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A Macroscopic Analysis of a Later Stone Age Assemblage from Southwestern Tanzania

by

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Abstract

This thesis presents a macroscopic lithic analysis of a Later Stone Age archaeological assemblage from the site of IdIu22 in the Songwe River valley in southwestern Tanzania. Typological and technological analysis with comparisons to other East African sites aim to place the site within a relative culture historical context. This data also forms the basis of analysis and discussion of site use and mobility in the region, raw material availability and utilization, lithic reduction, assemblage variability, as well as statistical measures of assemblage evenness and richness. The site of IdIu22 is fully Later Stone Age and primarily of Holocene age. Its manufacturers are sedentary with a high reliance on locally available raw materials for lithic production. In the absence of preserved organic material, there is no evidence to suggest that anything more than stone tool manufacturing took place on site.

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Dedication

This thesis is dedicated to my parents for allowing me to make my own decisions and follow my own path in life, wherever it may lead.

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Chapter 1 – Introduction and Background

1.1 Introduction

One of the most popular and most contentious issues in paleoanthropology today is modern human origins, for it seems that no one can come to a decision as to where, when and how modern *Homo sapiens* first evolved (Ambrose 1998; Henshilwood and Marean 2003; Klein 1995). In what is at times a very heated debate, there are many lines of evidence used to prove one's argument. However, no matter what side of the fence you sit on, these data can be used to further one's ideas in what is a very cloudy debate, indeed. New methods in DNA analysis, as well as fossil and archaeological evidence all help to piece together this puzzle of where and when did the first people like us come from, and what was it that served as the final push that put them over the edge into being fully modern *Homo sapiens.*

Roughly analogous to the Middle and Upper Paleolithic in Europe and North Africa, Middle Stone Age (MSA) and Later Stone Age (LSA) are used in Sub-Saharan Africa in order to reflect more local traditions. Predominantly flake based, the MSA is dominated by scrapers, retouched points, bifacial pieces and peripheral or circular/radial core reduction, while the LSA is dominated by blade technology, patterned platform cores and microlithic technology (Klein 1992). In Sub-Saharan Africa, the development of modern human behaviour is represented archaeologically with the transition from the Middle to the Later Stone Age, the onset of which has been dated to between 30,000 to 50,000 years ago BP (Ambrose 1998:377). It is thought that at this time some stimulus prompted a major shift in how modern humans behaved, which is reflected in changes in the material culture.

With modern behaviour comes a whole new suite of artifact types and raw materials, exploitation of a wider variety of game such as large mammals, fish and fowl, and most importantly an explosion of cultural and personal adornment (Klein 1992; Ambrose 1998; Henshilwood and Marean 2003; Mellars 1991). However, genetic evidence (Cann et al. 1987; Ingman et al. 2000; Vigilant et al. 1991), as well as new dates on early modern fossils (Clark et al. 2003; McDougall et al. 2005; White et al. 2003), puts the origin of anatomical modernity in Africa somewhere in the range of 100,000 to 200,000 years ago. Herein lies one of the major questions on the topic of modern human origins. Why is there such a large gap in time between anatomical and behavioural modernity, and what is the stimulus that leads to the development of this new way of thinking? It is clear that more research is needed before these questions can finally be answered, and this controversy is the main reason why this area of study is currently so popular.

This thesis presents data from six test pits excavated at a Later Stone Age site from the Songwe River region, Lake Rukwa Basin, in southwest Tanzania in 1995 and 1997. Analysis and discussion of the data will build on a previous analysis (Sipe 2000) from a single test pit at the same site. Typological and technological questions such as manufacturing techniques and stages of production will be addressed by examining morphological characteristics of both tools and debitage. Raw material procurement and preference in the manufacturing process will also be addressed and each of the test pits will be examined level by level in order to identify any change in the assemblage over time. In addition, questions of site use and mobility strategies will be examined from a macroscopic perspective built upon the typological and technological analysis. Conclusions derived from this study will then be used to comment on certain aspects of modern human behaviour in the Later Stone Age of Southwestern Tanzania. It should be noted that I did not participate in the actual excavations of the material, but did work in the laboratory as a research assistant.

1.2 Mitochondrial Eve and the African Origin of *Homo sapiens*

One area of scientific research that is gaining popularity and has many possible applications with respect to modern human origins is DNA analysis. By unlocking the human genome scientists hope to gain insight into many aspects of human history and evolution. By looking at genetic samples in living people, researchers hope to gain insight on the origin of modern humans. An article by Wilson and Cann (1992) expresses their confidence in this technique by stating that, unlike fossils that may or may not be ancestral to modern humans, our DNA definitely had to come from the actual modern human ancestor. Results of their analysis showed that, using mitochondrial DNA, all living humans can be traced along maternal lines to a single common ancestor who lived about 200,000 years ago in Africa (Cann et al. 1987:34). While this female ancestor does not represent the first modern human, it does represent the woman who gave rise to all modern humans alive today. Mitochondrial DNA (or mtDNA) was chosen for the study of human origins due to many advantageous properties. It provides a more detailed view of human diversity because of the rate of mutation is much higher in mtDNA than in nuclear DNA (Cann et al. 1987:31). Neutral mutations occur at a steady rate over time and that makes them perfect for analyzing the degree of genetic variation, and enable researchers to accurately predict the timing of the most recent common ancestor to all humans (Cann et al. 1987:31; Wilson and Cann 1992:69; Ingman et al. 2000:708; Vigilant et al. 1991:1503). Another advantage is that mtDNA has a strictly maternal mode of inheritance, which means that there will be no recombination of genes; it therefore traces the female line of descent (Cann et al. 1987:31; Ingman et al. 2000:708; Vigilant et al. 1991:1503).

