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NEW METHODOLOGICAL APPROACHES TO THE STUDY OF  
THE ACHEULEAN FROM SOUTHERN MOZAMBIQUE

by

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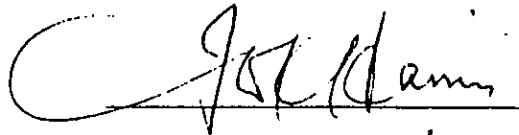
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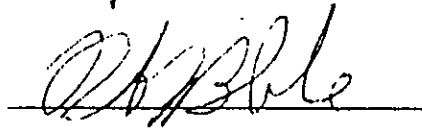
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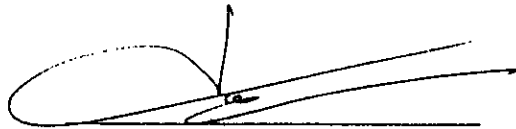
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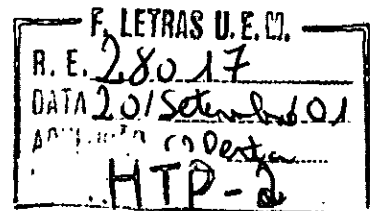


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ABSTRACT OF THE DISSERTATION

New Methodological Approaches to the Study of the  
Acheulean from Southern Mozambique

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This dissertation aims at addressing some theoretical and methodological issues regarding the study of the earliest secure archaeological evidences excavated from southern Mozambique, and compared to the "classic" Acheulean sites from neighboring South Africa.

Mozambique, from the standpoint of ESA archaeology, is shown to hold important information regarding an increasing elaboration of the Acheulean technological behavior ascertained by the presence of new conceptual modules of tool manufacture (as suggested by the emergence of new tool forms, such as the handaxe), wider incorporation of new raw materials, land-uses, etc.

In order to interpret the emergence of new artifactual forms, it is crucial to grasp the relationship between the tools used in manufacture and the techniques employed in flaking stone. By identifying the flaking techniques used by Acheulean hominids, the archaeologist is able to get better insights regarding the development of the technological complexity.

The methodological framework of analysis developed for this research is based on three main assumptions:

- that the technology of production and use is recorded on the implements;
- that it is possible to recognize (at least partially) through actualistic studies the procedures used in the past, and place them in a sequence;
- that by meticulous identification of the activities with produced that specific set of lithic artifacts (including production and use) and by matching them against the paleogeographical and paleoenvironmental settings (the framework where the assemblages were produced and used), a detailed picture of the area under study can be achieved.

By using a technological approach granted on a sturdy actualistic study (where the experimental base includes functional analysis) compared against the archaeological record, it became possible to develop some hypothesis regarding patterns of Acheulean land use in southern Mozambique. One of the more important aspects of this work became the recognition of a set of characteristics, which indicate the presence of soft hammer percussion in an assemblage.

The results of the initial work on the Acheulean of southern Mozambique described in this paper has several implications towards a re-evaluation of the meaning of the Acheulean period, both in terms of technology of production and use.

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## CHAPTER I - INTRODUCTION

### 1.1 THE ACHEULEAN, WITH AN EMPHASIS IN AFRICA

#### 1.1.1 Foreword

The Acheulean constitutes the earliest securely-identified archaeological period in Mozambique (Alberto, 1958, Morais, 1984, Meneses, 1988), although this country represents one of the major geographical gaps bearing on our understanding of the early stages of African prehistory. Hence, I decided to pursue the study of this period, focusing the research on the development of technological complexity.

In southern Mozambique, where the research for this study took place, the Acheulean is still not chronometrically dated; however, in Southeastern Africa it has been recognized that the late Early to Middle Pleistocene archaeological assemblages, starting from around 1.5-1.4 Mya tend to be characterized by the appearance of large bifacially worked artifacts -- handaxes and cleavers (Isaac, 1975, Butzer et al., 1978, Clark, 1982, 1988, Leroi-Gourhan, 1988, Asfaw et al., 1993). These new distinctive artifactual forms were first identified as early evidences of human technological activity in northern France, at the site of St. Acheul. Hence the term "Acheulean", used to identify the entire sequence of the archaeological record which extends over a million years (e.g., Isaac, 1967, Leakey, 1967, 1975).

Due to the paucity of fossil remains, lithic artifacts represent the major archaeological traces of the past of this region of Southeastern Africa (Deacon, 1975, Isaac, 1982, 1986). Undoubtedly, when discussing the surviving evidence from the Acheulean in southern

Mozambique, one is referring almost exclusively to stone tools. Therefore, the identification of sites attributed to this period are usually defined by using the presence or absence of particular lithic forms -- the handaxes and cleavers as cultural and temporal indicators.

The research carried out for this dissertation is based on the study of eight Acheulean assemblages excavated by me in southern Mozambique. It also includes, for comparative purposes, data collected from some South Africa Acheulean sites. The research was designed to address some theoretical issues that could bring some new insights regarding the study of the earliest archaeological evidence from southern Mozambique.

The methodological framework of analysis designed for this research is based on three main assumptions:

- That the technology of production and use (identified by means of studying the chaînes opératoires) is recorded on the implements;
- That it is possible to recognize and assess (at least partially) through actualistic studies the manufacturing procedures used in the past, and place them in a sequence;
- That by meticulous identification of the activities which produced that specific set of lithic artifacts (including production and use), and by comparing them against the environmental settings (the context in which the assemblages were probably produced and used) some hypothesis regarding patterns of land-use by the makers of the Acheulean tools can be predicted and verified against the archaeological record.

Thus, a more detailed picture of the area under study can be achieved.

By using a technological approach based upon rigorous actualistic studies (where, for the case of replication of lithic tools, the experimental base includes functional analysis) to be compared against the archaeological record, it became possible to develop some hypotheses

regarding patterns of Acheulean land use in southern Mozambique. The approach I use would allow one to understand and assess past behaviors as it is represented in the sequence of decisions and the executed tasks (such being the case of the manufacture of a tool to fulfill a specific assignment), by examining traces of early hominid activities "frozen" in the recovered artifacts.

The data collected during fieldwork performed in the Umbeluzi-Tembe-Changalane area of southern Mozambique between 1993-1997 constitute the basis for characterizing the morphological features of Acheulean assemblages. The preliminary work performed in the region in the early 1940'-1950's called attention to the presence of a significant set of sites representing different lithic assemblages (Dias, 1947, 1948, Barradas, 1948, 1955b). However, the archaeological record was assessed by these early researchers within the strict limits imposed by the typological approach, aimed essentially at establishing a convenient space-time framework to evaluate the prehistoric activity in the region.

In this dissertation, the archaeological record is used to obtain a far more diverse range of information about technical competence, stone-knapping habits, practices of raw material selection and transport, insights into cognitive development, and on the nature of activities carried out at the different sites. These issues, patterned in the Middle Pleistocene archaeological record from southern Mozambique, will be addressed through a set of spatial factors. First, at the level of site specific studies, paleoenvironmental features and the availability of raw materials and their utilization to produce artifacts are discussed. Secondly, at the broader level of the landscape, patterns in the variation of the composition of stone tool assemblages from a number of sites are related to specific environmental contexts, in an effort to reconstruct localized hominid activities and lifeways.

### 1.1.2 Setting the problem of the concept of the "Acheulean"

Since the 1960's, the archaeology of Lower to Middle Pleistocene Africa has undergone significant changes in methodological and theoretical orientation, leading to an increase in behavioral information about prehistoric hominids. The studies performed by G. Goodwin, C. Van Riet Lowe, J.D. Clark, G. Isaac, M. Leakey, F.C. Howell, M. Kleindienst, H. Deacon, R. Mason, among many others, were based on the excavation and study of a significant set of sites classified as Acheulean. Today, although the database of sites attributed to the Acheulean is numerically large, its study and interpretation is still quite unsatisfactory. In fact, most of the sites in Southern Africa are described as Acheulean mainly due to the presence in the assemblages of diagnostic lithic pieces of this period -- handaxes and cleavers. However, if archaeologists assume that Acheulean assemblages are defined by the presence of these large bifacially worked lithic artifacts, at the same time, they also agree that these particular artifacts constitute only a part of the lithic tool kit from this Industrial Complex. In addition, the status of the Middle Pleistocene stratigraphy in this region of the African subcontinent is still not very clear. Many seemingly well established regional stratigraphies are inadequate and stratigraphic superstructures are misleading (Cooke, 1958, Butzer, 1975, 1978). Altogether, these facts reinforce the weakness of the utilization of handaxes and cleavers "fossil directeurs" (Vaufrey, 1960).

So, what is the Acheulean? The controversy over functional versus cultural (phylogenetic) interpretations of the Acheulean archaeological record has dominated most of the studies for this period, as I discuss in the next sections of this dissertation. In part, this problem reflects the main focus of research performed on the earlier stages of human cultural development. Metric and numerical analysis that have dominated the Acheulean studies became

abstract and mechanical, giving little or no attention at all to the toolmakers and to the circumstances in which the artifacts came were produced (Dunnell, 1982).

In order to understand the exigency for a new theoretical approach to the question of the Acheulean as presented in this dissertation, a brief historical overview of some of the problematic issues related to the emergence of the concept of the "Acheulean" are presented and discussed here.

### **1.1.2.1 The emergence of the concept of "Acheulean"**

#### **1.1.2.1.1 Establishing the antiquity of Humankind**

For much of history, with the exception of a few myths, Western writers did not suggest that there were other prehistoric populations before contemporary human beings. It was widely believed that each kind of organism had been created in one place from which it subsequently spread, and that each kind had been adapted from the beginning to a certain set of environmental conditions (Daniel, 1950).

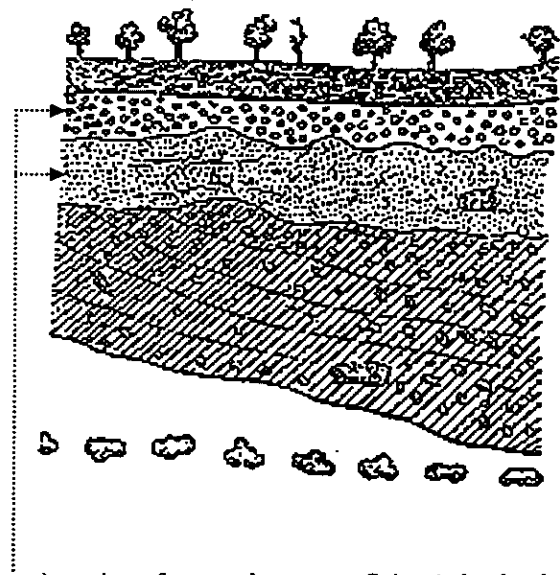
By 1800, Frere published one of the earliest accounts on the presence of handaxes and other flint implements at Hoxne, England. Frere referred to them being from "a very remote period". The middle of last century witnessed the emergence of the "Three Age System" based on the classificatory work of Thomsen at the National Museum in Copenhagen. Thomsen's principle of classification helped secure recognition that the human species had passed through a long historical sequence (Childe, 1975). At about the same time, Lyell published his "*Principles of Geology*" (1833), in which this author stated the principle of uniformitarianism. This principle holds the central idea that geological strata could only be interpreted correctly by assuming that the agencies that formed them had operated at a uniform rate and in a uniform way, just as they work in the present. Nevertheless, all this was not enough to establish the true antiquity of

humans. In the late 1830's, Boucher de Perthes, in France, published his views on the antiquity of humankind in a five volume work entitled "*De la Creation: essai sur l'origine et la progression des êtres*", where he mentions the presence of "haches diluviennes" (crude handaxes) found at Abbeville, in the Somme region, north of Paris. Later on, in his work "*Antiquités celtiques et antediluviennes*" (1847) Boucher de Perthes states the emergence of humankind prior to the Deluge, sustaining an association of human artifacts with extinct animals. The cooperation between French and British researchers demonstrated the existence of similarities in terms of ancient evidences of humans on both sides of the British Channel and put a final end to the battle on the immutability of the species and catastrophic diluvialism (Evans, 1860, 1872). In 1871, Darwin published his views on the relations between man and the general evolutionary theory in his "*Descent of Man*", applying uniformitarianism and evolution. The doctrine of evolution proposed that humankind evolved from a pre-human ancestor, and that there should be evidences of its passage from savagery through barbarism to civilization. In this way, the stone tools from France and England became the evidence -- the "fossil directeurs" -- of the great ancestry of humans. Therefore, Darwin set the stage for the acceptance of the idea of the great antiquity of humankind.

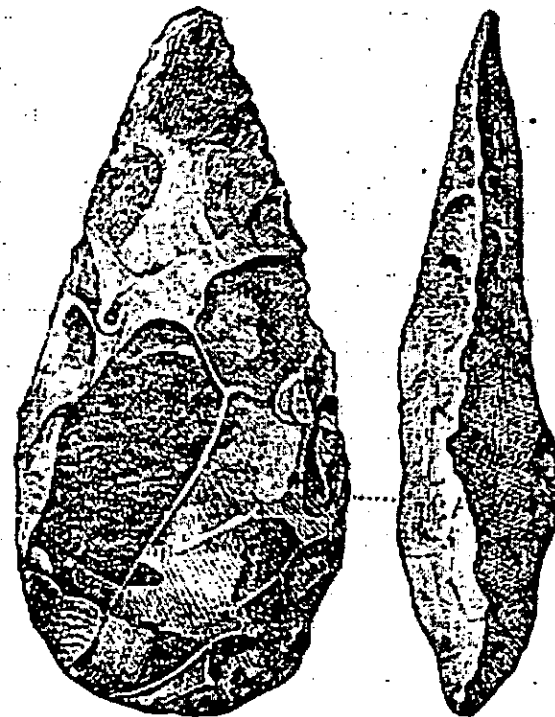
#### 1.1.2.1.2 The concept of Acheulean

Over a century ago, de Mortillet introduced the term Acheulean into the archaeological literature to make reference to a specific chronological and morphological stage in the archaeological sequence present in northern France, in the basin of the Somme river (de Mortillet, 1881). Named initially after the site of St. Acheul, this cultural term quickly became a world wide synonym for sites whose collections included handaxes and cleavers, suggesting a specificity in





a) section of a gravel quarry at Saint-Acheul, where some of the first "Acheulean" handaxes were found (indicated by the arrows)



b) Flint handaxe (then called "boucher", "hatchet" or still "almond-shaped type"; latter on these artifacts were also called "coup-de-poing")

Fig 1.1.1 The Acheulean from Saint-Acheul (after Boucher de Perthes, 1847)

terms of technology, knapping methods, forms and types of artifacts (see Fig. 1.1.1 representing a section of the gravels from the Somme river, where "Acheulean" handaxes were first found).

De Mortillet brought the human temporality to the structure of the lithic studies by introducing subdivisions defined typologically. The lithic artifact types and the techniques used for their manufacture were seen as reflecting the spirit of an age. The sequence of ages was determined using the principle that human history is progressive, i.e., de Mortillet's chronology operates by compartmentalizing time into a distinct number of named units (de Mortillet, 1898, 1900).

Breuil (1932) made a major change in Mortillet's scheme, stressing the importance of stratigraphy. It thus emerged that the first step in the classification of archaeological types should be to define recurrent assemblages, which subsequently are to be classified serially in Ages.

The durability of the chronological categories established early on, amongst which one finds the Acheulean period, illustrates the tenacity of chronologies once they have been adopted. This fact also demonstrates that preoccupation with classification involved the danger of an exclusive concentration on the study of types. The focus on typological studies (useful for the determination of chronology or the discrimination of assemblages and cultures) became the foundation stone for several hypotheses regarding migration and diffusion as key elements in determining the sequence of cultures.

Therefore, at a global level, the ideas expressed above imply the possibility of a branching pattern in which new groups developed from existing groups in a specific place and time while elsewhere other groups could continue to exist unaltered. If this is the case, it becomes clear that a uniform chronological and spatial framework could not be used for the study of the archaeological record.

### 1.1.2.2 The "new cultural terminology" for Southern Africa

In Southern Africa, although initially the search for lithic artifacts was merely an exercise for amateur researchers, soon the character of archaeological research was brought into the realms of the search for understanding the cultural development in the region. This meant that terminology such as Paleolithic became contested, since there was a need "for evolving an entirely new cultural terminology for Southern Africa" (Goodwin, 1958:25). For example, when referring to lithic collections containing handaxes, Peringuey (1911) mainly utilized the terms "Stellenbosh type" or "Orange type", from "classic" locations where these artifacts had been found. *The Stone Age Cultures of South Africa*, published jointly by Goodwin and Riet Lowe (1929) constitutes a clear example of empirical work on the classification of lithic assemblages from Southern Africa. The search for specificity of cultural evolution led Goodwin to formulate the following Southern African cultural-stratigraphic scheme of development of the lithic forms based on three main ages:

Table 1.1.1 Goodwin's scheme of Stone Age development in Southern Africa

Stages	
I	Early (Earlier) Stone Age (ESA)
II	Middle Stone Age (MSA)
III	Late (Later) Stone Age (LSA)

This researcher avoided using established European terminology because any direct correlation between the archaeological units -- recognized the length of a continent apart -- could not be shown. The South African archaeological sequence was based on what Goodwin would assume as technological progress, since, in his own words "we only reach each new "Age" as the

new technique becomes dominant and replaces previous modes. It is the dominant technique that marks the birth of each new period in man's story." (1946:74). Still in Goodwin's opinion, the characteristic tool of the ESA were the "handaxes" [it was still referred to as "coups-de-poing" (Capitan, 1900)], which "in the earlier phases of this Age [ESA], the attempts were crude and clumsy (...). As the period advanced, so the tool became more and more shapely, until a true almond, cleanly and neatly chipped, became the desired tool" (1946:74).

With the establishment of such a practical geo-archaeological framework in South Africa, it is not a surprise that the classificatory system used in the neighboring areas (including Mozambique) to analyze the lithic assemblages is based on the one developed for the Vaal River lithic sequence. This typological sequence was developed based upon the concept of increasing stone-tool making sophistication through time. For the Acheulean, the handaxes were perceived as "fossil directeurs" which evolved like organic entities (e.g., Riet Lowe, 1947). This supposition led to the rise of a widespread assumption among archaeologists working in the Stone Age of Southern Africa that the level of refinement of trimming reflects the level of technological sophistication of the tool manufacturer.

Based on this hypothesis, several researchers have assumed that such refinement can be used to chronologically compare different stone age assemblages (see Fig. 1.1.2 -Borde's model of morphological evolution). It should be mentioned that this assumption became quite widespread in Southeastern Africa, among researchers of the Stone Age (e.g., Clark, 1977). For the specific case of the Lower to Middle Pleistocene in Southeastern Africa, this approach has been applied to evaluate the Acheulean time-span, basing the analysis of the level of "refinement" patterned by the Acheulean handaxes (e.g., Riet Lowe, 1952b, Mason, 1962a, Cole, 1967, Fock, 1968, Humphreys, 1969, O'Brien, 1969, Isaac, 1978, Clark, 1988). But before discussing some of these important aspects, I would like to refer to some of the theoretical and

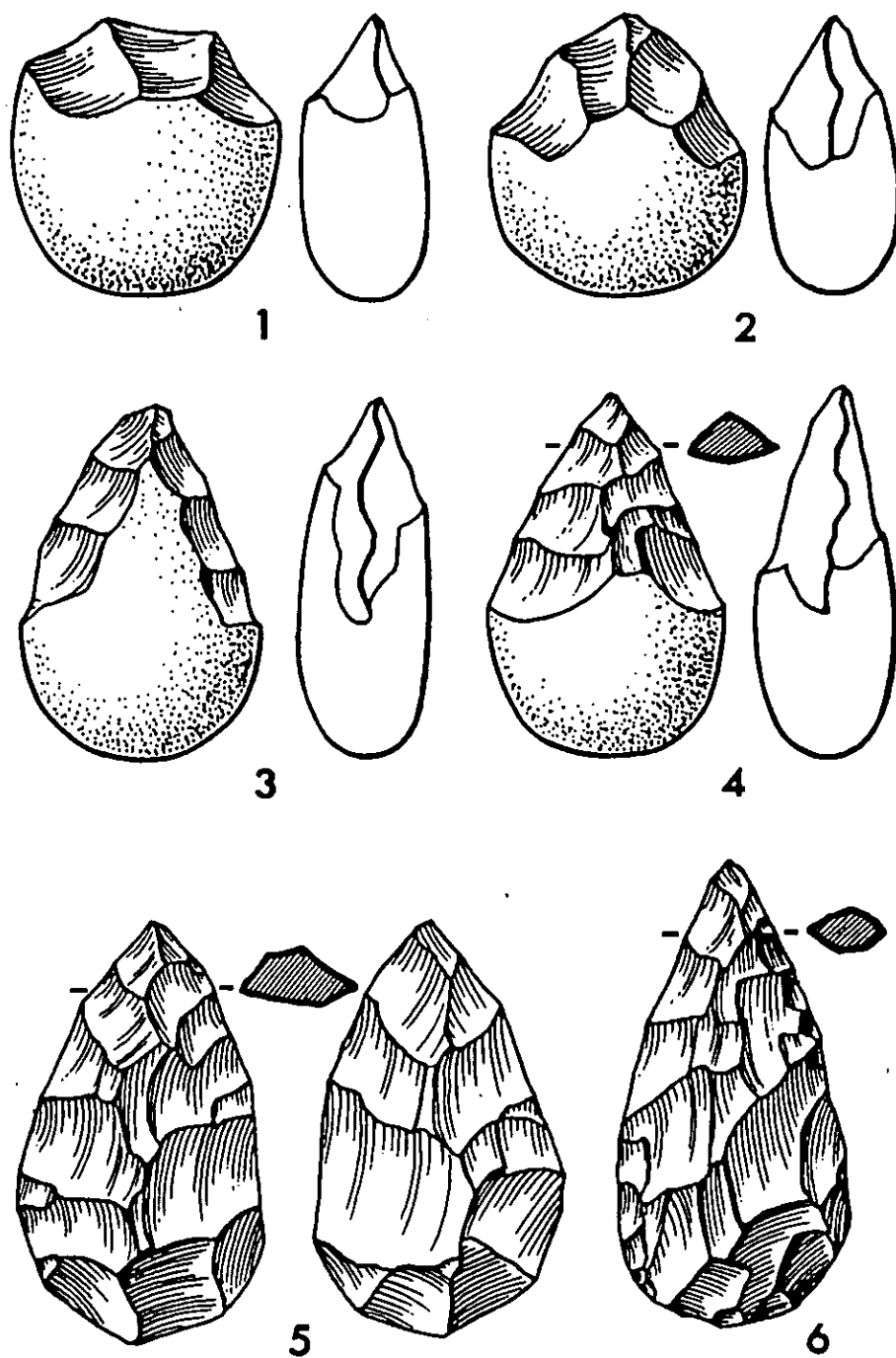


Fig. 1.1.2 Suggested morphological evolution of handaxes (after Bordes, 1968)

methodological achievements in Southeastern Africa, based on data collected from several important sites excavated in the past 30-40 years.

### 1.1.3 The Acheulean research undertaken in Africa - an overview

In East Africa, as in South Africa, most of the earlier work in African Prehistory was especially concerned with establishing a regional succession of cultural stages and relating this to a series of paleoclimatic events as evidenced by the stratigraphic record (e.g., Goodwin & Riet Lowe, 1929, Leakey, 1965). This explains the urge to find new sites presenting the "characteristic" tool types, which were used as "fossil directeurs" to chronologically interpret the temporal status of the site within the general prehistoric framework of Africa. The study of regions such as the Vaal River region (in South Africa), or the Olduvai Gorge in Tanzania (Eastern Africa) constitute typical examples of studies where the goal was aimed at identifying the evolution of cultural behavior through the use of a good stratigraphic sequence. In the first case, the Vaal River was understood for a long time as presenting a classic sequence of alluvial terraces and industrial successions (e.g., Songhe & Visser, 1937, Riet Lowe, 1937, 1952a, Malan, 1947); at Olduvai Gorge, the presence of a good geological sequence yielding an eleven-stage evolution sequence of "handaxe culture" laid the foundation for the formalization of a reference sequence for the Eastern African Stone Age (Leakey, 1929, 1952).

From the late 1950's on, the situation shifted significantly. One of the support elements of the temporal regime -- the geological framework using the climatic succession -- was severely scrutinized by Cooke (1952). Previously, interest in past climates was stimulated by the claim of the link between northern hemisphere glacials and African pluvials. This hypothesis was used both as a relative dating tool and to explain changes in stone tool manufacture. Leakey (1929)

identified four pluvials from geological deposits in Eastern Africa, and several researchers were quick to apply the scheme to Southern Africa fossil and artifact bearing localities (e.g., Goodwin & Riet Lowe, 1929, Barradas, 1952a, 1952b). Another scheme of relative dating available for Southern Africa which was based on the mapping and interpretation of the Vaal River artifact bearing terrace deposits and described within the pluvial model (Sohnge et al., 1937) also was criticized in the ensuing years (Partridge & Brink, 1967, Butzer et al., 1973, Helgren, 1977a, 1977b, 1978).

Table 1.1.2 The classification of classic sequences correlated with the European Ice Age sequence

East Africa (pluvial-interpluvial sequence)	Vaal River (South Africa)	Europe (glacial-interglacial sequence)
Makalian and Nakurian wet phases		Holocene
IV Pluvial or Gamblian	Youngest Gravels	Wurm
III Interpluvial		Riss/Wurm interglacial
III Pluvial or Kanjeran	Younger Gravels	Riss
II Interpluvial		Mindel/Riss interglacial
II Pluvial or Kamasian	Older Gravels	Mindel
I Interpluvial		Günz/Mindel interglacial
I Pluvial or Kageran	Basal Older Gravels	Günz

In Cooke's opinion (1952, 1957), the limited geological data did not justify attempts at correlating climatic oscillations of Southern Africa with other areas, and certainly not with Europe. Together with the greater emphasis on stratigraphic principles, Cooke's work created the basis for rejecting the idea of pluvial-interpluvial sequence and its correlation with the glacial sequence in Europe (Flint, 1959). At the same time, the beginning of large-scale excavations, aimed at understanding the significance of "living-floors" (e.g., Howell et al., 1962, Clark, 1969, 1974) shifted the attention from the use of tools as fossil directors, to their understanding as

"visiting cards" (Isaac, 1981b). By looking at the spatial relationships of artifacts, together with several other lines of evidence, it became possible to start addressing questions regarding the activities potentially performed by hominids at a site. From then on, most of the studies included a detailed geological study, as well as the recording, analysis and illustration of the findings, together with spatial plots (e.g., Leakey, 1975, Isaac, 1977, Keller, 1973, Harris, 1978).

Until the emergence of large scale excavations, the collections of Acheulean artifacts were generally biased towards those pieces considered to be exclusive to this period -- mostly handaxes -- as these tool forms were mainly used as time indicators based on the level of refinement presented. With the advent of a new focus -- the study of "living floor" -- another element was brought to the picture: the importance of understanding the concept of space from the perspective of prehistoric populations, of the makers and users of the lithic instruments (e.g., Leakey, 1971).

Amongst some of the key sites excavated in Africa and characterized as being of the Acheulean period, are Ternifine, Olorgesailie, Isenya, Isimila, Kalambo Falls, Cave of Hearth, Montagu Cave, and Amanzi Springs (see Fig. 1.1.3, picturing the map of Africa with the location of the main Acheulean sites referred in the text, in the wider context of the Acheulean distribution in Africa). In fact, the excavation and data analyzed from these sites has become the basis of the contemporary body of archaeological information for Southeastern Africa. Here, the large multidisciplinary projects addressed several specific questions, amid which one should point out:

- a) studies related to site formation processes (e.g., Butzer, 1973b, 1974, Schick, 1992, Schick & Toth, 1993),
- b) behavioral interpretations such as



- the hunting hypothesis (Clark & Haynes, 1969, Shipman et al, 1981, Binford & Todd, 1982, Klein, 1978, 1988, Koch, 1990), and
  - the role of technology (e.g., Humphreys, 1979, Clark, 1980, Toth, 1982, 1997, Schick & Toth, 1993),
- c) environmental interpretations (e.g., Clark, 1964, 1984, Klein, 1975a, 1975b, 1988, Deacon, 1975, Butzer, 1984),
- d) questions of classification and terminology (Clark, 1957, Clark et al., 1962, 1966, Kleindienst, 1961, 1967, Isaac, 1977), etc.

This research also triggered a theoretical evaluation of the established assumption of progressive typological and morphological development through time, accompanied by increased refinement of forms -- the model suggested long ago by Breuil and Riet Lowe.

During the past several years, besides the study of the ESA from southern Mozambique (described in more detail in Chapters II and V), I have had the opportunity to undertake a study of the Acheulean industries in the Southeastern region of Africa. While some of these sites, their deposits and their assemblages will be discussed more detailed in this dissertation (see Chapter II), a brief overview is presented here by way of introduction.

#### **1.1.3.1 Kalambo Falls**

One of the important sets of sites whose study contributed towards setting up new directions in the archaeology of ESA in Africa is Kalambo Falls. This site complex is located in a small river basin in the Zambezi catchment area, on the border between Zambia and Tanzania. The sites of Kalambo Falls contained artifacts and other associated materials in a good state of preservation, and in a minimally disturbed context (Schick, 1992). Here, several cultural

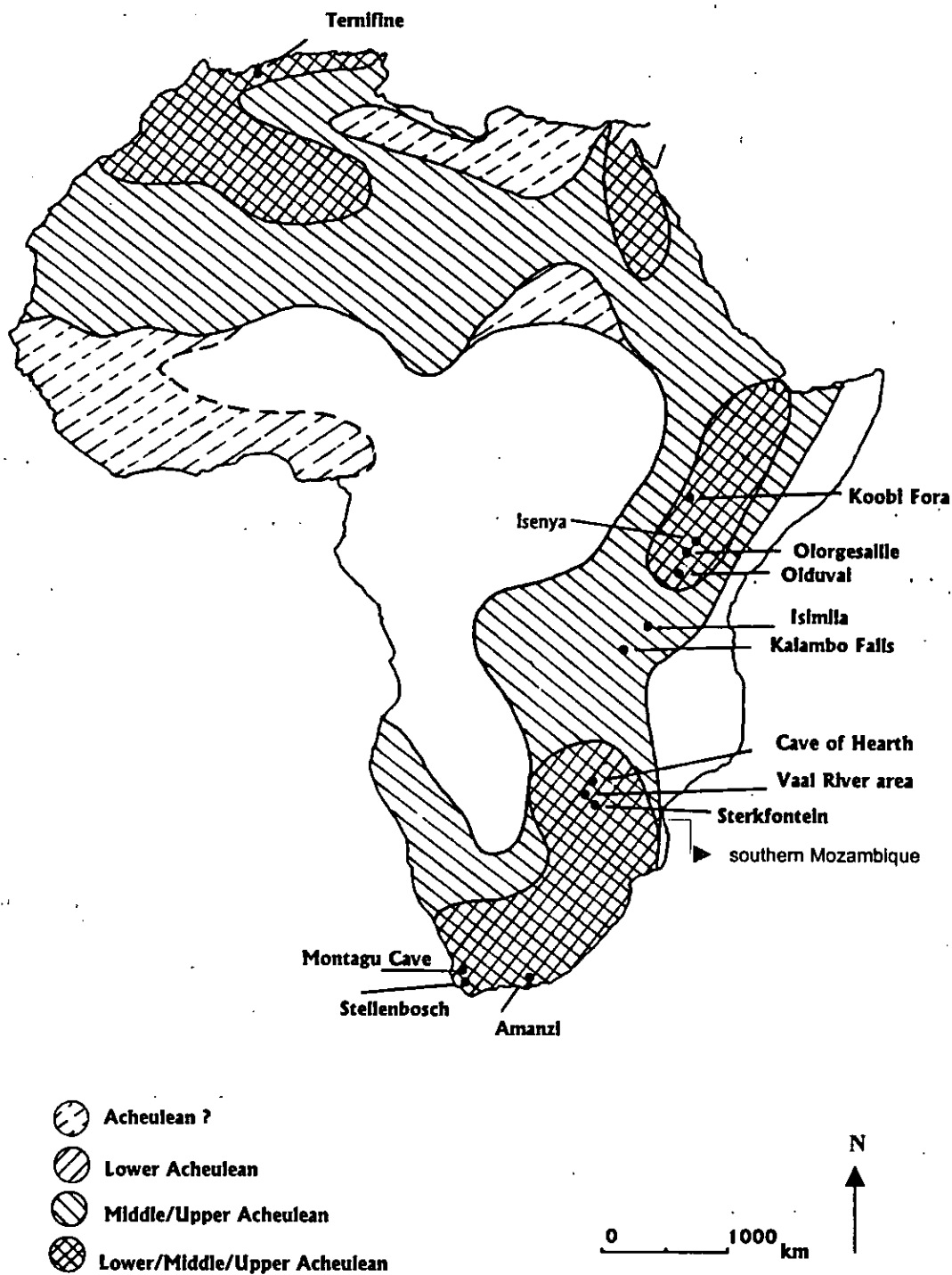


Fig. 1.1.3 Acheulean in Africa - main sites referred to in the text (adapted from Garanger, 1992). The unmarked area refers to regions where information is not available; this includes the study area of this dissertation, southern Mozambique.

complexes were identified, spanning from the Acheulean to Iron Age. Therefore, it became possible to trace the so-called "technical development of prehistoric cultures", as well as to obtain some information regarding the potential use of the sites, through the study of "living-floors" (Clark, 1969, 1974, 1984). The fact that wood, pollen and other vegetation remains were recovered from deposits at Kalambo Falls, led the researchers to extrapolate some hypothesis regarding the relationships between environmental conditions and artifacts. In fact, Clark (1984) suggested that the Acheulean was related to drier conditions, contrasting with more open and wet vegetation of the Sangoan period (a broader discussion on the subject of the Acheulean-Sangoan dichotomy in Southeastern Africa is presented in Chapter II). The analysis of the artifacts continues (Schick, 1992, Sheppard & Kleindienst, 1996). The most recent technological approach undertaken suggests that this "cultural" and temporal differentiation correlates with a change in the raw materials and blanks used to produce artifacts (Sheppard & Kleidienst, 1996).

#### 1.1.3.2 Isimila

Isimila became another important site (or rather, a series of sites), due to the abundance of Acheulean artifacts. The large-scale excavation performed in this Tanzanian locality showed clear differences in stone artifact composition between assemblages within a single geological horizon (Howell et al., 1962). This fact challenged the established assumption of progressive typological and morphological development through time. This issue laid the foundation for a broader theoretical and methodological examination of the lithic data, based on a comparative study between the Acheulean assemblages from East Africa, principally Kalambo Falls and Isimila. M. Kleindienst's assessment of the variability present resulted in the development of a classificatory scheme (e.g., 1961, 1967), where the emphasis was placed upon function. In Kleindienst's approach, the emphasis is placed upon the dimension (in a volumetric perspective)

of the working edge, resulting in the division of the assemblage into "heavy duty" and "light duty" tools. For authors, such as Cole & Kleindienst (1974), the distinctiveness between archaeological samples gathered at Isimila resulted from diverse human activities. For other authors (e.g., Hansen & Keller, 1971) the differences between artifactual samples within the geological sequence at this series of sites were interpreted as a reflection of change through time.

### 1.1.3.3 Ternifine

Ternifine, in northern Africa (Algeria) was one of the first sites where it became possible to contextualize the Acheulean archaeological findings in terms of hominid forms responsible for its manufacture. In fact, this site, typologically classified as of the Early Acheulean, yielded some fossil specimens (mandibles and a parietal) described as *Homo erectus* (Arambourg, 1954, 1955, Rightmire, 1990).

The spatial association of Acheulean artifacts and fossil remains attributed to *Homo erectus* set up a framework, in which the Acheulean period was viewed in general in association with the hominid stage of *Homo erectus* (e.g., Clark, 1977, Gowlett, 1984, 1986, 1996, Klein, 1989, Schick & Toth, 1993). Fig. 1.1.4 is an example of such a generalist association.

### 1.1.3.4 Olorgesailie

At Olorgesailie (Kenya) several sites were excavated and studied by G. L. Isaac (1977), using approaches developed for the study of Kalambo Falls, Isimila and Olduvai. At this complex of sites, the Acheulean bearing levels occurred in fine-grained sediments with minimal disturbance. Hence, the distribution patterns observed on several excavated episodes were used to understand associations between artifacts and fauna, and thus provide some insights regarding

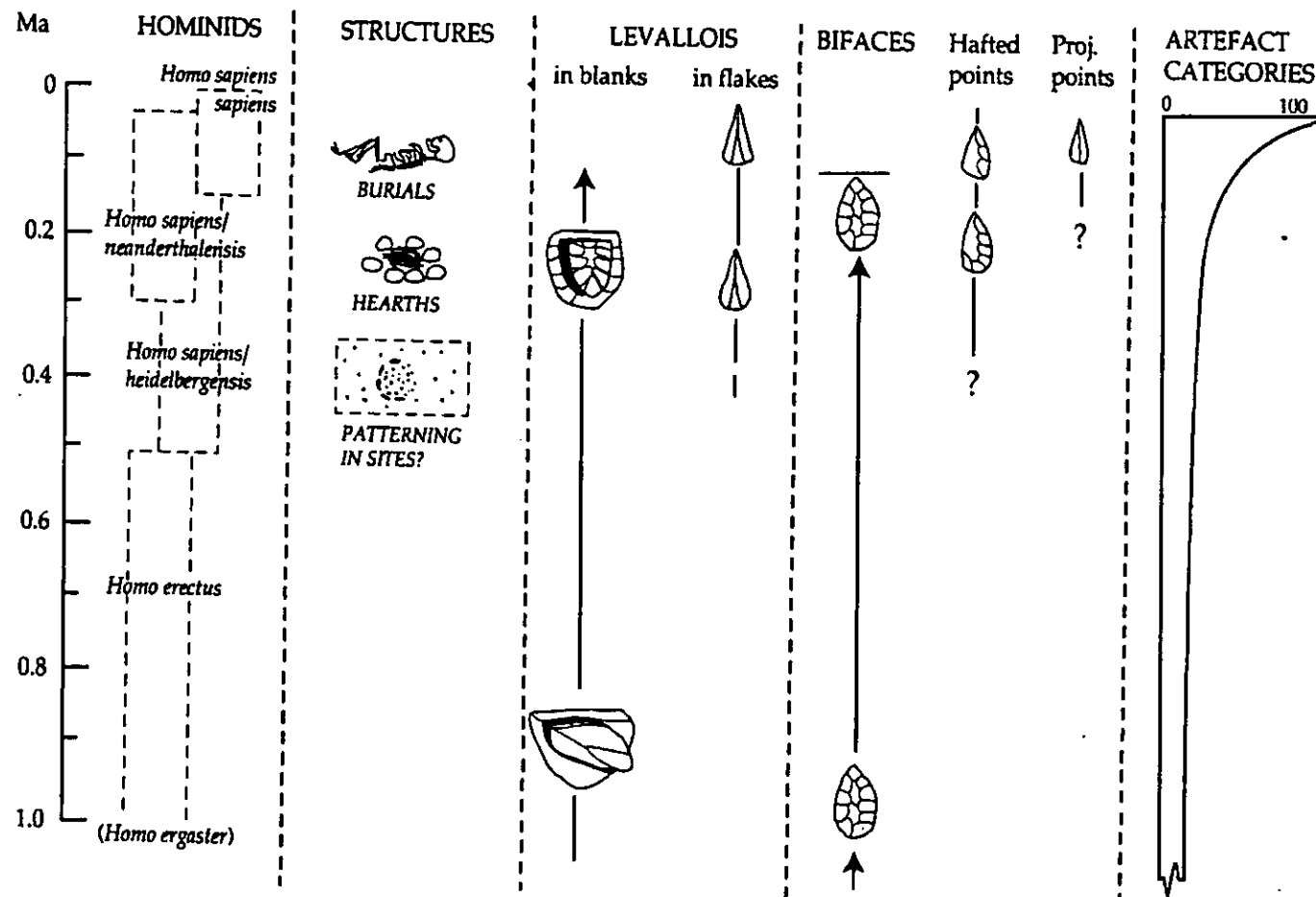


Fig. 1.1.4 Suggestion of an evolutive path through the Pleistocene (after Gowlett, 1996)

the activities performed there by ancient populations (Shipman, 1981, Binford, 1982, Koch, 1990). The analysis of the Acheulean artifacts from Olorgesailie was subordinated to the goals of understanding the assemblages as a series of events on ancient landscapes. This fact triggered the development of a broader, landscape approach (overstepping the previous site oriented studies) which recently has been applied to sites presenting laterally extensive deposits bearing ESA assemblages (e.g., Potts, 1989, Peters & Blumenschine, 1995, Rogers, 1997, Sampson, 1998). Nonetheless, the most recent studies (e.g., Potts, 1994) have been focused essentially on large lithic pieces. However, a comprehensive landscape approach will require a more complex study of the lithic assemblages, which will need to include the smaller lithic pieces. Another important aspect of the landscape approach will be the study of the sources of lithic raw material (both in qualitative and quantitative terms), as well as the evaluation of the influence of the raw material in determining the form and size of the blanks used to produce the lithic artifactual forms found at the sites (e.g., Perlès, 1992, Texier, 1996).

#### 1.1.3.5 Isenya

The Kenyan site of Isenya has been under research since the early 1980's (Roche et al., 1987). The Acheulean assemblage from this site -- dates to the Middle Pleistocene -- has been studied from a technological perspective (Roche & Texier, 1991, 1996, Texier & Roche, 1995). The study's emphasis on the complex processes related to the manufacture of handaxes, cleavers, polyhedrons and bolas has shown the possibility of understanding the organizational procedures used by the Acheulean lithic knappers, through careful replicative study of the lithic assemblage. This has allowed some insights into planning depth, anticipation and behavioral procedures that once occurred at this early Acheulean site. Here, an important advance lies in the information recovered through knapping experiments, combined with theoretical development of a model of

interpretation of the technological behavior reflected in the assemblage (Texier, 1996). A more detailed evaluation of this methodological approach will be discussed in Chapter VI of this dissertation.

Several additional studies of the Acheulean have been undertaken in other regions of Africa (e.g., Gowlett, 1982, 1990, 1991, McBrearty, 1991, Cornelissen, 1992, Kuman, 1996). Since this dissertation will include a section of reference to some South African Acheulean sites whose artifacts were studied for comparative purposes, here I only briefly refer to the main sites excavated in the neighboring region of southern Mozambique. In general, authors mention the paucity of fauna and paleoecological information in association with artifactual materials and how this deficiency reduces the ability to make further inferences about Acheulean hominid behavior. **Amanzi Springs** (Deacon, 1970, 1975) is among the few sites in near primary context, where paleoenvironmental data (fossilized wood) was found in association with artifacts. Another site presenting a complex geo-archaeological sequence is **Cave of Hearths**, located in northern part of South Africa. At this cave, fossil remains were found in levels yielding Acheulean artifacts (Mason, 1962a, 1988). From a perspective of chronological follow up of lithic variability through time, important information was also achieved from the excavations of a multilayer sequence present in **Montagu Cave**, in Cape Province (Goodwin, 1929, Keller, 1970, 1973). The implications of the Acheulean data used from Sterkfontein and other Vaal River sites, together with its geological context will be discussed in Chapters V through IX.

From the above-mentioned brief reference to the studies on the Acheulean on Southeastern Africa, it becomes clear that most of the archaeological research has been directed along a single path. Only in the recent years have we witnessed a strong concern for complex behavioral interpretations, more theoretically oriented (e.g., Peters & Blumenschine, 1995). Still,

the refinements in methodological and theoretical issues, such as taphonomic analysis, refitting methods to study production sequences, knapping experiments, and meticulous dissection of horizontal exposures, which provided a dynamic model of site activities, have been essentially applied only to the Oldowan.

Hence, when compared to the quality and quantity of results achieved for the Oldowan and MSA periods, one asks why have so few Acheulean sites been studied? The number of unsettled issues related to the study of the Acheulean led Isaac to label this period as "the muddle in the middle" (Isaac, 1975). This situation is especially striking for Southern Africa, where we observe an increasing decline in interest in this subject, with scholars gradually changing their field of study to other periods.

#### 1.1.4 The main issues

Since the 1960's the archaeology of early Human Origins in Africa has undergone significant changes both in methodological and theoretical terms, accompanied by a substantial increase in behavioral information. In South Africa, Tanzania, Kenya and Ethiopia, the application of absolute dating methods (e.g., Isaac & Curtis, 1974, Bye et al., 1987, Walter et al., 1991, Feibel & Brown, 1993, Semaw, 1996), the development of new approaches to the faunal and lithic archaeological assemblages (e.g., Jones, 1981, 1994, Toth, 1982, Blumenschiné, 1988, Binneman & Beaumont, 1992, Texier, 1994, 1996), and the new approaches to the study of the archaeological record in a broader spatial and temporal perspective (e.g., Stern, 1993, Potts, 1994, Peters & Blumenschine, 1995, Rogers, 1997, Blumenschine & Peters, 1998) led to a notable increase in the amount and diversity of data regarding the Lower and Middle Pleistocene. Although the focus of these studies remains mainly on the early stages of ESA, they set up an important methodological framework for the research on the Acheulean period. Several unsettled



questions related to the study of the Acheulean period will be pointed out in the following section of the introduction.

#### 1.1.4.1 The dating problem

The following dated Acheulean localities in Southeastern Africa are the most important (e.g., Sampson, 1974, Clark, 1975, 1994, 1996, Isaac, 1982, Volman, 1984, Klein, 1994):

Table 1.1.3 The Acheulean in Southeastern Africa

Site	Date	Period	Country	References
West Turkana	«1.6 Mya	Early Acheulean	Kenya	Kibunjia, et al., 1992, Roche & Kibunjia, 1996
East Turkana	≈1.6 Mya	Karari Industry	Kenya	Harris, 1978, Brown, 1994, Rogers, 1996
Olduvai (from upper Bed II)	1.5-1.4 Mya	Early, Middle and Later Acheulean	Tanzania	Hay, 1976, Walter et al., 1991, Leakey & Roe, 1996
Sterkfontein - Member 5	« 1.5 Mya	Early Acheulean	South Africa	Klein, 1984, Partridge & Watt, 1991, Kuman, 1998
Konso-Gardula	1.4 Mya	Early Acheulean	Ethiopia	Asfaw et al., 1992
Peninj Group	1.35 Mya	Early Acheulean	Tanzania	Isaac & Curtis, 1974
Olorgesailie	990-600 Kya	Early Acheulean	Kenya	Deino & Potts, 1990, Potts, 1994
Isenya	700-650 Kya	Early Acheulean	Kenya	Roche et al., 1987
Border cave	195 Kya	Later Acheulean	South Africa	Butzer et al., 1978, Beaumont, 1980
Rooidam	115 Kya	Later Acheulean	South Africa	Butzer, 1974, Szabo & Butzer, 1979

One of the more problematic issues related to the study of the Acheulean in Southern Africa results from the absence of absolute dating material. This contrasts significantly with the

Eastern African region, where studies on the ESA rely mostly on the use of secure radiometric and paleomagnetic methods for dating the sites (Alimen, 1977). In addition, several locations in East Africa, such as Olduvai Gorge and Koobi Fora, present a long stratigraphic record (e.g., Hay, 1976, Feibel et al., 1989, Brown, 1994), illustrating a long sequence of human activity. In Southern Africa, however, there is no single site, which has yielded such a complete sequence. Therefore, the dating questions have been addressed essentially through biostratigraphic correlation with Eastern African sites with fossil faunal assemblages.

For a long time the Acheulean in Southern Africa has been associated with the Middle Pleistocene (Butzer, 1984). In Africa the Acheulean is generally defined between 1.5-1.4 Mya and 250-100 Kya (Butzer, 1975, Butzer et al., 1978, Clark, 1981, 1988). The Lower-Middle Pleistocene boundary in its formal definition is placed at the beginning of the Bruhnes Normal Polarity Epoch - 700,000 BP, and the Middle-Upper boundary at the beginning of the last Interglacial, approximately at 130,000 BP (e.g., Butzer, 1974a, Maud, 1986, Partridge et al., 1990). This is important because biostratigraphic zonation was from the beginning linked to resolving the mid-Pleistocene time interval (Butzer, 1975). On the other hand, all sites lie beyond the range of the radiocarbon ( $C^{14}$ ) dating method (Deacon, 1992, 1996). Thus, the dating of the ESA sites in Southern Africa has been based essentially on stratigraphic interpretations, typological analysis, and regional biostratigraphic studies.

For surface sites (most of the African Acheulean), temporal assignment to the Middle Pleistocene is based on traditional typological classification. Thus, Acheulean assemblages are considered of Middle Pleistocene age (and vice versa --see for example, Beernardt, 1987) while Fauresmith and Sangoan (still presenting bifacially worked lithic pieces amongst their characteristic artifacts) are generally considered Upper Pleistocene and excluded from this table. This approach entails a margin of error, since some of these latter assemblages may actually be of Mid-Pleistocene in age (e.g., McBrearty, 1991, Cornelissen, 1995, Deacon, 1996).

#### 1.1.4.2 The paleoenvironmental reconstructions

A critical aspect of contemporary archaeological research is related to the possibility of reconstruction of the environment(s) in which the Acheulean hominids lived. To what extent are we successful in interpreting this from the paleobotanical, paleozoological and artifactual remains? How significant were the inter- and intra-regional differences?

##### 1.1.4.2.1 Some problems...

The available paleoenvironmental data available from South Africa is quite scarce for the Acheulean period (Partridge, 1986). Only the Cave of Hearths presents a more or less secure stratigraphic context for the fossil fauna, but here also, the fauna is sometimes too fragmented even to make species identification (Cooke, 1962, Klein, 1988). Elandsfontein, a mid-Pleistocene open-air site in Cape Province, does not present any stratigraphy and the faunal and lithic material was found redeposited and mixed with much later cultural remains (MSA artifacts and Iron Age ceramics). Fluorine analysis performed by Oakley (1954) indicates that the great bulk of the fossil fauna from the site was contemporaneous.

In Mozambique, in the Sul do Save Region, there is almost a complete absence of fossil specimens. In fact, the only evidence of faunal remains for this period is related to a skull of a *Kolpochoerus africanus* (?) found in the coastal limestone sediments (Ponta Milibangalala) during the late 1960's (T. White, pers. com.). This fossil suid species was present in Southeastern Africa between about 4 Mya and 500 Kya (T. White, pers. com.). Still in southern Mozambique, but in the Upper Pleistocene, the fossil faunal remains from Caimane shelter (see Chapter V) remain another possible data source (Jonsson, 1983, P. Sinclair, pers. com.).

#### 1.1.4.2.2 ...related to the interpretation of the environmental context

##### in Southeastern Africa

The general trend towards a more open, less wooded environment identified for Eastern Africa from the early Quaternary on (e.g., Cerling, 1992, Feibel & Brown, 1993), also seems to be present in Southern Africa (e.g., Avery, 1995). However, the paleoenvironmental reconstructions based on faunal and sedimentological data from South Africa suggest the existence of still moister conditions during most of the Acheulean (e.g., Bond, 1963, Fock, 1968, Klein, 1975a, 1975b, Butzer & Cooke, 1981, Butzer, 1985, Maud, 1986). These conditions have changed by the end of the Acheulean towards semi-arid conditions and continued until the present. The vegetation changed from thick bushes and grasslands gradually to more open plant cover (e.g., Butzer, 1973a, 1973b, 1974, 1984, Horowitz, 1975). However, one should bear in mind that the vegetation changes have been very slow, probably human induced, and that several periods of changes towards wetter conditions also took place (Maud, 1986, Partridge, 1990, Partridge et al., 1991, O'Brien & Peters, in press). Also, the paleoenvironmental reconstructions undertaken for the Southern African Acheulean indicate only a general picture of this period; this picture was achieved basically through the study of fossil ungulate communities for climate and environment, with pollen data, whenever existing, used as a control. As mentioned by several authors (e.g., Volman, 1984) the Acheulean in Southern Africa is characterized by the lack of chronological controls, with few primary or near-primary contexts sites usually lacking fossils and organic remains.

Since the paleoenvironments seem to present distinct conditions through the Early and Middle Pleistocene, these facts bring into question the potential use of faunal correlations between East and Southern Africa. Moreover, the approaches used are also different, since in

South Africa the majority of paleoenvironmental reconstructions were undertaken using the fossil data obtained from the Transvaal cave site, and seldom using open air faunal assemblages, as in Eastern Africa. Finally, the fossil assemblages from South Africa (especially from the main cave sites) have not been completely studied, both in terms of taxonomic identification, and taphonomic history, in order to assess the factors that may have altered or biased the faunal collections (e.g., Clarke, 1985).

#### 1.1.4.3 Site formation processes

The study of the Acheulean archaeological assemblages is limited by the fact that few sites have survived in primary context, and those that have represent a biased sample of early hominid behavior (e.g., Clark, 1975a, 1987, Villa, 1991, Schick, 1992). In Southeastern Africa, the few sites available for study are generally restricted to areas having favorable conditions for preservation of the assemblages (both lithic and fossils) and in which the sedimentary strata are exposed to modern view (Howell & Clark, 1964, Isaac, 1981b). Indeed, most of the sites defined as of Acheulean are located close to water sources, normally valley bottom situations, around ephemeral lakes, springs and seepage points (e.g., Howell & Clark, 1964, Clark, 1975a, 1981, Deacon, 1975, 1996, Klein, 1975b, Isaac, 1977, Sampson, 1985). Consequently, most of the sites have experienced some sort of natural disturbance in alluvial or colluvial contexts, which affects the analysis and interpretation of the assemblages under study.

In South Africa, the study performed on both open air and cave sites yielding Acheulean data such as Sterkfontein Member 5, the Vaal River locations, and elsewhere (e.g., Kalambo Falls in Zambia) has an important role to play in the paleoanthropology of Africa. However, the very different geological context and biogeographical position requires careful reconstruction of the site history (site formation processes) in order to understand the potential of the site in terms

of information obtained. In Eastern Africa, very few Acheulean sites yielding both artifacts and fauna have been studied in the sort of detail similar to the one used currently for the Oldowan period (Isaac, 1981, Schick, 1992). Perhaps the only examples would be Kalambo Falls (Schick, 1992), Olorgesailie (Potts, 1989, 1994) and, more recently, Peninj -- Tanzania (Dominguez-Rodriguez, pers. com.)

#### **1.1.4.4 The geographic hiatus**

If the picture just drawn is true for the overall southeastern part of the African continent, several gaps persist in terms of the geographic coverage of this region. A notable case is Mozambique, an important area that links Eastern and Southern Africa, and where so few archaeological sites are known. However, Zimbabwe, Swaziland and Lesotho, are also poorly known in terms of fossil and lithic assemblages from the Lower and Middle Pleistocene (e.g., Cooke, 1963, Cooke et al., 1966, Clark, 1967).

In extensive areas of Western and Central Africa, geo-archaeological surveys have started to be conducted predominantly in the more recent years. The sporadic character of the ESA studies in this area have contributed little to our understanding on the presence and character of the Acheulean in that region of the African continent (e.g., Ervedosa, 1980, Van Noten, 1982, Nygaard & Talbot, 1984, Lafranchi, 1990, Millogo, 1993).

#### **1.1.4.5 The advent of the contemporary analytical framework**

The Acheulean, together with the Oldowan, constitutes the ESA period in Southeastern Africa. However, the earlier period, the Oldowan, was restricted geographically to the African continent. The Acheulean, which prevailed for more than a million years (Alimen, 1977, Isaac,

1988, Clark, 1994, 1996, Roche, 1996) was not only present over the vast majority of the African continent, but in other parts of the Old World as well. Sites such as Ubeidiyeh (Bar-Yosef & Goren-Inbar, 1993, Bar-Yosef, 1994) and Gesher Benot Ya'aqov (Goren-Inbar et al., 1992) in Israel, together with Dmanisi in Georgia (Dzaparidze et al., 1993, Bar-Yosef, 1995, 1998) suggest that Acheulean hominids had traveled into Eurasia over a million years ago.

In Europe, several Acheulean sites are believed to be over 500,000 years old (usually dated by paleomagnetically reversed sediments). Among them the best studied are the classic area of the Somme valley – France (Tavoso, 1978, Tuffreau et al., 1997, Leopold, 1997), in Spain, the cave site of Atapuerca, (Bermudez de Castro et al, 1995) and the open air sites of Torralba and Ambrona (Freeman, 1991, 1994), Boxgrove - England (Bergman & Roberts, 1988), and Fontana Ranuccio and Natarchirico in Italy (Biddittu & Segre, 1984, n.a., 1996, Piperno et al., 1998).

Although the geographic focus of this dissertation is the African continent, one should also point out that in Asia, including the far east region, several localities yielded assemblages with handaxes, (e.g., Mishra et al., 1982, Paddayya, 1985, Senshui, 1985, Huang, 1989, Young-Wha, 1989, Mishra, 1992, Petraglia, 1998, Corvinus, 1998, vs. Clark, 1994, Schick, 1994).

Surprisingly enough, the search for the distinct character of cultural development in Europe and Africa (e.g., Alimen, 1978, Roe, 1981, Clark, 1981, 1994, Tuffreau, 1996, Rolland, 1998) created diverse analytical frameworks. The methodological discussion related to the analysis of Acheulean assemblages will be presented in detail in Chapter VI. However, and in order to contextualize some of the ideas still prevailing among researchers dealing with the specificity of this chronological and spatial span, some general principles should be described and discussed in this section.

Initially dominated by a technologically driven attitude (e.g., Evans, 1872, Coutier, 1931, Goodwin, 1933, Bowles, 1944, Goodman, 1944, Baden-Powell, 1949), the study of lithic

assemblages very soon became dominated by the metrical evaluation of the typological indices of the artifacts present in an assemblage. These indices were usually computed on the basis of relative frequency of the "tool" forms present. This is exemplified clearly by the approach developed by several researchers (e.g., Balout, 1955, Bordes, 1961, Roe, 1964, 1968) who state the priority of typology over technique. For example, in Bordes' opinion (1961), the technique is never more than a means, the tool, defined by its morphology or use, being the end. The search for the identification of predominant forms as cultural indicators (and the aim of avoiding the problems associated with functional analysis) led most of the researchers in this line of thought to disregard the implications of raw materials and crafting techniques (or still potential functional factors) favoring just the main shape of the artifact (Jelinek, 1965). For the case of the Acheulean -- the main characteristic became the bifacial knapping of the lithic pieces.

In South Africa, the researchers instead set the tone for the technological analysis of Acheulean artifacts. For Goodwin (1946), the emergence of a new technological stage constituted the threshold for the establishment of a new age, of a new period. Riet Lowe placed a similar emphasis upon technology; in 1945 this archaeologist wrote:

"(...) my belief being that it is safer to stress affinities on technological rather than on typological grounds, where typology is confined, as it all too frequently is, to the final objects of human industry and excludes the rejects and processes men practiced in achieving those objects."

Speaking strictly on cultural-typological grounds, the ESA is used specifically for Southeast Africa and the Early Paleolithic for northern Africa and Europe. Nonetheless, in both systems the Acheulean is present, being similarly defined by the presence of handaxes and cleavers -- which are perceived as the essence of the Acheulean period. For example, referring to the Acheulean of Southern Africa, Sampson (1974:102) asserts that "the handaxes and cleavers are recognized as characteristic tools". In Villa's opinion (1983:6-12), when speaking about the European record, "the Acheulian is a Lower Paleolithic stone-tool assemblage which is



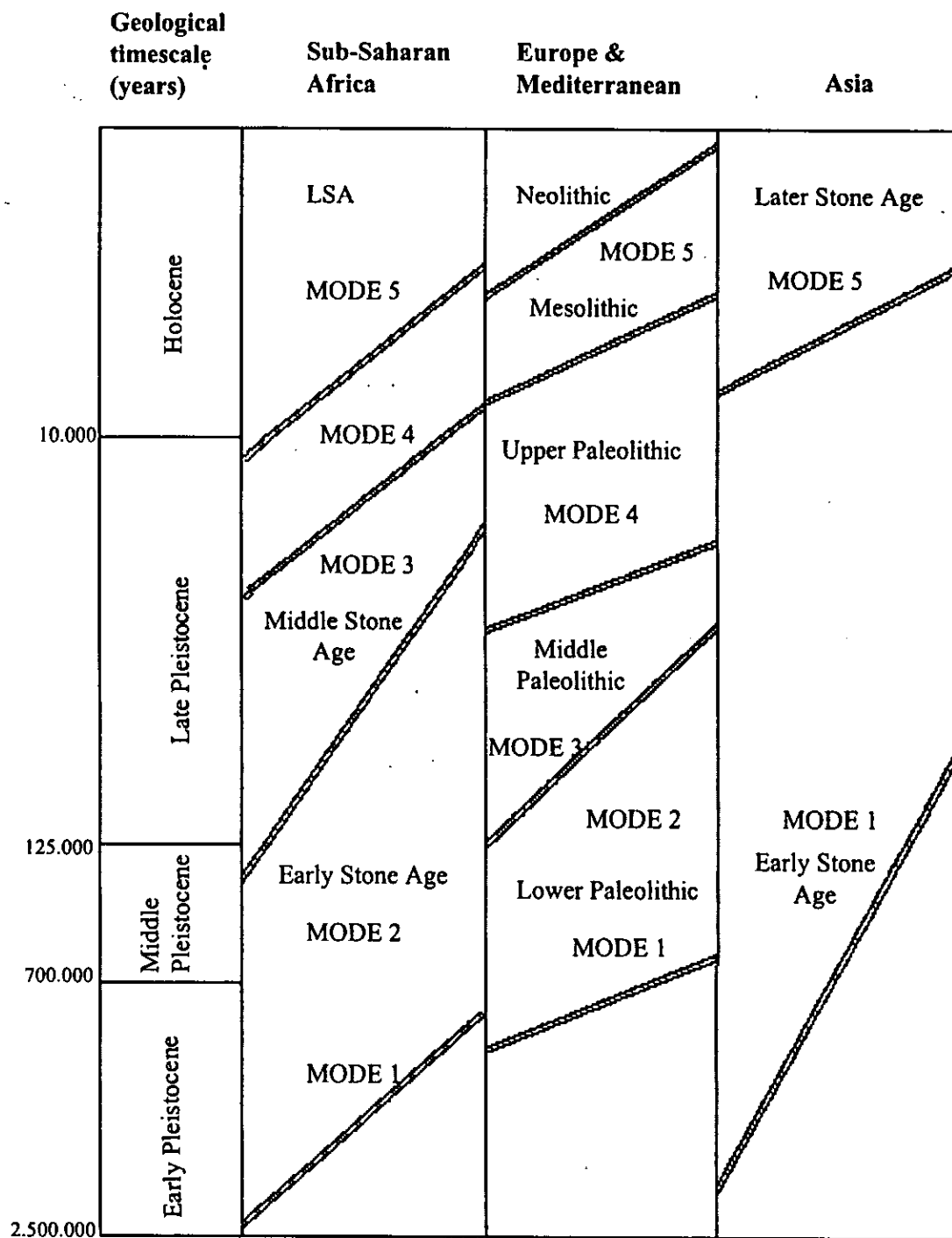


Fig. 1.1.5 Classification of earlier phases of prehistory in relation to the geological timescale and technological modes (adapted from Foley, 1987:43)

characterized by the presence of bifaces"; further, this author reaffirms her opinion, saying "only the bifaces are a well documented trait that what is the Acheulean by definition". Clearly, the opinion stated by these scholars reflects the persistence in defining the Acheulean by the presence of bifacially worked lithic pieces (i.e., handaxes and cleavers), in the Lower to Middle Pleistocene deposits of the Old World.

The attempt to formulate a regional archaeological sequence reflecting the specificity of cultural development was not achieved either in Europe or in Southeastern Africa. This persuaded some researchers to develop a general approach where the Old World was taken as a single cultural system. In this sense, the scheme applied by G. Clark (1977) is a good example.

Hence, when trying to bring together a consistent cultural sequence for the whole Old World, Clark introduced the concept of modes of development, based on the new characteristics emerging from the archaeological record (see Fig. 1.1.5 presenting an example of the correlation among the geological timescale, and technological modes). The Acheulean corresponds then to Mode 2, where in Clark's opinion (1977:29), the

"most striking technical innovation to appear was the handaxe, a tool flaked over part or the whole of both faces [i.e. bifacial tool] in such a way as to produce a working-edge round the greater part of its perimeter and apparently intended to be gripped in the hand".

Here, several questions arise immediately:

1. The assumption that a similarity of form implies the same production-use sequence is implicitly inherent in all applications of formal typologies in cultural interpretations. In this sense, bifacial flaking present in both handaxes and cleavers is used to group these implements under the category of "biface", although these pieces are distinct both conceptually and in terms of the implementation of the operative scheme (see Roche & Texier, 1991, 1996);

2. The presumption of the evolution of forms; here, these forms acted as “fossil directeurs” permitting the detection of the emergence of the new cultural entity. In the case of the handaxes, assuming that the main criteria for prehistoric populations was the form, it was taken for granted that the earliest and most primitive hand-axes developed from evolved forms of pebble-tool that were bifacially flaked. All that was involved was the extension of secondary flaking from the edge to the surface of the artifact. As time went on, the knappers learned to remove shallower flakes and to turn out hand-axes that were thinner in cross section, had a more regular working-edge, were easier to handle with precision and needed a smaller quantity of raw material. This idea of the “evolution of tool forms” and the concept that handaxes and cleavers were technologically identical pieces (in the sense that shared both bifacial work) would encompass the studies related to lithic analysis for a long time to come (e.g., Clark, 1994, 1996) (see Fig. 1.1.6 and 1.1.7 picturing Isaac’s and Villa’s schemes of tool form “evolution”).
3. The assumption that the *Homo erectus* is the toolmaker of the Acheulean (see previously referred Fig. 1.1.4 where Gowlett presents a model of evolution through the Pleistocene). The direct association of *Homo erectus* with the Acheulean period assumed that the similarity of certain artifact forms reflected shared cultural knowledge, and hence biological identity at the population level (Foley & Lahr, 1997). A concomitant assumption is that the spatial distribution of the artifact types will reflect the geographic range of a specific population; the distinctions patterned by the assemblages have been interpreted as representing distinct cultural or even biological groups (e.g., Bordes, 1968, Mason, 1962a, Hensen & Keller, 1971, Leakey, 1975), local functional adaptability (e.g., Cole & Kleindienst, 1974, Clark, 1980, 1984) or still the result of randomly performed activities (Isaac, 1972).

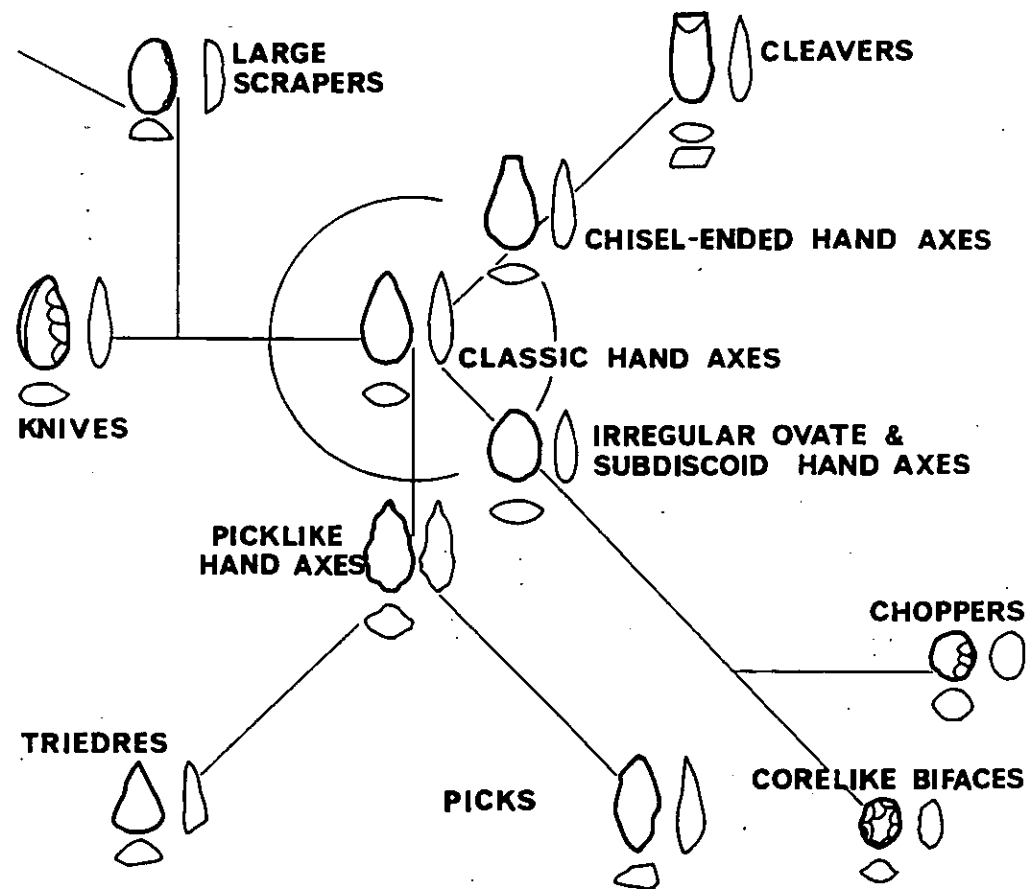


Fig. 1.1.6 Morphological phylogeny of handaxes (after Isaac, 1977)

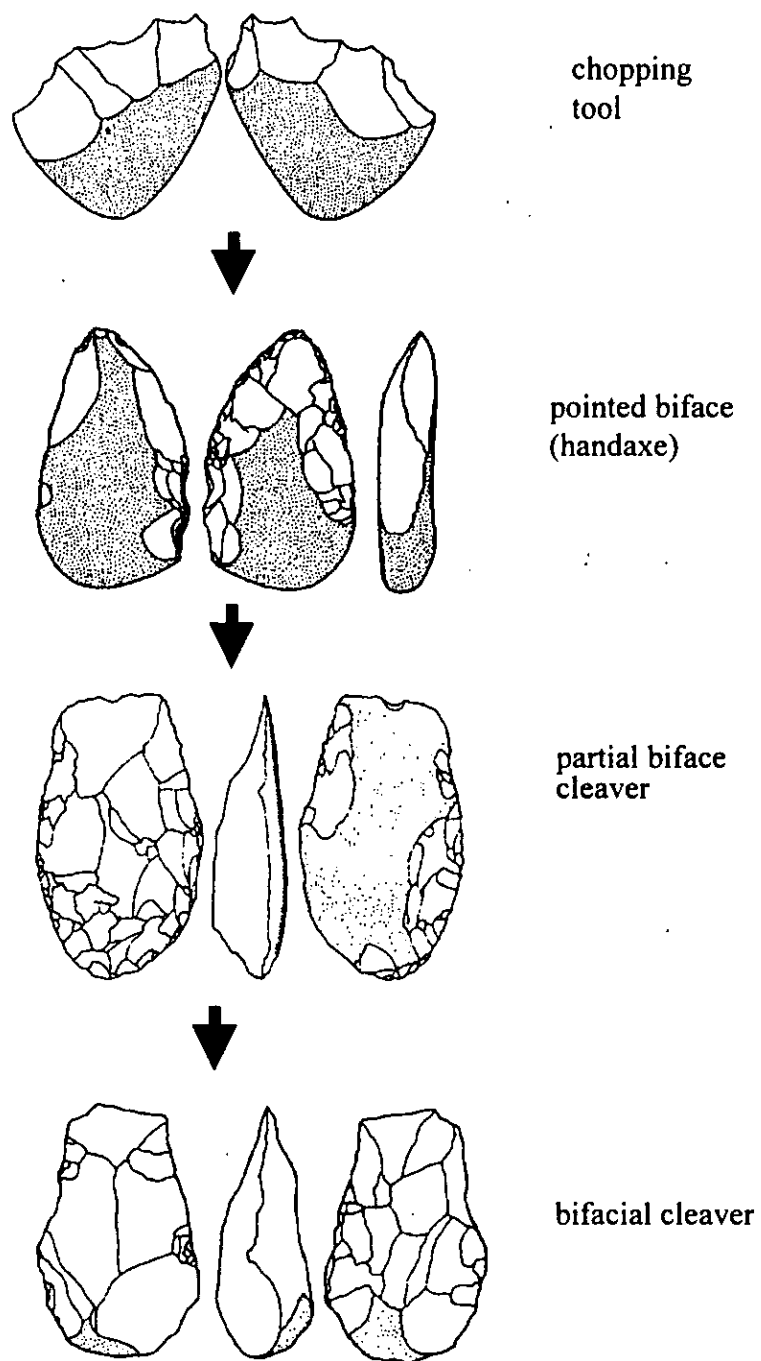


Fig. 1.1.7 Example of interpretation regarding continuity of form (bifacial flaking) in Lower Paleolithic lithic industries (modified after Villa, 1983)

## 1.2 WHO KNAPPED THE ACHEULEAN ARTIFACTS? SOME REFLECTIONS ON CHARACTERISTICS OF *HOMO ERECTUS* RELEVANT FOR THE UNDERSTANDING OF THE ACHEULEAN IN SOUTHEASTERN AFRICA

### 1.2.1 The chronological framework

Very little is known about the hominid species responsible for the manufacture of the Acheulean assemblages. The associated hominid form -- either inferred indirectly from its incorporation into contemporary geological contexts, or more seldom, directly, such as at Ternifine (Tighenif), Olduvai Gorge or Melka Kunturé (Ethiopia) -- is *Homo erectus sensu lato* (Rightmire, 1988, 1990, 1996). Although its phylogenetic origin remains unknown, *Homo erectus* seems to have evolved in Africa; the oldest specimens are dated back to 1.7-1.8 Mya at the Plio-Pleistocene boundary (Feibel et al., 1989, Feibel & Brown, 1993, Brown, 1994), and the later specimens seem to be present until about 400 Kya (Bradshaw & Rogers, 1993). As a result, *Homo erectus sensu lato* coexisted initially in Eastern Africa (e.g., Turkana region, Kenya) and Southern Africa (e.g., Swartkrans, South Africa) with two subsequent extinct taxa: the robust australopithecines and *Homo habilis* until about 1 Mya (Wood, 1992). By the time of the late Acheulean, genetic modification had brought about a geographical variability and forms possessing some *Homo erectus* characteristics; other forms presenting more modern traits, have been classified sometimes as evolved *Homo erectus* (ex. Salé, Day, 1986), as *Homo heidelbergensis*/*Homo rhodesiensis* (e.g., Broken Hill, Nduvu and Bodo, Rightmire, 1996), or still as an early/archaic *Homo sapiens* (Clarke, 1976).

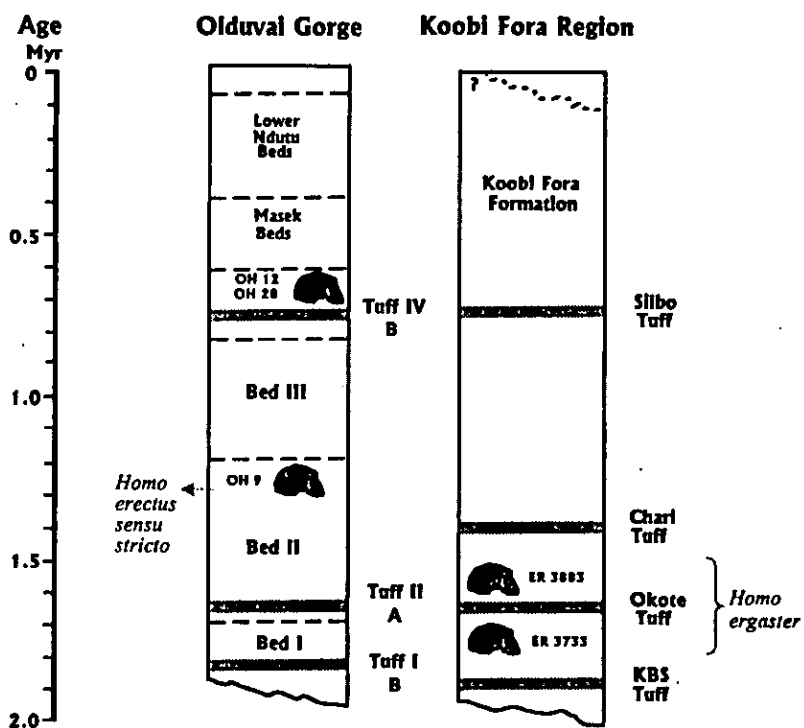


Fig. 1.2.1 Chronology for some localities yielding *Homo erectus* in East Africa (adapted from Rightmire, 1995)

In Southeastern Africa, among the specimens defined as belonging to *Homo erectus* species, one finds (Rightmire, 1988, 1990, Wood, 1991, Feibel & Brown, 1993, Walker & Leakey, 1993):

Table 1.2.1 Chronology for *Homo erectus* in Eastern Africa.

Country	Specimen	Fossil data	Date
Kenya (Turkana area)	KNMER- 2598	Occipital fragment	1.88 - 1.9 Mya
Kenya (Turkana area)	KNM-ER 1802	Mandible	1.88 - 1.9 Mya
Kenya (Turkana area)	KNM-ER 3734	Mandible	1.88 - 1.9 Mya
Kenya (Turkana area)	KNM-ER 3733 (oldest secure specimen)	adult cranium	1.78 Mya
Kenya (Turkana area)	KNM-ER 1808	adult mandible fragment	1.65-1.7 Mya
Kenya (Turkana area)	KNM-ER 3883	calvaria	1.5-1.65 Mya
Kenya (Turkana area)	KNM WT 15000	whole young skeleton	1.53 Mya
Tanzania (Olduvai Gorge)	OH 9	thick skull	1.29 Mya
Tanzania (Olduvai Gorge)	OH 28	Hipbone	0.8-0.6 Mya

(Based on data presented by Day, 1986, Feibel et al., 1989, Wood, 1991, Rightmire, 1995; see also Fig. 1.2.1.)

In South Africa, the fossil remains of the Lower-Middle Pleistocene are arguably too fragmentary for species diagnosis. The few hominid specimens found in cave deposits directly associated with Acheulean assemblages have been simply assigned to the genus *Homo* (Rightmire, 1984, Clark, 1994).



I will be using the definition of *Homo erectus*, in a broad sense, viewing the Lower-Middle Pleistocene hominids who manufactured artifacts in southern Mozambique as being part of the group of *Homo erectus sensu lato*. This discussion is not relevant since the imprecision in who did what does not have influence upon the arguments -- we know as little about archaic *Homo sapiens* as we do about *Homo erectus*. Hence, I will follow the traditional, non-cladistic taxonomic diagnoses of this species (Howell, 1978, Rightmire, 1990, 1996, Cachel & Harris, 1998). This broad definition of *Homo erectus* presents a number of anatomical distinctions discussed below.

### 1.2.2. The morphology of *Homo erectus*

#### 1.2.2.1. Cranial morphology and brain size

*Homo erectus* is characterized by a long, low cranium, with an endocranial capacity on average of about 1.000 cubic centimeters. In the latter hominids, the cranial capacity is generally greater than for the earlier specimens of *Homo erectus* (such as KNM-ER 3733, KNM-ER 3883 and KNM-ET 15000). The rates of brain evolution indicate an increase in volume, from about 770 cubic centimeters in the earlier specimens, to 1200 cubic centimeters in the latter forms (Holloway, 1996). The skull is heavily built, and the cranium lacks the sagittal crest (Day, 1986, Rightmire, 1990).

*Homo erectus* possessed a robust face projecting in its lower regions, showing strong prognathism, perhaps indicative of the front teeth for gripping and tearing. The face is also marked by heavy brows, a flattened frontal squama often with a midline keel, marked postorbital narrowing of the cranium, sharply flexed rear of the vault, a blunt transverse torus which projects most prominently near the midline, a flattened base of the skull (unlike our modern flexed configuration), a large and robust mandible, and absence of bony chin (Rightmire, 1990).

### 1.2.2.2. Limb proportions

*Homo erectus* was tall, slim and stronger (16% taller and 26% heavier than *Homo habilis*). Based on the fossil remains of six skeletons, Ruff & Walker (1993) predict an average stature of 170 centimeters for early *Homo erectus*, weighing about 50 to 60 kilograms.

One attribute likely to have conferred an advantage on *Homo erectus* relative to earlier hominids is larger body size, as documented at Nariokotome and Koobi Fora in Kenya. In fact, *Homo erectus* presents modern limb proportions: the lower limb has increased in length from earlier hominids, so that the relative proportion of the upper limb is like the one found in modern humans. An increase in size might have allowed this species to range over greater distances in search of food. Larger bodies (i.e., bodies presenting very long lower limbs represented by femurs with long necks), which made the abductor mechanism biomechanically efficient during bipedalism, also required more energy. It is probable that *Homo erectus* had an increased resting metabolic rate and expended more calories during daily activities than did other hominids.

Although the extent to which earliest *Homo* scavenged or hunted is uncertain, it is likely that *Homo erectus* consumed at least some meat in addition to plant materials (Wheeler, 1993). Animal products are energetically rich, and hunting would have provided an efficient way of meeting elevated metabolic needs. Another correlate of large size is the decreased risk of running afoul of predators. Tall and probably stronger hominids would have less to fear of carnivores and might therefore venture farther from territories already established (Cachel & Harris, 1998).

### 1.2.2.3. The small spinal canal

As reported by McLarnon (1993) in her description of the spinal canal of WT-15000 specimen, the vertebral column shows the normal pattern of curvature found in modern humans,

with the upper part of the back convex and the lower part concave when viewed from behind. However, the spinal canal is relatively small (i.e., the large central opening of the neural channels for the passage of the spinal cord), particularly in the thoracic region. In modern humans, this thoracic enlargement is correlated with an increase in the amount of gray matter in the spinal cord. Gray matter contains nerve cell bodies as well as nerve fibers. Its abundance in the cord at the thoracic region indicates motor activity in the intercostal muscles, which create movements of the rib cage, or in the anterior abdominal wall musculature. A probable explanation for this enlargement is thought to increased control over these muscles for bipedal walking and running. In addition, Calvin (1993) has argued that this enlargement could have contributed towards a stabilization of the thorax and abdomen for throwing, a hypothesis also advanced by O'Brien (1983) regarding a potential function for the Acheulean handaxes.

#### 1.2.2.4. The iliac pillar

In a study published in 1993, Rader and Peters reviewed the extreme hypertrophy of the iliac pillar of earlier *Homo erectus* (OH 28). This fact, together with the description of the limb proportions described above suggest a very robust upper part of the ilium, where important muscle groups -- used for bipedalism and powerfully executed behavior -- are attached. When compared to contemporary *Homo sapiens sapiens*, this pattern seems to suggest that this is a rare situation among modern individuals, and that this trait may have evolved through developmental growth, rather than phylogeny.

#### 1.2.2.5 Indication of secondary altriciality?

When compared to anatomical modern humans, *Homo erectus* is characterized by a long femoral neck (e.g., Kennedy, 1983, McHenry, 1991, Ruff & Walker, 1993). This characteristic feature of early *Homo* lower limb morphology has been attributed to an increase of the mediolateral bending strength of the diaphysis (Ruff, 1995). Together with the specific characteristics of the lower pelvis (M-L broad and A-P narrow) presented by these hominids, the evidence suggests that the principal differences in lower limb morphology of early *Homo* may be attributed to obstetric problems. In fact, the evidence seems to indicate that the birth mechanisms of early hominids were nonrotational (see also Tague & Lovejoy, 1986, Ruff, 1995); this factor may have placed a constraint on the newborn cranial capacity. All these lines of evidence, together with the brain increase present among these taxa specimens support the idea of *Homo erectus* as being secondarily altricial.

Ensuing, from the physical evidence available, the emergent picture of *Homo erectus* presents this specimen as a powerful animal, heavily muscled (see Fig. 1.2.2). The physical strength would have allowed performing heavy-duty activities, which would have included preparation of large cores to knap handaxes and cleavers. Regarding the species' cognitive potential, besides the notable enlargement of the brain capacity, some insights regarding the development of *Homo erectus* mental capacities will be assessed and discussed from the archaeological record.



Fig. 1.2.2 *Homo erectus* is normally pictured as a brutish male specimen, clutching his handaxe...(adapted from Brace, 1991)

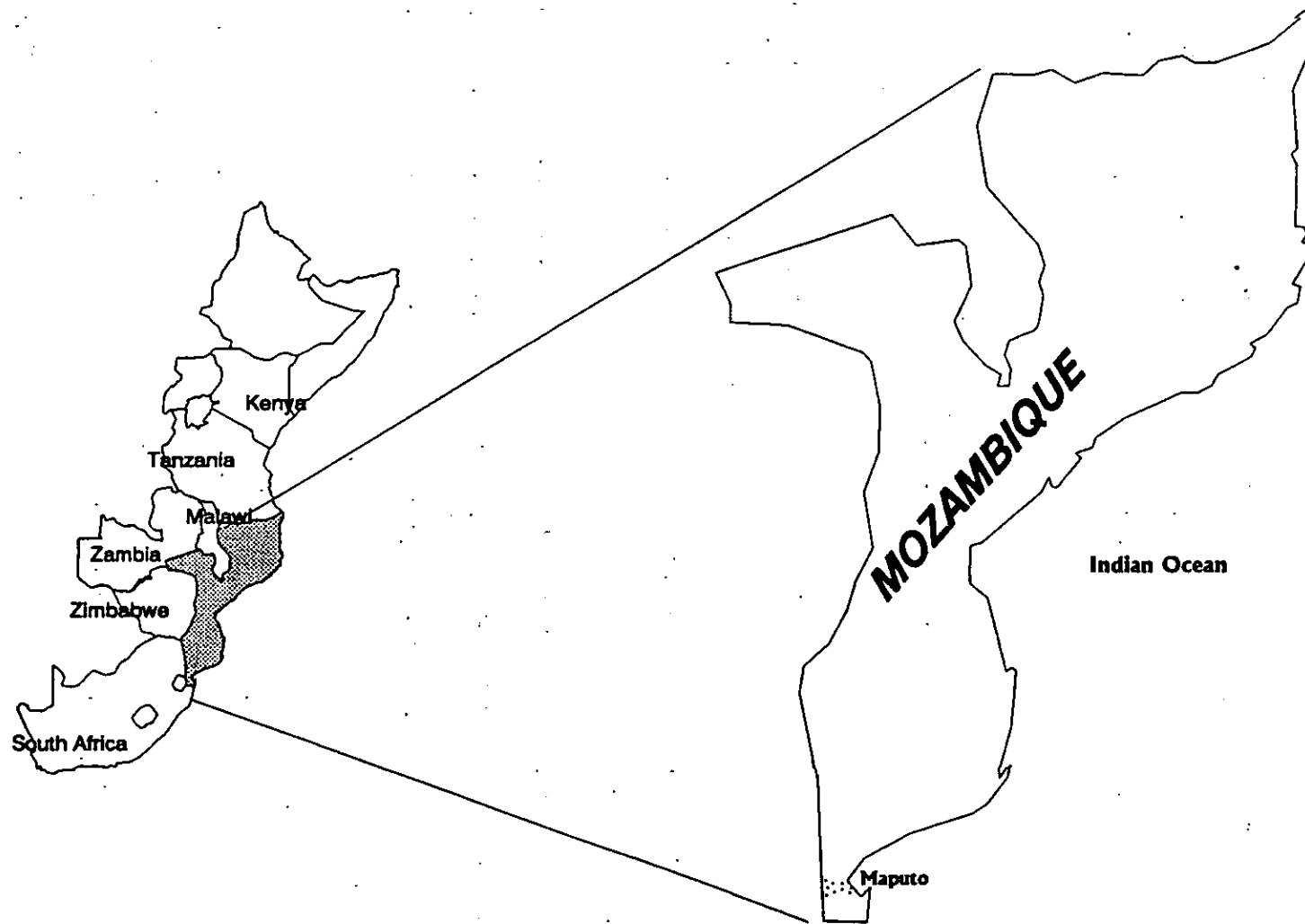


Fig. 1.3.1 Southern Mozambique: Area of research (:) for the purposes of this dissertation

### 1.3 THE ACHEULEAN IN SOUTHERN MOZAMBIQUE

Having set the framework for the emergence of the study of the Acheulean period and its potential manufacturers, I will introduce briefly the main topic to be addressed in this dissertation, the earlier evidence of hominid presence in southern Mozambique, through the study of the Acheulean assemblages (see Fig. 1.3.1. identifying the study area in the context of Southeastern Africa).

#### 1.3.1 Brief introduction to the dissertation goals

Less than 10 years ago the vast majority of comprehensive overviews regarding the Early Stone Age of Africa would have left out a vast region, where Mozambique is located (Morais, 1984, Meneses, 1988, 1989). Indeed, the current state of knowledge of the Stone Age archaeology in Mozambique is poor, particularly when viewed in the context of the state of Stone Age studies elsewhere in South and Eastern Africa (see, for example, Clark, 1967, 1981, Deacon, 1990, Gowlett, 1990, Kuman, 1996, 1998, Meneses, 1996). Thus, a basic goal of my dissertation has been to generate information as well as to propose interpretations in a broad context that may encourage and provide a basis for the future development of ESA studies in this relatively neglected area.

Following the re-examination of what is known on the Acheulean (discussed in the first two chapters of this dissertation), Chapters III and IV discuss the evolution of the landscape where the research occurred in southern Mozambique.

In terms of study area, this work is based primarily on the current results of my research developed in the study area -- the Umbeluzi-Tembe-Changalane region from 1993 through 1997.

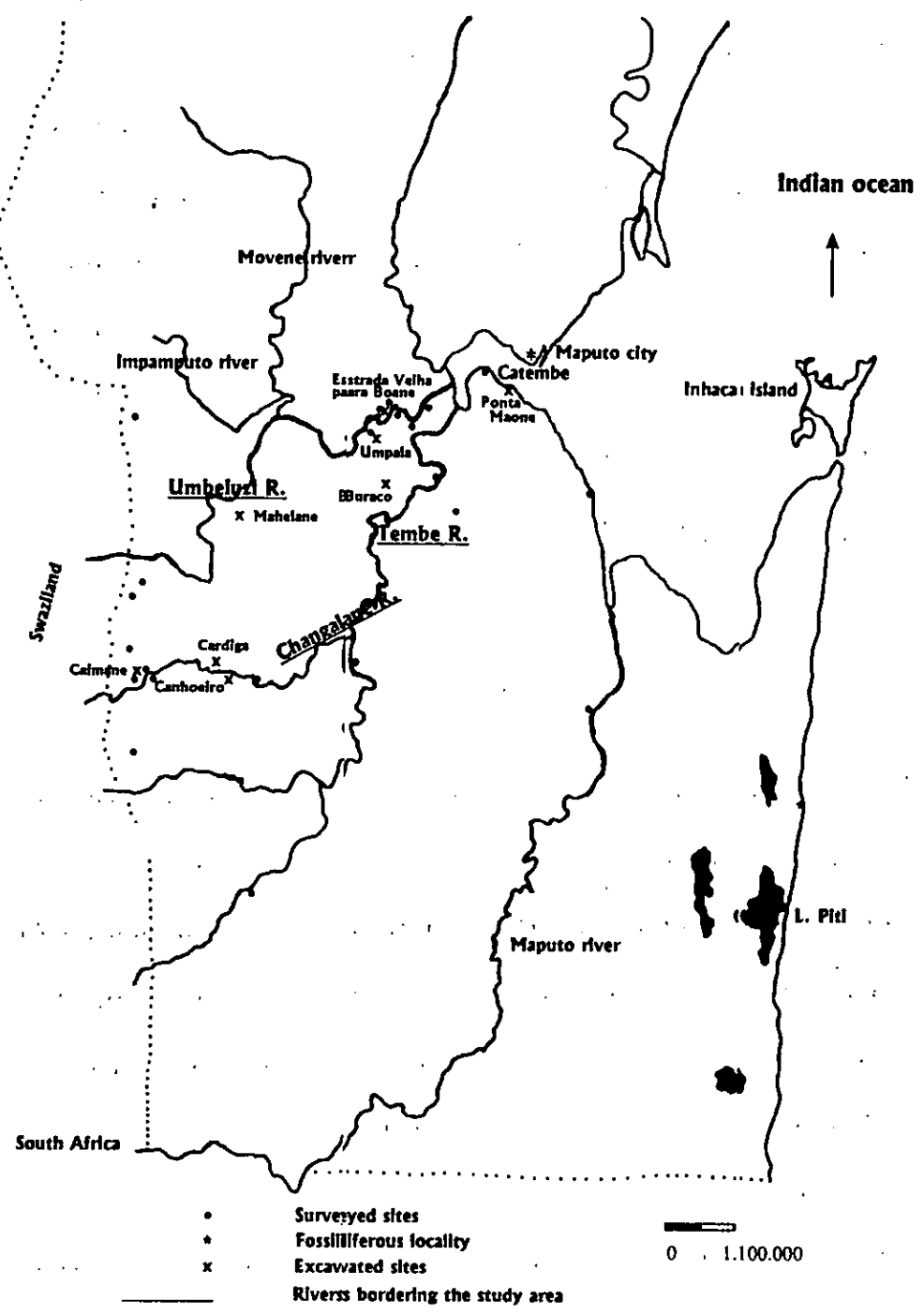


Fig. 1.3.2 Southern Mozambique: sites surveyed and excavated for this dissertation



See Fig. 1.3.2 representing the surveyed area and the sites excavated in southern Mozambique for the purposes of this dissertation.

