on understanding hominid behaviour throughout the course of hominid evolution (Toth & Shick 1986, Schick 1987, Kroll 1994, Clark 1996, Kyara 1996, Tuffreau *et al.* 1997). When investigating cultural remains from such a distant past, one must show caution when drawing conclusions, as the artefacts and their context may have been disturbed or changed since the tools were originally deposited. With an understanding of the formation of the tool-bearing deposits containing the ESA materials established within the Northern Kruger Park, consideration can be given to the archaeological materials to learn more about hominid behaviour. The range and type of behavioural statements that can be made are limited due to the non-primary context of the sites, but their nature does not exclude all questions regarding behaviour.

Discussion focuses on the ESA artefacts and site contexts. An analysis of the stone tools collected from various sites allows a fuller understanding of the characteristics of the Stone Age archaeology. This analysis, used in conjunction with the understanding and description of the various types of sites, will be used to learn more about the hominids, and the environment in which they lived and carried out their daily activities. The survey of the Northern Kruger Park provides data on the use of the landscape through time in the ESA, which adds considerably to the usual methods of excavation and analysis. Sampson (1985) believes that it is doubtful whether questions of prehistoric spatial organisation can be addressed effectively by conventional methods alone. Similar survey work concerned with landscape archaeology and inter-site distributions in the Makapansgat environs has revealed interesting results concerning the location of sites (Quinney & Sinclair 1999, Sinclair 2002). The Makapansgat investigation into site locality considered factors such as raw material availability, local topography (eg. local shelter, good vantage points), and access to and distance from water points (Sinclair 2002). The point must be made that the definition and understanding of a site could be incorrect (such as inferring that a cluster of artefacts represents a hominid living site). The whole landscape was used by hominids and should thus be examined at such a spatial scale. To this end, variations in the archaeology at the spatial scale of the landscape will also be discussed. This aspect will be considered within the context of the natural transformations which may have altered the behavioural picture.

4.2 The Earlier Stone Age

The ESA record in southern Africa consists first of artefacts dating to a late phase of the Oldowan Tradition, between *ca* 2 and 1.7 million years old (Kuman 1998, Kuman & Clarke 2000). This is then followed by an Acheulean Tradition, dating from *ca* 1.6 million years ago, with the majority of sites younger than one million years (Deacon & Deacon 1999, Klein 2000). This Acheulean Tradition then ends around 250-200 thousand years ago. Previous research has revealed that ESA sites occur virtually throughout southern Africa, but the majority of the sites lack stratigraphic context (Mason 1962, Seddon 1967, Sampson 1974, Deacon & Deacon 1999). Most assemblages have been recovered from surface sites, with fewer than 20 sealed sites reported so far. This pattern occurs because southern African landscapes, for millions of years, have been dominated by erosion and planation, with only rare sediment traps occurring in which early artefacts could become buried (Klein 2000). Many buried sites suffer from the problem that they lack suitable material for dating. This factor has meant that the cultural stratigraphy and dating for the region often rely on extrapolation from eastern Africa, where stratified sites are dated by absolute means (Klein 2000).

Oldowan assemblages across Africa comprise a variety of simple core forms and mainly unmodified flakes, with little or no conspicuous artefactual change through time (Kuman 1998). These assemblages are described as expedient, yet they still indicate an impressive level of cognition (Kuman 1998). The tool makers were able to evaluate different raw material qualities and shapes and to adapt the most appropriate flaking techniques.

The Acheulean has been distinguished from the Oldowan by the addition of handaxes, cleavers, picks and other large bifacial tools to assemblages, along with apparent behavioural and habitat changes (Toth & Shick 1986, Clark 1994, Schick & Toth 1994). The Acheulean, which is characterised by a slow change in artefact types, is then separated into the early and later Acheulean, with a few researchers suggesting that a middle Acheulean may exist for specific regional sequences (Isaac 1977, Mason 1988, Roe 1994). If a middle Acheulean can be said to exist as a concept, well dated sites such as Olduvai Gorge and Olorgesailie suggest it occurs from around one million to 600 000 years (see Roe 1994). During this period bifaces became a more standardised component based on tool types from such sites as Olduvai Gorge in Kenya, with the tools not so refined as the late Acheulean types (Roe 1994, 204). The early Acheulean, dating from *ca* 1.6 to one million years ago, and the middle and later Acheulean, dating from one million to 250-200 thousand years ago (if the middle and later Acheulean are grouped together), differ in that later bifaces are often much more extensively trimmed, thinner, and more bilaterally symmetrical than the previous ones (Klein 1994, Klein 2000). The later Acheulean is also generally characterised by prepared core technology and by a range of flake tools, both of which are forerunners to MSA types (Deacon 1975, Kuman 2001*a*, Clark 1994).

During the Acheulean in southern Africa, in addition to the stone artefacts, limited evidence exists for the controlled use of fire; and no evidence of structures has been found (Toth & Shick 1986, Klein 2000). Site location, which has been investigated to understand land use, is believed to indicate that Acheulean hominids may have been closely tied to standing water, with a preference to live at such locations (Klein 2000). Deacon and Deacon (1999, 81) describe Acheulean hominids as terrain specialists that occupied riverine habitats. These habitats are said to be a relatively constant environment, buffered against seasonal changes, and productive in animal and plant foods. Other researchers believe, however, that caution must be exercised when drawing such conclusions (Kuman 2003). When this pattern is investigated with a view to site formation processes, site location then appears to relate more to the sedimentation processes associated with such fluvial environments and not to hominid preference (Kuman 2003).

At this time it is also unclear as to whether hominids primarily hunted or scavenged, with few large animals represented. Klein (2000, 116) argues that this limited exploitation of large animals was probably the result of limited technology, with the consequence being a very low population density. In considering the actual tool-makers, many researchers believe that early representatives of the genus *Homo* produced most of the Oldowan and early Acheulean stone artefacts, with *Homo ergaster* and *erectus* making Acheulean artefacts until roughly 600 thousand years ago, and *Homo rhodesiensis* making the later ones (Klein 2000). A final point of note about the Acheulean is that it reveals the remarkable behavioural conservatism of non-modern humans, even as they were diverging anatomically on different continents (Klein 2000).

4.3 Stone Tool Classification and Analysis

Analyses conducted on the artefact assemblages provided a greater understanding of the technology and industries within the context of the preservation history. Study of the artefacts revealed information on the technology in terms of consistency across the landscape, time period within the ESA, and technological signatures of the hominids, as well as site formation processes.

As discussed in Chapter Two, a number of areas was selected for test pits and surface artefact collections. The location of the test pits is shown in Figure 3.3. A surface collection of MSA tools was also conducted from a scatter found on a basalt region of the landscape, as described previously in Chapter Three. The collection area is characteristic of MSA sites in the Northern Kruger Park, and it was chosen only due to its size and density of the tools. Similar sites, however, are found within the Northern Kruger Park. This collection has been analysed in the same manner as the ESA tools and is used for a comparison between the time periods.

Tool types (and attributes) collected from the Northern Kruger Park are defined below and listed in Tables 4.1 to 4.8. Along with the Tables a descriptive definition of the tool types is provided so as to clarify tool classification. The edges of the stone tool are not well preserved, but every effort was made to be cautious in classifying the tools given this drawback. Many pieces have been excluded that could have been made naturally by pressure loading within the gravels. Particular attention was made to identify and separate artefacts with clear signs of organised retouch from natural flaking produced within the gravels. The 'denticulate' and 'notched' tool types discussed below are problematic in this sense. However, much of the retouch is very patterned and sinuous in nature and appears to be artificial and not natural. It must also be remembered that the majority of the tools are from selected surface collections. There is, however, still much to be learned from these surface collections.

4.3.1 Earlier Stone Age Artefact Types: Formal Tools

Handaxe The general definition of a handaxe proposed by Kleindienst (1962) and Clark and Kleindienst (1974) is followed. They are bifacially worked tools, characterised by a cutting or bashing edge around a section, or the entire circumference, of the tool. Handaxes are often worked around the circumference except for the butt. The emphasis on manufacture is on the point of the handaxe and both edges. Handaxes are usually bilaterally symmetrical and more or less biconvex in major and minor sections. Some handaxes can be asymmetric. Figure 4.7 shows the range of handaxes from the Northern Kruger Park (photographs grouped at the end of the chapter). Among the handaxes collected, there are only a few well refined ones, despite constant searching for refined examples. The most refined examples found to date are the two top left tools in Figure 4.7a and the two far left tools in Figure 4.7b. A number of the handaxes in Figure 4.7a and b would probably be classified as handaxe rough-outs by other researchers. They have, however, all been grouped within this category as they all have emphasis on the point and edges. As only very few refined examples of handaxes have been found, despite five months of intense survey, it is thought that the less refined appearance of the handaxes, in comparison to later Acheulean examples, is a characteristic of the industry and they should not just be dismissed as all being rough-outs or blanks. Discussion on raw material type and its control on handaxe shape is addressed in the section "The Northern Kruger Park Earlier Stone Age".

Cleaver Cleavers are usually made on a large flake. All the cleavers so far collected from the Northern Kruger Park are produced from large flakes. They are generally worked on the butt and edges and have a cutting edge at one end more or less perpendicular to the long axis of the tool. The cutting edge is formed by two intersecting positive flake surfaces, by intersecting positive and negative flake surfaces, and sometimes by flake surface and cortex, giving a long, sharp edge (Kleindienst 1962, 88). Examples of cleavers from the Northern Kruger Park are shown in Figure 4.8a.

Pick Picks are heavy duty tools with a minimum of overall working. Emphasis is on the point of the tool rather than the cutting edge (Kleindienst 1962, 92). They exhibit a high-backed, plano-convex or triangular cross-section, with the ventral face usually not flaked (Clark & Kleindienst 1974, 98). Examples of picks from the Northern Kruger Park are shown in Figure 4.8a.

Uniface The same definition is applied for a uniface as for a handaxe, with the only difference being that a uniface in not bifacially worked, but the emphasis on manufacture is still on the point and both edges. All but one of the unifaces are made on large flakes (Figure 4.8b).

Convex Scraper Scrapers are tools characterised by a retouched edge with generally shallow to steep angles. No distinction has been made between large and small scrapers, although some authors classify scrapers as large if they are over one hundred millimetres (Clark & Kleindienst 1974). A convex scraper has a worked edge with marked convexity.

Side Scraper A side scraper has one or more fairly straight working edges with retouch more or less parallel to the long axis of the tool.

Oval-Core Scraper These are high-backed tools which are characterised by steep retouch from the flat ventral surface along the circumference to form a scraping edge (Clark & Kleindienst 1974, 98). These are interpreted as large tools rather than single platform cores (Figure 4.8b).

Denticulated Scraper In this type the scraping edge is denticulated rather than smooth. A "Denticulated Scraper" differs from tool types such as "Large Denticulates" in that edge angles are somewhat steeper, most likely forming a scraping edge rather than a cutting edge (Figure 4.9b). No rejuvenation was found on these tools.

Notched Scraper This is a scraper with a retouched notch but with no denticulation. It is produced on a large cortical, flat flake and shares more in common with denticulated scrapers than side scrapers.

Large Denticulate This is a variable component of the industry found in the Northern Kruger Park. A denticulated edge is created on a variety of flake forms, with the majority on large cortical flakes. As discussed, caution is required when considering these tool types within the larger assemblage, as some could have been produced naturally within the gravels. However, many examples contain retouch that is too patterned in nature to be natural and can only be classified as formal tools. Out of the 15 collected, four have later denticulation which is of a younger generation than the original flake and thus is rejuvenation by a later people. This later rejuvenation shows clear signs of organised retouch and is not natural flaking. Most denticulation has, however, been produced at a single early time period. A "Large Denticulate" is a flake over 80 millimetres that usually has only partial denticulation around its circumference (Figure 4.9a). Flakes tend to be flat with shallow retouched edges, most likely indicating a cutting function. Some of these flakes can be extremely large, up to 250 millimetres long, and are usually rounded in shape.

Small Denticulate This type is the same as "Large Denticulates", but less than 80 millimetres in length (Figure 4.9b). Three small denticulates have been struck using a bipolar flaking technique. No rejuvenation was found on these tools.

Large Denticulate With Notch Similar to "Large Denticulates", this is a combined type produced on a flake over 80 millimetres that has only partial denticulation around it circumference. Part of its circumference, however, also contains a notch created by retouch (Figure 4.9b). They also tend to be flat with shallow edges. No rejuvenation was found on these tools.

Denticulated Scraper With Notch This is a "Denticulated Scraper" that contains a notch along its circumference (Figure 4.9b). No rejuvenation was found on these tools.

4.3.2 Earlier Stone Age Artefact Types: Cores

Casual Core One or two flakes have been removed from the core, with no other defining characteristics.