It is with these facts in mind, that Cann, Stoneking, and Wilson (1987) embarked upon their pioneering studies to trace back through human mtDNA to find the most recent common human ancestor. Their sample consisted of 147 different individuals coming from five different geographical areas and was broken down as follows: 20 Africans, 34 Asians, 46 Caucasians, 21 aboriginal Australians, and 26 aboriginal New Guineans (Cann et al. 1987:32). However, one of the main criticisms of this study was the fact that 18 of the 20 DNA samples used for the African individuals were actually taken from African Americans (Vigilant et al. 1991:1504). After carefully scrutiny of the DNA results, it was shown that despite this, there was still a strong enough connection to native African groups in that 12 of the 18 samples contained restriction site markers predominantly found in native Sub-Saharan peoples (Cann et al. 1987:32). As well, it was discovered later that a Nigerian Yoruba and an African American did, in fact, share an identical mtDNA type (Vigilant et al. 1991:1504). Despite the initial problem, it seems that the African American samples used had strong enough ties to Africa that it would not skew the results.

These mtDNA sequences were then analyzed and compared using restriction analysis and the results were used to construct a tree diagram showing the relationship to one another for each individual in the study. By using the 'tree of minimum length', which minimizes the number of mutations required to relate the different mtDNA strands, Cann et al. (1987) were able to conclude that the common ancestor of all modern humans originated in Africa. They came to this conclusion due to the fact that one of the two primary branches of the tree diagram pointed exclusively to African mtDNAs, with the other primary branch also including African mtDNAs (Cann et al. 1987:33). Using this result to assume an African origin also minimizes the number of intercontinental migrations needed to create the relationships seen in the mtDNA analysis (Cann et al. 1987:33).

With their results pointing to Africa as the place of origin, Cann et al. sought to calculate the age of origin for the common ancestor. In order to do this, it was necessary for them to assume that the mutations in the mtDNA accumulated at a steady rate over time. To first find out the rate of accumulated divergence in the mtDNA they calculated the amount of differences between regional populations and related this to the amount of time since they colonized these areas. For this they used a date of 30,000 years ago for the colonization of New Guinea, 40,000 years for Australia, and 12,000 years for the New World (Cann et al. 1987:33). Using these estimates a rate of divergence in the mtDNA was calculated to be between two and four percent for every million years. The data suggest that the human mtDNA types have diverged from the common ancestor by approximately 0.57%, and assuming a rate of change of 2% to 4%, the mort recent common ancestor is believed to have lived between 140,000 and 290,000 years ago (Cann et al. 1987:34). This will be the first result in what will become a very popular, and contentious, area of study.

Not everyone accepted the results of this first study, however, as many were quick to point out possible errors or questionable methods that were used. Vigilant et al. (1991) attempted to point out any weaknesses they saw in the Cann et al. study, and addressed these issues in their own research. In addition to the previously mentioned problem of using African Americans as African samples, some other issues with the original study were: the use of restriction analysis (an indirect method) to compare the mtDNA; the use of the midpoint method (viewed as an inferior method) to place the common ancestor on the tree, as there was no justification for an African origin; and the calibration for the rate of mtDNA change was deemed inadequate (Vigilant et al. 1991:1503). This new study would seek to find the similar results as the previous attempt, only with more reliable methods and tests.

For their study, Vigilant et al. used 189 individuals, including 121 native Africans from a variety of sub-Saharan populations. Improving upon the previous study, they took some different approaches when constructing their tree. First, they used the parsimony method which attempts to minimize the number of mutations needed to relate the mtDNA types. For the rooting of the tree they employed the 'outgroup method', where they used the DNA sequence of another species to place the human ancestor on the tree. This, in contrast to the previous study, takes into account that the rate of evolution may not be the same in all lineages. However, this method also agrees with Cann et al. that the common ancestor had an African origin (Vigilant et al. 1991:1504).

In order to calculate the age of the common ancestor, Vigilant et al. used a chimpanzee mtDNA sample as an outgroup. The differences between the two groups are represented by a 15.1% sequence difference between human and chimpanzee mtDNA. This was then related to the estimate for the divergence between humans and chimpanzees, which was estimated to be approximately 4 to 6 million years ago, and a date of 166,000 to 249,000 years ago was calculated for the age of the common ancestor. Even with an adjusted human-chimpanzee divergence date of 9 million, the age of the common ancestor is only 373,000 years ago (Vigilant et al. 1991:1506). Despite the differences in methodology, the results do coincide with those of the previous study.