The research area serves as a transect through the major ecological zones of this part of southern Africa, from regions of about 600 meters above sea level (a.s.l.) down to sea-level. The choice of rivers to act as the northern and southeastern fieldwork boundaries was to a certain extent arbitrary. Thus, the Umbeluzi River and its tributaries define the northern boundary of the surveyed region. To the west there are a series of N-S oriented ridges and hills, the Pequenos and Grandes Libombos (in southern Mozambique the former reaches about 200 meters a.s.l., and the latter some 500-600 meters a.s.l.). The southeastern boundary is represented by the basin of the Tembe River and its affluent, the Changalane River. In terms of area, the portion of Maputo province under research covers approximately 100 square kilometers.

While there are still no absolute dates for the sites, the geochronographic scheme has in fact extended the chronology of human settlement in this part of the African continent back into earlier-mid Pleistocene. Prior archaeological surveys and field reports on the lithic assemblages recovered from the alluvial terraces of southern Mozambique were mainly focused on describing the most diagnostic pieces - handaxes and cleavers -- for chronological purposes (e.g., Dias, 1947, 1948, Barradas, 1952, Alberto, 1958). In addition, for years, people kept collecting and studying key Acheulean artifacts by means of an unconsciously prejudiced selectivity. In fact, one clearly observes that although the analysis of the artifacts is present in all the studies undertaken of the Acheulean period in Southern Africa, the linkage between typology(ies) and inferences is quite poorly articulated.

Therefore, the next chapter of this dissertation will present an historical overview of the research performed on the Acheulean period in Southern Africa. It will also include the study of

several Acheulean assemblages from South African sites, which constituted the "anchor" sequence used in Southern African ESA up to now.

The scope of the survey done on the current status of the Acheulean research suggested that, in order to bring some meaning to the interpretation of some of the patterns present in the Acheulean collections excavated in southern Mozambique (which will be described in Chapter V), a new methodological approach had to be developed.

In this dissertation the methodological approach used for the study of the Acheulean, while focusing on technological complexity as represented by the archaeological assemblages, requires the evaluation of several lines of evidence, in order to understand the southern Mozambique record during the Acheulean period. Besides the archaeological data from the area, several lines of evidence were taken into consideration, such as actualistic studies on modern landscapes, used to elaborate and test the hypothesis developed for this research project (the full evaluation of the actualistic studies and its interpretation will be presented in Chapters VI, VII and VIII).

### **1.3.2. Some methodological aspects of this research**

Briefly, this section focuses on a new methodological approach used to resume the study of the Acheulean in southern Mozambique.

The main problem addressed in this dissertation is related to the possibility of assessing the Acheulean as a new archaeological period rooted in the increase of the level of technological complexity if compared to the previous, Oldowan period.



If among lithic archaeologists there is generally assumed that that the Acheulean – as a whole new cultural period – is characterized by the emergence of large bifacial tools (i.e., handaxes and cleavers – e.g., Leakey, 1971, 1975, Isaac, 1977), very few researchers take into consideration the distinct conceptual procedures and technological strategies at place in the manufacture and utilization of these lithic pieces (e.g., Texier & Roche, 1995a, Roche & Texier, 1996). Indeed, as previously reported, the increasing refinement of a morphological trait – bifacial flaking – is generally presented as the most important element reflecting the refinement of the technological skills of the Acheulean lithic tool manufacturers (e.g., Crompton & Gowlett, 1993, Callow, 1994, Mc Pherron, 1997, Saragusti et al., 1998, Gamble, 1998).

However, are the lithic form tools characteristic of the Acheulean, transmitting the message that a new stage of technological complexity was emerging early on, instead of just observing a steady “evolution” of the flaking skills? While there is now a growing literature oriented explicitly to the subject of technology from a perspective of form transformation (e.g., Wynn & Tierson, 1990, Mc Pherron, 1997, Toth, 1997), the number of studies expressly concerned with the innovative character of the Acheulean in terms of technology is grossly underreported. Over the past 20-30 years, several of the discussions about the Acheulean technology became very reductionist and hyperfunctional, a trend which seems to perpetuate some of the worst excesses of the functional determinism of the New Archaeology in the 1960's and early 1970's (e.g., Young & Bonischen, 1984, Flenniken, 1985, Dibble, 1987, Torrence, 1989). While developing the methodological approach used in this study. I have tried to set it back to the human framework by emphasizing the role of social mechanisms in the formation and development of technological patterns, rather than as the product of virtual automatons reacting almost instinctively to any form of challenge or opportunity presented by the environment (e.g., Barton, 1988, 1990, Binford, 1979, 1989, Kuhn, 1996), and thus bringing back individuals and their behaviors into the realms of interpretation.

From the standpoint of lithic production and use, the Acheulean encloses significant technological achievements, which are reflected in:

- The increasingly use of large flakes as blanks to produce tool forms (e.g., Riet Lowe, 1945, Tixier, 1956, Leakey, 1971);
- The emergence of tools manufactured using blanks knapped as predetermined forms, which are a reflex of a deeper tactical and planning depth (e.g., Dauvois, 1981, Roche & Texier, 1991, 1996, Feblot-Augustins, 1993, Mithen, 1994, Texier & Roche, 1995a).

The production of handaxes became largely possible due to the emergence of soft hammer direct percussion (associated with the presence of hard hammer percussion technique), as a new technological breakthrough. In fact, as the replicative program carried out for this dissertation demonstrated, the use of a soft hammer allows to manufacture large stone tool forms with a less risk of destroying them; at the same time, it also assures a better control over the production sequence.

As several authors have argued, when dealing with the archaeological record one is limited not so much by the nature of the archaeological record as by our lack of principles for relating archaeological remains to past human behavior (e.g., Fritz & Plog, 1970, Binford, 1972, 1977, Stone, 1981, Hanen & Kelley, 1989). Just as artifacts tend to reflect more than one component of a cultural system, each component of a cultural system should be reflected in various material remains. The methodological strategy for obtaining information is based on the interpretation of distinct sources of evidence "captured" by a tool (see, for example, Fritz, 1972, Stone, 1981, Leroi-Gourhan, 1982).

When studying tool forms, three aspects of evidence are normally used:

- a) The direct, documentary evidence, which relates to the description of the tool form *per se*,
- b) The indirect evidences – such as the traces left on the tool during the manufacture and use stages – help the interpretive process, providing arguments about the development of the technological complexity during the Early Stone Age. These evidences can only be traced down by means of comparative evaluations of actualistic data against the archaeological record.
- c) The circumstantial evidence, as for example, such as data from paleoenvironmental contexts that may bring some shed about the reasons why certain tool forms are found associated with specific environmental settings.

While the first aspect remains predominately descriptive, the last two ones require the development of interpretive strategies, so that the data generated (both from excavations and from replicative, actualistic studies) will support conclusions about the past phenomena. This is possible using a methodological framework based on the study of lithic tools from the standpoint of a *chaîne opératoire*. From the point of view of the concept of *chaîne opératoire*, a lithic piece is studied with the aim of understanding not only the levels of technological complexity involved in its production, but also foreseeing its potential function framed in a specific landscape unit where it was found (vs. Speth & Johnson, 1976, Dunnell, 1978). This sort of retro analysis requires the comparative evaluation of replicative assemblages, reconstructing in a background sense, the stages through which each specific tool form when through, both in terms of production and use. Although one cannot go back in time, using this approach it becomes possible to perform a series of logically connected actions, from the direct evidences available – i.e., the lithic record -- until assessing the probable initial goals of the toolmaker. An important advance of this approach lies in the information recovered through knapping replicative

experiments, combined with theoretical development of a model of interpretation of the technological behavior reflected in each assemblage. Assuming the general principle of uniformitarianism, past phenomena can not be considered different in nature or in their interpretation from present phenomena just because they occurred in the past.

The fact that several researchers keep their faith in the use of morphological diagnostic criteria – the bifacial work -- for the study of handaxes clearly indicates that they did not grasp the real meaning of the technological complexity emerging with the Acheulean (e.g., Barral & Simone, 1981, Schick, 1992, Crompton & Gowlett, 1993, Callow, 1994, Clark, 1994, Toth, 1997, Gamble, 1998). On a methodological ground, one of the purposes of the research accomplished for this dissertation was to develop a sound argument, which would challenge the widely accepted conceptual interpretation. Hence, by rejecting the equivalence of soft and hard hammer direct percussion technique in the manufacture of similar handaxes (as specific tool forms), I assembled that there was a neat difference – in terms of production strategies and its accomplishment – in the archaeological record. In terms of statistical logic what I did was to support an alternate hypothesis indirectly (i.e., that there was another element besides stone involved in the manufacture of handaxes). The values obtained were then compared to the archaeological information (i.e., to the expected data) retrieved by means of experimental data (see also Fritz & Plog, 1970, Murray & Walker, 1988, Wylie, 1993, Stewart, 1997). Therefore, I was able to reject the wide accepted hypothesis, confirming the presence of soft hammer percussion technique (and hence, the existence of long gone, “invisible” percussors) in the Acheulean record from Southeastern Africa (including southern Mozambique).

In the next stage of my research I was aiming at identifying secure evidences on handaxes regarding the presence of a soft hammer percussion in the Acheulean of Southeastern

Africa. The crucial problem is that most of the information regarding the question of technological innovation in the Acheulean – such as a consistence use of soft hammers made of softer, biotic raw materials -- remains directly invisible in the archaeological record. In fact, although the presence of soft hammer percussor is mentioned throughout the available literature on the Acheulean period, it becomes evident that no secure criteria have been developed to support this assumption (e.g., Coutier, 1931, Cabrol & Coutier, 1931, Knowles, 1953, Crabtree, 1967b, 1970, Sollberger, 1968, Bradley, 1978, Wenban-Smith, 1981, Ohnuma & Bergman, 1982, Hayden, 1987, Inizian et al., 1992, Texier, 1996, Toth, 1997). Indeed, because biotic raw materials decays very rapidly once it enters the realms of the paleo record, the identification of criteria has to be based on the data collected from a sound actualistic study. Here, the main concern was to develop a methodological strategy to link the supposition (i.e., the presence of a soft hammer percussion technique) and the evidence proffered in the archaeological record (i.e., to be able to identify the effector, or at least the effects it left on the tools produce with its support).

Experimentally speaking, it is possible to verify the assumption that a cause – soft hammer – succeeded in developing a particular effect on the stone being flaked. This is so because one can directly observe the effect (and effector) after the cause occurred. Direct observation determined the existence of a causal connection between two kinds of events. By means of analogical reasoning (e.g., Ascher, 1961, Carloye, 1971, Leatherdale, 1974, Murray & Walker, 1988, Gifford-Gonzalez, 1991), one is able to the compare the data resulted from experimental work with the archaeological record, as a means of retracing past information. The hypothesis of African ironwoods being used as soft hammer percussors during the Acheulean of southern Mozambique was presented as the most parsimonious explanation for the phenomena observed. Indeed, the handaxe replicative project carried on using locally available biotic and abiotic raw materials supplied the adequate evidence, which allowed to formulate the existence of a direct relationship between the cause and the effect/effector. In the case under research –

Acheulean handaxes -- what was being tested was not whether the effect occurred, but whether if the cause (soft hammer) occurred, the effect occurred. Here, the cause represents the determining principle which "explains" the observed phenomena (i.e., for the case of a handaxe, the smoother, and more even surface of the lithic piece). By statistically evaluating the more meaningful evidences observed on the surface of the experimentally produced handaxes, I was able to assess criteria, which proved to be consistent in distinguishing hard- from soft-hammer percussion technique (that is, that would unambiguously accommodate the range of variability observed) and finally replicable and testable against the archaeological record (that is, the set of rules identified are as free from subjectivity as possible).

Since the hypothesis being evaluated involved a relation between two events, a logical outcome was to extend the actualistic studies to search for the sources of raw materials to be used as soft hammers. The systematic experimental work performed clearly indicated that the handaxe chaîne opératoire requires, in terms of technology, the presence of soft hammers, probably made of locally available ironwoods. It also indicates that some of the tool forms emerging with the Acheulean are most probably connected with woodwork activities, as I will be discussing in Chapters VI, VII and VIII. This partially explains the ecological approach applied in this dissertation. The studies performed in southern Mozambique suggest that in terms of lithic chaînes opératoires (assuming that a tool is crafted in order to fulfill a specific functional goal -- see Pelegrin et al., 1988, Edmonds, 1990), during the Acheulean period several episodes had to be linked together in terms of spatial and temporal sequential actions, so that survival could be possible. The spatial scale of analysis used here (from locale to region) pictures a periodic, seasonal use of the resources for the area (i.e., seasonal behavior) due to the presence of specific affordances in distinct environmental settings. The interpretative models derived from actualistic studies, and established while evaluating the probable sequence of production and use



of some Acheulean tool forms, were then applied to the archaeological data, as a means of testing their interpretive adequacy.

Up to now, several researches (e.g., Binford, 1985, Gamble, 1995) have been arguing that Acheulean hominid behavior, in terms of artifact production, portrays a predominance of expedient technology (e.g., Binford, 1977; 1979), lacking or showing only a very incipient development of the symbolic organization of technology and culture (see also Gowlett, 1984, 1986, Wynn, 1995, 1996). In terms of adaptation, the ecological framework of the technological development becomes the more important analytical instrument for understanding the contingencies at a specific place. This point will be addressed later in this dissertation (with a special emphasis on Chapter VIII), taking into consideration the information available in terms of archaeological data from southern Mozambique, and surrounding areas, their use of environmental resources and the use of environments in general (seasonality, etc.).

The study of the Acheulean patterns of resource utilization will be used to demonstrate that in terms of lithic production, use and discharge (i.e., the whole chaîne opératoire) several episodic scenes occurred linked sequentially, so that survival could take place. Hence the need of an ecological approach, where several lines of information, namely:

- behavioral generalities observed among contemporary foragers,
- experimental replication of lithic material,
- and the evaluation of the contemporary ecological setting of Southern Africa,

are used as the framework of reference and analysis to build up meaningful assumptions against which the archaeological data from southern Mozambique and South-eastern Africa in a broader scale is evaluated and tested. Except where specific reference is made to differences before European and Bantu (agro-pastoralistic) occupation of the area, as in sections dealing with fauna and flora, the present-day situation is regarded as being of direct relevance to the geographical area under research.

The suggested hypothesis would have to be tested against the archaeological data and paleoecological setting to be developed for the study area in southern Mozambique.

#### 1.4 CONCLUSION

When analyzing the contemporary situation of the Stone Age research in Africa, it is noticeable the advance attained in the last 20-30 years, if compared to the previous interpretations of the archaeological past of the region. The coordination between archaeology and other sciences, such as physics, chemistry, botany, paleoecology, etc., have opened new perspectives for a better understanding of the Early Stone Age, and more specifically, to the understanding of the Acheulean period.

The surveys performed both in the field, in the laboratories of Mozambique and South Africa, and in libraries revealed not only the intensity of the search, but also laid bare a site data base formed through more than a century of (mostly) unsystematic activities by amateurs and professionals. The vast majority of the lithic assemblages were not found on primary or next to primary context; it is almost impossible to identify the context and homogeneity of surface collections. Generally, no field notes are available, only short filed reports or brief publications providing few, if any, contextual and behavioral information. More recently, the studies have been concentrated on the already discovered sites and the material recovered.

Another problematic factor for the study of the Acheulean in Southern Africa is related to absence of absolute dating material. In fact, in the East African Rift region, the specific conditions present allow the use of different radiochronologic or geomagnetic method for dating the sites (Alimen, 1977). Also, several locations in East Africa, such as Olduvai Gorge, present a long stratigraphic record, illustrating a long record of human occupation. In Southern Africa, however, there is no single Acheulean locality, which has yielded a long sequence of stratified deposits. Therefore, the dating questions have been established essentially through biostratigraphic correlation with East African sites yielding faunal assemblages. Here, the use of

relative dating is complicated by the fact that only a very few Acheulean sites have faunal material found in good, minimally disturbed contexts.

If one adds to this sequence of critical issues the fact that the Acheulean is mostly based on a biased, selective set of early collections and excavations which gave rise to a definition that has been perpetuated throughout most of the publications, one realizes that a new approach has to be applied in order to reconstruct even a limited part of the behavior of the Acheulean hominids. Most of the recent trends towards the re-establishment (e.g., Toth, 1982, Jones, 1996) of a technological analysis have been performed basically to reinforce and reaffirm the original typological "definition", creating a vicious circle in which many archaeologists are still caught. Thus, the concept of Acheulean remains quite imprecise and subject to several controversies (e.g., Mason, 1961, Leakey, 1975, Schick & Toth, 1993, Roche & Texier, 1996, Leakey & Roe, 1994, Gowlett, 1997, Toth, 1997) regarding not only the meaning of the diagnostic tools of the Acheulean, but also broader issues, related to the development of cognitive capacities of the hominids who produced and used these artifacts.

With this framework in mind, I decided to pursue a technological approach to the study of the lithic Acheulean assemblages from southern Mozambique. The archaeological materials contained in the sedimentological levels defined as of Middle Pleistocene are clearly time-averaged palimpsests (see Stern, 1994). Therefore, I decide to undertake a regional and long-term approach to the analysis of the behavioral ecology of the Middle Pleistocene record based on predictions drawn from actualistic data. The archaeological record allowed the identification of some aspects of complexity of Acheulean hominids, not just immediately about tool use, but also about tool production and the complex framework of planning and tactical depth associated with it. Although the data obtained are still insufficient to draw wide conclusions regarding the character of the Acheulean in the area, a new methodological ground was established. Clearly, only through a complex study involving a combination of experimental and functional data, to be

compared against the archaeological data, will it be possible to develop models of behavior of the manufacturers and users of the prehistoric artifacts who settled southern Mozambique during the Middle Pleistocene.

## **CHAPTER II - THE REGIONAL CONTEXT OF THE ACHEULEAN IN SOUTHERN AFRICA**

### **2.1 THE HISTORY OF ARCHAEOLOGICAL RESEARCH (ESA) IN SOUTHERN AFRICA**

#### **2.1.1 Introduction**

In order to understand the research issues raised in this dissertation concerning the study of the Early Stone Age in southern Mozambique, the history of Stone Age research in Southern Africa should be chronicled, with all the inherent problematic issues associated with the investigation of this early period of human past.

The Early Stone Age of Southeastern Africa comprises one of the longest archaeological records for human activities of over two million years. This period encompasses two main industrial complexes: the Oldowan and the Acheulean.

In Southern Mozambique, the archaeological research began as a follow up to emerging studies of lithic and early hominid studies in Southeastern Africa. Initially, the overriding goal of the people searching for "stone tools", was simply to collect and record the range of artifacts found at a specific spot and to compare the finds within the geo-archaeological framework developed for the assemblages from the neighboring regions (e.g., Dias, 1948, Barradas, 1948, 1955b, 1956a, 1956b, Alberto, 1958). The main point of reference, however, soon became South Africa, where the knowledge of Stone Age archaeology was established by the pioneer work of researchers such as Riet Lowe, Goodwin, Sohngé amongst others. Their basic work, yielding information about the stratigraphy and the broad sequence of the main prehistoric periods based on typological studies, is still in use in the region today.

Because Mozambican Stone Age archaeology has been for long integrated in the

theoretical and methodological framework developed for South Africa, I decided to include in my dissertation the analysis of some Acheulean assemblages from the Vaal River area. These sites, their context and the stone artifact assemblages will be discussed in more detail in this chapter. However, it is not the purpose of my dissertation to undertake a comprehensive review of the Acheulean Complex from Southeastern Africa. Here, I only describe in general the Early Stone Age (ESA) for Southern Africa, together with a more detailed description of the sites and the data used to contextualize Mozambique in the regional archaeological setting. The aim is to correlate and integrate the Mozambican Acheulean sites within the broad geo-archaeological framework established for the ESA of Southeastern Africa.

### 2.1.2 The correlations with South Africa

Although occasional references testify to the richness of the archaeological past in southern Mozambique, very little was accomplished, in terms of stone age studies, prior to the 1940's. Until then, as already stated, the goal of the earliest collectors of lithic artifacts was to discover the limits of the spatial and temporal distribution of Stone Age artifacts in the area, and to speculate about who had made them (e.g., Peringuey, 1912, Wayland, 1914, Santos Junior, 1940, Smuts Jr., 1945).

A critical point in the development of the research in southern Mozambique was the visit of Breuil and Riet Lowe to the country in the 1940's (Breuil & Riet Lowe, 1944, Breuil, 1959). Several visits were made to areas known to yield rich artifact deposits. Part of the visit included a survey of the Umbeluzi River terraces, where several sites containing handaxes were observed and compared to the ones already known in the Vaal River area. From this time on, archaeological studies of the region of the Sul do Save became integrated in the geo-archaeological sequence established for the Transvaal.

Accordingly, the system for analyzing lithic artifacts and assemblages practiced in southern Mozambique is based on that one developed for the Vaal River lithic sequence (Goodwin & Riet Lowe, 1929, Alberto, 1958). For the next decades researchers focused on the ESA of Mozambique were interested in describing the temporal relationships and regional variability of the lithic industries (e.g., Alberto, 1951, 1958, Barradas, 1955b, 1956b, 1961a, 1963b). Because Mozambican archaeology still lacked a long and securely dated archaeological or a detailed geochronological framework, the collectors turned, once again, to using diagnostic artifacts as "fossil directeurs" (e.g., Barradas, 1966, Senna-Martinez, 1968b, Beernardt, 1987). This clearly reflects the bias in the cultural interpretation derived from the use of handaxes as cultural and temporal indicators. Hence the rationale in Mozambique for studying the Acheulean toolkit in more detail. Still, my study is focused on the study of handaxes and cleavers, so that the analysis of other components of the Acheulean assemblages (such as bolas, cores, picks, small flakes tools) is still incomplete.

In order to rectify the imbalance of having the Acheulean defined only on the basis of "fossil directeurs", more recent studies in Southern Africa have been defining the Acheulean as a techno- or industrial complex, rather than a culture (Clarke, 1968). Hence, the Acheulean could include for different cultures, groups and traditions of people that used different tools for different activities or not, depending on the environment in which they lived at a given time (Isaac, 1982, 1986, Clark, 1994). The Industrial Complex of the Acheulean (Mode II technology – see Clark, 1977) can be broken into industries, which sometimes receive local names (e.g., Fauresmith in South Africa, or the Sangoan in Southern-central Africa). This indicates that the Industry contains a group of assemblages or sites which have a certain amount of technical and typological features in



common in a recurrent association, but due to the presence of a more general prehistoric framework, are restricted to a specific environment and time period (Clark, 1974).

Table 2.1.1 Simplified summary of the terms used for the ESA in Southern Africa

	Possible dates	Main terms used	Other terms used
MSA	170-200 Kya		Sangoan
	200 Kya	Late (Upper) Acheulean	Fauresmith Acheulean-Levallois
Acheulean	700 Kya	Middle Acheulean	Stellenbosch (South Africa) Chelles-Acheul (East Africa)
	1.4 Mya	Lower (Early) Acheulean	Chellean Abbevillian Hope Fountain Acheulian type B (East Africa) Karari Industry (East Africa)
Oldowan	2.5 Mya	Developed Oldowan	Pebble-tool pre-Acheulean Kafuan

### 2.1.3 The Vaal River stratigraphy and dating

The understanding of the Stone Age archaeology in Southern Africa is closely related, in its early history, with the development of the archaeology and geology of the Vaal River area. The discovery of artifacts and fossils along the Vaal began during the diamond rush in the late 1800s, and continues to the present. The enormous empirical work carried on by several researchers along the Vaal River area was aimed primarily at constructing a time-space framework for the region (Goodwin, 1928a, Sohnge et al., 1937, Cooke, 1949, Riet Lowe,

1952a).

Goodwin and Riet-Lowe published the initial synthesis in 1929. Their main goal was to study the distribution of the Stone Age cultures in Southern Africa in relation to geography and climate. The model established by Goodwin and Riet Lowe incorporated both technological and environmental changes to explain changes through time. For very long, this scheme, which underwent successive changes, became the sole relative dating scheme available in the region.

The next important stage in the study of this area was to integrate the lithic industries identified in the region within the broader scheme of Northern Hemisphere glacials and African pluvials. As mentioned in Chapter one, the four pluvials that Leakey (1929) had identified from geological deposits in Eastern Africa were added to the scheme, as a relative dating tool. As a result, the Vaal River gravel terrace deposits were mapped and interpreted, and placed within the pluvial model. The lithic assemblages, each of them patterning some technological difference in successive river terraces, were placed into a relative dating framework that was linked both to sea-level fluctuations and pluvial sequences from Eastern Africa (Sohnge et al., 1937). Although a general geo-archaeological sequence was established within a regional geological framework, there was no secure dating available. The only additional source of information was the description of fossil mammals published by Cooke in 1949. A final systematic version of the geo-archaeological sequence of the Vaal River was suggested by Riet Lowe, in the early 1950's (see Table 2.1.2).

Table 2.1.2 Vaal River area: the Acheulean sequence

Geological event	Industry	Context
Redistributed red sands	Fauresmith III	Surface collections from sands
Youngest gravels (present bed of tributary streams)	Fauresmith II	Surface collections from stream floor
Downcutting of river and deposition of younger gravels III (present bed)	Fauresmith I	Samples from surface of calcified silt
Calcification of silts	Sterile (?)	
Deposition of silts	Sterile (?)	
Current bedded sands	Chelles-Acheul V	Artifacts from surface and spoil
Younger gravels IIB	Chelles-Acheul IV	Abraded and fresh artifacts from gravels, spoils and gully floors
Younger gravels IIA (6 m bench)	Chelles-Acheul III	Abraded and fresh artifacts from gravels, spoils and gully floors
Younger gravels I (12 m bench)	Chelles-Acheul II	Abraded specimens from gravel exposures and digging spoils
Redistributed red sands over the older gravels	Sterile	
Older gravels derived from basal older gravels to form hill wash (60-150 m bench)	Chelles-Acheul I and mixed Oldowan?	Specimens from surface and gravels
Calcified Red sands	Sterile	
Basal older gravels deposited	Oldowan?	Artifacts collected from calcrete matrix

(adapted from Riet Lowe, 1952a; see also Fig. 2.1.1 presenting a cross-section of the Vaal River area)

However, this system soon came under serious scrutiny when the pluvial scheme was discredited (Cooke, 1957, Flint, 1959a, 1959b; see also Chapter I). Further work carried on along

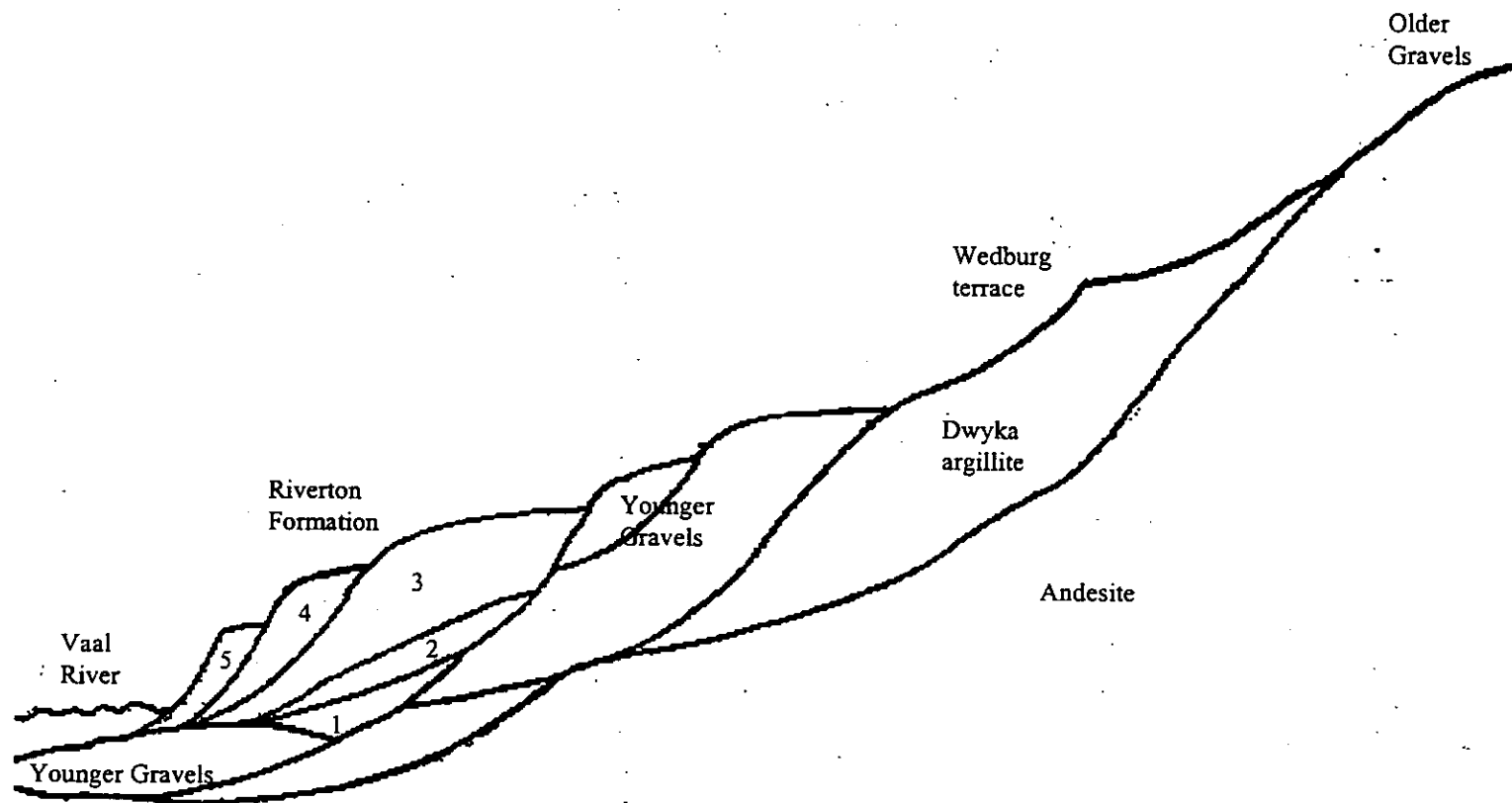


Fig. 2.1.1 Schematic stratigraphy of the ancient alluvia of the Lower Vaal River (after Helgren, 1980)

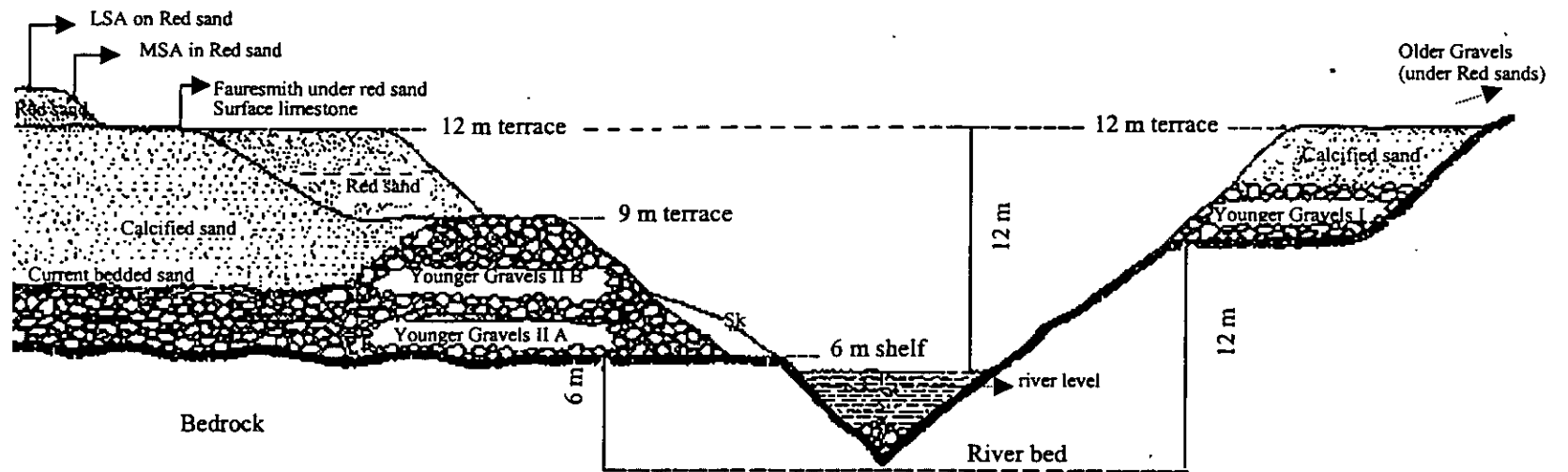


Fig. 2.1.2 Cross-section of the Vaal River area at Riverview Estates (adapted from Riet Lowe, 1952a). Not to scale.

the alluvial deposits posed several objections to both the archaeological sequence (Mason, 1962a) and depositional model (Partridge & Brink, 1967, Butzer et al., 1973):

More recent geological investigation of the Vaal River (Butzer et al., 1973, Helgren, 1977, 1978, 1979, 1980) led to the expansion of the stratigraphic framework of the Plio-Pleistocene. The work of these researchers led to a major re-examination of the alluvial sequence and produced new, regional lithostratigraphic units. Initially, the main gravels deposits of the Vaal River were labeled Older, Younger and Youngest, with the Acheulean artifacts found in the latter aggregations of the Younger gravels and overlying calcified sand with a predominately Middle Pleistocene fauna. The Fauresmith (normally accepted as the final stage of the Later Acheulean) was defined from finds in the surface of calcified sands and in the Youngest Gravels of the Vaal River tributaries (Helgren, 1979). With the re-evaluation of the stratigraphic record, new subdivisions were introduced in the Younger Gravels (with a thickness ranging from twelve to 22 meters), dated to Middle Pleistocene age (by fossil fauna). Thus, the Younger Gravels consists of three separate depositional units, being dominated by coarse textures and high-energy sedimentary structures (Helgren, 1977). This Riverton Formation (see Fig. 2.1.1), post-dating the Younger gravels, is composed predominately of fine-grained sediments (Butzer et al., 1973). Acheulean artifacts occur throughout the Younger Gravels and Member I of the Riverton Formation whereas the archaeological remains found through the middle-upper part of the Riverton unit have been attributed to the MSA (Helgren, 1978, 1980) (see Fig. 2.1.2 representing the schematic stratigraphy of the ancient alluvia of the Lower Vaal River).

The complex nature of the sequence, together with the absence of sites securely identified as *in situ* and yielding fossil fauna that might be used for developing a biostratigraphic sequence (Helgren, 1980), posed again a pertinent question -- how to date the Early Stone Age in

Southern Africa? In East Africa the chronometric revolution triggered by the application of new dating techniques to specific episodes of volcanic activity led to the establishment of a secure geological framework (e.g., Hay, 1976, Brown, 1994). In Southern Africa, however, the absence of volcanic strata in the Plio-Pleistocene record restricted the dating possibilities essentially to biostratigraphy (for the fossil bearing sites, which are very few) and typological analysis of the lithic assemblages.

## **2.1.4 Other options for dating the ESA in Southern Africa**

### **2.1.4.1 The typological approach**

#### **2.1.4.1.1 The use of handaxes as "fossil directeurs"**

Since the Vaal River scheme posed so many problems, some other approaches were put to use. In relation to the Acheulean, the geo-archaeological scheme developed for the Vaal River included the assumption that, an "evolutive pattern" was present through the sequence, in terms of the techniques used to prepare handaxes (Goodwin, 1928a, 1933, 1946, 1958). The technique of the earlier period (then referred to as Chellean-Acheul or still Abbevillian) resulted in the production of bifacial forms, roughly trimmed using nodules or blocks of raw material as blanks for its manufacture. The striking of alternate faces was repeated until the desired symmetry and form was achieved. This knapping procedure resulted in crudely flaked handaxes, with sinuous, jagged edges. The next stage suggested already the presence of more delicate blows, struck to give a more perfectly modeled tool. The Acheulean phase would seem to have appeared a new technical method – the use of a soft (wood?) hammer instead of a hard-stone hammer for removing the unwanted spalls in the process. This new tool seems to have produced a flatter side profile, a result due in all probability to the greater "follow through" of a blow struck with wood hammer. However, for Goodwin (1933), this represented only a considerable fining of the

original technique, but no further advance in methods until the close of the Acheulean.

As one clearly observes, Goodwin's system of "artifact evolution" is a good example of formal typology (established on the basis of some technological criteria), with supposed chronological value. Several researchers working in the area later used the assumption that reduction in size and increase in refinement in shape were good chronological indicators. Among them, one should refer the work of R. Mason on the Transvaal Stone Age. Through the use of statistical techniques, Mason (1962a, 1967b, 1967b, 1975) tried to quantify changes through time. His work constitutes a clear example of an attempt to establish a technology-based (avoiding the functional approach) culture-stratigraphic framework for the Stone Age in South Africa.

If in the early 1940's Riet Lowe (1945) would stress the need for a technological analysis, the strict morphological analysis of the Acheulean assemblages initiated essentially with Goodwin would set the tone on the form, on the type of artifact recovered at a specific site. The assumption that similarity of form implies a similar production sequence is implicitly inherent to formal typologies in cultural interpretation. As a result, *alter on*, handaxes and cleavers were lumped together under the same category of "bifaces", based on the sharing of a single morphological characteristic – the bifacial flaking of the piece. Further on, the emphasis would be placed upon the study of an artifact perceived as an end product, ignoring the procedures used for its manufacture. Hence, it became impossible to detect any alteration on technological behavior, within the compared archaeological units. This approach would be widely used by scholars working in the region, who would rather use the generalistic term of "biface" when referring to the bifacially knapped pieces present in Acheulean assemblages (e.g., Leakey, 1971, 1994, Callow, 1994). The vagueness of the morphological description of the Acheulean diagnostic tools gave rise to several debates over the industrial affinity of several archaeological assemblages. Due to the presence of handaxes, Mason (1962a, 1962b) defined the



assemblages from Member 5 of Sterkfontein as of the early Acheulean, but Leakey (1970) attributed it to the "Developed Oldowan B". The Acheulean is distinguished from the Oldowan primarily by the addition of bifacially worked artifacts (handaxes, cleavers, picks), which still are regarded by several researchers as a logical outgrowth of the Oldowan bifacially trimmed choppers (e.g., Hayden, 1987, Isaac, 1989). Oldowan choppers and other flake artifacts usually continue alongside handaxes at Acheulean sites, and assemblages in which Oldowan types heavily outnumber bifacial artifacts have sometimes been attributed to a separate "Developed Oldowan B" tradition (Leakey, 1971, 1975). The "Developed Oldowan A" is typically described as an early variant of the Oldowan, without the presence of "bifaces". Mary Leakey later introduced a quantitative indicator to distinguish the Acheulean from the "Developed Oldowan B" based on the percentage (above or below 40%) of bifacial artifacts present. Also the "Developed Oldowan B" was distinguished by "bifaces" being to be more crudely made (Leakey, 1971, 1975). However, one should keep in mind that Leakey objected to the use of bifacial tools as the tool type diagnostic of the Acheulean, stressing a complex evaluation of the assemblage lithic toolkit (1976). Later, Leakey's approach to the industrial attribution of the Swartkrans and Sterkfontein Member 5 industries was statistically supported by Bower's analysis (1977). For Mason (1962b, 1976) the presence of a more sophisticated flaking technique leading to the emergence of handaxes was the principal identification marker, and hence the characterization of the assemblage from Member 5 (MB5) from Sterkfontein as of Early Acheulean age. More recently Clark (1990a, 1991) has suggested that the lithic forms from Member 3 of Swartkrans may be in fact an Acheulean assemblage, due to the presence of handaxes and cleavers among the artifacts. Now, most scholars believe that variation in handaxe/cleaver abundance imply only differences in the activity mix at different sites (e.g., Jones, 1980, 1994, Keeley, 1980), or perhaps in some cases, differences in local raw material availability (e.g., Humphreys, 1969, 1979, Callow, 1994). The "Developed Oldowan B" is

Table 2.1.3 Relationship of some Acheulean bifacial artifact types in five classificatory systems

F. Bordes (1961)	R. Mason (1962a)	J.D. Clark/M. Kleindienst (1969-1974)	M.D. Leakey (1971, 1994)	G. Isaac (1977)
<b>Chopping tools</b> (unifacial) <b>Choppers</b> (bifacial)  <b>Bifaces:</b> Abbevillian Ficon Nucleiforme  <b>Bifaces</b> (13 shapes) and <b>Cleavers on flake</b> (Hachereau sur éclat - 6 categories)  <b>Picks</b>  <b>Biface a dos</b>	<b>Choppers</b>         <b>Handaxes</b> (mainly 6 geometric shapes)  <b>Cleavers</b> (4 geometric shapes)  <b>Picks</b>  <b>Backed flakes?</b>	<b>Choppers</b> (mostly bifacial) 5 main categories    <b>Core-axes?</b>  <b>Handaxes</b> (inside large cutting tools category - 13 shapes)  <b>Cleavers</b> (inside large cutting tools category - 4 shapes and a chisel)  <b>Picks</b> (4 categories)  <b>Knives</b>	<b>Choppers</b> , mostly bifacial (5 main categories)    <b>Proto-bifaces</b>  <b>Bifaces</b> (irregular, ovates, double pointed, flat butted)  <b>Cleavers</b>  <b>Oblong picks</b> , heavy-duty <b>picks</b>  ?	<b>Choppers</b>         <b>Core-like bifaces</b>  <b>Handaxes</b> (classic; chisel-end, ovate, subdiscoid) <b>Cleavers</b>  <b>Picks</b> , picklike handaxes  <b>Knives</b> and large scrapers

therefore now commonly subsumed within the Acheulean (Gowlett, 1988, Stiles, 1991). Table 2.1.3 presents a relationship of some Acheulean bifacial artifact types present in distinct classificatory systems.

Still in relation to the typological classification of handaxes, a preliminary evaluation of southern Mozambique and some Southern African Acheulean assemblages led me to conclude (Meneses, 1994) that we should avoid defining the Early Acheulean as being dominated by "crude" handaxe forms, as opposed to later Acheulean, with more "refined" forms. In fact, in some assemblages, the samples present clearly indicates that the form of the handaxes depends not only upon the raw material quality (Jones, 1979, 1994), but is also related to the stage of production of the specific artifact.

#### **2.1.4.1.2 The emergence of prepared core technique**

A final typological argument was brought about by the establishment of the technological approach to the study of the lithic industries. As Goodwin pointed out (1928a), Victoria West cores, i.e., cores evidencing intentional preparation to allow the detachment of a large flake, were present in the early stages of the Acheulean period in the Vaal River gravels. These cores, initially described by Jansen (1926) are manufactured usually on a large river boulder (about 15 to 30 centimeters in diameter) as a blank. The core is shaped to the form of a handaxe or pick, although one face of the block is always more convex, even pyramidal. The core also presents a jagged edge resulting from the removal of a series of flakes from around the perimeter. The main flake consists therefore of a rough disk, one face of which was made up of a positive flake-scar, and the other of a number of negative flake-scars both whole and partial (see Fig. 2.1.3 Victoria West Cores and flakes detached from them). These large flakes were used to

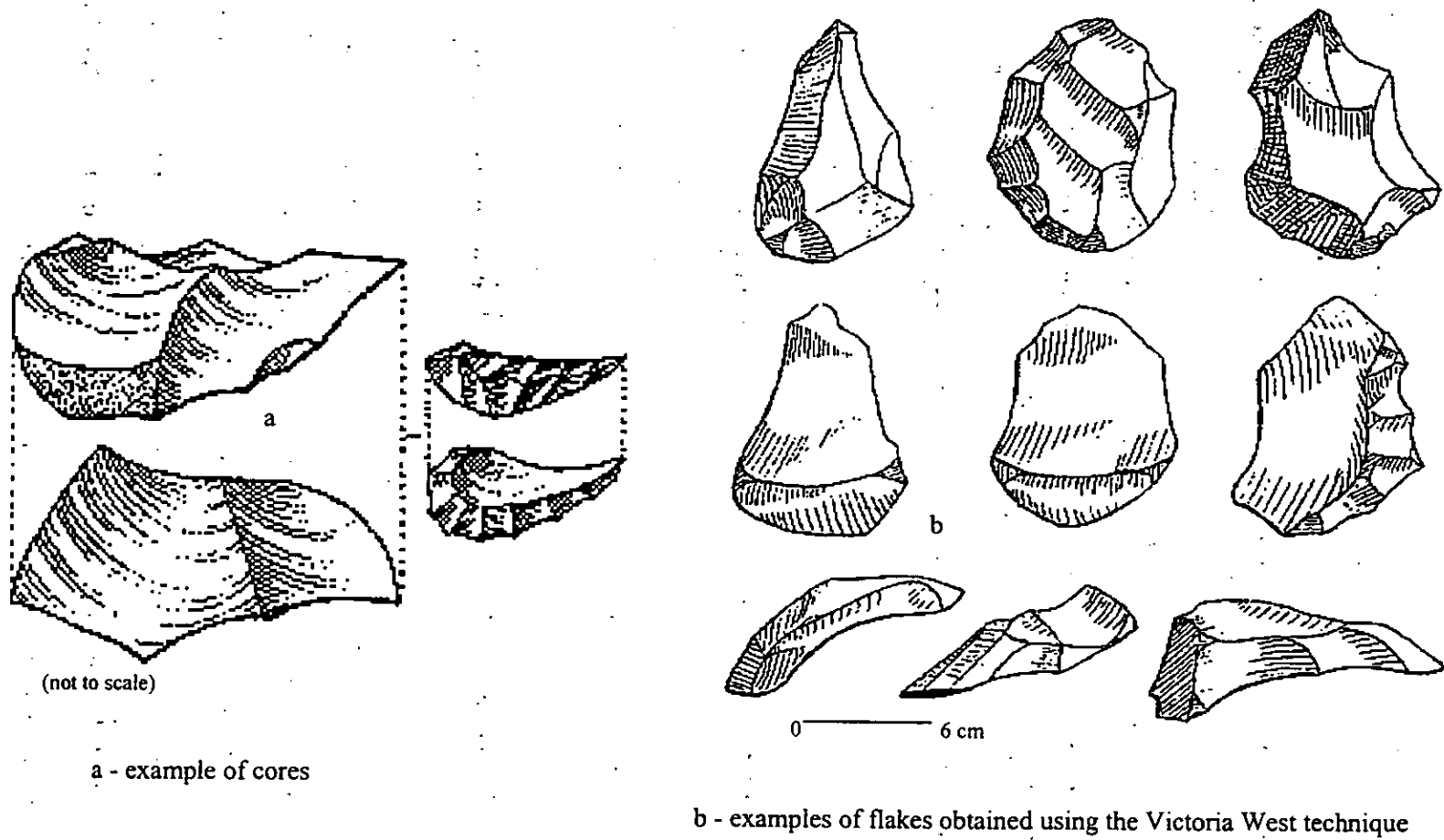


Fig. 2.1.3 Victoria West cores (a) and flakes (b). After Jansen, 1926, Brezillon, 1971.

manufacture cleavers and some of the handaxes found in the Acheulean assemblages from the Vaal River. In some cases, the final trimming for cleaver production is very light, indicating the work entailed in preparing the core.

The work performed in more recent times along the Vaal River terraces suggest that even the oldest units of the Younger gravels (apparently from Lower to Middle Pleistocene) do contain cores patterning the Victoria West technique (e.g., Helgren, 1978). Because by classic "typological" definition a prepared core technique is of MSA age (or still, at least an indicator of a transitional period), these assemblages have been attributed to the final, Late Acheulean (e.g., Volman, 1984). Nonetheless, the technological reading of these cores suggest a much earlier age for the emergence of predetermination of a tool support form.

Other lines of evidence seem to confirm an earlier development of prepared core technique. Recent archaeological work in Uganda has suggested that cores displaying systematic radial flaking removal may be present in the archaeological record as old as 1.8 Mya in East-Central Africa, although the flakes present in the assemblage do not display yet a standardized morphology (Texier, 1995, 1996).

#### 2.1.4.2 The quest for biostratigraphic correlation

Once handaxe typology had been ruled out as a serious temporal indicator for the Acheulean, researchers started searching for new forms to date the sites.

In South Africa, and for the particular case of the Acheulean period, even sealed sites cannot generally be linked to any dated external stratigraphy and few contain faunal remains that could be useful for biostratigraphic correlation and age determination. As a result, sites such as Amanzi springs (Deacon, 1970) and Montagu Cave (Keller, 1973) are very problematic to place in time except on circular typological grounds.

Table 2.1.4 South African sites which have been dated either by biostratigraphy (i.e., sites with good fauna associated directly to artifacts found in context) or by other chronometric methods

Site	Age	Ref.
<b>Rooidam</b>	174,000 Kya (Uranium series dating)	Szabo & Butzer, 1979
<b>Duinefontein 2</b>	195,000 Kya (beginning of isotope stage 6)	Volman, 1984
<b>Kathu Pan</b>	post-Bed IV (biostratigraphy)	Beaumont et al., 1984, Klein, 1988
<b>Vaal River "Younger Gravels"</b> (Power's site, Rietputs Formation)	0.8-0.6 Mya equivalent of Bed IV at Olduvai (biostratigraphy)	Cooke, 1949, Helgren, 1977a, 1977b, 1978, 1979
<b>Swartkrans - Mb 3</b>	≈1.0 Mya (biostratigraphy)	Vrba, 1985 Brain, 1993
<b>Klipplaatdrift</b>	≈1.5-1.0 Mya (biostratigraphy)	Partridge, 1985
<b>Sterkfontein - Mb 5</b>	1.5-1.3 Mya (biostratigraphy)	Clarke, 1985, 1988, 1994 Partridge, 1978, 1985 Stiles & Partridge, 1979 Vrba, 1985

The Acheulean faunas can only be dated by reference to Eastern Africa, particularly to Olduvai Gorge Upper Bed II through Bed IV, where the fauna is bracketed roughly between 1.6-0.6 Mya (Hay, 1976, 1994). Therefore, the faunal data imply a long time span for the Acheulean in this region, before 1.0 Mya and after 600 Kya.

The dates presented in Table 2.1.4 are grounded both on biostratigraphic and chronometric interpretation of the sites, as well as on typological analysis of the assemblages: sites with "crude handaxes" are attributed to the early Acheulean, while the assemblages presenting "very late" handaxes, i.e., very refined and small handaxes, are assigned to the final stages of the Acheulean (e.g., Mason, 1962a, Sampson, 1974, Klein 1994). The dating of the Acheulean before 1.0 Mya and until about 200 Kya is consistent with dates from Eastern Africa (Clark, 1988), but this clearly suggests that new dating methods need to be improved to help clarify the indefinite dating in Southern Africa sites.

At Montagu Cave (Keller, 1973), Wonderwerk Cave (Beaumont et al., 1984), Cave of

Hearths (Mason, 1962a), Olieboompoort (Mason, 1962a), and Kathu Pan (Beaumont et al., 1984, Butzer, 1984, Klein 1988), the Acheulean is stratified directly below the succeeding MSA.

However this does not help in dating, because:

1. the MSA occupations are also themselves not well dated,
2. quite often a sterile level separates both periods.

The dating uncertainties (also present in a smaller degree in Eastern Africa, due to the lack of fossil data and good dating material later than 0.7 Mya) make it difficult to perceive any time and spatial trends within the Acheulean in the region (Isaac, 1975a). Normally a general trend is pictured -- that later handaxes tend to be thinner and more extensively trimmed than earlier ones (e.g., Mason, 1962a, 1976, Deacon, 1975, Klein, 1994). Hence, for Southern Africa, a great deal of the assumption in terms of behavioral interpretations still relies on the use of the level of refinement of handaxes as temporal markers (e.g., Volman, 1985, Klein, 1994).

## **2.1.5 Previous work on the ESA in southern Mozambique, with emphasis on the Umbeluzi-Changalane-Tembe area**

### **2.1.5.1 Why the Umbeluzi-Changalane-Tembe area?**

Surveys undertaken in Mozambique up to the present have identified over 200 locations where Stone Age artifacts have been collected. Among the stone age sites identified in the country, 116 included artifacts described as being of the Early Stone Age (ESA); of these about 70% held artifactual collections apparently exclusively of the ESA (Meneses, 1988, 1989; Roque, in press).

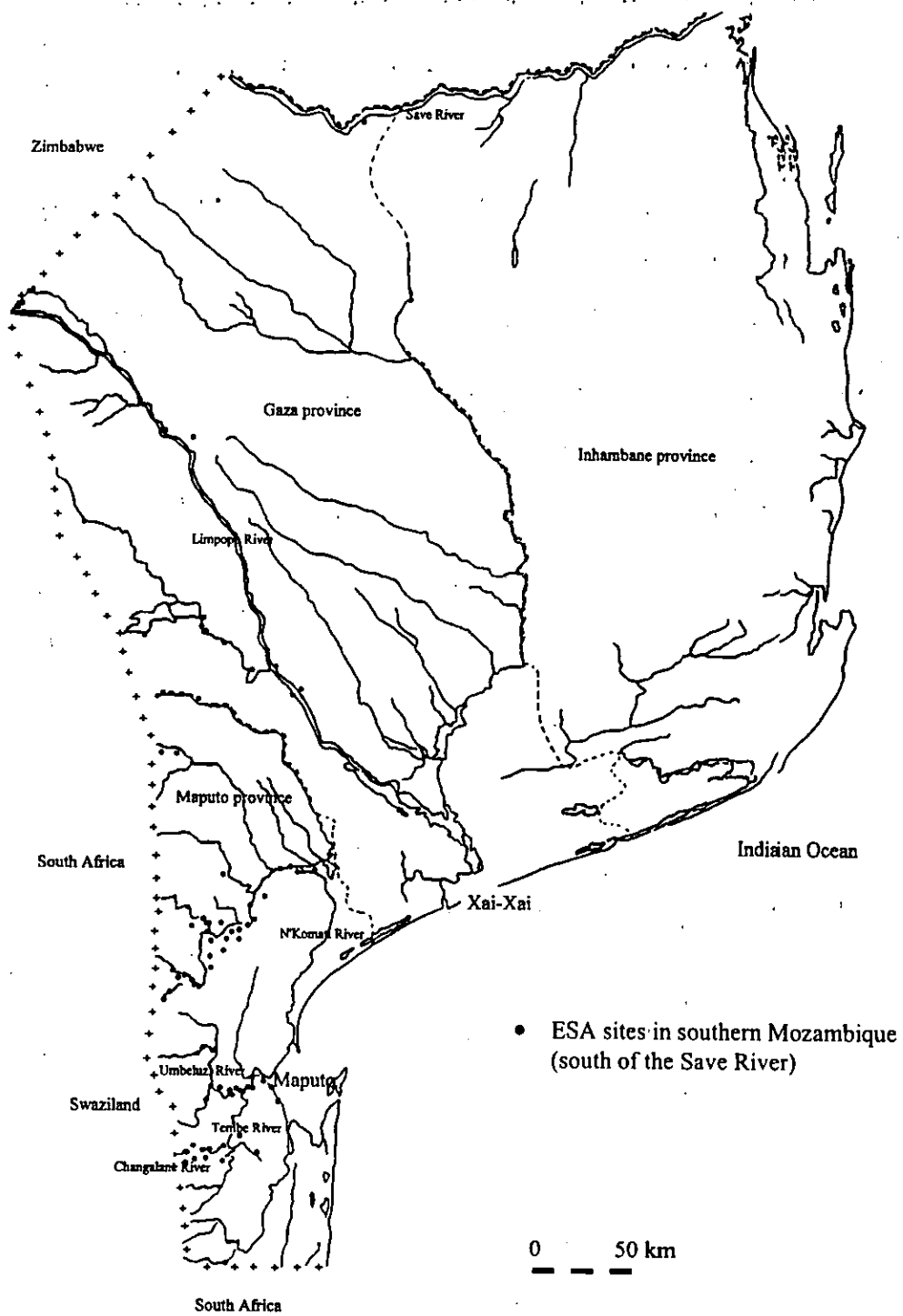


Fig. 2.1.4 Early Stone Age sites located in southern Mozambique



Table 2.1.5 Stone Age sites in Mozambique by region and by period

Region	South	Center	North	Total
<b>Period</b>				
ESA	101	13	2	116
MSA	58	3	6	67
LSA	35	8	32	75

Table 2.1.6 Stone Age sites in Mozambique  
(includes ESA, MSA and LSA sites)

Region	Number of sites
South	153
Center	24
North	37
<b>Total</b>	<b>214</b>

However, although sites with stone age collections classified as belonging to the ESA have been reported from several regions of the country, many areas still have not been surveyed, resulting in a biased pattern to the distribution of the location of the archaeological sites. In fact, the most surveyed area in Mozambique for stone age sites is the region located to the south of the Save River – the Sul do Save. Here, the surveys carried on since the 1940's led to the identification of over 150 lithic archaeological sites (see data sheet in Appendix 5, as well as Fig. 2.1.4 identifying the ESA sites in southern Mozambique).

The Sul do Save region of Mozambique is archaeologically the best known region of country. This is due to several factors, including:

1. The long cultural sequence of Stone Age occupation. This occupation has generated large lithic artifact assemblages by prehistoric inhabitants that could be described to distinct industries in the time-sequence;
2. The proximity to the capital of Mozambique - Maputo, as well as the accessibility

due to the support of the landowners, and to the satisfactory network of car tracks crossing the region. In other words, the logistical factors made the region accessible to survey teams;

3. The influence of long term studies focused on early stages of Human Origins and the Early Stone Age undertaken in the neighboring regions of South Africa (Gauteng and KwaZulu provinces);
4. The existence of a well published record of the geology, flora and fauna of the neighboring regions both in Swaziland and South Africa;
5. The accuracy of the geological study within the region. In fact, the geological studies undertaken -- although with a strong economic purposes -- have produced several preliminary geological reports.

The studies performed in the southwest region of Mozambique -- mainly in the terraces around the Tembe, Umbeluzi, N'komati and Limpopo Rivers-- were based on artifactual collections obtained from fluvial sediments, and hence, were in a redeposited context.

Table 2.1.7 Context of stone age sites in Mozambique

Region	Regions			Total
	South	Center	North	
<b>Site context</b>				
Surface	43	7	4	54
Secondary context	31	7	1	39
<i>In situ</i> or relatively secure context <sup>1</sup>	35	2	3	40
Unknown	43	9	29	81
<b>Total</b>	<b>152</b>	<b>25</b>	<b>37</b>	<b>214</b>

<sup>1</sup> *In situ* - in this dissertation this term is used to indicate excavated material as opposed to surface finds, and does not imply a primary context.

Most of the sites described as having lithic assemblages *in situ* correspond to later stages of cultural development of the lithic technology, i.e., to the MSA and LSA.

The lithic artifacts were normally collected from surface "patches" and classified as Oldowan or Acheulean, upon their "typological" and quantitative character (inside the broader categories of artifacts, such as choppers, handaxes, cleavers, etc. suggested by the Vaal River scheme). Some of the collections are quite small (two to three dozens artifacts) but several of them reach several hundreds of objects. As I will refer further on in this chapter, the Acheulean period constitutes the earliest secure recognized archaeological period in southern Mozambique. The identification of sites attributed to the Acheulean is usually defined by the presence of diagnostic bifacially worked lithic pieces -- handaxes and cleavers.

The work on the Stone Age of southern Mozambique was essentially carried out by amateur archaeologists, who were interested in archaeology as a means of dating and interpreting the geo-morphological record of the area, a condition which persists until today in the geological literature (Beernardt, 1987, Momade, 1990). From the early 1970's on, most archaeological studies in the area have been focused on Iron Age research. For this time period, the sites are well preserved and from a time interval appropriate for use C<sup>14</sup> dating (Morais, 1984, 1988, Sinclair, 1985).

#### 2.1.5.2 The pre-Acheulean

The upper gravels of several river terraces (usually above 100 meter level - once again, following the pattern from the Vaal River sequence) in the Sul do Save region produced several collections of a few rolled artifacts made on pebbles, suggestive of the Oldowan period. The

pebbles (mainly quartzite or rhyolite) were worked both unifacially and bifacially resulting in chopper-like cores. There are few flakes in these assemblages. Although several pieces could be interpreted as Oldowan, the disturbed nature of the alluvial sediments and gravels of these open air sites, the absence of associated fossil fauna, as well as the lack of stratigraphic provenience makes one cautious about the identification of the Oldowan in the region. Nonetheless, previous archaeological work has reported at least twelve Oldowan occurrences concentrated along the river terraces in the Sul do Save region, (Alberto, 1951, 1958). Most of the sites have resulted from the pioneer work of Bettencourt Dias and Barradas (see Fig. 2.1.5), and all of the collections need to be reevaluated (Meneses, 1988). In addition, in the great majority of the situations, the sites containing Oldowan material also contain Acheulean artifacts. This fact makes it difficult to accept the presence of Oldowan assemblages due to the lack of an understanding of their stratigraphic context.

#### 2.1.5.3 The Acheulean Complex

In Southern Africa, the presence of Developed Oldowan and early Acheulean sites provides a basis to suggest widespread hominid occupation by about 1.5-1.3 Mya (Kuman, 1994, 1996, 1998). By the Acheulean time, artifacts in both open and sealed cave contexts are well documented, especially in South Africa and the southern part of Mozambique (Meneses, 1988, 1994, Kuman, 1998).

In southern Mozambique, the majority of the assemblages attributed to the Acheulean Complex come from fluvial (i.e secondary) contexts. Most of the artifacts are made on quartzite and rhyolite and are sometimes quite rolled. The "tool-kit" present for most of the collections is quite small, resulting essentially from fortuitous or surface collecting. The small collections consist normally of well-identified pieces, such as handaxes, cleavers, choppers and some cores. Large flakes (usually with cortex still present) are also found. Retouched flakes are less abundant, but this

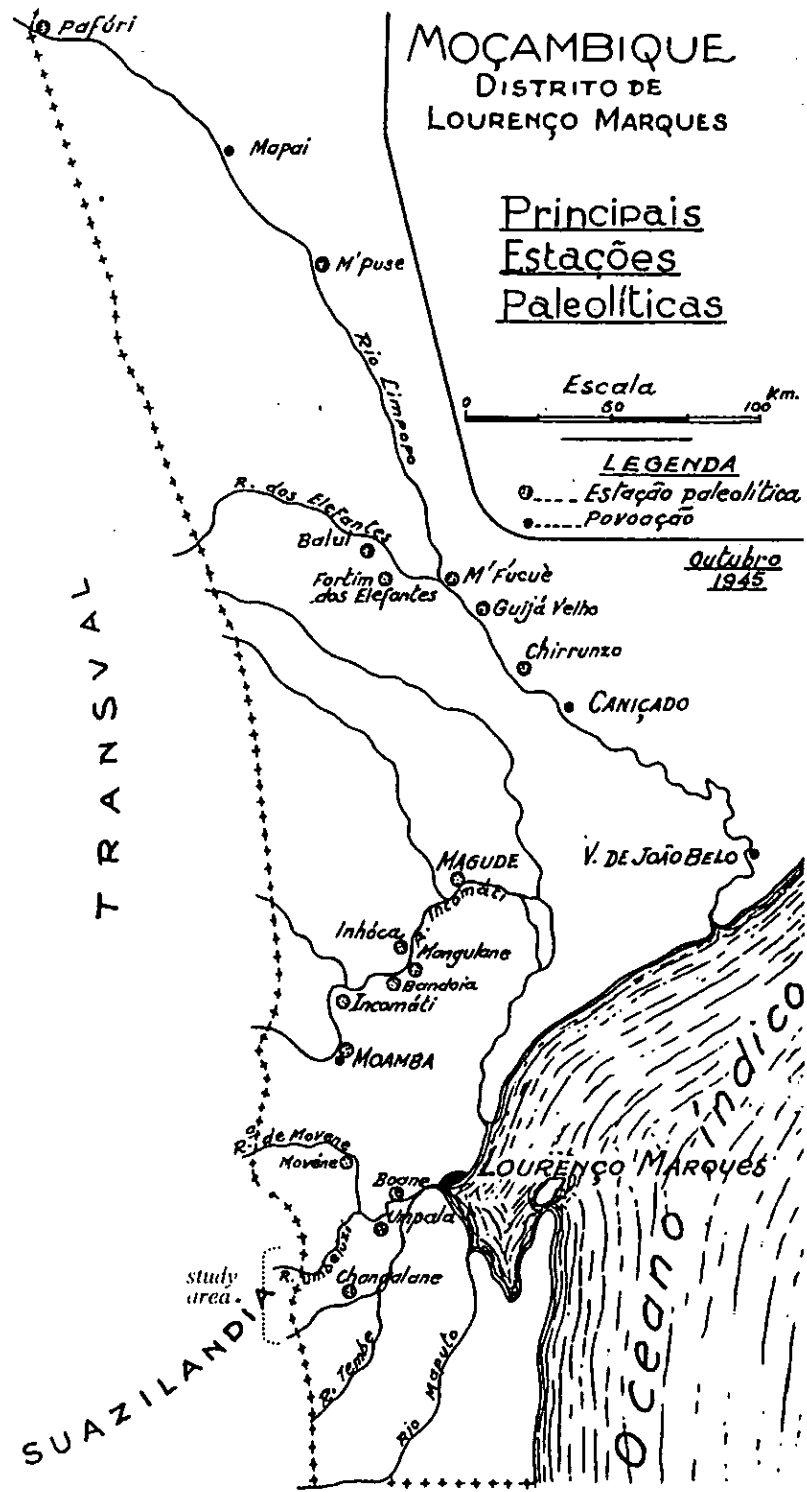


Fig. 2.1.5 Main archaeological ESA sites surveyed in southern Mozambique in the 1940's (after Dias, 1947)

seems to be more the result of the selective collecting.

Following the widespread typological approach established for Southern Africa, the classification of the artifacts collected from the sites was done initially by using the physical state of the material, i.e., weathering conditions, as well as the presence of "typical artifacts" (such as handaxes for the Acheulean period) as a main indicator on the age of the artifact assemblage (e.g., Senna-Martinez, 1968b). However, because quite often these assemblages are clearly reworked and in secondary context, it becomes not only quite difficult to assess their typological status, but also almost impossible to identify significant typological differences between them.

Assemblages belonging to the Acheulean Industrial Complex are reported from over 50 sites (see database in Appendix 5). However, as previously mentioned, these collections are essentially the result of haphazard surface collections or superficial examination of eroding geological sequences. For example, Acheulean artifacts from Umbeluzi V, Movene, Moamba and Magude are secondarily redeposited and were found eroding from well-defined fluvial contexts. The exceptions are Changalane (Dias, 1947, Jonsson, 1983) and Massingir (Prata Dias et al., 1975), where excavations were performed in an apparently sealed geological context. Up to now, the best evidence for the Acheulean Industrial Complex in Mozambique comes from Massingir, in Gaza province. Previous researches in the region (Prata Dias et al., 1975) indicated that there were probably three Acheulean components represented at this locality. Horizon I -- previously reported as "Early Sangoan" -- has provisionally been included in the Acheulean Industrial Complex. The other two horizons include a large collection of artifacts. The typology and geological sequence of these horizons is at present under revision (Meneses, 1996). Handaxes, cleavers, and chopping tools occur in each horizon, as well as utilized flakes. Finally, at the Pafuri site, on the Limpopo River Valley, a complex site structure is present, yielding the only known Acheulean assemblage containing Victoria West cores (Barradas, 1960, 1963a, Meneses, 1988).

Following the geo-archaeological approach developed for the Vaal River, and by using the

exposed geological sequences from southern Mozambique, Barradas attempted to correlate the stratigraphic sections with archaeological sites, aiming at synthesizing the Quaternary chronology of Mozambique.

This work is in need of considerable revision given the abandonment of the glacial/pluvial framework and given the recent advances in Southeastern Africa chronostratigraphic and archaeological framework.

Table 2.1.8 Geo-archaeological interpretation of southern Mozambique (Sul do Save region) based on a comparative study with the sequences present in Southeastern Africa

Geological Periods	Climatic sequence	Sea-level fluctuations	Archaeological sequence	Archaeological sites
Actual Recent	Actual Nakurian	Actual Regression	Iron Age	
Epi-Pleistocene	Arid	V Transgression (1,5-2,5 m)	Wilton & Smithfield	Concheiros da Matola
	Makalian (pluvial phase) IV Interpluvial	Regression IV Transgression (3-5 m)	Upper MSA	
Upper Pleistocene	IV Pluvial "Younger Gravels" Gamblian	Extensive Regression	MSA	Moamba, Matola, Massingir
	III Interpluvial	III Transgression (6-9 m)	Sangoan & Fauresmith	Revez Duarte, Massingir
	III Pluvial "Younger Gravels" Kanjera	Regression	Acheulean	Bandoia, Umbeluzi, Magude, Mangulane
	II Interpluvial	II Transgression (18-22 m)		
Middle Pleistocene	II Pluvial "Older Gravels" Kamasian	Regression	Early Acheulean (Abbevillian)	Movene, Incomanine, Balul, Pafuri
	I Interpluvial	I Transgression (115-125 m)	Oldowan	Machimbilana, Bunganine
Lower Pleistocene	I Pluvial "Basal Older Gravels" Kageran	Regression	Kafuan ?	

(after Barradas, 1955a, 1955b, 1956, 1958, 1965)

The site of Revez Duarte, in the Umbeluzi River area (see earlier mentioned Fig. 2.1.4), constitutes a good example of the status of our knowledge on the ESA of southern Mozambique. Initially visited by Breuil and Riet Lowe (1944), this site was studied further by Barradas (1955a, 1955b, 1965, 1966). Barradas reports, for the 40 to 60 meter Umbeluzi River terrace, the presence of rolled "early Acheulean" underlying "fresh Acheulean" which was supposedly followed by Fauresmith material. However, the typological status of these cultural components is questionable not only owing to the small size of the collection (about 200 pieces altogether), but also and basically, due to the approach undertaken for its classification (stratigraphical position and weathering stages).

Table 2.1.9 Geological interpretation of Revez Duarte (Umbeluzi River area)

Covering sands
MSA (Pietersburg)
Deposition of the shell middens during the IV Transgression (sea level at 2-3m)
Emergence of the terrace
III Transgression; renovation of the terrace (sea of Revez Duarte)
Fauresmith
Renovation of the terrace; abrasion of the Abbevilien artifacts during the II pluvial - Younger Gravels
Early Acheulean (very abraded); terrace formed before or at the beginning of the II transgression

#### 2.1.5.4 About the transition to the Middle Stone Age (MSA)

Although the Middle Stone Age is beyond the chronological limits of this dissertation, I would like briefly to discuss some question of the "transitional" period. From a typological point of view, while the Early Stone Age is characterized by a strong component of "flaked pieces" (Isaac, 1986) such as handaxes and cleavers, the Middle Stone Age is in essence characterized by the presence of flake tools and points (e.g., Coles, 1967, Volman, 1984, McBrearty, 1991). This transition however, is not a straightforward pattern. In fact, the Sangoan and the Fauresmith -- the



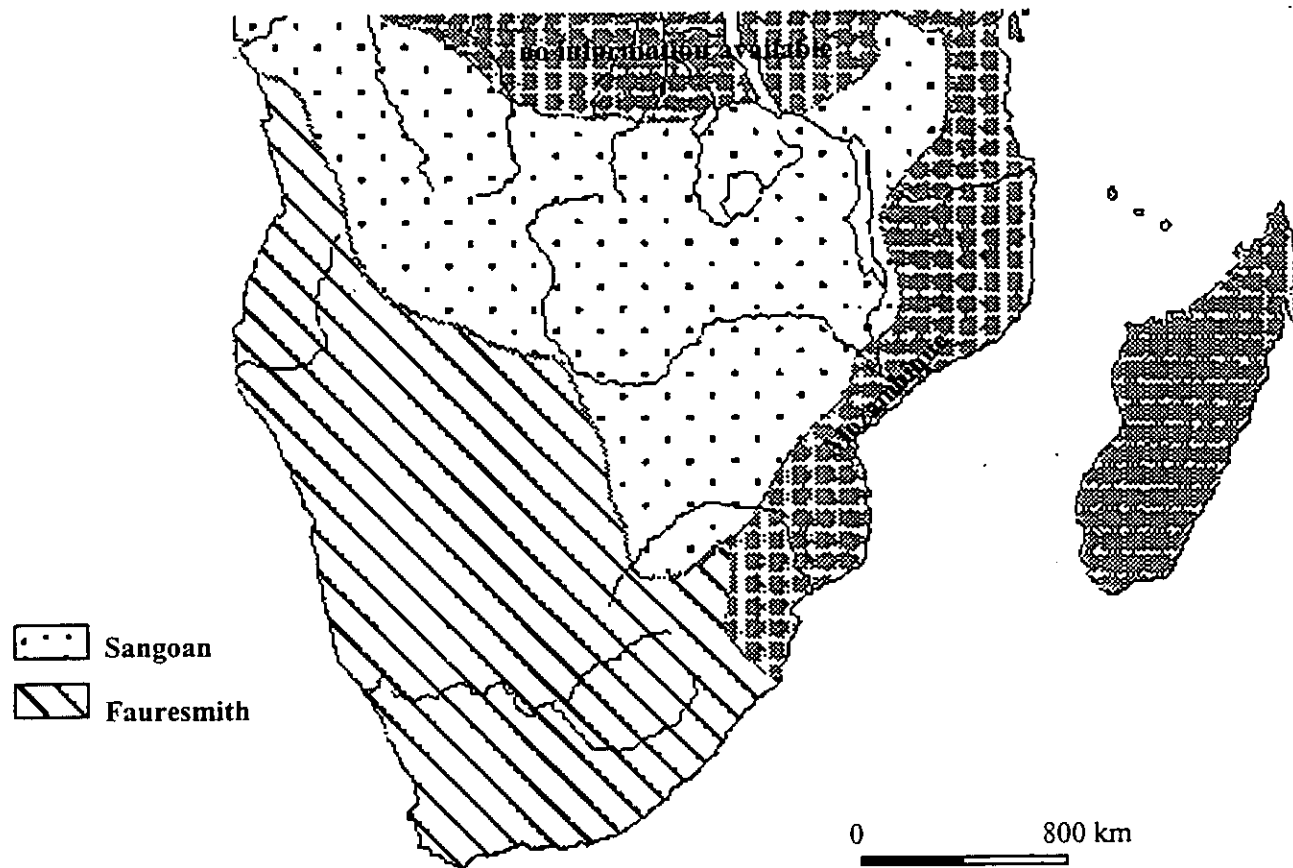


Fig. 2.1.6 Distribution of Fauresmith and Sangoan industries in south-central Africa (adapted from Newman, 1995)

so called later Acheulean -- provide evidence for this "metamorphosis", suggesting an increase in tool specialization and the use of new raw materials.

In Southern Africa the Fauresmith, with its small and finely retouched artifacts, is viewed as the final stage of the Acheulean (Malan, 1947) and hence included in this Industrial stage as a cultural entity (e.g., Fock, 1968, Sampson, 1974). On the other hand, the Sangoan which is characterized by typical heavy duty tools including picks, choppers and core axes, overlies the Acheulean in several stratified sites, such as Kalambo Falls (Clark, 1964, 1969, 1974) and underlies Middle Stone Age Industries, for example, at Pomongwe cave -- Zimbabwe (Cooke, 1963). In Clark's interpretation, the distribution of Sangoan represented a widespread, and new adaptation towards previously unoccupied more heavily forested areas, while the Fauresmith is found in open environments, following the previous tradition of the Acheulean period (1964, 1970).

In Southern Africa up to now, no "transitional" assemblages have been found South of the Limpopo valley (Deacon, 1975, Sampson, 1974, Volman, 1984). In fact, the general picture suggests that to the north of the Limpopo valley, the Sangoan persists after the MSA had replaced the Acheulean further south (see the regional distribution of the Fauresmith and Sangoan in Fig. 2.1.6).

In southern Mozambique -- the Sul do Save region -- several Sangoan and Fauresmith sites have been reported, following the pattern earlier noticed, i.e., with the Limpopo River acting as the major dividing line. The status of these collections is questionable, as previously mentioned, both in terms of retrieval methods, criteria used for typological definition of the Industries, as well in terms of chronological relationships.

The collection from Revez Duarte described as Fauresmith (Barradas, 1955b) is inadequate for typological definition due to the small number of the artifacts in the collection. Those claimed

from sites such as Ponta Maone, Incomanine, Languana, among others, have not been described. The assemblages, available for study, have not yet been re-analyzed. At Massingir, the Early and Late Sangoan components described by Dias et al. (1975) are probably best included within the Acheulean Industrial Complex (Meneses, 1988). Therefore, there are no sites in Mozambique that can reasonably be ascribed to the Fauresmith or Sangoan. This jumble also results from the undoubted typological similarity between the Sangoan and the Acheulean in terms of being both typologically described as predominantly "heavy duty" assemblages (Kleindienst, 1961, Clark, 1964), both sharing the presence of choppers, picks and large flakes. Clark (1970, 1981) however, stressed the technological differences between the complexes by surmising that the Sangoan artifacts were woodworking tools, present in areas with wetter environmental conditions. Nonetheless, as several authors have pointed out (McBrearty, 1991, Cornelissen, 1995) there is not yet enough information to resolve the technological and temporal relationships between sites and industries.

The problem of the Later Acheulean -- Sangoan dichotomy have led to considerable discussions, centered essentially upon variability in Sangoan and Acheulean assemblages (Clark, 1969, 1970, Mason, 1961, Sampson, 1974). Given the lack of chronological control and paleoenvironmental data from southern Mozambique and neighboring countries (South Africa, Swaziland and Zimbabwe) for both the Acheulean and Sangoan Industries, it is not possible to test the hypothesis regarding the emergence of two distinct archaeological entities towards the end of the Middle Pleistocene. However, recent data obtained from Eastern Africa seem to rebut the "environmental" shift hypothesis suggested by Clark. In fact, recent paleoenvironmental studies have suggested that the Middle Pleistocene period was characterized by the establishment of a savanna vegetation, contradicting the existence of an environmental turnover as the motive for a shift towards the Sangoan in the Acheulean Complex (ex. Vorster & Rooyden, 1984, Maud, 1986,

Tyson, 1990, Cerling, 1992). Indeed, the evidence available today, such as Sangoan artifacts described from Isimila (Cole & Kleindienst, 1974) and Andalee in Ethiopia (Kalb et al., 1982) attest that the Sangoan was widespread in a considerable range of present day environments and is inconclusive in the absence of more data concerning paleoenvironmental estimates.

The wide distribution of Sangoan sites has tempted some authors to postulate a more extensive area of occupation for Sangoan than for Acheulean (Bond, 1963, Deacon, 1975). Unfortunately, the absence of a good database of surveyed and excavated Acheulean and Sangoan sites precludes the rigorous assessment of this hypothesis using Mozambican data. Indeed, the number of Sangoan sites so far plotted does not suggest, at least in the southern part of the country, a presence which was considerably greater than the preceding Acheulean period.

#### **2.1.5.5 Potential of previously collected assemblages from southern Mozambique to be included in this study**

The pioneer work of people such as Breuil, Riet Lowe, Bettencourt Dias and Barradas contributed towards the recognition of the importance of southern Mozambique for the study of Early Human Prehistory (Clark, 1967). Regarding the potential of old collections derived from surveys and excavations carried out in southern Mozambique long ago, their techniques and recovery strategies would be unacceptable by today's standards. Also, the archaeological data recovered by previous researchers from the Umbeluzi-Changalane-Tembe area became impossible to locate. In the Department of Archaeology and Anthropology, several trays hold material from the region, although without a specific site identification label. In fact, some of the artifacts were still inside the field bags, without any reference. Only the raw material used would give some clue regarding the identification of the region of the collections. For most of the cases, neither the cultural remains, nor the contexts of the findings were described in detail. This

situation is quite common in Mozambique where lithic assemblages have been stored without proper curation! Moreover, it became impossible to identify the field notes of Bettencourt Dias. Therefore, the field notes of Barradas became very important in tracing the previously studied areas, although several of the landmark features mentioned have long disappeared. The only material available and well curated refers to the MSA and to LSA assemblages from Caimane cave (a broader reference to this site can be found in Chapter V). The situation just described seems to be also the case for South Africa, where for the old sites and excavations it is quite often impossible to find any additional information, besides the assemblage and what was published (e.g., Three Rivers, Doornlagte).

The circumstances drawn above, altogether with the absence of a secure geological interpretation of the findings, led me to rule out the possibility of using the materials previously excavated and/or resulting from surveys. Indeed, for now, this material can only be used as a geographical marker for the presence of ESA sites in a specific area.

## 2.2 THE NATURE AND THE CHARACTER OF ACHEULEAN ASSEMBLAGES FROM SOUTH AFRICA (INCLUDING THE STUDY OF SOME OF THE ASSEMBLAGES)

### 2.2.1 Some general questions

The archaeological work performed in South Africa for the Vaal River area has long been an "anchor" for the study of Mozambique stone age. Therefore, I decided to study some of these assemblages, in order to understand not only the archaeological sequence established, but also the potential for further regional interpretation in terms of chronostratigraphy, and the forms of hominid behavior, including aspects related to raw material selection and use, development of new technologies, etc.

The small number of Early Acheulean sites in South Africa, although suggestive of a fairly widespread hominid occupation by about 1.5 Mya (Kuman, 1998), so far has provided limited information on the technological behavior of the inhabitants. In contrast, by later Acheulean times, artifacts in both open and sealed cave contexts are better-documented (Sampson, 1974, Deacon, 1975, Klein, 1989, 1994).

Table 2.2.1 Setting of Acheulean sites through time in Southern Africa

Time	Lake basin, pans and springs	River valleys (including swamps and dembos)	Quarry sites	Marine coast and coastal plains	Caves
Middle and early Upper Pleistocene	Doornlagte Rooidam Amanzi Kathu Pan	Vaal River area Muirton	Orange River valley, and the adjacent Seacow valley	Hangklip Hopefield Elandsfontein	Montagu Olieboomport Wonderwerk Cave of Hearths
Lower Pleistocene		Three Rivers Klipplaatdrift Acacia Road			Sterkfontein (M5) Swartkrans (M3)

(after Sampson, 1974, 1985, 1998, Clark, 1981, Volman, 1984, Isaac, 1989, Klein, 1994)

These sites are tentatively assigned to geological time divisions on the basis of fauna present, general geological sequence or typology of the artifacts present. At most of the sites large concentrations of artifacts have been found (and where handaxes and cleavers are present, together with prepared core technique); these are predominantly open air sites, in alluvial colluvial contexts (e.g., Goodwin, 1928, 1933, Malan, 1947, Humphreys, 1969, Helgren, 1978, Beach & Morris, 1990). From this table, it becomes clear that for the later period, across Southern Africa there was a greater archaeological visibility of the Acheulean sites both in terms of numerical representation, and geographic location. However, many other sites in the region have been recorded but not studied or published due to their disturbed context and uncertainty regarding their age.

Since bifacially trimmed artifacts are the Acheulean "visiting cards", a logical question to ask would be -- when were the first handaxes and cleavers manufactured in this region? Since some of the South African sites ascribed to Early and Late Acheulean have been securely dated, a sound appreciation of their makers' technological skills could be achieved for comparative purposes with Mozambique assemblages.

#### **2.2.2 The sites studied for this dissertation and the sampling strategies used to select the artifacts**

For comparative purposes, and in order to find an answer for some of the question risen above, I decided to study some of the "classic" Acheulean collections (attributed both to early and later Acheulean) for comparative purposes, namely:

Table 2.2.2 The South African Acheulean assemblages studied for the purpose of this dissertation

Site	Period	Main References
Rooidan	Late Acheulean	Butzer, 1974, 1984, Clark, 1975b, 1981, 1988, Szabo & Butzer, 1979, Klein 1983
Pniel 6	Late Acheulean	Beach & Morris, 1990
Doornlaagte	Middle-Late Acheulean	Mason, 1966, 1967b, Butzer, 1974, 1984
Acacia Road	Early-Middle Acheulean	Beaumont, 1969, Sampson, 1974
Three Rivers	Early Acheulean	Mason, 1962a, Sampson, 1975, Clark, 1990b
Sterkfontein Mb 5	Early Acheulean	Clarke, 1985, 1988, Kuman, 1994, 1998

The map on Fig. 2.2.1 indicates the location of the South African sites whose assemblages were used in this dissertation.

Another question to be discussed briefly is related to the strategies used to sample the assemblages used for my research.

In relation to Sterkfontein Mb 5, I was able to study selectively the pieces which Kuman (1998) described as being typical of the Early Acheulean. It was not possible to study all the handaxes from the five remaining assemblages (Three Rivers, Acacia Road, Pniel 6, Doornlaagte and Rooidan). After preliminary observation of the boxes and trays where they were kept I decided to analyze in average 10 handaxes from each assemblage (although due to time constraints a smaller number was studied for Doornlaagte).

Initially, using a random table I picked up the boxes containing the objects to be analyzed; from each box I would select the handaxes and cleavers, until reaching the size of the sample I wanted to study. Thus, unintentionally biased selection, such as occurs when larger and more refined shaped pieces are chosen, was avoided.

Since all the assemblages, with the exception of Sterkfontein, do not have their artifacts numbered, each of them was given a code number, composed of a site name and the sequential



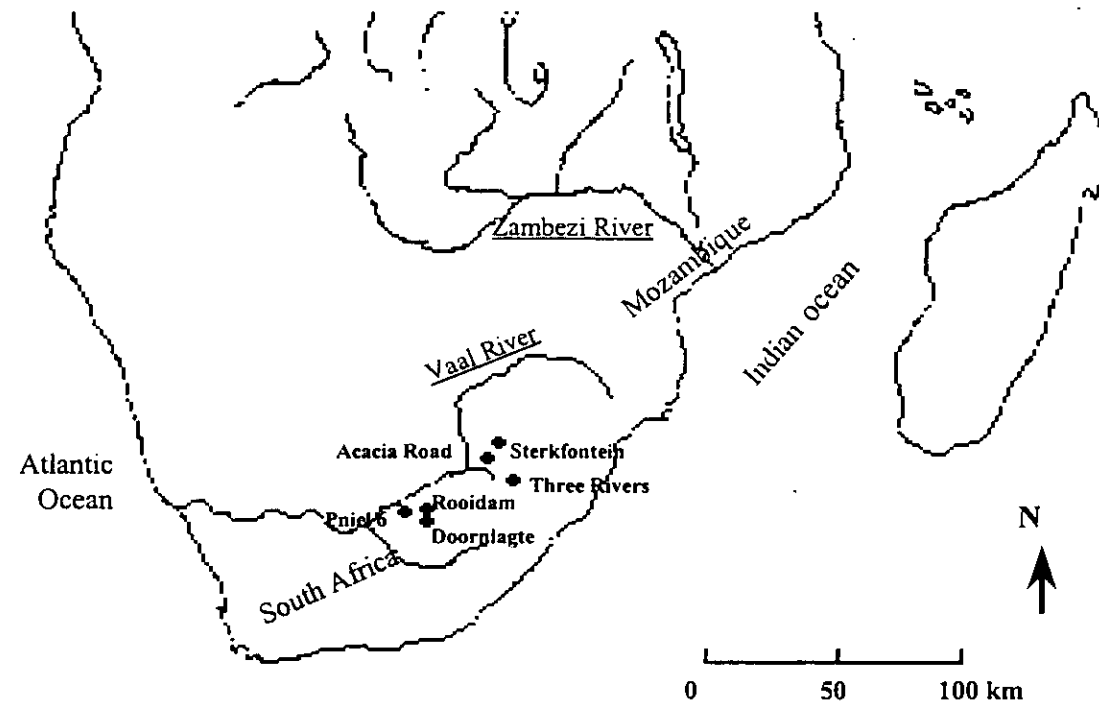


Fig. 2.2.1 Acheulean sites (in bold) in South Africa whose assemblages were used in this dissertation

number, as described below. Finally, and in view of the differences existing among scholars working about the Acheulean period in Africa in basic measurements and descriptive analysis of the artifacts, and in order to avoid possible misunderstandings, I have set out a system to analyze the lithic assemblages studied for the purposes of this research project (bearing in mind the specific purposes of technological evaluation of handaxes and cleavers). The data sheets are present in Appendices 1 and 2. The system combines the use of some variables considered by previous researchers (mainly focused on typological classification), with other variables considered to help gathering information to assess the level of technological competence patterned by each site and regionally.

### 2.2.3 The quest for the Early Acheulean

Sites described as of the early Acheulean have long been documented in South Africa, both in cave and open settings. In Gauteng (part of the former Transvaal), several open sites were identified and excavated in gravels contexts, such as Kliplaatdrift, Three Rivers and Acacia Road (Mason, 1962a, 1985, Beaumont, 1969, Partridge, 1985). These sites have been assigned to the Acheulean because of the presence of "crude looking" handaxes among the artifacts and the geological location in relation to the sequence of the Vaal River system. An example is the handaxe bearing assemblage from the six-meter terrace of the Klip River (tributary of the Vaal River). This site may be just as early (Mason, 1961, 1985, Partridge, 1985) as Sterkfontein, but confirming geological and paleontological evidence is lacking. At Swartkrans, another cave site, although some Acheulean handaxes were recovered from the limeminers' dumps, these artifacts cannot be reliably associated with the *in situ* breccias dated by biostratigraphy (Leakey, 1970, Brain, 1993).

### **2.2.3.1 Sterkfontein**

Since I was able to analyze part of the assemblage from Sterkfontein for my dissertation, I will describe in detail some of the problematic issues related to the interpretation of the assemblage attributed to the Early Acheulean period.

#### **2.2.3.1.1 The stratigraphy**

The stratigraphic sequence of Sterkfontein cave is very complex and not very clear yet (Partridge, 1978, Partridge & Watt, 1991, Clarke, 1994). At Sterkfontein, as Clarke (1985, 1988) and Kuman (1994, 1998) note, the earliest handaxes and cleavers were excavated from the breccia, which constitutes Member 5 East. This unit is now believed to be contaminated by latter infilling, and some of the "classic" Acheulean pieces may have been collected from limeminers' dumps, overburden or soft superficial deposits. New samples come from well-known, secure contexts in Member 5 West, and are currently under study by K. Kuman (1998).

#### **2.2.3.1.2 Age and palaeoenvironment**

Regarding the age of the breccia defined as yielding Acheulean artifacts, previous estimates by biostratigraphy suggested a date around  $1.5 \pm 0.3$  Mya (Stiles & Partridge, 1979) and  $< 2.0$  Mya (Vrba, 1985). The fossil fauna present (mostly bovids) and palynological data indicate an increase in grassland vegetation (Horowitz, 1975, Vrba, 1985).

### 2.2.3.1.3 The Acheulean assemblage studied

The overall Acheulean assemblage of Member 5 contains some 600 lithic pieces, made predominantly using quartz, quartzite and diabase which are found nearby. The collection is housed at the Department of Archaeology, Witswatersrand University, South Africa.

The Member 5 Acheulean assemblage is rich in cores, large chunks and stone fragments, with very few small flakes (Kuman, 1998); the artifacts are fresh and only in a few cases slightly abraded.

The sub-sample analyzed for this dissertation consists predominantly of handaxes and large flakes, totaling 13 artifacts. Kuman (1998) reports that the uncontaminated samples from this Member 5 also yielded a cleaver made on a large flake. This tool has been suggested as showing strong use-wear retouch in the form of large stepped scars at the distal end similar to the wearing patterned at some of the Olorgesailie tools (Isaac, 1977:88-89) and reproduced experimentally in the chopping and shaping of tree branches (Toth, 1982:241, Isaac, 1984:129).