Chopper-Core Chopper-cores are types with bifacial or unifacial removals, characterised by a chopping edge, or contiguous removals along an edge (Kleindienst 1962, 93-94). They are usually made on cobbles. Examples

Table 4.1: Earlier Stone Age Artefact Types: Formal Tools

Formal Tools (N = 94)			
Type and Attributes	Surface Collection	Test Pits	Total
Handaxe	42	1	43
Cleaver	8	0	8
Pick	5	0	5
Uniface	6	0	6
Scrapers:			
Convex Scraper	0	1	1
Side Scraper	0	2	2
Oval-Core Scraper	1	0	1
Denticulated Scraper	0	1	1
Notched Scraper	0	1	1
Denticulates:			
Large Denticulate	13	2	15
Small Denticulate	0	7	7
Combination Tools:			
Large Denticulate With Notch	0	2	2
Denticulated Scraper With Notch	2	0	2

of chopper-cores are shown in Figure 4.10a. This is a dominant type within the Northern Kruger Park. These types may just be cores, and therefore they are referred to as chopper-cores rather than tools. To call them 'choppers', definite utilisation would have to be apparent, but this cannot be determined due to the abraded condition of the artefacts.

Radial/Sub-Radial Core Radial and Sub-Radial cores have been grouped into one category. These core types have been worked in a radial manner by centripetal flaking, with varying numbers of removals (Figure 4.10b). Such types occur on cortical flakes, as well as on chunks. The use of cortical flakes for cores is a characteristic of the industry in the Northern

Kruger Park. There is also one example of a radial core produced on an old flake.

Radial/Sub-Radial Elongated Core This type differs from the previous type in being elongated. Some of these cores at first inspection could be grouped with the handaxes; however, they differ in that the emphasis on manufacture is not on the point and edges, and thus they cannot be classified as a formal tool (Figure 4.10b).

Single Platform Core These are cores with a single striking platform from which flakes have been removed from one flake surface (Clark & Kleindienst 1974, 90). As with other core types, single platform cores are often produced on cortical flakes in the Northern Kruger Park.

Prepared Core For Preferential Flakes Prepared cores are a prominent component of the Northern Kruger Park. The Levallois cores and associated techniques are characterised by several technical criteria. Northern Kruger Park prepared cores follow the volumetric rules of two asymmetric, non-interchangeable flaking surfaces, with the more domed undersurface serving to prepare the flatter upper surface for the removal of a single predetermined preferential flake (Boëda 1995). Further discussion on the prepared core technology will follow. "Prepared cores for preferential flakes" result from a method which produced a single or preferential blank (Figure 4.11).

Prepared Core For Preferential Flakes: Victoria West-like Separated from the above prepared cores, this type is characteristic of industries found in South Africa (Jansen 1926). These elongated prepared cores produce large side struck flakes that are believed to be used as blanks for handaxes and cleavers, or as cutting tools (Figure 4.12). Further discussion on this type and its significance will follow.

Prepared Core For Recurrent Bipolar Flakes These cores result from a method used to produce more than one predetermined blank from the same surface. In this case blanks were removed from opposed sides or poles of the core (Figure 4.13).

Prepared Core For Recurrent Unipolar Flakes This is the same as the bipolar type, except that blanks have only been removed from one side or pole.

Prepared Core For Recurrent Centripetal Flakes These cores are the result of a method used to produce more than one predetermined blank from the same surface. Blanks are removed from around the circumference of the core (Figure 4.13).

Polyhedral Core These usually have more than two striking platforms from different planes (Clark & Kleindienst 1974, 91). Only small numbers of flakes have been struck from each platform.

Two Platform Core This is core from which flakes have been struck at right angles to each other, on the same face, but opposed to each other (Clark & Kleindienst 1974, 91).

Opposed Platform Core Cores which have had flakes removed in parallel planes at opposite ends of the core (Clark & Kleindienst 1974, 91).

4.3.3 Earlier Stone Age Artefact Types: Flakes

Flakes Unmodified flakes are either struck off cores to be used as tools, or result as waste from the process of flaking cores or shaping tools (Kleindienst 1962, 99). Flakes are classified on the basis of their plan form. 'End struck flakes' are flakes in which the length, when measured perpendicular to the striking platform, is greater than the breadth. 'Side struck flakes' in which the length, when measured perpendicular to the striking platform, is less than the breadth (Clark & Kleindienst 1974, 89), are less common. Similarly, 'corner struck flakes', a flake in which the platform is situated to the side of the long axis, occur in limited numbers. Flakes have not been separated on size differences.

Incomplete Flakes Incomplete flakes are broken fragments of flakes from which the original measurements of the piece cannot be reconstructed (Clark & Kleindienst 1974, 92).

Table 4.2: Earlier Stone Age Artefact Types: Cores

Cores (N = 143)			
Type and Attributes	Surface Collection	Test Pits	Total
Casual Core	4	9	13
Chopper-Cores:			
Unifacial Chopper-Core	2	6	8
Bifacial Chopper-Core	19	9	28
End Chopper-Core	0	1	1
Radial/Sub-Radial Cores:			
Radial/Sub-Radial Core on a Cobble	15	1	16
Radial/Sub-Radial Core on a Cortical Flake	6	3	9
Radial/Sub-Radial Core on a Chunk	1	1	2
Radial/Sub-Radial Core on an Old Flake	1	0	1
Radial/Sub-Radial Elongated Core	18	0	18
Single Platform Cores:			
Single Platform Core	7	1	8
Single Platform Core on a Cortical Flake	1	0	1
Prepared Cores:			
Prepared Core For Preferential Flakes	17	1	18
Prepared Core For Preferential Flakes: Victoria West-like	4	0	4
Prepared Core For Recurrent Bipolar Flakes	1	0	1
Prepared Core For Recurrent Bipolar Flake-Blades	1	0	1
Prepared Core For Recurrent Unipolar Flakes	2	0	2
Prepared Core For Recurrent Centripetal Flakes	7	0	7
Miscellaneous:			
Polyhedral Core	1	2	3
Two Platform Core	1	0	1
Opposed Platform Core on a Split Cobble	1	0	1

Split Flakes Split flakes are flakes that have been split through the bulb of percussion and perpendicular to the platform during manufacture.

Core Trimming Flakes These are flakes knocked off generally at right angles to the flaked surface on the edge of a core, so as to rejuvenate the striking platform once it has become too battered for use (Clark & Kleindienst 1974, 90). The flake removed is triangular in section when the edge of the core has been removed.

Miscellaneous Retouched Flakes Flakes of all types that show patterned flaking with the intention of altering the form of the piece (Clark & Kleindienst 1974, 85). Flakes are often retouched to resharpen the piece.

Table 4.3: Earlier Stone Age Artefact Types: Flakes

Flakes (N = 263)			
Type and Attributes	**Surface Collection**	**Test Pits**	**Total**
End Struck	39	163	202
Side Struck	0	4	4
Corner Struck	0	2	2
Incomplete	3	45	48
Split	0	4	4
Core Trimming	0	1	1
Miscellaneous Retouched	1	0	1
Miscellaneous Retouched Incomplete	0	1	1

4.3.4 Earlier Stone Age Artefact Types: Miscellaneous

Chunks These are irregular pieces of stone that are the products of artificial fracture (Clark & Kleindienst 1974, 92).

Core Fragment Irregular pieces of cores that contain flake scars indicating that the core has been subsequently broken.

Table 4.4: Earlier Stone Age Artefact Types: Miscellaneous

Miscellaneous (N = 18)			
Type and Attributes	Surface Collection	Test Pits	Total
Chunks	0	17	17
Core Fragment	0	1	1

4.3.5 Artefact Types For The Middle Stone Age

The classification of sites as Middle Stone Age in the Northern Kruger Park was based on diagnostic tool types (Deacon & Deacon 1999). The types and characteristics of the flakes that characterise the MSA included:

- flakes (40 to 100 millimetres) struck from prepared cores,
- flakes with convergent sides and a pointed shape (termed 'points'),
- striking platforms of the flakes reveal two or more facets, indicating the preparation of the platform before flake removal,
- fine denticulation of flakes through retouch, and
- small finely retouched radial cores.

The above traits can also occur in ESA prepared core assemblages, but MSA types are generally smaller, more frequent and well refined. The condition of MSA stone tools is also fresher within the Northern Kruger Park (discussed further). Only MSA types different to ESA types previously discussed are defined below. Otherwise the same classification is used.

Convergent Scraper Scrapers are tools characterised by a retouched edge with generally shallow to steep angles. A "Convergent Scraper" has working edges that converge to form a point along the long axis of the tool (Clark & Kleindienst 1974, 102).

With the above classification of the tool types (and attributes) from the tool-bearing deposits, and the Northern Kruger Park, discussion now follows on further analyses that were conducted on the tools to clarify the archaeology and site formation processes. This data is used to evaluate the tool-bearing deposit formation model proposed in Chapter Three.

Table 4.5: Middle Stone Age Artefact Types: Formal Tools

Formal Tools (N = 9)	
Type and Attributes (Surface Collection)	**Total**
Scrapers:	
Convex Scraper	3
Convergent Scraper	1
Retouched Convex Scraper	1
Denticulated Scraper	2
Denticulates:	
Large Denticulate	1
Small Denticulate	1

Table 4.6: Middle Stone Age Artefact Types: Cores

Cores (N = 18)	
Type and Attributes (Surface Collection)	**Total**
Casual Core	1
Chopper-Cores:	
Unifacial Chopper-Core	1
Radial/Sub-Radial Cores:	
Radial/Sub-Radial Core on a Cobble	6
Radial/Sub-Radial Core on a Cortical Flake	2
Radaial/Sub-radial Core on a Flake	1
Prepared Cores:	
Prepared Core For Preferential Flakes	1
Prepared Core For Recurrent Unipolar Flakes	1
Miscellaneous:	
Polyhedral Core	4
Opposed Platform Core	1

4.3.6 Raw Material

In terms of the raw materials used during both Earlier and Middle Stone Age times, one must first identify the types of material available. The materials available in the area consist of clasts from the Malonga Formation, basalt and sandstone bedrock, and dolerite from dykes. The clasts making up the Malonga Formation consist of red and other quartzite (Soutpansberg Group), agate amygdales and basalt (Letaba Formation), vein quartz, granitoid, dolomite, jasper and banded iron formation (Botha & Wit 1996, 168).

Various raw materials were utilised in the Northern Kruger Park (Figure 4.1). The 'Cryptocrystalline' category includes agate amygdales and jasper. A wide range of raw materials is exploited with quartzite the most dominant during the ESA and MSA (Figure 4.2). ESA people preferred quartzite, with cryptocrystalline and quartz also being utilised. The sandstone and dolerite dykes were utilised, but to a minimal extent. During the MSA there is a preference for 'Red Quartzite' over other 'Quartzite'. The 'Red Quartzite' is finer grained, very hard and produces strong, sharp flakes. MSA sites can be recognised anywhere in the research area by an accumulation of red pieces lying on the decaying basalt bedrock. The 'Red Quartzite's' better flaking characteristics seem to have been a draw for the MSA people.

The raw material data indicate that ESA people utilised raw materials that were easy to flake but at the same time produced sharp edges, namely the quartzites. The MSA people's choice differed in that they selected for finer grained, harder and stronger material that could be used to produce smaller and more refined implements, namely the harder 'Red Quartzite' clasts. The clasts from the Malonga Formation (pebbles, cobbles and boulders) form the dominant source of raw materials, with the bedrock utilised to a very limited degree.