Since these initial studies, there have been many more studies that have also come up with very similar results. Ingman et al. (2000) also came up with an African origin for the common mitochondrial DNA ancestor. One difference with their study, however, was that instead of using DNA sequences confined to the control area, which counts for less than 7% of the mitochondrial genome, they sequenced the entire mtDNA genome (Ingman et al. 2000:708). They believed that this method would provide more accurate, or at least more complete, results. Yet again, their results pointed towards an African origin of all modern human mitochondrial DNA. The mtDNA from African individuals show ragged distribution, which is evidence of a constant population size, while the non-African individuals showed a bell-shaped distribution, which is evidence of a more recent population expansion (Ingman et. al. 2000:710). As well, similar to the other mtDNA studies, the date that Ingman et al. calculated for their common ancestor was between 121,500 and 221,500 years ago (Ingman et al. 2000:711). These dates were estimated by calculating the maximum genetic difference between two humans, thus representing the longest amount of time to accumulate mutations. Despite their reservations about the limitations of using the control area for genetic studies, analysis of the complete mtDNA strand did not provide drastically different results.

However, not everyone is convinced by the mitochondrial DNA evidence. One complaint is that it only reflects what is going on in the female line, with no input from the paternal side. In response to this argument there have been additional studies done using genetic data from the Y-chromosome. Results of one Y-chromosome study puts the most recent male common ancestor at around 47,000 years ago with a 95% confidence interval of 35,000 to 89,000 years ago (Underhill et al. 2000:359). This falls within the range given in the mtDNA studies and is more evidence of an African origin to the modern human species.

The DNA evidence, from mitochondria and Y-chromosomes, is overwhelmingly in support of an African origin for all modern *Homo sapiens*. However, there still is a lot of work to be done, especially when it comes to the molecular clock used to date the appearance of the common ancestor. It has been admitted by some of the researchers involved that they were only able to date the common ancestor between 50,000 and 500,000 years (Thorne and Wolpoff 1992:83). As well, when calibrating this molecular clock it was assumed that the human and chimpanzee lineages diverged five million years ago (Wilson and Cann 1992:72). This is a fairly large assumption that could possibly be off by a factor of a million or more years, which would, no doubt, have a rather large effect on the date of the common ancestor. Admittedly this could be a problem. However, while the molecular clock may be wrong, one of the main goals of the mtDNA studies is not to put an exact date on the common ancestor but to prove that modern humans arose from a recent ancestor that lived in Africa, and this was clearly proven by these studies.

Detractors of the DNA studies who share a multiregionalist point of view have evidence of fossil and cultural continuity that may, or may not, be from the ancestors of modern humans. While their fossils show continuity, it may just be continuity in a species that went extinct, like the Neandertals in Europe. Multiregionalists (Thorne and Wolpoff 1992) believe that Neandertals are direct ancestors to modern Europeans, while replacement models suggest that they were replaced with no genetic mixing with *Homo sapiens* at all. Unlike the DNA evidence, there is just no way to directly link these fossils with the modern populations of *Homo sapiens*. One would think that populations separated by great distances, such as those between Europe, Asia, and Africa, would tend to diverge in their evolution and not end up as the same species. An interconnected web of lineages is said to have been what kept these local populations connected and evolving toward the same species (Thorne and Wolpoff 1992). On the other hand, in order to maintain these populations as a single species, huge levels of gene flow between continents would have been necessary (Wilson and Cann 1992:72-73). Given the probable population sizes at the time, this kind of gene flow would seem impossible. As well, even if there was sufficient gene flow between continents to maintain one species, one would think that this would effectively wipe out or blur the regional differences purported to be evidence of a multiregional evolutionary model in the first place. Given this genetic evidence, it seems clear that modern humans evolved from a common ancestor found in Africa who lived sometime around 50,000 to 200,000 years ago.

1.3 New Fossils, New Dates, and the Antiquity of Anatomically modern *Homo sapiens*

Until recently, one issue with the study of the archaeology and fossil remains of modern humans was the lack of effective dating techniques. For example, while radiocarbon dating is a powerful tool for archaeologists with more recent sites, the functional limit of around 40,000-65,000 years (Wintle 1996:128) renders this technique useless for early modern human sites in Africa. It is only with new methods, like electron spin resonance (ESR), Optically Stimulated Luminescence (OSL) and thermoluminescence of burned flints, that allow researchers to get a better resolution on the dates associated with the earliest modern human fossils and their associated remains by extending the limit of available dating methods to include this crucial time period. For example, the application of the ESR dating technique on teeth found in the sediments of two South African caves (Border Cave and Klasies River) has helped to establish the antiquity of anatomically modern humans in that area. Previously, radiocarbon dates were only able to tell researchers that the teeth taken from these layers were older than 45,000 years ago. However, the new ESR dates dated the remains at Border Cave to 70,000 to 80,000 years ago and those at Klasies River to around 90,000 years ago (Wintle 1996:133).