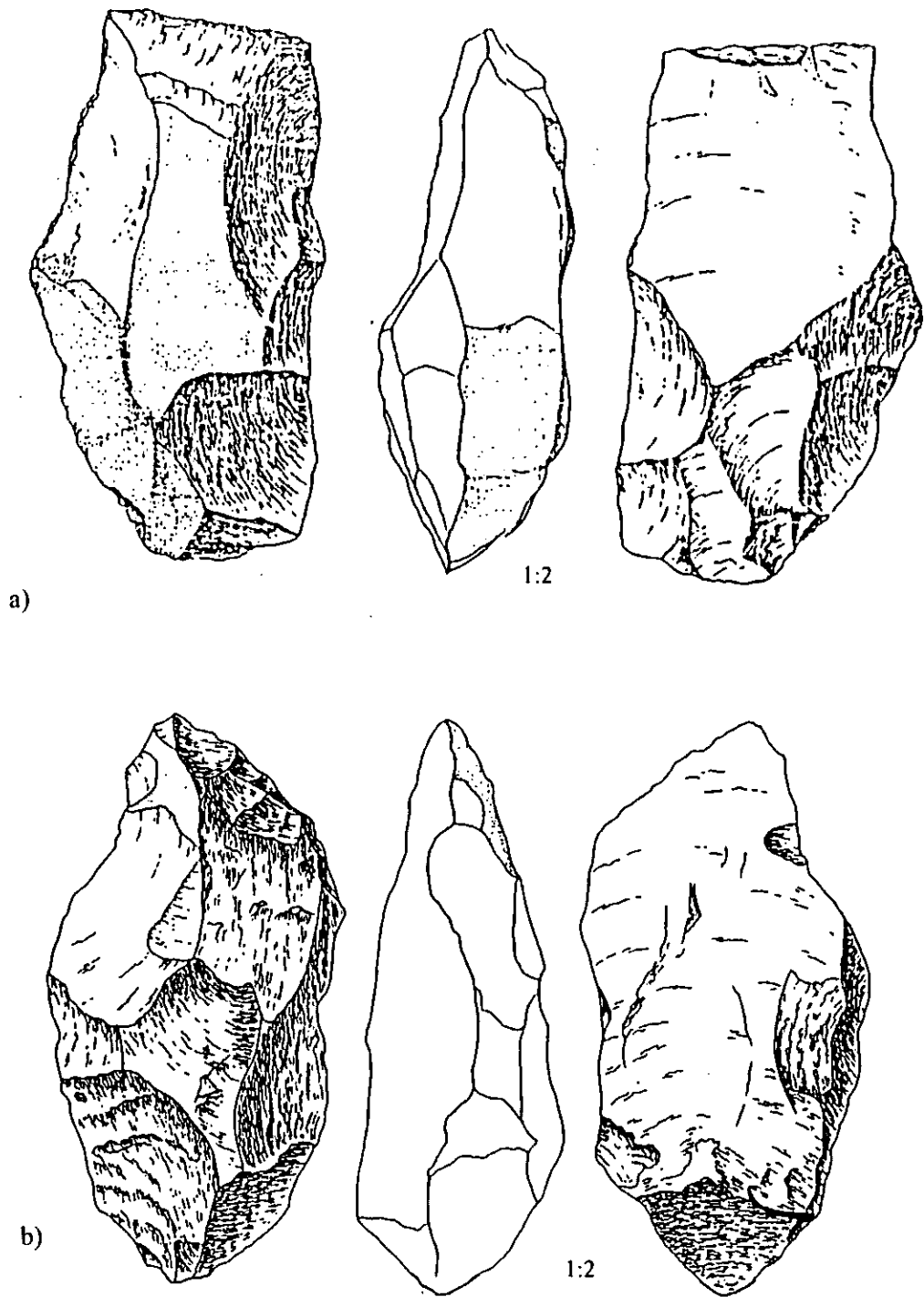


Fig. 2.2.2 Sterkfontein: example of two artifacts made on large quartzite flakes (cortex flake for a)). These artifacts, which were described by Kuman (1998), as cleavers, are indeed single platform cores made on large flakes and split cores (after Kuman, 1998).

Table 2.2.3 Description of bifacially knapped pieces (sts: 9 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt
sts7	quartzite	108	81	62	370	Handaxe?	cortex
sts8	quartzite	126	69	49	400	Cleaver or core?	flaked
sts9	quartzite	106	69	55	480	Handaxe or failure?	cortex
sts10	quartzite	141	71	51	430	Handaxe or core?	flaked
sts11	quartzite	116	70	57	378	Handaxe or core?	flaked
sts12	quartz	95	65	53	360	Handaxe?	cortex
sts13	rhyolite	104	68	32	251	Cleaver	flaked
sts14	chert	93	52	27	125	Handaxe	flaked
sts15	quartzite	126	79	43	478	Handaxe or core?	flaked
<b>Mean</b>		<b>111</b>	<b>68</b>	<b>48</b>	<b>349</b>		
<b>SD</b>		<b>16.1</b>	<b>8.0</b>	<b>12.3</b>	<b>111.8</b>		

The assemblage excavated from Sterkfontein Mb 5 has been ascribed to early Acheulean on the basis of typological affinity, due to the presence of crude looking handaxes and cleavers (Mason, 1962a, 1962b, Kuman, 1998). However, when speaking on technological grounds, and following the interpretations suggested long ago, the pieces described as cleavers are in fact cores on large flakes or split cobbles for obtaining small flakes (see Fig. 2.2.2). Among the bifacial pieces studied, 44% ( $n = 4$ ) of them are clearly cores, and only one cleaver was found (although belonging to the contaminated sample). The manufacture of other pieces using flakes or split cores as a blank has been reported for other post-Oldowan Industries (e.g., single platform cores from the Karari Industry; see Harris, 1978, Rogers, 1997).

The question here lies in the interpretation of the cleaver as a lithic tool. Although the discussion on the characteristic of the production of a cleaver will be developed further on in this dissertation, one should mention that a cleaver is by definition a flake tool (Goodwin, 1933). As I

will be describing in Chapter VI, the cleaver is made on a flake with a predetermined form. As a result, it presents a specific technological distinguishing element – a sharp bevel edge resulting from the intersection of a convex and a concave surface (Tixier, 1956, Balout, 1967).

In relation to the handaxes, of the three pieces securely identified as such, two were made on small cobbles, presenting a cortex butt (see Fig. 2.2.3 and Fig. 2.2.4); a third one was made on a flake (the handaxe made on chert – see Fig. 2.2.5).

Still according to Kuman (1998), very few small flakes were found in the cave, indicating a selection of detached pieces which were removed from the cave by early Acheulean tool makers.

Table 2.2.4 Large flake description (sts: 4 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
sts130	quartzite	85	103	31	320	VI	side-located bulb in relation to the axis of the flake
sts131	quartzite	69	91	28	180	VI	side-located bulb in relation to the axis of the flake
sts132	quartzite	131	125	55	1080	VI	end-located bulb in relation to the axis of the flake
sts133	quartzite	74	115	34	234	V	side-located bulb in relation to the axis of the flake
<b>Mean</b>		<b>109</b>	<b>90</b>	<b>37</b>	<b>454</b>		
<b>SD</b>		<b>14.7</b>	<b>28.3</b>	<b>12.3</b>	<b>421.6</b>		

The largest flakes found are made exclusively using quartzite; the predominant Toth's type is VI (3 flakes – see Fig. 2.2.6), i.e., multifaceted platform with a non-cortical dorsal face. The flakes present predominantly a side-located bulb in relation to the axis of the piece. In addition to the so-called cleavers, a technological reading of some of these large flakes suggests

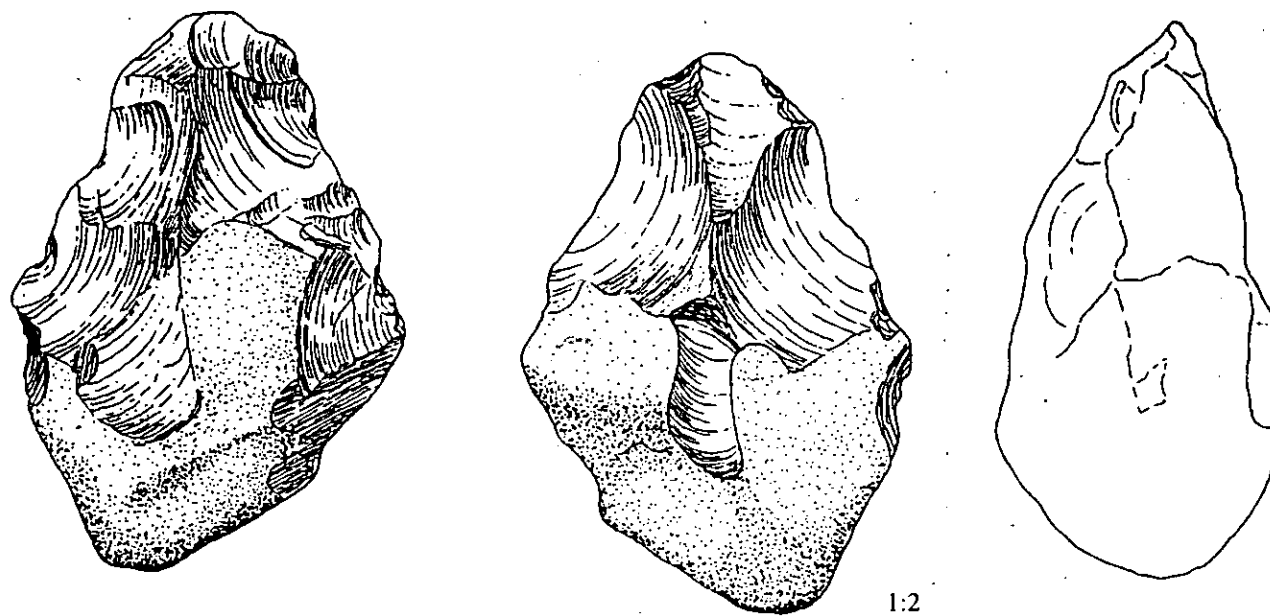
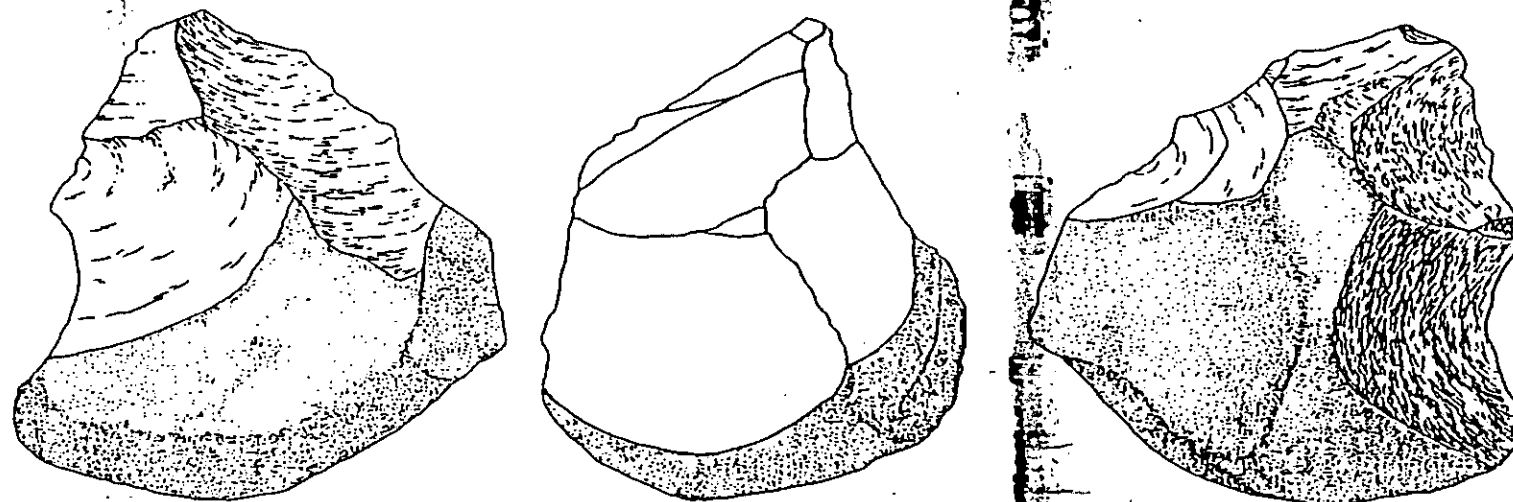


Fig. 2.2.3 Sterkfontein: handaxe on quartzite cobble (after Mason, 1962a)





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Fig. 2.2.4 Handaxe from Sterkfontein, on quartzite cobble (hard-hammer percussion technique). Adapted from Kuman, 1998.

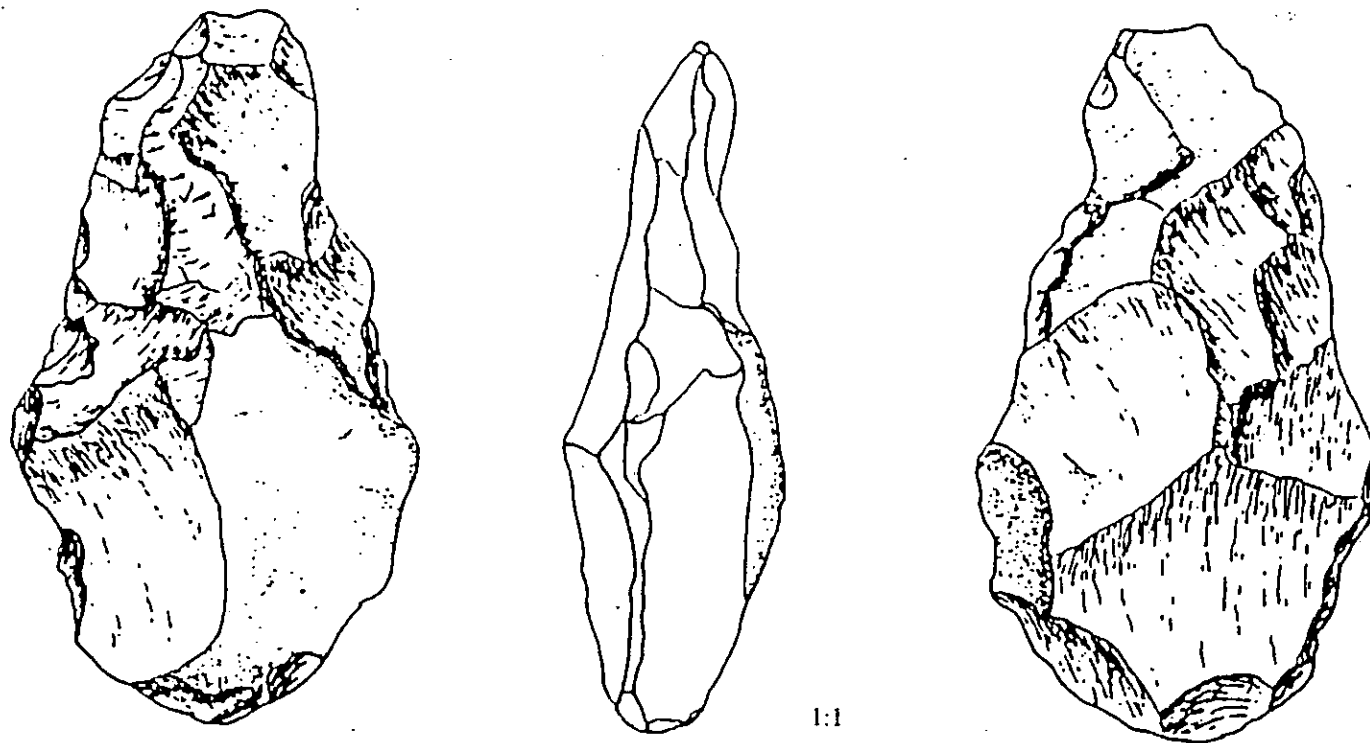
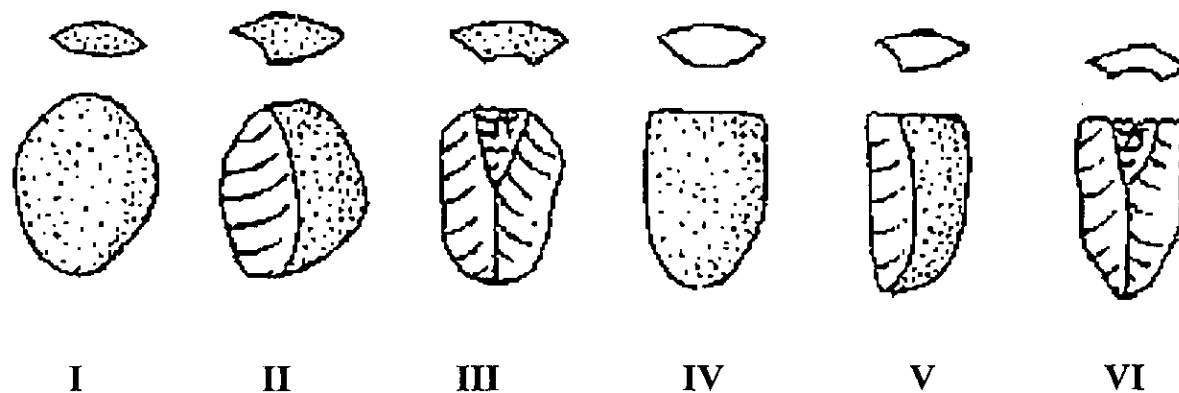


Fig. 2.2.5 Handaxe from Sterkfontein, made on chert. The characteristics presented by this artifact indicate the possible utilization a soft hammer percussion technique for its manufacture (adapted from Kuman, 1998)



**Toth's flake types**

- I - Cortical butt, totally cortical dorsal surface
- II - Cortical butt, partially cortical dorsal surface
- III - Cortical butt, non-cortical dorsal surface
- IV - Non-cortical butt, totally cortical dorsal surface
- V - Non-cortical butt, partially cortical dorsal surface
- VI - Non-cortical butt, non-cortical dorsal surface

Fig. 2.2.6 Toth flake types (after Toth, 1982)

that they have been used as cores, to obtain small size flakes.

### 2.2.3.2 Open Early Acheulean sites from the Younger gravels of the Vaal River

As mentioned earlier (Butzer et al., 1973, Helgren, 1979), all the artifactual occurrences from the Younger gravels of the Vaal River area suggest channel or close to channel sites (river vigorous and/or erosion of the slopes). The high incidence of artifact occurrences evidence intensive and apparently repeated occupation of the area (Butzer et al., 1973). Two sites were selected for study: **Acacia Road** and **Three Rivers**.

The pieces selected to be analyzed were classified previously as "bifaces" (11 pieces), together with 10 large-size flakes.

#### 2.2.3.2.1 The stratigraphy and age

The lithic assemblages from both sites - Acacia Road and Three Rivers were excavated from a hill rubble (Mason, 1962a, Beaumont, 1969). No fauna was found at the sites. Therefore, the attribution of these sites to the Early Acheulean is based exclusively on typological grounds (Mason, 1962a).

Initially the artifact collection from these sites were described as containing distinct groups, depending on the degree of abrasion (weathering) patterned (mostly worn for the Early Acheulean and unabraded for Middle to Later Acheulean). More recently, the character of the artifact surface was considered not to be a secure criteria for indicating the artifacts' age, and since typologically the differences are minimal, both assemblages have been assigned to the early Acheulean (Sampson, 1974).

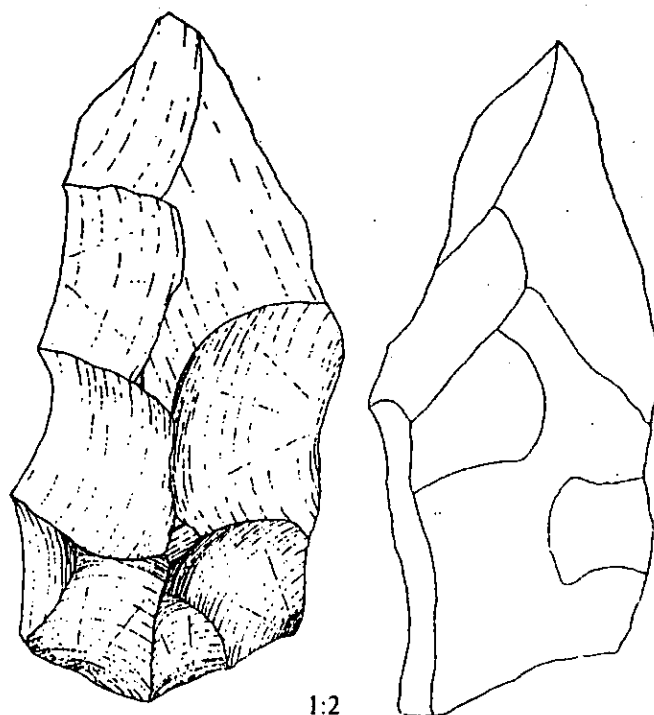
### 2.2.3.2.2 The Acheulean assemblages studied

Both assemblages are kept at the Department of Archaeology, Witswatersrand University, South Africa. Besides the bifacial artifacts and large flakes, the assemblages also include other lithic forms, such as choppers, polyhedrons, etc. They were manufactured using predominately quartzite pebbles from the river gravels. The assemblage from Three Rivers (3r) comprises 313 artifacts and the one from Acacia Road (acr) consists of 311 artifacts. Some of the artifacts from Three Rivers site are represented in Fig. 2.2.7.

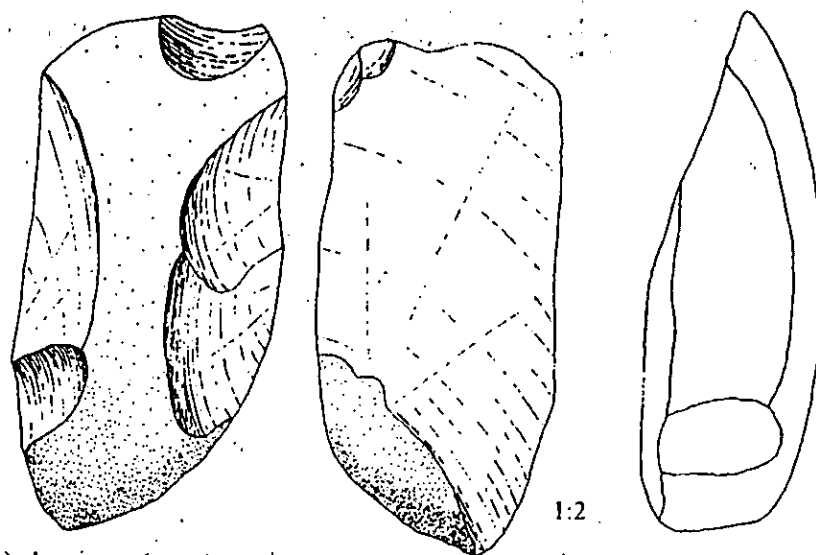
Table 2.2.5 Description of bifacially knapped pieces (11 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt
acr16	quartzite	132	80	51	490	Handaxe	flaked
acr17	quartzite	149	102	49	720	Handaxe	flaked
acr18	quartzite	112	71	44	350	Cleaver	flaked
acr19	quartzite	130	77	45	380	Cleaver	flaked
acr20	quartzite	103	94	55	590	Handaxe or core?	flaked
3r1	quartzite	205	101	75	1390	Handaxe	flaked
3r2	quartzite	117	87	48	506	Handaxe failure?	cortex
3r3	quartzite	132	81	81	710	Handaxe or core?	flaked
3r4	quartzite	156	99	47	720	Handaxe	cortex
3r5	quartzite	134	71	52	478	Handaxe	cortex
3r6	quartzite	133	79	49	520	Cleaver	flaked
<b>acr Mean</b>		<b>125</b>	<b>85</b>	<b>49</b>	<b>506</b>		
<b>acr SD</b>		<b>18.1</b>	<b>12.8</b>	<b>4.5</b>	<b>152.7</b>		
<b>3r Mean</b>		<b>146</b>	<b>86</b>	<b>59</b>	<b>721</b>		
<b>3r SD</b>		<b>31.4</b>	<b>11.8</b>	<b>15.2</b>	<b>344.5</b>		
<b>All Mean</b>		<b>137</b>	<b>86</b>	<b>54</b>	<b>623</b>		
<b>All SD</b>		<b>27.3</b>	<b>11.6</b>	<b>12.3</b>	<b>285.0</b>		

The "rough" stage of production presented by the bifacially knapped artifacts was used



a) handaxe produced using hard hammer direct percussion technique



b) cleaver made on large cortical flake (with cortical platform)

Fig. 2.2.7 Three Rivers: artifacts produced using quartzite (after Mason, 1962a)

as a chronological indicator. As Mason reported (1962a), the level of knapping refinement was not very advanced (including partial trimming) and the artifacts presented, in average, very few negatives scars removed from the artifact. Compared to the handaxes (45.6%), few cleavers were present (27.3 %) among both sampled assemblages. This can be explained because cleavers are produced using flakes detached with the specific objective of preparing this tool, i.e. result from flakes with a predetermined form (Texier, 1996), while handaxe production does not require a pre-determined flake blank. For my sub-sample, all but one handaxe was prepared using a flake as a blank. Since there are no very large boulders nearby, which could have been used to produce large size flakes, this probably accounts for the smaller proportion of the cleavers when compared to the handaxes also made on flakes.

In general, the pieces are fresh, or just slightly abraded; therefore, it is easy to identify the blank used to produce the lithic artifacts studied: 63.6% are made on flakes. The remaining 36.4% bifacial pieces are produced on cobbles, and although previously classified as handaxes, with one exception, they are probably cores (including the initial stage of handaxe manufacture, when the cobble/flake undergoing flaking was abandoned at the roughing-out stage).

When comparing the values of edge angles present at the top and at the middle section (the butt being the last part to be prepared) one notices that the average values for handaxes and pieces classified as cores are quite distinct. This indicates that if some initial effort was put to prepare the tip, the same didn't occur for the middle/central part of the artifact. Indeed, for the handaxes, of Three Rivers and Acacia Road ( $n = 6$ ), the average angle at the side edges is about 84 degrees, against 74 degrees for the top; in the case of the bifacial cores the values are 86.3 degrees for the top and a much wide value -- 93 degrees for the side edges. A Student T-test (at two tails) gave the following results:

Table 2.2.6 T-test for equality of means (handaxes vs. cores)

Variable	2-Tail Sig.
Edge angle value at the tip of the artifact	0.5
Edge angle value along the middle/central part of the artifact	0.02

Thus, the results achieved seem to suggest that the two sub-samples (cores vs handaxes) are distinct. Indeed, the handaxe-like cores present strong evidence of an initial and careful preparation of the tip. The careful preparation of the tip strongly contrasts with the central part of the artifact, where the very wide angles of the "non-finished" artifacts clearly suggest that they were abandoned during the initial stage of handaxe manufacture. A probable reason for their abandonment may be related with a strong loss of mass exhibited by these artifacts. The initial negatives of flake removals are quite deep, and the plane profile very irregular: the average length of the perimeter of these "failures" is almost identical to the "finished" handaxes, i.e., about 31 centimeters. A T-distribution test run for testing the similarity of this last variable equals 0.01, once again hinting at the fact that one is observing morphologically similar forms, which had totally distinct "life stories", in terms of the goal set for them by the prehistoric artisans.

Still, and for the Three Rivers site for example, the overall assemblage (Mason, 1962a) contains 26.2 % handaxes and cleavers; the choppers and cores constitute almost half of the assemblage (44.7%), and the remainder are flakes (29.1%). This fact *per se* strongly suggests that we are in fact observing a workshop where Acheulean knappers would come to test the raw material and prepare artifacts which were latter taken with them to be used elsewhere. However, the overall analysis of this assemblage was beyond the limits of my dissertation, since it would



have been very time consuming. Therefore, it is not possible to perform any frequency tests among the artifact types present here vs. the other assemblages; this task, however, should be accomplished in a near future.

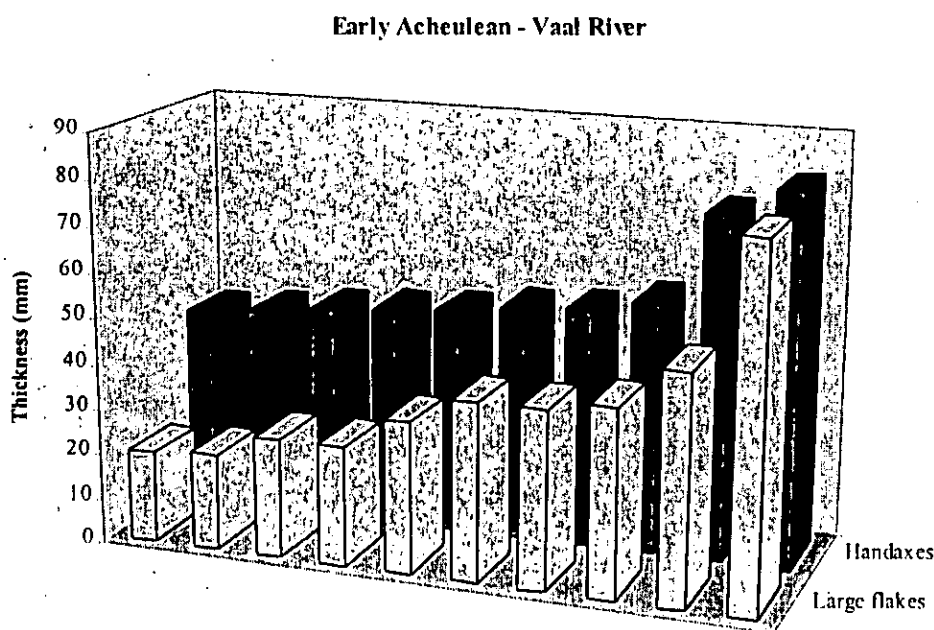
Table 2.2.7 Large flake description (10 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
acr134	quartzite	175	95	26	470	VI	end-located bulb in relation to the axis of the flake
acr135	quartzite	142	92	39	460	VI	end-located bulb in relation to the axis of the flake
acr136	quartzite	165	133	41	1100	VI	Kombewa flake
acr137	quartzite	170	137	78	1700	V	end-located bulb in relation to the axis of the flake
3r124	quartzite	87	60	20	143	V	end-located bulb in relation to the axis of the flake
3r125	quartzite	85	86	26	396	VI	end-located bulb in relation to the axis of the flake
3r126	quartzite	71	48	21	78	V	end-located bulb in relation to the axis of the flake
3r127	quartzite	84	95	33	296	II	side-located bulb in relation to the axis of the flake
3r128	quartzite	114	81	39	378	V	end-located bulb in relation to the axis of the flake
3r129	quartzite	114	69	50	369	II	end-located bulb in relation to the axis of the flake
<b>acr Mean</b>		<b>163</b>	<b>114</b>	<b>46</b>	<b>933</b>		
<b>acr SD</b>		<b>14.6</b>	<b>24.1</b>	<b>22.4</b>	<b>592.8</b>		
<b>3r Mean</b>		<b>93</b>	<b>73</b>	<b>32</b>	<b>277</b>		
<b>3r SD</b>		<b>36.5</b>	<b>29.9</b>	<b>14.3</b>	<b>160.0</b>		
<b>All Mean</b>		<b>121</b>	<b>90</b>	<b>37</b>	<b>539</b>		
<b>All SD</b>		<b>39.5</b>	<b>28.5</b>	<b>17.2</b>	<b>491.9</b>		

The flakes from Acacia Road are larger than the ones from Three Rivers. However, I

observed an inverse situation for the bifacial artifacts. Although one could argue that some of the flakes from Acacia Road could be used as handaxe blanks, the fact that they are normally second and third generation flakes indicates a selection for the first and second generation flakes in handaxe manufacture, normally thicker. In fact, the remaining flakes from these assemblages are too thin to allow further retouch, and hence, to allow the production of handaxes.

Fig 2.2.8 Vaal River - Early Acheulean: thickness of large flakes vs. of handaxes made on flakes



A particular feature of the studied artifact sample is the high incidence of end-located bulbs (60.0%). As some researchers have suggested (Isaac & Keller, 1968), the later Acheulean sites tend to show an increase in the proportion of flakes with an end-located bulb of percussion.

At **Acacia Road** one gets the glimpses of the new technology emerging, in terms of prepared core technique in the form of the Kombewa flakes, i.e., flakes presenting a bulb of

percussion on both sides (a more detailed description of the Kombewa method will be presented in Chapter VI). At Acacia Road, Kombewa flakes (where still a significant component of the flakes present a side located bulb of percussion) are found either used as blank forms for handaxes (one case) or still a broken, but recognizable one (9.5% of the overall sub-sample).

#### 2.2.4 The Later or Upper Acheulean

As mentioned already, in the Vaal River area typology (i.e., the assumed level of refinement) has been used to date both the geological context and to define culturally the assemblages.

For the lower Vaal River basin during the Late Acheulean, natural processes led to the formation of large concentrations of artifacts where "finely made" handaxes predominate, and where prepared core technique is present since early times. Victoria West and Kombewa cores are good examples of distinct technological methods developed to produce flakes with a predetermined form (Goodwin, 1928, 1933, Goodwin & Riet Lowe, 1929, Riet Lowe, 1937, 1945, Owen, 1938, Malan, 1947, Humphreys, 1969, Sampson, 1974; Helgren, 1978).

For my research I was able to study the Upper Acheulean assemblages from **Pniel 6**, **Rooidan** and **Doornlagte**. The assemblages studied are housed at the McGregor Museum, in Kimberley, South Africa.

#### **2.2.4.1 Pniel 6 (pn6)**

##### **2.2.4.1.1 The site and stratigraphy**

Pniel 6 is located in the channel and on the south bank of the Vaal, northwest of Kimberley. The archaeological accumulations, here abutting a low andesite hill, were initially described in the late 20's by scholars such as Goodwin and van Riet Lowe (1929; see also Goodwin 1928a), etc. Since then, diamond mining has largely destroyed the deposits.

Beaumont (see Beach & Morris, 1990) resumed the excavations in 1984. The geological sequence identified four strata in this area, with the Acheulean artifacts found in the lower stratum IV (Butzer et al., 1973, Helgren, 1978, 1979).

##### **2.2.4.1.2 The lithic assemblage**

The excavated collection contains about 6,700 objects, the vast majority of which are flakes. For this study, I used the bifacial pieces from three boxes, totaling 155 artifacts. Of them, about 70% were flakes, with handaxes, cleavers and cores representing the remaining 30%.

The raw material used to manufacture handaxes and cleavers is andesite and hornfels (indurated shale), found in abundance in this area of the Vaal River. The preponderant form of handaxes is "almond shaped", carefully retouched (Goodwin & Riet Lowe, 1929, Beach & Morris, 1990).

Table 2.2.8 Description of the bifacially knapped pieces (pn6: 18 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt
pn61	andesite	186	97	45	847	Cleaver	flaked
pn62	andesite	171	95	45	921	Handaxe	flaked
pn64	andesite	187	96	51	1063	Cleaver	flaked
pn66	andesite	130	70	29	276	Handaxe	flaked
pn67	andesite	177	75	45	727	Cleaver	flaked
pn68	andesite	185	97	47	827	Cleaver	flaked
pn69	andesite	144	71	42	410	Cleaver	flaked
pn610	andesite	204	82	46	781	Handaxe	flaked
pn613	andesite	169	81	38	458	Handaxe	flaked
pn614	andesite	204	100	45	984	Cleaver	flaked
pn621	andesite	175	93	32	641	Handaxe	flaked
pn63	hornfels	151	89	40	508	Cleaver	flaked
pn65	hornfels	117	79	27	249	Handaxe	flaked
pn611	hornfels	210	114	51	1287	Cleaver	flaked
pn612	hornfels	112	68	28	267	Handaxe	flaked
pn615	hornfels	131	67	41	346	Cleaver	flaked
pn616	hornfels	193	90	42	679	Handaxe	flaked
pn617	hornfels	112	67	27	210	Handaxe	flaked
<b>Mean</b>		<b>164</b>	<b>85</b>	<b>40</b>	<b>638</b>		
<b>SD</b>		<b>32.9</b>	<b>13.7</b>	<b>8.1</b>	<b>316.3</b>		

Because of the raw material size present at the site, handaxes and cleavers made on andesite are bigger and heavier, when compared to the ones manufactured on hornfels.

Initially, it was assumed that the raw material had no influence on the differences presented by the handaxes from these sites. Therefore, a chi-square test was used to test this null hypothesis. The critical value at  $\alpha = 0.05$ , with  $df = 2$  is  $\geq 3.84$ . Since the  $\chi^2$  exceeds this value ( $= 7.2029$ ), the null hypothesis of no difference was rejected. In fact, the examination of the data revealed a clear-cut difference among the handaxes produced on these two distinct types of raw material, a difference greater than what could be expected by chance alone.

Table 2.2.9 Mean values of handaxes depending on raw material

Raw Material	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (gr.)
Andesite	176	84	42	721
Hörnfels	147	82	37	507

Most of the handaxes and cleavers from Pniel 6 (94.4%) are made on flakes. They were lumped as bifacial artifacts because most of them (in this particular case) do show bifacial flaking.

The cleavers total half of the assemblage, a surprisingly high number, when compared to other Acheulean sites in the region. This result may have come about an unconscious biased collecting procedure. Still regarding the flakes used as blanks for cleavers' manufacture, two of them (22.2%) were made using Victoria West cores (the so-called "proto-Levallois" cores; Riet Lowe, 1945).

Table 2.2.10 Large flake description (pn6: 3 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
pn618	andesite	133	90	43	538	VI	end-located bulb in relation to the axis of the flake
pn619	andesite	148	106	45	715	VI	end-located bulb in relation to the axis of the flake
pn620	andesite	122	98	17	305	V	end-located bulb in relation to the axis of the flake
Mean		134	98	35	519		
SD		13.0	8.0	15.7	205.7		

There are, proportionally speaking, very few large flakes (longer than 100 mm) present

in the assemblage studied. The flakes studied present a carefully prepared platform, but are quite thin to allow further retouch:

The flake component is essentially bereft of blades or points, thus indicating that we are not observing a MSA industry.

#### 2.2.4.1.3 Faunal remains

Pniel 6, as most of the Vaal sites, is located in a channel setting. The bone assemblage is too fragmented to allow deeper insights regarding the role of hominid intervention in the formation of the faunal assemblage. Although the bone surface is too weathered, and the bones too fragmented, it became possible to identify several species present in the assemblage. The predominant fossil species are large ungulates (*Equus*, hippopotamus, rhinoceros, antelopes, wildebeest and giant cape horse) most of which were grazers, typical of open environments (Beach & Morris, 1990).

#### 2.2.4.2 Doornlagte and Rooidan

Doornlagte and Rooidan are situated close to each other, in northern Cape, on the Vaal River area (Mason, 1967a, Butzer, 1974). These two late Acheulean sites were discovered and studied in the 1960's (Mason, 1966, 1988, Fock, 1968).

##### 2.2.4.2.1 The sites, age and stratigraphy

Both Doornlagte and Rooidan are open-air sites, located on the edge of pans. The raw material used to produce the artifact is predominately andesite and hornfels (indurated shale),

which is found in the dykes located nearby (about one to two kilometers away).

A total of 18.791 lithic pieces were collected at **Rooidan**, of which only 33% present some sort of retouch. The high percentage of waste products near to a good source of raw material led Fock (1968) to describe the site as a condensed sequence of penecontemporaneous occupations. Here at Rooidan, the artifacts were found spread vertically (for about one meter) through sands from deep pan deposits. The predominant lithic pieces are flakes smaller than six centimeters (about 67% of the artifacts). As referred by Mason (1967a) and Fock (1968), handaxes and cleavers represent only 2.5% of the artifacts found (i.e., of the about 6,000 lithic pieces presenting some kind of retouch); the handaxes are mainly "of elongated form".

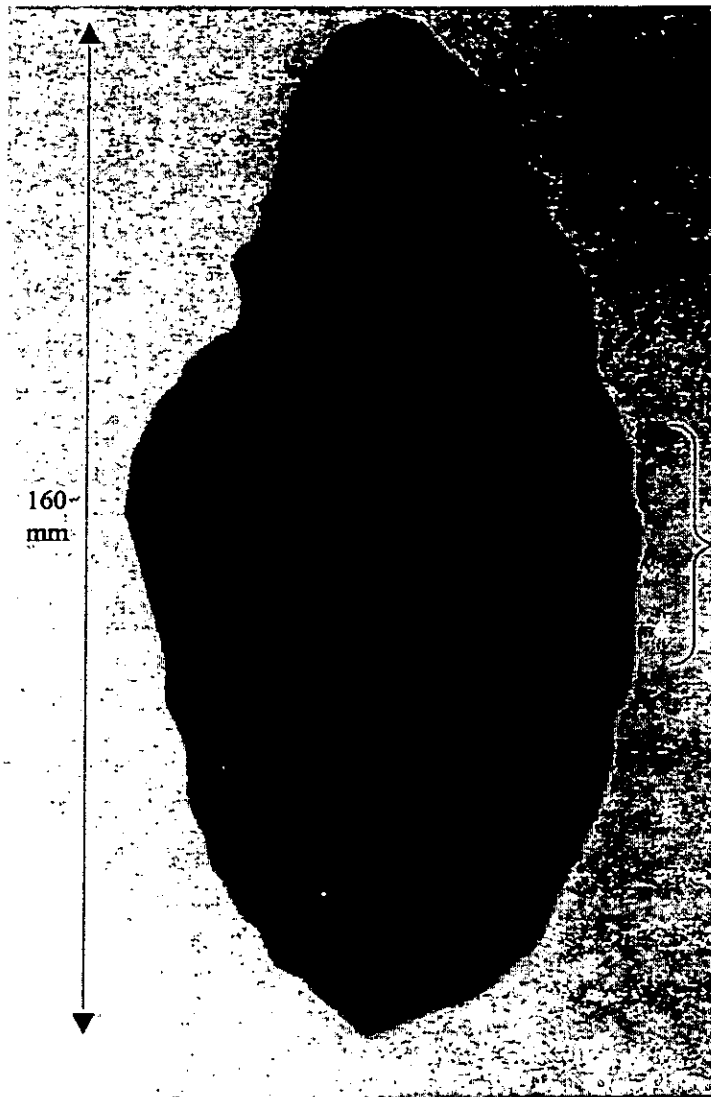
**Doornlagte** is also located on the edge of a pan, in a gentler sedimentary environment. As mentioned by Mason (1966, 1967b), the partial excavation of this site revealed a thick palimpsest; in fact, a large concentration of artifacts (about 2,000) was found in a horizon of about a meter thick.

Although no bones or teeth were found in both sites, Rooidan, as I mentioned already, has been dated circa 174,000 Kya by Uranium series dating (Szabo & Butzer, 1979).

#### 2.2.4.2.2 The lithic assemblage

The assemblages collected at both sites, and classified as of Later Acheulean included, besides handaxes and cleavers, picks, artifacts on flakes (such as scrapers and knives), choppers, bolas, etc. (Mason, 1966, 1967b, 1988, Fock, 1968).





a) Handaxe (hornfels) from Rooidan  
(South Africa).

b) detail of the side profile

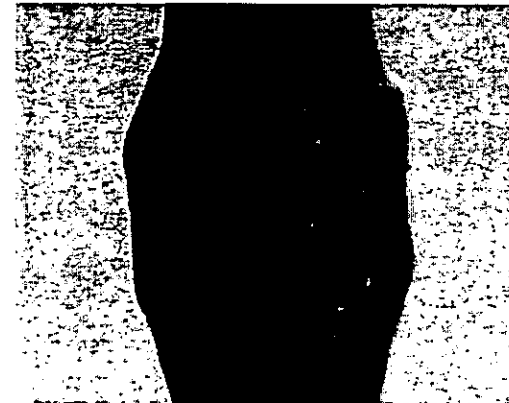


Fig. 2.2.9 Handaxe from Rooidan, manufactured using a soft hammer percussion technique.

Among several characteristics, this tool presents:

- a quite straight outline (plane view), with a flake sequence regularly spaced;
- no cortex (with flaking reaching up to the center of the piece);
- a flat/thin cross section;
- a narrow side edge angle;
- a more or less straight side profile ("straight blade").

Table 2.2.11 Description of bifacial pieces (10 pieces)

Handaxes & Cleaver	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt
roo1	andesite	144	89	41	560	Handaxe	flaked
roo2	andesite	137	65	51	467	Handaxe or core?	flaked
roo3	hornfels	89	51	36	148	Handaxe	flaked
roo5	andesite	148	73	39	402	Handaxe	flaked
roo7	andesite	81	74	39	285	Handaxe or core?	flaked
roo8	hornfels	157	65	29	300	Handaxe	flaked
roo9	andesite	125	62	33	264	Cleaver	flaked
roo10	andesite	141	98	32	523	Handaxe	flaked
dor1	andesite	202	125	73	1734	Handaxe	flaked
dor2	andesite	272	123	68	2380	Handaxe	flaked
<b>Mean</b>		<b>150</b>	<b>83</b>	<b>44</b>	<b>706</b>		
<b>SD</b>		<b>54.8</b>	<b>25.6</b>	<b>15.2</b>	<b>738.8</b>		

The preferred blanks to produce the bifacial pieces were flakes (60%), of which two pieces were made on Kombewa flakes (the cleaver and a handaxe). As Humphreys (1979) pointed out, and I was able to observe while visiting the area, the raw material (both for andesite and hornfels) constituted an important constraint for the production of artifacts, since its size did not allow for the detachment of very large flakes.

Some authors have used an apparent trend suggesting a decrease of length and an increase in relative handaxe breadth as a basis for time ordering the assemblages from the upper part of the Younger gravels (e.g., Keller, 1970). Others still (e.g., Humphreys, 1969, 1979), have argued that this pattern is due mainly to the quality of raw material used to prepare the artifacts. Fig. 2.2.9 is illustrative of a handaxe from Roodan, manufactured using a soft hammer percussion technique. The use of a soft hammer results in a "carefully trimmed plane profile and thinner cross section" (Humphreys, 1969). Hence, the Roodan assemblage which some have

attributed to the Fauresmith period (Sampson, 1974), should be actually classified as of late Acheulean age, based on the artifacts present and on the dating (Humphreys, 1979).

Table 2.2.12 Large flake description (2 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
dor138	andesite	226	130	47	1527	VI	end-located bulb in relation to the axis of the flake
roo139	hornfels	68	50	45	121	VI	end-located bulb in relation to the axis of the flake
<b>Mean</b>		<b>147</b>	<b>90</b>	<b>46</b>	<b>824</b>		
<b>SD</b>		<b>111.7</b>	<b>56.6</b>	<b>1.4</b>	<b>994.2</b>		

There are very few large flakes present among the artifacts collected, a feature referred to by both Fock (1968) and Mason (1988); this feature is especially striking at Rooidan. Indeed, and specifically at Rooidan, the reduced number of bifacial artifacts (where even some of them may be in fact cores) and large flakes, suggests that a selection for big flakes was occurring along the sites located in the vicinity of raw material sources; this fact, together with the presence of hammerstones in the assemblage (amongst our sample there was one hammerstone -- a broken dolerite cobble, with a battered surface, weighting about 350 gr.) reinforces the idea that the production of large bifacial artifacts was taking place at this site.

#### 2.2.4.2.3 Context interpretation

Further interpretation of these apparently repeatedly occupied Acheulean sites in "near-primary" context is limited by the absence of organic remains with the artifacts (e.g., Fock, 1968, Mason, 1962a, 1988, Deacon, 1975). This has been interpreted as resulting from a depositional

bias, since most of the sites described as of Acheulean period are found close to water sources, and therefore normally not in primary or close to primary context (Deacon, 1975, Klein, 1994).

Specifically for the case of Rooidan and Doornlagte (Mason, 1988), it has been suggested that these sites located nearby shallow water lakes were probably exposed to the elements for a protracted period, prior to eventual burial of the lithic artifacts (Fock, 1968, Mason, 1999).

### 2.2.5 Conclusion

The principal basis for classifying Acheulean industries has long been the comparison of "bifaces" morphology. A full discussion of the implications of comparative data (both from South African Acheulean sites and from the replicative program) for assessing the relationships of southern Mozambique data will be taken up in chapters V, VI and VIII. However, I would like to document some of the features that have been discussed in the literature as the predominant patterns emerging during this time period (all bifacial tools were considered during the collection analysis, but the more specific study was performed only on the handaxes):

- the refinement of flaking technique (frequently used for dating purposes as I stated earlier)
- a technological improvement in terms of artifact manufacture (justified by an increase in the careful trimming presented by latter pieces).
- and increase standardization in artifact forms in later times.

Table 2.2.13 Handaxe length (rank ordering list of sample means)

Localities (Southeastern Africa)			
Range (mm)	Lower Pleistocene	Middle Pleistocene	Middle/Upper Pleistocene
< 110	Sterkfontein Mb5		
111-120		Olorgesailie LSS	
121-130	Three Rivers		Rooidan
131-140	Olduvai EF-HR		
141-150		Isimila H20	Montagu L3 Amanzi
151-160		Kalambo Falls A5 B	Pniel 6
161-170		Kalambo Falls A5	
171-180	Peninj		
181-190		Isimila K 6 Kalambo Falls A6 Kalambo Falls B5	
>191		Olorgesailie- Catwalk	

Sources (other than my personal data)

- a) Olduvi, Leakey, 1971, 1975, 1994
- b) Peninj, Isaac, 1967
- c) Isimila, Kleindienst, 1961
- d) Amanzi, Deacon, 1970
- e) Rooidan, Fock, 1968
- f) Three Rivers, Mason, 1962a
- g) Montagu, Keller, 1973
- h) Kalambo Falls, Clark, 1969, 1974

This table clearly indicates that a consistent time trend in "biface" morphology is not obvious both among Southern and Eastern African assemblages where the sequences are known through stratigraphy and/or dating.

Still regarding the question on the potential identification of temporal tendencies among Acheulean assemblages, the ratio Breadth/Length (B/L) has been used by several authors (e.g., Volman, 1984, Mason, 1988) as a means of evaluating a progressive trend through towards an increasingly standardization of the handaxe shape.

Table 2.2.14 Breadth - Length (B/L) ratio for handaxes

Range (mm)	Localities (Southeastern Africa)	
	Early Acheulean	Late Acheulean
.50		Kalambo Falls B5 Kalambo Falls A 5
.55	Peninj, Olduvai EF-HR Isimila H20	Pniel Kalambo Falls A6 Kalambo Falls A5 B
.60	Three Rivers Olorgesailie LSS	Montagu L3, Amanzi Rooidan
>.66	Sterkfontein	

Finally, some authors (e.g., Isaac, 1977) have hinted that a marked distinction between earlier and later Acheulean samples emerges in the mean scar numbers present per piece and in the assemblage on average

The image we obtained for South Africa though is not very explicit in this respect.

Table 2.2.15 South African Acheulean assemblages: flake scar counts on handaxes

Range of Flake scar count	21-25	26-30	31-35	>35
Early Acheulean	Sterkfontein Three Rivers Acacia Road			
Late Acheulean		Doomlagte		Rooidan Pniel 6

The data obtained only suggests that the lowland area sites may be in fact similar, in terms of intensity of flaking, to the early Acheulean sites from South Africa. In sum, the examples briefly discussed suggest that temporal trends are neither unilinear nor irreversible, and that the use of biface typology in age estimates is strongly misleading. However, the low degree

of control on dating, on context and on our site data base set strong limits to assessments about evaluation of toolmaking based on older, typological oriented, studies.

In fact, these trends, although aimed at being defined "technologically" by some authors (e.g., Stiles, 1991) they are grounded on a typological evaluation of the "bifacial" forms found at the various sites, assuming that artifacts are the final product, the mental template of their manufacturer. The isomorphism of technological attributes in lithic analysis is quite difficult to evaluate, and hence, people functioning in terms of "formal type classification", observing the artifacts as final, end-products, tend to lump distinct technological categories. Later, when used to explain the presumed archaeological counterpart, the relationships observed have no predictable value, because they are not cognitive.

The picture drawn in this chapter clearly shows that the results of the various approaches applied to South African sites in terms of typological analysis proved that this avenue of investigation has become sterile, and that the use of bifaces as a temporal indicator, i.e., as "fossil directeurs" is impracticable. This is because technologically distinct artifacts have been quite often analyzed together (i.e., handaxes and cleavers) and the metrics used do not reflect the difference, thus the impracticability of trying to assess temporal trends. Indeed, the level of technological complexity potentially present at each site, in terms of knapping activities performed there, is unknown since no serious technological analysis has ever been applied to the lithic assemblages in the area.

All these facts just mentioned above make a clear case for a technological evaluation of the assemblages, before assigning any cultural/industrial affiliation. It also points out the range of problems associated with any attempt to establish comparative regional analysis, especially when Southern African paleoanthropological data is used as an "anchor" to correlate Mozambican assemblages.

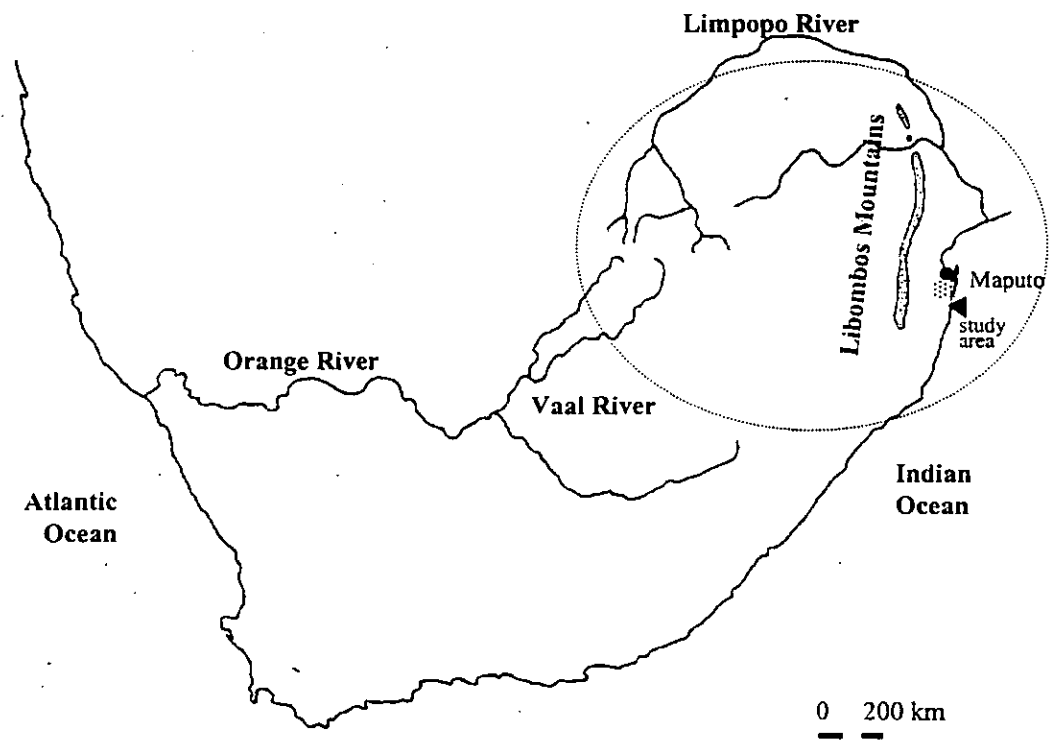


Fig. 3.1.1 Southern Africa. The dotted circle indicates the broader area from where available paleoenvironmental data were used for this study



## CHAPTER III – THE PAST LANDSCAPES IN SOUTHERN MOZAMBIQUE: THE QUATERNARY PALEOENVIRONMENTAL RECORD OF SOUTHERN AFRICA WITH EMPHASIS ON THE PLEISTOCENE

### 3.1 INTRODUCTION: THE REGIONAL SETTING

Bearing in mind the main objective of this study – to characterize the earliest stone age industries from southern Mozambique from the perspective of technological complexity present (both in terms of manufacture and use of artifacts), the emphasis was placed on location where Acheulean hominids focused their behavior and not just on the deposition of objects. In fact, one of the major aspects of the research has been the question of causality, and in particular the extent to which landform, climate and associated environmental changes influence the technological complexity patterned by Acheulean hominids in southern Mozambique.

Although the past geological history of southern Mozambique has been studied in some detail (Afonso, 1976, Momade, 1990), there is very little information of paleoenvironmental character for the specific area where this study was conducted in southern Mozambique (the Umbeluzi-Changalane-Tembe area). While the geological description is restricted to southern Mozambique, the paleoenvironmental information present here is based on research developed for a broader area. This includes, besides the study area, the adjacent territories of Swaziland and mostly of South Africa (Kwa-Zulu – Natal and Gauteng) for the late Tertiary and Quaternary periods (i.e., for the last part of the Neogene), as indicated in Fig. 3.1.1. Still, a detailed consideration of early Quaternary paleoenvironmental changes in Southern Africa is a topic of too great complexity to be properly evaluated within the scope of this dissertation. Besides, the knowledge of the region's geomorphology, geography and biotic environments during the Middle Pleistocene is very limited. In this broader region, with the kind of geological history and environment present, it is quite difficult to

achieve a fine temporal resolution in terms of paleoclimatic and paleoenvironmental reconstructions (Gasse, 1995); however, these reconstructions improve themselves towards more recent periods (e.g., van Zinderen Bakker, 1976, 1982, 1983, Price-Williams, et al., 1982, Scott, 1984, Nicholson, 1985, Maud, 1986, Campo et al., 1990, Partridge et al., 1990, Deacon, 1990b, Cerling 1992, Tyson & Lindsay, 1992, Partridge, 1993). As several authors have mentioned, the reconstruction of past climatic and environmental events is rendered difficult by the disparity in spatial and temporal distribution of evidence, the variation in regional importance of the distinct types of evidence and the lack of agreement in interpretation of the same data (Butzer, 1975, 1984, Butzer & Cooke, 1981, Deacon & Lancaster, 1988, Tyson, 1990). This situation is made more complex by the impossibility of dating accurately the data obtained (Scott, 1984, Deacon & Lancaster, 1988, Vogel, 1984). In fact, one is faced with an almost complete absence of long "conventional" records on land (i.e., from lakes, pollen records, etc.). Therefore, the data often appears to be somehow contradictory, especially for rainfall and type of vegetation cover, and it is uncertain whether the evidence reflects methodological or theoretical inadequacies, or still subtle deviations of the environmental history of the source sites themselves (Butzer, 1984, Gasse, 1995).

### 3.2 THE PAST LANDSCAPE: SETTING THE GEOLOGICAL FRAMEWORK

Numerous aspects of modern-day physiographic character of Southern Africa were apparently in place by the end of the Miocene (e.g., King, 1972, 1978, Truswell, 1977, Pritchard, 1979, Dingle et al., 1983). However, the onset of the coastal plains below the Libombos Mountains dates to a later period, the Pliocene and Pleistocene. The discussion in this section will be confined to the description of the major stages of the geological past of southern Mozambique; the full distribution and extent of formations occurring on a wider scale is not dealt with

Geologically, the area is underlain by Jurassic rocks of the Karoo Supergroup, as well as by rocks of Mesozoic and Cenozoic origin. The dominant country rocks are basalts and rhyolites, which form the Libombos range structure. Hence, the discussion in this section will be restricted to a general description of the major geological stages of the geological past of the area under study. This is aimed at obtaining insights regarding the geological and paleoenvironmental factors that influenced the formation and distribution of the archaeological sites studied for this dissertation.

In this region, a distinctive feature of the landscape is the absence of caves or rock shelters. In fact, cave formation is usually the result of differential weathering or erosion of weaker rocks between more competent layers. In the case of the Libombos rhyolites, these are siliceous rocks, which are resistant to erosion or solution (G. Botha, per. comm.). Consequently, there is just one case of two rock shelters -- Caimane I and II -- in the area, a site with relatively long and unbroken archaeological record from the Middle Stone Age through the Iron Age. The preliminary evaluation of the lithic and fossil remains from test-pit excavations performed at these sites will be briefly discussed in the next chapter of this dissertation.

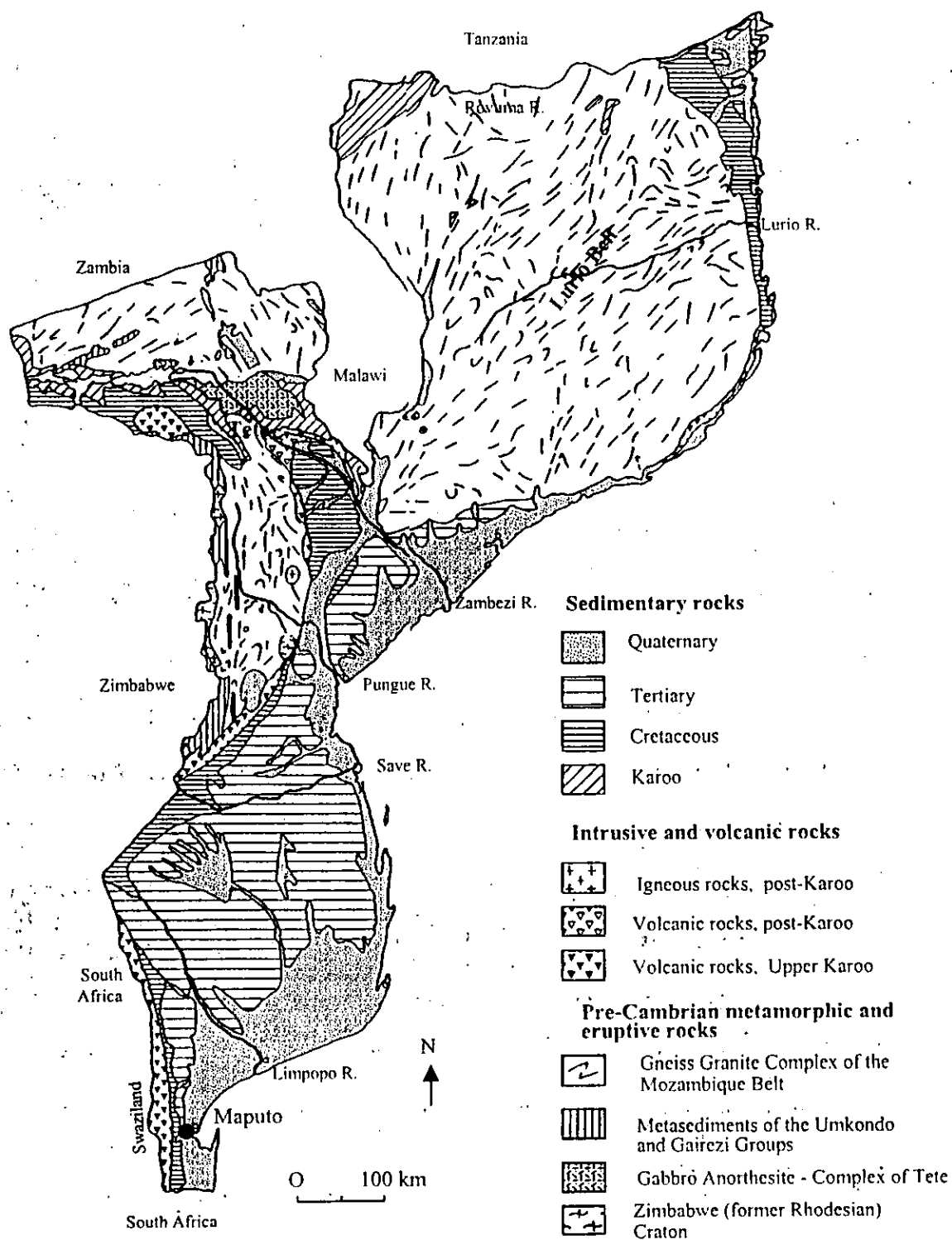


Fig. 3.2.1 Geological outline of Mozambique (adapted from Ferro & Bouman, 1987)

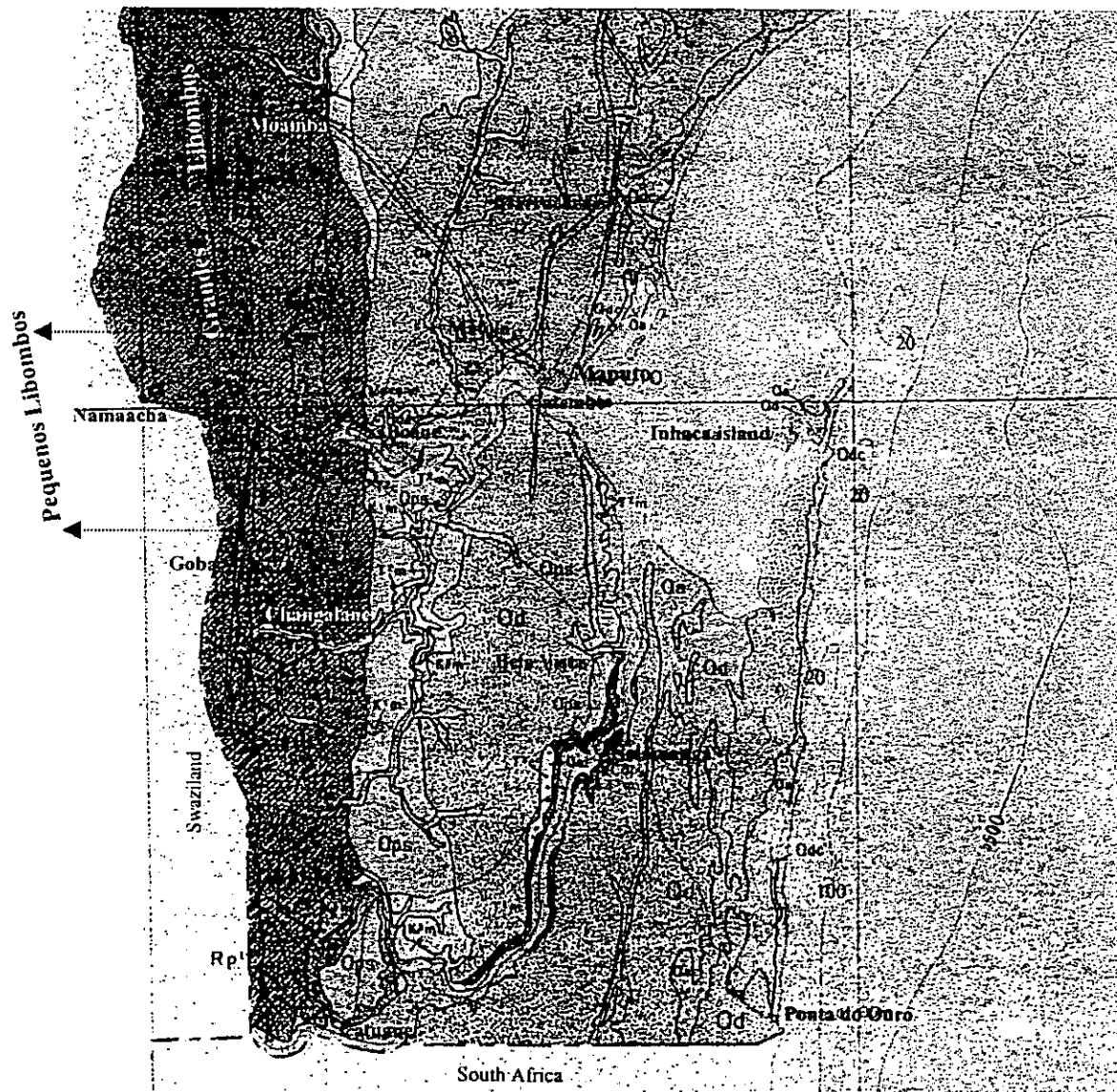


Fig. 3.2.2  
 Geology of southern  
 Mozambique:  
 Maputo province  
 (extracted from  
 DNG, 1987).  
 See next page  
 for the key to the  
 map.

Key to Fig. 3.2.2. Geological description of southern Mozambique (Maputo province; extracted from DNG, 1987)

#### Quaternary

- Qdc – Coastal dunes
- Qd – Interior dunes
- Qa – Recent alluvial sediments
- Qc – Bar-finger sands
- Qps – Fluvial sediments (sands and silts)
- Qt – Older sediments (Lower to Middle Pleistocene)

#### Cenozoic

- T<sup>1</sup>m – Fossiliferous limestone from Salamanga Formation
- T<sup>2</sup>m – Calcareous sandstones (Tembe Formation)
- T<sup>2</sup>c – Ferruginous sandstone – Magude and Boane

#### Mesozoic

- K<sup>1</sup>m – Maputo Formation – glaucous to silty sandstone
- K<sup>3</sup>m – Calcareous fossiliferous sandstone (Incomanine)
- R<sup>β</sup> - Undifferentiated basalts
- R<sup>β1</sup> - Lower Movene basalt
- R<sup>β2</sup>/ R<sup>ρ2</sup> – Upper Movene basalts and rhyolite from Pequenos Libombos
- R<sup>ρ1</sup> – Rhyolite from Umbeluzi

### 3.2.1. General geological description of Mozambique with emphasis on the Sul do Save region

The major part of the geological formations of Mozambique -- 57% -- is of Precambrian origin, as compared to the roughly 40% of post-Cambrian origin (Afonso, 1976; see Fig. 3.2.1 presenting the geological outline of Mozambique). The Precambrian formations (sedimentary and igneous) are mainly located in the northern part of the country, to about the Chire-Zambezi Rivers' confluence. The coastal region from 16° S to the extreme southern tip of Mozambique is covered by Pleistocene and Holocene unconsolidated sediments (see Fig. 3.2.2 with the main geological units identified in the Sul do Save region).

During the late Jurassic, a complex system of crustal extension led to the extrusion of basaltic lava in southern Africa. By the end of the Jurassic and during the early Cretaceous the volcanic activity in the region was again represented by an extrusion of rhyolite, followed by floods of basalt and than once more, by rhyolites. This volcanic activity was preceded by a relatively calm period. However, during the early Cretaceous ( $\pm 140$  Mya) there still occurred the rifting and breakup of Gondwanaland. This process led to the development of an incipient failure in the Limpopo River valley, producing an uplift of the southeastern part of the African continent (Partridge & Maud, 1978). As a consequence, the volcanic rocks were deeply weathered, eroded and subsequently covered with continental sediments. On the other hand, subsidence along deep north south oriented graben associated with the East African Rift System, and along the axis of the Mozambique Channel, resulted in the formation of two separate Meso-Cenozoic sedimentary basins:

- the **Rovuma Sedimentary Basin** (in the north-east) and
- the **Mozambique Sedimentary Basin** (in the south-east; Afonso, 1976, Ferro & Bouman, 1987).

The area of the **Sul do Save** occupied by the Mozambique Sedimentary Basin corresponds to about 170,000 square kilometers. This basin developed above a downwarped surface of Karoo

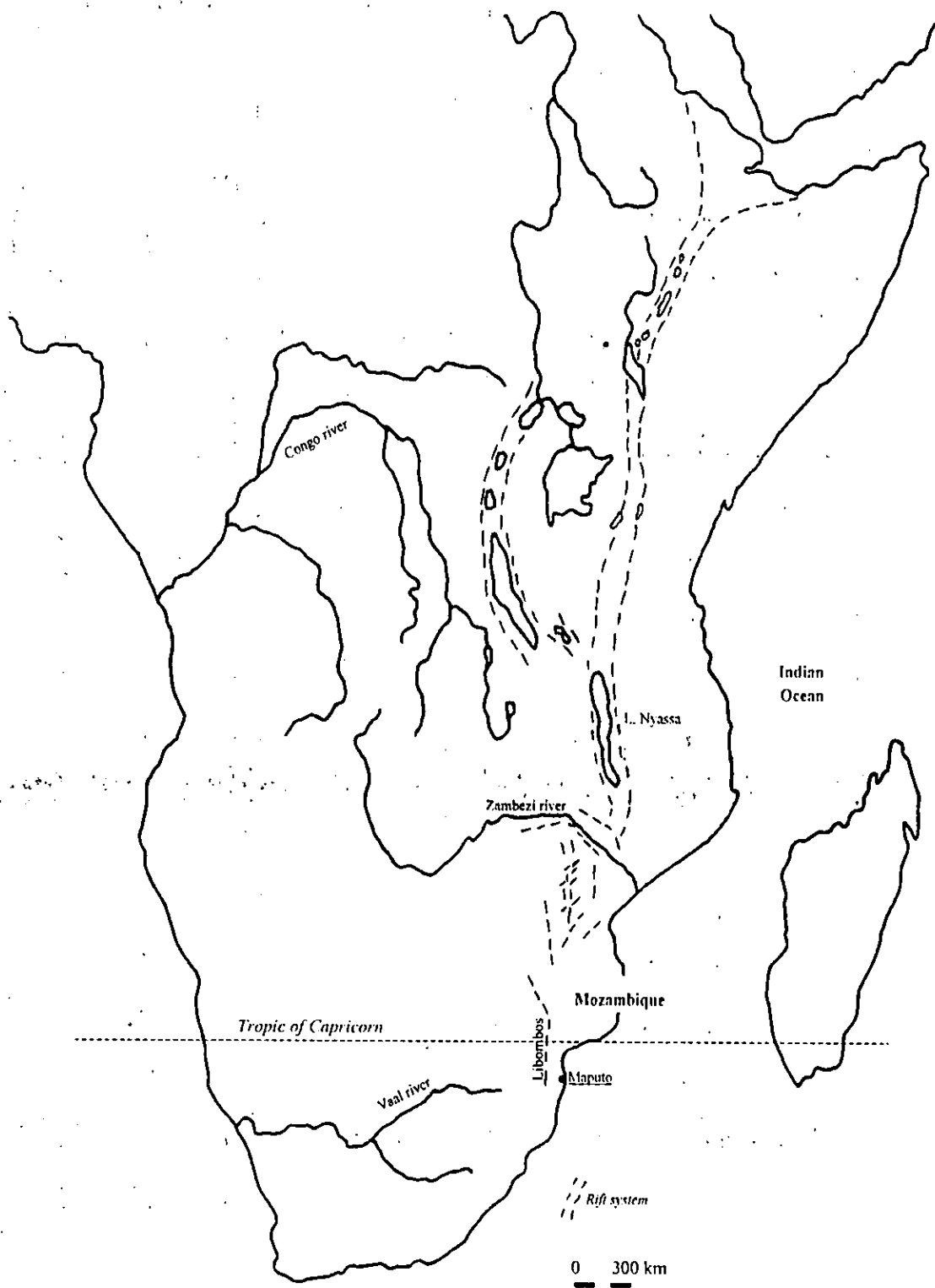


Fig. 3.2.3 Mozambique in Southeastern Africa



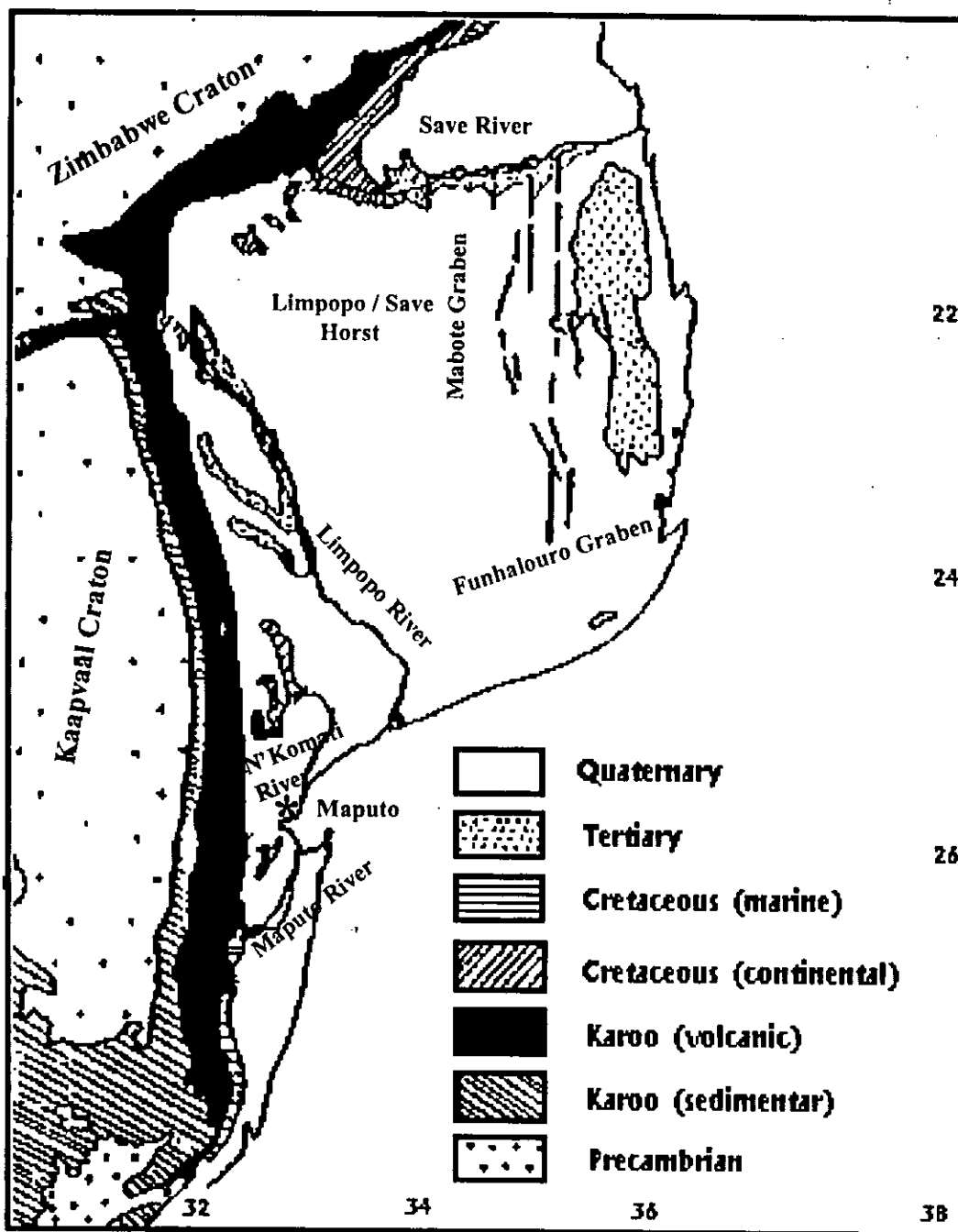


Fig. 3.2.4 Sul do Save Region - dominant geological units (adapted from Förster, 1975)

rocks. Starting in the Lower Cretaceous times, it was exposed to several marine transgressions; however, the main transgressions occurred in the Upper Cretaceous, and during the Palaeogene and Neogene. The Cretaceous and younger sediments cropping out at the western edge of the basin dip gently eastward under the very extensive cover of later Tertiary and Holocene sands and loams, which cover most of the sedimentary basin's surface (Flores, 1973). The depositional process that took place during the maritime phase was not continuous, being always followed by an erosional period (Afonso, 1976, Koch, 1964). Inland, the morphology of the Sul do Save region is characterized by extensive erosion plains, gently dipping coastward. They are intersected by the valleys of the Save and Limpopo Rivers and by smaller rivers, originating from the Libombos Mountains. In the northeast, the structural Urrongas Plateau is underlain by limestone. This is separated from the inland plains by the Mazunga Graben, of which the Funhalouro-Mabote Graben is a subsystem. These features, which represent the southern most extension of the eastern African Rift System (see Fig. 3.2.3.) in Mozambique (Flores, 1973), are portrayed in Fig. 3.2.4.

The Mozambique plain is part of the Mozambique Sedimentary Basin, being the most widespread coastal plain in southern Africa. In the southern part of the country, a dune area with an average width of 30 kilometers characterizes this coastal belt.

Finally, one should remark that rivers such as the N'Komati and Limpopo have built an extensive alluvial plain, inland from the dune belt.

#### **3.2.1.1 The Karoo Supergroup**

In southern Mozambique, the oldest exposed geological formations are referred to as being part of the Jurassic System - the Karoo Supergroup. Fossil evidence shows that the Karoo Supergroup was formed between the Upper Carboniferous and the Lower Jurassic, from about 300 Mya to 180 Mya (Truswell, 1970, 1977).

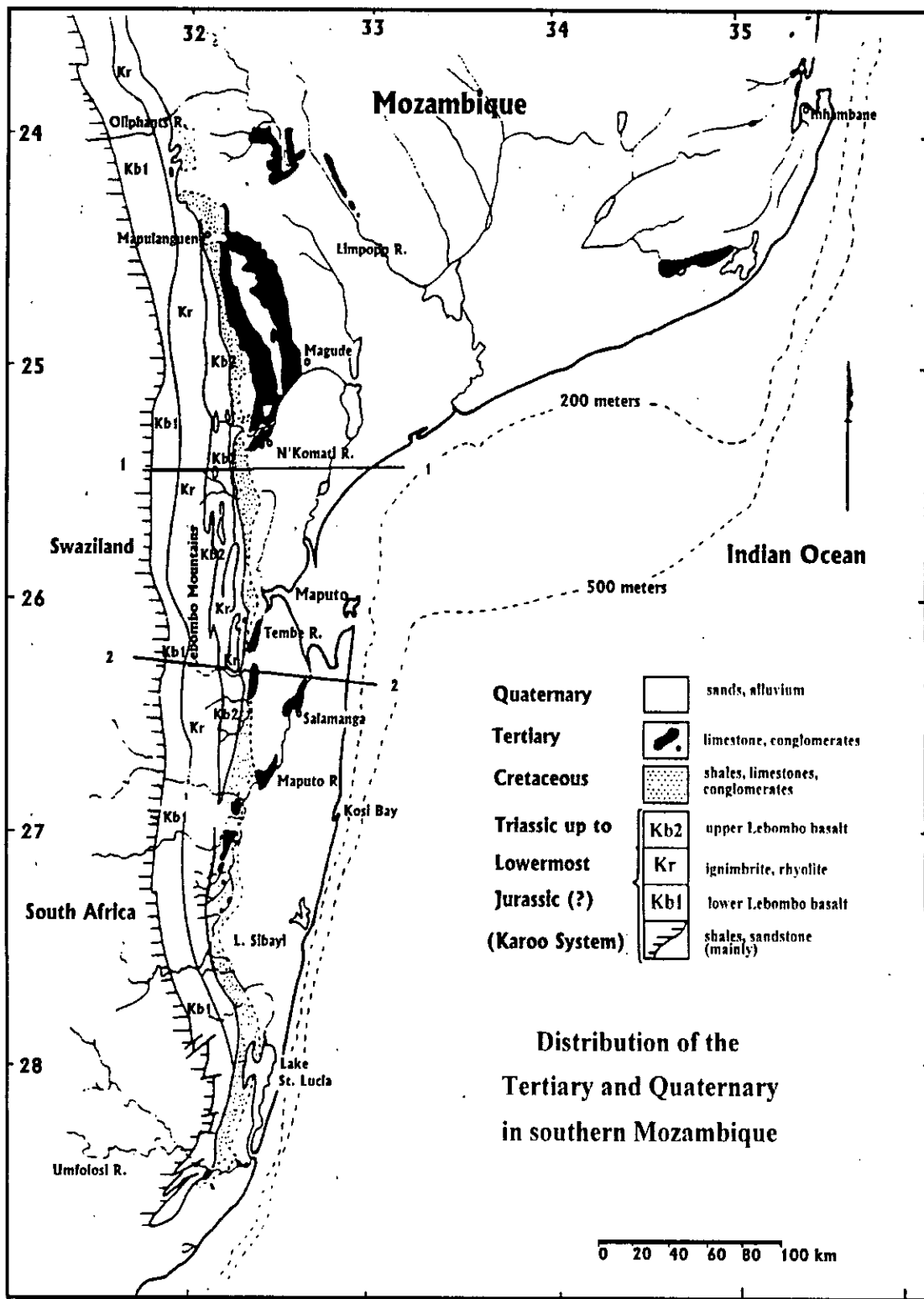


Fig. 3.2.5 The geology of southern Mozambique (after Frankel, 1972)

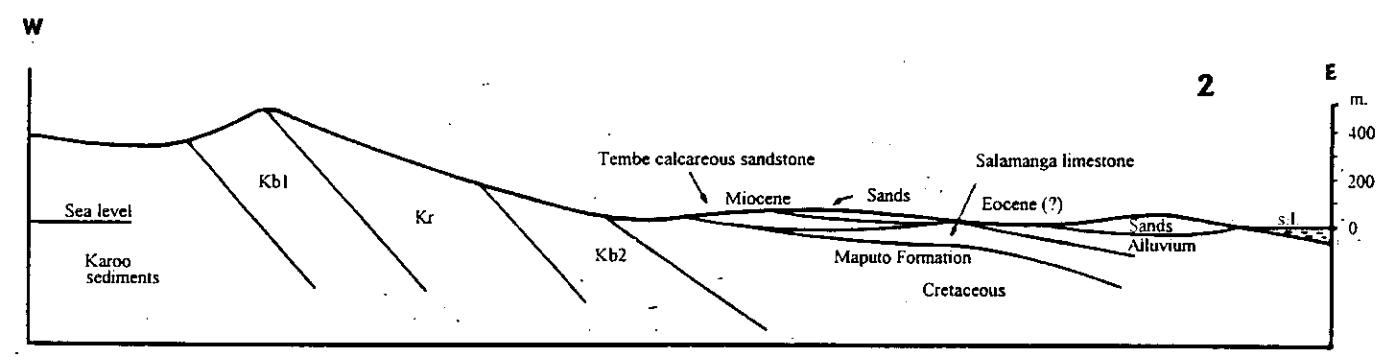
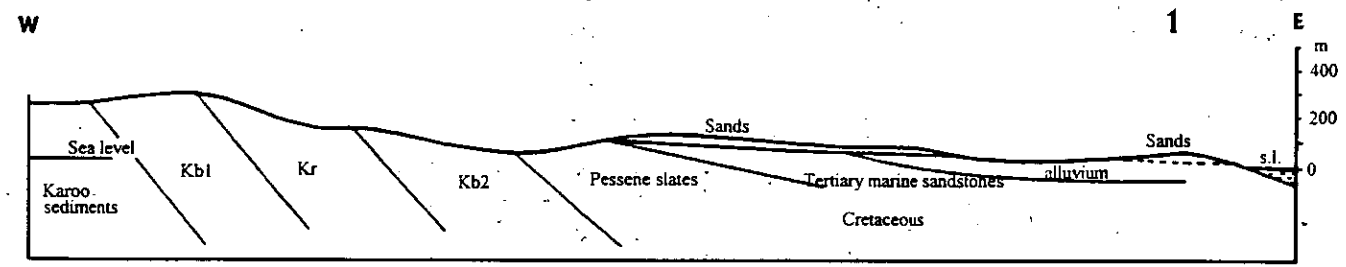


Fig. 3.2.6 Cross-section -- in a West-East direction -- of the geology of southern Mozambique along lines 1 and 2 pictured in Fig. 3.2.5 (after Frankel, 1972)

In the Sul do Save region, the Karoo is present as a narrow strip of easterly dipping, mostly extrusive igneous rocks of some 20-25 kilometers wide and over 400 kilometers long, with a maximum altitude of about 800-900 meters a.s.l. The Karoo sediments reach here a thickness of about 1.8 kilometers. This section of Karoo sediments form the straight and elongated Libombos ridge (including the Grandes Libombos and the Pequenos Libombos mountain ridges – see Fig. 3.2.5 and the more detailed presentation of the geological profile along some cross sections in Fig. 3.2.6). This topographic continuity is broken only by the gorges of the largest rivers, such as the Umbeluzi, N'Komati, Oliphants and Limpopo.

The structure of the Libombos range is a regular monocline, with basaltic, rhyolitic and pyroclastic strata dipping eastward. The basalts are usually black, and more easily eroded than the rhyolites, due to its specific chemical composition (richer in Ca and Na); therefore they form usually the depressions and pediment lowlands between the rhyolitic areas (BURGEAP, 1962, Abel, 1994). The basalts can be found from the Umbeluzi River to the Pongolo River (affluent of the Maputo River), in the southern most area of Mozambique (around Catuane area), forming a narrow strip with some twelve kilometers wide. The rhyolites are fine-grained light lava, of reddish to pink- to brownish coloration, very resistant to erosion, due to a high percentage of silica in its composition. Some of the "rhyolites" of the Libombos range are in fact large ignimbrites and welded tuffs (Assunção et al., 1962, Abel, 1994).

The igneous rocks overlying the initial basalts (see Fig. 3.2.7 representing a W-E transect of the study area, in southern Mozambique) are represented mostly, from bottom up, by limburgites, rhyolite, basalt and intercalated sandstones (for example, in the Goba area), rhyolite and again basalts (e.g., Movene River area). These latter basalts (Movene area), lying disconformably above the upper rhyolites, are dated about  $137 \pm 10$  Mya (i.e., i.e., being of post-Karoo, lower Cretaceous time). The resistant rhyolite lavas from the Libombos range extend as far as the western margin of the coastal

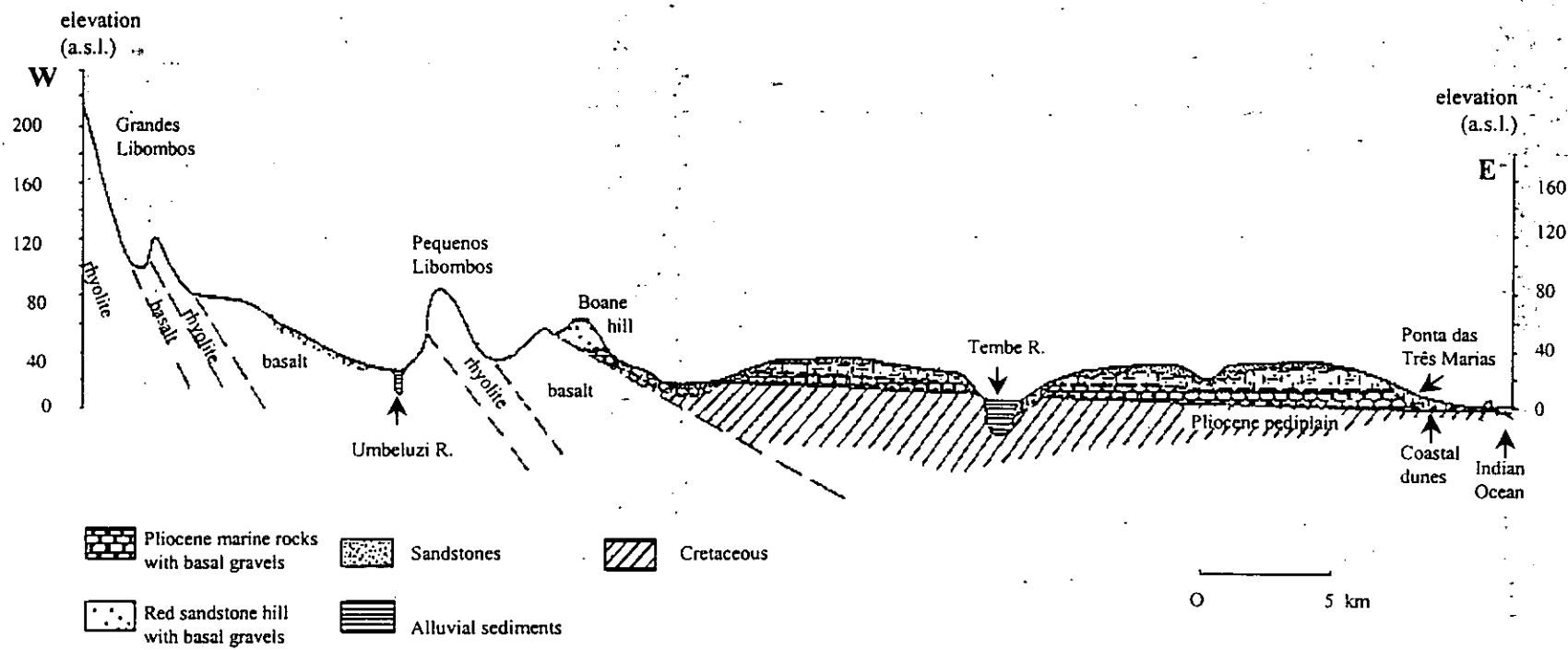


Fig. 3.2.7 West-East transect from the Grandes Libombos (at the border with Swaziland), through Boane, until Ponta das Três Marias (coastal area); adapted from Bernaert, 1987.