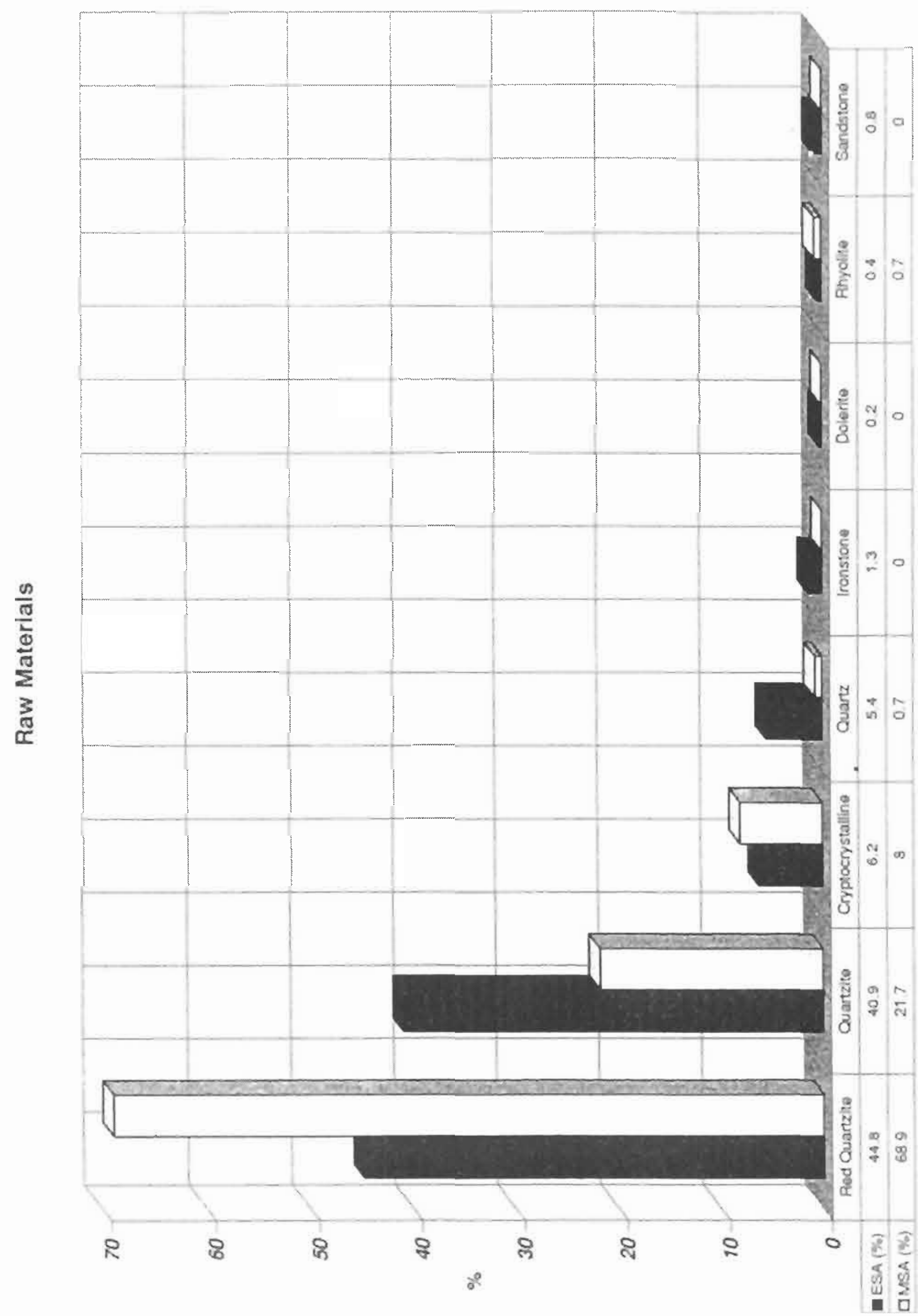


Figure 4.1: Northern Kruger Park stone tool raw materials used in the ESA (N = 518) and MSA (N = 138).

4.3.7 Artefact Condition

Artefact condition has been analysed in terms of artefact rounding or abrasion by fluvial processes. Several similar studies has been conducted on archaeological sites influenced to varying degrees by water (Clark & Kleindienst 1974, Shackley 1978, Schick 1986, Schick 1992, Paddayya & Petraglia 1993, Villa & Soressi 2000). Generally, artefact roundness, the overall degree of curvature of the edges and corners, increases with distance of transport by water. The rate of rounding is related to artefact size, hardness of the raw material, the transportation mode (rolling, saltation or suspension), as well as sedimentary conditions (Petraglia & Potts 1994, 233-234). Stone artefacts with sharp edges indicate minimal or no transport, while rounded edges and surfaces indicate movement. Petraglia and Potts (1994, 234) have formulated an artefact rounding model showing the relationship between water flow, artefact transport modes, and rounding. During transport, contact with fine-grained sedimentary particles can cause rounding of flake scar facets, ridges between facets and around the perimeter or artefact edges. A different pattern results when flowing water and suspended particles travel over stable or partially buried artefacts. In this case rounding occurs on the exposed face, with little or no rounding on the edges, and little or no rounding on the buried face. The third pattern of rounding develops when artefacts are transported with coarse sediments, such as pebbles and cobbles. These may collide with and chip the edges of the artefacts, producing some fresh flake scars that may be out of place from the rest of the removals.

When analysing the artefacts one can also consider the 'overall condition' of the artefacts, as well as the 'edge condition'. The 'overall condition' refers to the degree of deterioration (rounding, pitting, or other signs of chemical weathering), observed on flake scar facets and intersections between facets (Petraglia & Potts 1994, 243). The term 'edge condition' refers to chipping, crushing, and rounding of artefact edges (Petraglia & Potts 1994, 243). Only analysis of the 'edge condition' was conducted, as the 'overall condition' of artefacts in other studies has proved difficult to judge when considering flake scar facets and intersections between facets from tools manufactured on quartzite (Petraglia & Potts 1994, 243). Since around 85 to 90 percent of the Northern Kruger Park tools were produced from quartzite, this analysis was not considered. This specific analysis has also proved fruitless, in that 90 to 100 percent of artefacts from a variety of sites, all influenced by varying degrees of fluvial processes, showed rounding or abrasion of flake scar facets and intersections between facets (Petraglia & Potts 1994, 244-245). In contrast the edge damage analysis has proved to be more closely related to movement by flowing water in such studies.

For the various degrees of rounding or abrasion of the tools collected from the Northern Kruger Park, the following classification scheme has been used. As with all classifications of this type, an accurate method of measurement is impossible (Petraglia & Potts 1994, 233). Although classification is subjective, it still serves the purpose of producing a relative scale of artefact condition which can be used for comparisons. All tools were analysed by the author and thus consistency issues do not arise.

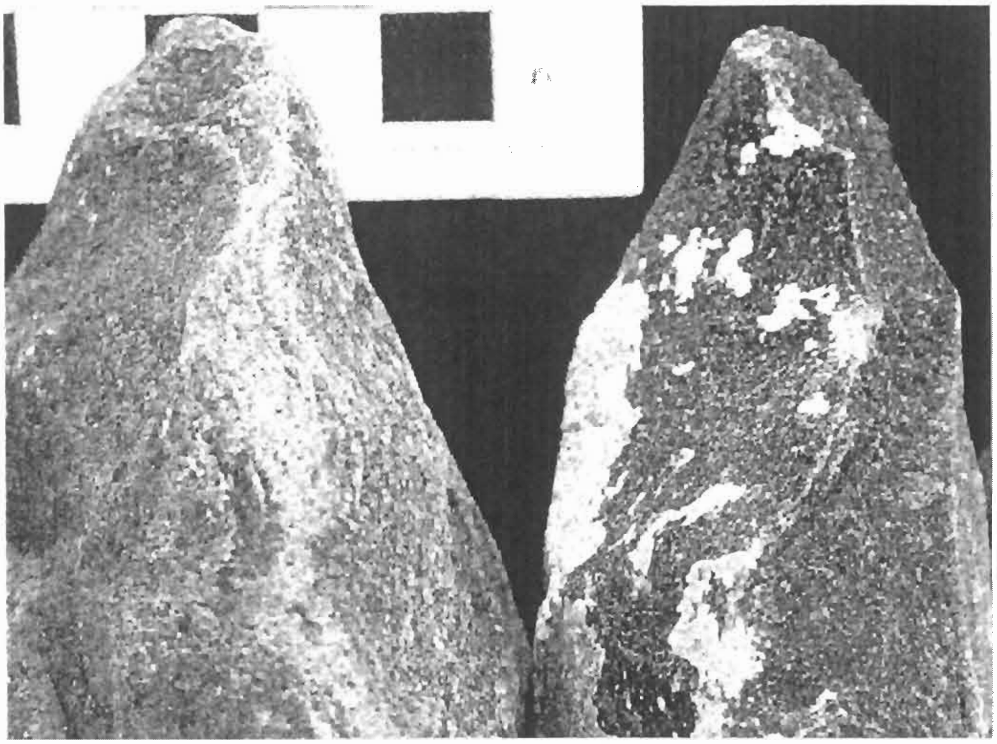
Fresh Artefacts with sharp edges, showing no signs of rounding or abrasion due to fluvial action (Figure 4.3a).

Slightly Abraded Artefacts with relatively fresh edges; however, evidence of chipping, crushing or rounding due to fluvial action can been seen.

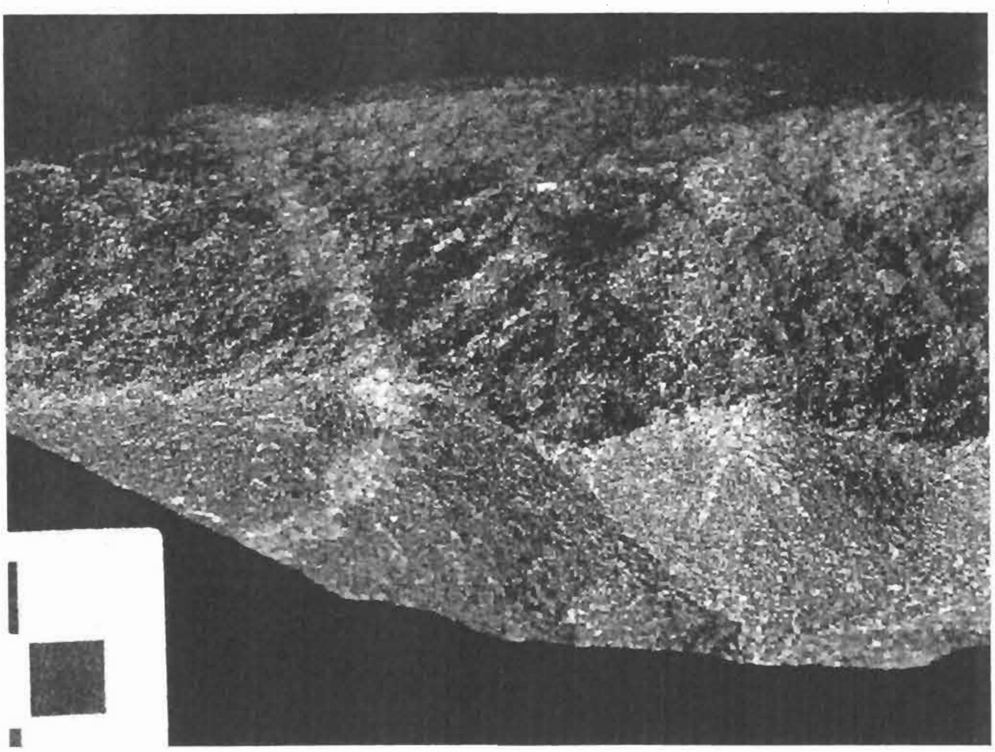
Abraded Artefacts with markedly abraded edges, showing predominant evidence of chipping, crushing or rounding due to fluvial action.

Very Abraded Artefacts that have been dramatically rounded and abraded by fluvial processes and can now only be described as heavily rolled (Figure 4.3a).

From Figure 4.4 it can be seen that the ESA tools dominate the 'abraded' and 'very abraded' categories making up 64.5 percent of the total, while the MSA tools make up 79 percent of the 'fresh' and 'slightly abraded' categories. In terms of the ESA tools it is apparent that the majority has been rounded



(a) Artefact abrasion classification showing the two extremes on handaxe examples: very abraded and fresh (left to right).



(b) Artefact rounding on the exposed face of a handaxe (top), with. ittle or no rounding on the edges, and little or no rounding on the buried face (bottom).

Figure 4.3: Artefact condition

or abraded to varying degrees by fluvial action. This agrees with the geomorphological model proposed for the formation of the tool-bearing deposits. The fresh tools that have escaped rounding or abrasion by fluvial action are special cases. Tools have perhaps become trapped rapidly within sediments by fluvial processes and as a result remained relatively fresh. Reworking of these tool-bearing deposit gravels over substantial periods of time could also account for differences in artefact condition, with later tools dropped on the gravels far fresher than the tools that became incorporated into the gravels through fluvial action.

Artefact condition has also demonstrated that fluvial conditions existed where flowing water and suspended particles travelled over stable or partially buried artefacts. This is demonstrated by rounding on the exposed face, with little or no rounding on the edges, and little or no rounding on the buried face (Figure 4.3b). The Northern Kruger Park artefacts also show evidence of chipping as a result of transportation with coarse sediments and gravels. As discussed, natural denticulation of artefacts has occurred within the gravels. However, hominids have also produced denticulated tools that form part of the industry. Analysis of the condition of the 'denticulated' and 'notched' tools indicates that 44.4 percent fall within 'fresh' and 'slightly abraded' categories, while 55.6 percent fall within the 'abraded' and 'very abraded' categories. If all the 'denticulates' were part of the 'abraded' and 'very abraded' categories, this might suggest that potentially all of the denticulation was natural and not artificial. However, as this is not the case, it is clear that denticulate tool types form part of the Northern Kruger Park industry. In general, however, the fluvial processes have tended to round or dull the edges.