In addition to finding new specimens, the application of new and more refined dating techniques has led to the discovery of older dates for previously studied fossils. Recently, researchers have reevaluated the dates on a pair of specimens originally excavated nearly 40 years ago and whose dates were never fully accepted. Omo I and Omo II were recovered from the Kibish Formation in Southern Ethiopia in 1967 and were previously assigned a date of approximately 130,000 years ago, based on ^{230}Th/ ^{234}U dating of mollusk shells found in the hominid level (Butzer et al. 1969:18). However, new dates on the stratigraphic levels that buffer the fossils have pushed this date back to nearly 200,000 years ago. Dates taken on feldspar crystals from pumice clasts using ^{40}Ar/^{39}Ar dating provide a lower limit of 198,000 ± 14,000 BP while feldspar crystals from an upper layer provide the younger limit of 104,000 ± 7,000 BP. These dates, in addition to other geological data, led the researchers to conclude that the fossils date to approximately 195 ± 5 kyr old, making them the oldest anatomically modern *Homo sapiens* ever discovered (McDougall et al. 2005:733-736). These new dates make the Omo I and II specimens older than the newly discovered hominid fossils from Middle Awash, Ethiopia.

A number of specimens from Herto, Middle Awash, Ethiopia, consist of bones belonging to two adults and one immature individual. Researchers (White et al. 2003) argue that the specimens belong to a new subspecies of humans, *Homo sapiens idaltu*, which was immediately ancestral to anatomically modern humans. Morphologically these specimens fall just outside the accepted range of variation for anatomically modern *Homo sapiens* and, therefore, are considered to be on the verge of being considered anatomically modern (White et al. 2003:745). However, taking into consideration that the older Omo specimens are regarded as anatomically modern *Homo sapiens*, and that other researchers (Clark et al. 2003:750) studying the chronological and archaeological aspects of the same hominids refer to them as anatomically modern *Homo sapiens*, for the purposes of this study they shall be considered to be anatomically modern. $^{40}Ar/^{39}Ar$ dating of pumice and obsidian clasts from the level containing the fossils, as well as dates from the overlying layers allowed the researchers to place the fossils between 160,000 ± 2,000 and 154,000 ± 7,000 years BP (Clark et al. 2003:750). At the time, this made the Middle Awash hominids the oldest anatomically modern humans to be found, and still among some of the oldest, helping to solidify the notion that modern humans first evolved in Africa.

1.4 Anatomical versus Behavioural Modernity

These new dates are helping to resolve the gap that existed between the DNA studies and previous dates for early modern fossils. However, this only serves to widen the gap between the development of anatomical modernity versus behavioural modernity, a key issue in the study of modern human origins. While the Omo and Herto hominids are considered to be anatomically modern *Homo sapiens*, the artifacts associated with them are clearly Middle Stone Age and Acheulean (White et al. 2003:742; Clark et al. 2003:748). However, it is accepted by some (Klein 1992, 1995; Ambrose 1998) that fully modern human behaviour is represented by the development of the Upper Paleolithic in Europe and North Africa (or the LSA in Sub-Saharan Africa), which occurs after the development of the modern body type. A discussion of the archaeology of modern humans and how it changes from the MSA to the LSA follows in the next section. This presents an interesting challenge to researchers interested in the field of modern human origins: if ancient humans are physically modern, then why are they not acting modern? There have been numerous theories presented as to why there appears to be such a gap between anatomical and behavioural modernity, but no proposal has proven more reasonable than the others. Klein (1995:183) believes that there was some fundamental change in the brain structure of early modern humans that revolutionized the way humans thought, planned, and even saw the world. It is believed that this neural change could have also prompted the development of a fully modern and symbolic language. Unfortunately, this neurological change would be impossible to detect in the fossil record, and therefore is not testable. However, it does seem to explain why there was a sudden and drastic change in the archaeological record.

Recent genetic studies, however, are attempting to shed new light on the idea of a neural change being responsible for the origin of modern human behaviour. Researchers (Enard et al. 2002; Lai et al. 2001) studying the FOXP2 gene have discovered that a disorder involving this gene affects an individual's language ability by having an impact on the ability for language processing and grammatical skills. Therefore, it is believed that a past mutation in this gene may be involved with the development of human language. Gorillas, chimpanzees and rhesus macaques are all identical in the FOXP2 sequence with two differences from humans, but orangutans have three differences (Enard et al. 2002:869). The researchers estimated, using a model of random mating and constant population size, that the changes in the FOXP2 gene happened during the past 200,000 years of human history (Enard et al. 2002:871). This would place the genetic change at the same time as the development of modern behaviour and, therefore, in support of Klein's (1995) idea of a 'neural change' that may have sparked this development.