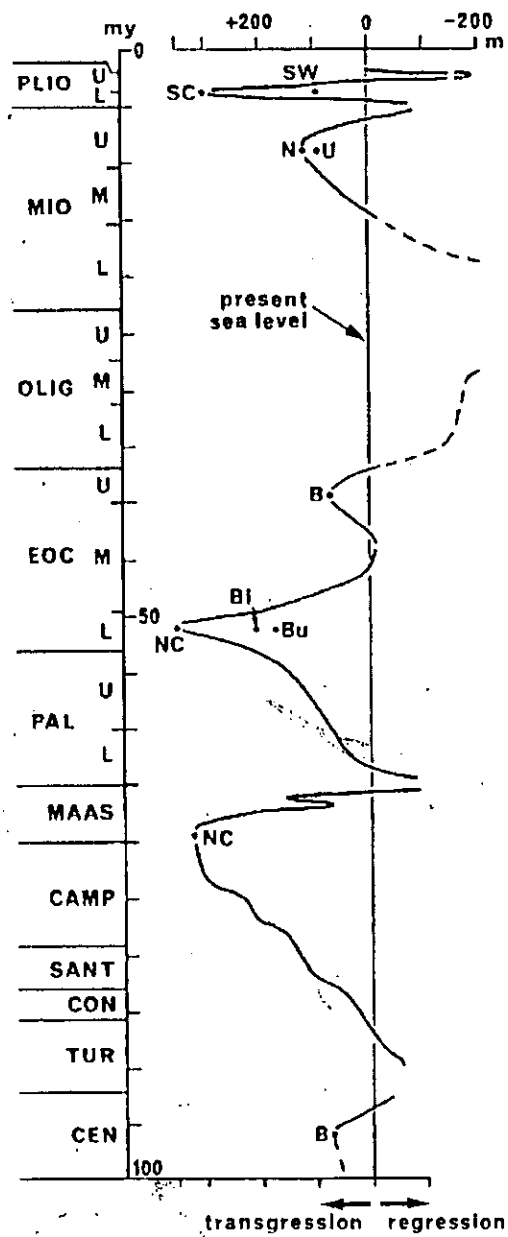


Fig. 3.2.8 Upper Cretaceous and Tertiary sea level movements plotted in relation to present sea level (after Dingle et al., 1983)

plain, below which they also occur beneath a covering of younger rocks, at an increasing depth in an easterly direction (Maud, 1980).

### 3.2.1.2 The Cretaceous System

The southern Mozambique region has its origin with the breakup of Gondwanaland and the formation of a new sea and coastline. The depositional environment extending into the Cretaceous was thus characterized by the intermittent vertical tectonic movements of the newly formed continental margin and the sporadic supply of large volumes of sediments (Förtser, 1975, Tankard et al., 1982). Hence, Cretaceous sediments are widely developed beneath the Mozambique coastal plain. See Table 3.2.1 for a detailed description of the chronostratigraphy of Southern Mozambique.

The breakup of the Gondwana supercontinent had several important implications for the geological processes that occurred in the Mesozoic Era in Southeastern Africa. About 140 Mya the rifting process led to the formation of the proto-Indian Ocean. This fact triggered a cycle of marine transgressions and regressions, which took place during the Cretaceous, as well as contributed towards the development of the drainage system today present in the region (see Fig. 3.2.8 illustrative of the sea level movements in relation to the present sea level).

The beginning of the formation of the East African Rift System and the development of the East African coast lead to a disruption in the continental system of deposition: shallow- to deepwater marine rocks, usually richly fossiliferous, were deposited. These nearly flat-lying rocks form an eastward thickening wedge. In the study area, marine deposition lasted until the beginning of the Tertiary in the eastern region. During this period in the study area, sandstone and conglomerate beds comprising clasts derived from the Libombos rocks, with intercalated flows of alkaline lavas, extended in central part of the southern basin far to the westward of the present-day shoreline. This deposition occurred directly above a surface of igneous rock (Stormberg rhyolite). Hence, the Lower



Table 3.2.1 Chronostratigraphy of southern Mozambique

Periods	Lithostratigraphy (South of Maputo)	Localities
<b>Holocene</b> (0 - 10 Kya)	Fluviatile alluvium, terrestrial gray sandy cover, coastal sand dunes	Maputo River, N'Komati River
<b>Upper Pleistocene</b> (10 - 125 Kya)	Regression and short transgressional cycle; coastal sandstones and coastal dunes; shelly, " <u>Inhaca Formation</u> " (submerged terraces)	Revez Duarte Kassimatis Forno da Cal
<b>Middle Pleistocene</b> (125 - 780 Kya)	Regressive-Transgressive cycles; coastal dunes, sandstones; interior red dunes; " <u>Gondzo/Malhazine Formation</u> "; regressive red dunes, parallel to the coast; lacustrine deposits; " <u>Machava Formation</u> "; formation of the middle level (10-15 meters) river terraces	Boane Tembe River Moamba Inhaca coast Infulene River
<b>Lower Pleistocene</b> (0.78-1.6 Mya)	Transgression-Regression; Porto Henrique coastal line; consolidated dunes; conglomerates, " <u>Matola Formation</u> "	Ponta Maone Alto da Enchisa Moamba
<b>Upper Pliocene</b>	" <u>Cacho Formation</u> " and " <u>Magude Formation</u> "; red sandstones	Boane area
<b>Middle to Lower Pliocene</b>	Transgression with a basal conglomerate overlain with calcareous/clayey/silty sandstones; " <u>Tembe Formation</u> ",	Maputo River
<b>Miocene</b> (5 - 22.5 Mya)	Late Miocene uplift and tilting; Widespread planation; " <u>Santaca Formation</u> "; fossiliferous limestones, glauconitic sandstones; rolling planation on the Libombos	Tembe River Changalane River Maputo River
<b>Oligocene</b> (22.5 - 37 Mya)	Local marine and continental sedimentation; Maputo grey clays; " <u>Inharrime Formation</u> "	Maputo River Changalane River
<b>Eocene</b> (65 - 53 Mya)	" <u>Salamanga Formation</u> " (maritime origin); glauconitic fossiliferous limestones; planation	Maputo River (Salamanga), Tembe River
<b>Cretaceous</b> (137-65 Mya)	Marine sediments; " <u>Grudja Formation</u> "; glauconitic sandstones; lagunar clays and conglomerates; Turonian continental sandstones, arkoses and conglomerates; " <u>Sena Formation</u> "; cycle of transgressive activity; " <u>Maputo Formation</u> "; silty glauconitic sandstones	Santaca Umbeluzi River Tembe River Boane Maubué River Changalane River
<b>Karoo</b> (150-190 Mya)	Upper Stormberg lavas: Drakensberg (Triassic-Jurassic); Libombo fissure eruptions: rhyolite, basalt, dolerite; Dwyka, Ecca, Beauford and Stormberg sediments	Catuane, Movene
<b>Precambrian</b>	Intercratonic basin; Transvaal supergroup: quartzites, arkoses, conglomerates; Limpopo belt; Kaapvaal and Zimbabwean cratons	

(after, Barradas, 1962, 1966, Föster, 1975, Afonso, 1976, Beernaert, 1987, Momade, 1990)

to Middle Cretaceous is here represented by marine shelly sandstone with glauconite which has been called "Maputo sandstone" or Maputo Formation (with a thickness of about 100 meters; Freitas, 1957, BURGEAP, 1962, Frankel, 1972, Flores, 1973, Föster, 1975).

An upper Cretaceous unit - the Grudja Formation, of littoral to neritic origin is present in the area. This unit is present in the bed of the Uanetze River (Grudja?/Uanetze Formation). In KwaZulu-Natal, the St. Lucia Formation reflects the same time; in fact, the only dated sample from the Grudja Formation estimates its age about  $60 \pm 6$  Mya (Freitas, 1957, Maud, 1980, Momade, 1990; see Fig. 3.2.9 representing a schematic lithostratigraphic correlation of Tertiary strata between Kwa-Zulu/Natal and the Zambezi area).

### 3.2.1.3 The Cenozoic Erathem

Starting from the Paleogene, several transgressions and regressions continued to occur until the beginning of the Miocene, when the sea started gradually withdrawing from the central part of the Mozambique Basin. In fact, during Tertiary times, the main characteristic of the tectonics of the area under study is its geomorphic stability, (Flores, 1973). Most of the Tertiary deposits present estuarine (marine) characteristics (including transgressive, regressive and continental phases). See Fig. 3.2.10, illustrative of the development of southern Mozambique coastline.

In Beernard's opinion (1987) two sedimentary cycles were present in southern Mozambique during the early part of the Cenozoic:

- The Paleogene: silts, fine sandstone with facies similar to Upper Cretaceous. Eocene fine limestones;
- The Neogene with a well developed Pliocene structure, representing a transgressive basal conglomerate overlying coarse sandstones.

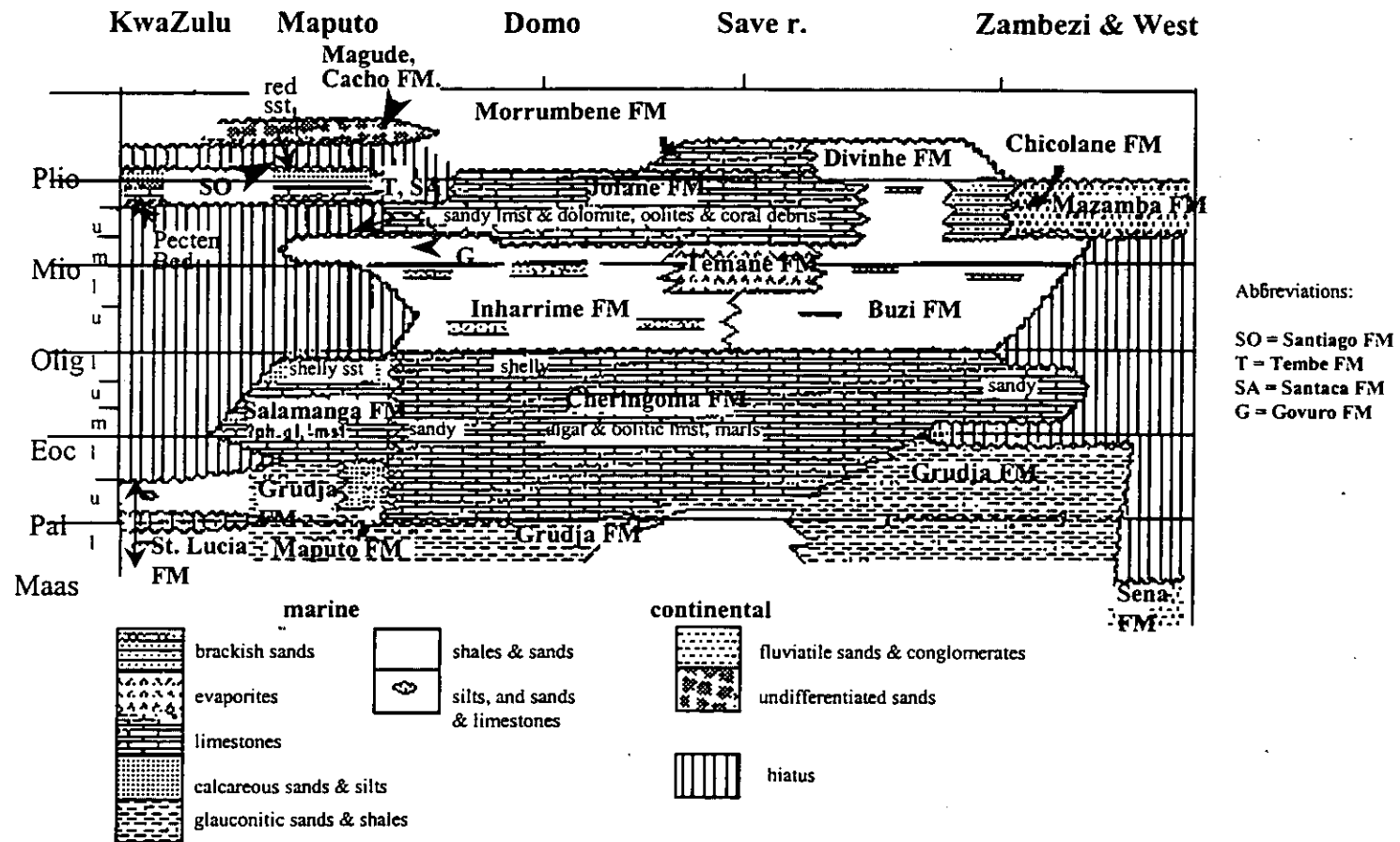


Fig. 3.2.9 Schematic (not to scale) lithostratigraphic correlation of Tertiary strata between KwaZulu/Natal and the Zambezi area (aprox. 1200 km long). Data from Frankel, 1972, Flores, 1973, Förster, 1975, Dingle et al., 1983.

### 3.2.1.3.1 The Paleogene

The Paleocene and Eocene rocks in the Mozambique Basin are all of marine origin and nowhere is observed an unconformity at their base except to the south of Maputo city (i.e., in the study area). This marine sequence - known as the Grudja Formation - is dominated by medium to fine grained calcareous sandstone and siltstone (Bernardt, 1987). The Grudja Formation was deposited from the Upper Cretaceous until the Paleocene (see previously refereed Fig 3.2.9 for a schematic interpretation of the lithostratigraphy during the Tertiary in southern Mozambique). This formation is overlain by a limestone unit of Eocene age - the Salamanga Formation of marine origin - that is exposed along the Maputo River and the Tembe River. The Eocene rocks are predominantly carbonate facies with well-developed algal-oolithic limestones, becoming sandier and more marly to the east (Föster, 1975, Dingle et al., 1983).

The onset of the Oligocene in the Mozambique Basin was marked by an extensive marine regression, which extended until the early Miocene. In the study area, this regressive period is apparent in the absence of Oligocene deposits. The only Oligocene section seems to be restricted to some small outcrops forming the Inharrime Formation. This later formation consists of argillaceous sandstones and covers the Salamanga Formation (Flores, 1973, Beernaert, 1987).

### 3.2.1.3.2 The Neogene

In the extreme south of Mozambique two unconformity surfaces are present: one below the marine Miocene, and another one above it. The early (lower) Miocene sandstones and conglomerates were deposited above a distinct unconformity surface underlain by the Upper Cretaceous - Paleogene sandstone (Grudja/Uanetze Fm.). The uppermost part of the marine Miocene, not easily distinguished from the overlying Pliocene, is represented in the coastal cliffs

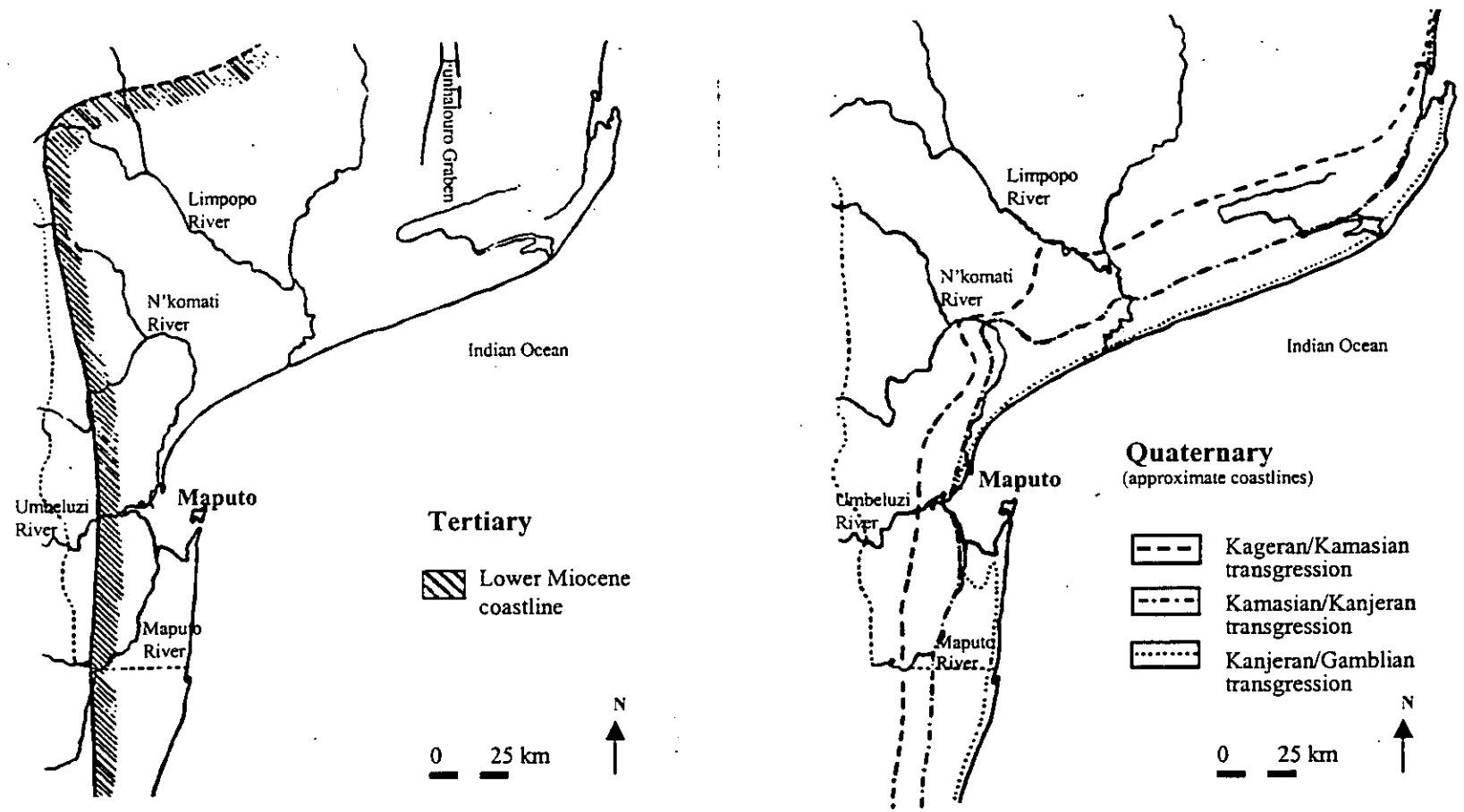


Fig. 3.2.10 Coastline of Southern Mozambique (adapted from Föster, 1975)

in southern Mozambique. These beds -- called the Jofane Formation -- consist mostly of basal conglomerates, covered with sandstones and dolomite, commonly with oolites and coral debris, thus indicating a shoreline or shallow offshore environment (Koch, 1964, King, 1966). However, in the study area this marine facies is designated as Tembe Formation. The Tembe Formation, in the area under research, is present in the subsurface in the Umbeluzi and Tembe Rivers, as well as at Ponta das Três Maria (Momade, 1990). This formation, which underlies most of the dunes in the coastal belt, overlies a basal unconformity (Ferro & Bouman, 1987). It should also be mentioned that some authors distinguish the Tembe Formation (richly fossiliferous) and the Santaca Formation, the latter poor in fossils (Momade, 1990).

A regression starting in the west at the end of the Miocene (and lasting throughout the Pliocene) indicated the end of the Tertiary depositional cycle. This cycle culminated with the deposition of the Jofane Formation. During this regressive period, sandstones were strongly eroded and modified, and in several outcrops only the basal conglomerate remains, a situation that seems to be typical of the Pliocene-Quaternary in the area (Bernardt, 1987).

However, it should be pointed out that some local transgressions continued during the Plio-Pleistocene (Barradas, 1958, 1961, 1965, Koch, 1964). This fact led to a widespread development of deltaic to lacustrine sequences, usually identified as Infulene sands (Ferro & Bouman, 1987). Reaching normally a thickness of 50 meters, these sands are composed of Pleistocene-Holocene deposits: Matola Formation, Machava Formation, Costa do Sol swampy deposits, as well as marine deposits (Momade, 1990).

#### 3.2.1.3.2.1 The Plio-Pleistocene

The present day land surface owes its origin to the extensive, thick, unconsolidated sands accumulated from the Pliocene, the Pleistocene and the Holocene. A continuous eastward sea retreat during the Plio-Pleistocene resulted in the formation of new depositional units (mainly

with dune characteristics), and developing the present day geomorphology. Further on, during the Pleistocene and the Holocene, another series of dunes were deposited in response to a sequence of marine transgressive and regressive cycles (Maud, 1968, 1980).

In southernmost Mozambique, the Miocene rocks are covered with discontinuous continental reddish conglomeratic sandstone - the Magude Formation. This formation is of Plio-Pleistocene origin (Flores, 1973, Föster, 1975, Momade, 1990), and may reach a thickness of 30 meters in the outmost southern area. In the southernmost Maputo area this unit is labeled the Cacho Formation. Its deposition history is linked to the tectonic uplift in the region, which was followed by fluvial deposition and eolian accumulation of sediments. In the study area, the Lower Pleistocene units have lost their dune (eolian) characteristics, keeping only their conglomeratic component (Koch, 1964).

Overlying the Cacho/Magude Formation a continental facies occurs - the Matola Formation. This unit, of lower Pleistocene origin, is composed of basal conglomeratic strata, covered by clayey sands. The Matola Formation was developed along the eastward Maputo river valley lowlands (Beernardt, 1987). Its deposition seems to be linked to a regressive post-Eemian incision and to a vertical uplift in the area (Momade, 1990).

A younger continental facies (Middle Pleistocene), also lying over the Magude/Cacho Formation is represented by clayey yellowish sands and ferricretes, covering a basal pebble bed (Momade, 1990). This facies -- the Machava Formation -- is present in the Umbeluzi valley, and although younger, its origin is similar to the Matola Formation (both the Matola and Machava Formations have an average thickness of 15 meters).

To the interior, a cordon about 100 kilometers wide of inland ancient dunes is present. These unconsolidated dunes which resulted from regressive/transgressive sea movements, are mainly of middle-to-late Pleistocene origin (Malhazine/Congolote Formation). They consist of orange-brown

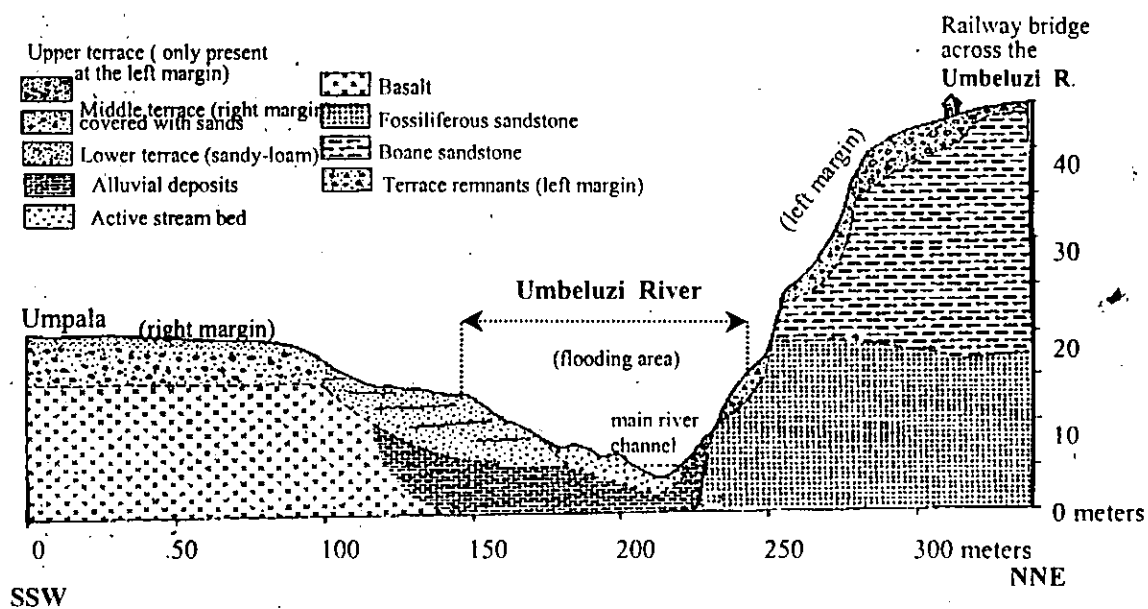


Fig. 3.2.11 SSW-NNE cross section of the Umbeluzi river in the Umpala area (after Lopes, 1979)



Image of the geological sequence present at Boane, on the Umbeluzi River, 50 meters to the left of the railway bridge (pictured on the extreme right of the above cross section)



to reddish colored clayey sands of fine to medium texture (Koch, 1964). Still in this period occurred the formation of 30-60 m river terraces along contemporary river systems (Barradas, 1962, 1966).

Most of the sites excavated for the purpose of this dissertation were located apparently associated with geological deposits attributed to the Middle Pleistocene (see Chapter V for a deeper description of the geological context of each site studied in southern Mozambique).

In the late Pleistocene a large accumulation of fluvial material formed the 15-25 meter river terraces (Barradas, 1962). During the same period, the deposition of the second eolianite (less consolidated than the first one of early Pleistocene origin) took place, with reddish-brown clayey sands, which stretch themselves from Ponta do Ouro to Inhambane, i.e., from the extreme south of Mozambique, until about the area of the Tropic of Capricorn (Maud, 1980, Beernardt, 1987).

Finally, and at the very end of the Pleistocene a third eolianite was deposited (covering the second one) as a sandstone cap. This process has formed the core of the 100 meters level dune system along southern Mozambique coast (Beernardt, 1987). The final regression led to river incision and the formation of clayey reddish soils on low alluvial terraces along the main river valley systems in the area (N'komati, Umbeluzi, Tembe, Maputo; see Fig. 3.2.11, with an example from the Umbeluzi River, near Boane-Umpala). Indurated calcretes or lacustrine limestones of Quaternary age can be found locally in poorly drained alluvial depressions. Along the coastline these sediments are known as "beach rocks", i.e., coastal sandstones, being present, for example, at Inhaca. These deposits are usually of late Pleistocene origin (Barradas, 1962, Koch, 1964).

#### **3.2.1.3.2.2 The Holocene**

The final regression (of Holocene origin) resulted in a quick process of riverine vertical erosion, creating the three-to-five meters terraces. In the study area there are also present marine

deposits of Holocene age. In fact, an early Holocene littoral to sublittoral formation, composed by fossiliferous sandstone, is present in some localities along the coast (e.g.: Ponta Maone). This Coasta do Sol facies is almost everywhere covered by coastal dunes (Barradas, 1952b, 1956b, 1958, 1962, 1965, Koch, 1964, Afonso, 1976). The coastal dune belt, from recent Holocene, consists of a narrow strip of dunes. These late littoral dunes, whose thickness may be over 100 meters, consist of clean, medium to coarse textured sands (Xefina Formation). Coastal swamp deposits formed by white-gray fossiliferous sands of lacustrine and/or fluvial origin emerged also in the Holocene. In the study area, they are present at Catembe (Futi depression). At the same time, the southern lagunar dune belt formed (including the presence of shell-middens and coastal sandstones). The estuarine areas (e.g. Umbeluzi, Matola and Tembe Rivers) display well-developed alluvial sediments, sometimes reaching a thickness of over 60 meters. These sediments, of Holocene origin, present a fluvial facies, being composed of clayey-sandy deposits with some limestone lenses (of lacustrine origin?). In some locales it is possible to observe some marine influence in the formation of these deposits (Momade, 1990).

### 3.2.1.3.3 Conclusion

The mountain areas are formed by rhyolite, ignimbrite and basalt (mainly south of Goba) of Jurassic/Cretaceous age. The sandy formations of Cenozoic age are present along a wide strip that stretches from the Umbeluzi River southward passing by Porto Henrique to the Mandjene lagoon. The lowlands and slightly undulating central region are underlain by limestones/sandstones of Miocene origin. These Miocene sediments form three main areas: two around the Tembe River (the first at Mugazine and the second in the Licuati area); the third zone is located in the Maputo River, spreading from Santacá to the Mandjene lagoon. The coastal lowlands consist mainly of dune formations, as well as of sandy alluvial sediments (these later to the south, in the Futi River area).

Table 3.2.2. Quaternary chronological sequence in southern Mozambique (Maputo province), compared to Southeastern Africa

Geological periods	Eastern-Southern Africa		Southern Mozambique		Archaeological evidences	
	Climatic sequence	Sea-level oscillation	Geological formations Marine	Coastal	Occurrences	Period
Holocene	<ul style="list-style-type: none"> <li>• Actual</li> <li>• Nakurian</li> <li>• Arid</li> <li>• Makalian</li> </ul>	<ul style="list-style-type: none"> <li>• Actual</li> <li>• Regression</li> <li>• Transgression</li> <li>• Regression</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion</li> <li>• 2 meter level terrace</li> </ul>	<ul style="list-style-type: none"> <li>• Alluvium, white continental dunes (Maputo R.)</li> </ul>	<ul style="list-style-type: none"> <li>• Shell middens (?)</li> </ul>	<ul style="list-style-type: none"> <li>• Wilton, Smithfield (LSA)</li> </ul>
Upper Pleistocene	<ul style="list-style-type: none"> <li>• Interpluvial</li> <li>• Gamblian</li> </ul>	<ul style="list-style-type: none"> <li>• Transgression</li> <li>• Regression (with small transgressional phases)</li> </ul>	<ul style="list-style-type: none"> <li>• Calcareous sandstone</li> <li>• Coastal dunes (Inhaca Fm); Submerged terraces</li> </ul>	<ul style="list-style-type: none"> <li>• Modern dune formation</li> <li>• Diatomites &amp; lacustrine calcareous</li> </ul>	<ul style="list-style-type: none"> <li>• Shell middens (Revez Duarte, Kassimatis and Forno da Cal)</li> </ul>	<ul style="list-style-type: none"> <li>• Mangosian (MSA)</li> </ul>
Middle Pleistocene	<ul style="list-style-type: none"> <li>• Interpluvial</li> <li>• Kanjeran</li> <li>• Interpluvial</li> <li>• Kamasian</li> </ul>	<ul style="list-style-type: none"> <li>• Transgression</li> <li>• Regression</li> <li>• Transgression</li> <li>• Regression</li> </ul>	<ul style="list-style-type: none"> <li>• Coastal lagoons &amp; sandstone formations</li> <li>• Regressive dunes (Gondzo Fm)</li> <li>• Marracuene coastal line</li> <li>• Regressive dunes (Machava Fm) &amp; small transgressive phase (Infulene R.)</li> </ul>	<ul style="list-style-type: none"> <li>• Red interior sand dunes</li> <li>• 10-15 m terraces</li> <li>• Red sands &amp; dunes parallel to coastal line</li> <li>• Deposition of middle fluvial terraces</li> </ul>	<ul style="list-style-type: none"> <li>• Boane, Tembe R., Bandoia, Magude</li> <li>• Boane, Tembe R., Palmeira, Mangulane</li> <li>• Boane, Moamba, Inhaca coast</li> <li>• Moamba</li> </ul>	<ul style="list-style-type: none"> <li>• Sangoan, Fauresmith</li> <li>• Upper Acheulean</li> <li>• Lower Acheulean</li> <li>• Lower Acheulean (Abbevillian)</li> </ul>
Lower Pleistocene	<ul style="list-style-type: none"> <li>• Interpluvial</li> <li>• Kangeran</li> </ul>	<ul style="list-style-type: none"> <li>• Transgression</li> </ul>	<ul style="list-style-type: none"> <li>• Porto Henrique coastal line</li> </ul>	<ul style="list-style-type: none"> <li>• Red sands and consolidated dunes</li> </ul>	<ul style="list-style-type: none"> <li>• Ponta Maona cliffs; sea-side conglomerates</li> </ul>	

(after Barradas, 1962, 1966, Föster, 1975, Beernardt, 1987)

Thus, most of the area under study is covered by late Tertiary - Quaternary sediments, while the coastal area is either covered by dunes or fringed by marshes and swamps of Holocene origin (Beernaert, 1987) The chronological sequence for southern Mozambique, while compared to Southeastern Africa is shown in Table 3.2.2.

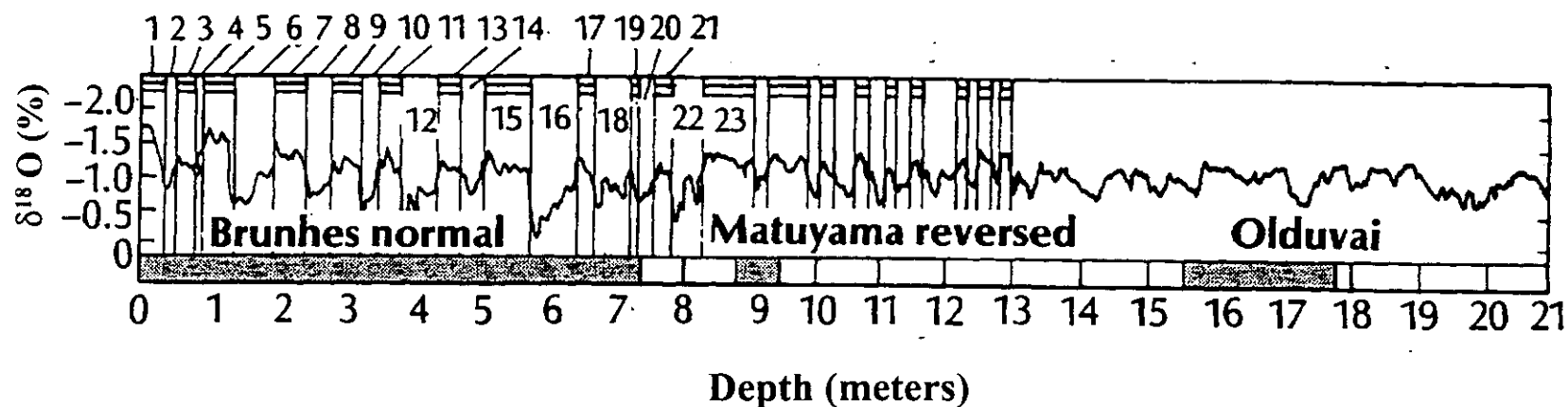


Fig. 3.3.1 Oxygen isotope fluctuations for the last 2 million years. This proxy record for climatic change is very complex and complete. The more negative values (upward fluctuations) are interglacials; the more positive values (downward fluctuations) are glacials. (adapted from Shackleton & Opdyke, 1976). The numbers on top refer to the isotopic stages, and their correspondence to the magnetic polarity time scale is shown. When evaluating the data available regarding the global climate change over the last 2 million years, the large variation observed is owed to the large-scale glacial-interglacial variations displayed by the Northern hemisphere ice sheets. This resulted in a significant increase in aridity in middle- to low-latitude regions. However, due to its geographical position (about 3° south of the Tropic of Capricorn), southern Mozambique was probably not significantly affected by the climatic changes (e.g., deMenocal, P.B., 1995).

### 3.3 PALEOCLIMATE AND LANDFORM INTERACTIONS: INTERPRETING THE EVIDENCE AVAILABLE FROM SOUTHERN AFRICA

#### 3.3.1 Some general aspects

Southern Africa is a region of the Old World that was not glaciated during the Pleistocene. However, and before describing the general paleoclimatic picture during the Quaternary for Southern Africa during, where southern Mozambique occupies a foreground position, one should be aware of the fact that the gradual development of the Antarctic ice sheet and the circum-Antarctic current heralded the onset of the modern climatic system in Miocene times. The development of the Antarctic ice sheet caused dramatic changes in the paleoenvironment of southern Africa as the subcontinent, which was semi-arid during the first half of the Tertiary, has since Late-Miocene times being dominated by an entirely different atmospheric and oceanic circulation system (Butzer, 1978, Vogel, 1984, Tyson, 1986, 1990). The atmospheric system has since then been characterized by the interplay of the zone of the westerlies with cyclonic rains and the zone of tropical convection rains. This situation will be described in the next chapter. One of the most important differences between the early and late Tertiary conditions was the development of the polar heat sink and consequently the steep temperature gradient between high and low altitudes (Tyson, 1990, O'Brien & Peters, in press). Although temperatures were significantly above any Pleistocene value during much of the Miocene, the Antarctic ice cap did not melt away (van Zideren Bakker, 1986). Superimposed on this climatic pattern considerable variations occurred during the Quaternary in terms of climatic oscillation (e.g., Butzer, 1978, Salinger, 1981, Maud, 1986, Tyson, 1986, O'Brien & Peters, in press; see also Fig. 3.3.1). Nonetheless, due to its geographical position (about 3° south of the Tropic of Capricorn), southern Mozambique was probably not severely affected by these climatic oscillations.

### **3.3.2 The final stages of the Neogene: the paleoenvironmental record of Southern Africa with emphasis on the Pleistocene**

#### **3.3.2.1. Short appraisal of the development of paleoclimatic and paleoenvironmental studies in Southern Africa**

The following paragraphs present a very general summary of the paleoenvironmental information available for Southern Africa, with a focus on the period under research, i.e., on the Early to Middle Pleistocene.

As referred earlier in this work, since the early stages of geological studies in South-East Africa, an alternation of moist and dry periods has been recognized, which were defined as pluvials and interpluvials; the stages were named after the identification of geological deposits in eastern Africa (Leakey, 1929). According to this perspective, pluvials were supposed to be correlated with the European Ice Ages and the interpluvials to interglacials in the formerly glaciated areas (i.e., were correlated to the classic system of Penck-Bruckner). The fluctuations of precipitation were then explained by the displacement of the climatic belts, during the glacial and interglacial episodes. During the cold periods, the present-day arid areas would be brought within the belt of precipitation-bearing westerlies, resulting in pluvial conditions (Nilsson, 1983). As described in more detail in Chapter IV, this scheme was widely utilized in the African subcontinent for dating the Stone Age cultural progression (Sohnge & Visser, 1937).

Mozambique was not an exception and the few attempts to integrate the southern region in a paleoclimatic setting for the Quaternary period were performed in the 1950-1960's, under the influence of both models: the Pluvial-Interpluvial model and the Vaal River sequence (Barradas, 1952a, 1952b, 1955a, 1955b, 1956b, 1958, 1961, 1963a, 1963b, 1965, Bosazza, 1956, Koch, 1964, King, 1966, 1972). The data presented in Tables 3.2.2 summarize the possible chronological sequence of the Quaternary in Southern Africa, with special emphasis on southern Mozambique.

However, in more recent years, several authors have addressed this hypothesis quite critically, reproaching the attempts made to correlate climatic oscillations in southern Africa with other areas of the globe (e.g., Cooke, 1952, 1957, Cooke, 1967, Butzer & Cooke, 1981).

Since the collapse of the model, few attempts of regional and sequential character were made to reassess the Quaternary paleoclimatic history of Mozambique and Southern Africa, especially of that of the earlier times. In fact, most of the regional studies are focused on more recent time, essentially the last 18-20,000 years, i.e., the last glacial maximum before the onset of the Holocene period (e.g., van Zinderen Bakker, 1982, 1983; Deacon & Lancaster, 1988, Partridge et al., 1990, Deacon, 1990b, Tyson & Lindsay, 1990). This is easily explained because the last glacial cycle is a climatic event clearly discernible in deep-sea cores through the world (CLIMAP, 1976), falling within the range of the  $^{14}\text{C}$  dating method.

However, for earlier periods, there is very few available; also, most of the studies have been concentrated in South Africa, and very few work has been performed elsewhere in other regions of Southern Africa (including Mozambique). Along the following paragraphs, I will present an evaluation of the status of paleoenvironmental studies in a broader context, for the surrounding region for southern Mozambique.

### 3.3.2.2 The regional setting

If the sedimentological, palynological and faunal data available indicates the presence of mesic conditions during the Early Pleistocene in South Africa (Butzer et al., 1978, Partridge, 1978, 1985, 1986, Vrba, 1985), associated to fluctuating spring discharge, implying a wetter climate, the regional Middle Pleistocene record is quite tenuous (e.g., Butzer, 1975, Scott, 1984).

In Southern Africa (i.e., essentially in South Africa), most of the paleoenvironmental reconstructions available for the Middle Pleistocene are of indirect nature, based on the interpretation



of faunal data. Unfortunately, very little, if any evidence is available regarding the tree and bush cover (in terms of tree species and subspecies) for Southern Africa.

Exploring large ungulate diversity as an indicator of past environmental settings, Klein (1983, 1984) suggests that the southern extremity of Africa may have been warmer and wetter. A long-term evaluation of the paleoclimatic conditions during the Middle Pleistocene in South Africa (using micromammalian fauna) indicates increasing dissection, suggested by an increase in open and dry vegetation and a concomitant decrease in the tree and bush cover (Avery, 1995). The vegetation became increasingly open, presumably owing to an overall decline in rainfall; in fact, lake sediments at Roodam, near Kimberley – northern Cape Province, South Africa suggest the presence of a period of aridity around 200-180 Kya, followed a humid phase (Szabo & Butzer, 1979).

The studies performed for Border Cave and Klasies River Mouth in South Africa indicate that during the Last Interglacial ( $\approx$  140-120 Kya) was present a warm and somewhat moister conditions (Butzer, 1974, Szabo & Butzer, 1979, Beaumont et al., 1978, Thackeray & Avery, 1990, Avery, 1995b). For Southern Africa, the indication is that vegetation in the region was initially woodland (*Brachistegia*), which today occurs at least 3° north; rainfall would have been 25-100% higher than it is today, and more seasonal, with drier winters. The temperature may have been similar or slightly higher than it is today.

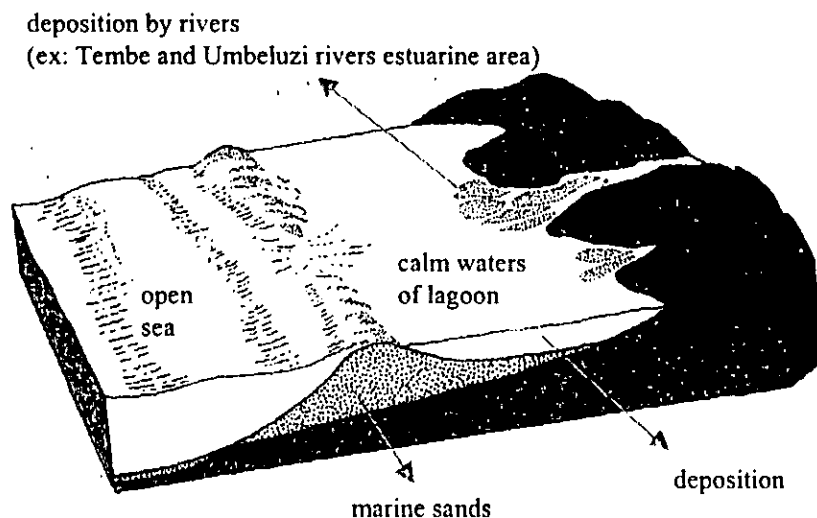
From around 100 Kya, vegetation, and consequently, rainfall, appear to have become much as they are today: dense woodlands and forest supported by rainfall around 800 mm. The temperatures were probably somehow lower than today. From around 50 Kya on ( $\delta^{18}\text{O}$  stage 3?), the vegetation appears to have been somehow more open woodlands; rainfall may have been 25-55% lower than today and relatively unpredictable, while temperatures were lower.

The terrestrial record for temperature change over the Last Glacial Maximum (LGM) in South Africa includes three temperature curves based on isotope analyses of sample derived ultimately from rainwater precipitated from the Indian Ocean (e.g., Howard & Prell, 1984, Martison et al.,

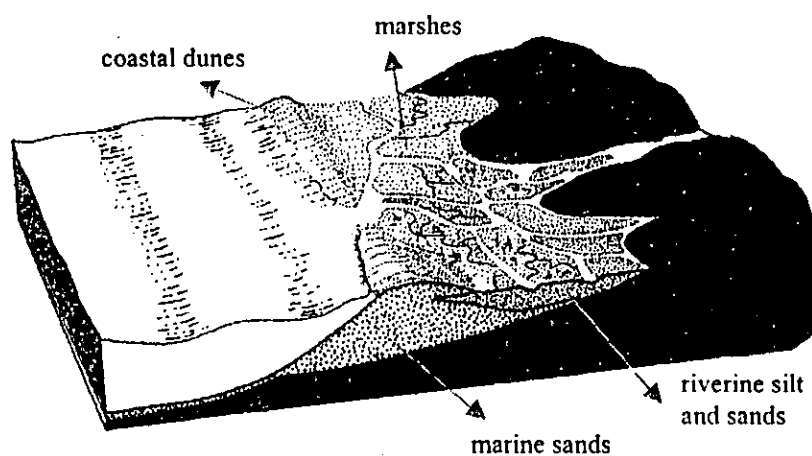
1987, Deacon, 1990b). Temperatures were probably 3°C to 6°C colder than the present during the last cold maximum (i.e., cooler than most of the Holocene). In fact, there is a general agreement that in southern Africa there was a cold period from about 25 Kya, followed by a climatic amelioration at about 15 Kya (Nicholson & Flohn, 1980, van Zideren Bakker, 1983, Salinger, 1981, Tyson, 1986, Deacon & Lancaster, 1988, Partridge et al., 1990, Deacon, 1990b). The time of maximum cold (about 22-18,000 years ago) coincided with the driest conditions, but higher rainfall than at present was widespread during the lead down to and out of the LGM. Faunal evidence adds credibility to this (Klein, 1984, 1989, 1994). In fact, the archaeological evidence gathered from Late Stone Age sites in the highland region of Natal (e.g., Maggs & Ward, 1980, Mazel, 1989) indicates the presence of large ungulates among the grassland fauna.

Apart from temperature and precipitation changes, the LGM is also characterized by a low sea-level, although the evidence available for the east coast of Southern Africa indicates that the coastline was not so much far away from its present position (Deacon & Lancaster, 1988).

The ITCZ (Inter Tropical Convergence Zone - see section on Climate in the next Chapter) would have been nearer the equator during these cold periods (Nicholson & Flohn, 1980), affecting the dispersion of the cyclonic rains. With the southward migration of the southern westerlies after 15 Kya and the maintenance of the northern westerlies near the equator as the glacial persisted in the north, the ITCZ can be predicted to have moved further southward, before reverting to its actual position after 12 Kya. Thus, it would have increased the rainfall in the northern part of southern Mozambique. Finally, and during the transition to the Holocene (between 12-8 Kya), the climate was apparently warmer, although rainfall probably remained fairly high (Lorius et al., 1979, Street & Grove, 1979). During the Younger Dryas, at about 9-8 Kya, another climatic change - cooling - occurred, as suggested by the South African data (Thackeray & Avery, 1990). Another phenomena occurring during the Younger Dryas is associated with the weakening of the African monsoon. After 9-8 Kya, rainfall approximated to the present values, but with minor oscillations in amount and temperature.



a) the large estuarine system present in Maputo bay area (5 rivers) carries material onwards, depositing it as sand spits to the head land. This process originated sand bars (i.e., elongated ridges of sand running parallel to the coast. The constant repetition concentrated the sand in a submerged line just behind the wave breakline where the backwash is slackening and dropping the sand load. The constant addition of sand causes the bar to rise above the water surface as a foreshore bar. A lagoon of calm brackish/salty water forms behind the bar and fills with alluvium brought down by the rivers



b). The water of the lagoon increases in freshness and vegetation begin to colonize the shores. Gradually the bar migrates (especially when the sea level is lowering) as waves remove sand from its seaward side and a flat marshy coastline bound by unconsolidated dunes(as present along southern Mozambique) emerges. This process keeps repeating itself, leading to an expansion of the coastal system.

Fig. 3.3.2 Block diagram representing the formation of the coastal system in southern Mozambique (adapted from Pritchard, 1979)

### 3.3.2.3 The southern Mozambique record

In the east, in the Libombos Mountain area, the paleoclimatic record is almost absent, since, due to taphonomic processes, very little sediment (including pollen) and fossil data did get "trapped" in the area. An evaluation of the potential of the distinct landscapes identified in the study area, in terms of their potential for "trapping" archaeological and paleoenvironmental information will be discussed in Chapter VIII.

A characteristic trait of the study area is the repeating pattern of coastal plain formation, at place since the Tertiary (see the block diagram representing the formation of the coastal system in Fig. 3.3.2).

The primary components of the lowlands sedimentary system from are the marine sandstones, siltstones and limestones of the Cretaceous period, as described in the previous section of this chapter. During the Tertiary successive periods of erosion and sedimentation occurred. The Tertiary sediments are comprised of compact calcareous sand, sandstone and grit, as well as shelly limestone, reaching a thickness of approximately 100 meters.

A conspicuous feature of Quaternary sedimentation is the occurrence of prominent ridges parallel or slightly oblique to present shoreline (Tankard et al., 1982). The dune cordons (see Fig. 3.3.3 representing a section of the coastal area) are thought to be progressively younger seaward, and are attributed to sea level fluctuations, with the overall regressive trend characteristic of the Pleistocene (Koch, 1964. Dingle et al., 1983).

As suggested by several researchers (e.g., Koch, 1964) the coastal system present nowadays in southern Mozambique represents a repeating pattern of coastal plain formation, as I will be describing in the next chapter. The progressive lowering of the sea level (eustatic change) resulted in a constant development of the coastal plain. A particular feature associated with the



Fig. 3.3.3 Scenes of the coastal area in the area where the field work was accomplished (showing some of the typical vegetation cover of the dune system; picture taken during the beginning of the dry season - May 1995).

emergence of a coast is the raised beaches identified in southern Mozambique (Barradas, 1958, 1961a, 1965, Beernardt, 1987). As a result of this lowering process, the shoreline is quite even and the offshore water very shallow (Buckle, 1996). This originates the formation of barrier beaches and other depositional features, such as coastal lakes, a peculiar feature of this wetland system. A broader discussion on the implication of the wetlands for the Middle Pleistocene archaeological record from southern Mozambique will be presented in the next chapter of this dissertation).

The contemporary coastal dune cordon is through to be associated with sea level depression that occurred during the final stages of the Pleistocene (125 Kya). At this period, it is estimated that the sea level stood about 200-250 meters below the present level, exposing part of the now submerged continental shelf. In fact, it is assumed that the sea stood removed from the coast perhaps as much as 160 kilometers (Davis, 1977, Dingle et al., 1983; see also the geological map of southern Mozambique, presenting the dept of the sea along the coast of southern Mozambique). In South Africa, the dune cordons immediately south of Mozambique comprise typically of a basal beach conglomerate overlain by eolian sands (Davies, 1975, 1977). In consequence, much of the sites along the coastal plains inhabited by hominids during these regressive phases are now submerged.

In addition, at the time of the end of the Middle Pleistocene, the river valleys from the Umbeluzi-Changalane-Tembe area were more deeply eroded than at present. With the rise of sea level, gradients in the stream would have declined, leading to a loss of potential and the aggregation of the headwaters.

In the South African side, lakes have experienced a 60% reduction in surface area, as well as significant shallowing due to sedimentation in the Holocene; a similar pattern is likely to

have occurred also for coastal lakes in Mozambique (Tinley, 1971, Tyson, 1986, Pollett et al., 1995).

In terms of general biotic panorama, a slight wetter and warmer climate, characteristic of most of the Middle Pleistocene, would mean probably a picture similar to the one present nowadays, with a stronger influence in the interior areas, with the interior plains and the Libombos mountains presenting a longer wet season, which probably less shortage of water.

### 3.3.3 Conclusion

Clearly, it is not yet possible to attempt detailed reconstructions of the paleoecological systems of Southern Africa in antiquity. Such interpretation will require the efforts of specialists in other disciplines working in southern Mozambique, such as in palynology, paleobotany, paleoclimatology, geomorphology, etc. However, maps of present-day temperature and rainfall, together with other climate-related information can offer a starting point in trying to relate the paleoenvironmental evidences to the archaeological evidence, as I will be discussing in the next Chapter. Even where quantitative estimates are not possible (e.g., precipitation), the combination of paleoclimatic data with an understanding of the general principles governing the modern climate should permit the identification of relatively wetter and drier, or cold and warmer, regions. This will be used to model the probable system of land-use at place in the area under study in southern Mozambique

## CHAPTER IV – THE PRESENT LANDSCAPE OF SOUTHERN MOZAMBIQUE, IN REFERENCE TO SOUTHERN AFRICA

### 4.1 INTRODUCTION

#### 4.1.1. Setting the stage

In this chapter I do present a descriptive understanding of landforms, climate and vegetation as they exist today in southern Mozambique.

Aspects such as rainfall, temperature, humidity and evaporation rate provide the climatic framework, which structure the affordances present nowadays in the study area – the Umbeluzi-Changalane-Tembe region. Although the availability of shelter and abiotic raw materials (particularly isothropically fracturing rocks) are of some importance in determining the *foci* of occupation, it is the productivity of animal and plant resources, coupled with the availability of fresh water, that principally influence the patterns of land-utilization of populations on the large scale (e.g., Jochim, 1979, Peters & Blumenschine, 1995). Therefore, an evaluation of the potential value of the affordances in the area under study becomes really an example of organization of space and time, being related to the impact of ecology on the organization of subsistence.

The identification of the different landscapes, habitat types and animal and plant communities in the ecosystem of Maputaland (i.e., the phytological area where this study was carried out; see van Wyk, 1996) was made possible through fieldwork activities. Additional information was gathered from the neighboring areas from South Africa and Swaziland (e.g., Murdock et al., 1971, Maud, 1980, Moll, 1980, Price-Williams et al., 1982, Davies, 1994, Kalb, 1995, Chonguica, 1995).



The present day information was used to develop models of land utilization, which should be tested against the archaeological and paleoecological evidences available for the region under study (see Chapter VIII). Besides, in the absence of fine-resolution paleoenvironmental information, and grounded on the information presented in the previous chapter, one can assume that the contemporary conditions are a reasonable model of the environmental settings during the Middle Pleistocene times in southern Mozambique. For example, and regarding plant foods, direct measures of paleoproductivity are not obtainable, but estimates can be made from correlations observed among contemporary data (e.g., O'Brien, 1993, O'Brien & Peters, in press). Based on the available information, it may therefore be suggested that the relatively wetter regions, as the coastal plain area, and the Tembe River valley, were the most ecologically productive parts of the study area at the time (see also O'Brien & Peters, 1998).

In fact, studies of rainfall reliability and drought occurrence have shown that the wettest parts of Southern Africa tend to be those which suffer least from drought (Wellington, 1955:255) and that rainfall predictability is strongly correlated with mean annual precipitation. The overall effect will have been to increase plant and animal productivity (O'Brien, 1993) and thus enhance further the security of the Acheulean hominids in areas receiving higher precipitation compared to those receiving less. On the other hand, increased topographic diversity to the west could have been expected to have favored a greater diversity of habitats, and hence of exploitable food resources, and have concentrated this diversity within a comparatively small area. Variety in the number of veld-types occurring within areas of same size in different parts of southern Mozambique is due to variation in climate, topography and lithology (Barradas, 1966, Myre, 1968, 1971; see also Acocks, 1988). In so far as altitude and latitude govern climatic variations, these factors are likely to have been little changed under the very different conditions of the Middle Pleistocene. The highveld of the interior mountain area is believed to have been covered by grassland environments during the Middle-Upper Pleistocene (see Chapter III). However, these grass-dominated plant communities, although associated periodically with a high animal

biomass, are unsuitable for direct human consumption (Myre, 1971, Lobão Tello, 1972, Smithers & Lobão Tello, 1976, Rautenbach, 1982, Stuart & Stuart, 1990, van Wyk, 1996). As several studies have revealed (e.g., Lee, 1979, Mazel, 1981, Plug, 1984), tropical and subtropical hunter-gatherers seems to have depended more upon foraged plantfoods, than on hunting. The reason for this is that while foraging is a relatively high-yield and low risk activity (since the resources are immobile, more predictable in occurrence and generally easier and safer to exploit), hunting is a relatively low-yield but high-risk activity in Southern African grasslands. The significance of this is that an abundance of large game within an area, such as of migratory species, may by itself have been insufficient to have rendered an area suitable for maintaining the Acheulean population for long periods of time. The existence of more stationary and reliable resources, such as plantfoods, insects, etc., would then have been critical.

#### 4.1.2 The present day landforms in the Umbeluzi-Changalane-Tembe area

##### 4.1.2.1 The specifics of the area under study

The contemporary ecosystem of Maputaland contains a great variety of different landscapes, habitat types and animal/plant communities (Davies, 1994). The landscape classification suggested here is based on careful field evaluation of the distinct areas, and represents an attempt to stratify this area into environmentally homogeneous units at various levels of generalization. This part of the research aims at providing a sampling framework to describe ecological units for data analysis and contextualization of the archaeological record. (e.g., Peters & Blumenschine, 1995). Because this part of the research deals with two distinct time concepts (*ecological* at the level of selection and *evolutionary* in the long term), the decision was to use a model that builds from the site through the region (e.g., Gamble, 1986, 1995, Blumenschine & Peters, 1998). This way, at each increase in spatial scale, it is possible to compare the organizational abilities of Acheulean hominids, by

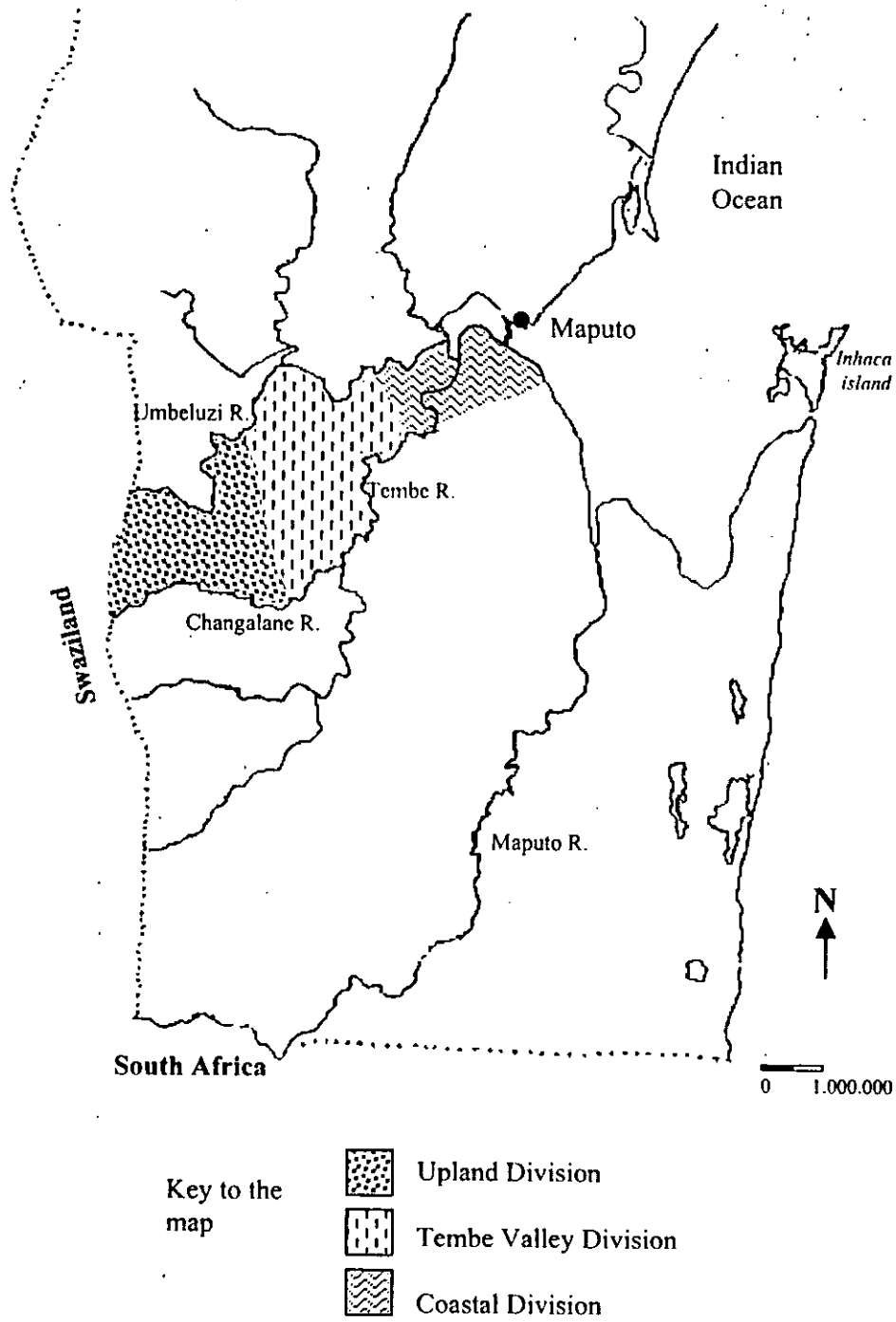


Fig. 4.1.1 Main landscape units identified in the study area

evaluating the use of the region as revealed by the use of raw materials and anticipating the use of specific resources from within landscape units identified in the study areas.

The Umbeluzi-Tembe-Changalane area should be regarded rather as a substantial sample of an annual territorial range of a prehistoric population group; the important point here is that the research area samples all the ecological zones likely to have been significant to prehistoric populations in southern Mozambique. More importantly, it was felt that an area with clear seasonal and geographic contrasts in environment over a relatively small distance offered great potential for the study of prehistoric exploitation patterns. Furthermore, existing evidence suggested that a regional approach might enable the formation of a more complex view of the ESA archaeology of the southern Africa area than previously existed.

#### 4.1.2.2 The scales of landscape analysis

Because the research was aimed at understanding, the regional use of a specific area – the Umbeluzi-Changalane-Tembe area – scale relationships among the major components influencing ecogeographic dynamics becomes a crucial concept. Unlike site-based scales of analysis, these broader scales of landscape study permit to understand the geographic and ecological basis of patterning of local affordances.

From broader to finest, three scales of analysis were used for the study area (see Fig. 4.1.1). These are the landscape association, the landscape division and the landscape facets.

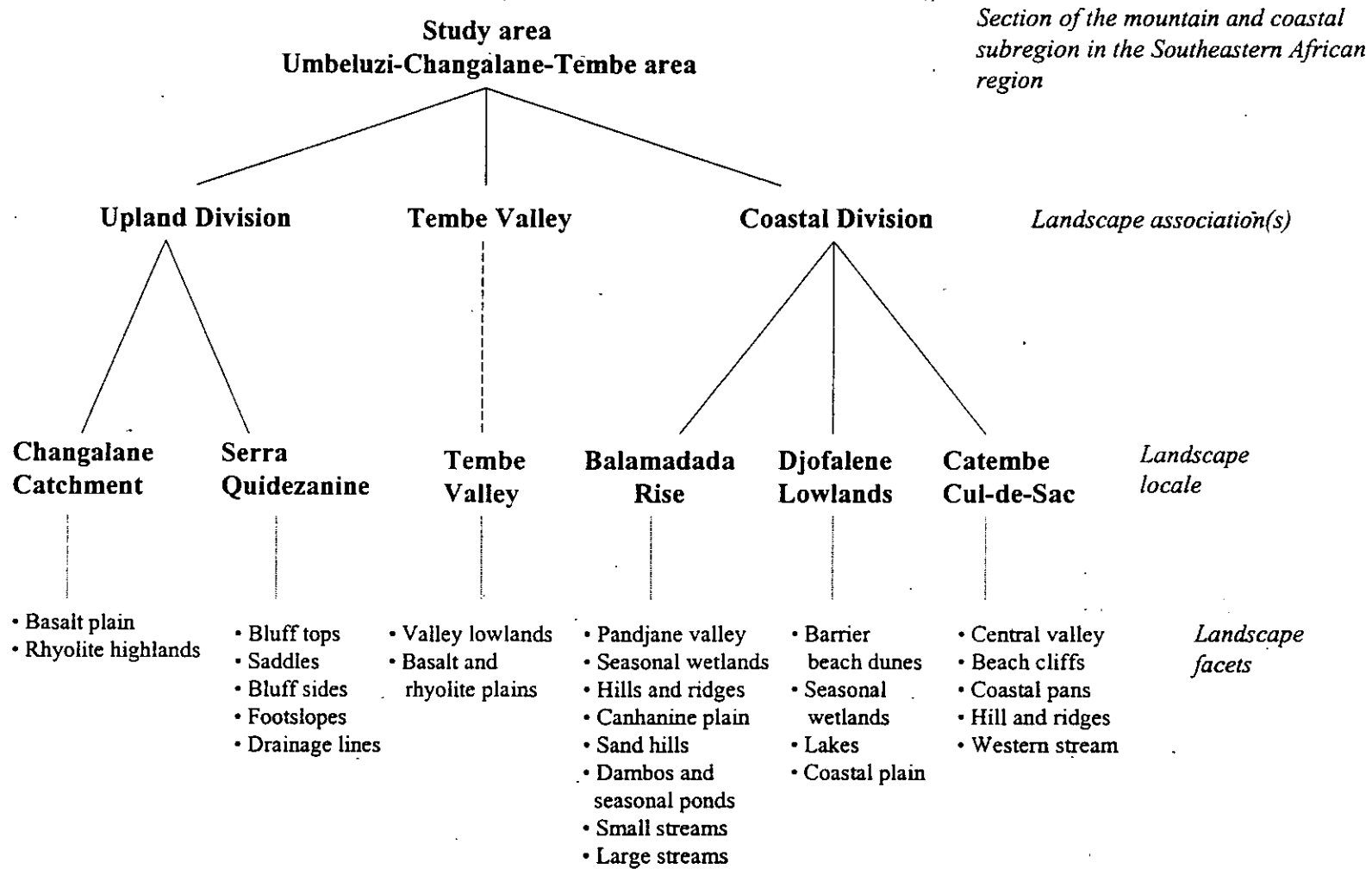


Fig. 4.1.2 Scheme of the landscape system identified for the study area in southern Mozambique

Table 4.1.1 Nested hierarchy of space-temporal analytical scales for land use by mobile early hominids

## Ecotemporal scales

Ecospace	Ecotime	Related concepts
Subcontinent to geographic region e.g.: southern Africa	Transgenerational (subspecies / species) spatial distribution	Acheulean Industrial Complex; Ecoregions
Interregion	Intergenerational spatial range	Physiographic Regions; Archaeological industry (Acheulean)
Region e.g.: the Umbeluzi-Changalane-Tembe area	Life range	Archaeological industrial facies (= phase or variant); Refuge source / site
Landscape association e.g.: the Upland Division (1:250,000 topo map)	Annual range	Migratory circuit; Corridors vs. conduits; Core vs. periphery
Landscape locale e.g.: the Changalane Catchment	Seasonal range	Archaeological "catchment" Seasonal refuge
Landscape facet e.g.: the Basalt Plains (1:50,000 topo map)	Foraging site (week to day range)	Archaeological horizon; Specialized purpose tool kits; Resource patch
Landscape element e.g.: Umpala site <1:50,000 topo map	Event point (minutes)	Artifact occurrence(s)

(adapted from Peters & Blumenschine, 1995).

For the specific area under study, the land classification is organized as follows:

- The **subregion**: this is formed by the set of complementary resource zones, the **Umbeluzi-Changalane-Tembe area** (see Fig. 4.1.2 representing a scheme of the landscape system identified for the study area in southern Mozambique (West-East direction)).

- The **landscape association**: is equated here with broad ecological zones, in this case, the **Upland Division**, the **Tembe Valley Division** and the **Coastal Division**. The land association is a rank of classification distinguishing units on the basis of soils, water regime, ecological position, vegetation, microclimatic conditions, etc.
  - 1 - **Upland Division**: refers to the westernmost section of the region, being characterized by the presence of two main mountain systems, the Pequenos and Grandes Libombos.
  - 2 - **Tembe Valley Division**: corresponds to the central section, and constitutes a transition from the mountain division to the coastal area.
  - 3 - **Coastal Division**: ranges from the undulating relief on the west side, through the central lowlands presenting a characteristic wetland system, until the coastal and estuarine region.
- The **landscape locale**: is a smaller unit of the land system classification that describes a distinct mosaic of recurrent smaller landscape units -- the land facets --linked together in a consistent relationship that gives a landscape its particular character. The land locales are differentiated whenever land facets with different relationships form a new landscape pattern. For example, for the case of the Coastal Division, **three locales** were identified, namely:
  - 1 - the **Balamadada Rise**,
  - 2 - the **Djofolene Lowlands**,
  - 3 - the **Catembe Cul-de-Sac**
- The **landscape facet** scale corresponds to a local habitat (Peters & Blumenshine, 1995), i.e., the territory, which was exploited by a specific group. Most of the studies on ESA landscape archaeology have been focused on the facet-level scale. However, due to the lack of temporal resolution of the archaeological record, and its palimpsestic character (e.g., Stern, 1993, 1994,

Rogers, 1997), it is unfeasible to establish a strict contemporaneity among the archaeological occurrences, and hence, to access behavioral interpretations.

For example, for the **Catembe Cul-de-Sac** locale the following facets were identified:

- **The Central Valley**
- **The Beach Cliffs**
- **The Coastal Pans**
- **The Hills and Ridges**
- **The Western Stream**

These units were identified on air photos at a scale of 1:30,000 and geomorphological maps at a scale of 1:50,000; based on the information retrieved from the maps and referred by several authors (e.g., Gomes e Sousa, 1966, Myre, 1968, Lobão Tello, 1972, Ministério da Agricultura, 1977, Scholten, 1984, Maud, 1980, 1986, Gouveia & Marques, 1980, Moll, 1980, Pooley, 1980, Kalk, 1995, Pollet et al., 1995, Fernandes & Brito, 1996) and on the data collected during field surveys it became possible to identify the dominant landscape locale for each division.



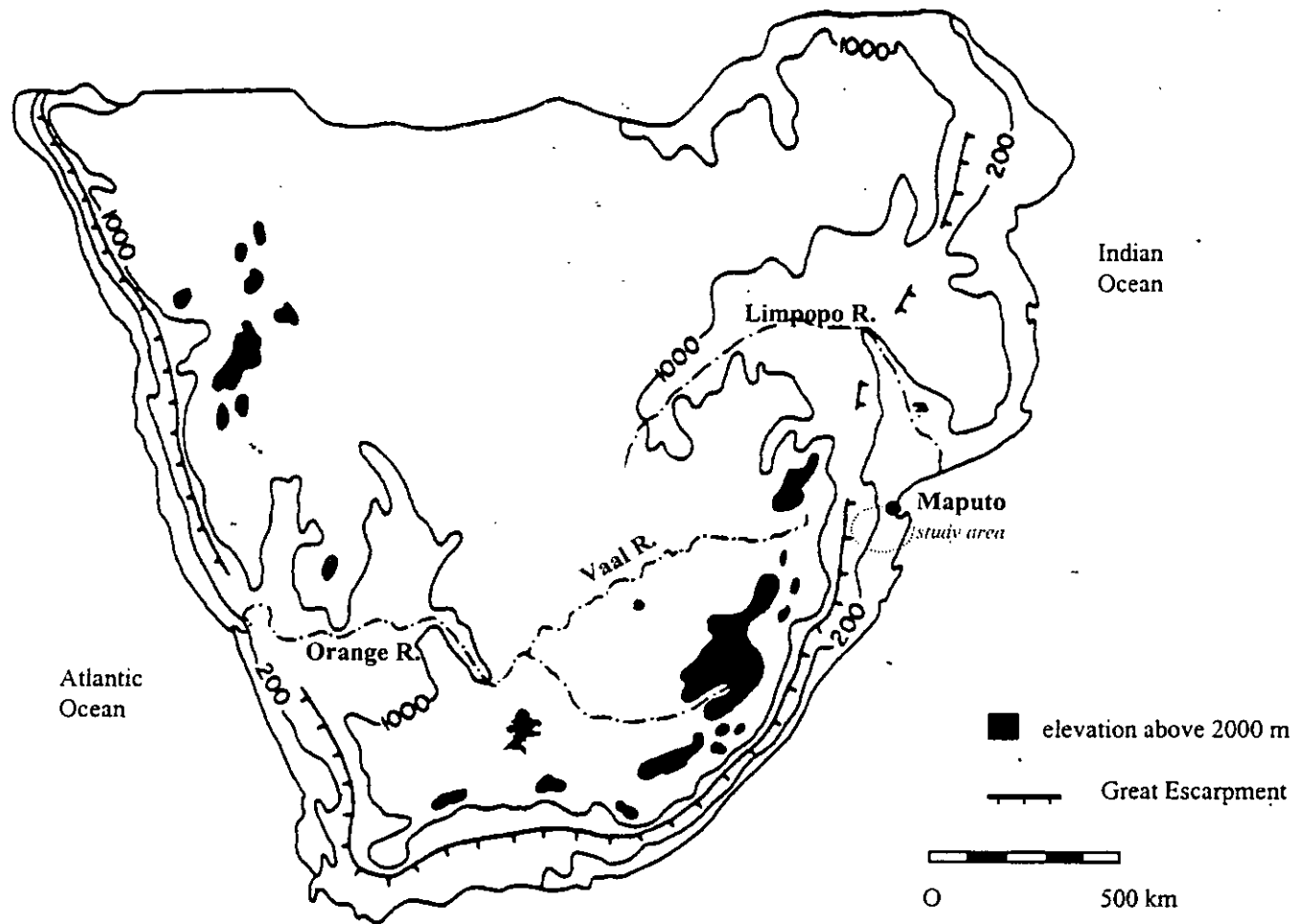


Fig. 4.2.1 Southern Africa relief (in meters). From O'Brien, 1993

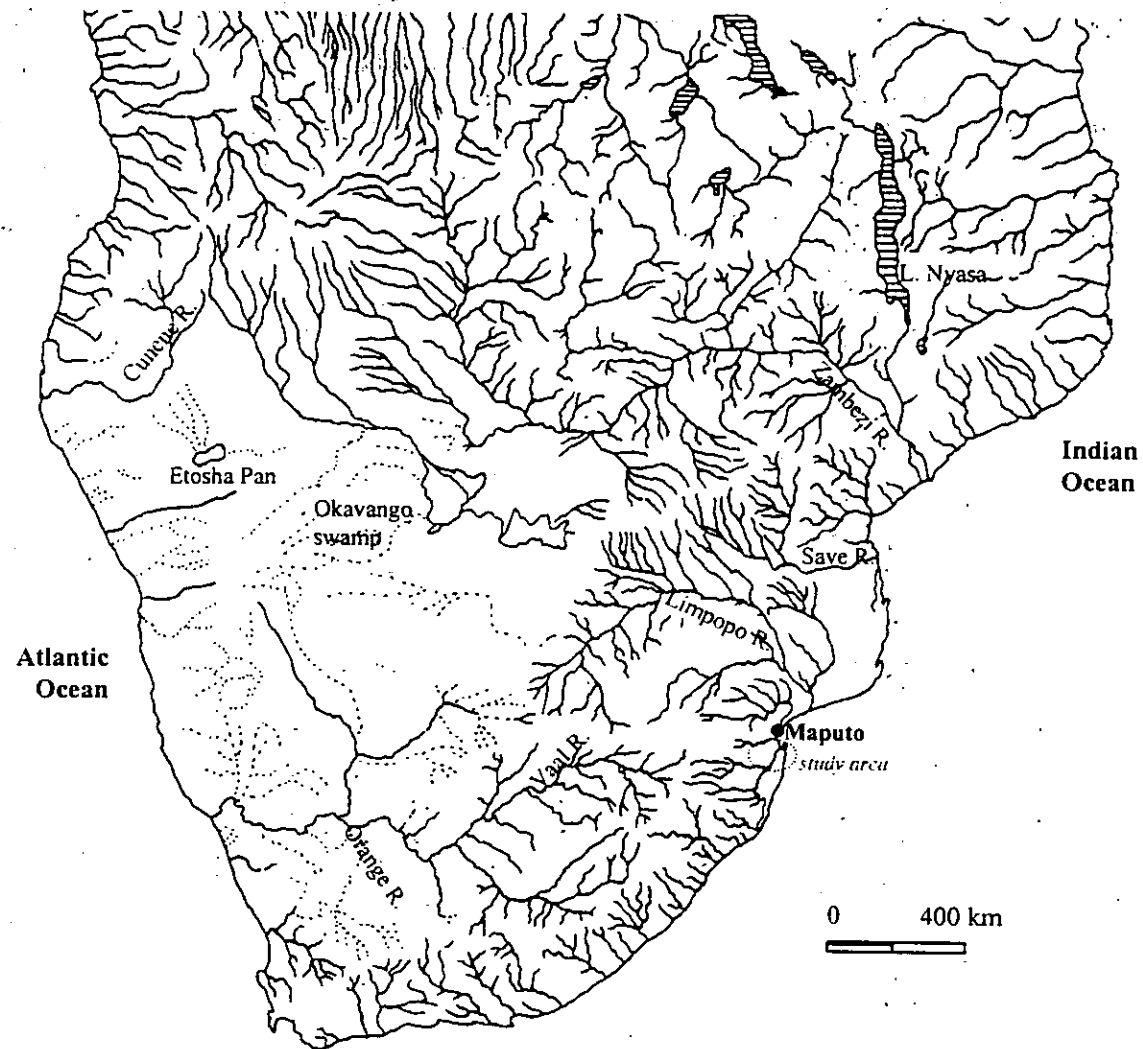


Fig. 4.2.2 Southern Africa: major river systems and drainage basins. From Sampson, 1974.

## 4.2 THE LANDSCAPE SYSTEM OF SOUTHERN MOZAMBIQUE

### 4.2.1 Introduction: the regional setting

In a broader sense, the landscape of Southeastern Africa was shaped by a sequence of rifting episodes and subsequent cycles of uplift and erosion (King, 1966, 1972, 1982, Partridge & Maud, 1987, Pritchard, 1979), as discussed in the previous chapter of this dissertation. These processes formed the Great Escarpment (see Fig. 4.2.1 representing the relief of Southern Africa), which receded from the coast after the establishment of an effective drainage system (see Fig. 4.2.2, indicating the major river systems and drainage basins in Southern Africa). In fact, the uplift of the area created renewed erosional cycles, with river incision starting at the coast (Pritchard, 1979). Southern Africa has several landscape levels representing different erosion cycles. However, one should keep in mind that processes such as tilting, folding and warping during uplift have complicated the pattern (Pritchard, 1979). Today, the Great Escarpment separates the elevated interior of Southern Africa (i.e., the older erosion surfaces) from the younger coastal regions. The coast of Southern Africa has been repeatedly tilted upward in a south-east direction, about a hinge line, off the present-day coast.

As a result of a complex set of factors, the interior high-elevation areas are quite cold and dry, when compared to the coastal system. Southern Africa today has moderate to warm mean annual temperatures, ranging from about 27° C in the coastal areas to about 15°C in the central highlands (see Fig. 4.2.3). The orographic effects of the Great Escarpment are also present in Southern Africa. The 500 mm isohyet divides the subcontinent into a drier west half and a moister eastern half (see Fig. 4.2.4; see also Deacon & Lancaster, 1988). As the map shows, the lowest rainfall values are found along the Namibia coast. In the eastern half, where the study area is located, these values are above 750 millimeters per year, with about 80% of the precipitation occurring in the summer.

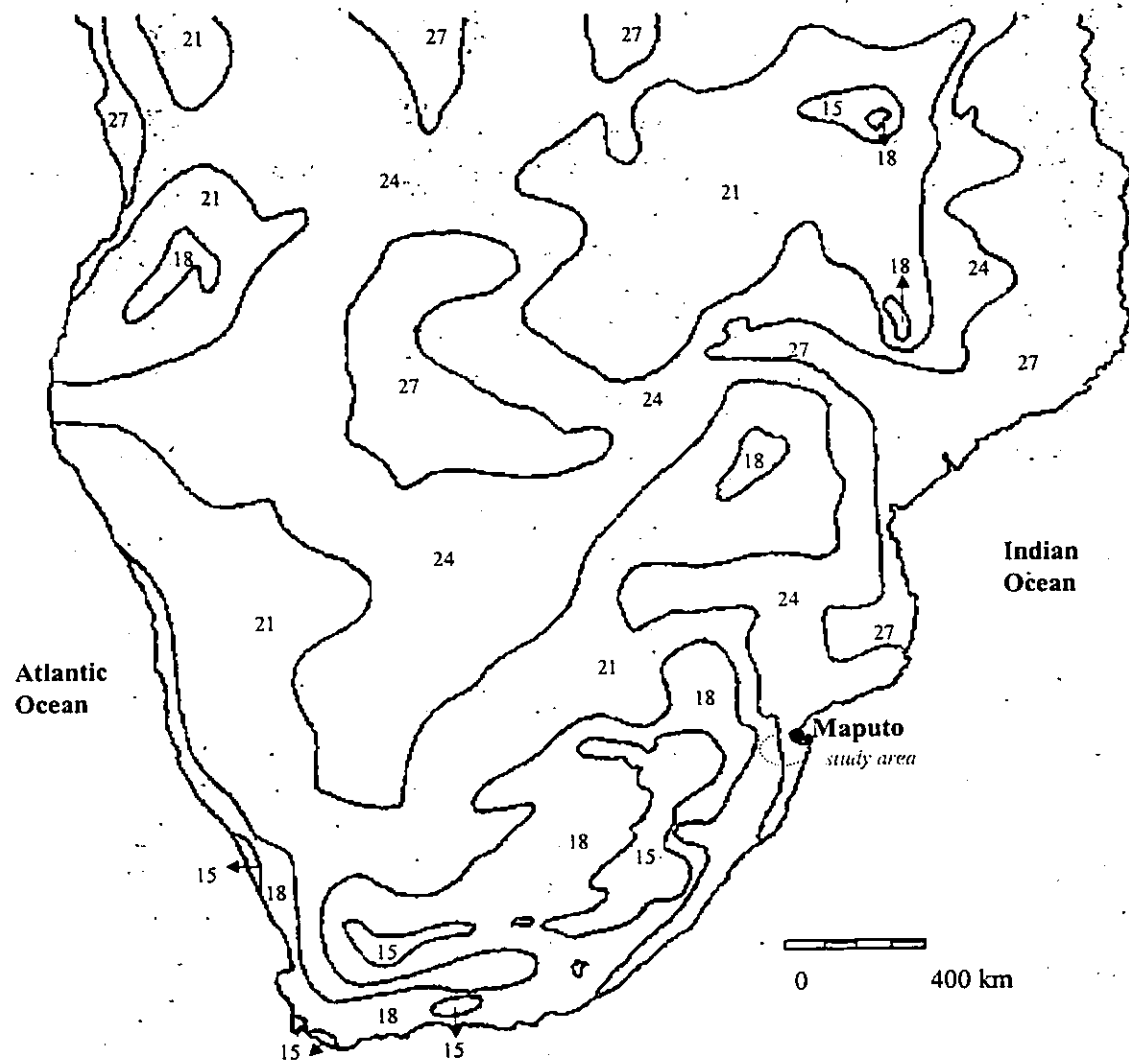


Fig. 4.2.3 Southern Africa: distribution of the mean annual temperature (°C). After Sampson, 1974 and Schulte & McGee, 1978

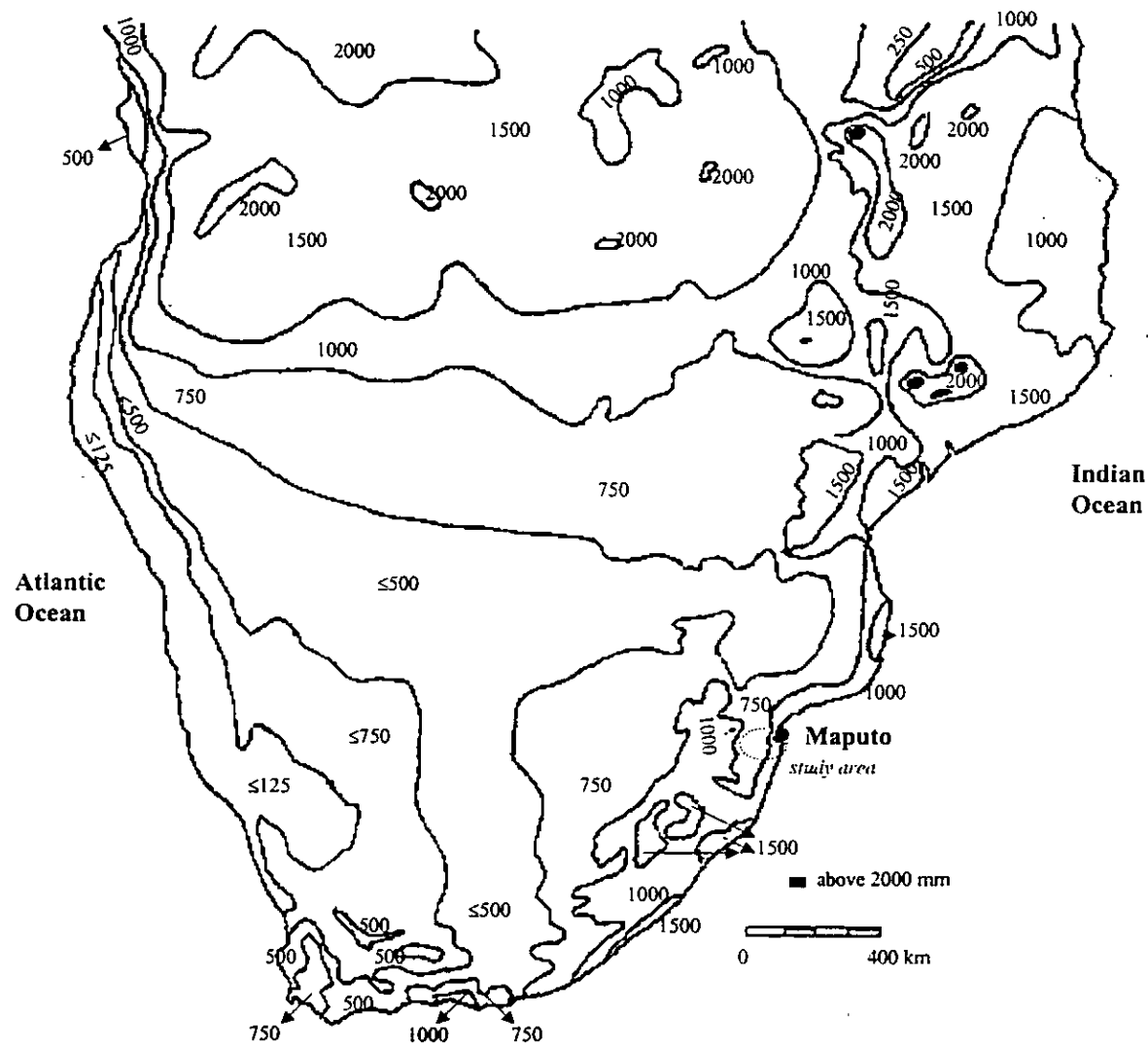


Fig. 4.2.4 Southern Africa: mean annual rainfall (mm). Adapted from Sampson, 1974 and Schulze & McGee, 1978

## 4.2.2 The landscapes of the study area

### 4.2.2.1 Geomorphology

A brief survey of the present land surface of southern Mozambique is useful in understanding the emergence of the region's present topography. The ecological context of the study area encompasses structural geological features that dictate surface geomorphology. These features affect relief, slope and hydromorphology, as well as the edaphic relation of slopes, soils and vegetation. Combining modern regional geomorphology, paleoenvironmental indicators, a sound perception of the dynamics of landscape evolution and probable environmental affordances allows understanding why a specific land facet was probably used (Reitz et al., 1996).

In southern Mozambique, the retreat of the scarps and the geology combine to produce the southern Mozambique a topographic zonation roughly parallel to the coast. The rivers, running on the most direct course to the sea, create valleys and the intervening ridges running consistently from west to east, producing a diversity of landscapes (Bosazza, 1956, Koch, 1964, King, 1966, 1972, Lopes, 1979). As mentioned before, one important component in the geomorphology of the Maputo province is the feature known as the Libombos mountain range. In less than 60 kilometers, the landscape drops from about 800 meters at M'Pondúine mountain in the Grandes Libombos, to the Indian Ocean on the east side (see Fig. 4.2.5, portraying a West-East transect of the study area).

From a structural standpoint, the Libombos range (including both the Grandes and Pequenos Libombos) constitutes a monocline. The original formation of the Libombos monocline dips towards the east, in the direction of the Indian Ocean. Subsequent to the creation of the monocline and its associated faulting, uplifting and tilting occurred on a number of occasions, leading to the formation of some aspects of the contemporary landscape. The most notable effect of this uplifting and tilting

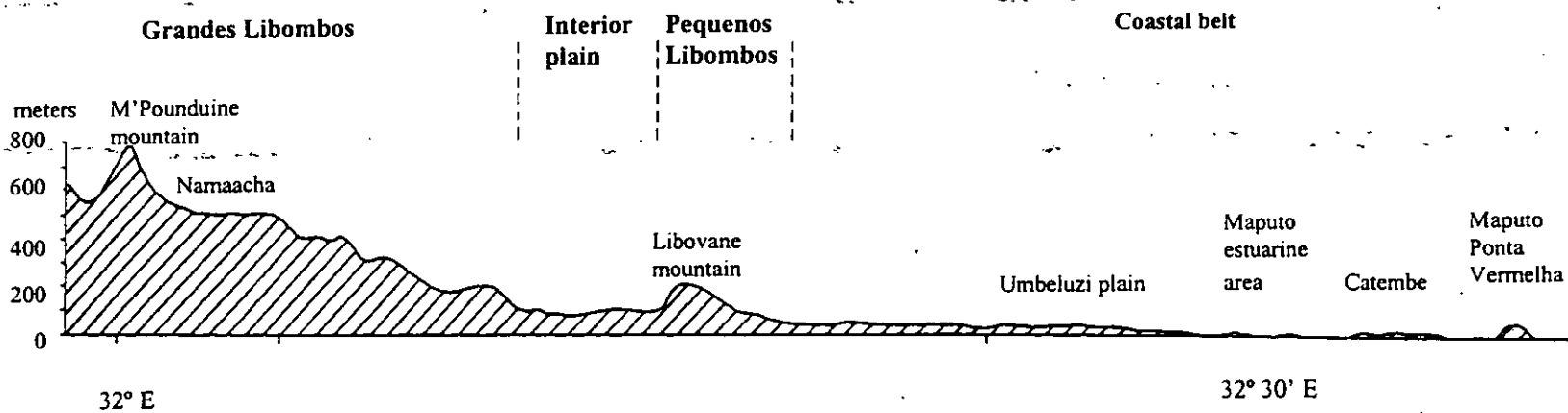


Fig. 4.2.5 West-East transect of the study area, along 26° S (elevation in meters), showing the main relief characteristics (after Lopes, 1974)

was on rivers that incised deep V-shaped valleys. The cross section of the Umbeluzi River at Umpala, reproduced in Fig. 3.2.11, is a good example of such a situation. Where these east-flowing streams crossed strata with contrasting resistance to erosion, east-facing steps are formed, e.g. Namaacha waterfall (see Fig. 8.2.9).

As described in more detail in the previous chapter, the Tertiary was characterized by distinct periods of continental uplift and downwarping of the margin of the main Libombos escarpment, which gave rise to successive periods of erosion and sedimentation (Hobday, 1982). Still, in the Libombos area, it is possible to identify the remnants of Miocene erosional processes, conserved as plateau fragments. In the following period, erosional cycles were covered by marine, calcareous sandstones of the Pliocene transgressions, up to the footslopes of the Libombos (Dingle et al., 1983).

A prominent feature of Quaternary sedimentation is the occurrence of ridges of sandy dunes parallel or slightly oblique to the present shoreline (Tankard et al, 1982; see also Fig. 3.2.10 representing the development of southern Mozambique coastline). The coastal dune cordon consisting of vegetated dunes rising to about 100 meters in places, is thought to be associated with sea level depression that occurred during the final stages of the Pleistocene (about 125 Kya – see Föster, 1975, Davis, 1977, Dingle et al., 1983).

Overall, from west to east the following main landforms can be distinguished (Fig. 4.2.5; see also Truswell, 1970, 1977, Murdock et al., 1971, Lopes, 1979, Barradas, 1962, 1966, Chonguiça, 1995).

- The **Grandes Libombos** mountain range, is the most prominent topographic feature. It forms a *cuesta* landscape composed of erosion resistant rhyolites and less resistant basalt (see previously



referred Fig. 3.2.2). This mountain range stretches along some 600 kilometers, and presents an average height of 400-500 meters above sea level (a.s.l.).

Parallel to the Grandes Libombos escarpment to the east, from the Sabié and N'Komati rivers down up to the Changalane River, there are the **Pequenos Libombos** mountains, also of volcanic origin. This is a range of lower elevation - a maximum of 291 meters - with altitudes usually lower than 150 meters a.s.l.

Topographically, these mountain ranges are characterized by straight-sided ridges with round crests desiccated by a moderate to closely spaced drainage network. These lava uplands slope gently towards the east. The slope is deeply scored by various steep sided valleys, forming a trellis network. Ridge crests are accordant and represent one level of an extensive erosion surface. The western margin is marked by a steep scar and more or less isolated ridges with colluvium and glacial accumulation on the foot slope. The plateau crest is level to gently sloping. In the upper reaches of the tributary streams, where gradients are steep and rivers fast-flowing, valleys tend to be deeply incised and steep, and gullies are frequent. The river valleys are oriented in a E-W direction through this plateau. When descending into the midlands the rivers become broader and with lower gradients; this fact associated with the existence of hard rock types results in the presence of waterfalls where formations that are more resistant are crossed. The valley floors, usually wide, include stream channels and local small terraces.

- The denuded basaltic mantles from the Jurassic to the Early Cretaceous cover both the Inter-Libombos and the Movene depression (**Interior Plain**). Being flat with faults, the drainage is structurally controlled with evidence of rill and gully erosion in certain sections.