The MSA artefacts have been influenced by fluvial processes to a much lesser degree. They have only been exposed to sheet wash and thus are not nearly as abraded or weathered. Their weathering state results rather from a combination of colluvial and other weathering processes discussed below. Their fresher condition demonstrates the differences in site formation history.

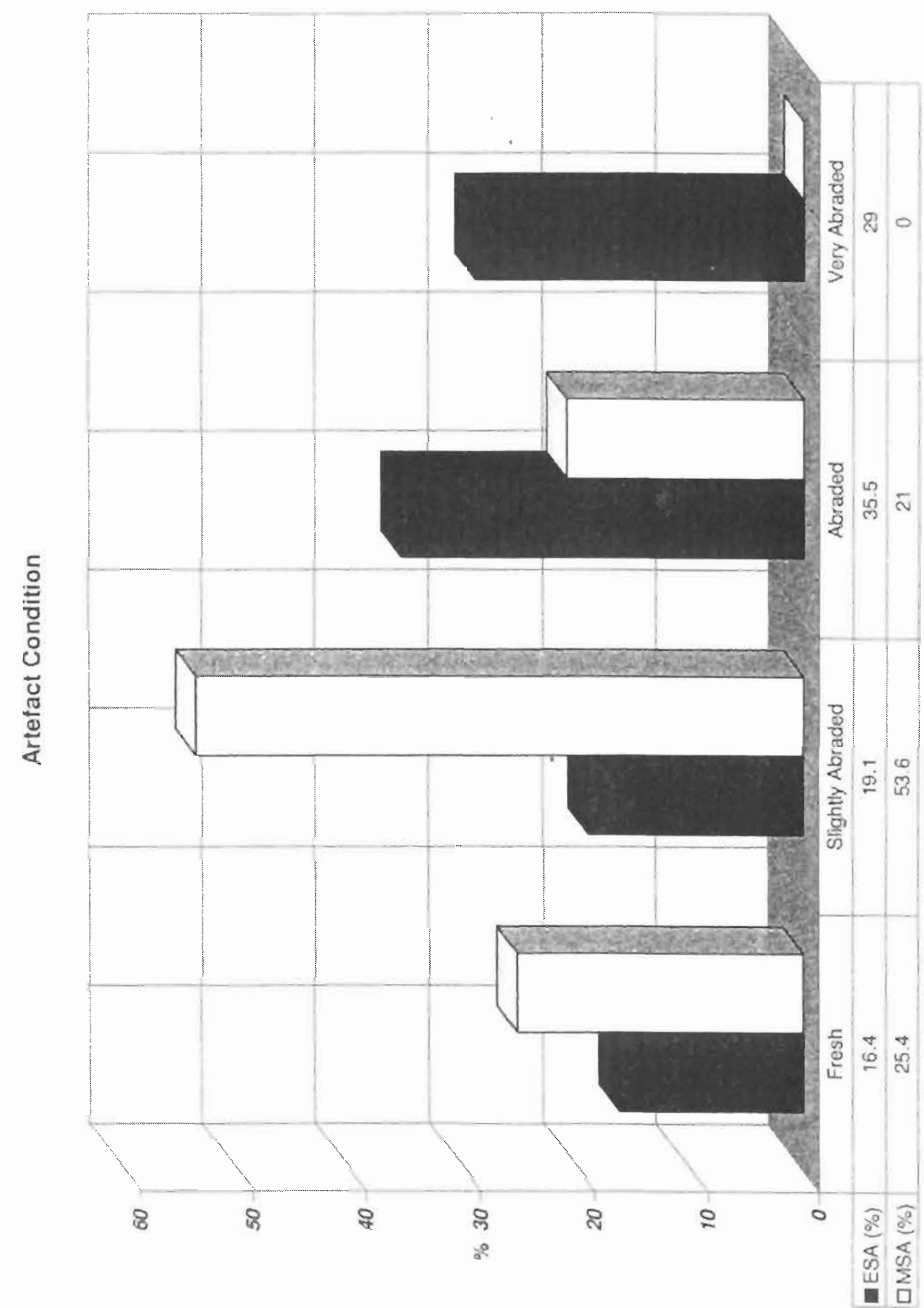


Figure 4.4: Condition of ESA (N = 518) and MSA (N = 138) stone tools from the Northern Kruger Park.

A further note about the artefact condition is that only rounding or abrasion due to fluvial processes has been analysed, however, weathering due to other processes has undoubtedly also caused deterioration to the artefacts. A combination of all these processes has produced the state of the tools today, with the fluvial effect being the most dominant and observable on the artefacts. Other such processes include patination due to chemical deterioration, trampling damage, and human damage due to use (Schiffer 1983, 681-684).

4.3.8 Artefact Size Analysis

Schick (1986) determined that an effective way of detecting site modification processes is to look at the size frequency of the fractured stones recovered from a site and to compare that with the size frequency found at original knapping locations. This was done because stone-flaking experiments produced flake and chip populations with predictable size frequency distribution patterns that were determined by the physics and engineering of stone fracture (Schick 1986). The experiments indicated that stone tool manufacture produces debitage with a very regular size distribution, with only minor variations according to the core type produced and raw material used (Schick 1991, 80). It was determined that extensive flaking of a few cores at a site produces large proportions of small flakes and flake fragments (Schick 1991, 80). Proportions of small debitage (less than 20 millimetres) ranged from about 60 to 75 percent among most experiments (Schick 1997, 246). If a debitage size distribution is dominated by small fragments under 20 millimetres in size, it can suggest on-site tool manufacture. Schick (1991, 89) believes that if size distributions differ from those produced by tool manufacture (ie. an assemblage dominated by larger material), then other possible interpretations must be explored. It could be, for example, that the site represents a place where already manufactured lithics were brought in by hominids, the site has suffered fluvial winnowing which has removed much of its material, particulary small debitage, or the site is made up of materials redeposited through fluvial processes from one or more locations upstream.

Focus is now given to the analysis of the size distribution from the test pits and to what this may indicate about the integrity of the sites. The frequency distribution of debitage from the ten test pits and from biface replication experiments is plotted (Figure 4.5). Most of the smaller pieces under four centimetres have been washed away, as indicated by the skewing of the frequency distribution to the larger size range when compared to the experimental results. The assemblages are consequently dominated by only the larger artefacts that have not been winnowed away. This analysis corroborates the geomorphological model proposed for the formation and preservation of the tool-bearing deposits discussed in Chapter Three.

4.3.9 Cortex Data

Around 80 percent of ESA artefacts from the test pits contain cortex (Figure 4.6). Observation of the cortex during classification corroborates the raw material data, indicating that the clasts from the Malonga Formation form the main source of raw materials.

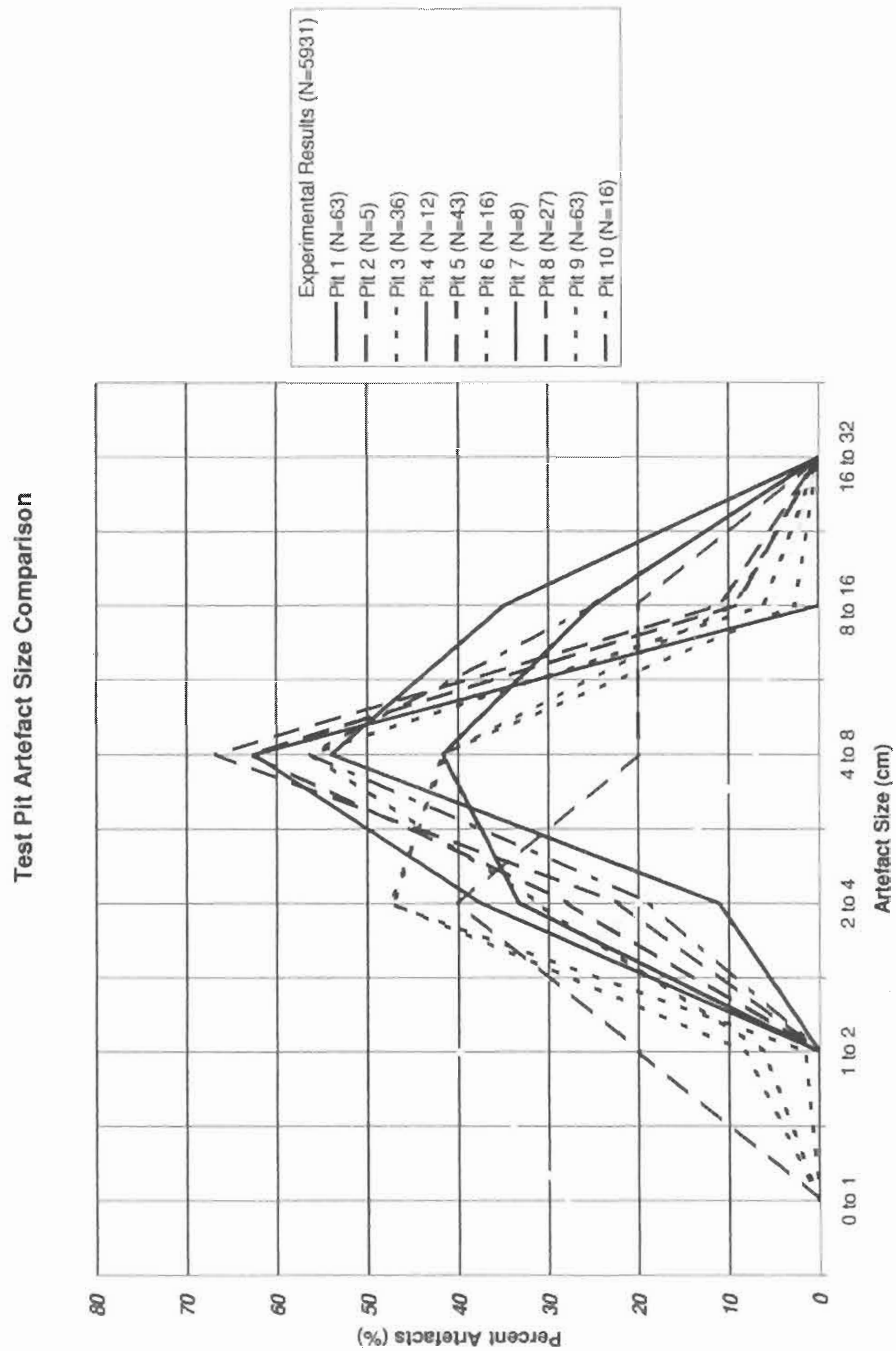


Figure 4.5: Frequency distribution of debitage from the ten test pits and from biface replication experiments from Schick (1992).

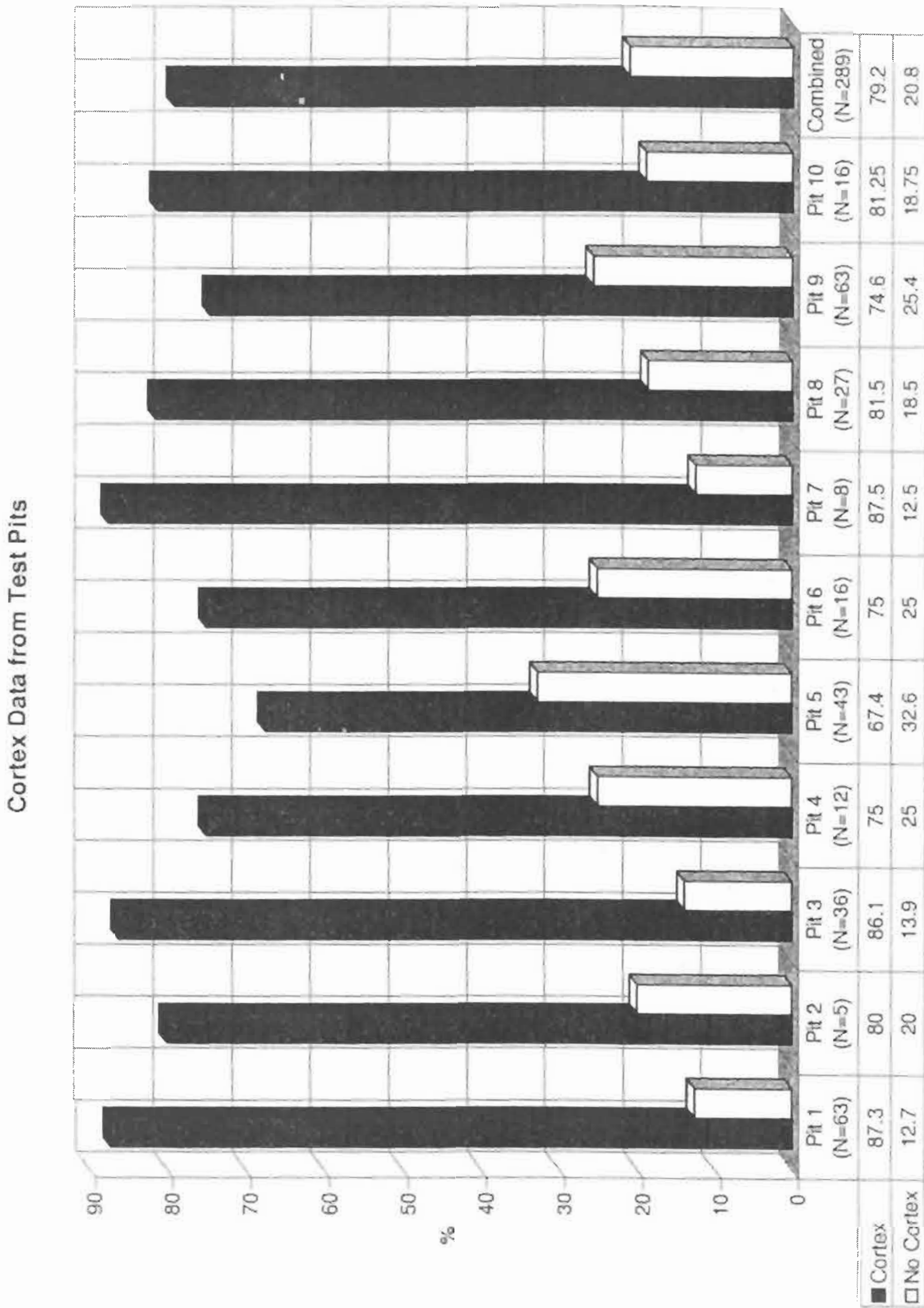


Figure 4.6: Percentage of ESA tools from test pits (N = 289) with cortex.