Other ideas suggest that this change in behaviour was not due to a sudden neurological change, but rather an evolution of behaviour over time. It could be entirely possible that some external, cultural influence was the catalyst for change in the way early modern *Homo sapiens* behaved. Tattersall (2002:152) believes that the capacity for modern behaviour may have been present long before it is expressed in human culture. It is only with an external, cultural innovation that this capacity for modern thought is activated and spread through cultural contact. This would eliminate the need for a complete genetic replacement of non-modern individuals who lack the genetic makeup to be behaviourally modern (Tattersall 2002: 152-153). Furthermore, a cultural stimulus could be passed from individual to individual, group to group with incredible speed, while a genetic change would take generations.

McBrearty and Brooks (2000) are also proponents of a gradual change to modernity over time and suggest that what others term as a cultural 'revolution' is actually a discontinuity in the archaeological record (McBrearty and Brooks 2000: 454). They state that if the change to modern behaviour was gradual archaeologists should see a slow accumulation of modern traits with sporadic innovations occurring at different times and places. The occurrence of several characteristics deemed to be indicative of modern human behaviour, including blades, microliths, and bone tools, in several MSA assemblages is thought to be evidence that the development of modern behaviour started in the MSA with a gradual development into the LSA/Upper Paleolithic (McBrearty and Brooks 2000). The development of tanged pieces and foliate points in the Aterian of North Africa (Ferring 1975) and the Howiesons' Poort Industry from Klasies River in South Africa where LSA elements such as blades and backed pieces appear in between levels of typical MSA artifacts (Singer and Wymer 1982; Thackeray 1989) are clear examples of LSA/Upper Paleolithic technology showing up in MSA/Middle Paleolithic contexts. While Upper Paleolithic elements do not appear in every Middle Paleolithic site, this would still appear to support McBrearty and Brooks' idea that these elements would appear sporadically throughout the record given a gradual change to modern human behaviour.

Soffer (1994) believes that a change in economic, and social relationships ultimately changed the way all modern humans behaved. She argues that unlike our Neandertal cousins, modern humans developed a sex-based division of labour as well as biparental care of the young, which in turn led to the development of a close family unit, thus separating one group from another and creating a group, or cultural identity (Soffer 1994:101-115). Thus, the 'creative explosion', as seen in the archaeological record, can be attributed to the idea of group identity and the need to distinguish oneself, or one's group, from others.

1.5 The Archaeology of Behaviourally Modern *Homo sapiens*

It may not be clear what the exact reasons were that lead to the development of modern human behaviour, but what is known is that there is a significant change in the archaeological record around 40,000 – 50,000 years ago that represents some fundamental shift in the way humans were thinking and acting. This change comes with the development of the Upper Paleolithic in Europe and the LSA in sub-Saharan Africa. Predominantly flake-based, Middle Paleolithic/MSA assemblages consist mainly of scrapers, denticulates, and points made on radial and Levallois cores (Klein 1992; Ambrose 1998). The Upper Paleolithic/LSA, however, shows a drastic change in human behaviour and is characterized by many innovative traits that include: the change from a flake-based to a blade-based lithic industry, the exploitation of a wider variety of game, increased variability in the toolkit as seen through time and space, the production of objects for art and adornment, the incorporation of new raw materials for making tools such as bone and ivory, more elaborate burials, the exploitation of harsh environments, increased trade networks and an increased use of exotic raw materials (Klein 1992; Ambrose 1998; Henshilwood and Marean 2003; Mellars 1991). These attributes represent a change in behaviour that indicates more forethought and planning in the behaviour of modern humans and can be seen happening rapidly throughout Africa, Asia, and Europe. It is hard to tell exactly where the change happens first, but some early evidence of modern behaviour in the form of ostrich eggshell beads comes from the site of Enkapune ya Muto in Kenya and date to approximately 46,000 years ago (Ambrose 1998:377) suggesting an African origin of modern behaviour around this time. While many researchers believe that modern human behaviour is present only with the change to the Upper Paleolithic/LSA, there are others (discussed below) who would argue that modern behaviour, or at least certain aspects of it, can be seen much earlier in the archaeological record.

The apparent gap between the development of anatomical modernity and behavioural modernity is no more obvious than in the Levant. Here anatomically modern humans predate the Neandertal occupations by tens of thousands of years with modern humans appearing between 80,000 to 130,000 years ago at Skuhl and Qafzeh (Bar-Yosef and Vandermeersch 1993:95; Shea 2003:178), while Neandertals are present at Tabun, Amud and Kebara between 50,000 and 75,000 years ago (Shea 2003:178). If modern humans pre-date the Neandertals in the area, why then did it take so long for the eventual replacement of the Neandertals to take place? It is noted that during this time of overlap, both the anatomically modern humans and the Neandertals were associated with Mousterian tools (Bar-Yosef and Vandermeersch 1993), and therefore must be behaviourally similar. However, around 50,000 years ago modern humans finally replace Neandertals in the Levant and eventually throughout Europe and Asia. It is at this time that there is a sudden appearance of Upper Paleolithic characteristics such as the use of symbols, specialized projectiles and prismatic blade technology (Shea 2003:182). This sudden appearance of Upper Paleolithic material culture is also closely associated with the rapid disappearance of Neandertals throughout Eurasia between 45,000 and 30,000 years ago (Shea 2003:184). It is only with the development of Upper Paleolithic tools, and other characteristics associated with modern human behaviour, that humans gained a competitive edge over Neandertals and were able to move into their territory and replace them. This result supports the idea of a sudden change, or revolution, to modern human behaviour. However, archaeological evidence from other parts of the African continent may suggest otherwise.