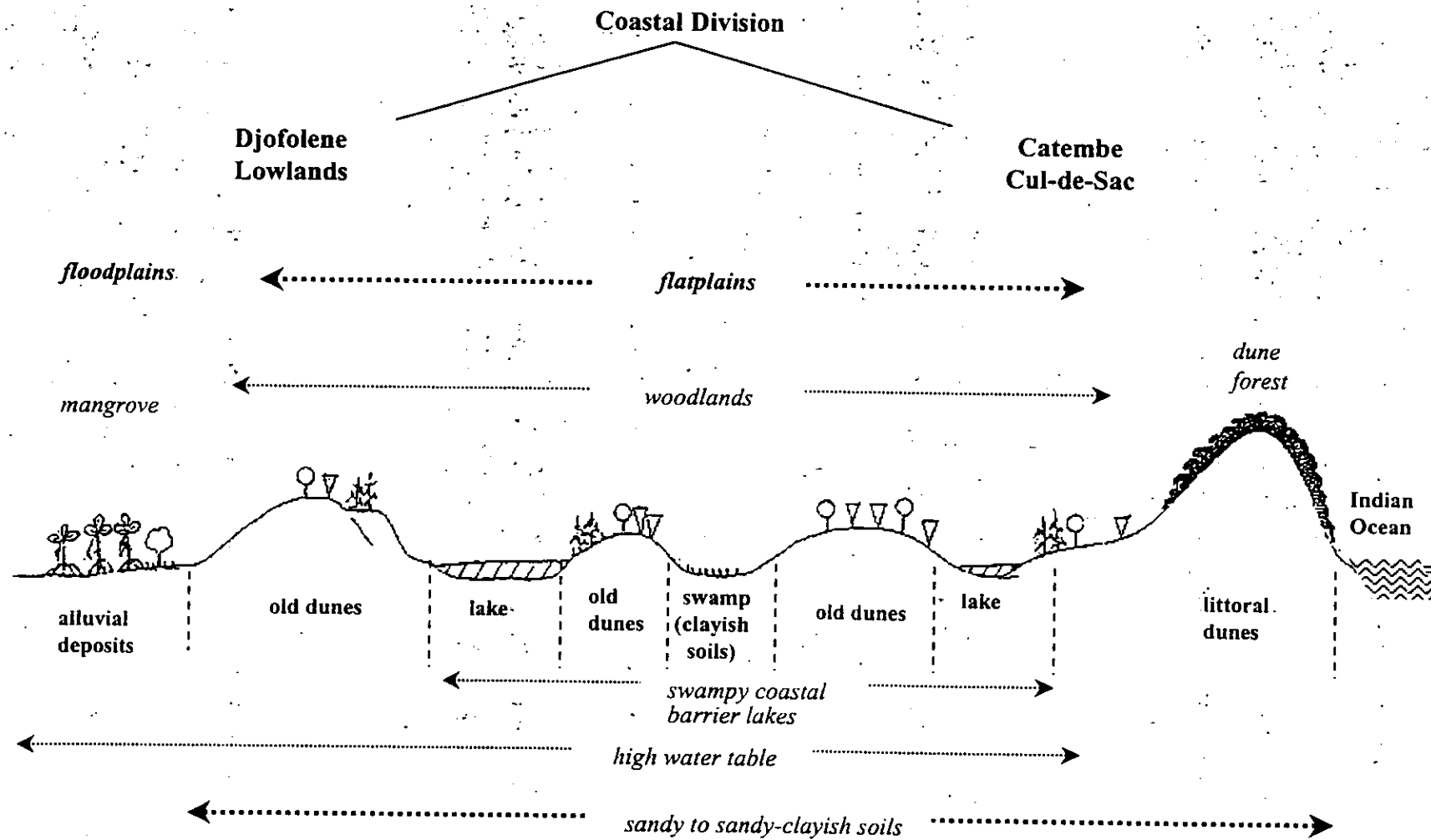


Fig. 4.2.6 Coastal Division: Djofalene Lowlands and Catembe Cul-de-Sac landscape locales (not to scale)

- Below the Pequenos Libombos, there is a vast shallow plain – the **Coastal Belt** -- stretching in a north-south direction (e.g., The Umbeluzi Plain). Here, the morphology results from depositional processes. South of Maputo city, this plain is typified by a frequent occurrence of wetlands and several large open water bodies (where the main channels are the Umbeluzi, Tembe and Maputo Rivers whose sections are structurally controlled). Local bank erosion and evidence of rill erosion can be observable in several places. The rivers drain into the tidal estuary of Maputo Bay. The mouths of the major rivers are drowned, spits and bars across their mouths form irregularly shaped lagoons which are a typical features of the coastline.

The central and western portion of this plain are characterized by the presence of plateaus (on average about 60 meter high) with localized depressions (which form perennial ponds).

The easternmost stretch of the **Coastal Belt** topography is relatively homogeneous, being characterized by a wide and **shallow sandy plain** slightly tilted towards the sea with a well-developed long-shore dune system. Fig. 4.2.6 -- representing a not to scale profile of Coastal Division section -- gives a feeling for the coastal topography. In general, the interior dunes - fixed and leveled - correspond to depositional areas resulting from sea regression processes combined with the action of eolian agents of the Late Quaternary erosion cycle. The modern dunes (very steep), stretch along a narrow coastal band. The modern dunes are not fixed and form an irregular feature. The sandy beach and the modern dunes are in many places cut by rocky outcrops and exposures up to the inter-tidal zone.

The great contrasts in relief, both from coast to the Libombos and between river valleys and their intervening ridges, have an important influence on the potential land uses of this area and on the contrasting opportunities probably available across southern Maputo province in prehistoric times.

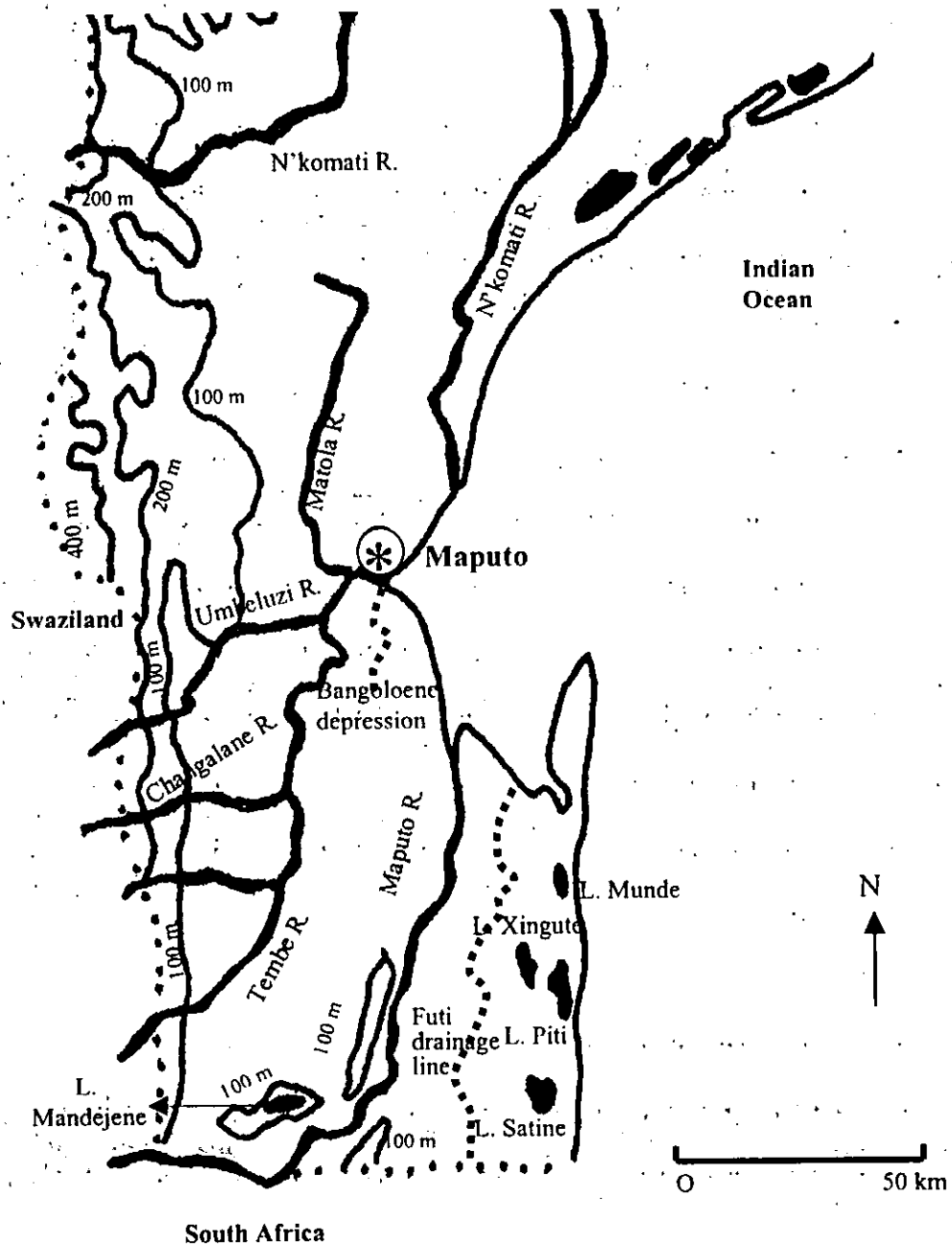


Fig. 4.2.7 The main rivers and lakes in southern Mozambique. The perennial lakes are the blackened areas and the rivers the thick lines. Dashed lines indicate swampy areas. Thinner lines are contour level (after Barradas, 1966, Myre, 1968).

#### 4.2.2.2 The drainage system – surface water bodies

In south-central Mozambique, the drainage system is oriented towards the Indian Ocean. The fluvial regimen is quite irregular as the flow fluctuates with the alternation of dry and rainy seasons. The high-water flow period occurs from January to March, and the low-water flow between June and August.

South of the Save River, the main rivers are, the Limpopo, the N'komati, the Umbeluzi and the Maputo (see Fig. 4.2.2 and Fig. 4.2.7, the latter showing the main rivers and lakes of Maputo province). In general these rivers have a permanent character, but frequently some have no flow at the end of the dry season. During wet season, under storm conditions (Indian ocean cyclones), floods do occur in rivers like the N'Komati, Umbeluzi and Maputo.

South of the Limpopo Rivers, smaller streams have a seasonal character; especially in the coastal belt. Numerous lakes and ponds are recorded in the coastal belt, but usually less than 10% of them are permanent or semi-permanent in character (BURGEAP, 1962, Direcção Provincial dos Serviços Hidráulicos, 1969, Ferro & Bouman, 1989).

In the extreme south of Mozambique, the main rivers are:

1. The **N'Komati River** (normally perennial);
2. A smaller and ephemeral stream, the **Matola River**;
3. The **Umbeluzi River**, usually perennial, with the Impamputo and the Movene rivers as tributaries (these latter rivers not seen in Fig. 4.2.7);
4. The **Tembe river**, with the **Changalane river** as a tributary, dry during the winter/dry season;
5. The **Maputo river** (usually perennial).

In the study area, the main drainage channel is the Umbeluzi River. This river has its source at the Swazi highveld, at about 1600 meters a.s.l., and drains 314 kilometers eastward into Maputo Bay. Inside Mozambique, in the western –Libombos mountains – region, the course of the Umbeluzi River is controlled by the fault system in the volcanic bedrock, which forms narrow ports where the river cuts through prominent hill sills. Eastward, the river flows through a region dominated by a vast plain of Tertiary-Quaternary origin. The Tembe and the Changalane rivers (together with the Indian ocean) define the eastern margin of the study area. The Changalane River cuts its way through the Grandes Libombos, and in some places impeded drainage has created some vleis (case of Caimane and Cardiga sites – see next chapter). The area occupied by the Tembe rivers represents a vast alluvial plain, with minimal relief (BURGEAP, 1962, Barradas, 1966, Beernardt, 1987).

The Tembe, Changalane and Matola rivers, are of perennial character during most of the year. However, during the peak of the dry season, and during very dry years, it is possible to find ponds or swampy areas, or still dig to water about 1-2 meters deep. Finally, smaller streams e.g., Maubué stream), usually dry during most of the year feed the main rivers described above.

Features such as the Futi, while often described as rivers, are more typically swampy drainage lines, with intermittent pools of standing water (Direcção Provincial dos Serviços Hidráulicos, 1969). For example, the Bangoloene depression (which is part of the eastern boundary of the study area) is an old streamline, now silted with marine and estuarine sediments.

When trying to assess the natural resources of the study area, the numerous lagoons to be found in the lowlands, stretching along the coastal plain become quite important (BURGEAP, 1962, Pollett et al., 1995). They have different water qualities, as follows:

1. **salt waters, especially**

- Lake Xingute (with 17.5 square kilometers);
- Lake Piti (with 32.5 square kilometers);
- Lake Uembje (with about 23 square kilometers);

2. of **brackish waters**, such as
  - Lake Satine (also with 7.5 square kilometers);
  - and Lake Changana;
3. and **sweet waters**, as
  - Lake Mandejene (with 7.5 square kilometers).

Along the coastal belt, the high permeability and the low water holding capacity of the surface sands ensures that infiltration is rapid and that surface flow is unlikely unless the water table becomes exposed by surface topography. As a consequence, geohydrological processes, rather than surface flow, play the key role in the distribution and characteristics of both ground and surface water. Surface water bodies occur when the groundwater becomes exposed due to depressions in the surface topography. Since the groundwater table is known to fluctuate during dry and wet periods, it follows that many wetlands are ephemeral or seasonal, with only those in the deepest depressions retaining surface water throughout the year. In the area, most of the lakes are concentrated along the coastal belt; however, there are some others inland, located at low elevation, especially in the western part of the coastal belt. These lakes can occupy large surfaces in the rainy season, normally drying out completely in the dry season (Myre, 1971). In southernmost Mozambique, the most important inland lake is Lake Mandejene. Some of the coastal lakes, such as Lake Xingute, present a very high surface area to volume ratio, experiencing high evaporative loss. Hence, the lakes and ponds in the coastal area may be of fresh water in very wet years, but become highly saline during most of the time. Some of these lakes could be considered permanently brackish (e.g., Lake Piti).

Wetland environments, i.e., settings in which swamps, estuaries and marshes are prominent features of the land forms in southern Mozambique (BURGEAP, 1962, Lobão Tello, 1972, Pollett et al., 1995, Couto & Hutton, 1995). Wetlands represent not only a transitional zone

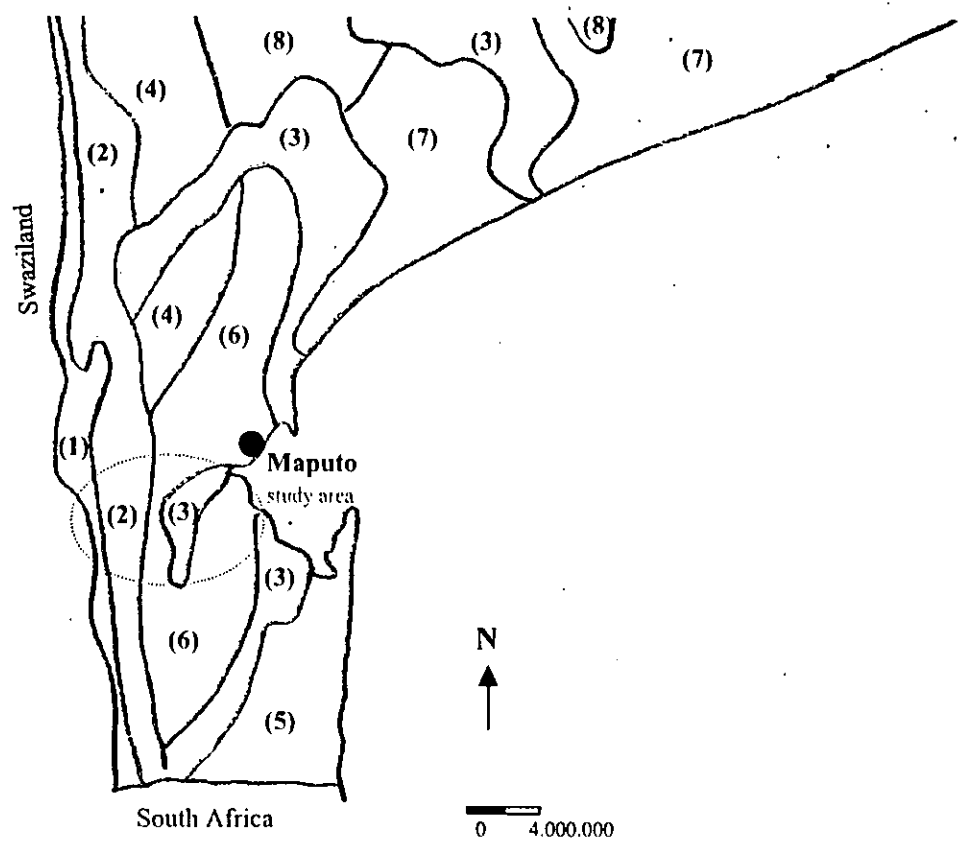
between the drier land and open water, but a distinct set of ecozones in their own right (e.g., Mitsch & Gosselink, 1986). In southern Mozambique, wetlands are found predominantly in the coastal area, in a setting in which water can accumulate at least on a temporary basis.

Nonetheless, in the interior setting, i.e., in the western, Upland Division, during the dry season lakes and pond systems originate during the dry season along ephemeral streams and rivers.

In the study area in southern Mozambique, both internal and coastal settings, wetlands are normally highly dynamic entities that underwent substantial change over time in response to changes in the local geomorphological and climatic factors, originating a constant process of landscape formation. (see Fig. 3.3.2). Therefore, areas seasonally or periodically water-covered, associated with faunal and floral food sources, such as swampy areas, deltas, spring, waterholes, lakes, river margins, deltas become crucial elements in evaluating the potential of a landscape facet in terms of affordances. Wetlands tend to be a relatively stable resource base owing to high values of resource diversity, productivity and reliability, especially the usually year-round availability of water, even during times of drought (e.g., Nicholas, 1998).

Although very little information is available on the archaeological record associated with the wetlands, some recent studies have focused their attention on this important component of the landscape. As seasonal or permanent features, wetlands were part of the landscape of East Africa during the Early to Middle Pleistocene. Indicators of wetland conditions were identified at Olduvai and Koobi Fora (Rogers et al., 1994, Blumenshine & Peters, 1998). Evidence of Acheulean sites associated with wetlands are referred to by several authors, not only in Southeastern Africa as mentioned earlier in this dissertation (e.g., Deacon, 1975, Clark, 1981, Klein, 1984, 1989, 1995, Potts, 1994), but also elsewhere in Eurasia. A concrete example is Torralba and Ambrona sites in Spain (e.g., Klein, 1989, 1994, Freeman, 1994). For example, waterholes in the dry season are attractive and dangerous places for humans, due to the presence nearby of several predators. Hence, and because routinely exploited by predators, wetlands were most likely used in a restricted way by Pleistocene hominids. In fact, evidence of predation on





Key to Fig. 4.2.8 (dotted circle identifies the study area):

- (1) - Lithosol present from the mid to top escarpment of the Libombos mountains. These are very thin and stony soils.
- (2) - Chromic luvisol, at the Libombos mountains area. Sandy to heavy clayish soil; presents a medium texture.
- (3) - Eutric fluvisol. This is a clayish soil (normally with a medium to fine grained texture) present along the river valleys in the study area (interior and coastal plains).
- (4) - Soil complex. Ferric luvisol and Chromic cambisol. These are deep to medium-deep, sandy-clayish soils, with distinct textures.
- (5) - Albic arenosol. Fine grained sandy soil, very poor in nutrients.
- (6) - Cambic arenosol with Chromic luvisol. Sandy soil, normally medium to coarse grained in texture. Present in the interior and coastal plains (both present low fertility)
- (7) - Cambic arenosol with Chromic luvisol, pellic vertisol and eutric gleys. Essentially, these are medium to fine grained sandy soils, present from the interior to coastal plains (medium to low fertility).
- (8) - Luvic arenosol.

Fig. 4.2.8 Soil map of southern Mozambique (compiled with data extracted from Barradas, 1962, 1966, Gouveia & Marques, 1980, FAO/INIA, 1982a, 1982b, Konstapel et al., 1987, INIA, 1991).

hominids is present in the archaeological record (Klein, 1989). Besides predators, other factors may have significantly restricted their use by hominids, such as malaria carrying mosquitoes (e.g., Peters & Blumenschine, 1995). Therefore, studies of actual wetlands are important in providing a representative view of past land-use practices.

#### 4.2.2.3 Soils

The soils of the region are closely related to geomorphological history and current landform. In Mozambique, significant achievements have been obtained on the soil classification since the early 50's (e.g., Gouveia & Azevedo, 1954). The following brief review is based largely on the work of Gouveia & Marques (1980), on the studies performed under the scope of FAO (FAO/INIA, 1982b), as well as on research performed individually by several people in my study area, primarily Beernardt (1987). The data available presents the Sul do Save plain as part of the broad soil region 43 (FAO/UNDP/MOZ, 1980), characterized in general by eolian and fluvial deposits of Tertiary and Pleistocene age. These underlie large sandy areas. Large areas of heavy soils occur at the edges of the sandy plain.

Fig. 4.2.8 is a simplified soil map of southern Mozambique.

In the Libombos range area, the main soil unit present is the **lithosol**, which results from the deterioration of the basal rhyolite. These are immature soils, with hard rock at very shallow depth. In terms of composition and texture, the lithosol forms a shallow gray sand to loam, being especially well represented on the ground within the rounded ridge crests. **Chromic luvisol**, with a clay horizon, occurs in unfavorable ecological conditions with insufficient water supply. This soil type is mainly present in a strip area along the slopes of the Libombos range. Along perennial streams in large valley tributaries, braided flats of sand and gravel dominate. Here coarse sand and gravel

(mineral hydromorphic with alluvium) develop along seasonal floodplains (Barradas, 1962, 1966, Myre & Ripado, 1953, Murdock & al, 1971, Lopes, 1974, FAO/INIA, 1982b).

Shallow, very clayey soils - red or black-brownish- have formed in the rotten layers of basalt in the inter-Libombos and Movene plains. Heavy textured alluvial soils (eutric fluvisol) occur on the depositional plains of the Tembe and Umbeluzi rivers. These soils, generally fertile, are derived from alluvium, river terraces and Cretaceous sediments, composed of sand to clay. These soils present normally a slope gradient of less than 2% (Ospina, 1988, Scholten, 1984).

Areas of "mananga" soils (**Cambic arenosol**) occur to the west. The manangas represent the main soil unit of the coastal-sedimentary area, developed over the step-like platforms of southern Mozambique. They comprise a thick mantle of yellowish-brown, sandy clay loam (Beernardt, 1987).

The expansive swamps in the east result from the drainage of the main rivers and are composed of saline marine and estuarine sediments (**eutric fluvisols**) (Gouveia & Marques, 1980).

Sandy dune soils (**cambic arenosols**), low in organic matter, occur in the lowlands towards the coast (mainly in dry regions), including the alluvial soils bordering the rivers. The large expanse of undulating sandy plains west of the dunes comprise a variety of infertile sandy soils of recent origin (**haplic, ferrallic and albic arenosols**; not in the image) (FAO/UNDP/MOZ, 1980). The dune soils are characterized by adverse physical and chemical properties. In high-rainfall eastern portions of the region under study, the soils are also much leached, which makes them even more inherently infertile on dune areas. The interdune zone is characterized by a high water table, which leads to them generally being waterlogged. In the drier western portion of the region, water in the deep sands drains downward very rapidly from the surface zone, with consequent adverse effects on most forms of vegetation growth (Barradas, 1962, 1966, Maud, 1980).

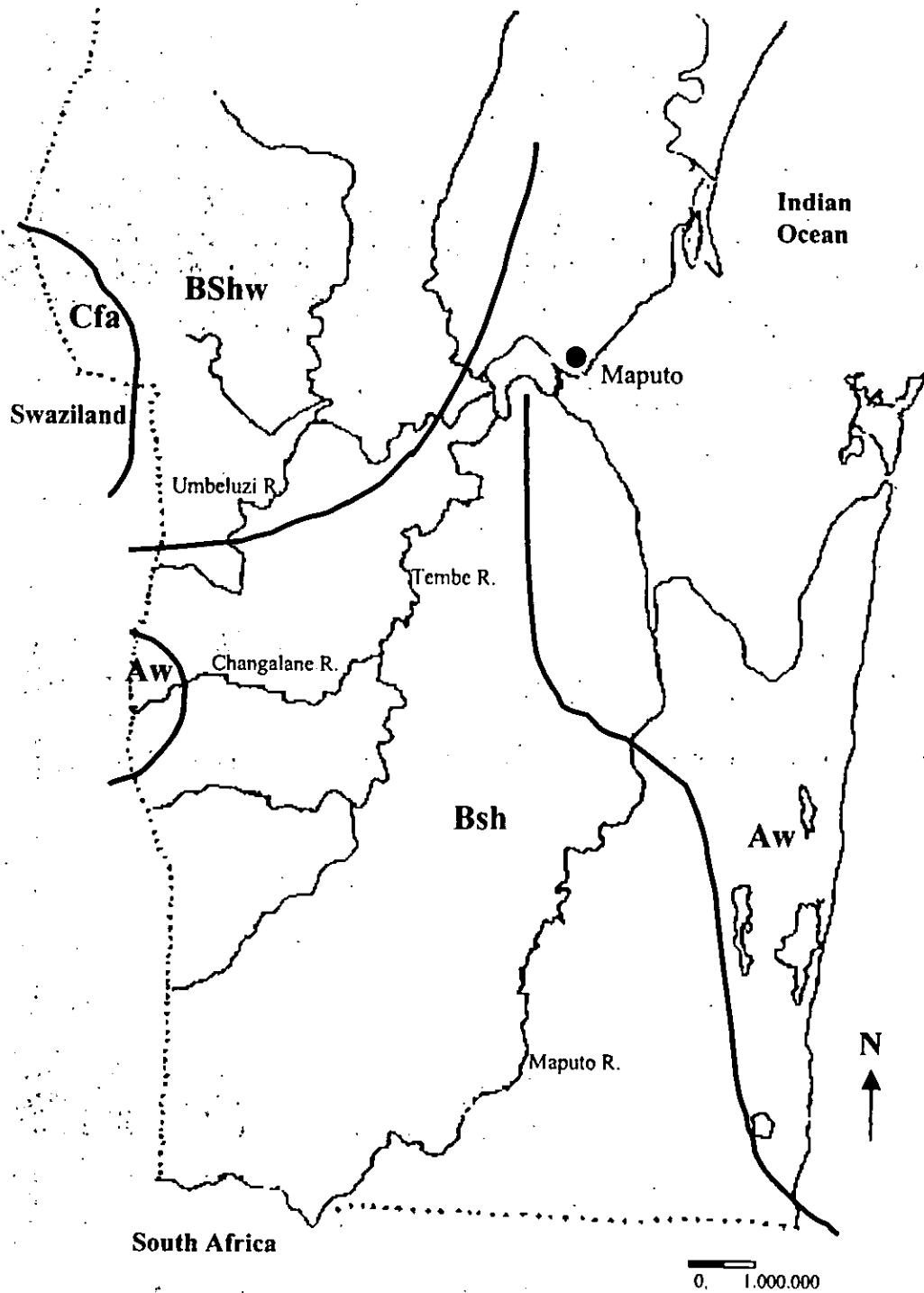


Fig. 4.2.9 Köppen climatic classification for Maputo province, southern Mozambique. The description of the sub-regions is presented in the text (adapted from Lopes, 1974, FAO/INIA, 1982, Barca, 1992, Couto & Hutton, 1995)

### 4.2.3 The present day climate

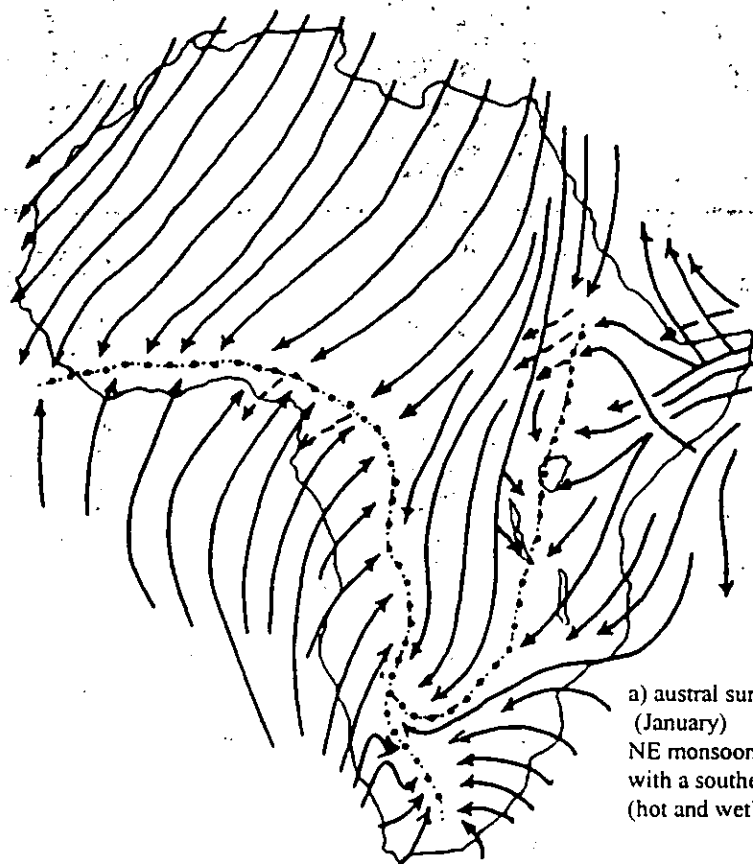
#### 4.2.3.1 Overview of the main factors determining the climatic environment in the study area

The climatic environment of Mozambique is determined by a wide range of factors derived from its position within Southeastern Africa: insolation; the warm Mozambique current, seasonal winds, rainfall, and orographic effects of topography. These elements form a climate pattern that, together with the soil type, geological context, fauna and flora, influence affordances for each of the landform associations identified in the region.

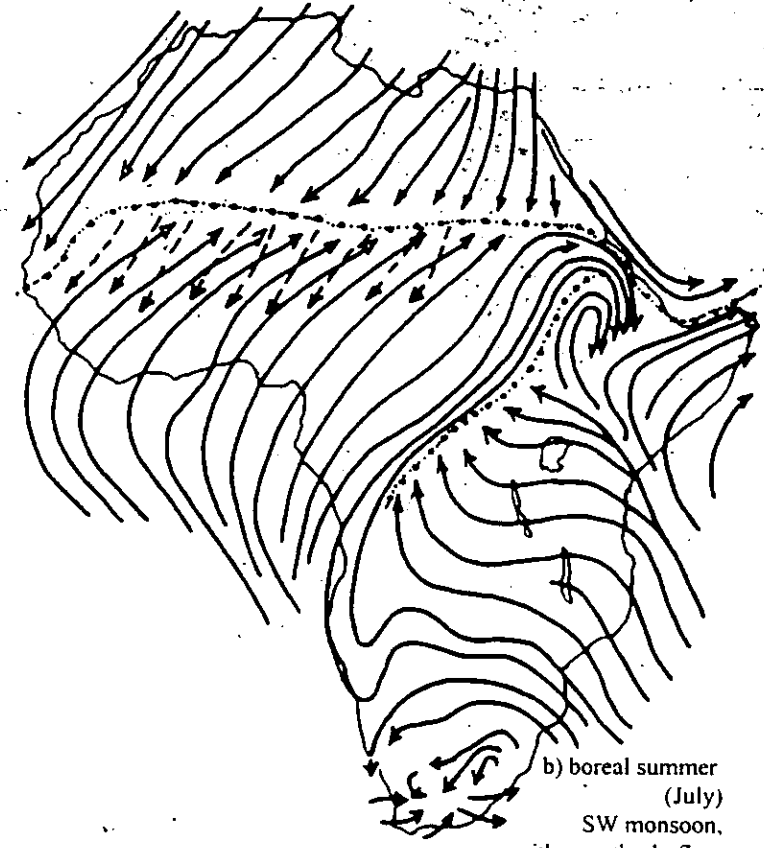
The climate of Maputo province – southern Mozambique (where the study area is located) can be summarized in four main units (after a modified Köppen's climatic classification - see Fig. 4.2.9):

- The low altitude coastal belt, with a warm, wet and very humid summer period and a short dry, winter season (**Aw**);
- The interior lowlands (i.e., interior river valleys) with a warm rainy season and a very dry winter (i.e., a hot and semi-arid climate (**Bsh**)); nonetheless, it should be noted that the Pequenos Libombos are less hot and dry;
- The uplands zone (Grandes Libombos), with a cool and moist summer and a dry and cold winter season (**Cfa**);
- The northern interior zone (**Bshw**), with a semi-arid climate, a short humid hot season and a dry and cold winter season.

(adapted from Soares & Barroso, 1972, Lopes, 1974, 1979, Ministério da Agricultura, 1977, FAO/INIA, 1982a, Couto & Hutton, 1995, Pollett et al., 1995).



a) austral summer  
(January)  
NE monsoon,  
with a southerly flow  
(hot and wet)



b) boreal summer  
(July)  
SW monsoon,  
with a northerly flow  
(cold and dry)

Fig. 4.2.10 The prevailing wind patterns and migration of the Intertropical Convergence Zone (ITCZ) over the African continent determine seasonal variability in rainfall (adapted from O'Brien & Peters, in press, after Martin & O'Meara (1986)). Dotted lines indicate the location of the ITCZ and associated low pressure zones.

In the study area, and essentially throughout the entire Sul do Save region, two seasons are recognized: a warmer and wet, rainy period (from October to March), and a cooler and dry period (from April to September).

#### 4.2.3.2 Circulation patterns

In the Sul do Save region, as well as in Southern Africa, the climatic circumstances are dominated by three atmospheric systems, which are arranged in a meridional sequence (van Zideren Bakker, 1976, Tyson, 1986, 1990).

1. The summer solstice system associated with the Inter Tropical Convergence Zone (ITCZ – see Fig. 4.2.10 representing the wind patterns and the migration of the ITCZ over the African continent). A marked seasonal reversal of surface winds occurs from April to October (NE monsoon with a southerly flow) and October to March (SW monsoon with a northerly flow), which are related to the seasonal movement of the ITCZ, affecting especially those regions north of the latitude  $20^{\circ}\text{S}$ <sup>1</sup>. During the dry and cooler season (e.g., July), the winds blow from south and east. In summer time (e.g., January) the winds blow normally from north and east. The subtropical high pressure belt of anticyclones has a constant drying effect on the central regions (a subtropical anticyclone is situated above the Indian Ocean, between  $25^{\circ}\text{S}$  and  $38^{\circ}\text{S}$ ; see Lopes, 1974, Schulze & McGee, 1978, Kalk, 1995).
2. The zone of mid latitude westerlies, bringing cyclonic rains to the southern regions (Lopes, 1974).

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<sup>1</sup> In summer time, the ICTZ is located between  $30^{\circ}$ - $35^{\circ}\text{S}$ , and in winter time between  $25^{\circ}$ - $30^{\circ}\text{S}$ .

3. Finally, the warm "Mozambican current", paralleling the coast, flows from NE to SW. The sea temperature is quite uniform throughout the summer and winter periods (i.e., a core temperature of about 25°; see Tinley, 1971, Kalk, 1995). This gulfstream causes higher air temperatures compared to regions in the Atlantic coast at the same latitude.

The distinct wind patterns are well known to the local population. In summer time, the "north wind" results, along the coastal belt and in the uplands, in very hot and humid weather (where temperatures average 35°-40°C, with humidity between 90-100%). In general it brings heavy storms, normally in the late afternoon or night, especially along the coast and littoral plains. Throughout the year, the "south wind" lowers the air temperature, raises the humidity and sometimes brings heavy and continuous rains, associated with a cold, south wind. If the north wind is unpredictable and unstable, the weather brought about by the "south wind" is quite constant, especially during the dry and cold season (winter time). In the inland areas, especially in the Grandes Libombos, it is also normal to have the presence of a NW wind, blown from the mountains, during the winter season. This very dry wind is relatively warm during the day, but cold at night; hence, the weather is normally clear and dry during the winter.

In the region under study, the climatic conditions are largely under the influence of maritime air, which exercises a moderating influence on the otherwise arid to semi-arid conditions that prevail. In summer time a low-pressure zone is formed above the land, causing an influx of moist tropical air, whilst in winter the high-pressure zone is intensified over land and maritime air is inhibited from entering, resulting in a dry winter season. Thus, over the major part of southern Africa rainfall occurs mainly in the summer, from October-November to April, and about 70% of the rainfall in the research area falls during this period. In the summer-rainfall period, when precipitation drives mainly from the inflow of oceanic air-stream from the east coastal area, orographic effects (caused here by the Libombos mountains) and the distance from



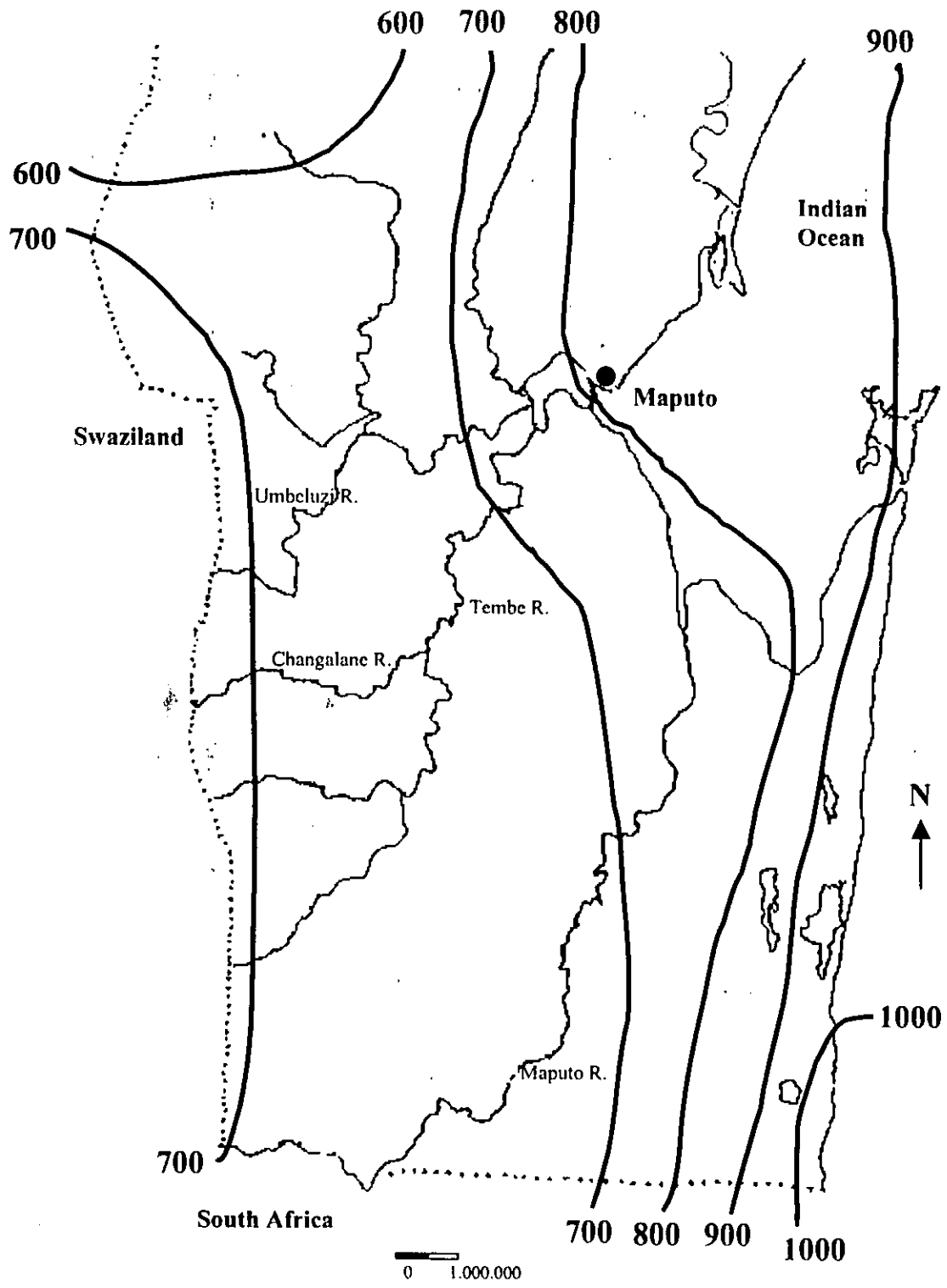


Fig. 4.2.11 Mean annual precipitation (mm) across Maputo province, southern Mozambique (average of a 10 years period, including both wet and dry years). Compiled by the author, from data made available by INAM, Mozambique.

the Indian ocean combine to render the study area, the wettest parts of Southern Africa (Wellington, 1955, Tyson, 1986). As a result, the rainfall pattern during the wet, summer season follows a parallel orientation from the coast to the interior in the regions south of Save River (see Fig. 4.2.11 referring to the pattern of rainfall present in southern Mozambique), with a marked increase in rainfall occurs along the Libombos Mountains (BURGEAP, 1962, Ferro & Bouman, 1987, Konstapel et al., 1987).

### **4.2.3.3 Climatic elements: insolation and temperature**

#### **4.2.3.3.1 Insolation**

As for the case of most climate factors in the research area, incoming solar radiation (insolation) displays marked seasonal variation, both in the daily duration of sunshine and in the ratio of actual to possible received sunshine. In Maputo province maximum sunshine duration is reached between May and June, the minimum in December-January. The summer has not only less sunshine but mornings tending to be sunnier than afternoons due to the build-up of cumulus clouds (Lopes, 1974; Ministério da Agricultura, 1977). In general, the high atmospheric water content at the coast associated with the Mozambique Current results in lower insolation values all year round compared to the interior. A particular aspect in the area under study is the fact that overall, the north-facing slopes are usually warmer and drier than the south facing ones (Tyson, 1986, 1990), a fact that may have influenced prehistoric land use in this region.

#### **4.2.3.3.2 Surface temperatures**

Compared to other regions of Southern Africa, southern Mozambique experiences relatively high temperatures, as a result of its proximity to oceanic influences (e.g., the warm Mozambique

Current) and to local topographic effects (see previously referred Fig. 4.2.3, illustrative of the distribution of the mean annual temperatures for Southern Africa).

All stations in Maputo province share a basically similar annual temperature curve, with maximum mean monthly readings occurring from January through March (i.e., summer time) and minimums in June through August (winter, dry season). Actual mean temperatures vary from the warm tropical to sub-tropical zone of the coastal belt and hinterland (e.g., Maputo city, Inhaca, Zitundo, Umbeluzi) to high altitude locations (e.g., Namaacha, Goba Fronteira) where frost occurs regularly in the winter. Hence, if during the hottest months the coastal area and the eastern lowlands presents a month mean temperature above 25°C, at the western mountain areas even during the hottest month of January the mean average temperature is always below 25°C. In relation to the coolest month, the data obtained shows clearly that it is in June that the lowest values are normally obtained.

Table 4.2.1 shows temperature data for stations in and around the research area (the values were collected by INAM<sup>2</sup> in most cases for periods covering at least ten years).

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<sup>2</sup> Instituto Nacional de Meteriologia - Maputo, Mozambique.

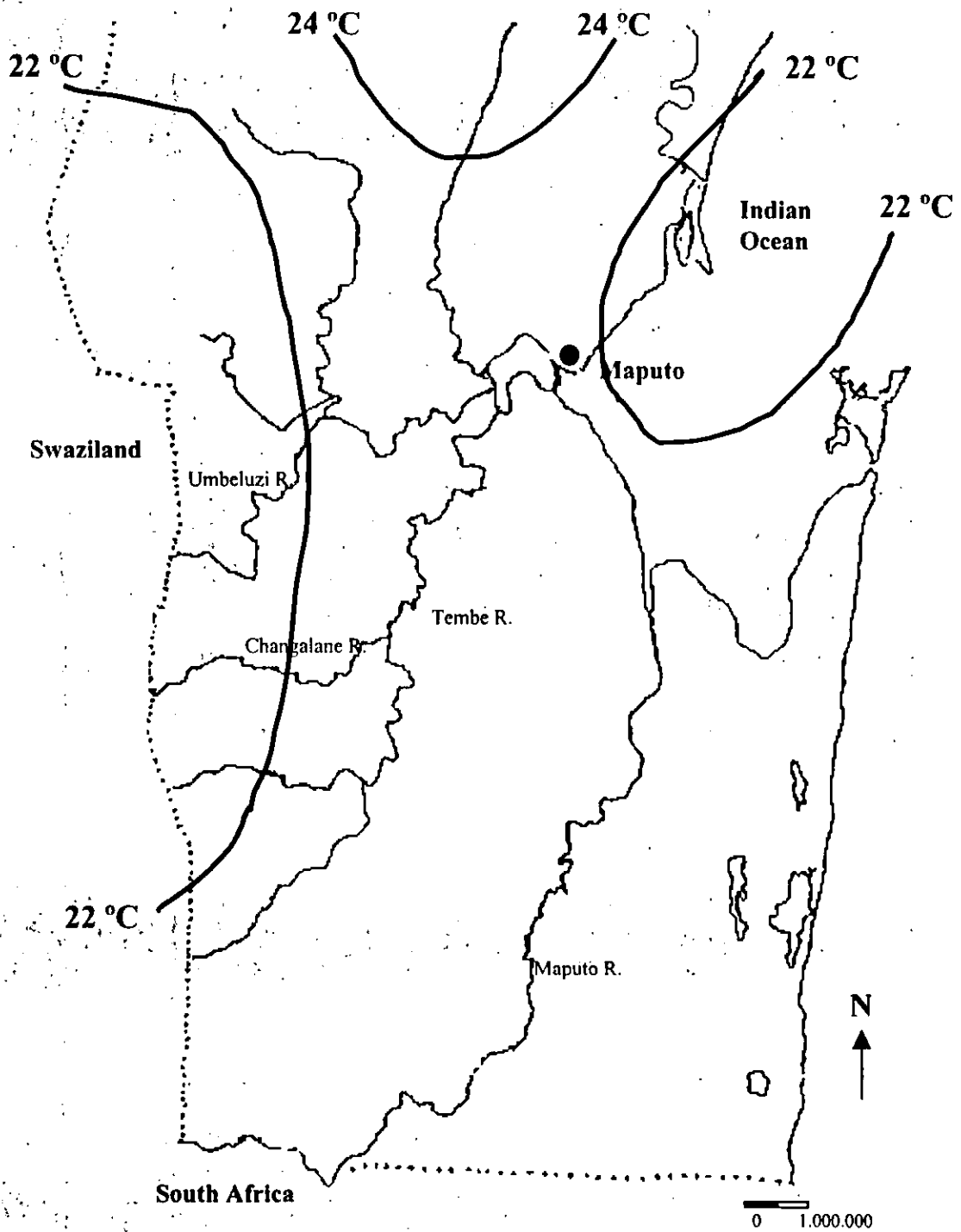


Fig. 4.2.12 Mean annual air temperatures ( $^{\circ}\text{C}$ ) for Maputo province, southern Mozambique; average of daily temperatures for the last ten years (compiled by author, with additional information from Soares & Barroso, 1972, Lopes, 1974, Konstappel et al., 1987, Barcá, 1992, Pollett et al., 1995)

Table 4.2.1 Temperature (in °C); see also Fig. 4.2.12 showing mean annual temperature isolines for the area

Station	Lat. (South)	Long. (East)	Elev. (m)	Average Temp.	Max. Average Temp.	Min. Average Temp.
<b>Inhaca</b> (coastal area)	26°02'	32°56'	27	22.9	26.8	19.1
<b>Zitundo</b> (coastal area)	26°45'	32°50'	71	22.1	27.2	17.0
<b>Bela Vista</b> (coastal area)	26°20'	32°41'	15	22.6	28.5	16.9
<b>Maputo city</b> (coastal area)	25°53'	32°36'	60	22.8	27.4	18.3
<b>Umbeluzi</b> (interior lowlands)	26°03'	32°23'	12	22.9	29.9	15.9
<b>Catuane</b> (interior lowlands)	25°50'	32°17'	37	22.6	30.2	15.5
<b>Mazeminhana</b> (Grandes Libombos footslopes)	26°27'	32°15'	61	22.5	29.6	15.4
<b>Moamba</b> (interior lowlands)	25°36'	32°14'	110	23.9	31.1	16.6
<b>Changalane</b> (Grandes Libombos footslopes)	26°18'	32°11'	100	22.8	28.7	16.9
<b>Goba-Fronteira</b> (Grandes Libombos mountain area)	26°15'	32°06'	418	21.9	27.2	16.6
<b>Namaacha</b> (Grandes Libombos mountain area)	25°59'	32°01'	523	21.1	26.7	15.6
<b>Ressano Garcia</b> (interior lowlands)	25°36'	31°59'	145	23.5	30.5	16.7

Basically, isotherms of actual mean surface temperatures run parallel to the Libombos escarpment. However, the major river valleys create significant anomalies, with low elevation valleys being heated by reflected as well direct radiation during the day and being cooled at night by

cold air draining into the valleys, often resulting in dew and fog (Lopes, 1974, Ministério da Agricultura, 1977).

In terms of thermal amplitude, temperatures are more accentuated during the cooler, dry season, especially towards the interior areas. In fact, along the coastal area (where the annual thermal amplitude shows values of about 7.5-7.8°C) the humidity brought by the winds constitutes an element of moderation, especially from day to night period. At the other extreme, in the mountain areas the elevation represents the role of moderator. Here, both during the hot and the cooler season the daily thermal amplitudes are similar (about 7.5°C).

#### 4.2.3.3 Climatic elements: rainfall, evaporation and humidity

As mentioned above, the study area falls within the region of Summer Rain Climate and Tropical Savanna (de Voss, 1975). The climatic divisions of Mozambique, complementing Koppen's classification, shows a general pattern in which the tropical summer rains are still present in southern Mozambique along the coastal regions (Werger, 1978, Lopes, 1979; see Fig. 4.2.13 illustrative of the average annual water surplus for southern Africa and Walter's climatic diagram for Maputo city).

Precipitation in southern Mozambique occurs mostly during summer time (from October through March); the dry season stretches from April-May through September. In the interior, western areas (Grandes Libombos), over 85% of rain occur in the wet, summer season. Along the coastal areas (e.g., Inhaca, Zitundo, Maputo city), ca 75% to 85% of the rains occur during the summer period. The bulk of precipitation falls as rain during thunderstorms (normally lasting only a few hours in the afternoon), instability showers and cyclonic rainfall (this latter occasionally in the coastal part of the area).

Table 4.2.2 and Fig. 4.2.14 are illustrative of the seasonality of rainfall in southern Mozambique.

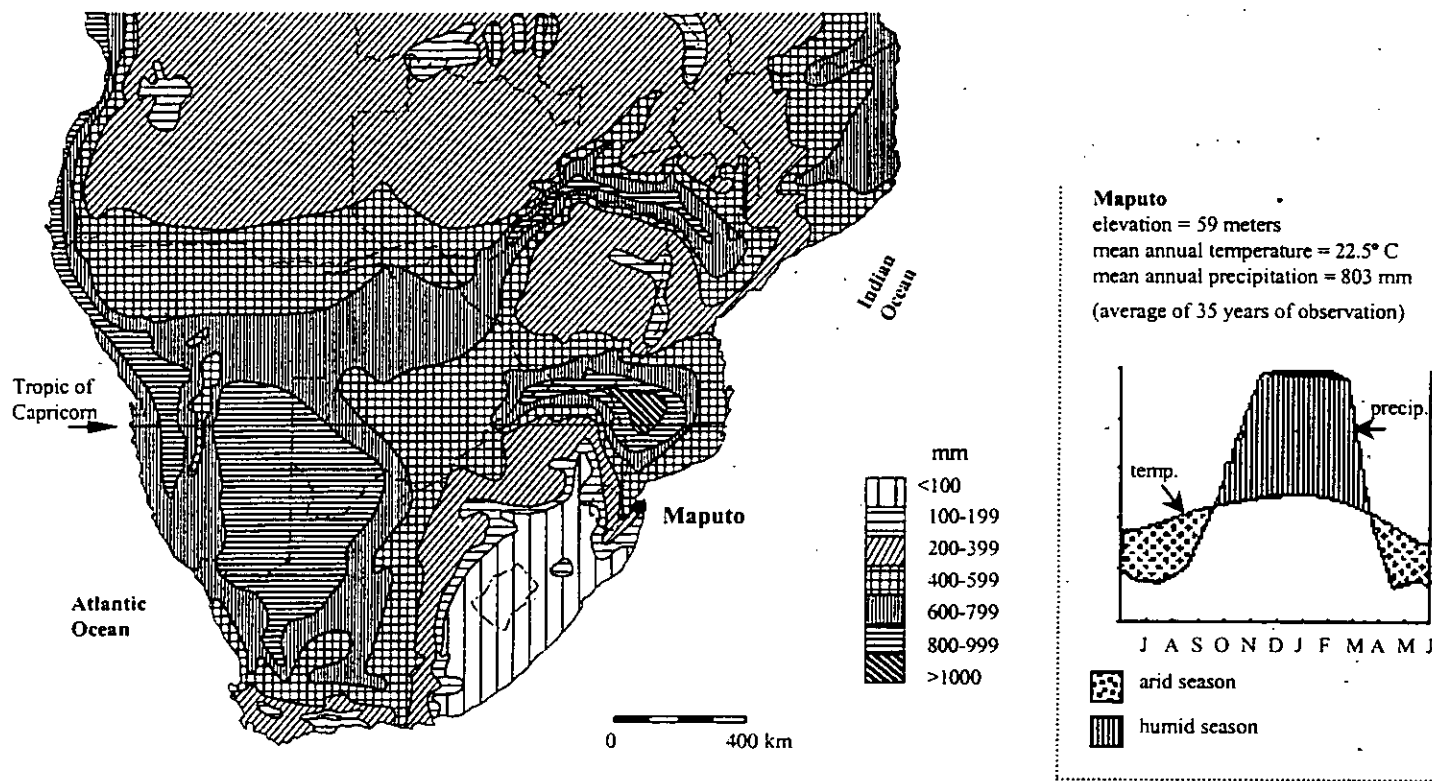


Fig. 4.2.13 Southern Africa: average annual water surplus (after Schulze & McGee, 1978) and the Walter climatic diagram for Maputo (after Walter & Lieth, 1960)

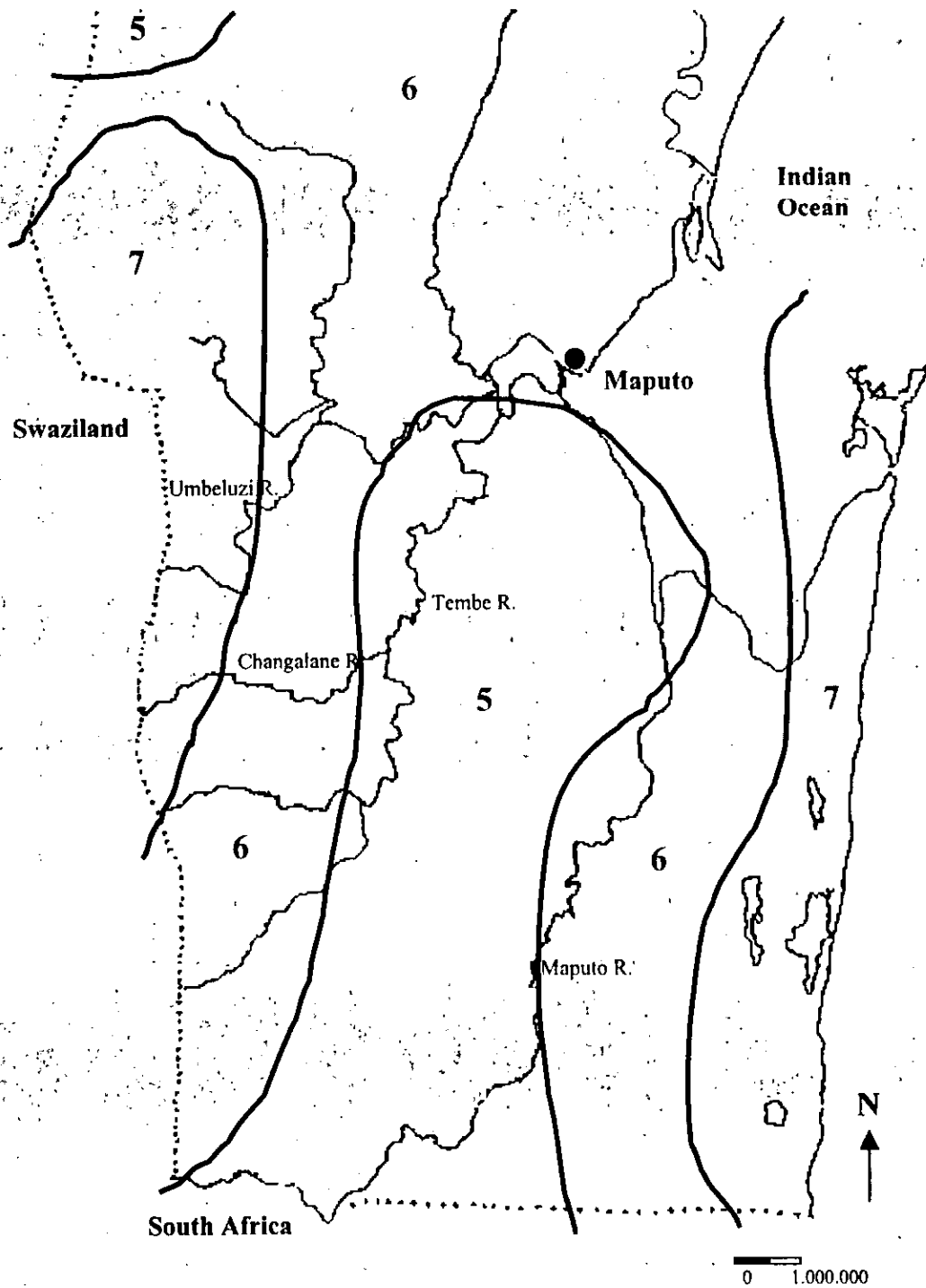


Fig. 4.2.14 Duration (months) of the rainy season in southern Mozambique (average of the last ten years (with wet and dry years) compiled by author, with additional information from Konstappel et al., 1987, Pollett et al., 1995, Couto & Hutton, 1995)



Table 4.2.2 Seasonality of precipitation in southern Mozambique

Station	Summer/wet season (October through March)	Winter/dry season (April through September)
Inhaca (coastal area)	76%	24%
Zitundo (coastal area)	79%	21%
Bela Vista (coastal area)	81%	19%
Maputo city (coastal area)	84%	16%
Umbeluzi (interior lowlands)	85%	15%
Catuane (interior lowlands)	76%	24%
Mazeminhana (Grandes Libombos footslopes)	89%	11%
Moamba (interior lowlands)	89%	11%
Changalane (Grandes Libombos footslopes)	87%	13%
Goba Fronteira (Grandes Libombos mountain area)	85%	15%
Namaacha (Grandes Libombos mountain area)	84%	16%
Ressano Garcia (interior lowlands)	85%	15%

One of the most striking climatic features present in the study area is the variation of rainfall across, from east to west (see Fig. 4.2.11). In the littoral plains (in the east), rainfall averages some 800-900 millimeters annually; in some areas it reaches 1,000 mm/year. However, it declines progressively westward, to some 600 mm/year in Catuane, Ressano Garcia, Moamba, etc. These later stations are located at the inter-Libombos depression, up to the footslopes of the main Libombos range. On the crest of the Libombos range itself, the rainfall increases again, to about 950-1,000 mm/year (e.g., Namaacha) (FAO/UNDP/MOZ, 1980, FAO/INIA, 1982a).

In fact, the areas benefiting from more rainy days per year are the ones located close to the coast (e.g., Inhaca, on the coast has an average of 105 days of rain per year). Towards the interior, and sometimes still close to the coast, the rainfall decreases dramatically (e.g., Bela Vista, situated some 25 Km from the coast, has an average of only 52 days of rainfall per year).

Other types of precipitation occurring in the study area include hail, fog and dew. Fog is sometimes present in the southern Maputo region at elevations above 200-300 meters, on the east facing slopes of the Libombos mountains. Neither dew nor hail are thought to be significant sources of moisture, although the former, most common in summer and fall, may be of some importance in dry river valleys. Hail, also most common in summer and early winter season, rarely cause severe damage to vegetation in the highlands.

In the interior lowlands, the low rainfall is exacerbated by evaporation. On average, mean annual pan evaporation ranges from 1,500 to 2,000 millimeters in the study area (Schulze & McGee, 1978). Monthly averages exemplify that at Namaacha (located in the Grandes Libombos), evaporation varies from 50.2 millimeters in March to 101 millimeters in August. At Maputo city, the highest monthly values of evaporation are usually present in December-January. When analyzing the relationship between the mean precipitation and the potential evaporation (e.g., Lopes, 1974, 1979) a distinct pattern emerges, differentiating the interior lowlands from the coastal and mountain areas. Although the data analyzed show that the region under study is quite arid, the coastal and the mountain areas present two to three months (January-March) when the precipitation surpasses the potential evaporation. For the case of the interior lowlands (such as Boane, Umbeluzi and Moamba, situated along large river valleys), during the full year the potential evaporation surpasses the precipitation. The coast shows a year-round water surplus (Walter & Lieth, 1960, Soares & Barroso, 1972, Lopes, 1974).

The picture for relative humidity at several stations along the coast (e.g., Bela Vista, Inhaca) shows a maximum for the period that runs from February to July, while the minimum occurs from November through December. In the low interior (e.g., Umbeluzi and Changalane) the picture of relative humidity approaches the one present on the coastal area (with a peak in March-April and the

minimal values from August to October). Upland stations, such as Namaacha and Goba-Fronteira, show a maximum humidity in February-March, and a minimum generally in June-July.

#### 4.2.3.3.4 Interannual periodicity in rainfall pattern

The rainfall totals vary from year to year, presenting an interannual variability of about 20% in the wetter eastern areas of Southern Africa. (Tyson 1986, 1990, Tyson & Lindesay, 1992). The information gathered about the climate of southern Mozambique over the last 50 years (besides the raw data obtained from INAM, see also Lobão Tello, 1972, Lopes, 1974, 1979, Konstapel et al., 1987) suggests that for the summer rainfall area a certain oscillation is present. In fact, a strong temporal patterning is present for rainfall periodicity, with a nine to ten predominantly dry years being normally followed by 18-20 wet years in southern Mozambique (Fernandes & Brito, 1996). This means that periodically droughts do occur in this region, posing considerable risks in terms of survival strategies for those depending on surface water. These droughts affect especially the interior lowlands, where water is scarcer. Along the coastal belt, the lagoons assure a steady and predictably located source of water, although sometimes it is brackish during the very dry years (as I was able to observe during fieldwork in 1993-94). Still, some of the smaller but deeper lagoons are known to have potable water during severe droughts (i.e., up to two-three years without rain).

#### 4.2.3.4 Discussion

Although no significant information is available in terms of paleoclimatic characterization for the period which includes the ESA in Southern Africa, the current Holocene climate pattern makes it possible to speculate about early hominid land use in southern Mozambique.

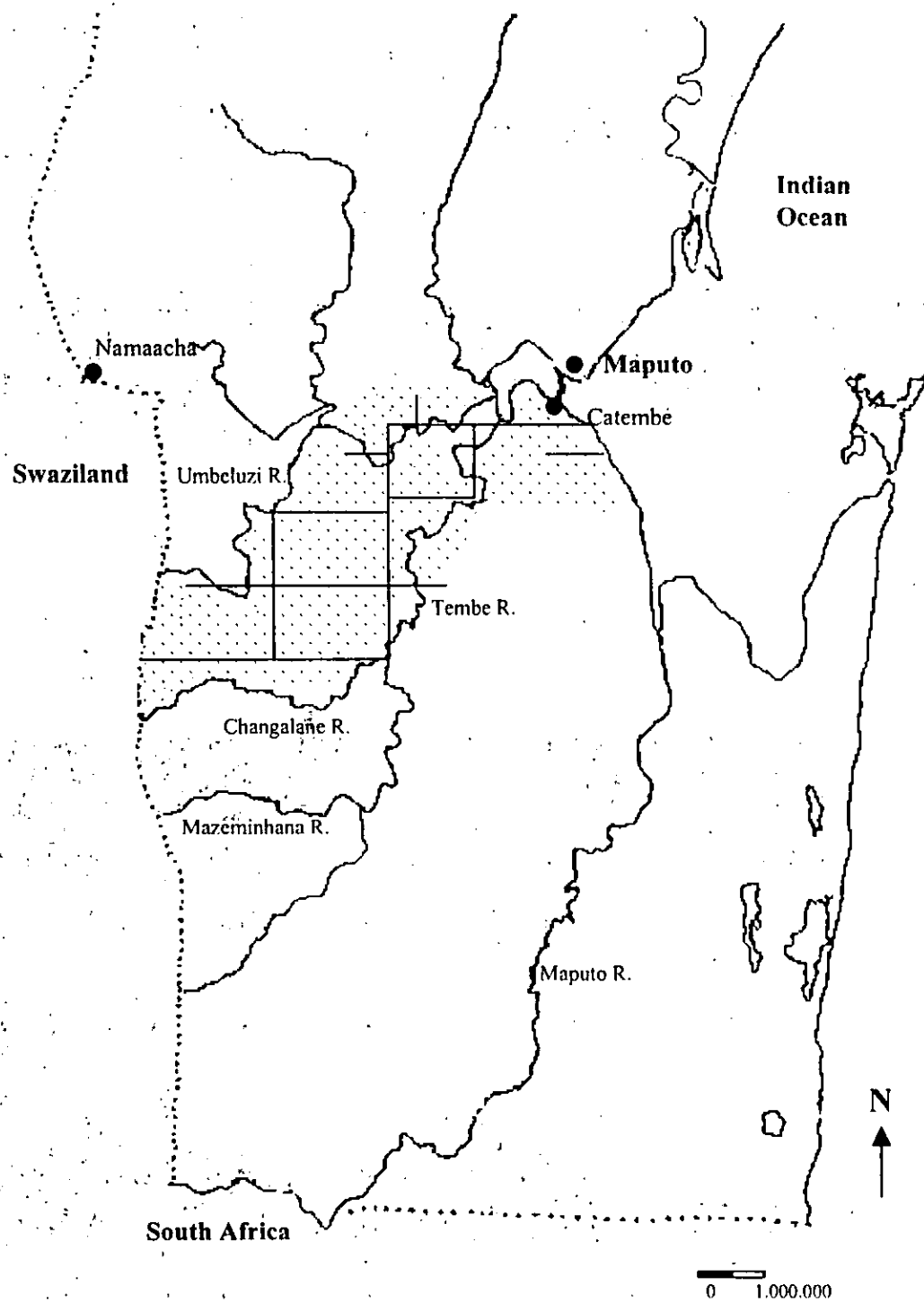


Fig. 4.2.15. Southern Mozambique. Dotted area represents the main region surveyed for archaeological sites and vegetation cover. The thick black lines the transects used (Umbeluzi-Changalane-Tembe area).

Potential season differences in landscape values considering both temperature, wind and rainfall were just discussed. On the overall one observes that from the sea to the west, extending over the plains until one reaches the mountains, drought, heat and evaporation increase. The mountains (clearly illustrated by the information available from Namaacha) and the coastal plain (well represented by Inhaca, Zitundo and Maputo city) emerge as the most productive zone throughout the year in terms of water availability. The interior lowlands (Umbeluzi or Moamba areas are good examples) are relatively arid.

The eastern slopes of the Grandes Libombos benefit from the humidity brought by the proximity of the sea. Along the western slopes of the Grandes Libombos, facing the dry interior of the subcontinent, the rocky substratum is visible almost to the bottom of the mountain area. Hence, the riverine areas of the eastern slopes emerge as a potentially important area for earlier hominid land use, due to the presence of potable water at some pools, even during the peak of the dry season.

The close relationships between climate, vegetation cover and seasonal resource productivity will be presented in the next section of this Chapter.

#### **4.2.4 The biotic pattern of the study area, with an emphasis on the vegetation**

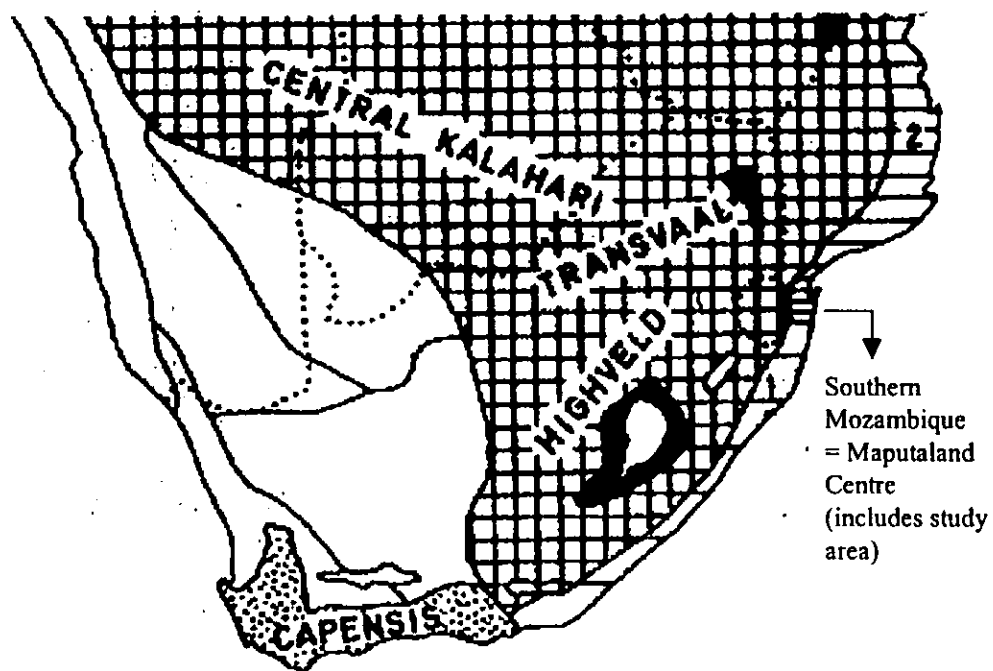
##### **4.2.4.1 Overview of the studies focused on southern Mozambique's vegetation patterns**

The modern vegetation in most of the research area is largely secondary, basically due to the effects of recent agro-pastoral practices. This situation is especially notorious on the interior lowlands, along the river valleys, where the present vegetation consists of secondary forest, most of it in an early stage of succession (see also Lopes, 1979, Chonguiça, 1995, Fernandes & Brito, 1996). While a thin understory of grasses, forbs and thorny shrubs is present, the surface of the ground frequently lies exposed in irregular sandy patches.

The biota present at the time of the Acheulean occupation of the area remains to be determined, but some data resulting from the evaluation of the historic vegetation, together with Holocene paleoenvironmental information of a regional character (especially from KwaZulu-Natal, South Africa; e.g., Nicholson & Flohn, 1980, Beaumont et al., 1984, Butzer, 1984, Klein, 1984, Deacon & Lancaster, 1988, Tyson, 1990, Partridge, 1990, Avery, 1995a, 1995b) can be used for further inferences of speculative regarding the Middle Pleistocene paleoenvironmental setting. In fact, studies performed on the vegetation of the region in the first decades of this century (e.g., Cardoso, 1950, 1951, Gomes e Sousa, 1931, 1948, Myre & Ripado, 1953, Pedro & Barbosa, 1955), followed later by more complex studies (such as the ones performed for the Elephants Natural Reserve, and more recently for the Santaca area; Gomes e Sousa, 1966, Lobão Tello, 1972, Myre, 1960, 1968, Fernandes & Brito, 1996, Siteo & Faria, 1996), make it possible, by extrapolation, to obtain a reasonably accurate assessment of the natural vegetation of southern Maputo province, i.e., information that should have direct relevance to the conditions encountered by its earlier prehistoric inhabitants.

The few vegetation maps available covering the research area were done at the scale of 1:250,000 (see Myre, 1968, DINAGECA, 1991). The large-scale approach used by both authors detracts from their applicability to the research area. Hence, several local surveys were performed, including a quite wide area, broader than the study area (from Namaacha until the Mazeminhama region; see Fig. 4.2.15).

My field observation led to the elaboration of several data bases on the flora (see Appendices 3 and 4, presenting distinct check lists containing information on the flora from the study area). These surveys were carried out from 1994 until 1997. Latter on, the results were compared with the published work of Myre (1968), Lobão Tello (1972), Moll (1980), White (1983) and Couto & Hutton (1995). Several of my surveys relied upon the support of personnel from the National Instituto for Agronomic Research, Mozambique (INIA) and the Faculty of Agronomics and Forestry







-  Karoo Namib
-  Afro-Montane Region
-  Sudano-Zambeziian Region (Zambeziian Domain)
-  Indian Ocean Coastal Belt
- 1 Tongoland-Pondoland Regional Mosaic (includes Maputaland Centre)
- 2 Zanzibar - Inhambane Regional Mosaic

Fig. 4.2.16 Southern Africa phytological divisions (after van Wyk, 1996)

of Eduardo Mondlane University, Mozambique. Also, mid-to-late 19th century photographs and descriptions (e.g., Monteiro, 1891, Selous, 1893 ) were examined to see how the vegetation in the Umbeluzi area, and to a lesser degree towards the south, has changed.

As a result, I now have a reasonably detailed list of edible plants (including information on their seasonal availability, parts of the plant that are normally consumed, etc.), a check list of the potential ironwoods identified in the study area is presented. This information is found in Chapters VI and VIII (see Table 8.2.1), as well as in Appendices 3 and 4 of this thesis. It should be emphasized that the classification presented in these Appendices is of botanical character. It is intended only to provide a background against which to view the distribution and availability of resources. The vegetation types do not necessarily equate exactly with any ecological or resource zone that may have been significant to past human populations.

#### **4.2.4.2 The biogeography of the study area**

##### **4.2.4.2.1 The Maputaland Centre of biodiversity**

Phytogeographically, the area where my studies were performed forms part of the northernmost Maputaland Centre (van Wyk, 1996). This Centre comprises the northern part of the Tongaland-Pondoland Regional Mosaic (see Fig. 4.2.16). The Maputaland Centre represents the southern end of the tropics in Africa, and many animal and plant species reach the southernmost limit of their range here. Another remarkable characteristic of this region is its unique location, intersecting the tropical and semi-temperate zones. At the same time, and because of Maputaland's character as a region of biotic transition, it is also a regional centre of endemism (Davies et al., 1994, van Wyk, 1996). Nonetheless, the bulk of the Maputaland Centre flora and fauna is clearly of Afrotropical derivation (e.g., Maud, 1980).



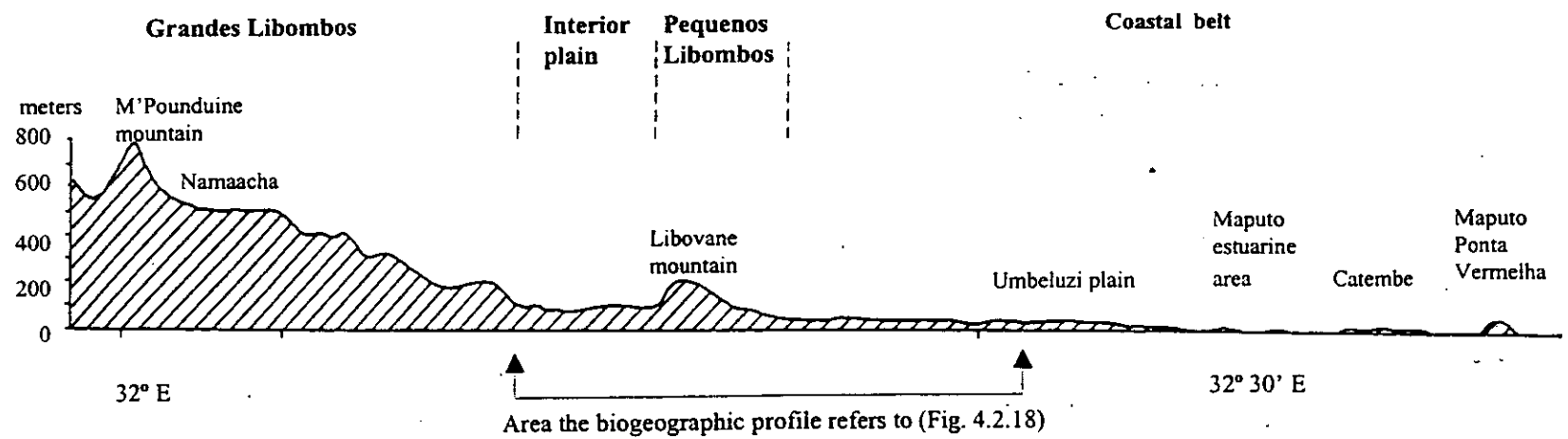


Fig. 4.2.17 West-East transect of the study area, along 26° S (elevation in meters), showing the main relief characteristics (after Lopes, 1974)

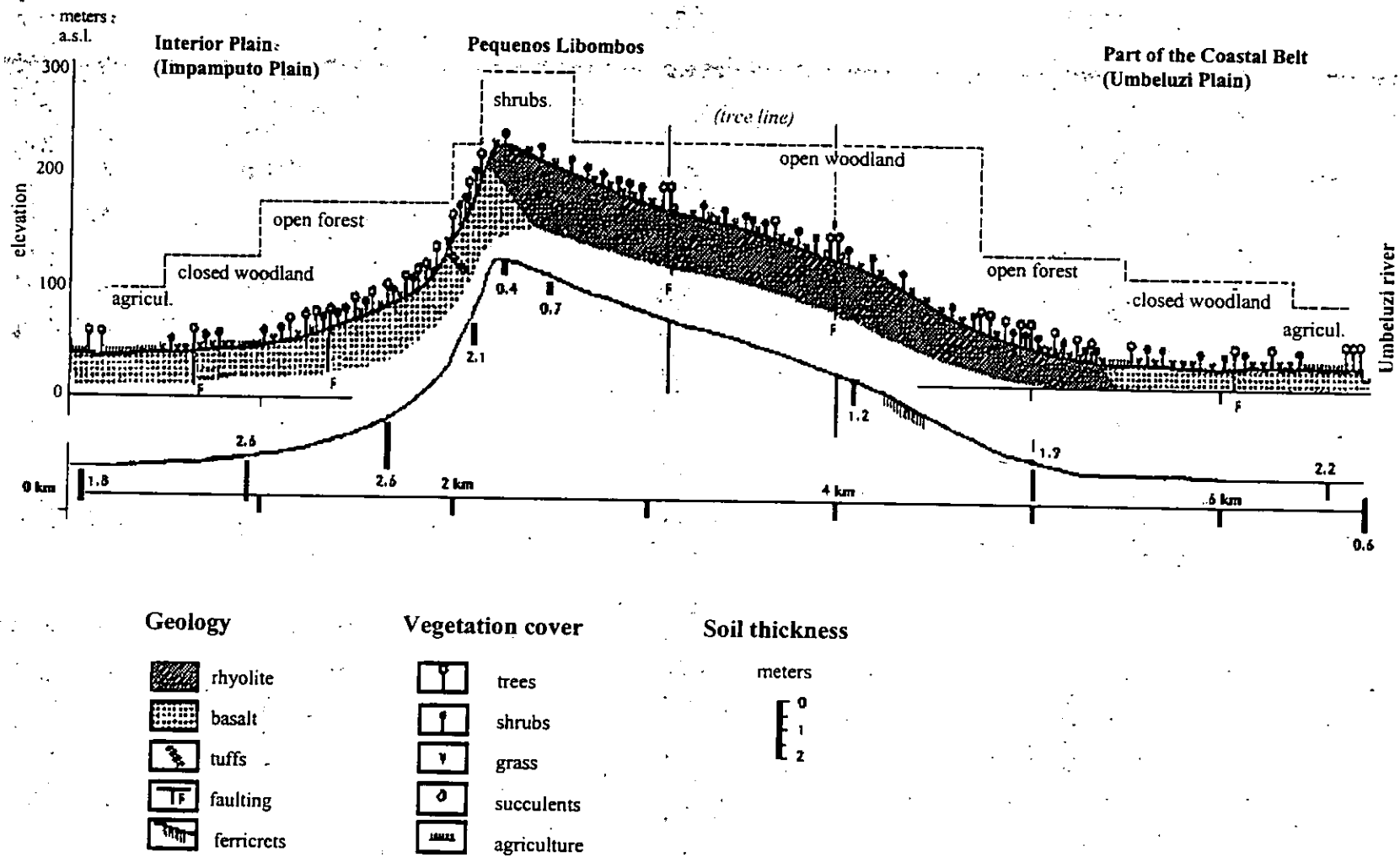


Fig. 4.2.18 Phytogeographic profile of the Interior Plain and part of the Coastal Belt (adapted from Lopes, 1979). Compare to Fig. 4.2.17 (W-E physiographic transect of the study area)

#### 4.2.4.2.2 The vegetation

In the distant past, much of the topography must have been wooded, but the precise history of deforestation remains undocumented. However, it should be pointed out that several pollen samples were collected from the lakes of southern Mozambique and are currently being analyzed in Sweden (P. Sinclair, pers. comm.).

The vegetation of this region is very diverse and consists of a mosaic of mainly extensive grasslands, (arranged in complex patterns), forest (mainly now restricted to coastal dunes and the Libombos Mountains) and marshes, the latter determined by local edaphic conditions (Moll & White, 1978, Moll, 1980, White, 1984, Davis, 1994, van Wyk, 1996). On a more refined level several communities have been described, for example, Tinley (1971) identified about 20 different "ecosystems" in the Maputaland Centre.

A latitudinal west-east pattern of landforms is characteristic of the region, and hence its vegetation. See Fig. 4.2.17 representing a W-E transect of the study area along 26°S and Fig. 4.2.18 showing a phytogeographic profile of a section of the study area.

The results obtained during my field surveys led to the refinement of several previously published transects, illustrative of the vegetation and soil profiles of the study area. The distribution of the principal vegetation associations is presented in Fig. 4.2.19 and Table 4.2.3.

The vegetation can be summarized by the following main units

1. **Forest.** This is a stratified, closed woody plant community, dominated by trees, usually with more than two woody plant strata. Young stages of canopy trees, subordinate trees, shrub layers and a herbaceous understorey, including some grasses, are typical. The trees are predominantly

evergreen, but dry forest types are semi-deciduous. In the study area it became possible to identify the following forest forms

- Inland open forest. This is mostly present at the slopes of the Libombos mountains (mainly semi-deciduous).
- Riverine, gallery forest. This is a narrow strip of tall forest (up to 25-30 meter tall) occurring on riverbanks. This forest type depends on the availability of water and it can also take the form of gallery and swamp forest.
- Coastal forest-thickets. This is found along the coastal lowlands, up to 200-300 meter contour level, mainly on a sandy soil.

a) The typical coastal belt forest is composed of dry to evergreen forest, five to twenty meters tall, with a large scrub community (climbing plants quite common). Grass is usually discontinuous. The coastal vegetation is very dense and tangled, although inland on seaward-facing sandy slopes it is taller and less tangled, about 20 meters high.

Thickets (with evergreen trees up to 15-20 meters tall) can be primary or secondary, with non-thorny coastal bushes or thorny ones (e.g., *Acacia* spp.). The Sand Forest is mainly associated with the generally north-south trending belts of ancient dunes, supposedly representing former shorelines. It is particularly rich in woody taxa, such as *Azelia quanzensis*, *Balanites maughamii*, *Cordyla africana*, *Dialium schlechteri* (ironwoods), *Ficus* sp., *Hymenocardia* sp., *Newtonia* sp., some *Acacia* spp., *Combretum* sp., *Erythroleum lasiathum*, etc.

b) To the inland, a palm veld is present associated with sandy soil, with *Phoenix reclinata*, *Hyphaene crinata*, and the banana-like plant *Strelitzia nicolai* as the typical species.

c) Finally, littoral dune forest occupies a narrow belt on the high dunes running along the seacoast, stunted by salt spray on the seaward side, up to ten meters high along the landward side. Principal species include *Mimusops caffra*, *Euclea natalensis*, *Canthium*

*sp.*, with *Scutia myrtina* and *Allophylus natalensis* important among the climbers and shrubs.

2. **Woodlands** (including secondary grasslands). To the west of coastal forest, the area of the deep river valleys has a mixed woody community, ranging from dense woodland to open bushland (probably secondary), with a grass understory dominated by *Themeda triandra*. Specific communities vary greatly according to soils, aspect, etc. Examples include *Spirostachys africana* woodland-riverine forest on alluvial soils in the valley bottoms. On drier north-facing steep slopes mixed deciduous communities are dominated by *Acacia* spp., *Aloe* sp. and *Euphorbia* sp. Nowadays, a so-called "Acacia wooded grassland" occurs on the flatter land, the primary vegetation there is an open grassland of small trees, three to six meters tall, with *Acacia* spp., *Ziziphus mucronata*, *Euphorbia* sp. and *Rhus pentheri* as common species.
  
3. **Wetlands.** In the study area the following forms occur
  - Marshes - consist of saline marine and estuarine sediments and are present mostly along the coastal plain and also around some interior lakes. The Bangoloene marsh (located in the easternmost part of the study area, in the Catembe Cul-de-Sac landscape locale), part of the eastern boundary of the study area; while described as a stream, is more typically a marshy drainage line with intermittent pools of standing water
  - Floodplains
  - Swampy saline wetlands, close to river mouth (e.g., the wide Maputo estuarine area). It is possible to find typical mangrove vegetation, with *Bruguiera*, *Rhizophora* and *Avicenia*.

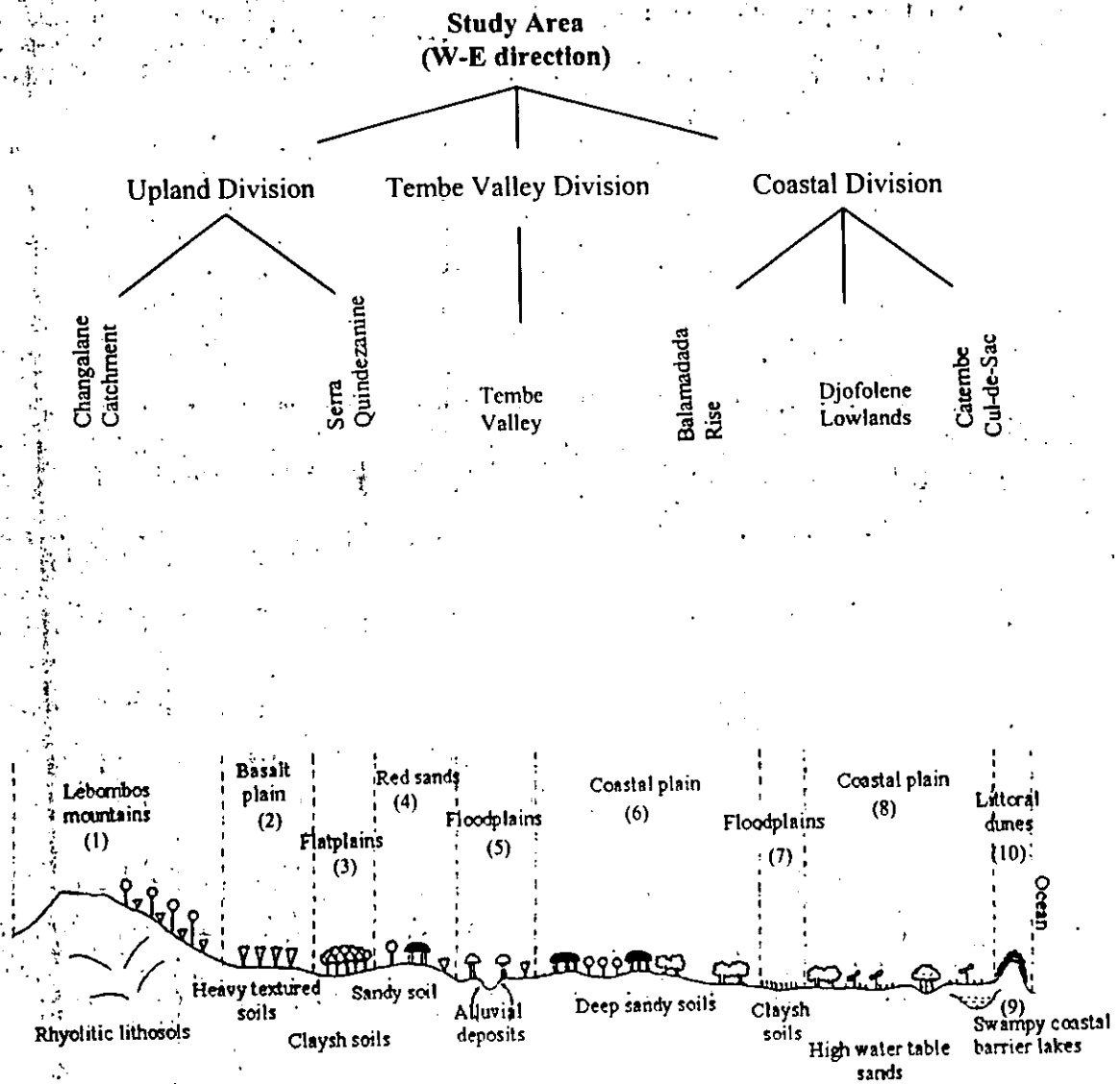


Fig. 4.2.19 Schematic W-E cross section of the study area, with the main terrain, soil and vegetation types. Numbered vegetation types associated with terrain types are described in Table 4.2.3

Table 4.2.3 Description of the numbered terrain types\* (including predominant terrain form, soils, hydrology and vegetation types) described in Fig. 4.2.19

Terrain	Terrain form	Geology, soils and hydrology	Vegetation types and dominant economic (food and fiber) species*
(1)	<ul style="list-style-type: none"> <li>Mountain area (Libombos mountains)</li> </ul>	<ul style="list-style-type: none"> <li>Geology: rhyolite and basalt</li> <li>Soils: absent or embryonic (lithosols); only present at the bottom of the slopes and along the valleys</li> <li>Free draining</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: At the top of escarpment: grassland, fungi. Along the valleys: forest and woodland</li> <li>Food spp: <i>Acacia</i> sp., <i>Sclerocaria birrea</i>, <i>Lannea</i> sp., <i>Ficus</i> sp., <i>Ziziphus mucronata</i>, <i>Aloe</i> sp., <i>Olea africana</i>, <i>Cleistochlamys kirkii</i>, <i>Rhynchosia totta</i>, etc.</li> <li>Fibers: <i>Afzelia quanzensis</i>, <i>Themeda</i> sp., <i>Combretum</i> sp., <i>Androstachys johnsonii</i>, <i>Dichrostachys cinerea</i>, etc.</li> </ul>
(2)	<ul style="list-style-type: none"> <li>Interior plains (foothills and interior plains with heavy black soils)</li> </ul>	<ul style="list-style-type: none"> <li>Geology: basalt substratum</li> <li>Soils: heavy textured black soils (chromic soil)</li> <li>Poor drainage</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: predominantly woodlands</li> <li>Food spp: <i>Acacia</i> sp., <i>Sclerocaria birrea</i>, <i>Olea africana</i>, <i>Ziziphus mucronata</i>, <i>Aloe</i> sp., <i>Panicum</i> sp., <i>Gardenia</i> sp., etc.</li> <li>Fibers: <i>Spirostachys</i> sp., <i>Combretum</i> sp., <i>Themeda</i> sp., <i>Setaria</i> sp., etc.</li> </ul>
(3)	<ul style="list-style-type: none"> <li>Flatplains along the interior river systems</li> </ul>	<ul style="list-style-type: none"> <li>Geology: basalt, rhyolite and alluvial sediments</li> <li>Soils: sandy to clayish soils (chromic soil and cambic arenosol with chromic luvisol)</li> <li>Seasonally waterlogged</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: predominantly woodland and shrubland</li> <li>Food spp: <i>Garcinia livingsstonei</i>, <i>Strychnos</i> sp., <i>Trichilia emetica</i>, <i>Digitaria</i> sp., <i>Panicum</i> sp., etc.</li> <li>Fibers: <i>Dichrostachys cinerea</i>, <i>Albizia</i> sp., <i>Themeda</i> sp., <i>Sporobolus</i> sp., <i>Eragrostis</i> sp., etc.</li> </ul>
(4)	<ul style="list-style-type: none"> <li>Flatplains east of Boane hill</li> </ul>	<ul style="list-style-type: none"> <li>Geology: rhyolite, limestone, ferricrets and fluvial sediments</li> <li>Soils: red sandy soils (eutric soil and cambic arenosol with chromic luvisol)</li> <li>Seasonally waterlogged</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: woodland and grassland</li> <li>Food spp: <i>Sclerocaria birrea</i>, <i>Strychnos</i> sp., <i>Lannea</i> sp., <i>Kigelia pinnata</i>, <i>Cleistochlamys kirkii</i>, etc.</li> <li>Fibers: <i>Albizia</i> sp., sweet grasses</li> </ul>
(5)	<ul style="list-style-type: none"> <li>Floodplains along the main drainage lines, towards the coast</li> </ul>	<ul style="list-style-type: none"> <li>Geology: predominantly recent alluvial sediments and fluvial sediments</li> <li>Soils: sandy to clayish soils along the drainage lines (eutric fluvisol), increasingly more sandy towards the coastal area (cambic arenosol)</li> <li>Medium to poorly drainage</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: riverine forest, grassland and woodland</li> <li>Food spp: <i>Ficus</i> sp., <i>Syzygium</i> sp., <i>Trichilia emetica</i>, <i>Garcinia</i> sp., <i>Annona senegalensis</i>, <i>Dialium</i> sp., <i>Kigelia pinnata</i>, <i>Typha</i> sp., <i>Phragmites</i> sp., <i>Nymphaea</i> sp., etc.</li> <li>Fibers: <i>Afzelia quanzensis</i>, <i>Spirostachys africana</i>, <i>Manilkara</i> sp., <i>Acacia</i> sp., <i>Juncus</i> sp., grasses, etc.</li> </ul>
(6)	<ul style="list-style-type: none"> <li>Coastal area (plain, with slight undulation from ancient dunar system)</li> </ul>	<ul style="list-style-type: none"> <li>Geology: sandstone, limestone, reds and interior dunes</li> <li>Soils: deep sandy soils (cambic arenosol with chromic luvisol)</li> <li>Free draining</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: coastal forest and woodland</li> <li>Food spp: <i>Syzygium</i> sp., <i>Dialium</i> sp., <i>Terminalia</i> sp., <i>Trichilia emetica</i>, <i>Acacia</i> sp., <i>Hyphaena</i> sp., <i>Phoenix</i> sp., <i>Mimusops</i> sp., <i>Vangueria tomentosa</i>, <i>Sorghum</i> sp., etc.</li> <li>Fibers: <i>Albizia</i> sp., <i>Balanites maughamii</i>, <i>Dichrostachys</i> sp., <i>Pterocarpus angolensis</i>, <i>Digitaria</i> sp., <i>Setaria</i> sp., etc.</li> </ul>

(7)	<ul style="list-style-type: none"> <li>Coastal floodplain (flat area, with swampy, mangrove areas)</li> </ul>	<ul style="list-style-type: none"> <li>Geology: sandstone, limestone, ancient dunes and fluvial sediments</li> <li>Soils: predominantly clayish, sandy-clayish soils (Eutric soil)</li> <li>Seasonally waterlogged</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: riverine forest, marshes and swampy areas (mangrove)</li> </ul> <p>Food spp: <i>Ficus</i> sp., <i>Syzigium</i> sp., <i>Trichilia emetica</i>, <i>Kigelia pinnata</i>, <i>Strychnos</i> sp., <i>Acacia</i> sp., <i>Diospyros</i> sp., <i>Hibiscus</i> sp., <i>Typha</i> sp., <i>Nymphaea</i> sp., <i>Sorghum</i> sp., <i>Themeda trianda</i>, <i>Panicum</i> sp.</p> <p>Fibers: <i>Barringtonia</i> sp., <i>Balanites</i> sp., <i>Avicenia marina</i>, <i>Rhizophora</i> sp., <i>Brugiera</i> sp., <i>Manilkara</i> sp., <i>Rauvolfia</i> sp., <i>Juncus</i> sp., etc.</p>
(8)	<ul style="list-style-type: none"> <li>Coastal plain (with a slight undulation from the dunar system)</li> </ul>	<ul style="list-style-type: none"> <li>Geology: dunar system, sandstones</li> <li>Soils: sandy soils with distinct textures; high water table (Eutric fluvisolils and Cambic arenosol with Chromic luvisol)</li> <li>Free draining</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: coastal forest/thicket</li> </ul> <p>Food spp: <i>Parinari curatelifolia</i>, <i>Strychnos</i> sp., <i>Annona senegalensis</i>, <i>Dialium</i> sp., <i>Garcinia livingstonei</i>, <i>Strelizia nicolai</i>, <i>Rhus</i> sp., <i>Tamarindus indica</i>, <i>Landolphia</i> sp., <i>Sarcostemma viminale</i>, <i>Maerua</i> sp., <i>Momordica balsina</i>, <i>Asparagus setaceus</i>, <i>Vitex</i> sp., etc.</p> <p>Fibers: <i>Milletia</i> sp., etc.</p>
(9)	<ul style="list-style-type: none"> <li>Coastal lakes</li> </ul>	<ul style="list-style-type: none"> <li>Geology: dunes with a limestone/sandstone substratum</li> <li>Soils: sandy soils, turning clayish in the areas where the lakes exist (Cambic arenosols with Chromic luvisols)</li> <li>Good drainage, although in some area are seasonally waterlogged</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: woodland and forest</li> </ul> <p>Food spp: <i>Ficus</i> sp., <i>Syzigium</i> sp., <i>Hibiscus</i> sp., <i>Diospyros</i> sp., <i>Dialium</i> sp., <i>Typha</i> sp., <i>Phragmites</i> sp., <i>Nimphaea</i> sp., etc.</p> <p>Fibers: <i>Rauvolfia</i> sp., <i>Sporobolus</i> sp., etc.</p>
(10)	<ul style="list-style-type: none"> <li>Littoral dunes (undulated terrain; some dunes are over 20 meter high)</li> </ul>	<ul style="list-style-type: none"> <li>Geology: contemporary dunes and sandstone and limestones</li> <li>Soils: sandy soils (Cambic arenosol)</li> <li>Free draining</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation: thicket and coastal forest</li> </ul> <p>Food spp.: <i>Ziziphus</i> sp., <i>Mimusops</i> sp., <i>Diospyros</i> sp., <i>Hibiscus</i> sp., <i>Grewia</i> sp., <i>Ipomoe</i> sp.</p>

\* Partially reconstructed. Currently degraded.