4.4 The Northern Kruger Park Earlier Stone Age

4.4.1 The Handaxes

Discussion follows on the ESA industry in the Northern Kruger Park, with emphasis on the relative time period and hominid behaviour. One of the most important characteristics to note about the ESA industry found in the Northern Kruger Park is the relative appearance of the handaxes, which can be used to place the artefacts within a larger scheme within the Acheulean. Previous research has revealed that the early Acheulean, dating from *ca* 1.6 to one million years ago, and the middle and later Acheulean, dating from one million to 250-200 thousand years ago (if the middle and later Acheulean are grouped together), differ in that later bifaces are often much more extensively trimmed, thinner, and more bilaterally symmetrical than the previous ones (Isaac 1977, Klein 1994, Roe 1994, Klein 2000). If a middle Acheulean can be said to exist as a concept, well dated sites such as Olduvai Gorge and Olorgesailie suggest it occurs from around one million to 600 000 years (see Roe 1994). During this period bifaces became a more standardised component based on tool types from such sites as Olduvai Gorge in Kenya, with the tools not so refined as the late Acheulean types (Roe 1994, 204).

The early Acheulean is not a dominant component in southern Africa. Sterkfontein early Acheulean bifaces are simpler and much less standardised than the Northern Kruger Park bifaces (see Kuman 1998), and thus the artefacts appear not to belong to this time period. This assessment is strengthened when one considers that prepared core technology is also a characteristic of the industry, with further discussion on this below. Thus based on the flaking of the handaxes, I argue that they should be placed within the middle Acheulean. Not a single example is as extensively trimmed and refined as later Acheulean examples from sites such as Kathu Pan and Olduvai Gorge post-bed IV (Klein 2000, Roe 1994). Irrespective of the debate as to whether a middle Acheulean exists, the Northern Kruger Park handaxes are not as refined as other later Acheulean examples from throughout southern Africa (see Mason 1988), and thus I place them within a middle Acheulean, as other researchers have suggested for other sequences (Roe 1994). As this argument is supported by geomorphological data (see below), adopting a middle Acheulean classification is appropriate.

It must be remembered that raw material type may also have an effect on the quality of biface manufacture (eg. in the numbers of flake scars needed to produce a good functional tool) (Jones 1978). The question that needs to be considered is "why can not raw material type have conditioned artefact/handaxe form throughout Acheulean occupation, forcing later Acheulean hominids to make tools that look typologically like middle Acheulean ones?". Several lines of evidence are available to indicate that the characteristics of the industry (middle Acheulean) are real and not controlled by raw material type.

- A few relatively more refined examples have been found on the same types of raw materials as the less refined handaxes.
- Refined later Acheulean handaxes from Cave of Hearths in the Makapan Valley, are similarly produced on quartzites (Mason 1988).
- The Malonga Formation contains fine grained quartzite clasts that could be used to make refined handaxes.
- Within the industry there are large, flat flakes that lend themselves to be used to make well refined and symmetrical handaxes.
- One finds well refined MSA pieces, such as small radial cores and scrapers, on the same types of material as the ESA handaxes.

The non-late appearance of the handaxes could, however, be argued to result from the Northern Kruger Park tool-bearing deposits representing one large factory site, as clasts from the Malonga Formation dominate the area and provide the raw material; thus more refined examples indicating a later Acheulean period would be found at living or activity sites further away. I argue, however, that the middle Acheulean classification has been affirmed by the extensive survey of the Northern Kruger Park. The area is large enough (±350 square kilometres) that abundant refined examples would have been found if the relative working of the handaxes be put down to incomplete working of the tools at a factory site. In support of this, the area would also have been a favourable region for hominids to inhabit at the time the tools were discarded (discussed below), and thus many refined examples would have been found if they were a component of the industry. In addition, the rest of the formal tools, cleavers, picks, unifaces and scrapers, are not inconsistent with a middle Acheulean time for the industry.

Geomorphological support for a middle Acheulean time period comes from the height of the tool-bearing deposits above the current drainage levels, up to 30 metres in some instances. This finding indicates that they are too old in geological terms to belong to the final phase of the Acheulean, as it seems very unlikely that 30 metres of bedrock could have been eroded since this time. When this is considered in conjunction with the fact that MSA tools occur on bedrock on top of present basalt hills, which are at the same height as the tool-bearing deposits, it becomes impossible to see how the tool deposits could belong to a time period (later Acheulean) just before the start of the MSA. Discussion on further support for this middle Acheulean time period follows.

4.4.2 Other Components of the Industry

Large numbers of chopper-cores and the use of cortical flakes as cores form a dominant component of the industry in the Northern Kruger Park. This pattern is also found over 145 kilometres to the west in the Vhembe-Dongola National Park (Kuman *et al.* in press). The ESA sites from the west are believed to represent a late ESA, Sangoan-like industry. The use of pebbles and cobbles as the raw material source, most of which are spherical clasts, in both locations can be used to explain the use of cortical flakes as cores. Thick cortical flakes provide a flaking surface with more acute angles that can be easily flaked with a radial technique. All the cores produced on cortical flakes are clear hominid produced cores and do not result from natural flaking within the gravels. A variety of core types are produced and all contain several removals from the flaking surface. As chopper-cores are reported throughout the Acheulean, from all over Africa, their abundance cannot be used as a time signature.

As discussed previously, using the denticulate tool types to learn more about the industry may be problematic. Denticulated flakes have been found from later Acheulean sites such as Elandsfontein Cutting 10 (Klein 2000, 111). Examples illustrated in Klein (2000) are more refined than the examples from the Northern Kruger Park, however, the same principle seems to have been followed. No firm statements can be made from this tool type as denticulated pieces are found from all over Africa, throughout the Acheulean (Clark & Kleindienst 1974) and the early MSA (Volman 1984). All that can be said is that they form a component of the industry in the Northern Kruger Park. Their numbers may be slightly inflated by natural flaking occurring within the gravels that looks like artificial flaking. This process may have produced some pseudo-artefacts. This type cannot be used as a time signature.

Focus needs to be given to one of the most important components of the industry, namely the prepared core technology (Levallois concept). There are great numbers of prepared cores found within the Northern Kruger Park. The types of prepared cores found have already been discussed. A point that needs to be made about this technology is that there is only one Levallois concept, with the various methods employed within the technology not implying a difference in concept (Kuman 2001*a*, 10). As long as the interaction of several technical criteria are upheld, the concept is the same (Boëda 1995). The rules followed involve the volumetric rules of two asymmetric, non-interchangeable flaking surfaces, with the more domed undersurface serving to prepare the flatter upper surface for the removal of predetermined recurrent or preferential flakes. The prepared cores from the Northern Kruger Park follow the Levallois concept, and although they may be large and less refined looking than many European examples (see Boëda 1995), the hominids still employed the technique to produce predetermined flakes from the core.

A characteristic of the prepared core types is the inclusion of a Victoria West-like component. In this method the predetermined flake is detached from the side of an elongated core and is thus often wider than it is long. Side struck flakes are a characteristic of the Victoria West Industry and have been emphasised because of their use for handaxe blanks and cleavers, or as cutting tools (Kuman 2001*a*, 10). This link between Victoria West cores and handaxes' has long been noted (van Riet Lowe 1937). This industry has in the past been viewed in South Africa as Proto-Levallois. Victoria West artefacts have been described indicating three distinctive shapes of cores. The 'hen's beak', the 'horse-hoof' and the high backed forms (Jansen 1926). Figure 4.12 shows examples of the 'hen's beak' types. This is the only type yet found in the Northern Kruger Park. It must be mentioned that these cores are rare, unlike their frequent occurrence in the Vaal Basin. The Victoria West industry has been found from Victoria West in the Karoo, to the Vaal River Valley, and to Nakop on the border with Namibia (Kuman 2001*a*, 10). It has never been reported this far east or north before.

No absolute dates for the first appearance of prepared core technology in South Africa are available. An early date for the technology from Israel can be placed within the middle Acheulean, with this absolute age of greater than 700 000 years (Goren-Inbar & Saragusti 1996, Goren-Inbar *et al.* 2000). Prepared core technology becomes widespread in the later Acheulean and then continues in the MSA where it is dominant.

4.4.3 Handaxes and Prepared Cores

Further discussion is needed on the occurrence of the non-late Acheulean handaxes and prepared cores together in the Northern Kruger Park. Researchers have pushed the earliest appearance of prepared cores into the middle Acheulean (Goren-Inbar *et al.* 2000), with this technology coming to dominance in the later period. The prepared cores from the Northern Kruger Park are relatively large and unrefined when compared to later examples, with this exemplified in the Victoria West-like types. Consequently they are not out of place in the middle Acheulean and could merely represent the first appearance of this technology in the region.

The material from the Northern Kruger Park must also be compared to the Sangoan, the final phase of the Earlier Stone Age, reported from north of the Limpopo River which contains extensive use of prepared core technology (McBrearty 1988). The Sangoan is notable for its heavy-duty component of picks, core-axes, and core scrapers, and the extensive use of prepared core technology (McBrearty 1988). In nearby Zimbabwe the industry may also contain abundant 'pigmy picks', crude unifacial and bifacial points, a variety of steeply retouched, notched, denticulated or convex scrapers and small bifacial tools (Clark & Kleindienst 1974, McBrearty 1988, Kuman *et al.* in press). The industry from the Northern Kruger Park does not share most of the Sangoan's characteristics. No core-axes, 'pigmy picks', crude unifacial and bifacial points, or small bifacial tools have been found in the Northern Kruger Park. Comparison with artefacts from the Vhembe-Dongola National Park, thought to be a Sangoan-like Industry, also supports this conclusion (Kuman *et al.* in press). In addition, as the Sangoan follows the later Acheulean, the height of the tool-bearing deposits excludes a Sangoan industry eroding out of the deposits.

Before a firm conclusion as to the specific time period of the industry can be stated, the archaeology in terms of consistency of the artefacts that make up the industry must be understood. First, in terms of the consistency across the landscape, study of the artefact types from the various test pit and surface collection locations does not suggest any significant technological differences. All of the formal tool types used to define the industry are found from all of the tool-bearing deposits in the Northern Kruger Park.

Second, the question must be considered 'do the artefacts from the tool-bearing deposits represent a mixture of tools from throughout the Earlier, Middle and Later Stone Age?'. The Malonga Formation and associated derived gravel clasts have no doubt been utilised throughout the Stone Age, as long as people have been in the area. Examples of both Middle and Later Stone Age tool types have been found on the tool-bearing deposits, with some of these later tools becoming engulfed in the deposits through the action of bioturbation. Antbears regularly dig into the tool-bearing deposits, resulting in any material on the surface falling in and becoming part of the deposit. The rejuvenation of old artefacts, and the raw material types found at the MSA sites in the Northern Kruger Park, support the use of the gravels through all time periods. The majority of the tools that constitute the tool-bearing deposits, however, represent a single industry within the Acheulean, as there is a consistency when these tools are analysed. None of the tool types recovered from the test pits indicate mixing from different time periods. This is further strengthened from the consistency seen across the landscape within the Northern Kruger Park.