Found widespread in North Africa and the Sahara is the Aterian tool tradition, which displays some unique characteristics. While the assemblages are mostly Mousterian-like consisting of high proportions of sidescrapers, few endscrapers or Mousterian points, all exhibiting Levallois technology, it is the addition of tanged pieces, or pendunculates, and foliate points to these assemblages that makes them unique (Ferring 1975:113). The addition of pendunculates can be viewed as an attempt at expressing group identity in that it is a specific way of manufacturing tools that are different from others. The problem is, however, that while these peoples are anatomically modern, they are behaviourally Middle Paleolithic, and therefore should not be acting like fully modern *Homo sapiens*. Can the presence of culturally specific stone tool manufacturing techniques in the MSA mean that these people were fully modern, or perhaps this is just a first step on the long journey to becoming behaviourally modern *Homo sapiens*?

A similar situation exists in South Africa with the Howieson's Poort variation of the MSA (Singer and Wymer 1982; Thackeray 1989; Wurz 2002). Stratigraphic layers containing Howieson's Poort tools are sandwiched in between layers of typical MSA flake-based industries at the site of Klasies River and are believed to date to 70,000 BP or earlier (Thackeray 1989:35-37). Comprised of well made crescents and other segments and backed tools, this variant of the MSA reflects later innovations of the Later Stone Age. However, the main difference is the fact that the Howieson's Poort tools are much larger and were not made from true blades, but from flake-blades (Singer and Wymer 1982:87; Thackeray 1989:45). In the later LSA, backed microliths are believed to have been manufactured for insertion into wood or bone hafts, and are also thought to be used for composite arrows (Klein 1992; Ambrose 2002; Clark 1977). If the Howieson's Poort artifacts were manufactured for the same purpose, then they may resemble the earliest examples of composite tools in the world (Klein 1999:438).

Examples like the Aterian and Howieson's Poort industries may represent the occurrence of some form of modern human behaviour while still technically in the MSA or Middle Paleolithic. The main difference is, however, that they do not represent the whole suite of characteristics that occurs with the development of behaviourally modern humans at the MSA/LSA or Middle Paleolithic/Upper Paleolithic boundary. While it does suggest that there was some form of modern behavior occurring earlier than expected, it does not mean that these peoples were fully behaviourally modern. However, proponents of a gradual development of modern behaviour (Henshilwood and Marean 2003; McBrearty and Brooks 2000; Tattersall 2002) may view this as evidence of the beginnings of modern behaviour occurring gradually in the MSA. In order to determine if the development of modern human behaviour was, in fact, a 'revolution' or just a gradual change there is a definite need for more research to be done in Africa, especially during the transitional period between the MSA and LSA when it is believed modern human behaviour emerged. Therefore, LSA assemblages are important to the understanding of modern human behaviour as the archaeological remains should represent the whole suite of characteristics associated with the archaeology of modern humans. It is only with the development of the LSA (or Upper Paleolithic) that it can be said with certainty that prehistoric peoples are acting like fully modern *Homo sapiens*. In order to understand the behavioural change that occurred we must be able to understand the differences in the archaeological remains as represented by the development of the LSA in sub-Saharan Africa.

1.6 Previous Research in East Africa

While the archaeological record for the Middle to Later Stone Age transition is relatively sparse in East Africa, it is now being considered as a likely place for the origin of modern humans. With the discovery of more intact sites with a clear progression from the MSA to the LSA, researchers will be able to shed more light on the dramatic transition in human behavior and culture that occurred at this time. The site of Enkapune Ya Muto in the Central Rift Valley of Kenya is one such site that spans the MSA/LSA transition. From this site came valuable information as to when the transition occurred. Dates taken from some of the earliest ostrich eggshell beads discovered date the transition of the LSA to approximately 46,000 years ago (Ambrose 1998:377). Ambrose goes on to discuss the cultural significance of the ostrich eggshell beads in the LSA considering them as objects of a complex social relationship. He believes that they are involved in a complex system of gift-giving and exchange, just as they are in the modern *hxaro* exchange system of the San peoples of Africa. This system of reciprocity is seen to strengthen social and economic relationships with neighbouring groups and act as a 'safety net' for groups living in difficult environments (Wiessner 1982:66-72). Unfortunately, the number of continuous MSA/LSA sites in East Africa remains low, as is the case elsewhere in

Africa, but that does not mean that there is a lack of valuable work being conducted in the area.