Currently, most of the plantfoods (fruits, berries, leaves, roots, seeds, nuts) are concentrated on

- The valley region between the Grandes and the Pequenos Libombos, where the presence of rich moisture bearing basalt soils makes plant life more diverse
- On the furthestmost eastern coastal wetlands.

In the southern part of the study area, the information available (Myre, 1968, 1971, Lobão Tello, 1972) seem to suggest that the protein and phosphorous content of the pasture in the region is among the highest to be found in Southern Africa.

#### **4.2.4.3 Short appraisal of some of the mammalian fauna associated with the vegetation types identified in the study area**

In terms of landscape associations and due to a more consistent pattern in terms of water and plant diversity and abundance, the Coastal Division and, in a lesser stage, the Tembe Valley Division, do create more shelter. Consequently, a more significant number of animals is supposed to be associated with these vegetation communities, creating a wider source of animal protein.

The fauna of southern Mozambique is quite rich (although severely deprived over the last years), representing the southernmost part of the range of many components of East African fauna. Hence, this region exhibits high levels of diversity (e.g., Lobão Tello, 1972, Couto et al., 1995, van Wyk, 1996).

Each of the above mentioned vegetation types provides suitable habitat for distinct animal species, which, in some cases, are particularly associated with them.

For example, in the area under study, before human action there was present a continuous association of tropical forest with thicket mosaic. Among the mammalian species utilizing forests, troops of *Cercopithecus* sp., live and feed in the canopy using thickets where these are available. The red squirrel *Paraxerus palliatus*, is confined to the lower strata of underbush, where there is

sufficient light to support such a growth, living and feeding among the detritus of fallen logs and other debris on the forest floor. They also occur in the drier parts of forest areas. The bushbaby, *Otolemur (Galago) crassicaudatus* is common in evergreen forest and thicket, as is the *Galago senegalensis (moholi?)*. In the forest it is also possible to identify the following bovidae: *Neotragus moschatus*, *Cephalopus natalensis* (in the tropical forest) and the *Tragelaphus scriptus* utilizing the forest fringes. *Tragelaphus angasi* and *Raphicerus sharpei* are among other dry forest - ticket species. Other species present in this association are the mice *Grammomys dolichurus* and *Grammomys (Thamnomys?) cometes*.

The woodlands and open grasslands do carry a rich fauna of mammalian species, as they provide a wide range of browse plants for some of the bovids and other large species, in some cases on a yearly basis, in other seasonally. Troops of *Cercopithecus* sp. and *Papio ursinus* occur in the area; the *Galago senegalensis (moholi?)* is particularly associated with thorn grasslands and *Acacia* sp. The bush squirrel *Paraxerus cepapi* is found in all subdivisions of this latter vegetation community, as does the scrub hare, *Lepus saxatilis*. The following bovidae are (or were until quite recently) associated with more open woodland: *Sylvicapra grimmia*, *Kobus ellipsiprymnus* (?), *Aepycerus melampus*, *Hippotragus niger*, *Hippotragus equinus*, *Tragelaphus scriptus*, *Taurotragus oryx*. In fact, this community presents extensive vleis areas, which provide suitable habitat for species associated with grasslands.

Actually, in the study area, dry, moist and floodplain grassland occurs widely in the region, especially within the area of low rainfall (below 600 mm/y). The grassland association is important to grazing species. Most of them are now absent from the area, but several available reports refer them as part of the landscape until the early 1900's. This includes *Redunca arundinum*, *Equus burchelli*, *Connochaetes taurinus*, *Raphicerus campestris*. The mouse *Lemniscomys rosalia (griselda?)* occurs in grasslands; where there are high stands of *Hyparrhenia* sp. (grass) another species of mouse is present, the *Dendromus melanotis*, as well as

the *Dendromus mystacalis*. Finally, in the arid areas (below 600 mm/y), where there are open short grassland areas, some hares can be found (e.g., *Lepus capensis*). Where the grassland has a sandy substrate, *Tatera leucogaster* (gerbil) and *Saccostomus campestris* commonly do occur.

In marshes, swamps and river fringes one observes a number of species which require a wet habitat, which can occur within any of the vegetation associations, referred on the text. These include the following rat species: the *Otomys angoniensis*, the *Dasymys incomtus* and the *Thryonomys swinderianus*.

In relation to mammalian species present in fresh water habitats (river systems which hold water in pools on a permanent basis/lagoons), the *Hippopotamus amphibius* represented. An otter species - *Aonyx capensis* - occurs widely in the major river systems and the water mongoose - *Atilax paludinosus* -- is closely associated with the fringes of this type of habitat. Also, marshes do occur at the mouth of rivers and for some distance inland as far as the associated areas are subject to tidal influence and inland on saline clays of floodplains and internal drainage basins. In shallow coastal waters (including offshore islands and estuaries with suitable substrates where the water remains relatively clear of silt) suitable habitat is provided for undersea grasslands, on which the dugong - *Dugong dugong* feeds. Still close to the coast it is possible to find several species of dolphins.

On the other hand, rock outcrops or rocky hillsides (Libombos mountain range) can occur within several of the vegetation associations listed and provide suitable shelter and living conditions for species such as the *Procavia capensis* (dassie), the *Oreotragus oreotragus* (bovid), the *Pronolagus crassicaudatus* (hare), the *Aethomys namaquensis* (rat). There are still other species that while using rocky habitats are also found in other types of associations, such as the *Aethomys* sp. that uses holes in trees where rocky habitats are not available.

Finally, one should mention some species that are particularly associated with sandy soils (including sandy alluvium), such as the *Cryptomys hottentotus* (rodent), and the *Chacochloris (Amblysomus) abtusirostris* (mole). Among the *Muridae*, the following are particularly associated with this type of substrate: the *Tatera leucogaster*, the *Steatomys pratensis* and the *Saccostomus campestris*.

#### 4.2.5 Conclusion

The information discussed in the last two chapters of this dissertation indicates that, for the area under study in southern Mozambique the specifics of local processes of land formation resulted in the formation of archaeological palimpsests, i.e., deposits clearly time-averaged (e.g., Stern, 1994). Also, and due to the almost complete absence of information on the paleoecological setting of the area (requiring the use of information from the Holocene), I decide to undertake a regional and long-term approach to the analysis of the behavioral ecology of the Middle Pleistocene record based on predictions drawn from actualistic data. The archaeological record allowed the identification of some aspects of complexity of Acheulean hominids, not just immediately about tool use, but also about tool production and the complex framework of planning and tactical depth associated with it.

In order to understand the choice of locations by the Acheulean hominids that once settled southern Mozambique, one needs to try to perceive the present environmental setting in terms of the resources and hazards that these hominids may have faced. This way it becomes possible to reconstruct a landscape, which no longer exist.

The model developed in this dissertation (see Chapter VIII) tries to show that the distribution of Acheulean hominids in southern Mozambique during the Middle Pleistocene times can be understood in terms of the effects which precipitation, topographic diversity, etc., are likely to have had on the availability, reliability and productivity of affordances. The model

developed predicts that areas with a highest resource productivity and diversity are likely to have been the most densely occupied in Acheulean times. However, due to the nature of the distinct occupational activities performed at each landscape element, as well as due to problems inherent to the nature of the archaeological record itself, this question will be very difficult to test.

## CHAPTER V – THE ACHEULEAN ARCHAEOLOGICAL SITES FROM SOUTHERN MOZAMBIQUE (INCLUDING THE DESCRIPTION OF THE SURVEYS AND EXCAVATIONS)

### 5.1. THE SURVEY: SOME METHODOLOGICAL APPROACHES

#### 5.1.1 The organization of the work in the field: the survey goals and strategies

In the field, the initial goal of this research was to map the potential sedimentary traps to be found in the region, and then decide where to orient the search. A secondary goal of the project was to obtain necessary information regarding environmental and paleoenvironmental frameworks for the archaeological data.

As part of my field work, I proposed to carry out a systematic survey by expanding the search laterally from the known artifact-bearing deposits, looking for additional sites adjacent to and between the main rivers in the study area, namely the Umbeluzi, the Tembe and the Changalane in order to obtain a good sample representative of the Acheulean.

1. To assess the distribution and density of archaeological material, and whether the artifacts were widespread over a laterally extensive area or in small isolated patches of deposits;
2. To study the geological and geomorphological context of surface occurrences;
3. To facilitate the selection of representative sites for excavation. In fact, one of the main goals of this research project was to develop survey strategies suitable for locating and recording of archaeological sites visible on each of the landscape units identified in the study area. In this project, a lithic scatter including a variety of artifact forms is called a site (for problems related with the use of the concept of "site" in southern Mozambique, see Meneses, 1989);

4. to gather information to contextualize the archaeological findings in terms of resource availability at several landscape scales, i.e., from finest to broadest, the landscape facet, the landscape locale and the overall study area.

Between 1993 and 1995 a team from the Department of Archaeology and Anthropology from Eduardo Mondlane University under my supervision surveyed the area around the Chagalane River; afterwards the survey was extended to the region of the Umbeluzi and the Tembe Rivers (see previously referred Fig. 4.2.15 representing the study area and the main transects surveyed). Here, maps and satellite images became crucial helpers while navigating across the landscape, namely:

- Composed Spot satellite images provided by Uppsala University, Sweden (1:250,000)
- Aerial photographs of 1:30,000 provided by DINAGECA<sup>1</sup>
- Topographic maps of 1:50,000 and 1:250,000 provided by DINAGECA
- Geological maps of 1: 1,000,000 and 1:250,000 provided by DNG<sup>2</sup>
- Soil maps of 1:250,000 and 1:50,000 provided by DNER<sup>3</sup>
- Biomass maps of 1:50,000 provided by DNFFB<sup>4</sup>

The survey area came to its final shape and size through a chain of decisions, unexpected findings, new opportunities, routine field tactics and a few outright mistakes.

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<sup>1</sup> Direcção Nacional de Geografia e Cadastro - Ministério da Agricultura, Mozambique

<sup>2</sup> Direcção Nacional de Geologia - Ministério dos Recursos Minerais, Mozambique

<sup>3</sup> Direcção Nacional de Extensão Rural - Ministério da Agricultura, Mozambique

<sup>4</sup> Direcção Nacional de Floresta e Fauna Bravia - Ministério da Agricultura, Mozambique

Table 5.1.1 Archaeological assemblages located in southern Mozambique (1994-96): Sites identified during survey and not excavated

Site	Code/Site	Lat.	Long.	Dist. (m)	# artifacts collected	Area	Classification
Catembe	2632Ba03	26°00'	32°34'	40	20	Coastal area	ESA, MSA, LSA
Bela Vista	26 32 Bc03	26°20'	32°40'	22	256	Coastal area	LSA
Ponta Milibangalala	2632				-	Coastal area	fossil remains
Tembe	2632Ad03	26°18'	32°28'	22	87	Tembe area	ESA, MSA
Boane	2632Ab01	26°03'	32°19'	50	64	Umbeluzi area	ESA, MSA
Estrada Velha de Boane	2632Ab11B	26°00'44"	32°22'45"	55	41	Umbeluzi area	ESA, MSA
Estrada Velha de Boane	2632Ab11C	26°00'39"	32°22'47"	59	15	Umbeluzi area	ESA, MSA, LSA
SMAE	2632Ab04	26°00'	32°30'	43	102	Umbeluzi area	MSA
Umpala	2632Ab08	26°03'	32°23'	33	80	Umbeluzi area	ESA, MSA
Quinta Olsa	2632 Ab12	26°01'39"	32°23'18"		75	Umbeluzi area	MSA
Antigo Posto de Goba	26 32 Aa02	26°12'	32°08'	90	49	Umbeluzi area	MSA
Estrada para Goba	2632Aa05	26°13'45"	32°09'15"	85	38	Umbeluzi area	MSA
Rio Bidongo	2632Aa07	26°03'34"	32°06'38"	130	45	Changalane area	MSA, LSA
Estrada Boane-Catuane (km 45)	2632Ad04	26°23'	32°15'	40	641	Changalane area	ESA
Alto da Enchisa	26 32 Ad02	26°21'	32°16'	75	33	Changalane area	ESA
Changalane II	2632Ac03	26°19'00"	32°08'09"	105	135	Changalane area	LSA
Caimane cave	2632Ac04	26°19'00"	32°08'40"	150	672	Changalane area	MSA, LSA, Iron Age
Portas de Changalane	2632Ac05	26°19'13"	32°08'04"	96	500	Changalane area	ESA, MSA
Bassope	2632Ac06	26°17'20"	32°07'17"	90	122	Changalane area	ESA, MSA
Maubue	2632Ad06	26°12'54"	32°26'14"	23	115	Tembe area	LSA
Porto Henrique	2632Ad05	26°18'	32°21'	21	49	Tembe area	ESA
Mazeminhana	2632Ac09	26°25'97"	32°09'03"		37	Mazeminhane/ Tembe area	ESA, MSA
<b>Total</b>	<b>18 sites</b>				<b>3219 artifacts</b>		



### 5.1.2 The survey plan

As pointed out above, my objective was to establish a systematic survey of the region between the Umbeluzi, the Tembe and the Changalane rivers, so that I could carefully document the presence of lithic sites. Therefore, the survey has been designed with the aim of providing a statistical estimate of site density and preferred site locations during the Acheulean, as well as comparing it to other periods.

During all the field seasons, actual field survey was conducted by three to ten individuals on foot; the group usually comprising of one or more researchers from the Department of Archaeology and Anthropology, Eduardo Mondlane University as well staff members and students seeking training in archaeological work.

#### 5.1.2.1 What was not surveyed?

From the starting point of the fieldwork, several areas were excluded from the survey plan for several reasons.

1. The top sections of the western mountain areas of the survey exhibit almost no soil cover; also, the high gradients present in these areas, associated with the absence of sedimentary traps, were good indicators regarding the potential absence of lithic sites in the area. Therefore, after a preliminary and brief survey, the initial assumption regarding the absence of artifacts was confirmed and consequently these areas were surveyed no further.
2. Several highly mined areas (remaining still from the guerrilla war) were avoided. Thanks to the support of the teams carrying on the removal of the mines, it became possible to identify the potentially dangerous areas. In the study area, two main

problematic regions were identified: the Umbeluzi dam region and the Alto da Enchica satellite center. The latter is located along the Changalane River, in the southern bordering part of my study area.

3. In most of the region, the impact of road building and other construction work seems to be minimal, with the exclusion of the region of the Umbeluzi "Pequenos Libombos" dam area, built in the early 80's. Nevertheless, the widening of the road from Boane to Catuane which took place during the study program led to the destruction of several surface sites. It is reasonable to estimate that other sites were destroyed during the initial road set construction in the area, as well as during the railway construction (although several sites were recorded since researchers as Barradas and Dias were following the construction process). Normally, secondary roads fail to obliterate surface sites, except for very small lithic scatters for only a few dozen flakes or so. Such roads have truncated hundreds of surface sites, but their presence is still obvious on the graded edges, and they are almost all still typologically identifiable to the level of industrial complex. In many cases, the remnants of the artifacts can still be recorded as well. From my observations, typologically most of these sites belong to the MSA and LSA (see Table 5.1.1 where the surveyed sites are described according to their typological affinities).
4. Powerlines, camp fences, telephone poles apparently have no marked effect on surface sites in this region.
5. As mentioned already, among the development activities carried out in the region, the most threatening to surface site are dams, weirs and soil conservation programs involving mechanical leveling of eroded stream banks, since these actions can totally obliterate surface sites or mix up the information. This is the case of the "Pequenos Libombos dam", built in the area without a proper archaeological survey strategy linked to the dam construction program.

6. The foot coverage of the Tembe River proved to be unsuccessful since this river has a very slow water stream, with no exposures. This fact was confirmed in 1997 when I returned to the area, expecting to find some good exposures due to the stream margin erosion as a result of a very heavy rainy season. Unfortunately, only LSA artifacts were found in very small patches along the Tembe valley.
7. The best time of the year for observation seems to be the beginning of the rainy season (September through December), when the land has been prepared for planting, there has been some rain to wash out the lithic pieces, and crops have not yet obscured the surface. I was also lucky because during the survey time a severe drought occurred in southern Mozambique, laying bare huge stretches of sediments, with sparse vegetation cover. This fact made the survey much easier, since one of the big problems in the region is related to the lack of visibility due to thick grass cover.
8. The eastward progress made me aware of the fact that the presence of suitable raw material (i.e., good quality and with good size) decreases towards the east (i.e., towards the ocean), a reason that led me to halt part of the survey in that area, without following it completely to the sea.
9. Finally, the inaccuracy - in terms of careful locating the site - of field work activities carried out in the past made it almost impossible to identify the old archaeological sites. With one exception - which resulted in the identification of few scattered handaxes at Revez Duarte - I was unable to locate with precision the areas identified in the 40's and 50's as artifact bearing areas. Some of them have been destroyed by road and railways construction; other regions have changed names, and finally, the high interest demonstrated in the past by amateur artifact collectors may have resulted in the destruction of these sites.

### 5.1.2.2 The sequential organization of the survey

At this stage of the research work I was able to define the borders of the area where a careful survey should take place. The overall area covers mostly the area from the Grandes Libombos (midslopes) down to the valley below the Pequenos Libombos mountain system. From the basalt plain below the Pequenos Libombos and up to the ocean, the sand deposits obscure for the most part the underlying stratigraphy.

Initially the survey was concentrated in the west part of the Umbeluzi-Changalane-Tembe region, where the most important lithic collections classified as of Acheulean age had been found in the past: The surface scatters identified during the survey were quite scarce, even though predominantly highly visible (due to seasonally sparse vegetation cover), and only occasionally affected by construction activities. In some areas the shallowness of the deposits rendered the evidence inconclusive. However, the area was still too extensive to survey by foot and several other strategies were used to get a representative sample of the archaeological remains to be found in the region.

Therefore, I attempted to subsample the area to be surveyed randomly, in order to get some "un-biased" idea regarding the geological context of the areas where artifacts were about to be located. Using topographic maps, the area to be surveyed was divided into ten by ten square kilometers; using a random numbers table, some squares were selected for study. Soon this method proved to be preposterous, since based on the knowledge of the geomorphological context of the terrain, I could quite accurately predict if the stretch we were observing would hold artifact bearing sediments. It also became frustrating walking kilometer after kilometer knowing "a priori" that the chosen square would probably be devoid of any lithic remains.

In order to get a better understanding of the geological and ecological context of the region, I decided to undertake several transects along and across the study region. Using the

railways path, which crosses almost horizontally the region, from Boane to Salamanga (i.e., towards the coast) and to Goba (i.e., towards the mountain, border area with Swaziland) it became possible to identify some of the unsuitable areas for search, since the thickness of recent sandy deposits made the inspection of older sediments impossible. Also, it confirmed the fact that river cuts presenting good geological sections are located essentially in the intermountain area and slightly east of the Pequenos Libombos area. From there on, and towards the east, the gradient becomes too slow, and the rivers are not sufficiently active to cut deep into the sediments.

Subsequently, I decided to count upon the help of a geologist familiar with the sort of geological situations present in southern Mozambique. With the support of Dr. Greg Botha -- from Council for Geoscience, South Africa -- I was able to distinguish the main morphological patterns of the landscape, and therefore restrict the survey study to the areas where potentially one would expect to find good cuts exposing archaeological material. At this point, and having finally defined the "survey core" of my study area I decided to established several transects that were walked over by the survey team. For this purpose mapping was facilitated by the use of aerial photographs and topographic maps (mostly 1:50,000). The day walkpath was planned according to the terrain types present in the area and most of the day was spent exploring the river ridges and the low-lying areas, in order to identify potential sedimentary traps and exposed sections. Each day the survey the team(s) walked over a specific area (the team members' walking about 500 meters away from each other), navigating with aerial photographs and topographic maps in hand, searching for lithic artifacts on the surface of the ground. It should be pointed out that not every square meter of terrain was inspected on foot. After the preliminary survey program was done, and keeping in mind our goal of mapping the largest number of sites in the greatest diversity of environments at the lowest possible cost, I decided to place five transects, of about one kilometer wide each, across the territory, stretching west-east. One was placed along the northern boundary (which more or less coincided with the survey performed along the Umbeluzi

River margin; the southernmost coincided partially with the Chagalane and Tembe rivers.

Finally three other transects were arranged to cover the region between the main water systems (which in the study area run mainly east-west). Therefore, the transects were established keeping a west-east and north-south track (see previously referred Fig. 4.2.15).

#### 5.1.2.2.1 The Umbeluzi River

The work was concentrated mainly on the area of the river readily accessible, i.e., from the dam down to the water station treatment area, near Boane and the upper part, until almost the border area. The survey was concentrated on the southern banks (i.e., immediately inside the study area); however, from the dam south, the survey was also carried on the northern bank. A tour of the country lying to the south Pequenos Libombos was made and several tributaries (such as the Maubué stream) examined. On the southern bank, examination was carried on as far as a point about 15 to 20 kilometers down the Umbeluzi River and located circa twelve kilometers from the estuarine region.

#### 5.1.2.2.2 The Chagalane River

The deposits laid down by this river (tributary of the Tembe River) proved to be of considerable significance, since the deposits are of considerable depth and contain valuable archaeological material, as I will describe in the next section of this chapter. The Chagalane was surveyed for a distance of about 25 kilometers upstream, from Porto Henrique area. Around this area band below, the survey of the margins shows that the sandy cover has concealed any exposed artifacts in older sediments; essentially, only LSA artifacts could be spotted on the river bank deposits. In the Chagalane River was found one of the best MSA/LSA sequence, at Caimane cave. In the gravels several handaxes and cleavers were found.

#### **5.1.2.2.3 The Tembe River**

The deposits in this river were examined in its upper part. This fact results from difficulties to access the area, as well as because in the study area, the river cuts through late sandy deposits that are devoid of ESA artifacts. Therefore, the river was surveyed in specific places, where previously the presence of stone artifacts had been noticed.

#### **5.1.2.2.4 The interfluvial area of the Interior Plain**

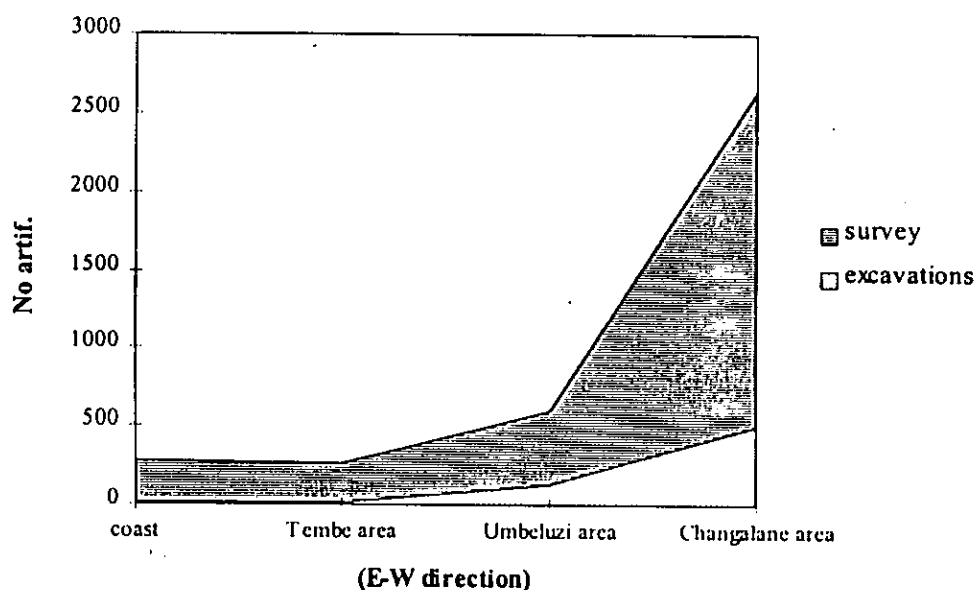
The interfluvial area was mostly devoid of significant cuts which might had good exposures; only by luck we were able to identify some gullies and erosional structures where artifacts were exposed, although most of the assemblages would be classified, from a typological perspective, as being of the MSA and LSA period.

#### **5.1.2.2.5 The Coastal Belt**

This survey also encompassed the region down at the coastal area where a number of sites were located, namely: Catembe, Ponta Maone, Ponta de Santa Maria, and the fossil bearing locality of Ponta Milibangalala.

In this way I was able to learn what types of terrain yielded the highest and the lowest number of Acheulean sites (and overall, stone age sites) and concentrate on the former terrain types for further work (i.e., to develop a deeper survey and to perform small scale excavations). This also means that I was able to get a representative cover of the study area, both in terms of geological setting, archaeological data, and ecological framework.

**Fig. 5.1.1- Archaeological visibility in the study area  
(stone age sites)**



### 5.1.3 Site location and the initial artifactual inventory

When a site was found, its was located (latitude, longitude and altitude) through the help of a GPS system and the dimensions of the site were recorded and its features noted. Table 5.1.1 presents a list of the sites identified during the survey (although not excavated). A description and analysis of the sites excavated for this dissertation is presented in the next section of this chapter.

Each new location yielding artifacts (no matter if surface or excavated) was assigned a two dimensional coordinate identification based on the national coordinate system of the country, and the site was accurately plotted on the map. Later in the laboratory, this number was written on the artifacts in ink. Most of the sites were systematically photographed.

Still in the field, the next step required a careful gathering of the lithic remains recognized on the area. Here, a quick written inventory of all artifacts was performed. The



assemblage was collected and bagged in bags identified with the site number and date of collection. This was followed by a qualitative evaluation of the weathering level on the artifact surfaces. An initial judgment was made on the typological classification to which the site was ascribed (still without a numerical analysis of the assemblage collected).

Mixing by natural, post-depositional processes seems to be a common situation in some of the land-units of this region. Therefore, in several cases the artifacts from two or more industries are found mixed together. However, it was possible to recognize this process, and this fact has not affected the basic assumptions built into our recording methods. A separate record of the artifacts ascribed to each lithic industry was compiled later in the laboratory.

Up to now, and from a strict typological point of view (i.e., when the style of the artifact shapes' were assumed as being typical of a specific prehistoric period), the stone tools from distinctive industrial periods have been perceived as being sufficiently unique so that surface scatters of artifacts could be assigned to distinct periods, such as the Acheulean.

#### 5.1.4 Conclusion: evaluation of the results achieved

It must be stressed that it was never our intention to find every site in the study/surveyed area; instead, my goal was to come as close as possible to one hundred percent recovery without slowing down the planned schedule. The obtained site distribution is not a spurious byproduct of where I have chosen to walk; in fact, the search path is a coarse sketch of the actual overall site density in the distinct units of the landscape.

However, one should note that this survey technique has some drawbacks. It is possible that one can fail to notice sites because of the vegetation cover, especially at the end of the rainy season when the grass cover is quite thick. Sometimes there were not sufficient artifacts to complete a typological classification of the sites, either because the lithic sample was too small or

damaged, or still because our understanding of lithic sequences is not entirely correct. Further surveys in other areas can only refine the results of our initial survey.

In regard to the archaeological findings, the poverty of archaeological record in terms of *in situ* occurrences, led me to decide that the main indicative to be used of the presence of Acheulean would be the presence of big flakes (longer than ten to twelve centimeters, the minimal size of a handaxe in the area), as well as the presence of the characteristic Acheulean artifacts- handaxes and cleavers, together with picks, bolas, etc.

The sites located during the survey and the ones that were later excavated are located on:

- Cuts resulting from active fluvial actions (e.g., Canhociro site). In these eroded alluvial sediments, examples of artifacts typologically belonging to two or even three distinct industries are found juxtaposed in the stratigraphic sequence. Here, very few sites are found in primary or slightly disturbed context;
- Gully or coastal erosion (e.g., Buraco, Ponta Maone sites). Since these deposits are normally covered by thick layers of latter sediments, they became extremely difficult to identify, unless a serious erosion process brought them to surface.
- Local construction area (e.g., Estrada Velha para Boane, Cardiga sites).
- Local block faulting area, forming ports (e.g., Caimane, Mahelane sites).
- Finally, in shallow fills under fragile sand and/or siltstone cover or in rock crevices (Umpala site).

The eight sites studied for this dissertation, from within the Umbeluzi-Changalane-Tembe area briefly introduced here are presented in the next section of this dissertation.

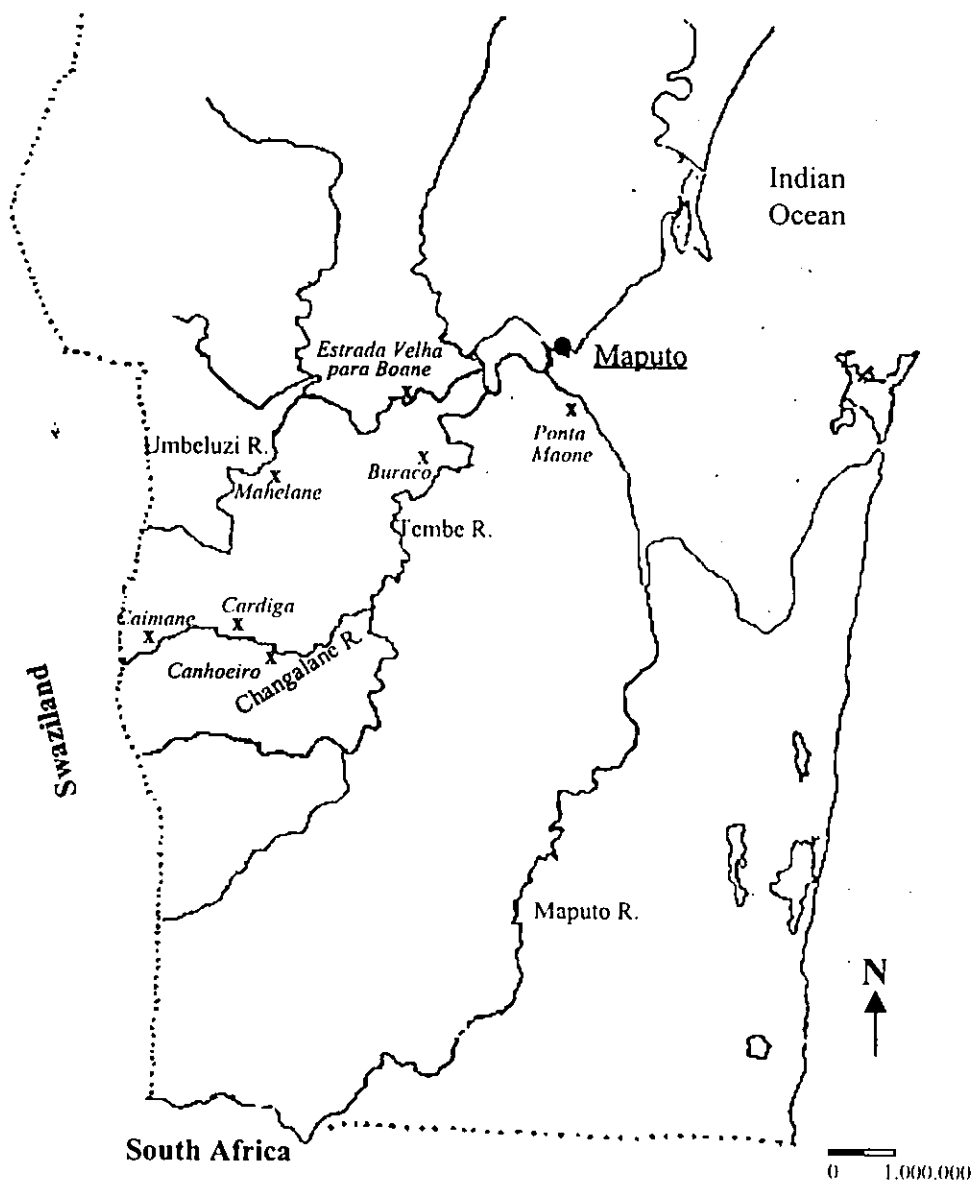


Fig. 5.2.1 Southern Mozambique: sites excavated for this dissertation

## 5.2 THE ACHEULEAN ARCHAEOLOGICAL SITES FROM SOUTHERN MOZAMBIQUE: THE DESCRIPTION OF THE SITES STUDIED

### 5.2.1 Introduction

Peringuey (1911) first drew attention to the presence of lithic artifacts in the southern Mozambique, recognizing that the implements were early forms similar to those found in the Paleolithic sites of Europe. Since then, a considerable number of sites have been identified and described preliminarily by archaeologists and geologists.

The bulk of the excavation work for this research project was undertaken during the years of 1994-1996. In 1997 further work was carried out to clarify some preliminary ideas regarding the ESA distribution in southern Mozambique.

This chapter contains a discussion of the context and character of the stone artifacts from the sites I excavated in southern Mozambique, as well as additional information I gathered while surveying and mapping Quaternary deposits bearing lithic artifacts in southern Mozambique. The information presented here constitutes the extent of our knowledge of the prehistory of southern Mozambique in the Early Stone Age and provides a basis for comparison of the archaeological materials to other areas of Southern Africa. The stone artifact assemblages which constitute the focus of this dissertation and which are described in this section resulted from the study of eight sites located in the Umbeluzi-Changalane-Tembe area, in southern Maputo province, Mozambique (see map in Fig. 5.2.1 representing the sites excavated in southern Mozambique).

### 5.2.1.1 The selection of the locations to be excavated

In attempting to define the distinctiveness of the lithic assemblages during the Acheulean, the presence of two artifactual types -- handaxes and cleavers, is often used (Leakey, 1975, Isaac, 1977, Clark, 1996). When compared with the previous Oldowan Complex (Mode I), the technological reading of the Acheulean from Southeastern Africa witnesses several innovations, including:

- The deliberate use of large blocks of diverse raw materials, as massive cores for obtaining large flakes -- longer than ten to twelve centimeters (Leakey, 1967, 1975, Isaac, 1977, Schick & Toth, 1993);
- The predetermination of the form of the blank (flakes) used for producing cleavers (Dauvois, 1981, Roche & Texier, 1991, Texier, 1996);
- The first presence of formal standardization of geometric tool design (Isaac, 1969, 1976, Gowlett, 1982, 1984, 1986, 1991, Texier & Roche, 1995a). In fact, the Acheulean handaxes and cleavers contrast with the characteristic artifacts of the previous Oldowan period; for the Oldowan, as Toth (1985) stated, the earliest known flaked artifacts represent technological "paths of least resistance", rather than preconceived "stylistic norms", as observed for the Acheulean.

The fieldwork carried out in southern part of Maputo province involved both surface survey and small excavations.

During the survey, after finding surface lithic scatters of any Acheulean characteristic artifactual forms, I proceeded with further intensive prospecting by shovel testing around the find-spot.

The survey has shown clearly that in southern Mozambique, commonly the surface collections one is dealing with constitute mixed and chronologically unrelated remains; therefore,

they probably reflect multiple phases of occupation, few of which may be chronologically diagnostic. For this reason, the only secure characteristic components of the Acheulean are the presence of large flakes and bifacially knapped artifacts -- handaxes and cleavers -- scattered over a geographically restricted area. The excavation was then undertaken where several bifacial pieces were found.

Moreover, the assemblages recovered from the small-scale excavations showed that the artifacts were usually found in disturbed contexts. Therefore, the term -- *in situ* -- is used to indicate excavated material, as opposed to surface finds, and does not necessarily imply a primary context (Cornelissen, 1992).

The primary aim of my study is the description and interpretation of archaeological remains in an effort to assess the dynamics of hominid adaptation (Binford, 1972:133) during the Acheulean period in southern Mozambique. Yet, since archaeologists can never directly observe behavior, it must be inferred from the archaeological materials which Isaac (1981b) refers to as "stone age visiting cards". In order to extract information on the technological behavior of Acheulean hominids from southern Mozambique, I used a combination of excavation, laboratory analysis, and insights from systematically carried series of experimentation. Hence, the contexts in which they are found are extremely important for behavioral inferences. Therefore, the sedimentary and paleogeographical contexts from which these assemblages derive are important for establishing a spatial, chronological and environmental framework within which lithic remains recovered in southern Mozambique can be studied. Additionally, information about the way in which the assemblages were recovered and the degree to which they are representative of cultural materials originally left at the sites is a necessary background to the study of lithic artifacts, from the point of view of technological complexity and knapper's expertise. Accordingly, the main objective of the small-scale excavations I conducted in southern Mozambique was to collect information about the nature of the Acheulean artifact assemblages.

Another objective of the excavations was to retrieve data regarding some behavioral aspects of Acheulean prehistoric populations in southern Mozambique.

Since the main approach to understanding the archaeological data is focused on the technological aspects of the lithic artifacts, the explanation of the excavation procedures and the specifics of the sites will be concisely provided for each one.

#### 5.2.1.2 A general description of the sites

Overall, eight sites were carefully studied inside the research area, namely Ponta Maone, Buraco, Estrada Velha para Boane, Umpala, Mahelane, Cardiga, Canhoeiro and Caimane (see previously referred Fig. 5.2.1 illustrating the sites studied).

In accordance with my research objectives, I decided to open up an initial 2x2 square meters excavation upon the location of the original surface finds, depending upon their size number and typological representativeness (i.e., cleavers, handaxes or large flakes exposed on the surface). The surface finds were collected, numbered and recorded within a five-meter radius of the area to be excavated.

The excavation proceeded by following the stratigraphic sequence present at each site. When it happened to be too thick, arbitrary ten-centimeter levels were used.

In southern Mozambique, the Acheulean sites are found predominantly in alluvial context, where the abundance of gravels and silt to clayish sediments imposed severe limitations to the use of the excavation methodologies developed for Eastern Africa (in terms of following the microstratigraphy of the site and plotting carefully the artifacts in three dimensions). Thus, the excavation was performed using picks and shovels and screens (five-millimeter mesh size). Provenience was recorded by quadrants (one meter by one meter) and by level. The excavation sometimes would be enlarged (see below for each case), following the trend of the distribution of

the cultural remains (whenever they happen to suggest the following of a significant concentration of artifacts).

The microstratigraphy of each site excavated is described here using a Munsell soil color chart.

It should be mentioned that no fossil bones were observed during the excavations. The only exception is the coastal site of Ponta Milibangalala, where some fossil bones were identified in the late 1960's (T. White, pers. com.), a fact confirmed during a brief survey carried out in the area in 1994.

Table 5.2.1 List of sites excavated in southern Mozambique (1994-96)

Site	Code	Lat. (S)	Long. (E)	Elev. (m)	Landscape Units	Context	# art.
Ponta Maone	2632Ba01	26°01'	32°36'	26	Coastal Division Catembe Cul-de-Sac	Surface	7
Buraco	2632Ab05	26°18'	32°28'	21	Tembe Valley Division (Tembe valley)	Excavation	17
Estrada Velha/Boane	2632Ab11 A	26°00'45''	32°22'55''	58	Tembe Valley Division (Tembe Valley)	Excavation	162
Umpala	2632Ab02	26°04'34''	32°19'08''	33	Tembe Valley Division (Tembe valley)	Excavation	72
Mahelane	2632Ab03	26°10'89''	32°13'30''	45	Upland Division (Serra Quindezanine)	Excavation	17
Cardiga	2632Ad01	26°19'	32°11'96''	56	Upland Division (Serra Quindezanine)	Excavation	48
Canhoeiro	2632Ac03	26°18'52''	32°11'97''	49	Upland Division (Serra Quindezanine)	Excavation	232
Caimane	2632Ac05	26°18'84''	32°08'62''	97	Upland Division (Changalane Catchment)	Excavation	216
<b>Total:</b>	<b>8 sites</b>						<b>771</b>

In the laboratory, at the Department of Archaeology and Anthropology -- Eduardo Mondlane University (Mozambique), the artifacts were cleaned by gentle brushing and washed.



Then the field inventory was reconciled to the actual assemblages (including all the surface surveyed material). The artifacts were then classified by types and quantified.

Measurements of all the handaxes and cleavers were recorded along with the dimensions of other important pieces, such as large flakes, etc. In this part of my dissertation the analysis of the lithic artifacts is primarily of descriptive character, including however, some parameters considered of technological importance, such as the quality of the raw material utilized to produce the lithic pieces, as well as metrical evaluation of the lithic implements for the classificatory evaluation of the assemblages. In this dissertation, the artifact measurements were recorded using data sheets elaborated for the specific purpose of this research, but following the methods published earlier by several archaeologists (e.g., Bordes, 1961, Kleindienst, 1961, Roc, 1964, 1968, Jelinek, 1975, Isaac, 1977, Toth, 1991, etc.). The recording data sheets are presented and described in Appendices 1 and 2.

The assemblages are deposited at the Department of Archaeology and Anthropology, Maputo - Mozambique.

As a result of my fieldwork, Acheulean sites located in a relatively unknown region of Southern Africa are reported. The sites described in this section of my dissertation contain Acheulean assemblages, including a significant amount of flaked pieces, as well as cores that were not large enough to obtain flakes of sufficient size to be used to manufacture handaxes or cleavers. For this reason, they were not included in the more detailed analysis of the lithic material.

### **5.2.2 Ponta Maone**

The survey on the coastal area of southern Mozambique accomplished in the 60's led to the identification of surface finds of handaxes and large cores, mainly in the Catembe area -- a rocky cable across the bay from Maputo city (e.g., Barradas, 1961a, Senna-Martinez, 1968). In fact, the

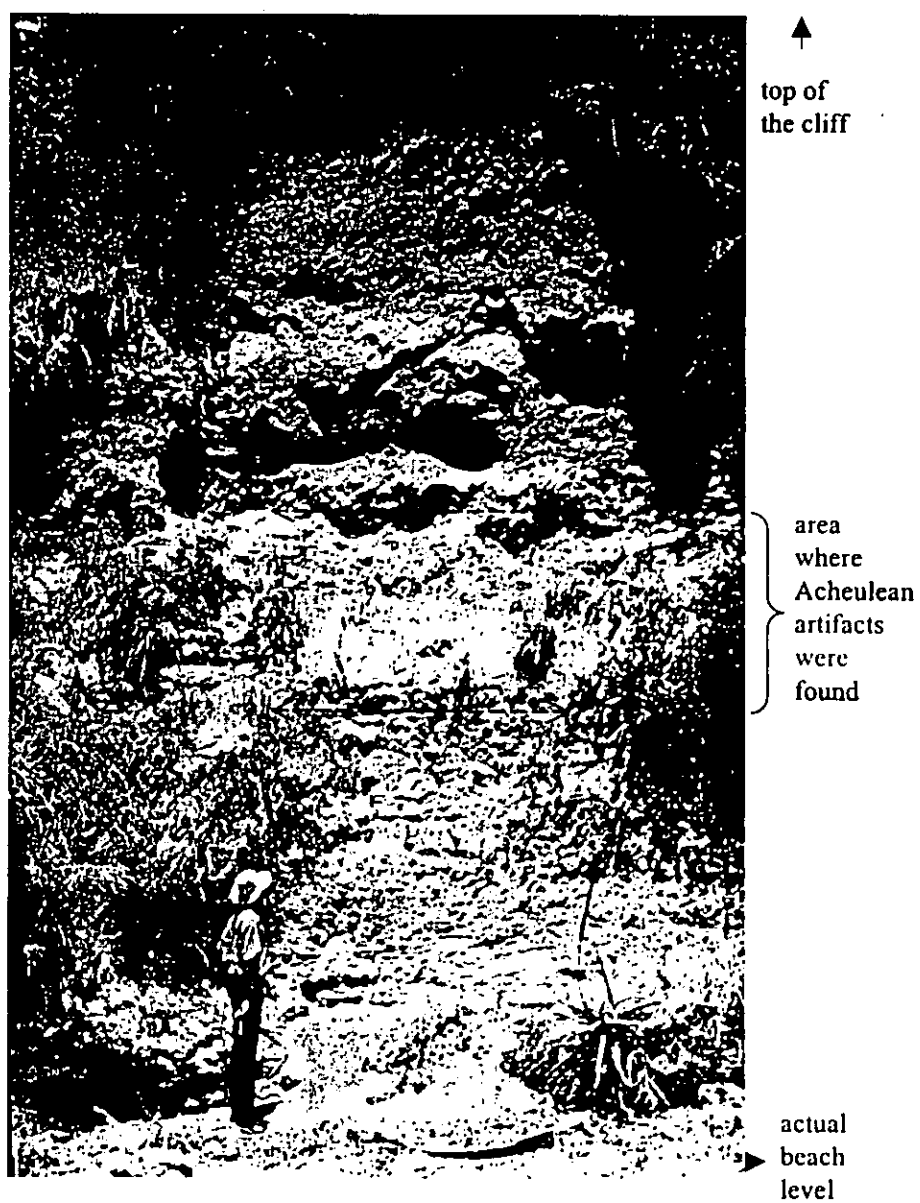


Fig. 5.2.2 Ponta Maone, southern Mozambique. The image represents a section of the coastal cliff where Acheulean artifacts were found.

area shows some potential for future geological studies, since the exposed profiles (steep hills) suggest the presence of a good sedimentological sequence reflecting the sea-level fluctuations in the region.

#### **5.2.2.1 The site**

There were references to the Ponta Maone site (see above), based upon the presence of several shell-middens with lithic artifacts in the area.

At the base of the cliff that constitutes this location there is a thick level of rhyolite, calcite and quartzite cobbles. This conglomerate bed presumably was brought to the coastal area as a result of the high gradient present along the river channels during the cycles of sea level lowering; this bed has been described as of Pliocene age (G. Botha, pers. comm.).

The survey performed at the beach and along the cliff (as much as is possible due to the severe logistic limitations, since an army base is present in the area) led to the identification of seven lithic pieces which could be described as Acheulean (large flakes and bifacially flaked artifacts). The artifacts --not weathered -- were lying on the surface of the beach, as well as encrusted in the sandy deposits that constitute the walls of the cliff (eroding from about one to two meters from the top of the cliff; see Fig. 5.2.2). They were lying within 3 meters of each other. However, because of military presence at this locality, I was only able to collect the surface findings -- any other activity was not allowed, including photographing the area.

#### **5.2.2.2 The geological context**

The cliffs of Ponta Maona extend over a length of four kilometers to the west and southeast of that rocky cape. The base of the cliff is formed by a gravel bed, consisting of quartz, rhyolite and basalt cobbles. This unit has been defined of Pliocene age. The unit is covered by a thick mantle of

reddish yellow (5YR 6/8) very cemented sand (Maputo sandstone), which alternates with loose sands. The top unit, about eight meters thick, is composed of brownish yellow (10 YR 6/6) sandy clay loam; the transition from the Maputo sandstone is irregular (about two meters thick), with deep pockets with reddish sandstone boulders, where the artifacts were found (Barradas, 1961b, 1964, Beernaert, 1987, Momade, 1990). The calcareous sandstone contains plenty of marine fossil material (Barradas, 1965).

### 5.2.2.3 The lithic assemblage

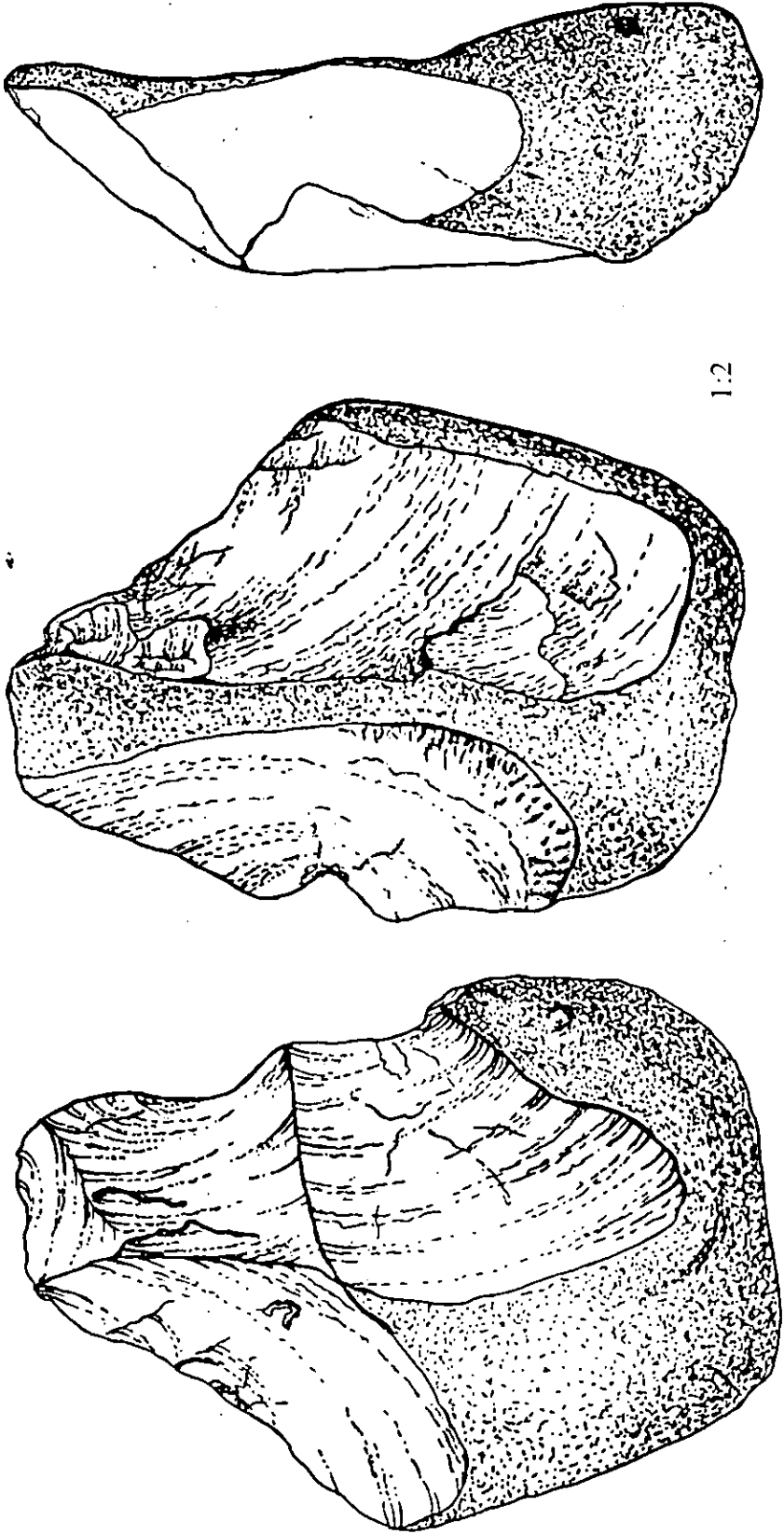
Table 5.2.2 Ponta Maone (pm) artifact inventory

Artifact (surface only)	N	%
Bifacially knapped pieces	2	29
Flakes longer than 100 mm (including one retouched)	2	29
Small flakes	3	43
TOTAL	7	100

Table 5.2.3 Description of large bifacial pieces (2 pieces)

Handaxe	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt
pm2	sandstone	139	97	56	550	Handaxe	flaked
pm4	rhyolite	176	108	59	810	Handaxe	cortex
<b>Mean</b>		155	103	58	680		
<b>SD</b>		30.4	7.8	2.1	183.9		

The two handaxes were made on cobbles, using distinct raw materials: rhyolite of the Libombos and local sandstone (see Fig. 5.2.3). Both present some cortex on both sides, with the rhyolite one having a non-flaked butt.



1.2

Fig. 5.2.3 Handaxe rough-out knapped on a rhyolite cobble (Ponta Maone)

Throughout this work the word cortex is used to make reference to the alteration of a natural rock surface; the word patina and/or weathered surface are used in reference to the alteration of an intentionally worked/used rock surface.

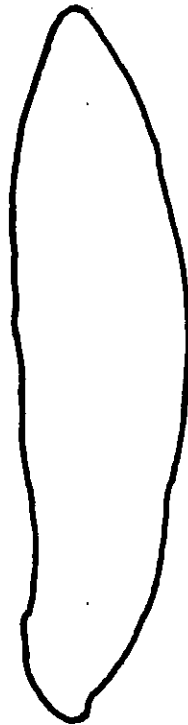
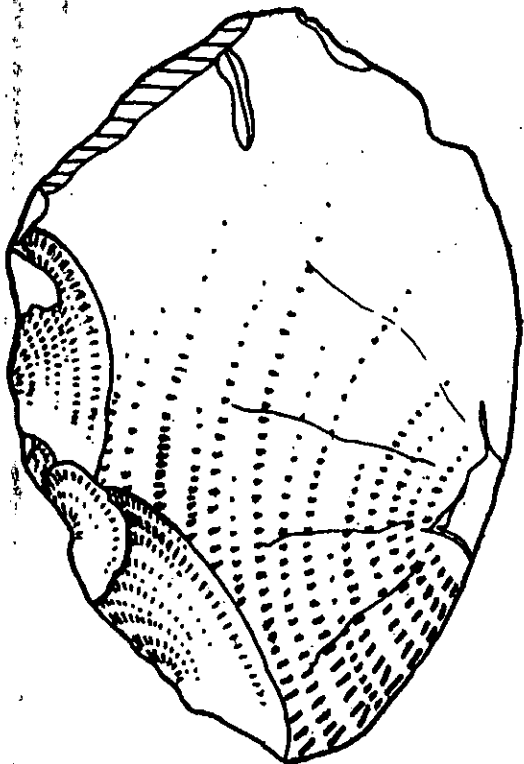
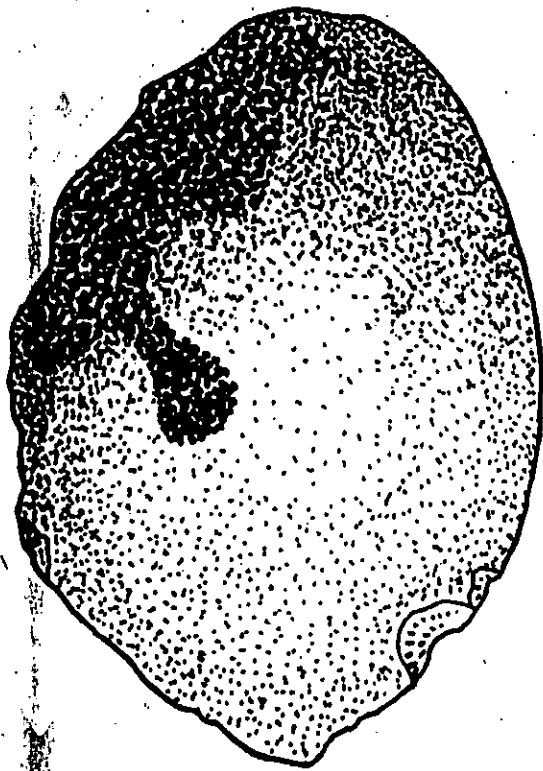
Table 5.2.4 Large flake description (2 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
pm202	rhyolite	128	126	45	520	IV	end-located bulb in relation to the axis of the flake
pm203	rhyolite	108	196	191	1050	I	side-located bulb in relation to the axis of the flake
<b>Mean</b>		118	161	118	785		
<b>SD</b>		14.1	49.5	103.2	374.8		

Fig. 5.2.4 presents one of the large flakes recovered at this site. The remaining small flakes were made on both rhyolite and quartz, which was locally available. Both flakes are large enough to produce a handaxe, but they don't show any retouch.

#### 5.2.2.4 Paleogeographical context

Ponta Maona cliffs are composed of resistant late Tertiary calcareous rock and red sandstone, capped by a sandy loam mantle. Towards the west and southeast of this cape, the cliffs are being eroded by the sea (and hence retreat rapidly), as they are composed only of loose sandy loam.



1:1.5

Fig. 5.2.4 Rhyolite flake (Type I) from Ponta Maone

### 5.2.3 Buraco

The coastal plains in southern Mozambique form a thick sandy cover overlaying the earlier Plio-Pleistocene formations. This thick sandy cover along the coastal plain made it impossible to find any ESA sites. In fact, although LSA and Early Iron Age (EIA) sites are quite often found in the coastal area (e.g., Morais, 1988), the process of coastal formation -- through a series of sea-level fluctuations -- led to the emergence of a coastal plain of mid to late quaternary origin (Förster, 1975, Davies, 1977, Beernardt, 1987). Therefore, the plain below the Pequenos Libombos mountains and to the east of the Tembe River is mostly of dunar origin. The fixation of this dunar system probably rapidly constructed during marine regressions, which uncovered abundant sand on the continental shelf. Its fixation may have been due to continued regression, which removed the shore so far that beach-sand no longer reached the dune; hence, the dunes became fixed by vegetation (Koch, 1964, Davies, 1975, 1977).

#### 5.2.3.1 The site

While surveying the Tembe River area, the survey team came across a large gully. The survey of it led to the identification of some artifacts exposed in the walls, including one handaxe. Therefore I decided to open a two by two-meter small excavation to check the context of the artifacts, as well as to retrieve more artifacts (see Fig. 5.2.5).

#### 5.2.3.2 The stratigraphy (geological context)

The sediments are uniform from bottom to the top, being composed mostly of sandy clays, with some gravels.



Description of the geological profile (see Fig. 5.2.6)

1) Coarse sandy layer of brownish color (7.5 YR 4/4), about 90 to 100 centimeters thick. Some red clay patches (2.5 YR 4/6) of about two to three centimeters in diameter were found dispersed within the section. The level yielded very few artifacts, mostly small size flakes (up to 5 centimeters long) and cores.

2) Coarse brown sandy-clay level (7.5 YR 4/4), sterile (ten to 30 centimeters thick). This level grades into the next one, in terms of coloring.

3) Coarse brown-grayish sandy clay (7.5 YR 5/3), very compact, yielding artifacts. This level is about 20 centimeters thick.

4) Sandy gravel of brownish color, turning into a conglomeratic bed at the bottom (7.5 YR 4/4). Some red clay patches found here also (ferricrets - ferruginous streaks?), together with very dark lenses, interpreted as manganese stains. This level was excavated for 30 centimeters, but no artifacts or fossil fauna were found.

**5.2.3.3 Excavation procedures**

The excavation proceeded using a pick and a shovel. The first 100 centimeters (dug in ten-centimeter horizontal spits) yielded several flakes and radially worked cores, probably of MSA to LSA age. The next horizon from 1.00 to 1.30 meter was sterile. The horizon from 1.20 to 1.40 meters presented two handaxes and some small flakes, in fresh condition. The screening of the sediments failed to present any artifacts, with the exception of some angular fragments from the horizon 1.20-1.40 meters. The excavation was stopped at about 1.60 meters, due to the absence of artifacts and the emergence of a distinct conglomeratic bed.



165 mm

Fig. 5.2.7 Handaxe from Buraco site (southern Mozambique); the artifact was knapped using a sandstone cobble. The artifact was produced using a hard hammer percussion technique, exemplified by

- an irregular outline;
- the deep, scooped flake negatives;
- wide flakes removed, variably spaced;
  - side edges curved/irregular
  - side edges hinged at the distal end
- some cortex present (central area).

### 5.2.3.4 The lithic assemblage

A total of 17 lithic pieces were gathered from this location made predominately using rhyolite (see Fig. 5.2.7 representing one of the artifacts retrieved at this site).

Table 5.2.5 Buraco (bur) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Bifacially knapped pieces	2	11.8	2	11.8
Small radial cores	2	11.8	-	-
Small flakes	2	11.8	9	52.9
TOTAL	6	35.4	11	64.7

Table 5.2.6 Description of large bifacial pieces (4 pieces)

Handaxes	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
bur206	Rhyolite	125	79	47	190	Handaxe	flaked	in situ
bur207	Rhyolite	176	101	56	840	Handaxe	flaked	surface
bur208	Sandstone	167	119	82	1320	Handaxe	flaked	in situ
bur209	Rhyolite	140	85	40	450	Handaxe	flaked	surface
<b>Mean</b>		152	96	56	700			
<b>SD</b>		23.6	19.9	18.4	492.1			

Here too, as at Ponta Moane, a handaxe, found on the surface, was made on a sandstone cobble. However, the majority of the large bifacial excavated tools are made on rhyolite flakes (75%). No large flakes were found in the area.

### 5.2.3.5 The paleogeographical context

Based on the sequence of sediments present at Buraco, the paleogeographical setting of this site, as especially of the main archaeological horizon (3) has been interpreted as representing a distal floodplain of the Tembe River.

### 5.2.4 Estrada Velha para Boane

#### 5.2.4.1 The site

This site is located on the top a hill, which is part of the distal alluvial terraces of the Umbeluzi River (see previously referred map on Fig. 5.2.1). This area was surveyed in the 40's by Barradas, Riet Lowe and Breuil (Breuil & Riet Lowe, 1944) who referred to the presence of significant scatters of large flakes and bifacially knapped pieces on the surface. However, it became impossible to identify exactly the locality to which these authors made reference to, since the landscape features described have altered so much since then.

During the field survey several surface concentration of artifacts yielding large flakes were found in the area. However, no cleavers or handaxes were found and the test pits opened in three other localities, also failed to provide any of these artifacts:

Table 5.2.7 Sites identified along the Umbeluzi River

Site	Code	Area
Estrada Velha de Boane	2632Ab11B	Umbeluzi area
Estrada Velha de Boane	2632Ab11C	Umbeluzi area
SMAE - Quinta Olsa	2632Aa08	Umbeluzi area

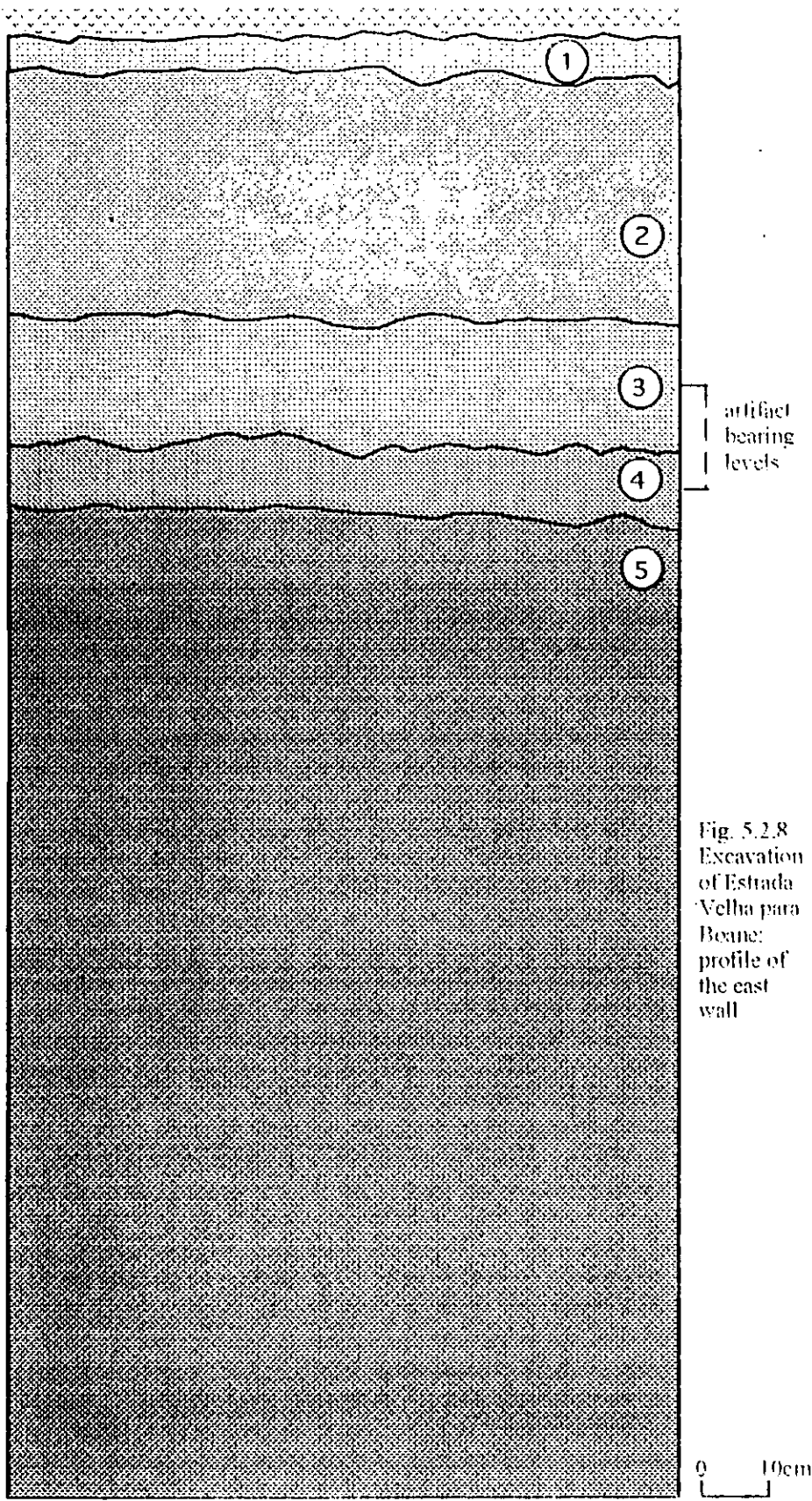


Fig. 5.2.8  
Excavation  
of Estrada  
Velha para  
Boane:  
profile of  
the east  
wall

#### 5.2.4.2 The geological context

The description of the geological sequence present at Estrada Velha para Boane is as follows (see Fig. 5.2.8)

1) Yellowish brown medium to coarse grain sands, pebbly at the base (10 YR 3/4), about 20 to 30 centimeter thick.

2) Gravel bed of about 40 centimeters thick (10 YR 3/4).

3) Conglomerate bed, cemented by sandy clays of grayish brown color (10 YR 5/2), between 20 to 30 centimeters thick. Towards the bottom some single large flakes were found.

4) Brownish coarse sandy-clayey level (7.5 YR 5/6), where most of the artifacts were found.

5) Conglomeratic bed (7.5 YR 5/8), devoid of artifacts.

#### 5.2.4.3 Excavation procedures

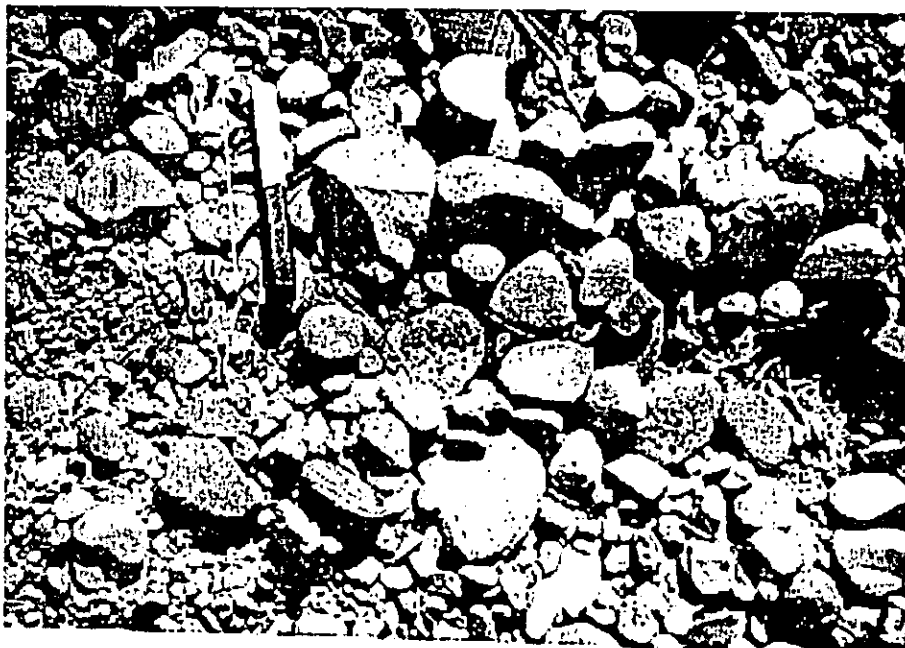
This site is on the slope of a hill (see Fig. 5.2.9 documenting the image of a conglomeratic bed at Estrada Velha para Boane, with some artifacts eroding at the surface). The excavation site was chosen based on the presence of a large number of massive flakes, a cleaver and a handaxe on the surface, together with several cobbles (on average of eight to twelve centimeters long) eroding from the conglomerate beds that form this old terrace of the Umbeluzi River.

A five-meter by two-meter surface grid was laid out, so that it would include the place where the handaxe and cleaver were eroding from (see Fig. 5.2.10 representing the excavated area).

The excavation took place with a pick and shovel in ten-centimeter horizontal spits. The first 20-30 centimeters contained several small flakes and carefully prepared cores, described as of the LSA period. This layer is composed mostly of coarse sands, mixed up with small pebbles.



a) Estrada Velha para Boane - gravel bed



b) detailed image - note the size of the cobbles

Fig. 5.2.9 General view of (a) the Umbeluzi gravels at Estrada Velha para Boane and (b) detailed image of the same area (note the size of the cobbles, including example of a core found on the surface)

### Estrada Velha para Boane

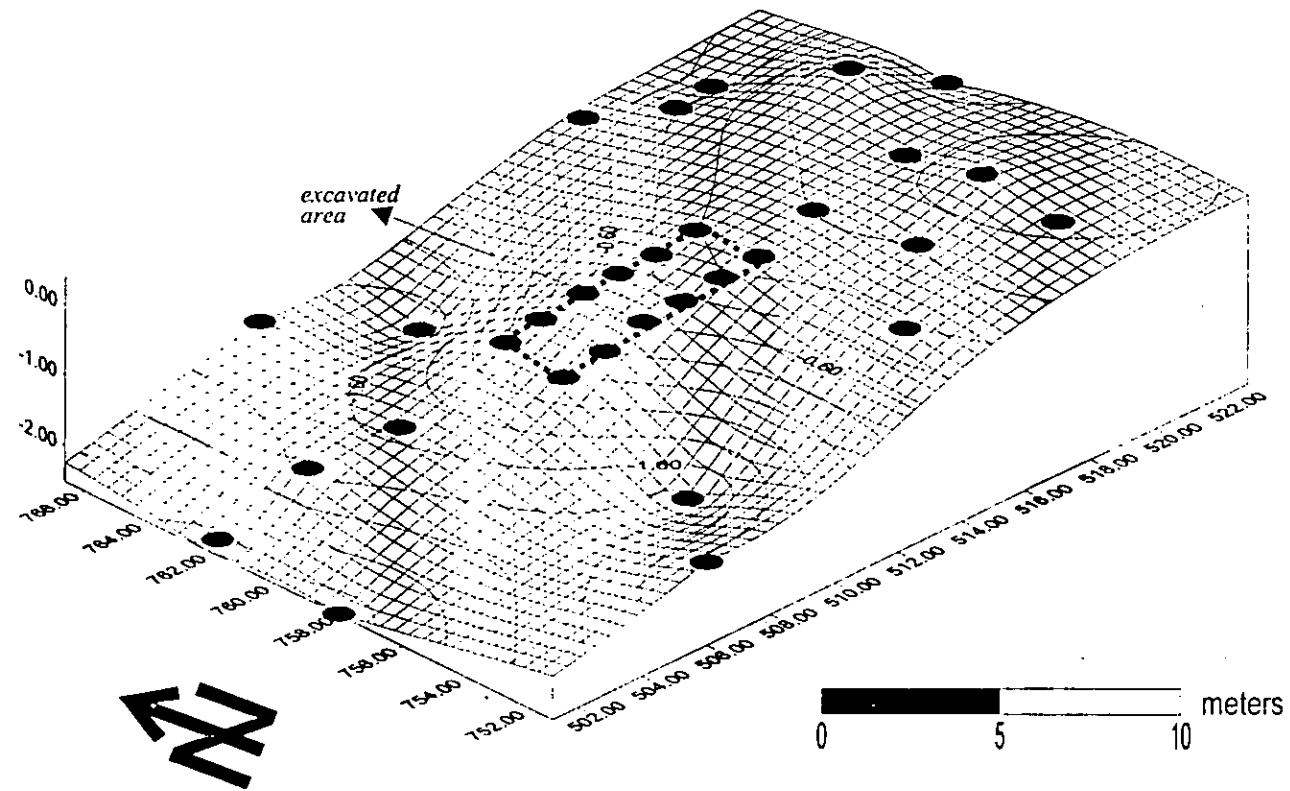


Fig. 5.2.10 Site: Estrada Velha para Boane - view of the excavation (2x5 meters) and the surrounding area. The dark circles refer to the points where the measurements were taken.



About 70 centimeters from the surface, some thick flakes appeared mixed with cobbles (20 to 30 centimeters long) and coarse clayish sand. In fact, the 20-centimeter horizon between 70-90 centimeters contained most of the artifacts identified as of Acheulean period; in this horizon were found two bifacially flaked pieces and some large flakes. I tried to conduct a systematic excavation in shorter horizontal spits using picks and small shovels, but the hard consistency of the sediments didn't allow it. Therefore, I was unable to piece-plot the artifacts.

As in all excavations and geological trenches, the excavated sediments were sieved through a five-millimeter mesh screen. For the site of Estada Velha para Boane, almost all of the material recovered in the screen came from the horizon between 60 to 90 centimeters. Further 60 centimeters were excavated, to test if the bottom of the artifact bearing-horizon had been reached. The sediments below 90 centimeters were sterile, and slightly different (conglomeratic bed) from the horizon above. The sediments are formed by very coarse gravels and with a stronger component of clay in their composition, which made the excavation very difficult and time consuming.

#### 5.2.4.4 The lithic assemblage

The total number of artifacts from this site sums up 162 pieces, of which I measured and studied in detail nine large pieces.

Table 5.2.8 Estada Velha para Boane (evb) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Bifacially flaked pieces	3	1.85	2	1.23
Flakes longer than 100mm	2	2.3	2	1.23
Cores	1	0.6	6	3.7
Small flakes	12	7.4	134	82.7
TOTAL	18	11.1	144	88.9

Table 5.2.9 Description of large bifacial pieces (5 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
evb190	rhyolite	235	154	93	2350	Handaxe	flaked	in situ
evb191	rhyolite	192	125	81	2050	Handaxe	flaked	surface
evb194	rhyolite	166	102	42	725	Cleaver	flaked	surface
evb196	rhyolite	147	103	53	650	Cleaver	flaked	in situ
evb198	rhyolite	122	71	48	370	Handaxe	flaked	surface
<b>Mean</b>		172.4	111	63	1229			
<b>SD</b>		43.4	30.8	22.3	902.5			

Half of the handaxes are produced on cobbles, and the other half on large flakes. The artifacts present distinct stages of weathering but the two found at the surface are abraded, making it almost impossible to "retrieve" the technological information from these pieces. One of the cleavers found is presented in Fig. 5.2.11.

Table 5.2. 10 Large flake description (4 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
evb192	rhyolite	91	152	49	620	V	side-located bulb in relation to the axis of the flake
evb193	rhyolite	112	180	32	700	V	side-located bulb in relation to the axis of the flake
evb195	rhyolite	145	103	43	560	V	end-located bulb in relation to the axis of the flake
evb197	rhyolite	118	97	43	350	V	end-located bulb in relation to the axis of the flake
<b>Mean</b>		117	133	42	558		
<b>SD</b>		22.3	39.9	7.1	149.5		

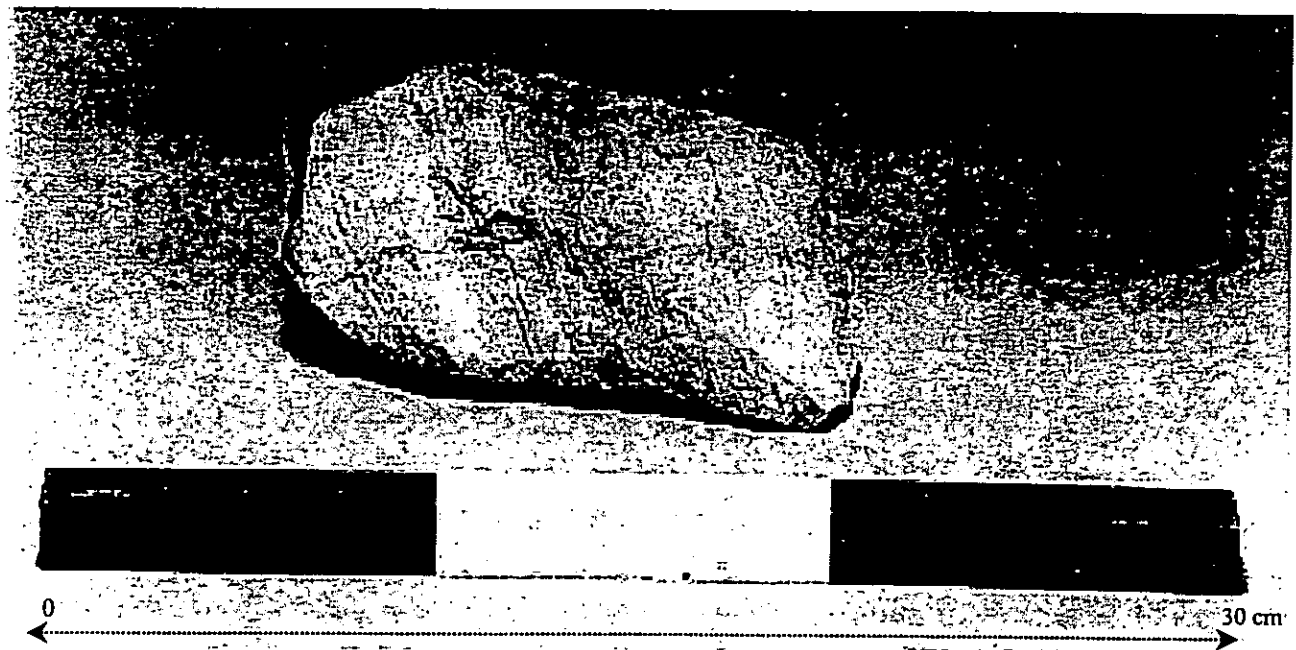


Fig. 5.2.11 Cleaver produced on a flake of laminated rhyolite (note the "holes" on the tool surface resulting from the erosion of phenocrysts present in the rhyolite) - Estrada Velha para Boane site, southern Mozambique

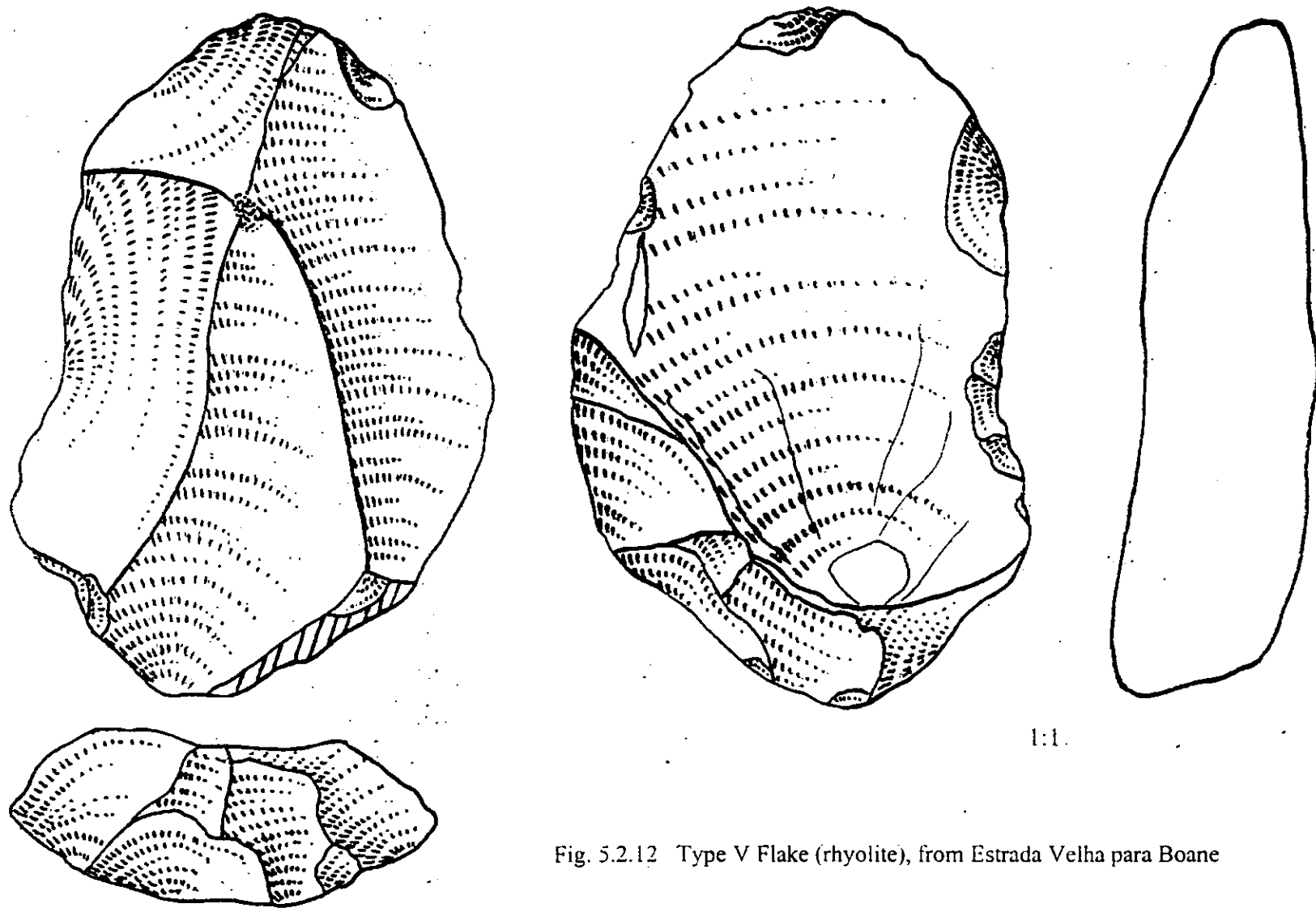


Fig. 5.2.12 Type V Flake (rhyolite), from Estrada Velha para Boane

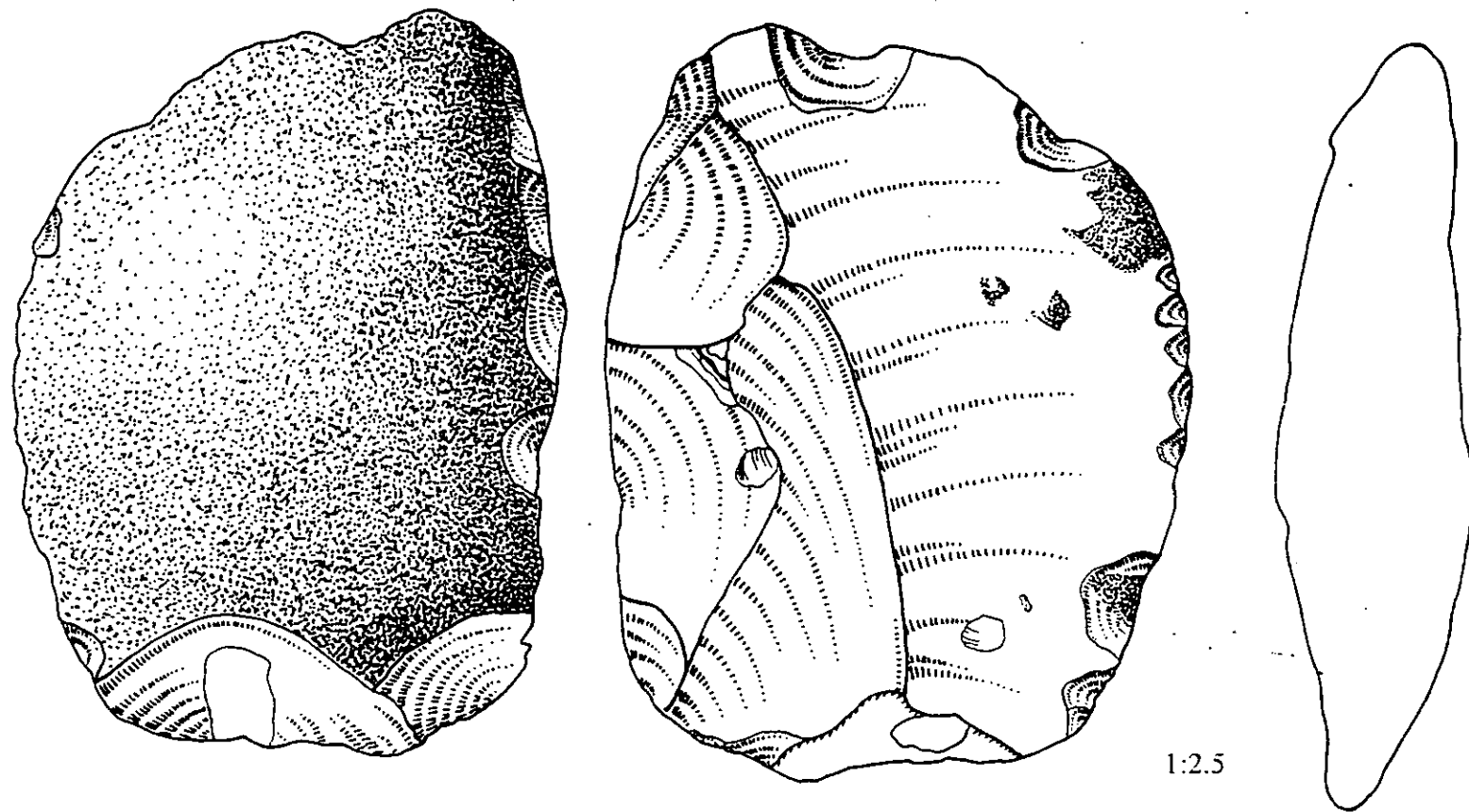


Fig. 5.2.13 Large flake on rhyolite (Type V), presenting with some retouch on the ventral side. Estrada Velha para Boane

All of the large flakes found indicate the presence of advanced stage of flake production at this site (stage V by Toth's scheme). However, some of them are quite big (e.g., evb195), suggesting that they had been removed from very large cores; nonetheless, on the overall the flakes are too small and thin to have been used as blanks for the manufacture of large bifacial pieces. Figs. 5.2.12 and 5.2.13 represent two large flakes from this site.

#### **5.2.4.5 The paleogeographical context**

The depositional record present at this site indicates that major fluvial activity occurred throughout the sequence; the deposition of gravel and cobble conglomeratic units is a clear indicator of a high-energy environment present at the time of deposition of these beds.

### **5.2.5 Umpala**

#### **5.2.5.1 The site**

This site is located on the southern side of Umbeluzi River, northwest of the site of Estrada Velha para Boane. Reports about this locality date back to the 1960's, when Barradas surveyed the area and recorded the presence of ESA artifacts. A preliminary surface collection was then gathered. This site is located on an old terrace of the Umbeluzi River, dated by Barradas as of the "Younger Gravels" (1955b, 1961a, 1966). A partial view of the excavation is presented in Fig. 5.2.14.