The tools from the tool-bearing deposits appear to represent an industry within the middle Acheulean, which contains evidence for the earliest appearance of prepared core technology within the region. As discussed, the geomorphological data supports a middle Acheulean time period. Large scale excavations and tool analysis from several of the tool-bearing deposits will, however, be needed to substantiate this fully. Large scale exposures and analysis of artefact condition differences, with emphasis on determining any technological differences between tool types based on the various states of weathering, will also be needed to confirm a single industry (a middle Acheulean industry with an early prepared core component).

4.5 Hominid Behaviour And Environment

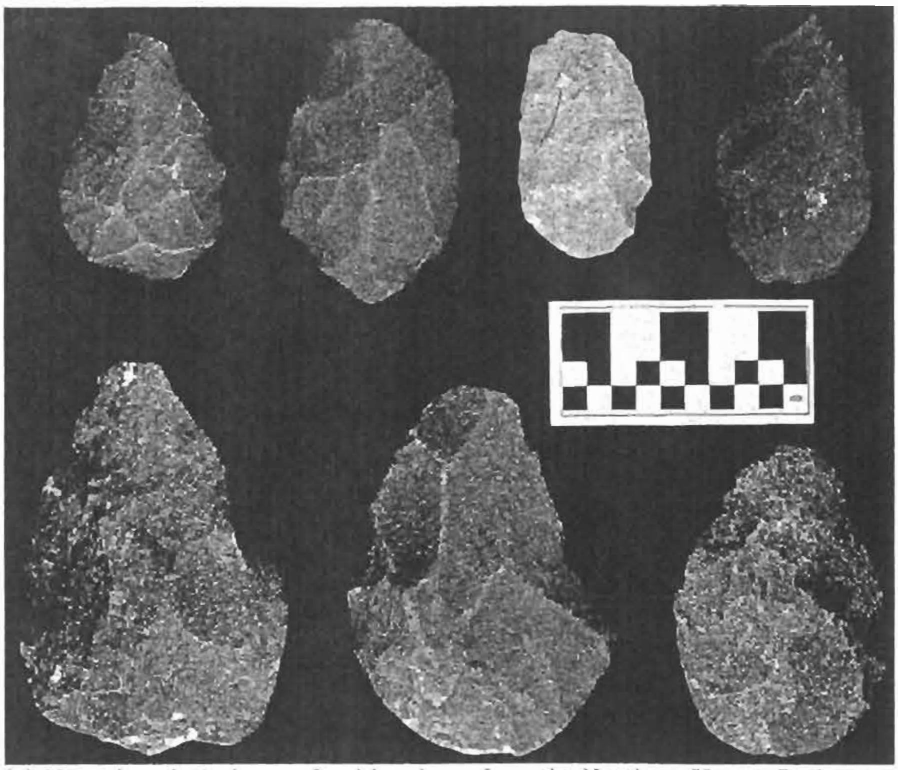
A discussion on variability in the archaeology across the landscape follows. In Figure 3.3 several tool-bearing deposit areas can be seen. The tool-bearing deposits can be separated into six areas as discussed in Chapter Three. In terms of the archaeology, the tool-bearing deposits labelled **A** (test pits one to five and eight) and **B** (test pit nine), contain considerably more artefacts than any of the other deposits. In these two areas stone tools occur in vast numbers eroding out of the deposits. Some areas are so rich that one could pick up over a hundred tools within a few minutes. In the western tool-bearing deposit areas the numbers of tools are far less, with considerable searching needed to locate tools in some areas. There is a distinct east-west change in tool concentrations across the Northern Kruger Park.

This pattern can be explained in terms of the distribution of the quality of the raw materials. There is variation in the clast materials and sizes eroding out of the various remnants of the Malonga Formation in the Northern Kruger Park. Differences in the formation spatially have been discussed in Chapter Three. In the east of the Northern Kruger Park the Malonga Formation contains good quality raw materials, both in terms of clast size and preferable material. Clast sizes range from small pebbles to boulder size, and are predominantly red quartzites and other quartzites. In the west the clast sizes are much reduced, with quartz becoming a prominent component. Quartzites still dominate the west, but there is a notable reduction in the amount of red quartzite. It must be noted at this point that the hominids were occupying a fairly consistent landscape in terms of resources along the water courses (discussed further below). As good quality raw materials are abundant in the east, and there are greater amounts of stone tools preserved, it appears that hominids may have been discarding more tools in the areas where good quality raw materials were plentiful. In the west, where good raw materials are scarce, tools were probably carried away with less discard. It is also possible that greater amount of hominid activity within the east, due to a preference for better quality raw materials, might also have resulted in a greater number of tools becoming engulfed within the deposits. It must be remembered, however, that this pattern may relate to the quality of the raw materials and site formation issues, rather than the hominid's preference for greater amounts of activity in the east.

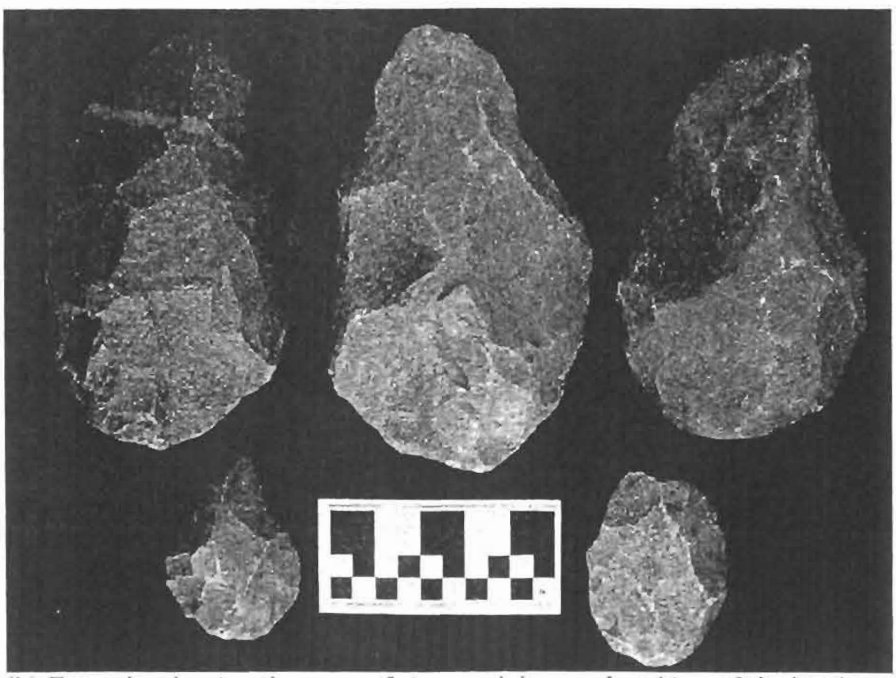
Along both the Limpopo and Levuvhu rivers there are gallery forests. These areas are a favourable location for the wildlife. Animals come here for shade, the abundance of food, and for water from the nearby rivers. Vervet monkeys and baboons dominate the area and use the large trees for protection from other animals. The small mopane trees that characterise the rest of the Northern Kruger Park do not provide much protection from predators. If a similar situation persisted in Acheulean times it can be seen that the Northern Kruger

Park would have been a very favourable location for hominids to inhabit. They would have had access to water from the Palaeo-Limpopo and Palaeo-Levuvhu rivers, as well as abundant food resources in the riverine habitat and protection from predators in large trees. The availability of raw materials in the area has proved to be a further asset.

A further question that also needs to be considered is 'were these hominids closely tied to standing water?'. The area would have been very favourable, with water essential to daily activities. The same dilemma is faced as before; fluvial processes ensured that the tools became preserved, and due to their preservation one is able to say that hominids occupied the region. The area does seem to have been favourable for activity, but this does not exclude other areas that were just as favourable for occupation but did not have geomorphological processes that preserved the archaeology.

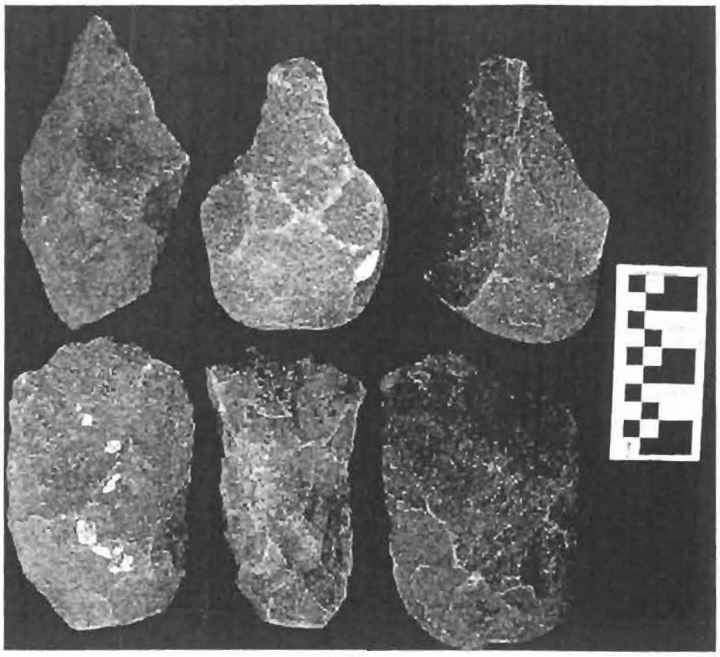


(a) Note the relatively unrefined handaxes from the Northern Kruger Park, with the two top left handaxes the most refined examples found to date. The top right handaxe has a broken point.

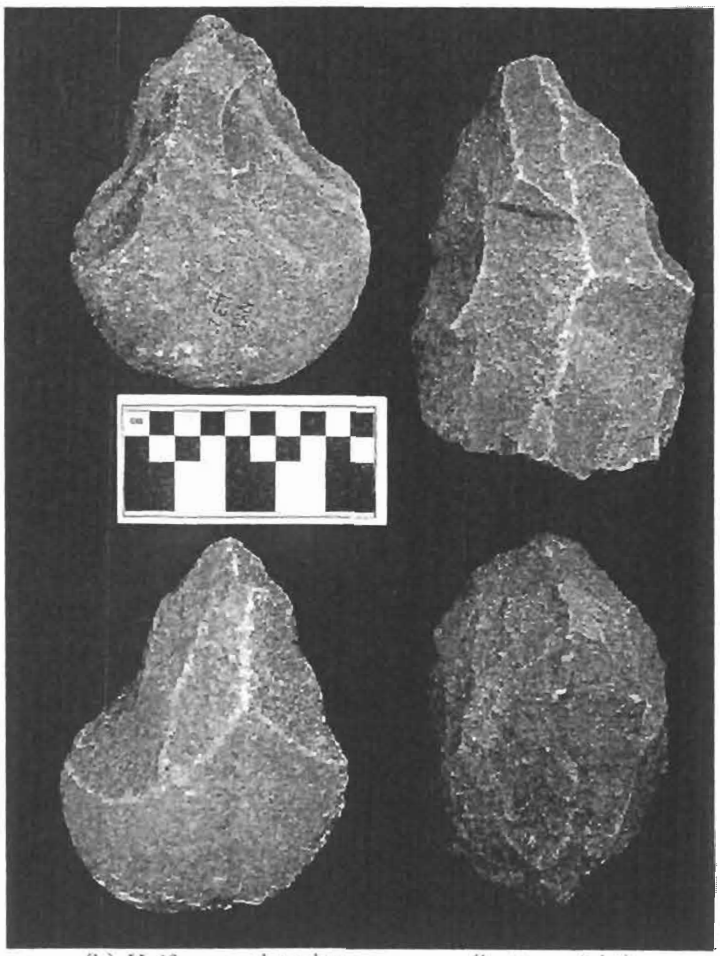


(b) Examples showing the range of sizes, and degree of working, of the handaxes from the Northern Kruger Park. The two far left pieces are refined examples. The bottom right handaxe has a broken point.

Figure 4.7: Handaxes

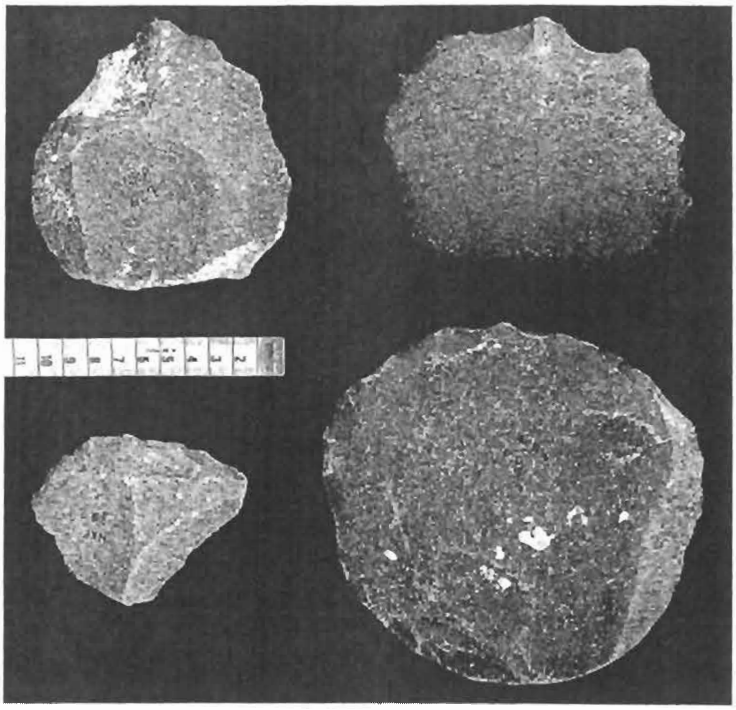


(a) Picks (top) and cleavers (bottom).