Also doing work in Kenya, Kusimba (1999) discusses land use patterns and mobility from the site of Lukenya Hill, which is considered one of the largest early LSA sites in East Africa. She does this by comparing lithic raw material procurement and artifact typology of five assemblages with modern ethnographic studies of hunter-gatherer land use strategies. This is in addition to her previous research (Barut 1994), at Lukenya Hill and Nasera where analysis of land use patterns, raw material procurement, and assemblage variability were used to highlight behavioural differences between MSA and LSA peoples. These studies are of particular interest to this work for comparison purposes and will be discussed further in chapter 3.

Similarly, Brandt (1988) also tested models for hunter-gatherer adaptations and land use strategies. Using data from artifact form and function, raw material procurement, and mortuary practices from the site of Buur Heybe in Southern Somalia, he tested the model of a cost-benefit relationship of humans to their environment. The theory states that group size and structure will fluctuate depending on the availability of resources available. For example, when critical resources needed for survival are scarce groups will express low population density, low group size, and a more nomadic lifeway.

Of particular importance, however, is the work done by Mehlman (1989) in the areas of Nasera Rock to the north of Olduvai Gorge and Mumba, on the eastern part of Lake Eyasi, both in Northern Tanzania. Using data from his own excavations as well as previously excavated materials collected in the 1930s, Mehlman's work was an in-depth typological analysis of MSA, intermediate MSA/LSA, and LSA assemblages from these sites and will be discussed in greater detail in chapter 3. Through this work he constructed a classification system that incorporates both MSA and LSA elements in a single system allowing for comparison between MSA and LSA, and will be used in this study.

1.7 Previous Research in the Songwe River Area

The area of research that this study is concerned with is the Songwe River area located in the Rukwa Rift Valley which is part of the Western or Albertine Rift Valley in Southwestern Tanzania. The Songwe River area has not been extensively examined but holds excellent potential. Early surveying of the area was done in the 1960s by Clark (1970) where a small number MSA artifacts made from quartz were discovered along the Nyara stream. Additional surveying done in the Songwe Valley uncovered fine gravel of an ancient beach layer approximately 10 m down from the top of a 30 m deposit of lake sediments. This layer contained a small number of flakes and a discoid core, which were attributed to the MSA (Clark 1970:350).

Further research conducted by McBrearty et al. (1982; 1984) revealed abundant remains from multiple culture periods. In the Southern Songwe valley, *in situ* Iron Age remains were found containing slag, scattered animal bone as well as potsherds. In the Kiwira Drainage numerous scatters of artifacts were discovered consisting mostly of untrimmed flakes and low numbers of formal tools. The Northern Songwe drainage contained material ranging from the Early Stone Age to the Later Stone Age. However, ESA remains are extremely rare in the area and it is believed that it is not until the MSA that the area is intensively occupied (McBrearty et al. 1984:131). MSA artifacts were recovered from a number of sites in the area (IdIu1, IdIu3, IdIu7, and IdIu9) and contained untrimmed flakes, blades, fragments, as well as disc cores, small bifaces, trimmed cobbles, burins, and trimmed flakes. The majority of these artifacts were manufactured on quartz and chert. LSA artifacts were found at two sites with small untrimmed flakes, irregular cores, a unifacial point fragment, and a burin being found at IdIf2, and small flakes along with chert and quartz bladelets at IdIf5. Overall it was deemed by the researchers involved that this area holds great archaeological potential for future investigation (McBrearty et al. 1984:131).

Further survey and excavation by Wynn and Chadderdon (1982) was conducted in the Nyakyusa Basin at the northern end of Lake Nyasa. One of the sites they excavated, the Kala Waterfall Site, revealed the largest and most informative assemblage with 10,606 artifacts. This assemblage is dominated by quartz artifacts, which comprise 94% of all collected materials. A range of artifact types were collected including small bifacially retouched points, scrapers, a small percentage of microliths, bifacial pieces, and a variety of core types. Comparison with other surface samples collected during the survey, it was determined that all localities belonged to a single industry that they called the Kiwira Industry with the Kala Waterfall assemblage serving as the type site for the industry (Wynn and Chadderdon 1982:131-142).

The most recent work in the area has been conducted in the 1990s by Willoughby (1993, 2001; Willoughby and Sipe 2002) with the goal of finding an intact transitional MSA/LSA assemblage. The chosen area is locally known as Mapogoro and is known for its numerous volcanic rockshelters with surface scatters indicating that they were used prehistorically (Willoughby and Sipe 2002:210). In 1990 a survey was conducted in the Songwe region uncovering new and previously discovered sites. MSA and LSA artifacts were collected from surface surveys, as well as three small test excavations (Miller 1993; Willoughby 1993; Willoughby and Sipe 2002). Further research continued in 1995 with test excavations occurring at the LSA and Iron Age site of IdIu17. These excavations uncovered 156 stone artifacts made predominantly on quartz and cryptocrystalline silica, as well as 11 potsherds. Excavations at the site of IdIu22 also began in 1995 with one test pit being excavated and five more following in 1997 (Willoughby and Sipe 2002:210-212).