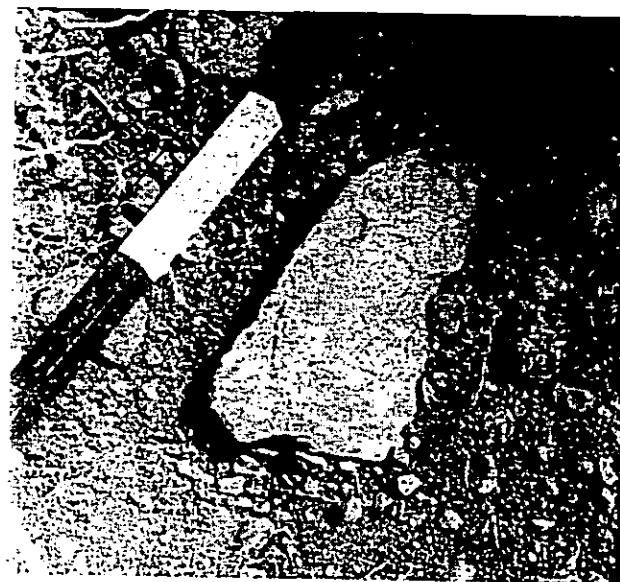


Fig. 5.2.14 View of the excavation performed at Umpala site, southern Mozambique. The picture on the right shows a cleaver found during the excavation:

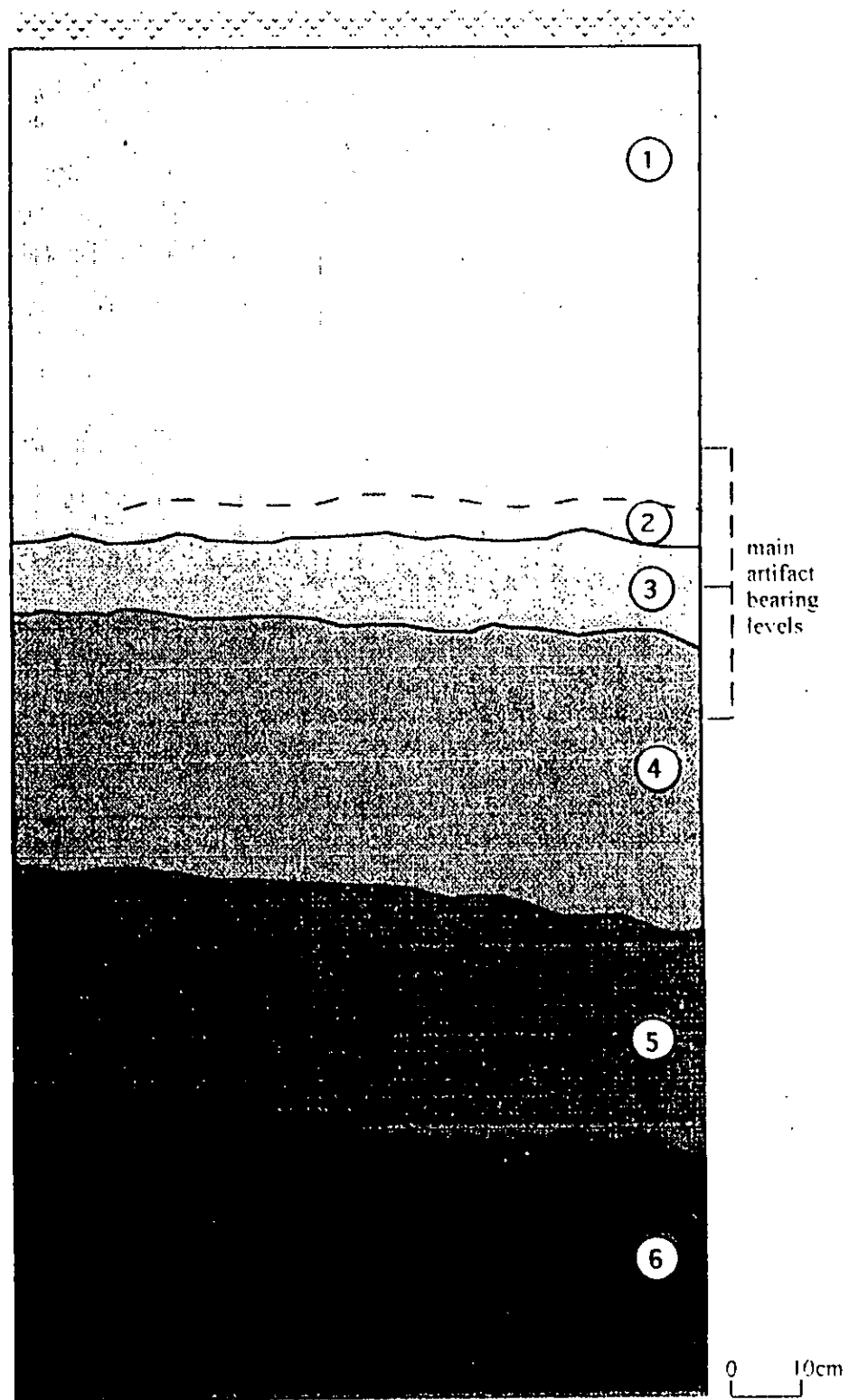


Fig. 5.2.15 Excavation of Umpala site: profile of the east wall



### 5.2.5.2 The geological context

The deposits in this locality, as in Estrada Velha Para Boane formed an almost vertical sequence of about 150 centimeters thick (see Fig. 5.2.15).

- 1) Coarse brownish sand-clayey level (7.5 YR 4/4), with few MSA artifacts throughout.
- 2) Conglomeratic (small size pebbles) level, cemented by clayish sand (7.5 YR 4/3).

Sterile.

- 3) Coarse brown clay, very compact (7.5 YR 4/3).
- 4) Artifact bearing level, about 40 centimeters thick, formed by very compact conglomerate, cemented by brownish sandy clays (7.5 YR 4/3).

From bottom to the top of these last four units it is possible to observe the presence of yellowish red clay patches (5 YR 4/6) (ferricrets?), similar to the situation observed at Buraco.

- 5) Gravel bed mixed with coarse reddish yellow sands (5 YR 6/8), about 35 to 40 centimeters thick.

- 6) A clayish conglomeratic bed, devoid of artifacts (7.5 YR 4/3).

### 5.2.5.3 The excavation procedures

A three-meter by one-meter trench was opened at the place where the bifacially flaked pieces were eroding from (see Fig. 5.2.16 illustrating the excavation).

The excavation revealed a thick coarse sandy level, of about 90 centimeters thick, underlain by two sterile horizons. Some small flakes occurred throughout the upper part of the unit. The sterile horizons are about 20 centimeters thick. Below we found the main artifact-bearing horizon, of conglomeratic origin. The four handaxes laying on the lower surface of the hill had eroded from the upper part of this level. The excavation revealed some more handaxes,

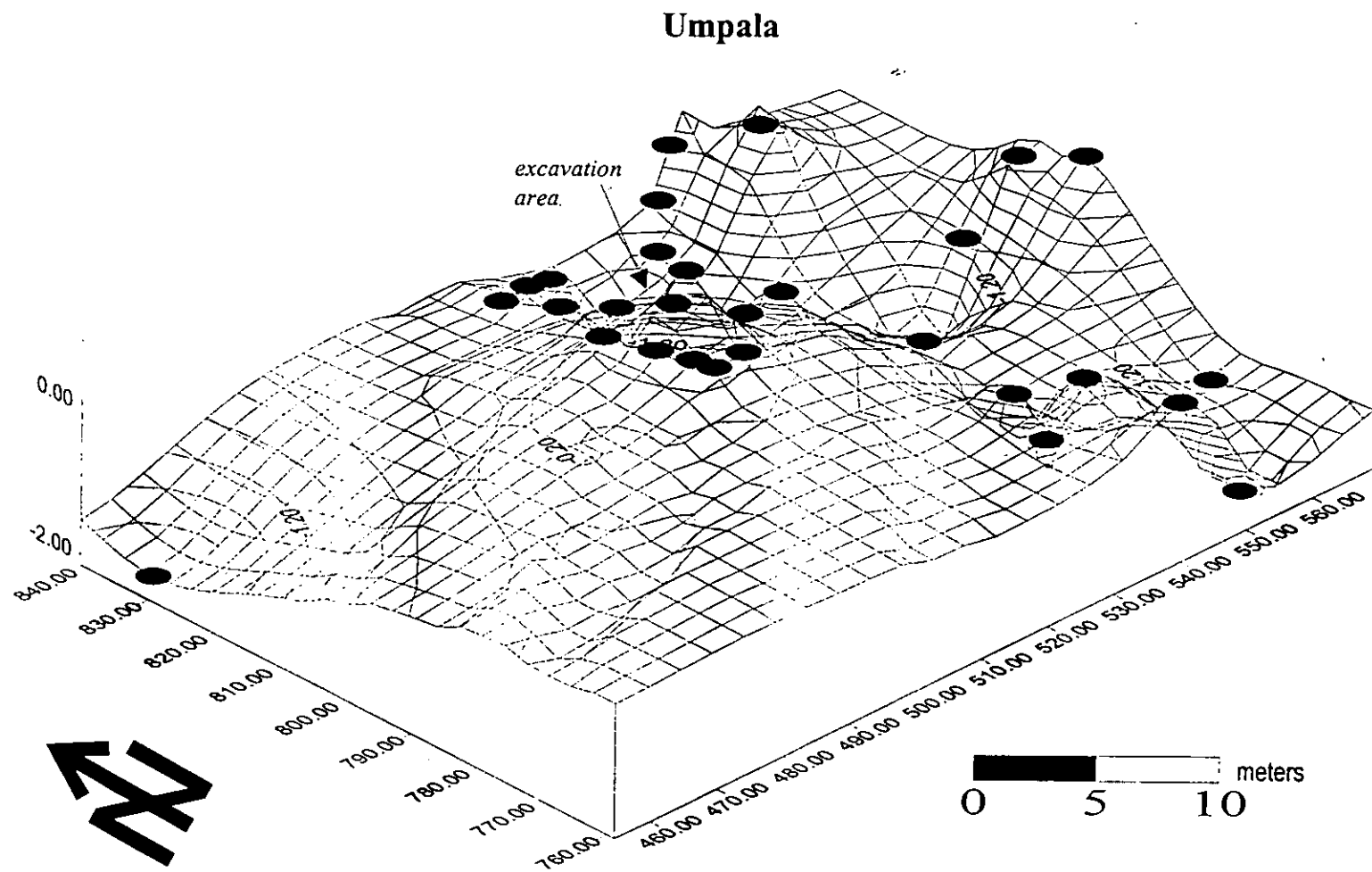


Fig. 5.2.16 View of Umpala site (3 x 1 meters excavation). The dark circles refer to the points where measurements were taken.

together with small cores, two choppers and a mass of small size flakes. As in the previous sites, the artifacts were not oriented in any particular direction and, with very few exceptions, were in fresh condition. However, due to the indurated nature of the sandy clays cementing this unit, it was impossible to proceed with a careful excavation, and the work proceeded with the help of picks and shovels.

We continued the excavation in ten or 20-centimeters spits down to about 1.60-1.70 meters, when we reached a horizon similar of Estrada Velha para Boane, with a strong component of clay in its sediments. At this point (about 1.90 centimeters deep), due to the extremely hard and consolidate substrate and lack of archaeological material, the excavation was stopped.

Two additional steps were excavated to expose a larger stratigraphic section, which seems to be in fact similar to the one present for Estrada Velha para Boane. Here, no artifacts were found, although the screening of the surface scrape led to the finding of some small flakes.

#### **5.2.5.4 The artifact inventory**

Overall, the subdivision of artifacts on the basis of physical condition as suggested by Barradas (1961b) is not usually desirable, but in the material under review there is such a contrast between the mint-fresh series and the rolled and weather specimens.

Table 5.2.11 Umpala (ump) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Bifacial knapped pieces	4	5.6	4	5.5
Flakes longer than 100mm	1	1.4	1	1.4
Hammerstones	-	-	2	2.8
Cores	-	-	4	5.5
Chopper	-	-	2	2.8
Small flakes	5	6.9	49	68.1
TOTAL	10	13.9	62	86.1

The series of artifacts retrieved at this site comprise 72 pieces, of which 12 were measured in detail. The raw material used to manufacture the pieces is rhyolite, quartzite and quartz.

Table 5.2.12 Description of large bifacial pieces (8 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
ump210	rhyolite	145	91	44	620	Cleaver	flaked	in situ
umo211	rhyolite	170	84	38	510	Cleaver	flaked	in situ
ump214	rhyolite	128	94	47	470	Cleaver	flaked	surface
umo215	rhyolite	166	110	91	1380	Handaxe	cortex	surface
ump216	rhyolite	142	93	59	805	Cleaver	flaked	surface
ump217	quartzite	133	88	51	560	Handaxe	flaked	surface
ump218	rhyolite	158	85	61	565	Handaxe	flaked	in situ
						failure? / core?		
ump219	rhyolite	153	104	49	800	Cleaver	flaked	in situ
<b>Mean</b>		149	94	55	714			
<b>SD</b>		15.1	9.1	16.4	296.4			

Fig. 5.2.17 illustrates one of the pieces collected and studied from this site. The study of these artifacts revealed that handaxes were exclusively made on cobbles. The cleavers represent the majority (71.4%; n=4) of the large pieces found. However, among them, two are in fact uniface, i.e., cleavers made on carefully prepared flakes, where the bevel edge is formed by the intersection of the cortex (dorsal) surface with the ventral surface of the flake, without any further flaking.

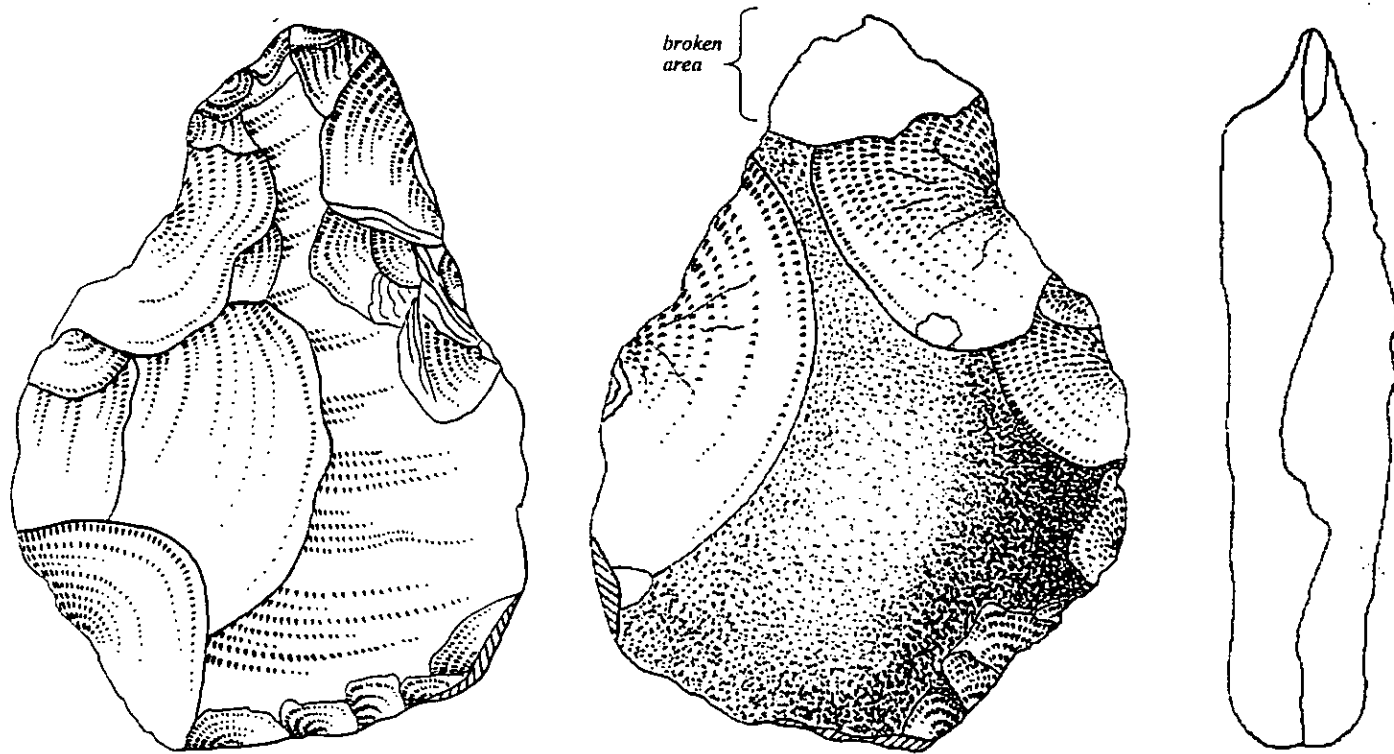


Fig. 5.2.17 Handaxe on a rhyolite split cobble (Umpala site)

1:2

Table 5.2.13 Large flake description (2 pieces – see Figs. 5.2.18 and 5.2.19)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
ump220	rhyolite	143	89	48	430	IV	end-located bulb in relation to the axis of the flake
ump221	rhyolite	134	88	48	350	II	end-located bulb in relation to the axis of the flake
<b>Mean</b>		139	89	48	390		
<b>SD</b>		6.4	0.7	-	56.57		

Finally, two damaged hammerstone were recovered at this site. One is made on basalt and the other using rhyolite. Their weigh averages 300 grams. The basalt cobble measuring 97 x 92 x 41 millimeters have pitted hollows, on both lower and upper surfaces. On one side the pitting is shallow and dispersed over an area of about square five square centimeters, whilst on the opposite side it consists of a single pecked hollow three centimeters in diameter and three millimeters deep. The other rhyolite hammerstone is slightly larger (110 x 83 x 47 millimeters). It presents small hollows very irregular, and is broken in one side.

#### 5.2.5.5 The paleogeographical context

Geomorphologically, the sequence present has been interpreted as reworked terraces of the Umbeluzi River. Natural erosion and the opening of the railways and roads have partially reduced the covering beds, but an appreciable amount of overburden has still to be removed before the artifact bearing level was reached.

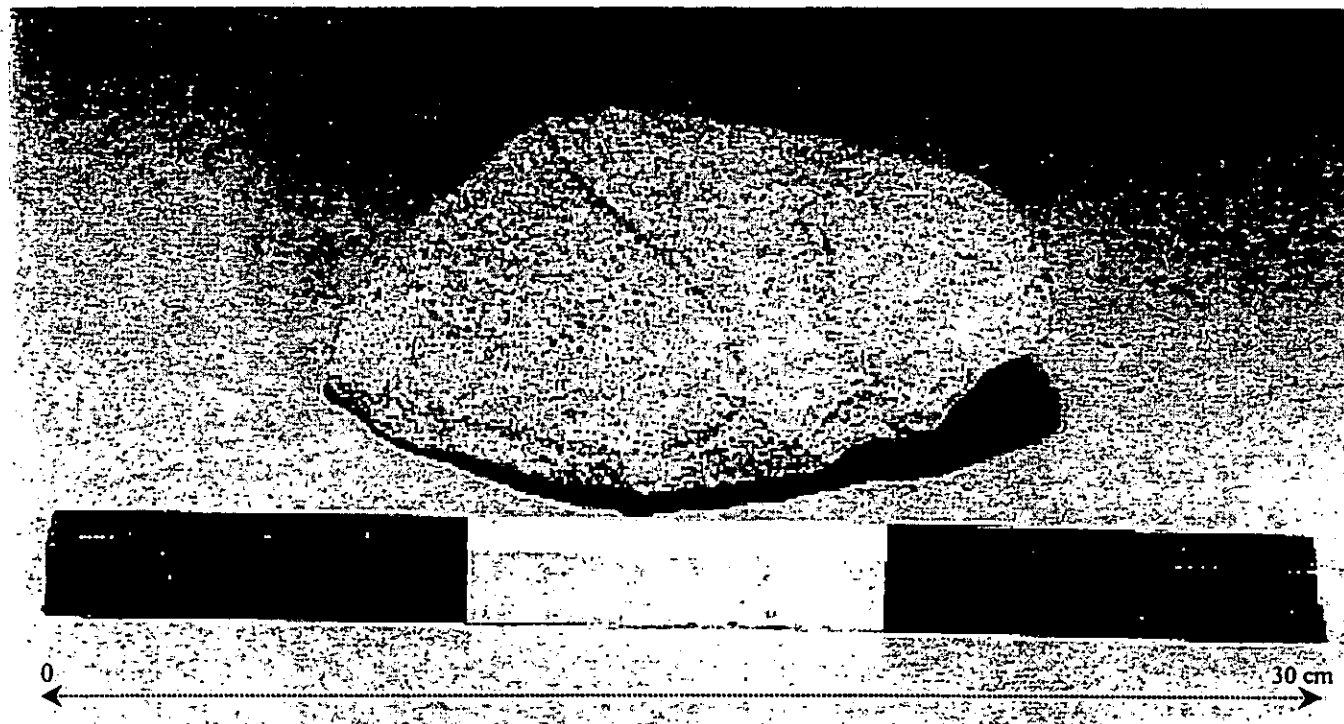


Fig. 5.2.18 Lower (ventral) side of a large prehistoric rhyolite flake (Type II). The fact that large flakes are sometimes found together with handaxes and cleavers in the excavated assemblages indicates that a selective process of choice of blanks occurred (Umpala site, southern Mozambique)

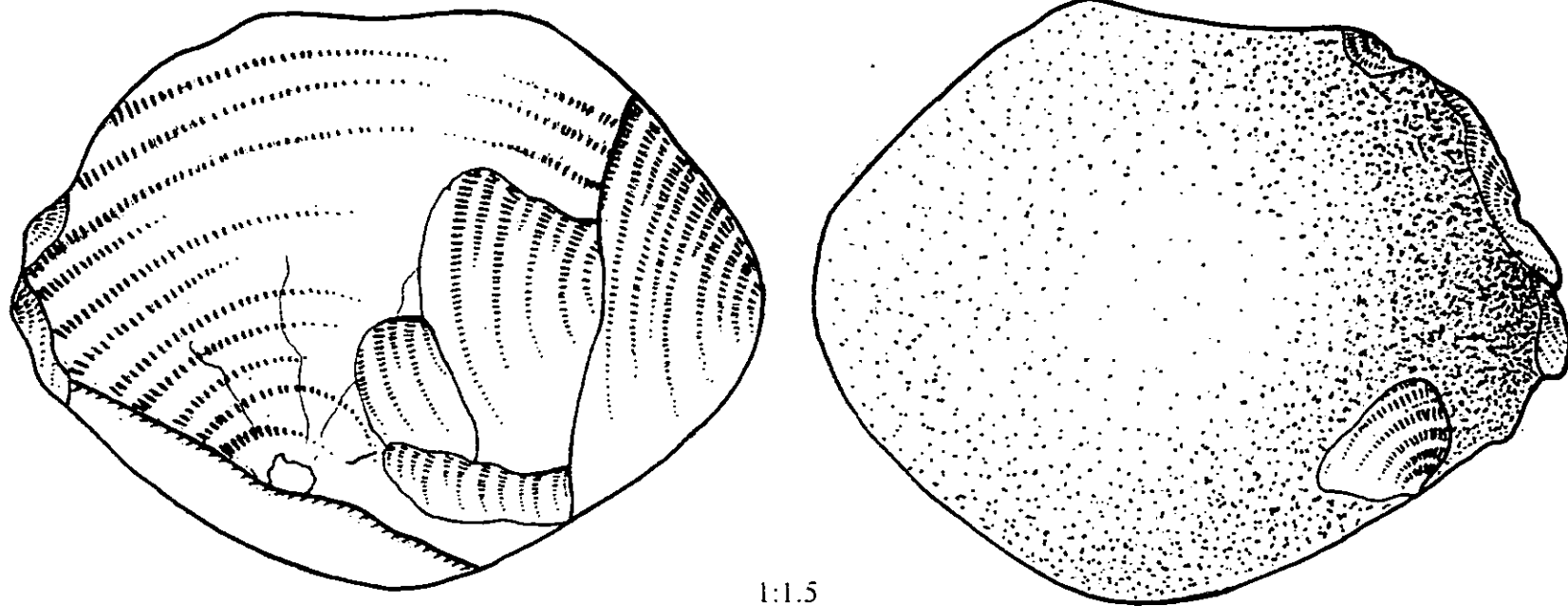


Fig. 5.2.19 Rhyolite flake (Type IV) from Mahelane site, southern Mozambique



## 5.2.6 Mahelane

### 5.2.6.1 The site

This site is located close to a stream and was found due to roadwork carried on in the area. The artifacts were recovered from an area where the streambed curved to the southeast and it seems likely that they accumulated at the bend (see Fig. 5.2.20). Although I made a previous reference to the composition of the conglomerates of the Umbeluzi River, here too, the conglomeratic bed consists of large pebbles and cobbles of rhyolite and basalt, with a small amount of quartz. Artifacts were recovered from within the conglomerate. They are quite fresh, with the pieces recovered from the surface showing, however, some abrasion.

### 5.2.6.2 The geological context

The excavation exposed the following stratigraphic sequence (see Fig 5.2.21):

- 1) Fine angular gravels mixed with coarse dark brown sands (10 YR 3/3). Some large rhyolite and basalt cobbles were found spread through this level.
- 2) Level composed of large angular gravels, grayish brown, very dark, also devoid of artifacts (10 YR 3/2). It is a discontinuous level.
- 3) Artifact bearing horizon, formed by rhyolite slabs and gravels, resulting from the erosion of the underlying rhyolite bedrock (2.5 YR 3/3, i.e., dark reddish brown). This level is about 40 to 60 centimeters thick. Here too, large nodules (about 35 to 60 centimeters long) of calcium carbonate were found, suggesting a shift towards a drier environment. Large stains of manganese were also observed in this unit.
- 4) Bedrock, rhyolite (2.5 YR 3/6, dark reddish).

# Mahelane

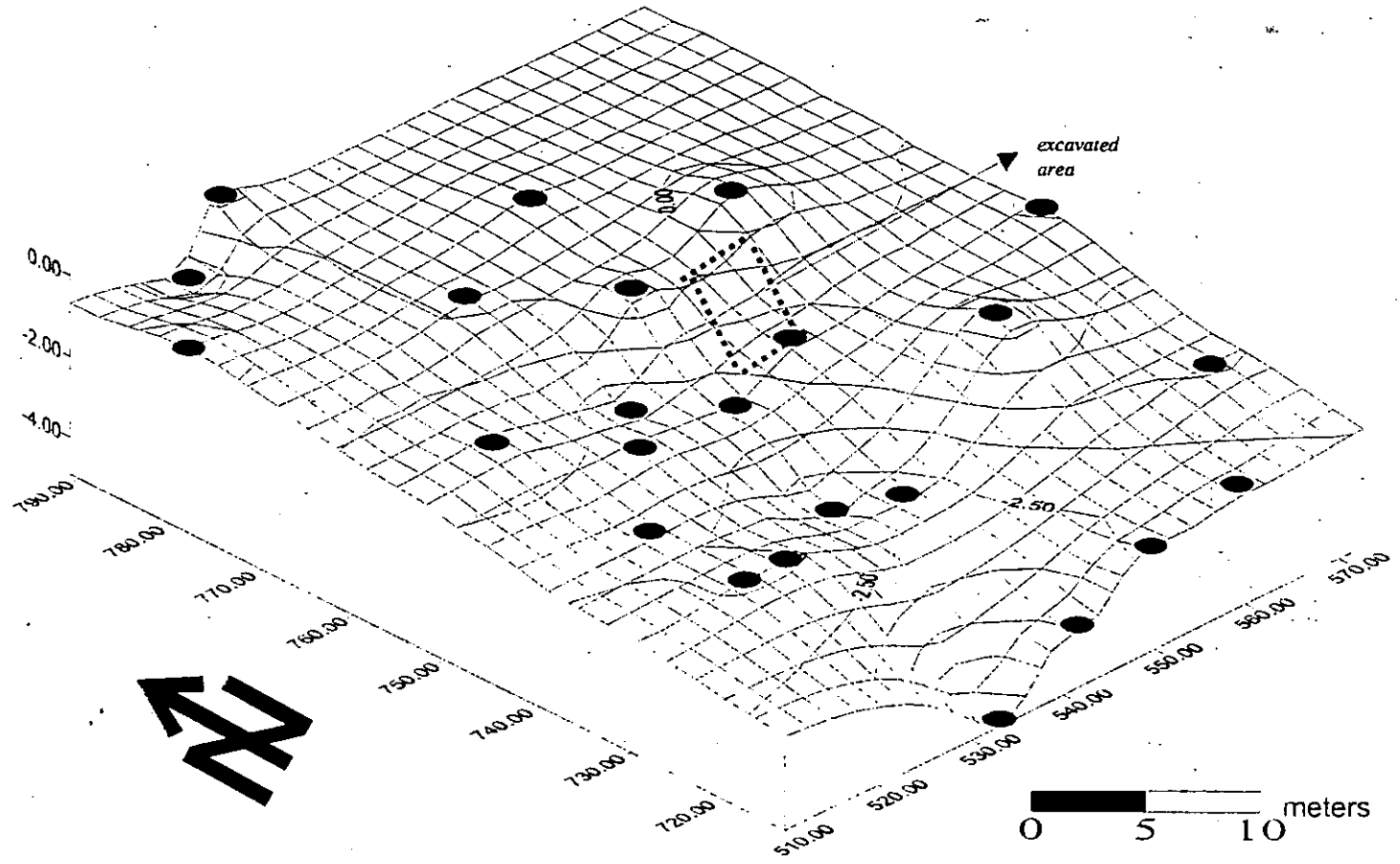


Fig. 5.2.20 Mahelane site - view of the excavated area (2 x 3 meters excavation)

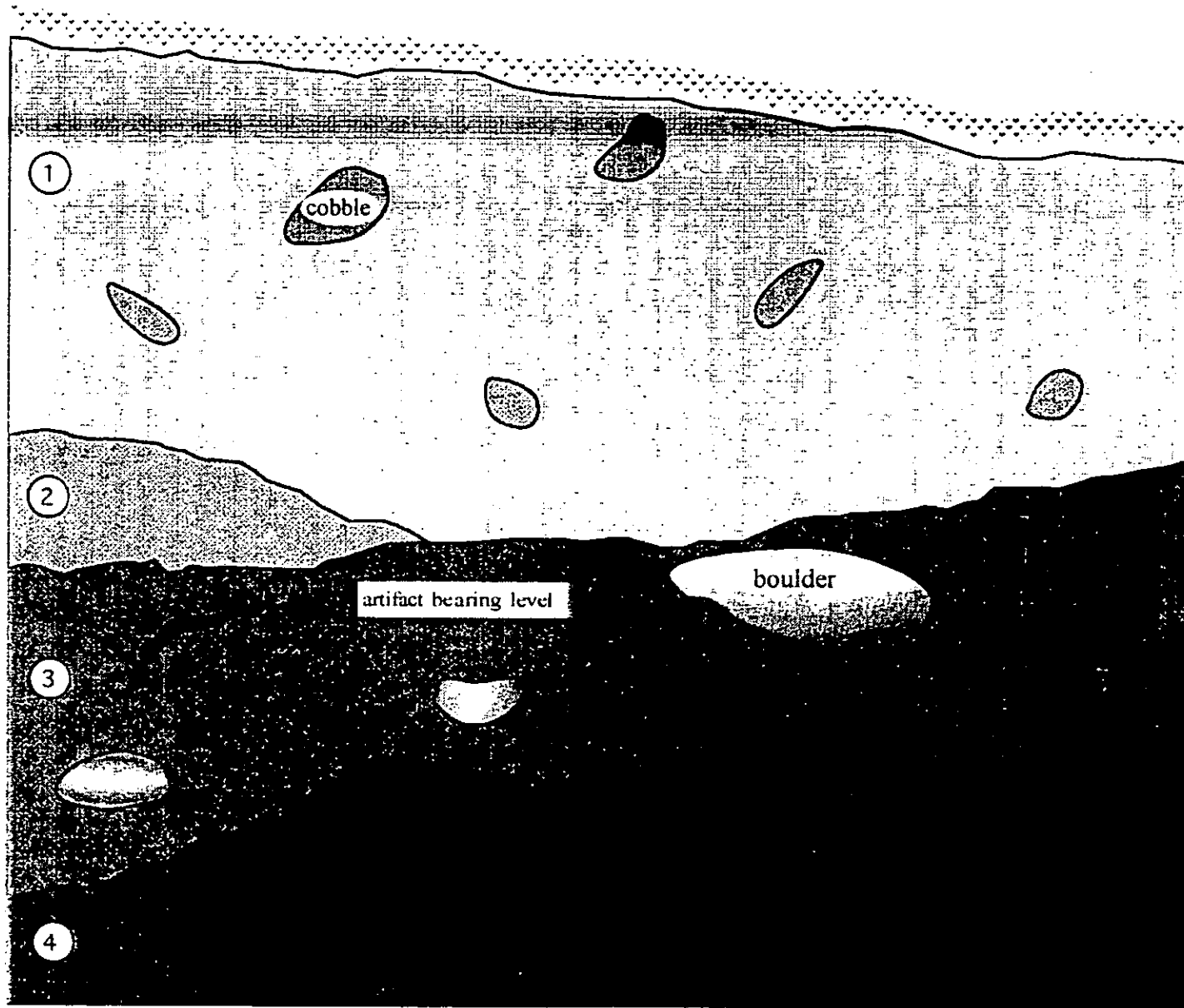


Fig. 5.2.21

Mahelane  
excavation:  
northeastern  
wall

0 10cm

### 5.2.6.3 The excavation procedures

A two-meter by three-meter surface grid was set out, once again where several slightly abraded artifacts were seen on the conglomeratic surface adjacent to the modern stream. A total of five artifacts (including two bifacially worked pieces and two large flakes) were found on the surface; further, two fresh flakes were recovered from the surface scrape.

As described previously, the excavation proceeded by spits, of ten centimeters intervals. However, the first two stratigraphic levels were sterile in terms of artifacts or fossil fauna. The remaining artifacts were collected from the top 20-centimeter of the artifact-bearing horizon. The excavation proceeded until about 1.50 meter deep when the bedrock was reached, but no more artifacts were found.

### 5.2.6.4 The artifact assemblage

At Mahelane, very few artifacts were found; the assemblage consists of 17 lithic objects, of which eight were studied. The lithic artifacts were produced using rhyolite and basalt as raw materials.

Table 5.2.14 Mahelane (mah) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Hand axe	2	11.8	4	23.5
Flake, long-handled 100mm	2	11.8	1	5.9
Small flakes	3	17.6	5	29.4
TOTAL	7	41.2	10	58.8

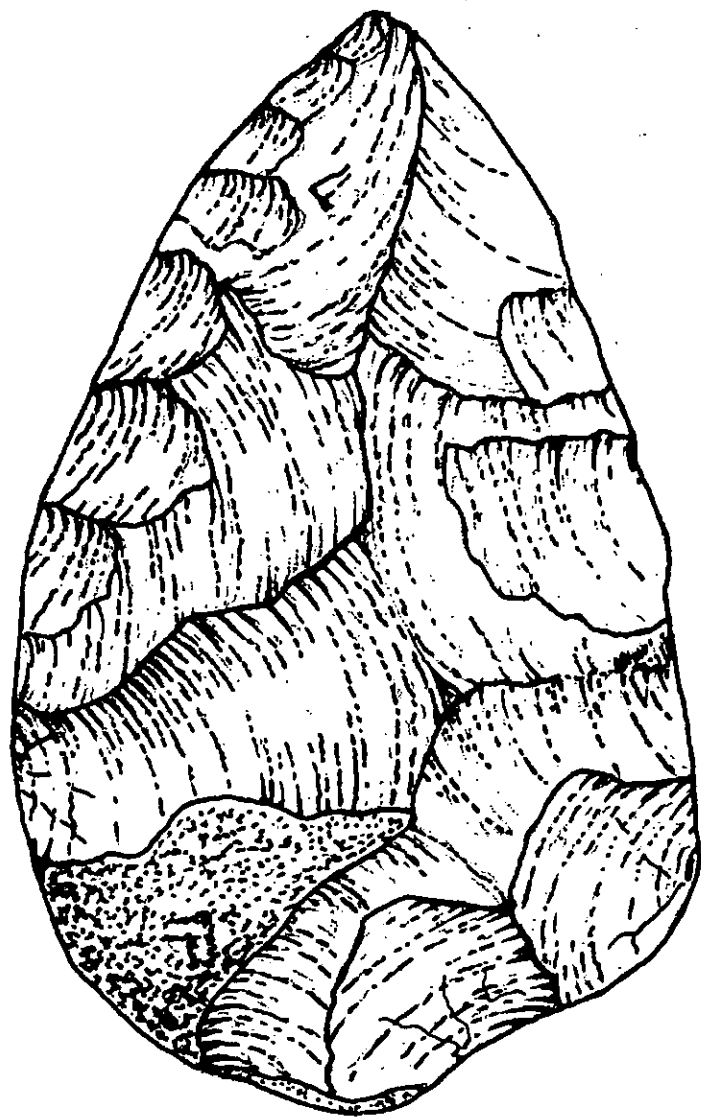
Table 5.2.15 Description of large bifacial pieces (6 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
mah222	rhyolite	119	82	55	260	Handaxe or core?	flaked	in situ
mah223	rhyolite	150	88	42	620	Handaxe	flaked	in situ
mah225	rhyolite	132	74	31	325	Cleaver	flaked	in situ
mah226	rhyolite	121	82	44	270	Cleaver	flaked	in situ
mah228	rhyolite	170	108	78	1150	Handaxe or core?	flaked	surface
mah229	rhyolite	150	90	53	670	Cleaver	flaked	surface
<b>Mean</b>		140	87	51	549			
<b>SD</b>		19.8	11.6	15.9	344.2			

The large bifacially knapped pieces were manufactured exclusively using rhyolite. Half of the sample is composed of cleavers; the remaining 50% were morphologically similar to handaxes. However, in one case, it may represent a core, since very few flakes were removed, and several platforms were still present. An example of a handaxe produced using a cobble as a blank is presented in Fig. 5.2.22. Fig. 5.2.23 represents a handaxe produced using a flake as a blank.

Table 5.2.16 Large flake description (4 pieces)

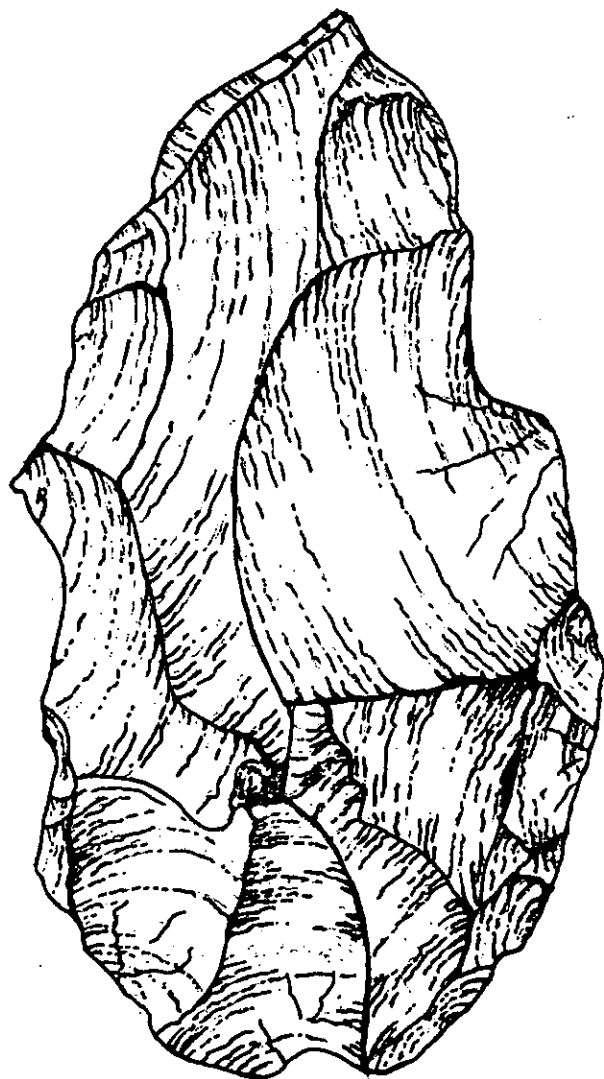
Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
mah224	rhyolite	165	88	37	400	V	end-located bulb in relation to the axis of the flake
mah227	rhyolite	124	83	48	420	IV	snapped flake
mah230	rhyolite	162	140	58	1275	IV	end-located bulb in relation to the axis of the flake
<b>Mean</b>		150	104	48	698		
<b>SD</b>		22.9	31.6	10.5	499.5		



1:1



Fig. 5.2.22 Handaxe produced using a rhyolite flake as a blank (Mahelane site, southern Mozambique). The tool evidences the use of hard and soft hammer direct percussion techniques



1:2.5

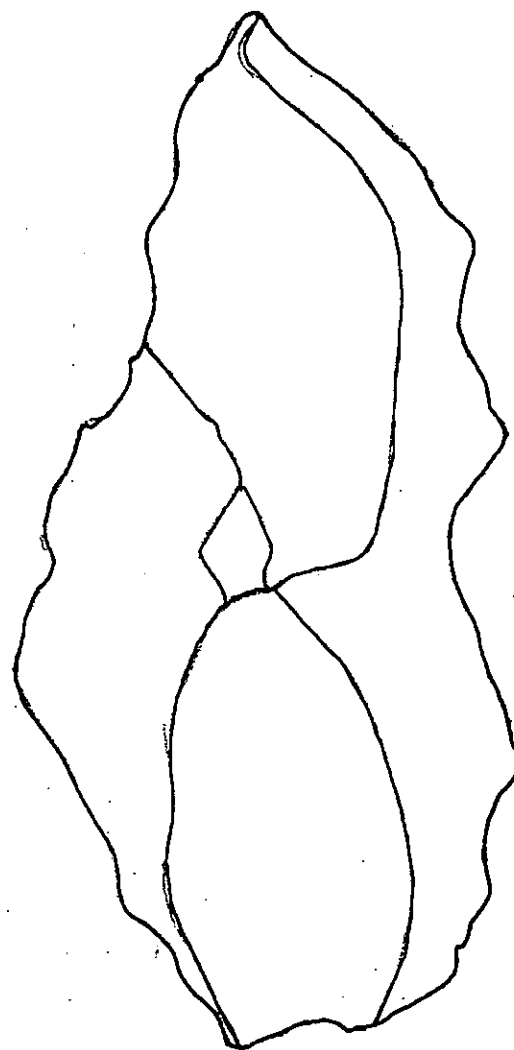


Fig. 5.2.23 Handaxe on rhyolite, knapped using a hard hammer direct percussion technique (Mahelane)

The flakes represent secondary stages of core reduction. They are smaller and normally thinner than the average handaxe size (see Fig. 5.2.24). Among the overall flake collection most of them (83%) are broken (split or snapped flakes).

#### 5.2.6.5 The paleogeographical context

This site consists of a small channel marked by a spread of conglomerate approximately three meter wide extending from up from the Umbeluzi River. However, this site is located in the inter-Libombos mountains plains, and the geological context is distinct from the previous sites on the Umbeluzi River. Here, the sediments contain basalt cobbles. The base of the channel, beneath the artifact-bearing conglomerate, is a conglomeratic clay of red color (see previously referred Fig. 5.2.21 representing the stratigraphic sequence identified at this location).

In general the channel is aligned northwest southeast draining southeast into the Umbeluzi River.

#### 5.2.7 The Chagalane area: Cardiga, Canhoeiro and Caimane

The existence of several Acheulean sites in the Upland Division (of which the Chagalane River area is part of) was mentioned several researchers (e.g., Dias, 1947, Barradas, 1964, Jonsson, 1983).

The first archaeological work in this area was carried out during the 1940's by Bettencourt Dias. His excavations consisted of two main trenches, two by six meters. There, several artifact bearing levels were found, containing mainly flakes and cores typologically ascribed to the MSA. Only a couple of handaxes and cleavers were found during this excavation. In the 1980's two other excavations were undertaken at two rock shelters previously located also



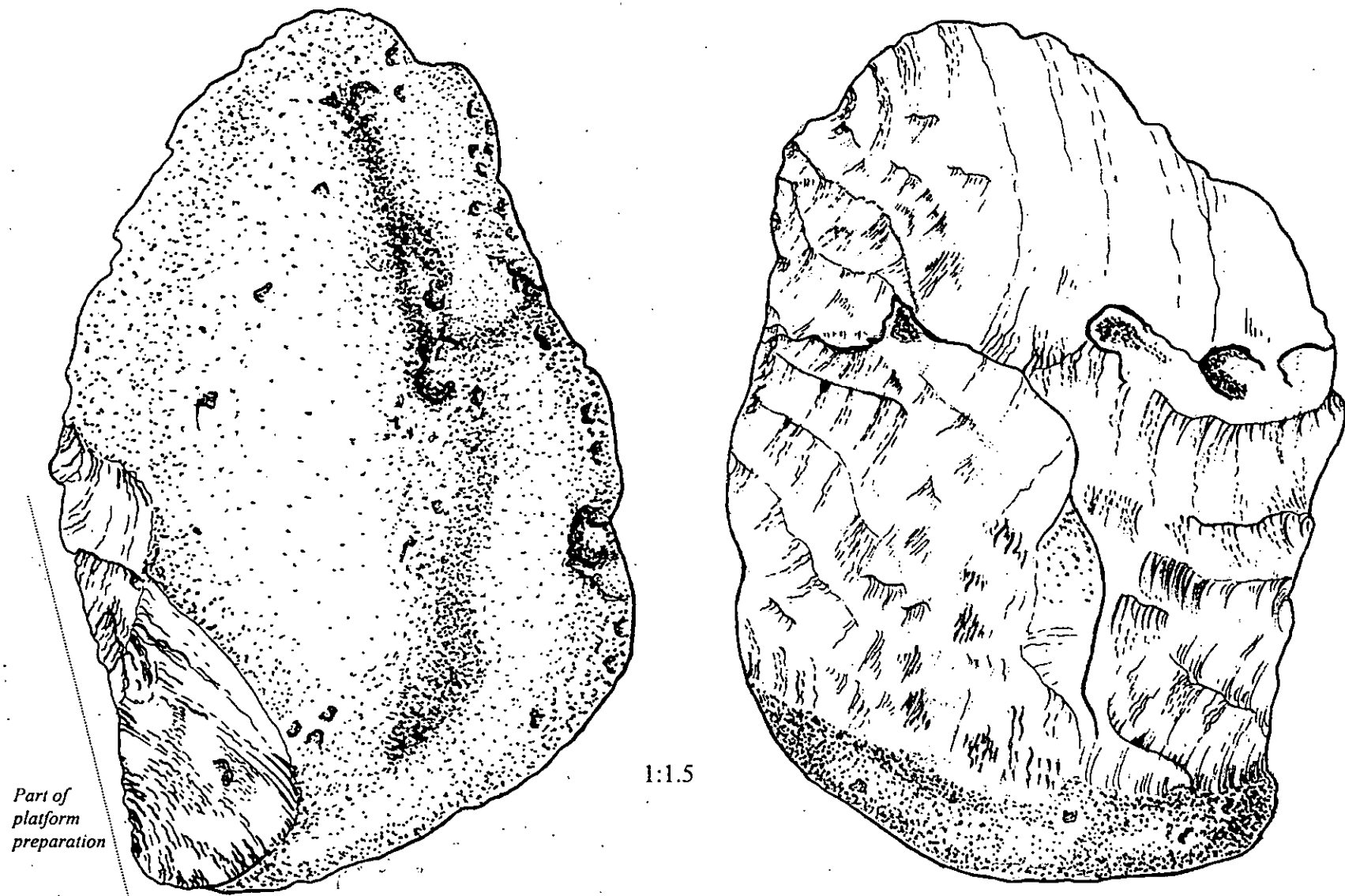


Fig. 5.2.24 Large cortical flake on rhyolite (Type IV), Mahelane site

by Dias in the mid slopes of the Grande Libombos Mountains, along the Changanane River (Jonsson, 1983, Morais, 1984). In 1995-1996 a research team under my supervision carried more extensive excavations.

#### **5.2.7.1 Location of the Cardiga and Canhoeiro sites**

More specifically, and in relation to Cardiga and Canhoeiro sites, in the course of exploring the Changanane area in the early 1940's, Bettencourt Dias noted a number of stone artifacts eroding from the red sands at a locality in the northern margin of the Changanane River, near to the locality of Changanane.

Although the place excavated by Bettencourt Dias was removed due to some construction work, a survey of the river margins led to the identification of two concentrations of lithic artifacts -- Cardiga and Canhoeiro. These sites are located about a kilometer apart from each other, on the upper terraces of the Changanane River. The area where these sites were found represents a natural port from the eastern coastal area to the interior of Southern Africa, crossing the Libombos Mountains. A description and an evaluation of these "natural ports" will be discussed in more detail in Chapter VIII.

##### **5.2.7.1.1 The geological context of Cardiga site**

The deposits in which the artifacts occurred consisted of small pebbles filling a stream channel.

The stratigraphic sequence found is as follows (from the bottom to the top – see Fig. 5.2.25):

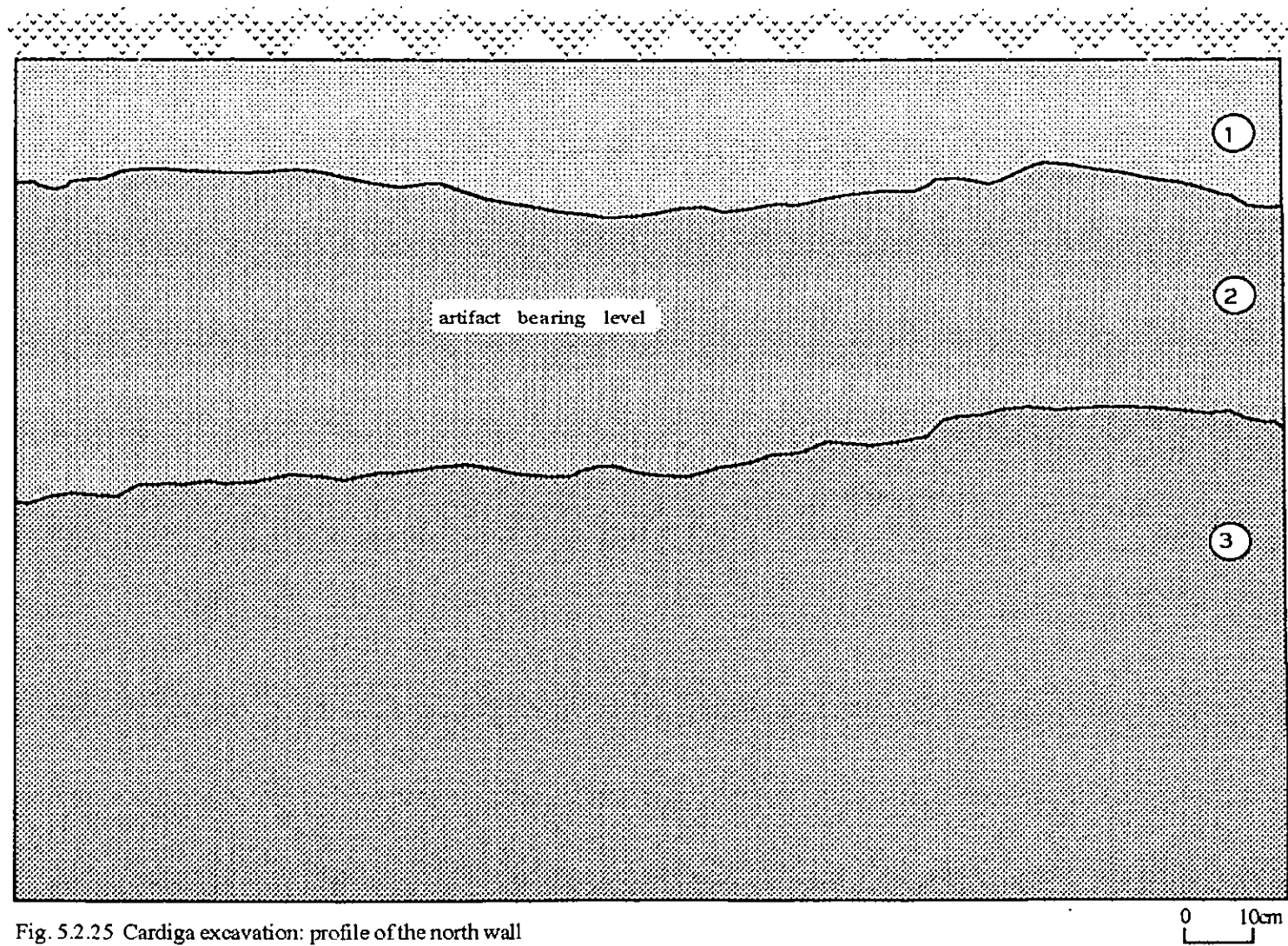


Fig. 5.2.25 Cardiga excavation: profile of the north wall

1) Coarse sandy-clayey level (5 YR 3/3 - dark reddish brown), with manganese stains, pebbly towards the base. This unit is about 20-30 centimeters thick.

2) Dark reddish brown clay (2.5 YR 3/4), with small quartz pebbles. Ferruginous streaks. About 50-60 centimeters thick.

3) Compact dark red clay (2.5 YR 3/6), with small angular fragments of quartz.

#### 5.2.7.1.2 The excavation details

At Cardiga, a two-meter by two-meter grid was set out on the upper bank of the Changalane River (see Fig. 5.2.26). Together with two cleavers, a handaxe and some flakes, the scatter contained on the top several hundreds of small pebbles and rhyolite angular pieces, all of which appeared to be of natural origin. The excavation proceeded as described above for the other sites. However, the two initial stratigraphic units were sterile (about 0.80 meters deep). Only after digging through a heavy sandy-clayey bed and another sterile bed composed essentially of clay, it became possible to reach the artifact bearing level. Here, the artifacts were dispersing through a horizon of about 20 centimeters thickness. This unit yielded one large flake and bifacially worked artifacts, together with some smaller flakes and cores. It is interesting to note that in the Changalane River area were found more cleavers than in the Umbeluzi River area. The excavation proceeded until about 1.50 meters deep, but no more artifacts were found, either on the excavation or on the screening.

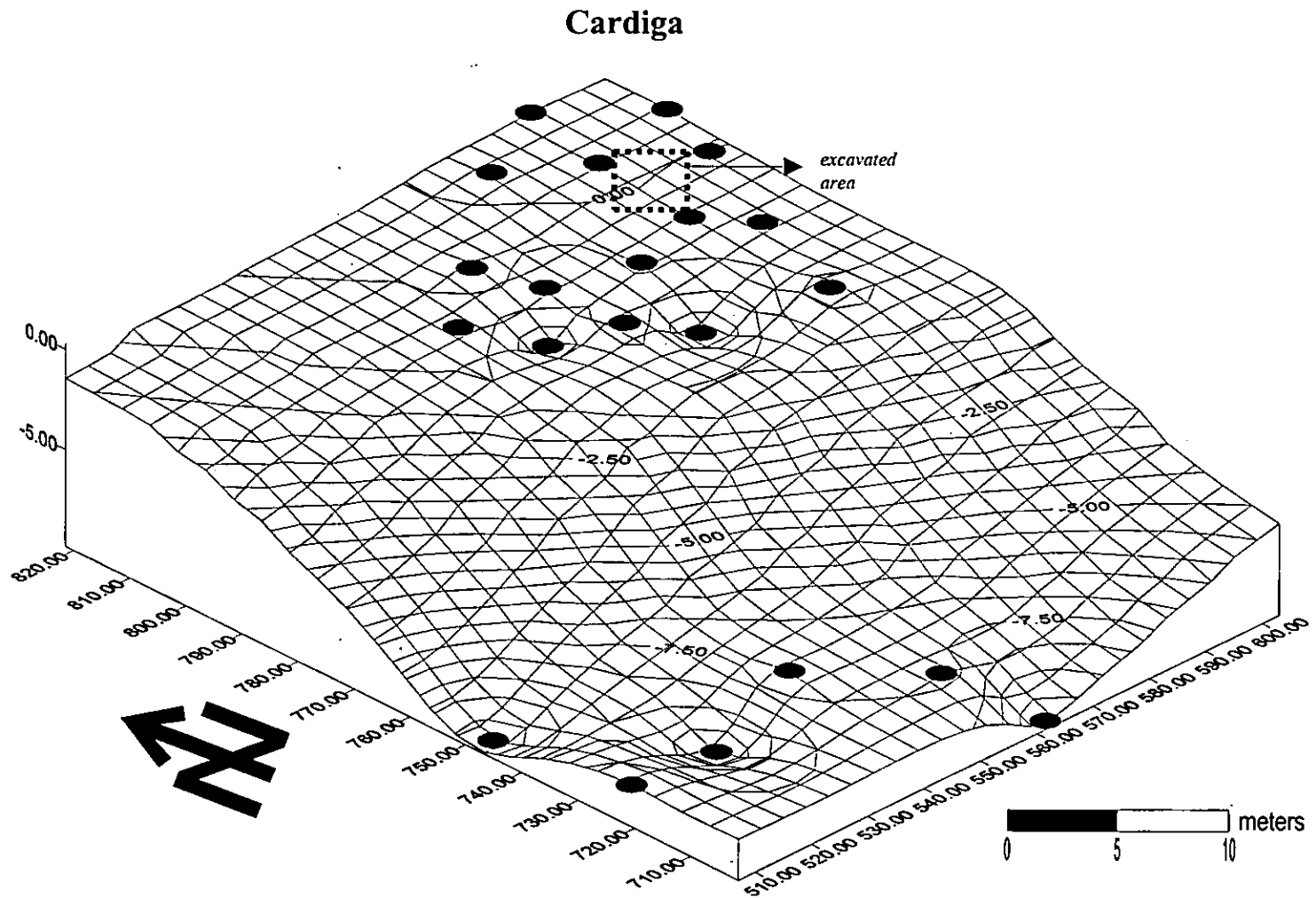


Fig. 5.2.26 Cardiga site - view of the excavated area

### 5.2.7.1.3 The artifact inventory

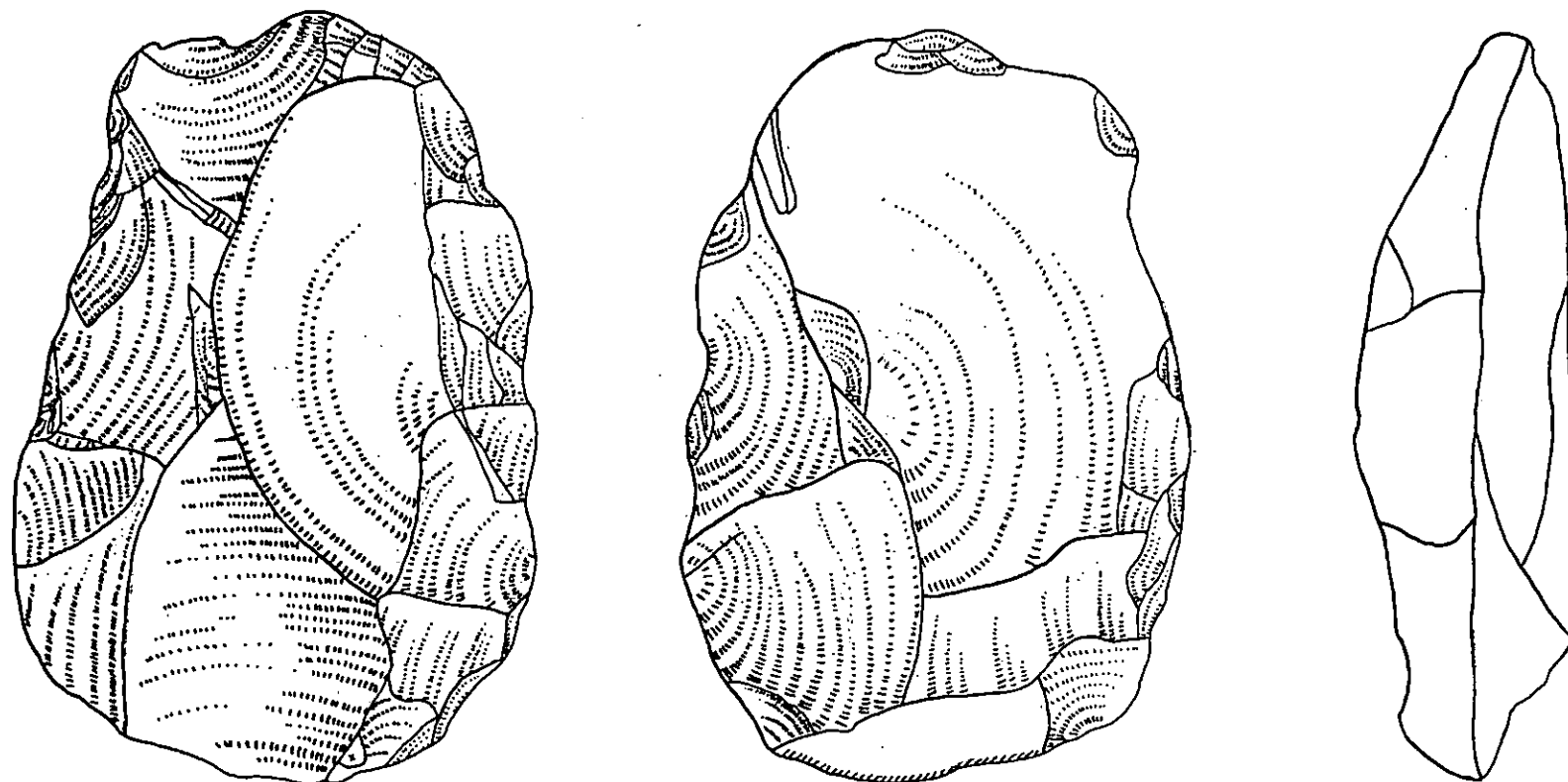
The lithic assemblage is composed of 48 pieces; the predominant raw material is rhyolite, but there is also a small number of flakes made on quartzite.

Table 5.2.17 Cardiga (car) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Bifacially knapped pieces	3	6.3	5	10.4
Flakes longer than 100 mm			1	2.1
Hammerstone			1	2.1
Cores	-	-	2	4.2
Small flakes	5	10.4	32	64.5
TOTAL	8	16.7	40	83.3

The cleavers represent 87.5% of the bifacial artifacts. One of them, pictured in Fig. 5.2.27 is made on a Kombewa flake (for an understanding of the concept of Kombewa technique, please refer to Chapter VI). Regarding the handaxe, it is made, similarly to Mahelane site, using a split cobble as a blank. The piece recovered is presented in Fig. 5.2.28.

One of the cleavers found on the surface is very weathered and abraded. The other two bifacially worked pieces are in mint condition.



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Fig. 5.2.27 Rhyolite cleaver on a Kombewa flake (Cardiga site)

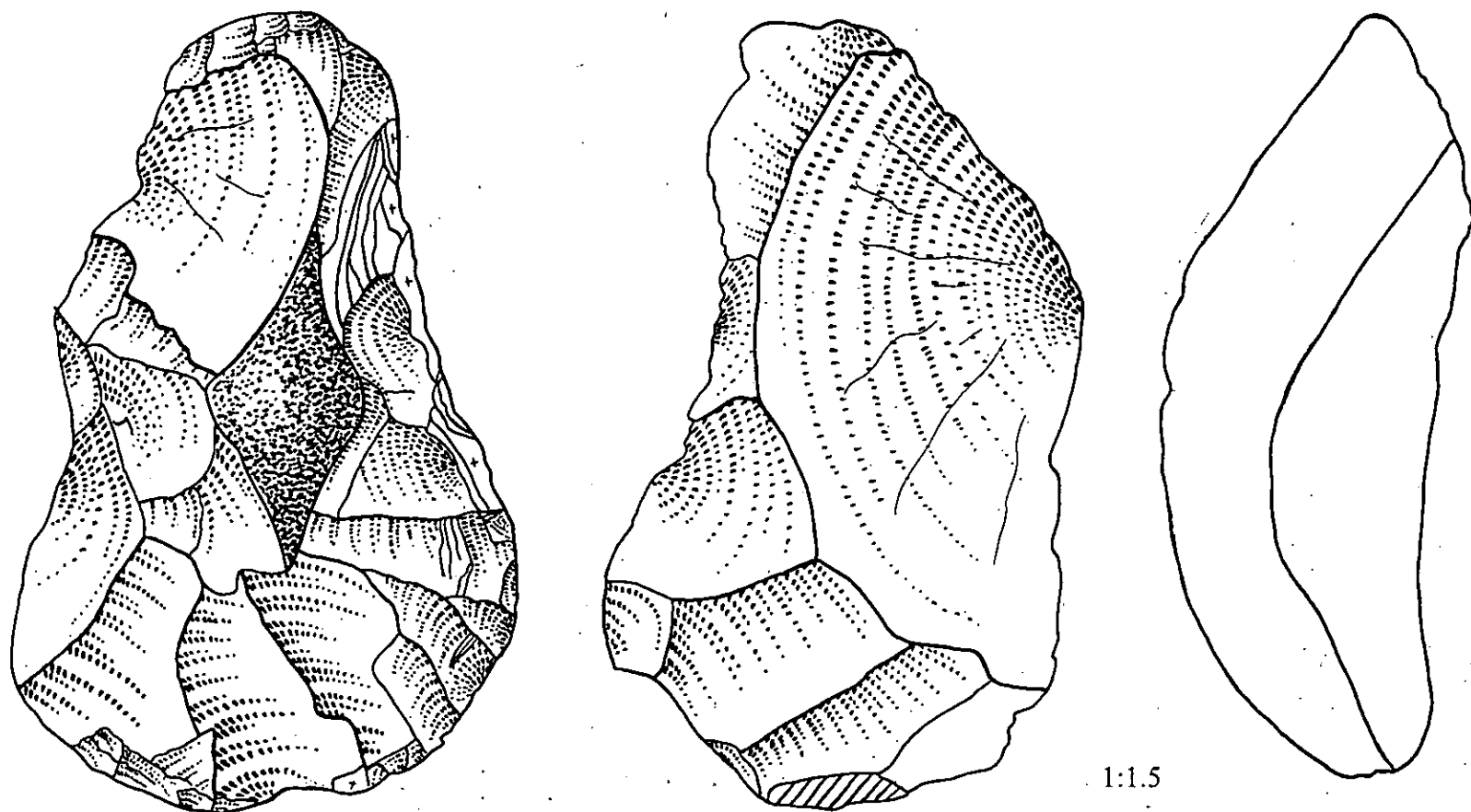


Fig. 5.2.28 Handaxe on a split cobble, using rhyolite as the raw material (Cardiga site)



Table 5.2.18 Handaxe and cleaver description (8 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
car268	rhyolite	142	89	42	425	Cleaver	flaked	in situ
car269	rhyolite	147	100	56	720	Cleaver	flaked	surface
car270	rhyolite	164	116	62	1025	Cleaver	flaked	in situ
car271	rhyolite	167	106	42	710	Cleaver	flaked	in situ
car272	rhyolite	155	99	56	825	Cleaver	flaked	surface
car273	rhyolite	189	92	55	820	Cleaver	flaked	in situ
car276	rhyolite	156	93	52	710	Handaxe	flaked	in situ
car277	rhyolite	166	98	52	840	Handaxe	flaked	surface
<b>Mean</b>		160	99	52	759			
<b>SD</b>		14.5	8.7	6.9	170.4			

The flake found together with the handaxes and cleavers on the surface of this site is quite well flaked, and could be described as a scraper made on a large flake.

Table 5.2.19 Large flake description (1 piece)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
car274	rhyolite	126	104	34	250	VI	end-located bulb in relation to the axis of the flake

At Cardiga too, an hammerstone was also found during the excavation. This exemplar consists of a circular cobble (72 x 64 x 49 mm, weighting about 225 grams) with flat upper and lower faces, each of which has an irregular hollow formed by a number of small, overlapping pits.

#### **5.2.7.1.4 The paleogeographical context of Cardiga site**

The artifacts were recovered from a clay (with gravel) unit, covered by another composed of sand and clay. The lower unit is quite fine grained. The whole section probably represents remains of a distal floodplain, apparently at some distance from a major channel. The nature of the context suggests that the artifacts -- in the lowest clay horizon -- were probably deposited in a stable distal floodplain.

#### **5.2.7.2 Canhoeiro**

##### **5.2.7.2.1 The geological context of the site**

The site of Canhoeiro, although located nearby Cardiga, geologically speaking, is not similar (see Fig. 5.2.29):

- 1) Alluvial level, composed of loose pebbles and coarse sand (7.5 YR 4/2 - brown color).
- 2) Conglomerate with sandy-clay of very dark brown color cementing the bed (7.5 YR 2.5/2).
- 3) Dark reddish-brown coarse sandy clay level, pebbly at the top (2.5 YR 3/3), making a smooth transition to the next level.
- 4) Dark reddish sandy-clay level (2.5 YR 3/3).

##### **5.2.7.2.2 The excavation procedures**

A two meters by two-meter grid was set out over the area where several cleavers were found on the surface (see Fig. 5.2.30 illustrative of the excavated area). The area also contained several big and medium sized unmodified cobbles (up to 16-20 cm) and pebbles, with no

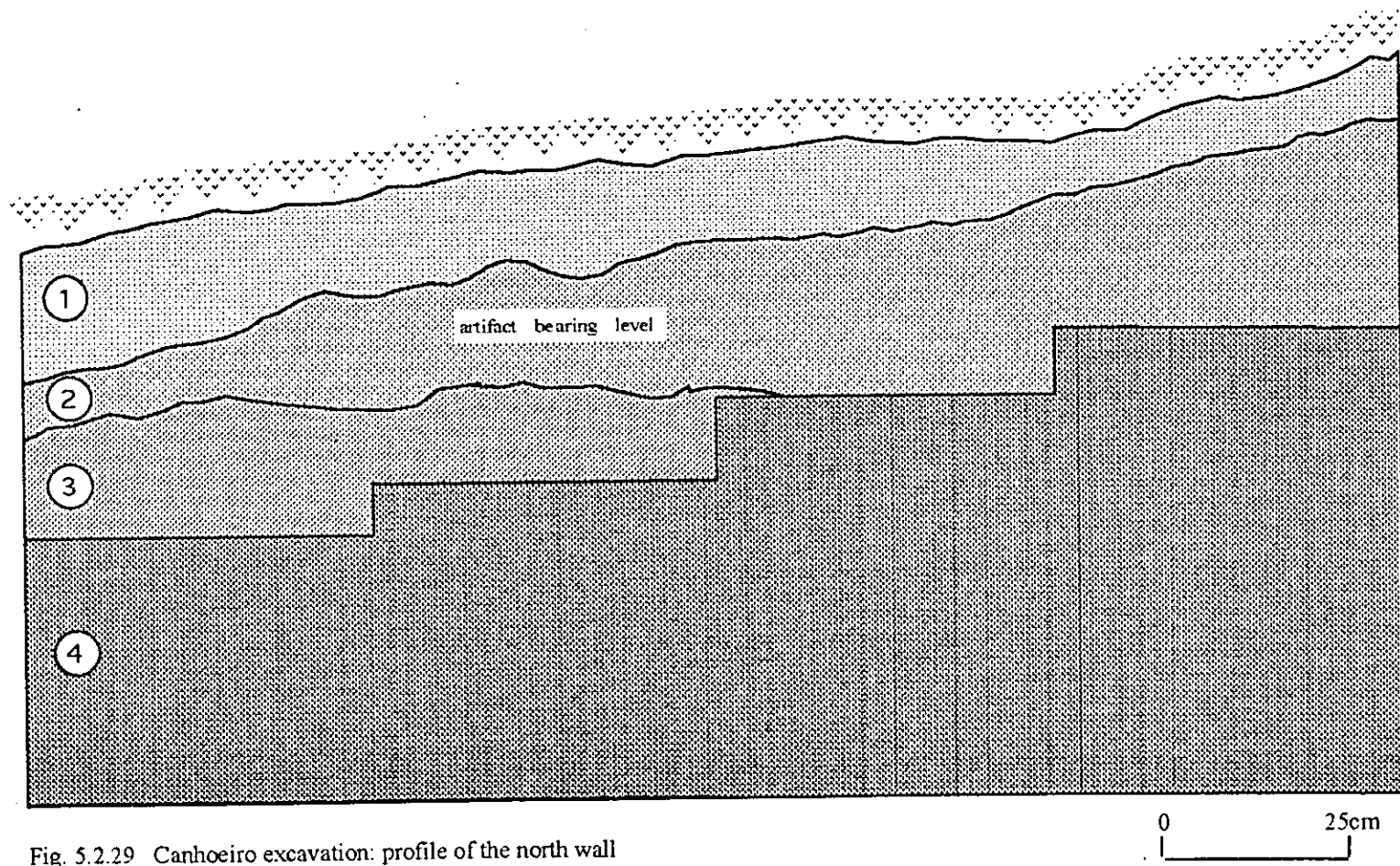
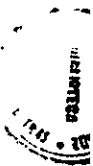


Fig. 5.2.29 Canhoeiro excavation: profile of the north wall



# Canhoeiro

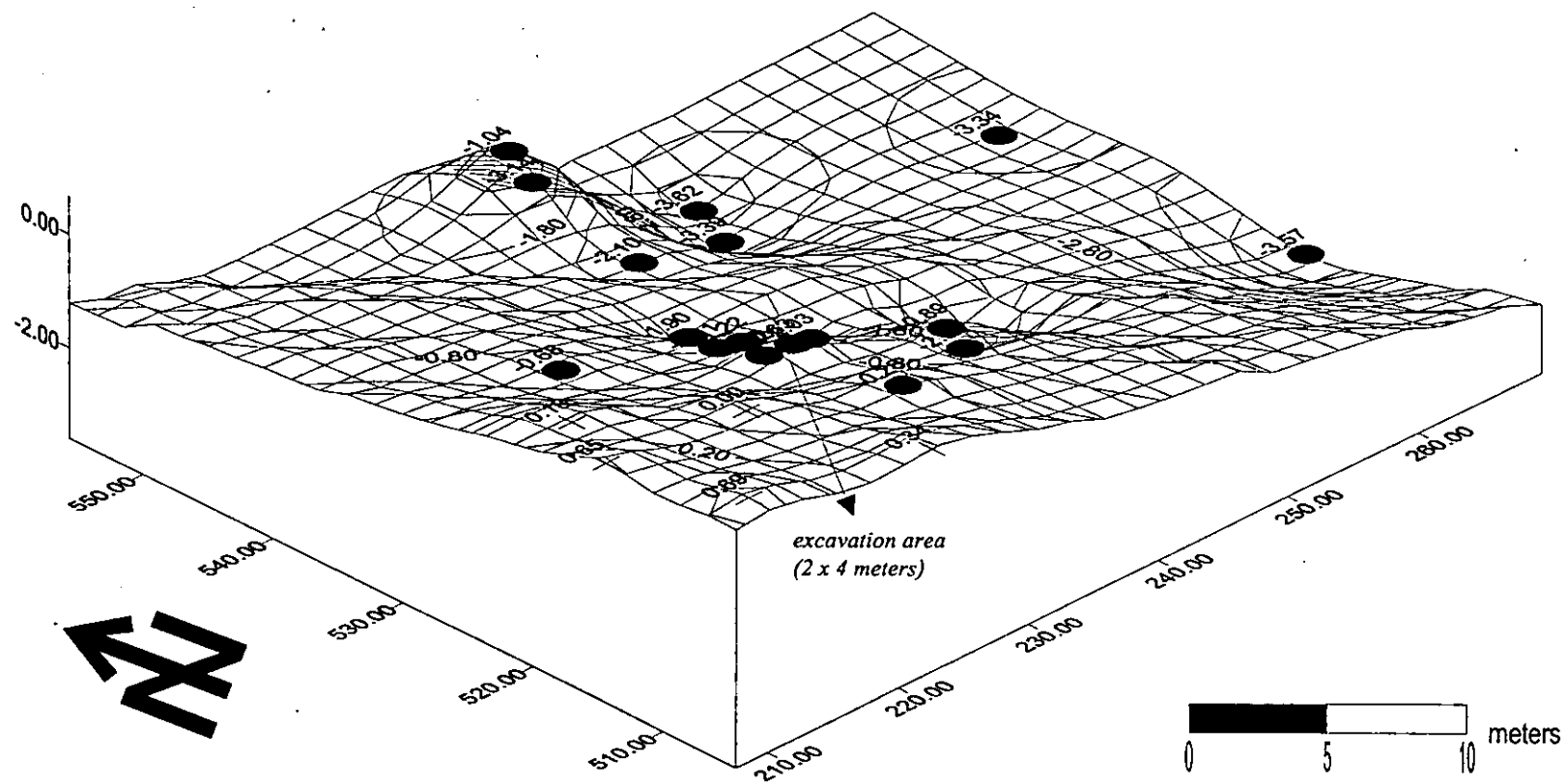


Fig. 5.2.30 Canhoeiro site - view of the excavation area

evidence for human knapping activity. The geological sequence consists of a series of interbedded cobbles and pebbles consolidated by with clays (i.e., of conglomeratic origin), which made the excavation extremely hard. Excavations were performed at ten centimeters spits, using picks and shovels. Artifacts occurred above or on a consolidated conglomerate clay horizon, about 0.5-0.70 meters from the surface. The excavation continued until 1.40 meter deep, but no more artifacts were found inside the conglomerate. The two following stratigraphic levels were also devoid of artifacts and fossil fauna. Hence, I decided to excavate another two additional steps of one meter each, in order to expose a larger stratigraphic section, to compare to the Cardiga site. Also, I was trying to determine lateral variation – in terms of artifact concentration – within a single geological horizon. Here, a single bifacially knapped piece, a chopper and some flakes were found in the same horizon. Generally, the artifactual material is fresh, but not in mint condition, due to weathering.

#### 5.2.7.2.3 The lithic assemblage

Table 5.2.20 Canhоеiro (can) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Bifacially knapped artifacts	5	2.3	3	1.3
Flakes longer than 100 mm	4	1.7	11	4.7
Chopper	-	-	1	0.4
Cores	-	-	4	1.7
Small flakes	7	3.0	197	84.9
TOTAL	16	6.9	216	93.1

The overall assemblage recovered is composed of 232 artifacts – mostly small size flakes (less than ten centimeters long). They were manufactured using rhyolite and quartzite. Once again, cleavers are quite significant among the bifacially knapped pieces, forming half of the

sample. Following the situation previously pointed out for other sites, the handaxes at Canhoeiro are all made on rhyolite pebbles.

Table 5.2.21 Handaxe and cleaver description (8 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
can231	rhyolite	152	108	67	890	Handaxe	flaked	in situ
can232	rhyolite	170	106	51	725	Cleaver	flaked	in situ
can234	rhyolite	138	79	57	520	Handaxe	flaked	in situ
can235	rhyolite	139	82	40	580	Cleaver	flaked	surface
can236	rhyolite	215	91	63	1210	Handaxe	flaked	surface
can248	rhyolite	173	102	52	750	Cleaver	flaked	surface
can250	rhyolite	210	112	73	1550	Handaxe	cortex	surface
can251	rhyolite	184	105	46	700	Cleaver	flaked	surface
<b>Mean</b>		173	98	56	866			
<b>SD</b>		29.5	12.5	11.1	348.3			

Although only a few large flakes were found on the surface, this excavation yielded a significant number of large flakes, made on rhyolite. The presence of big boulders in the proximity - within two to three kilometers radius -- may account for the fact that a significant amount of large primary flakes (mainly with a side located bulb of percussion in relation to the axis of the flake), almost not retouched, are found in this area.

Table 5.2.22 Large flake description (15 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
can234	rhyolite	174	129	54	1480	V	end-located bulb in relation to the axis of the flake
can237	rhyolite	140	195	60	107	V	side-located bulb in relation to the axis of the flake
can238	rhyolite	137	162	59	1250	V	side-located bulb in relation to the axis of the flake
can239	rhyolite	137	80	43	410	VI	end-located bulb in relation to the axis of the flake
can240	rhyolite	225	290	93	4050	V	side-located bulb in relation to the axis of the flake
can241	rhyolite	104	124	41	470	V	side-located bulb in relation to the axis of the flake
can242	rhyolite	80	125	50	520	V	side-located bulb in relation to the axis of the flake
can243	rhyolite	98	158	44	680	V	side-located bulb in relation to the axis of the flake
can244	rhyolite	71	141	37	350	V	side-located bulb in relation to the axis of the flake
can245	rhyolite	112	160	47	950	V	side-located bulb in relation to the axis of the flake
can246	rhyolite	79	165	42	425	II	side-located bulb in relation to the axis of the flake
can247	rhyolite	210	117	51	1050	V	end-located bulb in relation to the axis of the flake
can249	rhyolite	112	142	51	575	V	side-located bulb in relation to the axis of the flake
can252	rhyolite	275	150	54	2100	IV	end-located bulb in relation to the axis of the flake
can253	rhyolite	185	120	57	1230	IV	end-located bulb in relation to the axis of the flake
Mean		143	151	52	1043		
SD		59.9	47.0	13.2	983.0		

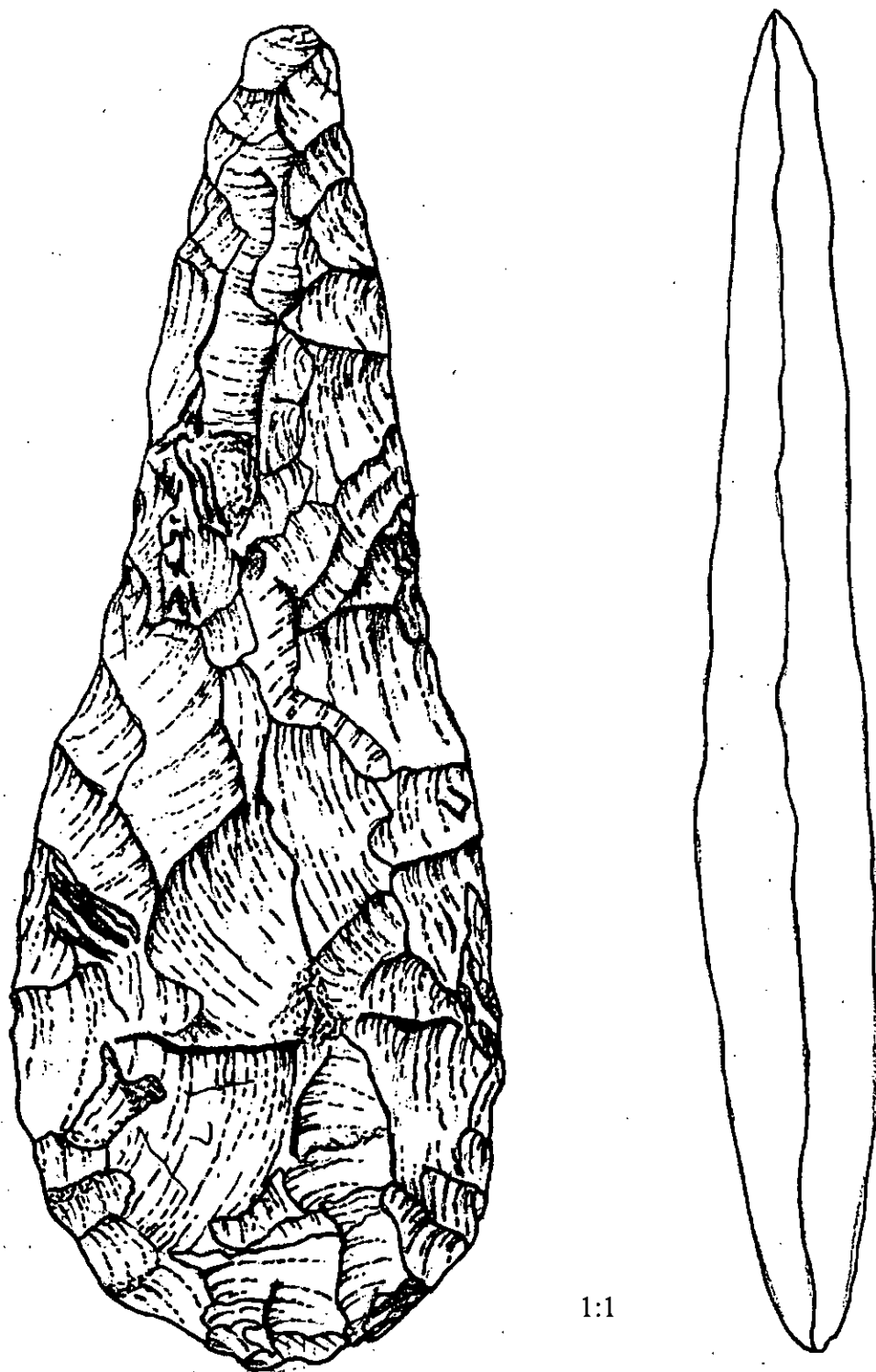


Fig. 5.2.31 Handaxe on rhyolite knapped using a soft-hammer direct percussion technique (Canhøeiro site)



Fig. 5.2.31 illustrates one of the lithic pieces studied from this site.

### 5.2.7.3 Caimane

The excavations performed in the 1980's at Caimane I and II rock shelters have revealed a long archaeological sequence. However, most of the archaeological material collected has not been studied nor published (Jonsson, 1983, Morais, 1984, 1988). The two rock shelters occur about 20 meters apart.

The larger shelter - Caimane I - is about 30 meters wide and eight meters deep. It has a rocky floor but a thick talus deposit outside on the slope towards the Changalane River. Here, four test pits (one meter by one meter) were excavated.

Caimane II is a smaller rock shelter (ca. ten-meter wide by three-meter deep); here, only one test pit was excavated.

The test excavations for Caimane I confirmed the presence of a thick Early Iron Age (EIA) level, mixed at the bottom with Late Stone Age (LSA) artifacts and fossil bones. Under this level a sterile unit was identified. Beneath it, several Stone Age levels were identified, including assemblages from the MSA and LSA.

The LSA levels contained smaller flakes usually made of chalcedony or rhyolite. MSA deposits were dominated by larger flakes often made on rhyolite. Some irregular and prepared platform cores were identified. It was not possible to reach the bottom of the sequence, since there is a stratum of intense roof spalling. Up to now there were no evidences of ESA artifacts

Both the EIA/LSA and LSA levels present very good bone preservation, including several human fragments (an almost complete male skeleton was found in the LSA layers). Regarding the non-human fauna, the assemblage is mostly composed of macrospecimens, such as antelopes, warthog, zebra, and carnivores such as hyenas. Iguana and turtle remains are also

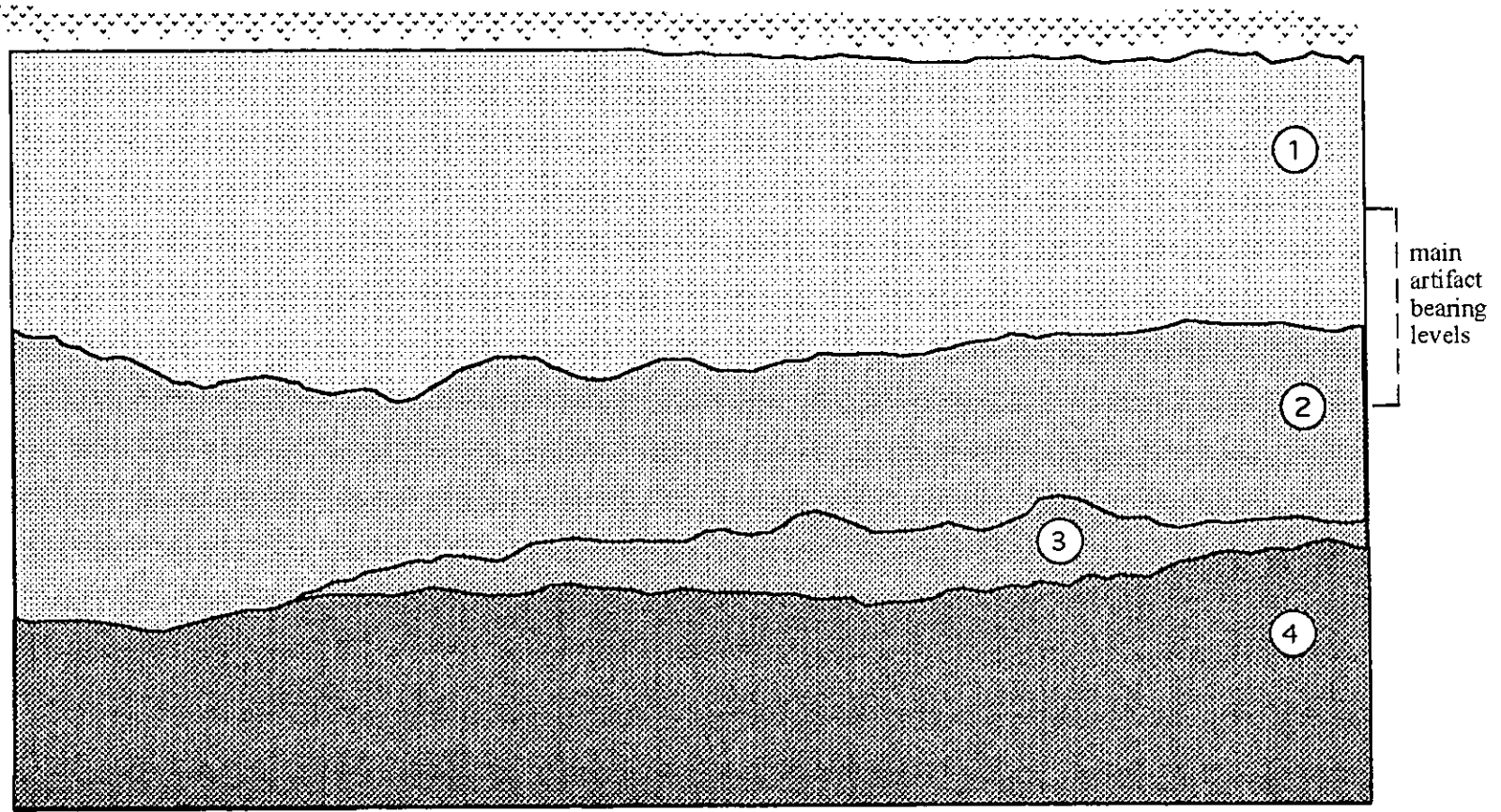


Fig. 5.2.32 Caimane excavation: profile of the north wall

0 20cm

common. Bones of frogs and micromammals probably result from owl pellets or other animals that lived in the shelter (Jonsson, 1983).

#### 5.2.7.3.1 The site excavated

Because of the presence of a rich rock shelter with MSA in the proximity, the area was carefully surveyed. It should be mentioned that once again, the Caimane area constitutes a natural port through the Grandes Libombos mountains, along the Changalane River, more to the west. In fact, this site is located some kilometers away from the border with Swaziland, almost 100 meters above sea level. At this locality, the Changalane River makes a wide turn, forming a pool where there is always water available, even in the drier years. The surface deposits present a very large number of artifacts – mostly flakes with carefully prepared platform and radial cores. In the other side of the river, i.e., on the northern margin, several larger flakes were found on the surface.

#### 5.2.7.3.2 The geological sequence

The geological sequence consists of two interbedded consolidated clayish sands and silts (see Fig. 5.2.32).

1) Dark reddish brown medium grained sandy clay, pebbly at the base (2.5 YR 3/3), about 50-60 centimeters thick.

2) Dark reddish brown clay level (2.5 YR 3/4), 40-50 centimeters thick, containing artifacts of the Acheulean period.

3) Coarse grained sandy-clayey discontinuous level, with angular fragments at the base, marking the transition to the bedrock (4).