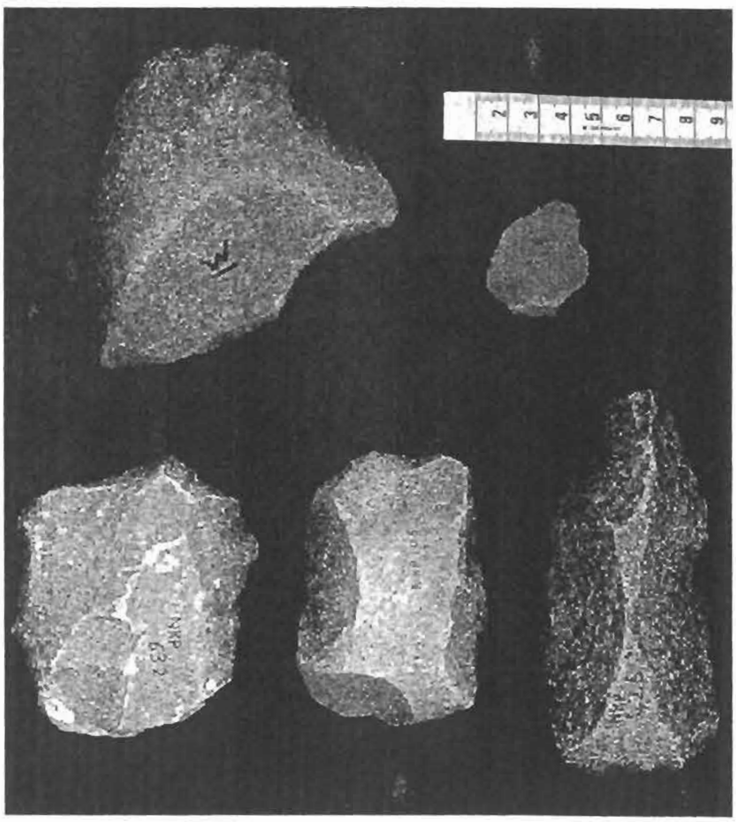


(b) Unifaces and oval-core scraper (bottom right).

Figure 4.8: Cleavers, picks, unifaces and an oval-core scraper.

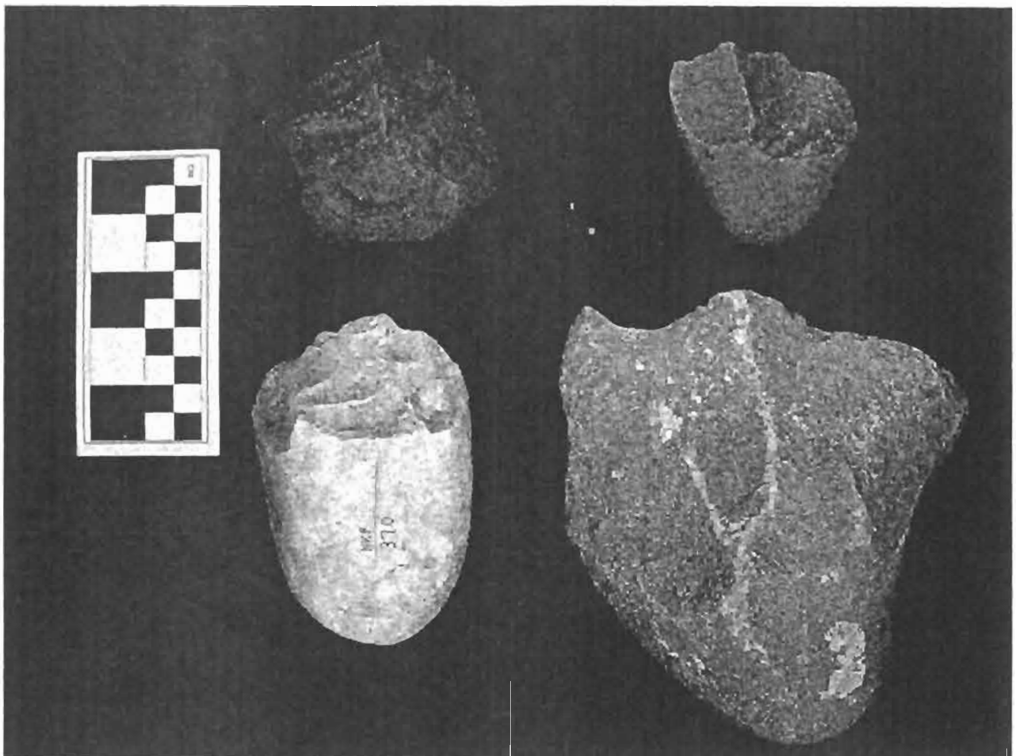


(a) Large denticulates



(b) Small denticulate and large denticulate with notch (top), and denticulated scrapers (bottom).

Figure 4.9: Large and small denticulates, and denticulated scrapers.



(a) Chopper-cores

(b) Radial/sub-radial elongated cores (top) and radial/sub-radial cores (bottom).

Figure 4.10: Chopper-cores and radial/sub-radial (elongated) cores.

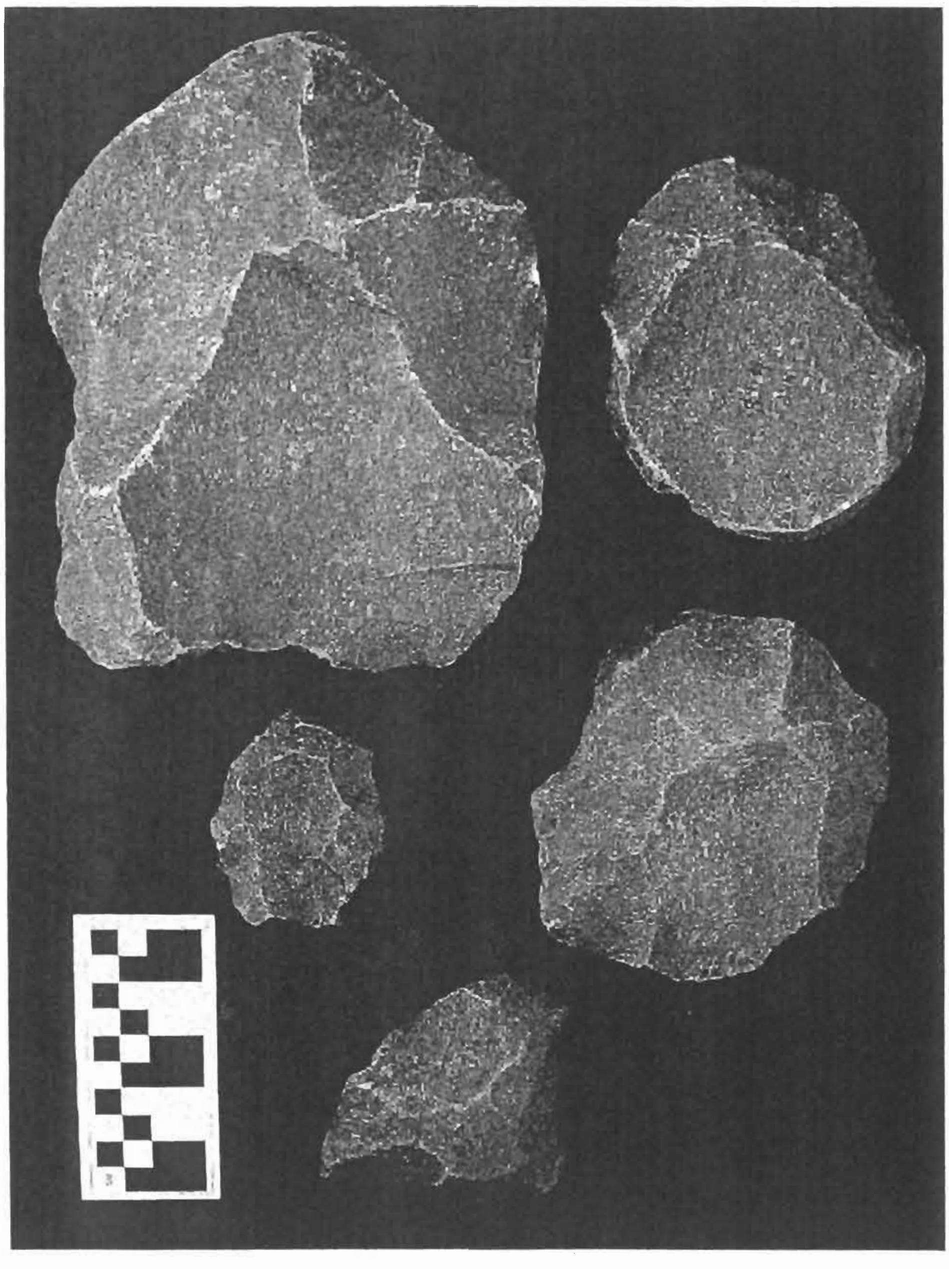


Figure 4.11: Prepared cores for preferential flakes - bottom piece showing the working on the more domed undersurface.

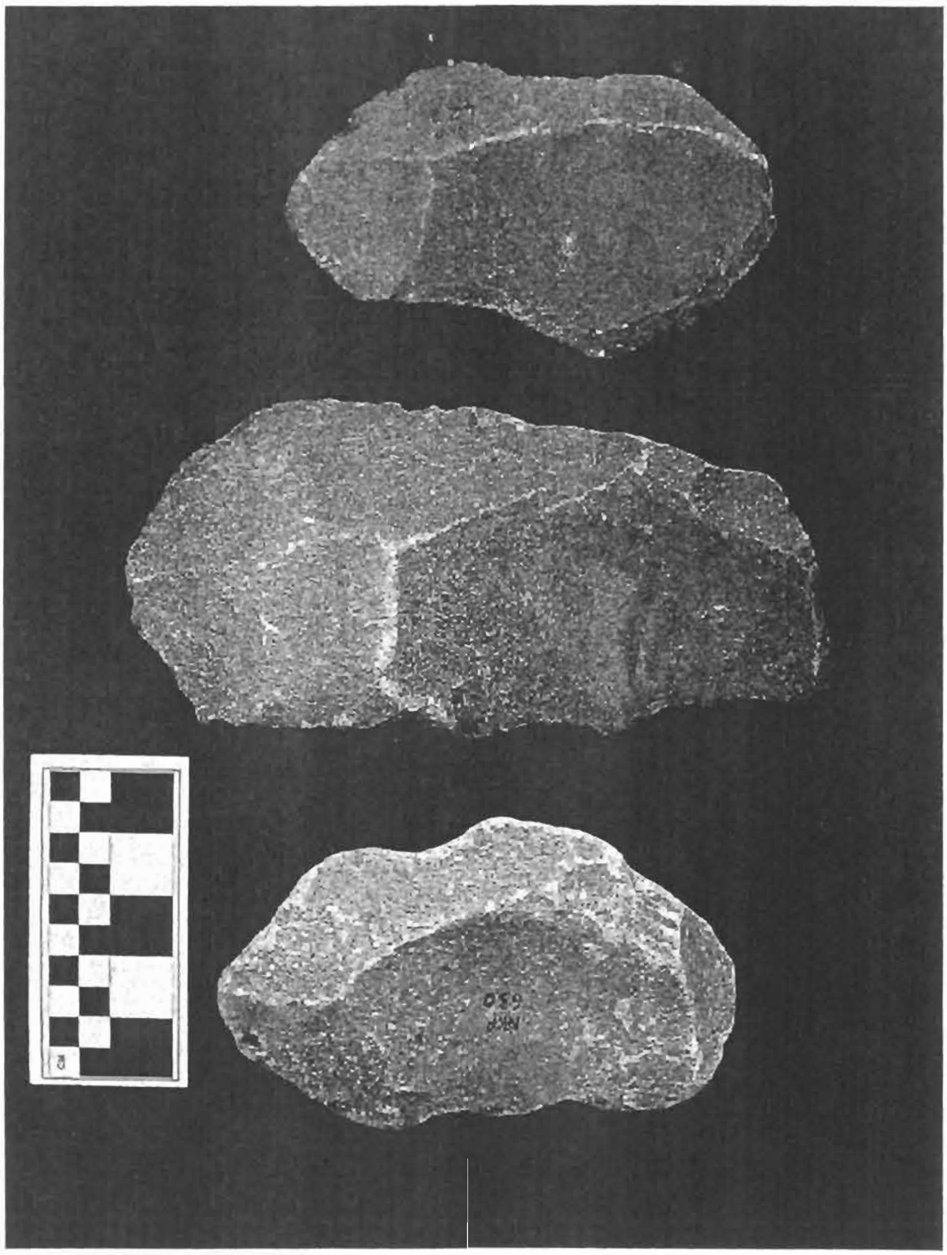


Figure 4.12: Prepared cores for preferential flakes: Victoria West-like.

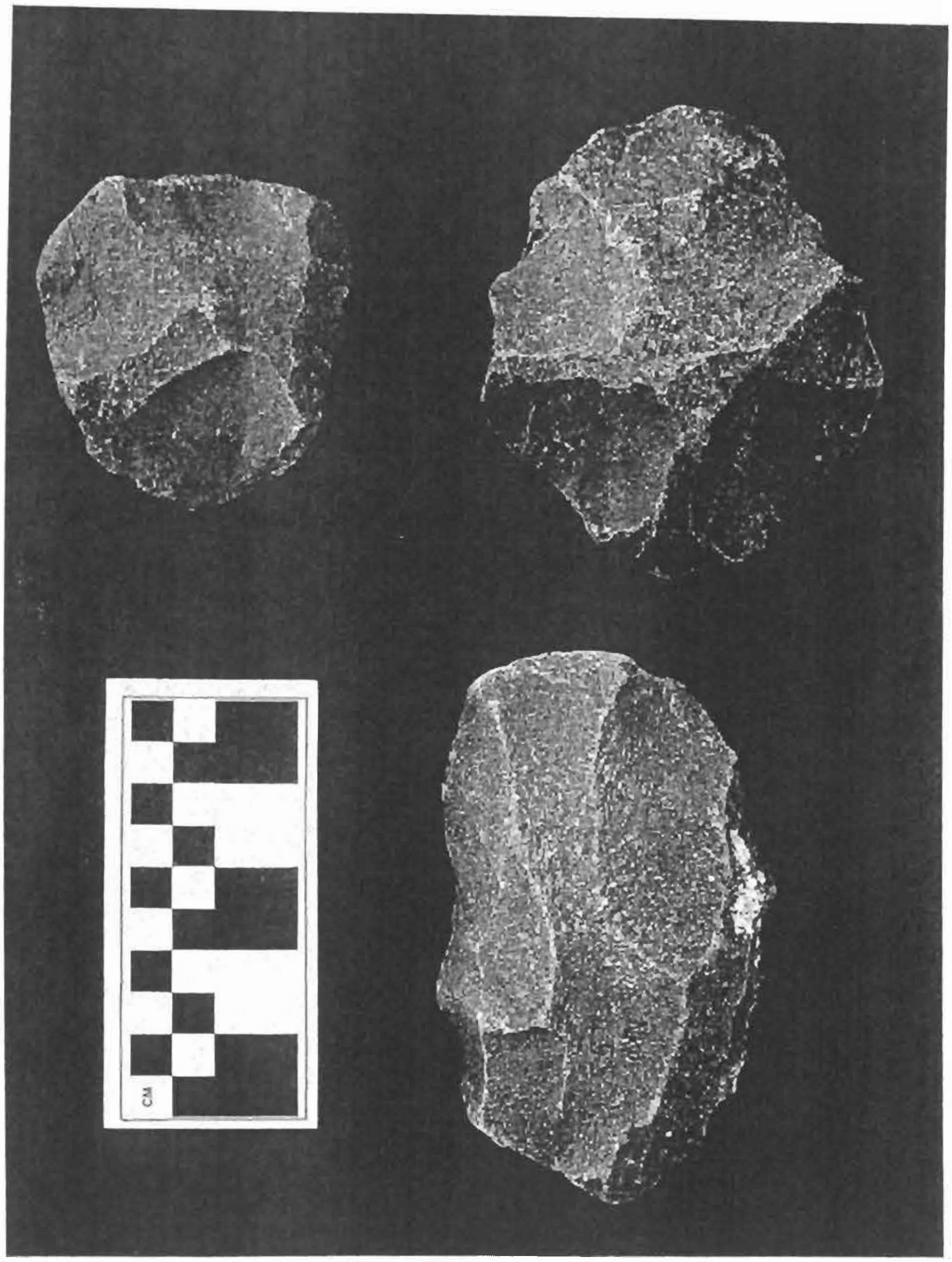


Figure 4.13: Prepared cores for recurrent centripetal flakes, and a prepared core for recurrent bipolar flake-blades (bottom).

Chapter 5

Conclusion

Northern Kruger Park research has focused on identifying patterns and relationships that can be attributed to hominid behaviour, within the broad cultural stratigraphy of the region, with crucial natural site formation and disturbance processes studied to prevent dubious behavioural interpretations. This approach provided data on the broad environmental and geographic setting in which the hominids lived and carried out their daily activities. The investigation has produced information on site formation, technology and industry, hominid behaviour, and the hominid environment.

5.1 Site Formation

ESA hominids were utilising the eroding clasts from the Malonga Formation to make stone tools. Once used, the tools were dropped on the landscape, and subsequently through a combination of alluvial and colluvial processes became engulfed within stream beds and outwash alluvial fans radiating from the Malonga Formation highlands. Fluvial activity concentrated sediment, pebbles, cobbles, boulders and artefacts along hydrological lines. Localised colluvial processes also contributed, with materials washed into streams along the edge of the retreating escarpments. Streams thus became filled with the Malonga clasts and stone tools. These alluvial and colluvial deposits then formed the resistant areas which occur as ridges and hills (height = 2 - 30 metres) on the landscape today. The deposits are far more resistant than the surrounding decaying, gravely basalt bedrock which forms the low areas between these features. Calcification of these deposits provided further resistance to erosion. Such features represent a local inversion of the topography, with the streams beds of the past now forming ridges on the landscape today.

5.2 Technology and Industry

The ESA archaeology preserved within these tool-bearing deposits is thought to be a middle Acheulean industry. The relative appearance of the handaxes indicates that they should be placed within the middle Acheulean, as only a few examples are as extensively trimmed and refined as later Acheulean examples. Several lines of evidence (discussed previously) indicate that the characteristics of the industry (middle Acheulean) are real and not controlled by raw material type. The Northern Kruger Park has been extensively surveyed, and it is large enough that at least a few more refined examples would have been found if the relative working of the handaxes be put down to incomplete working of the tools at a factory site. In support of this, the area would also have been a favourable place for hominids to live, and thus many refined examples would have been found if they were a component of the industry. In addition, the rest of the formal tools, cleavers, picks, unifaces and scrapers, are not inconsistent with a middle Acheulean time for the industry.

The prepared cores from the Northern Kruger Park (a prominent component of the industry) follow the Levallois concept, and although they may be larger and less refined looking than many European examples, the hominids still employed the technique to produce predetermined flakes from the core. A characteristic of the prepared core types is the inclusion of a Victoria West-like component. In the Victoria West method the predetermined flake is detached from the side of the core and is thus often wider than it is long. Side struck flakes are a characteristic of the Victoria West Industry and have been emphasised because of their use for handaxe blanks and cleavers, or as cutting tools. This industry has been found from Victoria West in the Karoo, to the Vaal River Valley, and to Nakop on the border with Namibia, but has never been reported previously this far east or north.

The prepared cores from the Northern Kruger Park are relatively large and unrefined when compared to later examples, with this exemplified in the Victoria West-like types. They are not out of place in the middle Acheulean and could merely represent the first appearance of this technology in the region. In support, prepared core technology has been found during this time period at other sites in Israel.

The majority of the tools that constitute the tool-bearing deposits represent a single industry within the Acheulean, as there is a consistency when these tools are analysed. None of the tool types recovered from the test pits indicates mixing from different time periods. This is further strengthened from the consistency seen across the landscape within the Northern Kruger Park. The tool-bearing deposits represent an industry within the middle Acheulean, which contains evidence for the earliest appearance of prepared core technology within the region. The geomorphological data support a middle Acheulean time period. Large scale excavations and tool analyses from several of the tool-bearing deposits will, however, be needed to substantiate this fully.

5.3 Hominid Behaviour

There is a distinct east-west change in tool concentrations across the Northern Kruger Park. This pattern can be explained in terms of the distribution of the quality of the raw materials. In the east of the Northern Kruger Park the Malonga Formation contains good quality raw materials. The greater numbers of tools found in the east indicate that this was a favourable area for hominids and that raw material quality was a major draw. As good quality raw materials are abundant in the east, and there are greater amounts of stone tools preserved, it appears that hominids may have been discarding more tools in the areas where good quality raw materials were plentiful. In the west, where good raw materials are scarce, tools were probably carried away with less discard.

It is also possible that greater amount of hominid activity within the east, due to a preference for better quality raw materials, might also have resulted in a greater number of tools becoming engulfed within the deposits. It must be remembered, however, that this pattern may relate to the quality of the raw materials and site formation issues, rather than the hominid's preference for greater amounts of activity in the east.

5.4 The Hominid Environment

Based on the ESA tool-bearing deposit formation and macro-scale geomorphic and climatic data, a few conclusions can be drawn about the environment in which the hominids lived and carried out their daily activities. The uplift and global interval of climatic deterioration at the end of the Pliocene brought about major environmental responses, which included the aridification of large areas of sub-Saharan Africa and the fragmentation of environments. There is very limited knowledge on the climates of the early and middle Pleistocene in southern Africa, when climate was characterised by glacial and interglacial periods at high latitudes. From 2.6 million years ago geomorphic evidence in the form of river terraces along the major rivers, attest to the influences of these cyclical changes, as patterns of global atmospheric circulation responded to the waxing and waning of high latitude ice sheets. Global and local evidence points to greatest aridity during the cool glacial maxima during these cycles. It has also been suggested, based on marine records, that there was a major shift to arid, open conditions in Africa at one million years ago. During times of greatest aridity, such as at one million years ago, one might thus also expect the fragmentation of environments, similar to that seen at the end of the Pliocene.

In terms of the environmental and climatic conditions necessary for the formation of the tool-bearing deposits, one can look at the modern drainage and drainage deposits for analogues. These findings point to different environmental and climatic conditions during the formation of the tool-bearing deposits than occur at the present. As discussed, there are two climatic regimes that could potentially account for the formation of the deposits:

1. Climatic conditions that were wetter than present (increased rainfall), producing high energy permanent and semi-permanent streams radiating from the Malonga Formation, with clast-supported stream bed deposits.

2. Climatic conditions with greater runoff than present producing clast-supported stream bed deposits. This may include increased thunderstorm and flood action. This would occur in a drier climate than present, with reduced vegetation cover allowing for greater runoff, and also the easier mobilisation of unprotected clasts to be incorporated in the stream bed deposits.

As the Malonga Formation remnants are fairly small in size, with their catchments insufficient to support semi-permanent to permanent streams in the mode of the current Levuvhu River, the second climatic regime is supported. It thus appears that the tool-bearing deposits accumulated under more arid climatic conditions than present, with a reduction in vegetation cover. It cannot be known for certain if the hominids were occupying the landscape at this more arid time, or if they were there previously during wetter times and the tools only became incorporated at the later time.

It has also been argued that the Northern Kruger Park appears to have been a favourable location for hominid activity. Hominids would have had access to water from the Palaeo-Limpopo and Palaeo-Levuvhu rivers, as well as abundant food resources in the riverine habitat. In a more arid climate than present, if the hominids were indeed inhabiting the landscape, then the presence of water and food resources along the water courses would have been even more critical for survival. The fragmentation of environments at one million years ago during greatest aridity, and during other glacial maxima, could have made such a riverine habitat ideal for occupation by our early ancestors. It is not yet clear why the area was not occupied during later Acheulean times. New climatic and environmental data, as well expanded research, may in the future be able to resolve this problem.

5.5 Future Work

There are three critical directions for future research which will provide a more complete understanding of the ESA archaeology in the Northern Kruger Park and surrounding region.

1. New large scale excavations and tool analyses from several of the tool-bearing deposits are needed to fully substantiate the time period, integrity and characteristics of the Acheulean industry in the Northern Kruger Park.

2. Widening the study area to see the extent of the landscape occupied by hominids, as the Malonga Formation remnants are far more extensive than the area surveyed to date. Spatial patterns relating to hominid behaviour, such as the preference for good raw material quality, could thus be investigated.

3. Investigate the sand on top of the Malonga Formation remnants, as these unconsolidated sand areas may have preserved ESA material in better contexts than stream beds and outwash alluvial fans. Exploratory test pits need to be dug at several locations to investigate if stone tools have preserved, as hominids have no doubt also transected these areas.

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