# Caimane

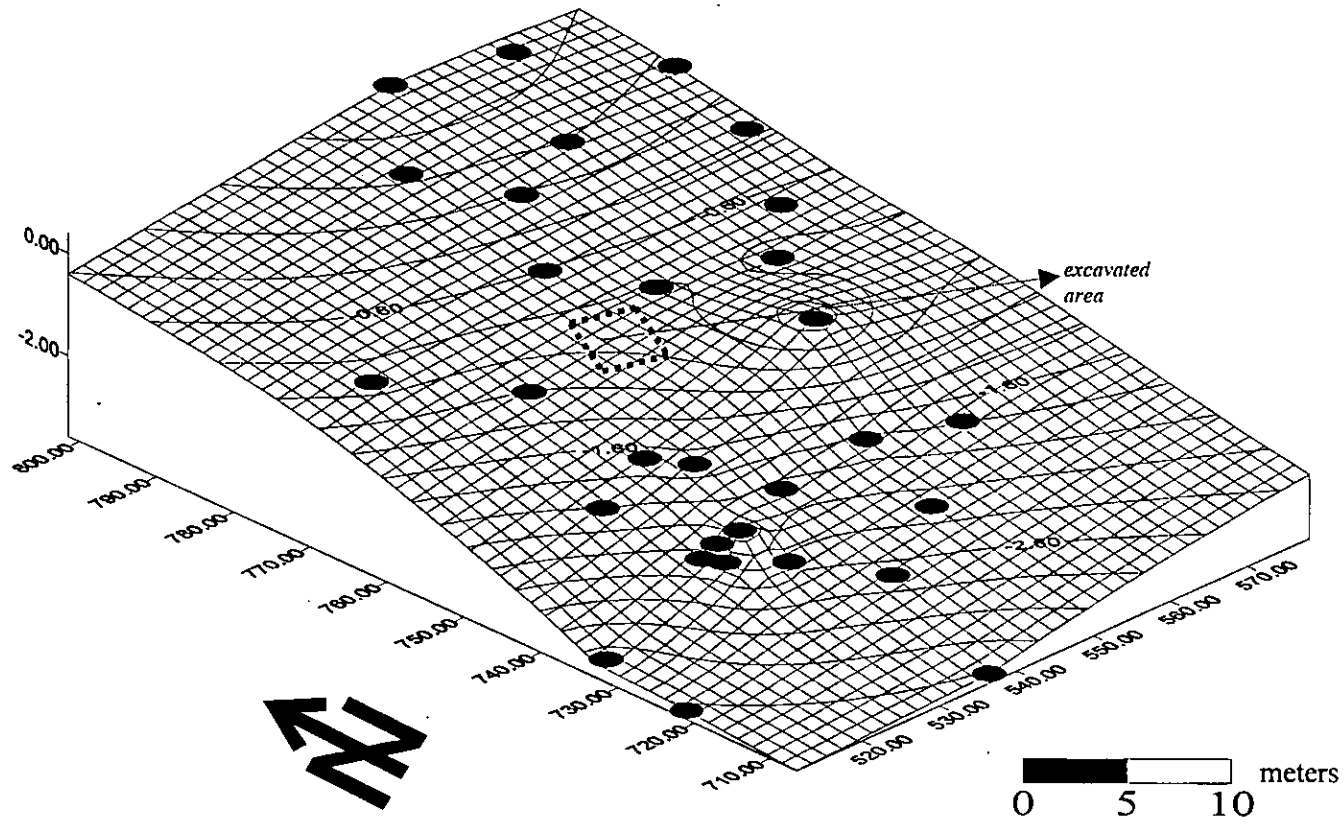


Fig. 5.2.33 Caimane site - view of the excavation (2 x 2 meters) and surrounding area

### 5.2.7.3.3 The excavation procedures

A two-meter by two-meter grid was established on the surface where the large artifacts were found and a small excavation carried on (see Fig. 5.2.33). Very few pebbles occur through the sequence. From the surface scrub as well as from the initial ten centimeters spit were recovered two handaxes and a cleaver, together with some large flakes, and other smaller flakes and cores. The following 50 centimeters were sterile, until another artifact bearing horizon was reached. This new horizon of about 40 to 50 centimeters thick yielded a significant quantity of flakes, cores and choppers, together with some flakes, handaxes and cleavers. The artifacts were spread throughout the horizon. The excavation was continued some more 20 centimeters deep, but no more artifacts were recovered, and the bedrock was reached. No fossil fauna was found during the excavation.

### 5.2.7.3.4 The artifact assemblage

The raw material used to make the lithic artifacts is more diverse. In addition to rhyolite and quartzite, basalt and quartz are also present, mainly in the form of small flakes.

Table 5.2.23 Caimane (caj) artifact inventory

Artifact	Surface		Excavated	
	N	%	N	%
Bifacially knapped pieces	3	1.4	4	1.9
Flakes longer than 100 mm	4	1.9	13	1.4
Cores	2	0.9	16	7.4
Chopper	1	0.5	5	2.3
Small flakes	24	11.1	154	71.3
TOTAL	34	15.7	182	84.3

It should be mentioned that this site yielded artifacts in general smaller and less weathered state than the remaining excavated sites. This is well patterned in the size of handaxes and cleavers. A Students t-test run for independent samples of weight and maximal length of the Caimane sample against the remaining excavated sample of cleavers and handaxes from southern Mozambique, gave the following results:

Table 5.2.24 T-test for equality of means

Variable	2-Tail Sig.
Weight	0.014
Maximal length	0.015

The results of the test clearly justify the statement regarding the particular character of the Caimane assemblage, with longer, thinner and lighter bifacially knapped artifactual forms.

The flakes are also smaller and thinner, and much more retouched, although close by, the river stream present large cobbles and angular pieces of good quality rhyolite that could have been used as raw material. However, for reasons already mentioned, the qualitative analysis of the whole flake sub-sample was not performed for this dissertation, since the focus of my work was centered on large bifacially knapped lithic pieces.

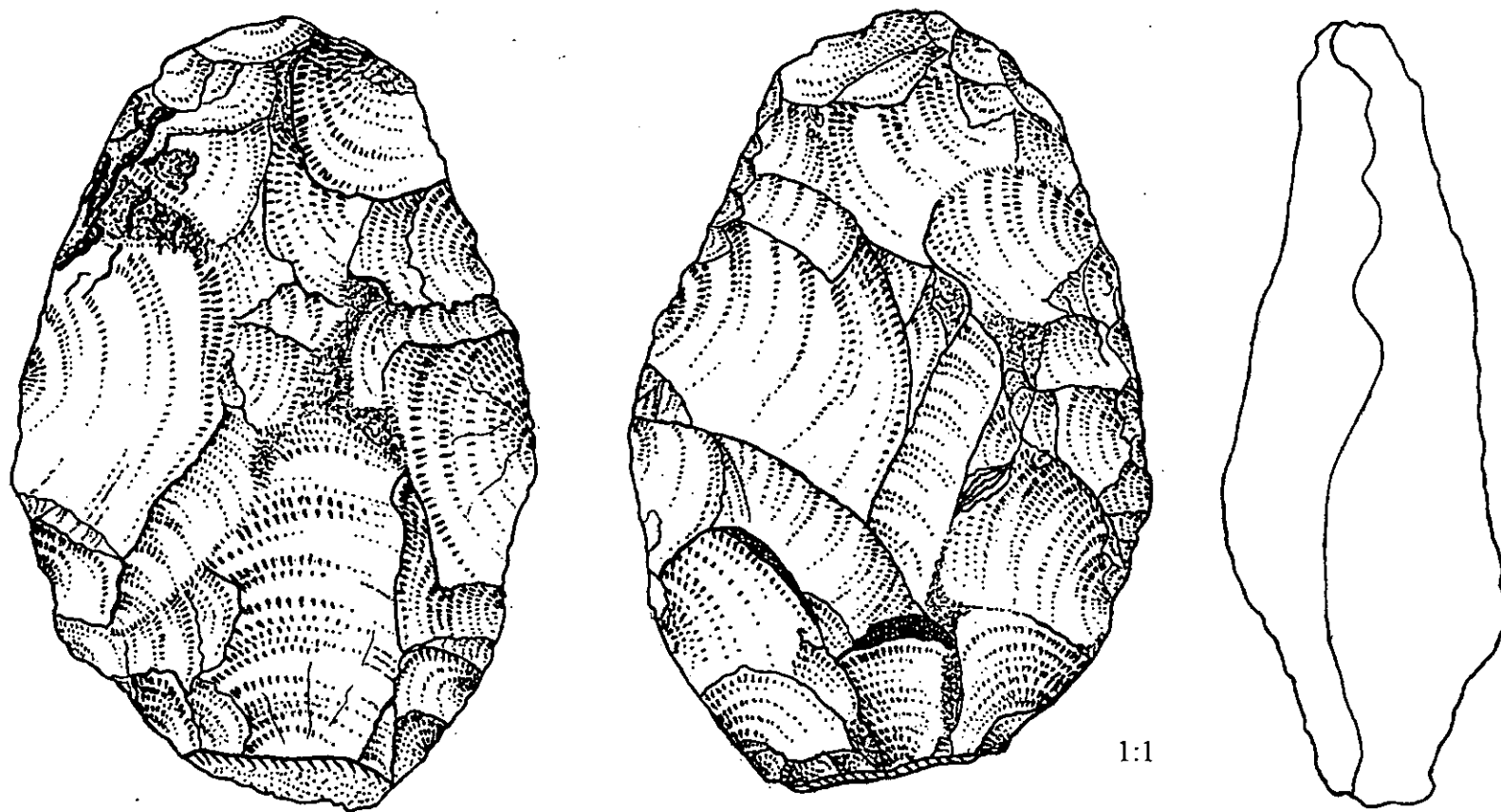
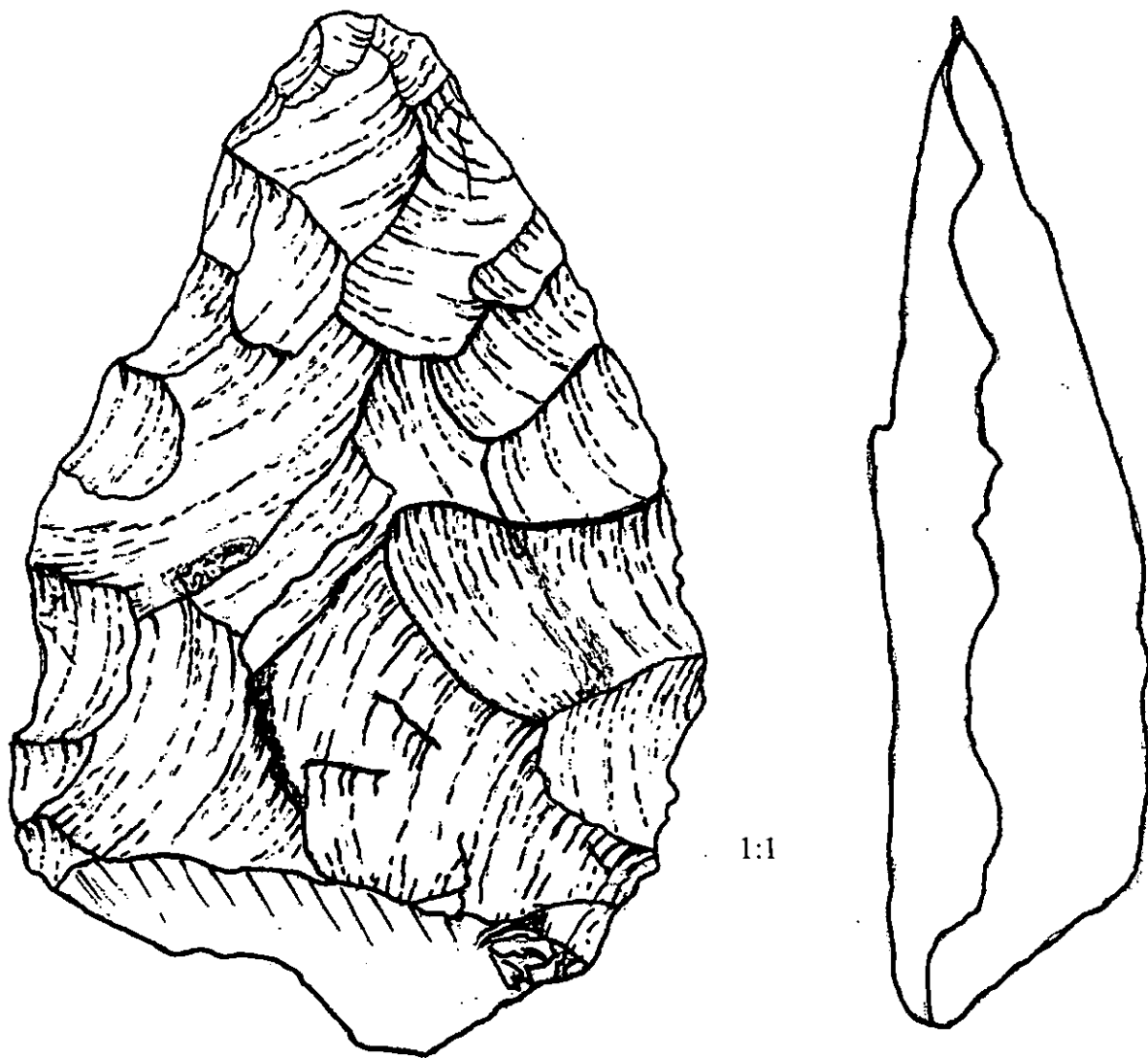


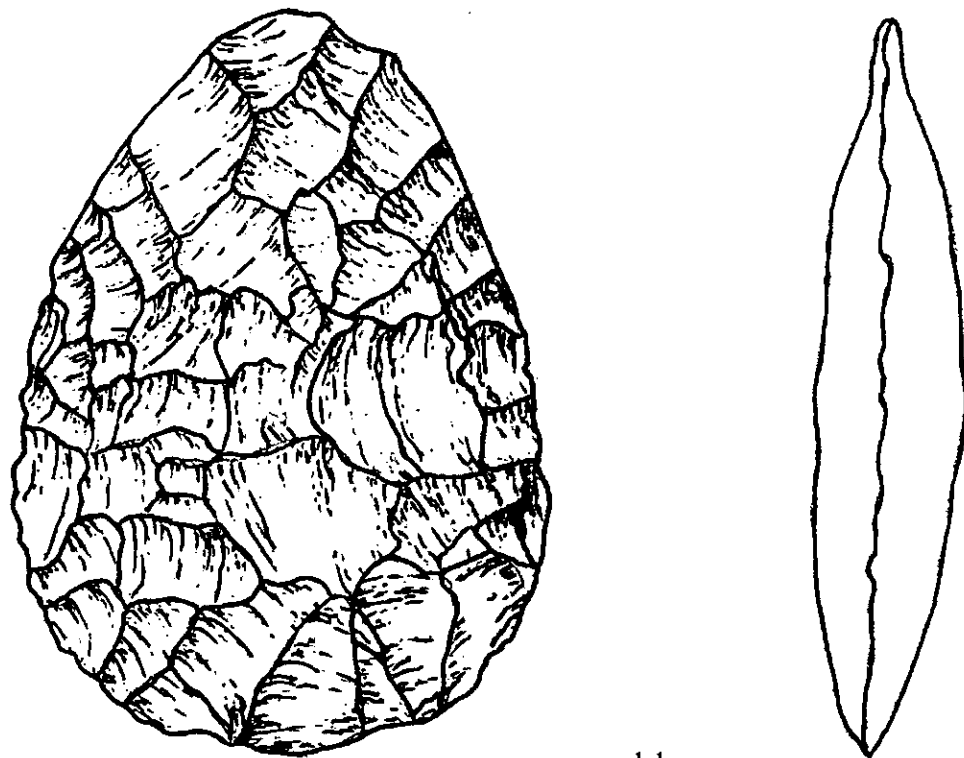
Fig. 5.2.34 Handaxe on a rhyolite flake (Caimane site); hard and softer hammer direct percussion technique present



1:1

Fig. 5.2.35 Handaxe on rhyolite flake, made using a soft hammer direct percussion technique (Caimane site)





1:1

Fig. 5.2.36 Caimane. Handaxe on rhyolite (soft hammer direct percussion technique)

Table 5.2.25 Description of large bifacial pieces (7 pieces)

Handaxes & Cleavers	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Type	Butt	Position
cai255	rhyolite	134	83	59	610	Handaxe	flaked	in situ
cai258	rhyolite	139	82	46	350	Handaxe	flaked	surface
cai259	rhyolite	164	100	49	670	Cleaver	flaked	in situ
cai260	rhyolite	187	136	70	1040	Handaxe or core?	flaked	in situ
cai261	rhyolite	140	94	46	530	Cleaver	flaked	in situ
cai265	rhyolite	143	90	53	490	Handaxe	flaked	surface
cai266	rhyolite	121	76	45	425	Cleaver	flaked	surface
<b>Mean</b>		147	94	53	588			
<b>SD</b>		21.8	20.0	9.1	226.5			

With the exception of the potential core, all the remaining bifacially knapped pieces were produced using flakes as blanks. Figs. 5.2.34, 5.2.35 and 5.2.36 are illustrative of the handaxes found at this locality.

Table 5.2.26 Large flake description (7 pieces)

Flake	Raw material	Max. Length (mm)	Max. Breadth (mm)	Max. Thickn. (mm)	Weight (gr.)	Toth's Type	Flake type
cai254	rhyolite	93	118	44	180	VI	side-located bulb in relation to the axis of the flake
cai256	rhyolite	142	92	38	310	VI	end-located bulb in relation to the axis of the flake
cai257	rhyolite	148	73	40	225	II	end-located bulb in relation to the axis of the flake
cai262	rhyolite	112	97	38	390	IV	end-located bulb in relation to the axis of the flake
cai263	rhyolite	122	64	28	150	V	end-located bulb in relation to the axis of the flake
cai264	rhyolite	132	67	35	220	IV	end-located bulb in relation to the axis of the flake
cai267	rhyolite	126	89	42	370	VI	end-located bulb in relation to the axis of the flake
<b>Mean</b>		125	86	38	263		
<b>SD</b>		18.6	19.2	5.2	93.8		

At Caimane the preponderant type of large flakes found (86%) presents an end located bulb in relation to the axis of the flake (the so called "end struck" flakes); as some researchers have suggested, this is a feature that tends to be characteristic of late Acheulean – MSA sites (Isaac & Keller, 1968). This latter age seems also to be confirmed by the fact that a high percentage (57%) of the flakes presents a prepared platform associated with a faceted dorsal surface.

#### 5.2.7.3.5 The paleogeographical context

The archaeological horizon lies below a coarse sandy-clay level, yielding very few cobbles, which are quite round. The lower horizon (3) represents a channel, possibly a depositional environment, while the artifact unit -- a sandy clay level -- seems to have been deposited during a lower energy period.

#### 5.2.8 The geological problems affecting the formation of the Acheulean assemblages from southern Mozambique

From the fieldwork performed, two questions were identified as of particular importance for a better understanding of the status of the surface and excavated assemblages, namely:

1. What post-depositional factors lead to the horizontal distribution of surface scatters? And which factors would account for the vertical distribution of the artifacts within the stratigraphic units? (i.e., trying to assess the site formation factors affecting the integrity of the assemblage)
2. What is the vertical relationship between the surface scatters and buried features and assemblages?

The survey performed in the area suggested that the ESA sites were mostly found in redeposited context, due to its geomorphological location. Indeed, the excavations demonstrated that the artifacts are found mostly in old river terraces and valley floors, i.e., they represent sites of disturbance. In fact, the composition of the lithic assemblages excavated, the orientation of the pieces, their size distribution, etc., clearly indicates the presence of geological disturbance.

For example, slope wash seems to have created a higher density of surface finds at the base of the hillside. Sites also occur in valley slopes (e.g., Caimane), although here too, they are

disturbed by the inclination and natural erosional factors. The areas on the top of the hills present a very thin layer of sediments; if any artifacts were ever left behind by hominids, they probably were washed away (see previously referred Fig. 4.2.18 where a profile of the Libombos mountain area and the inter-Libombos plains is presented, revealing the thickness of soil cover).

Inside the faulting in the Libombos region nothing was found, although some good raw material – mainly quartzite from the Drakensberg – is found quite regularly in this sort of setting. This raw material is sometimes present in some Acheulean sites, usually used to produce small, artifacts using these flakes as expedient blank.

Finally, the sea-level oscillations and the process of formation of the coastal plain and other anthropogenic activity affected too the horizontal distribution of the finds.

#### 5.2.8.1. The surface and the excavated assemblages

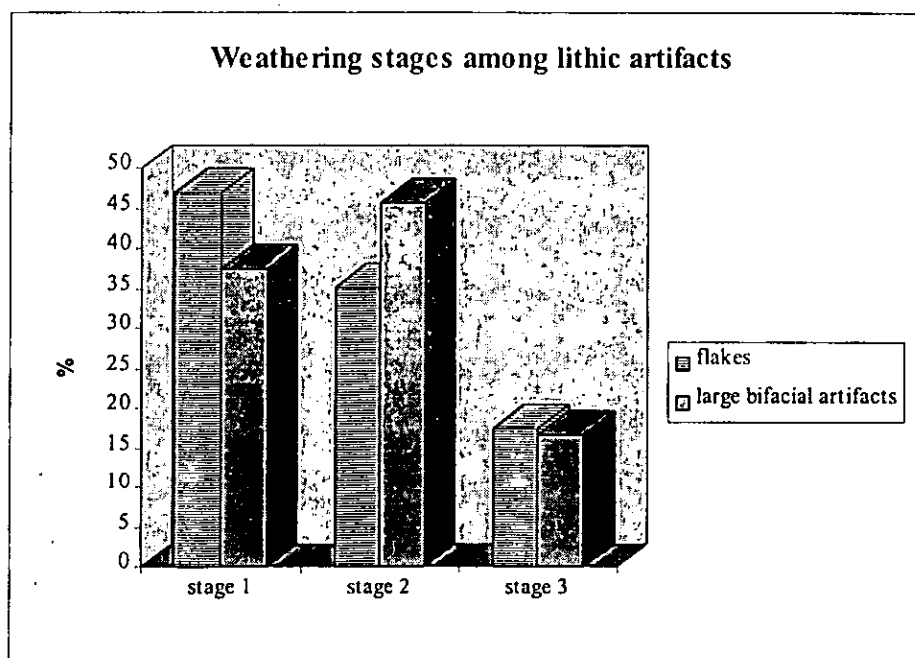
Along the Umbeluzi-Changalane-Tembe rivers area, artifacts are found in redeposited context; nonetheless the artifact-bearing deposits present a vertically and laterally concentrated distribution of artifacts.

In terms of weathering, artifacts found in minor gullies or eroding at the surface show wear, while artifacts lying a few meters away on slightly higher ground are unaffected.

For example, the artifacts found in gullies are usually small components and those on higher ground larger components, suggesting natural sorting out of smaller pieces. Considering that the land surfaces represent the sloping river margins, composed of easily eroded material, it is possible that artifacts – particularly the small ones – could be transported over greater distances and concentrated either by freshwater flowing into the streams after the rainy period (see Petraglia & Potts, 1994).

Therefore, in the assemblages from the Umbeluzi-Changalane-Tembe region, all the degrees of weathering are present, from fresh to heavily worn pieces – these latter corresponding

to artifacts where it is almost impossible to discern such important features as waves, hackles, etc. (stage 3). The prevalent pattern though, is the present of fresh (stage 1) too slightly abraded (stage 2) surface (see Fig. 5.2.37 showing the weathering stages identified for the lithic artifacts from southern Mozambique).



Typologically speaking (in terms of metric analysis and classification of the bifacially manufactured artifacts) there is no corresponding typological difference. These facts just listed, together with the geological setting of the findings (coarse silts and clays to conglomerates, together with the evidence of a context of high energy flow), the presence of clusterings in depressions and the differential sorting with an emphasis on large pieces, suggest that we are facing what Petraglia and Potts (1994) refer to as a “lag situation”, associated with some amount of transportation. The uniformity of the weathering (where the more worn pieces are the ones on the surface), together with the absence of evidence of recent retouch/damage due to water transportation of the artifacts seems to indicate that the material from each site was considered as a unit, despite the abrasion of some of the components.

### 5.2.8.2 Some questions on site-formation

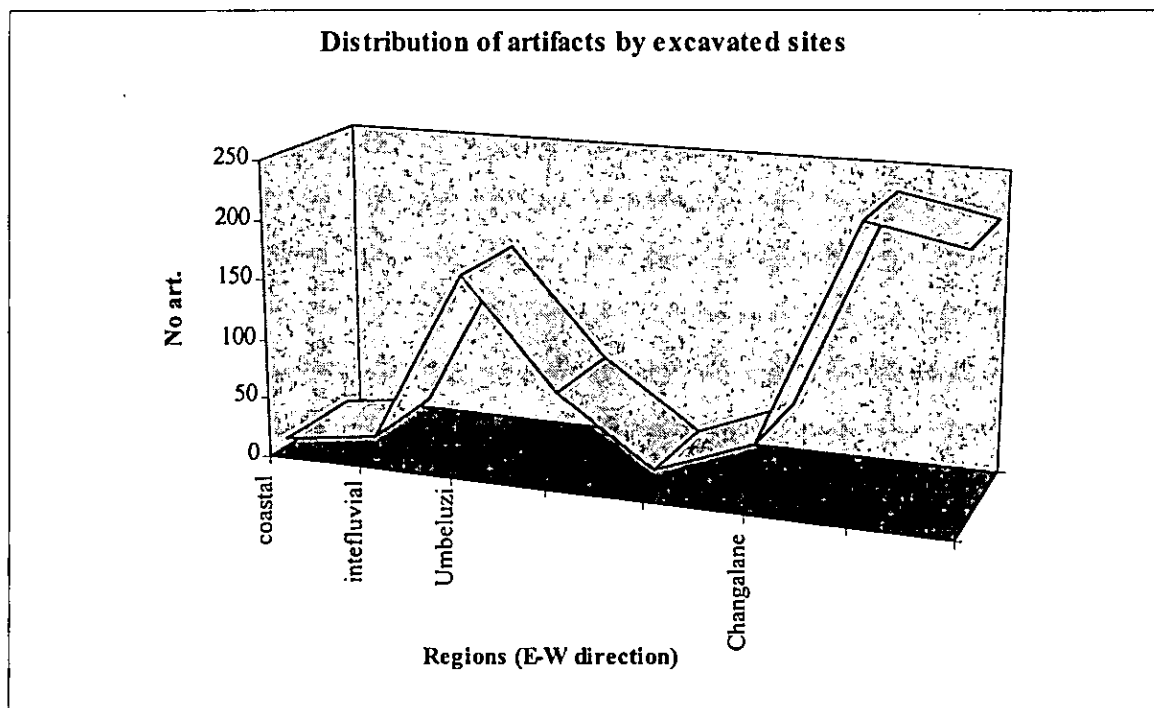
The picture one gets for southern Mozambique Acheulean sites is that the lithic assemblages are mostly found in deposits of fluvial gravels and sands, devoid of fossil bone component. This situation has been reported for several open-air sites of the Old World where Acheulean sites have been identified (e.g., Deacon, 1975, Harding et al., 1987, Schick, 1992, Bar-Yosef, 1995). Here, briefly, I would like to describe some of the possible stream mechanisms at place in the area that could help explain the concentration of handaxes, cleavers and large flakes from a wide catchment area.

In the case of southern Mozambique, these deposits were laid down by rivers during episodes of very high-energy erosion and deposition, a rather different set of circumstances than those present today. In fact, the gravels and sands originated from high concentrations of debris derived from the destruction of local rocks (rhyolite and basalt - see Chapter III for a description of the geological context of the region). The incorporation of the artifacts into the fluvial gravels and sands probably occurred in a period of increased lowering of the sea level; this would have resulted in an increased river gradient, leading to high flow velocities required to move such coarser materials (G. Botha, pers. com.); another possible explanation for the emergence of this deposits is the increase of the flow velocity in wetter periods (e.g., Schick, 1992). However, since the deposits are found with distinct size categories of artifacts normally not or just slightly weathered, most of the artifacts probably have been incorporated into river sediment by channel migration, overbank deposition or by burial following recycling by mass movement on the slopes in episodes of short-term deposition (Brandt, 1989). More recently, it has been suggested that the dynamic denudation of subtropical soils might help explaining the process of artifactual downwashing by means of bioturbation, water and root disturbance acting under gravity. This will cause artifacts to descend until buried right above the weathered bedrock (Johnson, 1989, 1993, Johnson & Watson-Stegner, 1990). Therefore, the stratigraphic units used to define

assemblages of lithic artifacts for our analytical purposes probably consists of material that was deposited over periods of unknown duration. The ideas exposed above help explain the possible "palimpsest effect" present in the excavated sites (e.g., Binford, 1981a, Stern, 1993, Holdaway et al., 1996), when surface and excavated collections not in primary context are understood as reflecting several phases of occupation (mixing chronologically unrelated remains).

At the same time, a second set of biases introduced through "taphonomic processes" - i.e., differential patterns of discard, burial, preservation and removal of artifacts -- also distort the distribution patterns (e.g., Gifford-Gonzalez, 1991, Zvelebil et al., 1992, Villa, 1993).

The points mentioned above imply that the assemblages found both in the surface or collected from excavations as material residues of human activities do not directly reflect the behavior that led to this discard; rather, they suggest that in active river systems such as the Umbeluzi and the Changalane rivers, artifacts occur in channel and bar gravels as a result of transport by the river over short-time spans.





The distribution of the number of artifacts collected within the study area is presented in Fig 5.2.38 (see above). It provides a diagrammatic summary of the spatial relationships. It can be seen that sites tend to be found as clusters close to the riverbeds and in a close proximity to the Libombos mountains (western side). In most cases the artifact clusters, as I mentioned above, were probably associated with particular topographic features, such as buried complex of channel streams.

This question will be re-address in Chapter VIII, taking into consideration several lines of information. In fact, the information available, gathered through the analysis of several sources of data, allowed me to develop several predictive models regarding the hominid land use patterns during the Acheulean, in the area under study. This research is aimed at achieving insights regarding the East-West spatial variation in the density and composition of the archaeological record, during the Acheulean time frame. If in this chapter the archaeological data is used as the main factor for developing an interpretation of potential patterns of land use in southern Mozambique, in Chapter VII, the archaeological data will be used as a test of the hypothetical resource distribution achieved for the area (see Peters & Blumenschine, 1996, Blumenschine & Peters, 1998).

### 5.3 SOME PRELIMINARY ASPECTS RELATED TO THE INTERPRETATION OF THE ARCHAEOLOGICAL DATA RETRIEVED FROM SOUTHERN MOZAMBIQUE

In this part of my dissertation, a general evaluation of the Acheulean lithic assemblages recovered from southern Mozambique is presented. At the same time some problematic issues raised by the data gathered are described and discussed preliminary.

#### 5.3.1 A preliminary analysis of the data excavated in southern Mozambique

Throughout the thesis, and whenever possible, the principles of systematic morphological analysis adopted follow the structure set out earlier by several researchers worldwide (e.g., Bordes, 1961, Tixier, 1963, Roe, 1964, 1968, Brezillon, 1971, Inizian et al., 1991). However, as several authors have mentioned (e.g., Kleindienst, 1961, 1967, Mason, 1962), much of the lithic material in Southeastern Africa cannot be accommodated within the above mentioned schemes of classification.

This section of my dissertation is centered on the evaluation of the morphological information available on the assemblages excavated in southern Mozambique, in order to make possible to contextualize the information in the Acheulean regional setting (see Chapter II). A statistical evaluation of the technological specificities of the southern Mozambique Acheulean assemblages (i.e., a study mostly concerned with the evaluation of the technology of production) will be presented and discussed along Chapter VI.

As already stated along the text, I chose as my analytical categories - handaxes, cleavers and large flakes, mostly unretouched or just with a few negative scars presented (i.e., flakes, which could not be mistakenly taken for other "types", such as scrapers, knives, etc.). In the

Umbeluzi-Changalane-Tembe area, the overall number of bifacial pieces studied is 48 (with a slight predominance of cleavers).

Table 5.3.1 Sub-sample of bifacial artifacts excavated in southern Mozambique

Artifacts	N	(%)
Handaxes	20	41.7
Cleavers and Unifaces	24	50.0
Cores	4	8.3

In several cases (such as at Umpala, Mahelane and Caimane sites), some of the bifacial-looking pieces are in fact radial cores, whose form resembles the one the handaxes. This question will further be more fully addressed on the section dedicated to technological analysis (see Chapter VI), but one should be aware of the fact that bifacial knapping is not synonymous with handaxe.

Regarding the remaining bifacially knapped artifacts, although the pieces are well manufactured -- and hence it is possible to typologically ascribe them to the categories of handaxes and cleavers -- it is still possible to identify, in most of the cases (with one exception), the blank used to produce the artifact. The cleavers (as it is defined technologically) can only be produced using a flake as blank (see, for example, Tixier, 1957, Chavaillon, 1965, Roche & Texier, 1991). Inversely, in the study are, the handaxes are predominantly prepared on cobbles.

Table 5.3.2: Blanks used for handaxe manufacture in southern Mozambique

Blanks	N	%
Cobble, Pebble	12	60
Flake	7	35
Impossible to determine	1	5

When talking about the identification of the blanks used to produce handaxes, the following pattern was observed: out of the seven handaxes were securely identified as made using a flake as a blank, only one handaxe was produced using a flake where the bulb is located at the base in relation to the axis of the artifact.

Table 5.3.3 Flake types used as tool blanks for the production of handaxes and cleavers in southern Mozambique

Tools	Type of flake	End-located bulb in relation to axis of the artifact	Side-located bulb in relation to axis of the artifact	Kombewa flake	Impossible to access flake type
Handaxe		14.3%	57.1%	-	28.6%
Cleaver		12.5%	54.3%	16.6%	16.6%

These results indicate that most of the flakes initially used to knap a handaxe were asymmetric on the profile plane (due to the presence of a side located massive bulb of percussion). Hence, the preparation of the handaxes would have required some extra planning and work in order to suppress the discordant planes, and rapidly reach a bilateral equilibrium plane (see further description on the handaxe production sequence on Chapter VI, for a more detailed explanation of this procedure).

The flake blanks used for the crafting of bifacial artifacts pattern a distinct method of acquisition:

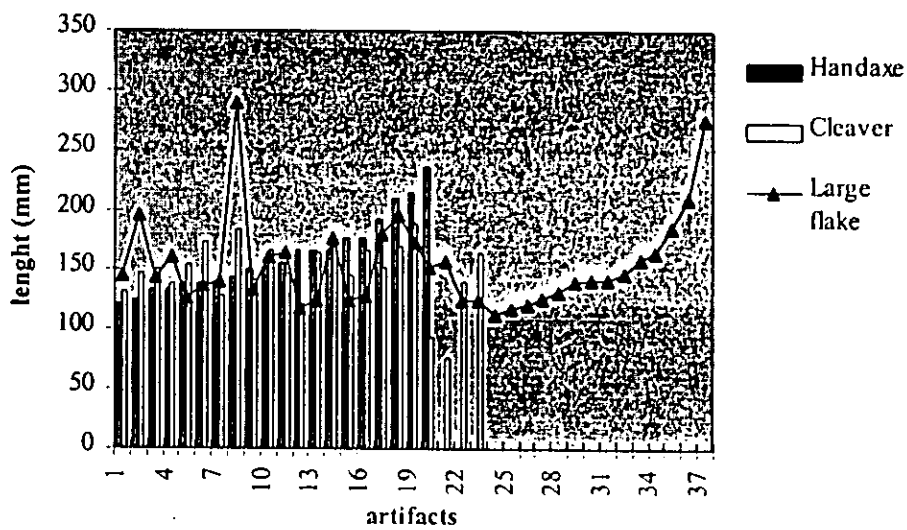
- predetermination for the case of cleavers,
- and an opportunistic adaptation for the handaxes.

Indeed, 16.6% ( $n = 4$ ) of the cleavers are made on flakes. These flakes are predetermined, a fact that confirms the special care put not only on the preparation of the flakes, but also on its

selection to be further be used as a blank in tool manufacture. Another step to be taken into evaluation is the level of predetermination present. In fact, distinct technological approaches can be applied to extract the blank flakes, such as the Kombewa technique (for a description of the technological procedures required to produce a Kombewa flake, see next chapter). Within the limits of the study area in southern Mozambique, no Kombewa flakes were detected to have been used to produce handaxes, although some of them were used as tool blanks to manufacture cleavers.

Fig. 5.3.1 Length of handaxes and cleavers vs. flakes

Lenght: handaxes, cleavers and large flakes



The graphic above, as well as the data presented in Table 5.3.3, indicates that in the overall, cleavers tend to be only slightly shorter than handaxes found at the sites, a fact that may have several explanations, involving variables both from the perspective of manufacture and use:

- The flake size selection shows a preference by Acheulean artisans for the longer flakes to be used for making cleavers (although this idea is not strongly supported by the fact that cleavers require a special predetermined flake form, a technological requirement which goes beyond the flake size);
- One is examining handaxes that have been re-flaked, resharpened several times, until got exhausted and entered the archaeological record, and this explains why handaxes are so close to cleavers in terms of length;
- One is examining cleavers whose blade very rapidly became blunt; hence, these artifacts were discarded very quickly and therefore, where never retouched, i.e., didn't lose mass to length.

These facts justify the need for a technological understanding of the lithic pieces under study. For example, the index of bifaciality (see Table 5.3.4) confirms the technological reading of handaxes, namely that these lithic tool forms, because produced on cobbles and large flakes, and due to the nature of the technological procedures required for their production (see next Chapter) have to be more intensively and symmetrically knapped to achieve a symmetry in terms of planes of equilibrium.

Two facts may explain why handaxes tend to be longer than the cleavers (see Table 5.3.4). The first one is probably related to the fact that large sized cores are not a common feature in the area; in fact, cleavers are produced using predetermined flakes, and therefore a selective use of the produce flakes is present, implying that the large flakes not suitable to manufacture cleavers could still be used to produce handaxes. A second factor indicates that handaxes are

preferentially made on large cobbles/pebbles (although the difference in mean breadth and thickness is not significant).

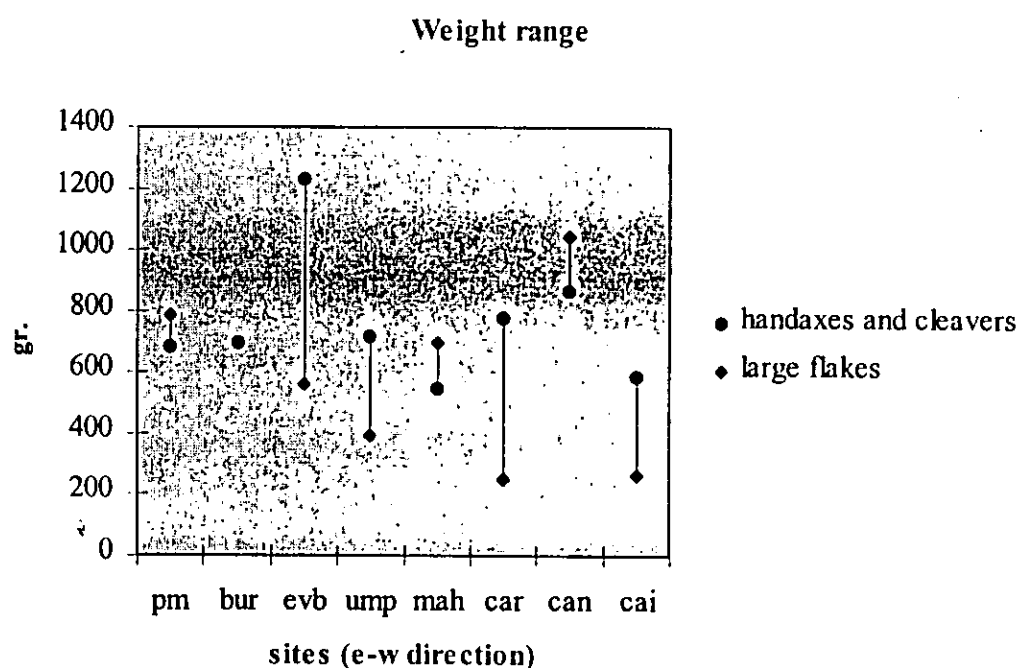
Table 5.3.4 Mean values for the studied artifacts from southern Mozambique

	Length (L)		Breadth (B)		Thickness (T)		Index of bifaciality <sup>5</sup>
	mean	sd	mean	sd	mean	sd	
Handaxes	160.6	31.3	99.7	20.2	61.7	15.2	1.5
Cleavers	152.9	18.7	95.5	10.5	48.0	6.8	4.2
Large Flakes	142.9	59.9	150.5	47.0	52.0	13.2	-

A striking pattern is that the artifacts (handaxes and cleavers) tend to be heavier towards the central region, i.e., right below the footslopes of the Pequenos Libombos mountains, at sites such as Umpala and Estrada Velha para Boane, or still at the footslopes of the Grandes Libombos, at Canhoeiro site. These are the areas where most of the very large cores of rhyolite were found. These tool forms were probably produced nearby the area where they entered the archaeological record; due to the vicinity of potential good sources of raw material, it the these lithic pieces do not present evidences of significant process of resharpening or re-tooling.

<sup>5</sup> On the dorsal surface / scars on the ventral face (adapted after Isaac, 1977)

Fig. 5.3.2 Contrasting evaluation of weight range: bifacial forms (made on flakes) vs. flakes



As the graphic illustrates, most of the flakes found weigh well below the average presented by handaxes, a fact that may help explain why there were not used as blanks to produce handaxes or cleavers. In fact, weight – seldom referred in the archaeological literature – seems to be, together with the variables that help defining form (i.e., mainly length, followed by breadth and width), very important in assessing the real potential / mass of a specific blank to be further on used to craft a handaxe. If one evaluates only the cleavers, a very similar picture is obtained:



Fig. 5.3.3 Evaluation of the cleavers' and large flakes' weight (rhyolite only)

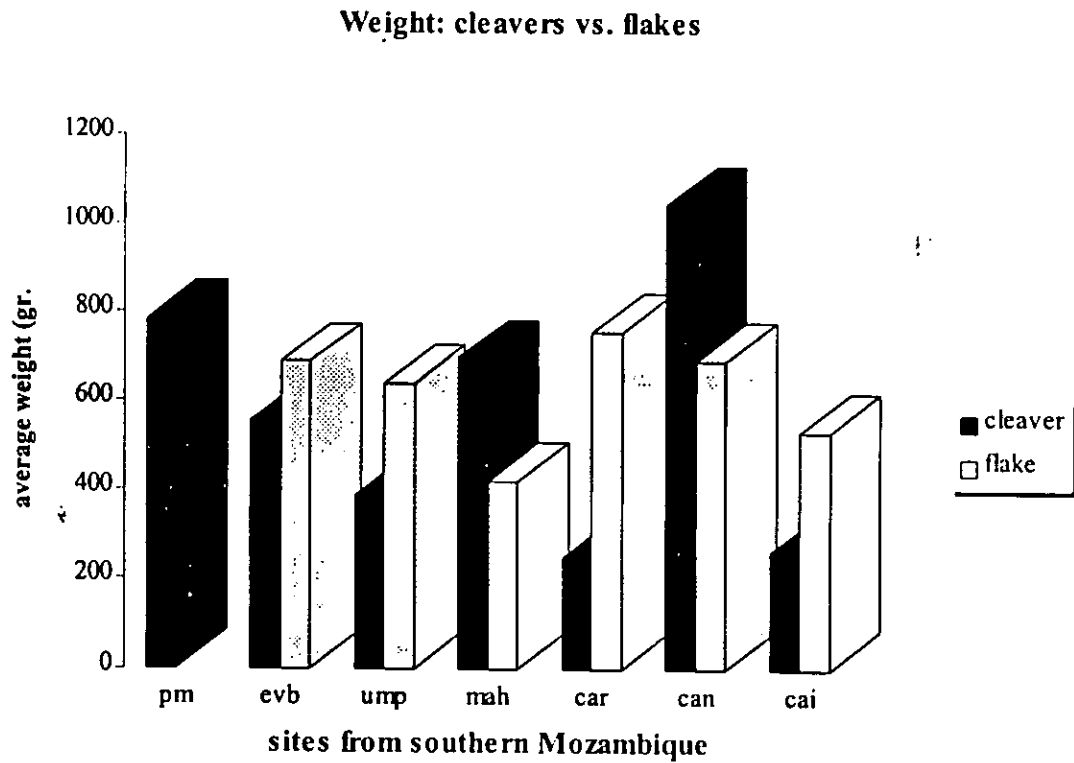


Table 5.3.5 Average thickness (mm) of the cleavers and the large flakes from the excavated assemblages of southern Mozambique

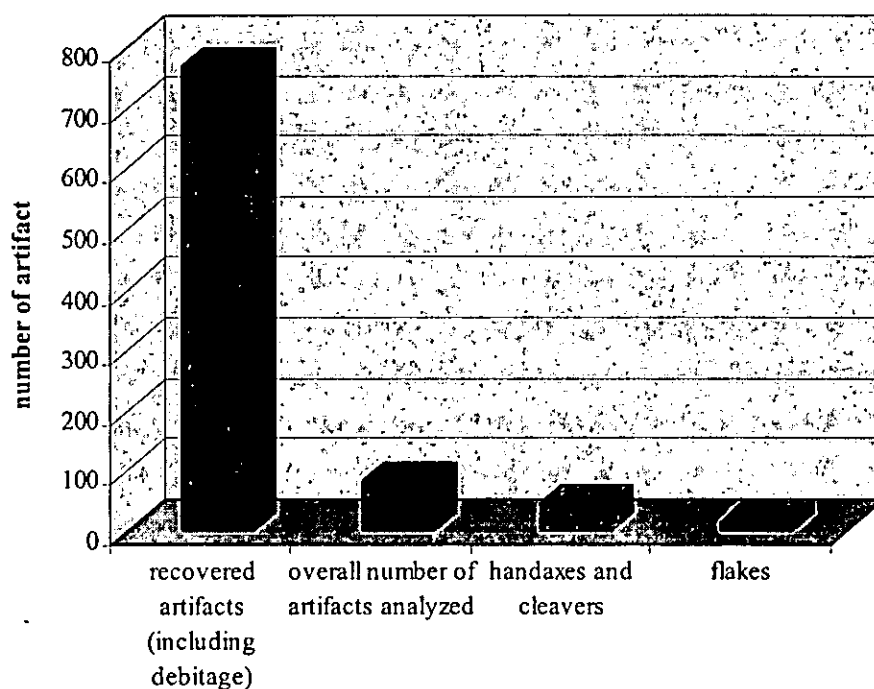
Sites	pm	evb	ump	msh	car	can	cai
<b>Artifacts</b>							
<b>Cleavers</b>	-	48	48	43	52	48	47
<b>Large flakes</b>	56	42	48	48	34	52	58

As the graphic Fig. 5.3.3 and table 5.3.5 indicate, in several cases – such as Umpala and Caimane, the large flakes found are long and thick to have been used to produce large bifacial artifacts. However, these flakes do not show the presence of predetermination in their shape, what ruled out their use as blanks for cleaver manufacture. At the same time, and because there are relatively thin, they could not have been used to produce handaxes. As referred previously, the development of the characteristic symmetry of the handaxes implies a significant removal of stone mass; in the presence of quite thin flakes, in an area where probably other cores and cobbles could be found, the knappers probably opted to search for more suitable blanks.

At the same time, most of the flakes (73.5%) fall inside Toth's types IV and V – i.e., flakes with prepared platform but with a cortical dorsal surface or with over 50% of cortex still present. This fact suggests that these flakes were mostly primary ones, although detached from an already prepared core, since the platform is predominantly (88.3% of the flakes) double or multifaceted. Finally, only one flake is of type I (i.e., plain cortex platform and with cortical dorsal side) was identified. This indicates that the sites excavated were not "quarry" sites, i.e., localities where extraction of large flakes was carried on by Acheulean hominids. At the same time, once it was determined that none of the cores found in the excavations of these sites could have been used to produce these flakes, the picture that emerges is that these flakes were probably selectively brought into the excavated sites, for future use. The ones found unretouched, for some reasons were left behind.

Fig. 5.3.4 Artifacts recovered during field work in southern Mozambique (data from excavated sites)

Artifacts recovered during field work in southern Mozambique



This chart clearly shows that among the assemblages excavated in southern Mozambique, a very small percentage is composed of handaxes and cleavers (6.3%). As I will discuss in the sections dedicated to technological analysis and potential functional interpretation (i.e., through Chapters VI and VII), the preparation of these artifacts in the overall is not very difficult or time consuming. However, one has to take into consideration that raw material of suitable size, the preparation of the blank, the search for the appropriate hammers (including the preparation of an appropriate soft hammer), together with the potential functions of these tools, makes it very difficult to predict where these artifacts are going to be integrated into the archaeological record. Clearly, the emergence of a distinct “tool” form that constitutes the benchmark of this period, reflects indeed a very specific perception of use of the resources available in the region by the Acheulean artifact makers and users.

### 5.3.2 Some problems regarding artifacts' measurements and morphology

#### 5.3.2.1 Regarding typological analysis

In my research, a preliminary typological study of the artifacts was performed for purposes of comparison with other assemblages from Southeastern Africa. Here, I followed the guidelines suggested previously by archaeologists working in Southeast Africa. Scholars such as M. Kleindienst (1961, 1967) and R. Mason (1962), together with M. Leakey (1971, 1996) suggested specific typological approaches to get insights regarding the specificity of the ESA. Their work provided a substantial typological base for comparison of collections. However, at the same time, the disparity of typological classifications in fact reflects the presence of distinct schools of analysis, rather than patterns in the material. This is another problem to be added to the discussion when talking about a base for comparing collections. So how can one assess variability?

As a consequence, I had to go back and re-analyze several collections on the basis of a common analytical base. The data were then screened through several statistic techniques, which allowed me to delineate similarities and dissimilarities among assemblages, and also identify some patterns of covariance between artifact types. Most of the results achieved will be compared against experimental data and discussed in the remaining chapters of this dissertation.

Yet, and as several researchers have pointed out (e.g., Frison, 1968, Bonnischen, 1977), formal types may or may not be the result of the same technological strategy and may not have taken part in the same functional situation. The assumption that similarity of form implies the same production sequence is implicitly inherent in all applications of formal typologies in cultural interpretation. And this does not correspond to the archaeological "reality" I found in southern Mozambique, where artifacts sharing a common "form" (such as handaxes and cores) were

erroneously lumped together inside the same typological (and implicitly functional) category. This fact had been previously reported for the archaeological record of Southeastern Africa ESA record. Indeed, the initial application of a technological approach to an Acheulean assemblage from Eastern Africa (Isenya - Kenya) by Roche & Texier (1991) showed that for most of the cases, the blanks used for the crafting of handaxes and cleavers attested the presence of a distinctive method of flake acquisition: predetermination for the case of cleavers, and frequently an opportunistic adaptation for the handaxes (Roche & Texier, 1991, Texier & Roche, 1995; Texier, 1996). This clearly indicates that the inclusion of these two forms inside the same category -- bifaces (see for example, Isaac, 1977, Schick, 1992, Wynn, 1979, 1991, 1995, 1996, Wynn & Tierson, 1990) -- in terms of analysis should be avoided.

The problem with the analysis described above results from the absence of some explicit statements on the real purpose of the classification, a purpose transcending the pure "sorting" of the material. In very few cases one can clearly observe a clearly stated relationship between behavior and the typological approach used. Sometimes one does not know what typology was actually measuring, or how the analyst got there, or even further, if the hypothesis can be tested (Bonnichsen, 1977). Further on in this text it will be shown that this type of relationship can only be formulated as the result of carefully conducted and documented observations in the actualistic mode, be they experimentation (e.g., Toth, 1982, Jones, 1996) or based on ethnographic observations (e.g., Yellen, 1977, Petrequin & Petrequin, 1983).

Most of the Acheulean collections from Southern Africa were obtained from find-spots of material which yielded nothing but a quantity of stone artifacts removed from their primary context. These artifacts were attributed to the Acheulean period just due to the presence of handaxes. But should they be studied at all, as opposed to merely being recorded, or still wholly discarded? The attempts to apply some kind of typological approach presented below share a common ground - the avoidance of the traditional functional pitfall. Therefore, the points of

reference range from the use of geometry -- i.e., the strict morphology of the artifact (Mason, 1962) -- through a pseudo-functional classification with lithic artifacts divided into three major classes:

- the large cutting tools (i.e., handaxes, cleavers and knives),
- the heavy duty tools (choppers, core scrapers, picks)
- and the small, "light duty" tools (e.g., Kleindienst, 1961, Leakey, 1975, Isaac, 1986),

to a set of generalized technological principles, where objects are perceived or as cores ("flaked pieces"), as flakes removed from them ("detached pieces") or still as "pounding pieces" (i.e., the potential hammers) (e.g., Isaac, 1986, 1989, Rogers, 1997).

A characteristic trait of all these definitions is that they cover only one aspect of the tool - its form -- even when the form is hidden under a pseudo-technological label. Formal attributes are an important aspect of tool production, and may show relevant variation on the idiosyncratic scale, but the analogy has to be extended to incorporate other relevant attributes too - attributes discerned by careful evaluation of analogous production-use situation. This misuse of formal type classifications actually lies at the heart of all archaeological "interpretation". Formal analogies are based on types (e.g., tool use, tool form). The attributes that define these types are not explicitly described and the relationships between selected and applied attributes are diffuse. Thus, when used to explain the presumed archaeological counterpart, these relationships have no predictive value whatsoever, because they are not logically deduced and validated. The relationship between the selected attributes is not properly understood and the relationship of the attributes to the situation "explained" is not explicitly stated (see Hodder, 1983, for a discussion of formal vs. relational "type" definitions).

For example, for the case of the Acheulean, formal classifications of lithic items (basically of handaxes) were used as analytical tools to detect "universal diffusion patterns" of handaxe manufacturers from Africa into Eurasia, but not into eastern Asia (e.g., Movius, 1948, Schick 1994). Along the north-south axis in the handaxe region, the imperious presence of

another bifacial artifact - the cleaver - has been frequently emphasized to distinguish an "African" variant (Jelinek, 1977, Santoja & Villa, 1990).

It should be said that typology played a major role as an initial sorting / analytical operation, and this is the reason why we present a brief typological analysis of the handaxes, cleavers and large flakes collected from the sites. But then, how to extract information from the artifacts?

#### **5.3.2.2 The problems due to artifactual isomorphism and the concept of "tool"**

The isomorphism of technological attributes in lithic analysis is more difficult to evaluate. Empirically speaking, the results of the experimental replicative program carried out for this dissertation demonstrated that variations in some of the input variables during tool production (e.g., know-how, flaking angle, type of blank, type of hammer used, etc.) do result in a corresponding variation in the technological variables. This means that different production strategies can be identified by the characteristics present in the "final" produced object, i.e., in the object recovered from the archaeological context. On the other hand, it is the analytical and documentary level that places specific restrictions on what is observed. Existing variation in applied technological strategy may be missed simply because the technological and/or functional attributes used in identification and type classification are inadequate.

The study of the archaeological and experimental data set allowed me to identify some pertinent characteristics in the experimental, controlled sample, which were tested against the archaeological data; therefore, the experimentally built-in check list of attributes proved to be essential to say which particular class of artifacts was present. For example, the index of bifaciality present in Table 5.3.4 clearly shows that the technological process of handaxe

production involves much more bifacial work (and hence producing more symmetric artifacts) when compared to the pattern observed in cleaver manufacture.

At the same time, this technological approach also demonstrated that special care is required in deciding upon the attributes to study or the measurements to take, so that they present a high degree of accuracy and give unambiguous information. However, it should be pointed out that the main unit of study here was the handaxe (since it was been widely established that it constitutes a technologically defined entity, a "maker's type" and not an "archaeologist type" (Roe, 1976:64), a form internally consistent in terms of manufacture (see also Texier, 1996). The characteristics analyzed were aimed at identifying secure attributes that would help build up a potential model for defining the presence of an hard or soft hammer production sequence, with all the technological complexity associated with this sequence of production.

A fundamental issue here is the concept of "tool", since a significant number of Middle Pleistocene archaeological localities in Southeastern Africa are identified only by the presence of the formal Acheulean tools - handaxes and cleavers. Part of the problem lies in the question of whether or not the artifact categories recognized by archaeologists (under the form of "types") and imposed as typologies were objects created successfully by stone craftsman with a desired shape in mind -- i.e., when retrieved stone artifacts are seen as designed tools, without assuming the possibility that part of the recovered lithic panoply may represent in fact specific stages in the process of lithic manufacture. In fact, none of the classic typological schemes take into consideration the possibility of evaluating "blanks", "partially completed", "failed products", lost or broken artifacts amongst the excavated assemblage (Johnson, 1979, Callahan, 1979, Rondeau, 1981). This trait is crucial since it allows the understanding of the technological complexity present at a site, being a window into the potential functional understanding of the assemblage recovered.



The typological approach assumes retouched stone artifacts to be finalities which can be recognized and identified by morphological similarity, i.e., by shape and characteristics of retouch (e.g., Bordes, 1961, Mason, 1962, Isaac, 1977). Based on the quantitative representation of the shapes/types of the retouched artifacts, assemblages can be grouped to define cultural entities (e.g., Mason, 1962, Bordes, 1968, Leakey, 1971, 1975, Hensen & Keller, 1971, Roe, 1996); other researchers have interpreted this typological similarity in terms of similar, shared function (Binford, 1972, 1989, Jones, 1980, 1996 Keeley, 1980). Isaac (1972, 1977) suggested that the morphological variability inside an assemblage and among them (although assuming the presence of specific morphological types) might in fact be just the product of a random walking situation. Finally, several scholars have raised the idea that some of the morphological variation could be simply related to technological aspects, such as stage of production or still by the quality and size of raw material used to produce the artifacts (Newcomer, 1971, Bradley & Sampson, 1978).

### **5.3.2.3 The artifacts studied**

#### **5.3.2.3.1 The raw materials used for their manufacture**

The initial technological emphasis of this research stressed the need to evaluate the lithic raw material used and its potential sources across the distinct landscapes identified in the region. Here, the main goal was to identify the raw materials suitable to fulfill the basic requirements involved in the production of the Acheulean emblematic pieces -- handaxes and cleavers. Another aspect to bear in mind, and already briefly mentioned in this chapter, is that the blank form or shape is also an important factor in determining the final morphological configuration of the lithic pieces (e.g., Cahen & Van Noten, 1971, Flenniken & Wilke, 1989, Perlès, 1992). Only large blanks (longer than ten-twelve centimeters at least) could have been used to produce handaxes and cleavers; the different morphologies of blanks are also determinant for the final morphology

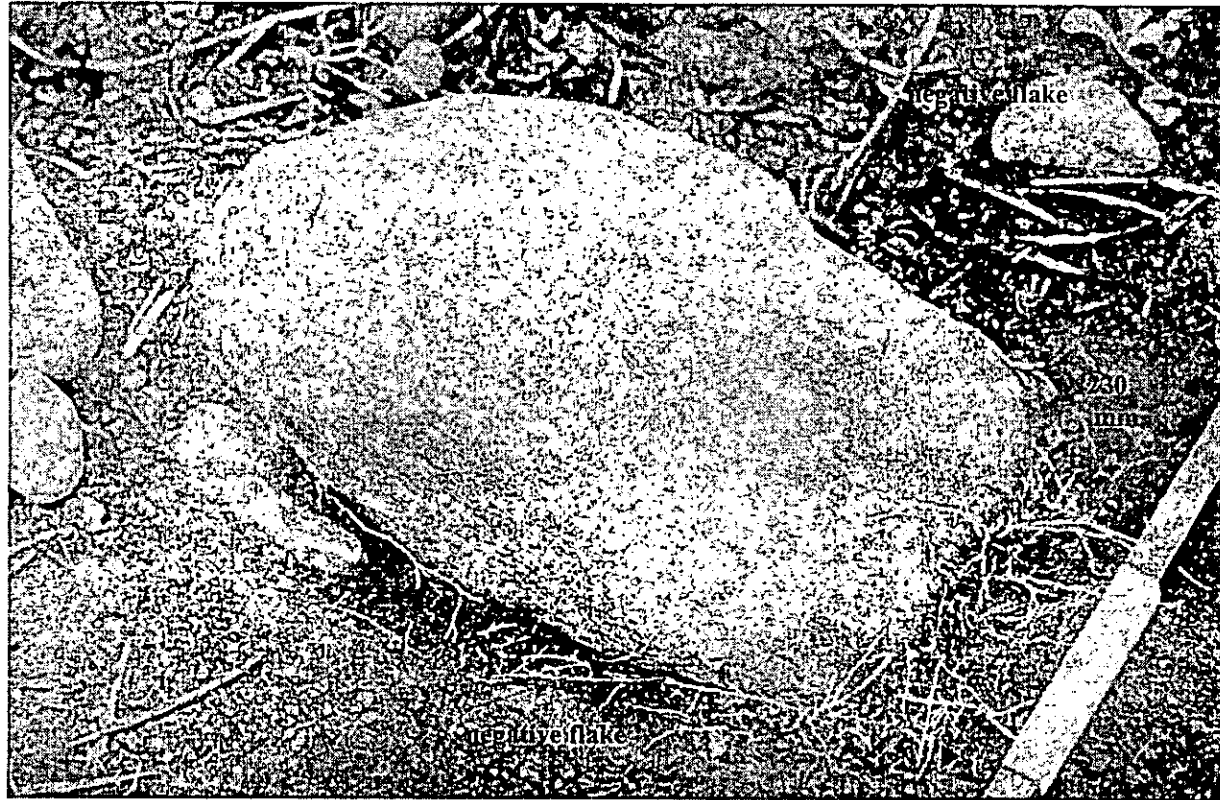


Fig. 5.3.5 Large core on rhyolite boulder found on the surface nearby Canhoeiro site in southern Mozambique. From this core two large flakes were detached (average length  $\approx$  190 mm).

of artifacts, since, for example, cleavers are only produced on flakes with a specific form, presenting however, distinct levels of predetermination (e.g., Roche & Texier, 1991, Texier & Roche, 1995a, Texier, pers. com.). This argument extends back to original raw material form and size. In other words, the size of lithic raw materials as well as the shape have much to do with the size and shape of the stone artifacts produced, as well as with the kind of manufacturing methods and techniques used to produce those artifacts.

The quality of lithic raw materials used as tools is important in artifact production and function (e.g., Crabtree, 1967, Isaac, 1984, Rolland & Dibble, 1990, Stiles, 1991).

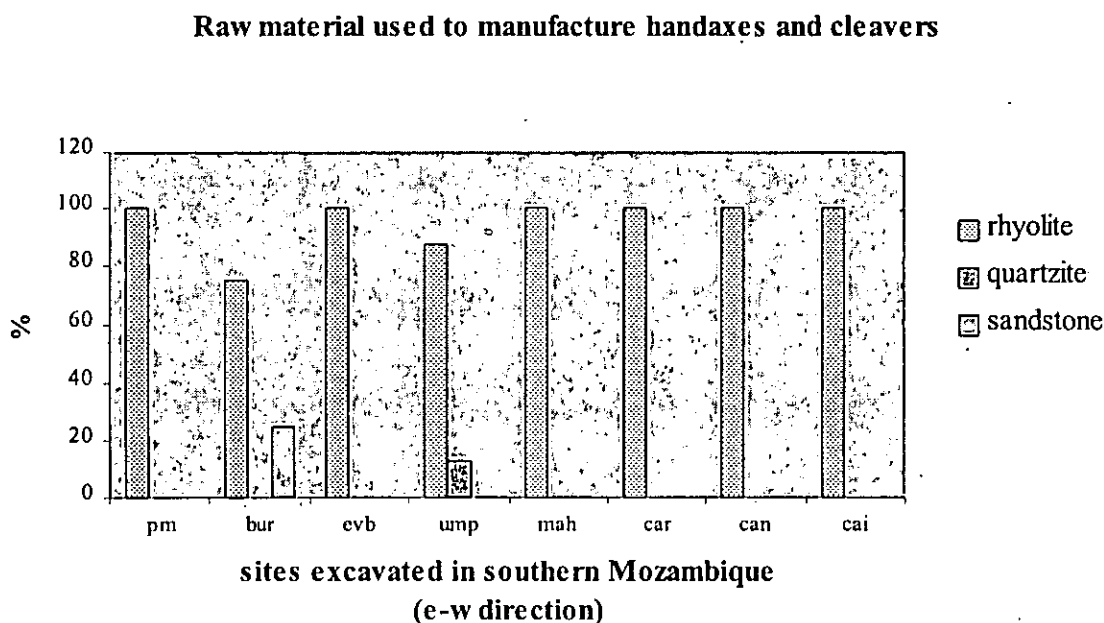
The riverbeds in the Grandes and Pequenos Libombos are pebbly or gravelly; the stones are mainly of rhyolitic origin. Pegmatoid quartz from granite and quartzite from ancient Barberton rocks are also found in the riverine gravels dragged by the Umbeluzi River from the western part of Swaziland (G. Botha, pers. com.). In fact, within the study area, fine-grained rhyolite and basalts, together with small pieces of chalcedony and coarse-grained quartzite occur naturally and are ubiquitous for most of the western part of the study area. However, the artifactual forms are dominated by rhyolite, with quartzite and basalt forms present in a much smaller proportions. Especially towards the Upland Division, one can find in the numerous streams that cross the mountains (in a west-eastern direction) cobbles and tabular pieces, normally of good quality rhyolite. Here too, large cobbles, weighing over 50 kilograms were found. Some of them in the past were used as cores to detach large flakes, potentially to manufacture cleavers and/or handaxes; During the field work performed in southern Mozambique for this dissertation I was able to locate a large boulder core (see Fig. 5.3.5), from where two large flakes have been struck off. However, these heavy pieces are not very common, as I will be discussing in the next chapter, on the section on the raw materials used to produce handaxes. In the former Transvaal region, large cores used to detach big flakes are also seldom found closeby

the Acheulean sites. Goodwin (1933) refers that he was able to identify one large core from which had been successfully removed two to three large flakes, about 20 centimeters wide and twelve centimeters thick. Several other sites have yielded large sized cores. For example, at Isenya -- Kenya, several large cores were found some of them weighting over 30 Kg (Texier, pers. com). A possible explanation for the absence of these cores, besides the fact that they normally do not occur immediately in the vicinity of the site, derives from their shapeless form, which can mistakenly be taken for just another large piece of rock.

Still in relation to lithic raw materials inside the study area, one should mentioned the various sedimentary rocks from the Mozambican Basin utilized by Early Stone Age manufacturers, especially calcareous sandstone (Obradinovic et al., 1983, Bauman & Ferro, 1987, Abel, 1994). This is especially important for the coastal area, where in fact the main raw material available is sandstone. Sandstone, although present in some large cobbles, crumbles very easily and normally is unsuitable to produce handaxes or cleavers. However, below the thick sandy cover of mid. to late Quaternary origin (King, 1971, Davies, 1977, Maud, 1986), there are a significant number of rolled pebbles, brought by the strong waterflows which occurred during the heavy humid and rainy periods of the Tertiary-early Quaternary (G. Botha, pers. com.). This helps explaining the presence of Acheulean sites along the coastal plain.

Regarding the question of soft-hammers, no fossil wood is known to have been found in this subcontinent part of Africa for the Middle Pleistocene (as the oldest evidence seems to be the piece found at Kalambo Falls - Clark, 1969). Therefore, the evidences had to be traced down through indirect, comparative work with experimentally derived data, as I will describe and discuss in Chapter VI.

Fig. 5.3.6 Raw materials used in handaxe and cleaver manufacture in southern Mozambique (data from excavated assemblages)



In all the eight excavated sites the large flakes were produced using rhyolite.

#### 5.3.2.3.2 The artifacts studied - why handaxes, cleavers and large flakes?

Although the Acheulean artifactual panoply is quite wide – including forms such as handaxes, cleavers, choppers, polyhedrons, denticulates, bolas, picks, etc. – the lithic analysis I performed for southern Mozambique assemblages was mainly focused on handaxes and, in a lesser stage, also on cleavers. Why the handaxe? As mentioned previously, the handaxe is a quite widespread tool form in the “Acheulean world” (i.e., Eurasia and Africa), found in large amounts in museum collections. The handaxes, unlike cleavers, are the largest tool with greatest bifacial work.

While it is generally acknowledged that the Acheulean witnesses the emergence of soft hammer percussion technique, many archaeologists appear to be at loss on how to identify and

interpret these evidences on the archaeological record. For example, the boundary between the Lower and Upper Acheulean -- place around 700 Kya -- is understood as the transition to a wide use of soft-hammer technique (Inizian et al., 1980, 1992) for the manufacture of handaxes. However, the criteria used by distinct authors to establish the difference between these techniques are not clear (e.g., Knowles, 1953, Bordes, 1969, Crabtree, 1970, Newcomer, 1971, Jones, 1981, Ohnuma & Bergman, 1982, Matiuchin, 1983 Whittaker, 1994).

The incipient study of the "chaînes-opératoires" present in the area for the manufacture of handaxes (together with the study of cleavers) opened a window towards the organizational procedures used by the Acheulean lithic knappers (e.g., Pelegrin et al., 1988, Edmonds, 1990, Pelegrin, 1990, 1994) in southern Mozambique. In this regard, an important advance lies in the information recovered through knapping experiments, combined with theoretical development of a model of interpretation of the technological behavior reflected in the assemblage (the concept of chaîne opératoire and a broader discussion of prospects of this approach will be discussed in Chapter VI). Therefore, through a series of experimentally controlled assemblages, it became possible to define a set of consistent criteria which helped detecting the presence of soft and hard hammer direct percussion techniques from the handaxes (and also cleavers) recovered at archaeological sites.

This approach tries to avoid some pitfall of previous typological analysis. In fact, quite often metric analysis --on which typological classification is normally based (e.g., Bordes, 1961, Kleindienst, 1961, 1967, Roe, 1996) -- are normally not sensitive enough to the differences present in the lithic assemblages, as I described earlier in this Chapter. This may help explaining the wide diversity of models and hypothesis suggested previously to explain the pattern of variability (in terms of metric data) among handaxes from the same site and from wide regions (e.g., Wynn, 1995, 1996, Wynn & Tierson, 1990, Fiedler, 1998).

Briefly, here some classic univariate and bivariate statistical computation are presented, although these data will later on be discussed together with the data achieved through replicative experiment.

#### 5.3.2.3.3 Why not the smaller flakes? Still some questions of context...

As described above, the Acheulean sites in southern Mozambique, as in most of the cases in Southeastern Africa, besides the presence of handaxes and cleavers, are also characterized by a wide range of retouched flakes, together with other artifactual forms. Some of the excavated sites yielded a significant part of debitage, so the "site" should be tough as a sample of a continuous zone of human activity; this activity likely involved the manufacture and use of lithic artifacts, and occasionally of large bifacial tools. At the same time, several factors related to the geological context of the archaeological sites from the Umbeluzi-Changalane-Tembe region show that some disturbance is present:

- The surface condition of the artifacts from the same "site" is not always the same (various degrees of weathering present);
- Discrete scatters containing all sizes of debitage are present, although it is not known if they are penecontemporaneous;
- There appears to have been some vertical dispersion of artifacts.

The fact that large lithic pieces are perceived as the most peculiar specimens of the ESA led to a general assumption that this period is composed of core-based industries (e.g., Clark, 1977, Nobles & Davidson, 1996). Specifically for the Acheulean, the "bifacial tools" (i.e., cleavers and handaxes) are described and perceived as "flaked pieces", i.e., as portable lithic cores from which flakes could be detached constantly (e.g., Kleindienst, 1961, Isaac, 1977, Harris, 1978, Rogers, 1996). This contrasts with the following periods -- MSA and LSA -- which

are, by definition, flake based industries (e.g., Hayden, 1987, Clark, 1988, Sheppard & Kleindienst, 1996) and where a decrease in the size of the artifacts is assumed to be correlated with the time frame. Therefore, most of the previously studies of the Acheulean period have been focused on these large pieces, without a complementary study of the flakes found in association (Sheppard & Kleindienst, 1996). Also, the disturbed nature of most of the Acheulean sites found in Southern Africa (e.g., Isaac, 1975b, Volman, 1987, Meneses, 1996, Klein, 1994) has a potential implication in that normally the artifacts exposed together at a specific location, might in fact belong to two or more industries. This ambivalence gave rise to some problematic aspects of site classification in terms of cultural and industrial affinity, since without a secure context one can not be sure of the association among the pieces found together in a specific site or archaeological level (Villa, 1983). Thus, the sort of reconstructions that have been suggested for the Acheulean sites in terms of understanding them "as living floors" -- i.e., that a specific archaeological site/level represents some sort of integrity in terms of homogeneity of the assemblage (e.g., Ohel, 1977, Cahen et al., 1980) -- is not reliable. For most of the ESA sites, the low level of stratigraphic integrity (Schick, 1992, Stern, 1993, Rogers, 1996) resulted in a very obscured pattern, where too many variables are involved in terms of site formation processes (i.e., it becomes very problematic to dissect and identify the key elements participating in this process -- see, for example, Schick, 1992, Schick & Toth, 1993). A possible alternative for this difficult situation might be the development of an approach which would combine studies of raw material sources and transport with experimental knapping and replication of the "chaînes opératoires" (Edmonds, 1990) detailed debitage analysis and spatial analysis based on refitting and microwear studies.



#### 5.3.2.3.4 Why not refitting?

Archaeological deposits in the area under study consist mostly of vertical open air scatters (G. Botha, pers. com.); in addition, accumulations of lithic pieces run down from many of the sites. Therefore, the study of these sites presents some methodological problems. Refitting, for example, a methodological approach that makes it easier to understand the status of the integrity of the assemblage (i.e., trying to reconstruct archaeological structures concealed by an apparent disorganized dispersion of material), and the evaluation of the technical attitudes performed at the spot, is not practicable. Indeed, refitting is a powerful method for following the movements of the artifacts during their lives by determining where they were made utilized and lost or rejected, or still the integrity of the production sequences performed at each site (e.g., Cahen et al., 1979, Hofman, 1981, Leroi-Gourhan, 1982, Villa, 1983, Bergman & Roberts, 1988, Schick, 1992, Pélegrin, 1990, Cziesla, 1990). I tried to reconstruct the large pieces with the flakes found nearby, by joining apparently matching pieces. However, I was unable to reassemble any of the artifacts and lithic fragments together. I described earlier in this chapter, in southern Mozambique, the studied sites do not represent single and undisturbed moments of lithic activity, and therefore refitting, as a methodological approach, is not possible.

#### 5.3.3 Conclusion

In the "classic" sense of site oriented studies, the archaeological data from southern Mozambique would had been labeled as unfeasible for retrieving information regarding the behavioral attitudes practiced by its producers (i.e., no direct primary context, absence of a securely dated sequence, no fossil information...). The only possible secure information would be to say that there is evidence of the Acheulean in southern Mozambique, giving a short information regarding some typological data.

The preliminary evaluation of the sites found and excavated in southern Mozambique clearly suggests that a new approach has to be applied, in order to accommodate the all new range of question the Acheulean periods brings about. If we accept the fact that about 1.6 Mya new morphological artifacts appear in the archaeological record, one needs not only to understand them from the point of view of complexity involved in its manufacture and use, but also to contextualize the findings in terms of region. Therefore, the analysis of several "classic" Acheulean sites from South Africa was undertaken, whose data was presented and discussed in an earlier section of my dissertation, aims at understanding the method and problems involved in the manufacture of handaxe and cleavers found in the Vaal River area.

From the description of the lithic assemblages from southern Mozambique and South Africa presented in this dissertation, it becomes clear that variability among Acheulean artifacts depends upon very distinct and specific factors. For the case of the tool forms I studied more specifically – the handaxes – since they are not biological entities, they cannot be subjected to laws of evolution (contra Bordes, 1968).

As I will be discussing in more detail in the next chapter, the idea of "reduction sequence" propelled the rise of attempts to understand Acheulean variability from the perspective of knapping procedures. Nonetheless, the focus continued to be placed upon the crafting process, or on the use of new technological improvements as a chronological reference (but see Toth 1982, Schick & Toth, 1993, Jones, 1994, Callow, 1994). So, little has been done in terms of the study of the cognition and psychomotor aspects of the technological actions, as an integrative approach (but see Piaget, 1961, Wynn, 1991, Corballis, 1992, Calvin, 1993, Mithen, 1994).

While in this chapter the study of the Mozambican Acheulean sites was predominately conducted following the "classic" approach mentioned earlier here, some new aspects were brought up. In fact, the object of classification and morphological study becomes the behavior of the individuals who crafted the pieces, integrated in a broader scheme of environmental dynamics and not the pieces *per se*. Assuming that an archaeological assemblage condenses information on

the production-use-discard sequence, a new methodological approach will have to include information not on the final stage of the process of manufacture-use, but rather, on how particular forms of the lithic knapping process may have served a variety of purposes, depending on their location within specific paleogeographical context. This will require shifting the focus of research from the archaeological artifact as the final and single font of evidence, to its biographical story, extending the study back to search for the reason that led to its creation; here, besides the direct, archaeological evidence, one can retrieve additional indirect evidence (see Stone, 1981), as exemplified by the use of wood in handaxe manufacture. In this realm, actualistic studies become an importance source of information, giving us further dimensions in which to monitor variability in the options and the decisions people faced in the process of artifact production and use.

## **CHAPTER VI - PRODUCTION TECHNOLOGY AS AN APPROACH TO THE UNDERSTANDING OF THE ACHEULEAN IN MOZAMBIQUE (IN THE CONTEXT OF SOUTHERN AFRICA)**

### **6.1 THEORETICAL DISCUSSION OF THE METHODOLOGICAL APPROACHES APPLIED**

#### **6.1.1 Introduction**

From the preceding discussion of southern Mozambique and Southern Africa, it is indisputable that the difficulty in understanding Acheulean is that most of the sites are apparently in secondary context. While at a descriptive level the identification of an Acheulean site results essentially from the presence of diagnostic tools in the archaeological assemblage (e.g., handaxes), the potential of the site for further inference is obscured by the lack of integrity of the archaeological occurrence that might offer some hints regarding the activities carried out there.

Since few Acheulean lithic studies have been reported recently, most of the questions posed in the 1970's and early 1980's concerning the meaning of Acheulean stone artifacts and the productivity of methods for lithic analysis remain open.

Archaeological assemblages, artifacts as they are found during excavations, represent the fossilized evidence of past human behavior, that is, they encode information of an activities from the remote past. Technology provided these hominids with means of manipulating the surrounding environment and the evidence for such a process can be recognized in the archaeological record of material culture. This record can provide some indication of prehistoric hominid capabilities in that the artifacts indicate the intentions and activities of hominids during

a specific episode of knapping activity. In this dissertation, the concept of "tool" is used to make reference to objects that were knapped following a specifically sought conceptual design, which reflected probably the need to fulfill one or a set of specific tasks; "artifact" is used in a wider sense, when referring to any object manipulated and or transformed by hominids in their interaction with the surrounding environment.

The archaeological record is static, but it is the result of past dynamic processes. One approach revealing the dynamic processes behind the static record is through experimentation (in this case including both processes of manufacture and use of artifacts). The tool is an object shaped according to a pre-conceived image that guided its construction, and it is considered a "finished product" at the point when it is brought into conformity with this image. Beyond this point is the sphere of use, rather than manufacture. In the case of the Acheulean in southern Mozambique, experimentation constitutes a valid method for studying the dynamics of lithic manufacturing systems. Indeed, it provides the only available means to reconstruct the technological complex that produces handaxes and cleavers and to compare the "expected" outcomes with the "observed" pattern in the archaeological record (Braithwaite, 1953, Young, 1989).

In this dissertation, the concept of **technology** is used to encompass the procedures used by hominids to manufacture implements. One can understand artifact technology through a careful process of examination of specific assemblages, using the knowledge developed from lithic replicative projects. This assumes that:

- manufacturing and functional behavior is recorded on the artifacts and debris of specific assemblages;
- through actualistic/replicative and comparative studies one can train oneself to read the archaeological record, and consequently, to translate the attributes observed into the

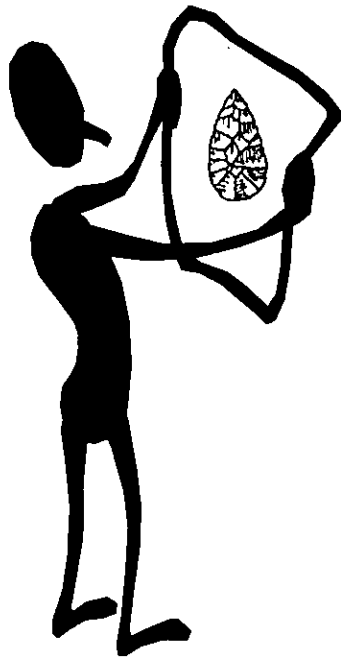
conceptual framework developed, in order to interpret the meaning of the assemblage. In this regard, a schematic representation about how to actively "read" an artifact is described in Fig. 6.1.1.

A replicative experiment implies not just producing a copy of a prehistoric lithic piece, but working with the same raw materials, tools and techniques that were used in the past or as near as one can tell from the available evidence. The archaeological interpretation is then based on the comparative evaluation of the excavated samples against what was experienced (Ascher, 1961, Coles, 1973, 1979). However, one also needs to be cautious about some of the potential biases introduced by actualistic studies. If processual studies place the focus of explanation on the process of tool production, throughout this dissertation, **technique**, as a whole, is considered a social situation.

In this way, I have tried to go beyond some of the constraints placed upon lithic research. Up until now most technological studies have been restricted to a descriptive stage (i.e., the study of the variable(s) the researcher assumes as being most important), rather than aiming at explaining and revealing the behavioral complexity embodied in the artifactual set that is produced or replicated (e.g., Pelcin, 1997).

Actualistic studies pose several problems, the most important is the fact that the replicator acts in an artificial situation. He or she does not belong to a specific social group where he or she is supposed to occupy a particular position, which the individual acquires through time, as well as a whole system of practical and theoretical technological knowledge. Additionally, facts such as individual skills, momentary impulses and inspiration, are all potential realities, which have to be expected to increase variability. However, in terms of ESA record, variation at the level of the individual is implicitly excluded from consideration, since one does not know how many artisans, how many knapping episodes took place at the spot under study (i.e., at the site), and how often a place was visited (Isaac, 1972). In general, the pattern observed at a site represents

## How does one “read” an artifact?



- an initial perception of the artifact, leading to the possible identification of the shape, volume, technological marks and their sequence;
- deciphering the distinct technological marks that led to the current state of the artifact in their chronological sequence, in order to assess the progression of intentions (successfully or not) of the artisan;
- identification of the final shaping, retouch; i.e., the events subsequent to the preparation/roughing out of the blank piece, according to their technological sequence;
- chronological mental reconstruction of the overall production process, based on a secure (replicative based) knowledge of the production sequences exhibited by a specific assemblage.
- identification of the subsequent modification of the tool (ex: resharpening) aiming at assessing potential activity patterns (i.e., the functional realms of technology).

Fig. 6.1.1 Schematic representation of how one is supposed to read an artifact...  
from the standpoint of production technology, implying a dialectic relationship of observation to known facts

rather a set of events, and only sporadically can one identify or perceive an archaeological assemblage as a single event point (e.g., sets of refitting artifacts indicate that these pieces result from a single, identifiable behavioral event). Therefore, the comparative analysis is normally produced at a broader scale, looking at each set of artifacts excavated from within the same subsistence continuum (Binford, 1982b). The landscape perspective is aimed at identifying the paleoenvironmental basis for the search and location of the lithic and bones used, discarded and lost by hominids (Blumenschine & Peters, 1998).

Archaeological research on lithic analysis has dealt with topics that lend themselves well to experimental verification and to inferring past events by analogy. The approaches to experimentation in lithic archaeology reflect the growth of awareness among researchers about the importance of this research for evaluating the strength of archaeological inferences.

The initial questions approached by means of experimentation were mainly concerned with how the earlier stone tools had been produced, and to a lesser stage, how they could have been used (e.g., Spurrell, 1883, McGuire, 1891, 1896, Cushing, 1897, Moir, 1926, Pond, 1930, Coutier, 1931, Ellis, 1939), based predominantly on ethnographic references. More recently, archaeologists have developed the capacity to identify the taphonomic factors that may influence the formation of lithic assemblages (e.g., Villa, 1983, Schick, 1992, Stern, 1993), aiming at addressing more complex questions related to the processes and context which may have created a whole set of relevant circumstances in the object under study (Gifford-Gonzalez, 1991). Nevertheless, researchers still could not access much more in terms of cognitive processes, functional purposes and behavioral relationships from the assemblages, i.e., assessing the complexity of the "meanings" (such as the multiple uses of handaxes) present in an assemblage.



The research carried out for my dissertation has shown that the time has come to shift towards a more complex analysis of holistic inferences about the lives of prehistoric hominids, in a temporal and spatial perspective (while interacting with the surrounding environment).

Prehistorians aim to reconstruct past behaviors from complex patterns of multiple information recovered through the main "signatures" of Paleolithic times - the lithic assemblages. Here I am referring to signatures as one way to "dissolve" the static character of the past, in order to reveal the dynamics that produced it. That is, assessing through experimentation the technological complexity of an assemblage allows one to retrieve the link between behavior and the distinctive pattern of residual formation (i.e., the assemblage and its contextual information). However, up to now lithic archaeology has kept itself in the main stream of "old time" classic typological archaeology, where actualistic studies and qualitative analysis are still viewed (consciously or not) as a means of inference and confirmation regarding the typological cannons established long ago. In this realm, most of the experimental work done has been used merely to justify the already assumed existence of specific forms (e.g., Jones, 1994, Schick & Toth, 1994) or functions (e.g., Keeley, 1977, 1980, Jones, 1980, 1981). This follows the contemporary trend present in lithic archaeology, in which stone tools are supposed to exist only for the purpose of immediate food extraction (i.e. foraging behavior - see Gifford-Gonzalez, 1991), and not to organize and to develop a complex system of relationships with the surrounding environment. This last part will bring into the picture non-linear and challenging questions, requiring the evaluation in the analysis of evidences with distinct levels of confidence, ranging from descriptive data to speculative non-testable inferences.

In this chapter I will discuss some issues regarding the enhancement of our knowledge of the development of the technological complexity which is characteristic of the Acheulean. An important component of the behavior is concentrated in the stone artifacts, namely the complex

nature of technological processes required to produce handaxes and cleavers. When looking at the artifacts through the lenses of a technological approach the archaeologist is able to retrieve information regarding technological development, and understand it as the material manifestation of mental phenomena. Here, a critical indicator of cognitive advance might consist of evidence of planning, or thinking many steps ahead of the present situation (i.e., the manufacturing of the artifact *per se*), and of curating or expediting or caching elements of material culture that will be required for these future activities (e.g., Binford, 1972, 1977, 1979, Bamforth, 1986).

The assessment of the lithic manufacturing strategies in place during the Acheulean in southern Mozambique was achieved by means of experimental replications and comparative analysis with other Acheulean archaeological sets from South Africa. Such research requires the use of well-controlled actualistic studies and observations to identify the probable causal linkages between the human agents and their requirements in terms of production and use of artifacts to survive within a specific environmental setting. The main goal of the replicative experimental project carried on for this dissertation was to identify secure criteria regarding the presence of soft hammer produced handaxes in the Acheulean record, together with an evaluation of the probable ecological constraints that led to its appearance in southern Mozambique. The experimental project carried out to produce handaxes allowed establishing several criteria to distinguish between the use of soft and hard hammer direct percussion techniques. These characteristics were then employed to detect distinct technological strategies at place in Acheulean archaeological sites. In fact, and as mentioned in Chapter I, in Southern Africa, the more probable raw material used to produce soft hammers were African ironwoods. Although references to the technology of tools are becoming more common in lithic studies, they are not always well grounded in research. Specially, references to soft hammers (using biotic materials) are very scattered and generalized. Site descriptions and inventories normally do not

provide these artifacts, since they normally get quickly destroyed. However, indirectly – through experimentation and comparative analysis of archaeological lithic pieces – it became possible to access information about this important component of early lithic knapping tool kit. This included not only evaluating the technological implications for the immediate production of handaxes and cleavers, but also the evaluation of other important issues, such as assessing the most suitable ironwoods and their ecological setting. For example, and specifically to evaluate the importance of the emergence of a soft hammer percussor for the Acheulean lithic knappers, several raw materials (both biotic and abiotic) were tested, in order to verify their potential adequacy (both as percussors and as blanks to produce the tool forms); the contexts for their occurrence were also evaluated (i.e., the determining structure – see Gifford-Gonzalez, 1991), in order to search for the effectors which may have created the traces observed in the excavated archaeological record.

### **6.1.2 The role of experimentation in archaeological research**

The middle range approach postulates that if a strong correlation can be established between specific aspects of behavior and material culture in the actual world, the presence of such material culture in the archaeological record allows the archaeologist to assume that the associated behaviors were also present in the past (e.g., Binford, 1972, 1981). The bridging argument which establishes the relevance of the actualistic studies for inferring past behavior is that of uniformitarianism (see also Gould, 1965, Simpson, 1970, Binford, 1977). Two main propositions have to be kept in mind in order that actualistic studies could be used as premises for inferences regarding the archaeological past, namely:

- What one observes constitutes a pattern or merely a coincidence?
- Is the proposed causation (if verified) also present in the past?

By using a uniformitarian principle, one acknowledges implicitly that stone artifacts and debris have responded to the same situations in terms of form and content uniformly over time. Here, analogy helps "revisualise" phenomena, by asserting that it is like another admittedly non-identical entity (Agassi, 1964, Carlolye, 1971); thus, it becomes possible to develop hypotheses against which the archaeological material can be tested and better rationalized. Since we are dealing with species other than anatomically modern humans, and because the human behavior is cognitively mediated, archaeologists must be careful when using generalizations based on such constraints to infer human behavior from the archaeological record. There is no guarantee that the thought processes and cortical areas involved in stone tool making by *Homo habilis* and *Homo erectus sensu lato* are similar to those of *Homo sapiens sapiens*. All of the methodological approaches used to access this issue are indirect, since neither hominid cognitive processes nor linguistic patterns fossilize in a direct manner (e.g., Bower, 1996, Gowlett, 1996, Wynn, 1986).

Also, and because hominids and the biotic contexts in which they existed are biological entities, researchers tend to rely on the use of assumptions about causation and inferential confidence and forget about the role of casualness (Salmon, 1982). I will argue that a more complex, holistic approach will be the only way to achieve new information, although one needs to be aware of the fact that several elements of uncertainty will be brought into the picture. There should be regularities within a dynamic world of uncertainty and randomness, and this latter should not be assumed as a dilution of inferential confidence. The application of analogical reasoning remains possible and required, although its application will be more complex, since one needs to take into consideration more parameters that were not even spoken before. In fact, one of the main mistakes has been to move away from the method of multiple working hypotheses (Chamberlin, 1860) in favor of a strict deductive approach that privileged various forms of ecological, technological or economic determinism. Doing so has resulted in a

premature theoretical closure (Trigger, 1995), which has inhibited the development of archaeological understanding.

When applying a holistic approach to a case study, one should be able to rise above formal analogies (when only the artifact form is evaluated, without understanding the complexity of the technological processes at place), and achieve a deeper understanding of the structural linkages between the phenomena specified (Leatherdale, 1974, Gifford-Gonzalez, 1991). Here, several independent lines of evidence (presenting distinct levels of confidence and testability) are combined to identify the circumstances that led to the emergence of a specific phenomenon, such as the appearance in the archaeological record of large lithic forms – the handaxe and the cleaver. In fact, besides technology of production (the main field of assumptions in this dissertation), actualistic studies on functional technology and ecological features become important data sources of actualistic information which help us to understand the systems of land-use in place across the landscape locales identified in southern Mozambique. The archaeological information on the lithic assemblage, together with the anatomical characteristics of the species who is normally associated with the manufacture of the Acheulean artifacts, are key elements against which actualistic models can be tested and interpreted (this discussion will be developed in Chapters VII and VIII). The experiments constitute hence the “controller” element in the development of a relationship between the dynamic past and present. For example, and still regarding the possibility of identifying the presence of a soft hammer direct percussion technique, experimentation becomes a means of verifying the behavior of raw materials used to produce the artifacts, the general morphology of the produced pieces, percentage and types of fractures present, etc.

### 6.1.3 Experimentation and the emergence of new approaches to the understanding of lithic industries

#### 6.1.3.1 The processual approach

The archaeological study of the African Acheulean collections has showed significant variation among lithic artifact assemblages. Previous theoretical work on this subject has suggested that the Acheulean artifact types represented end products. In fact, classic approaches assume that:

- a) everything that fits inside a specific artifact type represents a "finished" tool type (e.g., Alimen & Vignal, 1952, Bordes, 1961, Tixier, 1957, Chavaillon, 1965);
- b) "types" can be recognized and identified by morphological similarity (e.g., Bordes, 1961).

The similarity among artifacts and the variability across space and time among assemblages has been explained as a reflection of cultural systems (e.g., Leakey, 1971, 1975), a product of activity differences (e.g., Howell et al., 1962, 1963, Clark, 1975, 1980) or even the reflection of random walking behavior (i.e., stochastic movements – see Isaac, 1972a, 1972b).

These studies set up the interpretative framework in a static sphere of analysis, separated from the real world – i.e., the dynamic world which includes the decisions made about the choice of raw materials, the manufacturing process, the use of artifacts and possible further modification, until the piece was finally lost or discarded. Hence, morphological variation among artifact assemblages does not reflect the impact of technology along the path of artifact crafting (e.g., Bradley & Sampson, 1978, Flenniken, 1985, Edmonds, 1990).

The lithic experiments performed between the early 1940's and the 1960's tended to be sporadic (e.g., Goodman, 1944, Knowles, 1944, 1953, Baden-Powell, 1949). From the late 1960's on, the skills of Bordes in France (1947, 1950, 1961) and Newcomer in the U.K. (1971)