Detailed information about IdIu22 and its contents will be presented in the following chapters as it forms the main focus for this thesis. I will build upon the typological and technological stone tool analysis done by Sipe (2000) on test pit 4 by expanding the focus to incorporate a number of test pits from the same site. In addition, the site and its contents will be analyzed with the goal of commenting on site use and mobility strategies of the LSA people who inhabited the area. The typological and technological analysis will be used primarily to place the site in a culture historical context as certain typological and technological aspects change through time throughout the LSA and MSA and can even aid in the relative dating of the site. This analysis will form the basis for analysis and discussion on site use with an emphasis on technological analysis of lithic production, assemblage variability, as well as statistical measures of evenness and richness. These measures are used in order to gauge the range of activities that occurred on site by analyzing the diversity of tool types and subtypes in the assemblage. With respect to mobility, emphasis will be placed on raw material availability and utilization as the availability of suitable raw materials is believed to be related to hunter-gatherer settlement patterns.

In the context of modern human origins, the site of IdIu22 provides information dealing with the material culture fully modern *Homo sapiens.* It is with the transition to the LSA from the MSA that modern behaviour emerges in Africa and, therefore, the site of IdIu22 can provide valuable information on what it means to be behaviourally modern in the Songwe area. Comparing these results to those of earlier sites in this area also helps to provide information on cultural and behavioural changes specific to this area. Ultimately, the goal of this work is to provide a small piece to the puzzle with respect to modern human behaviour in the Songwe River region.

Chapter 2 – Environment Background, Site History and Description

2.1 Environmental Background

The early stage of the LSA (around 40,000 BP) was an unstable time period climatically for the African continent. At approximately 43,000-40,000 BP there is evidence of intense aridity, specifically in the south and south west areas, which saw extreme desert conditions with widespread dune activity (Adams 1998). Prior to the last glacial maximum (between 20,000 and 28,000 BP), the climate appears to have been warmer and wetter than conditions that developed later during glacial times (Adams 1998; Hamilton 1982:191). However, during this time, parts of Central and West Africa appear to have experienced conditions somewhat drier than seen at present times (Adams 1998).

With the onset of the full glacial period (OIS 2), the climate in Africa was marked by cooling temperatures and increased aridity. At this time there is evidence for a major rainforest retreat resulting in an increase in savanna and grassland environments. In addition, the Sahara desert appears to have extended hundreds of kilometers further to the south than it is at present (Adams 1998). In East Africa in particular, it is the coldest and driest period of the LSA with the dry phase beginning around 25,000 BP and the coldest period occurring between 21,000 and 14,500 BP. The extent of forest environments was greatly reduced at this time and lake levels measured significantly below current levels (Brooks and Robertshaw 1990:133; Hamilton 1982:191).

Between about 10,000 and 6,000 BP, however, conditions in Africa were becoming much warmer and moister. North and Central Africa, in particular, experienced wetter than normal conditions as is seen by the virtual disappearance of the Sahara (Adams 1998). In East Africa, higher than normal rainfall and increased temperatures led to the maximum extent of woodland cover and an increase in lake levels at this time. However, around 6,000 BP there is a shift to increased aridity throughout the African continent with conditions becoming warmer and drier towards the present date (Adams 1998; Hamilton 1982).

While the above discussion gives a broad overview of climatic conditions in various regions of the continent, it is important to have data from local sources to fully understand the environmental conditions experienced at IdIu22. Recently there have been a number of studies published that attempt to recreate environmental conditions for the past 23,000 years BP in the Lake Rukwa area using pollen (Vincens et al. 2005), sediments (Thevenon et al. 2002), and diatom analysis (Barker et al. 2002) from a lake core. Two parallel cores (R96-IA and R96-IB) were taken from the deepest part of the southern basin of Lake Rukwa (Figure 2.1) and were correlated using a distinctive grey clay horizon. The lake itself is large but shallow, and measures 150 km by 15 km with a maximum depth of approximately 14 m. It is fed by the Rungwa and Kavu rivers in the north and by the Lupa and Songwe rivers in the south (Vincens et al. 2005:148). Consequently, the proximity of IdIu22 to the coring site makes these studies ideal for the understanding of past environmental conditions at the site. A summary of the climatic conditions in the Lake Rukwa area based on the analysis of this core are presented in Figure 2.2.

Pollen analysis of the Lake Rukwa core (Vincens et al. 2005) indicate that there was a significant cooling of the African continent between 23,000 and 19,000 years BP, and the lack of woodland or bushland taxa in the pollen sample indicate drier conditions around the lake. Diatom analysis (Barker et al. 2002), as well as sedimentological analysis (Thevenon et al. 2002), for this time period indicate low lake levels dominated by shallow swamp or marsh environments around the coring site.

The next period identified by Vincens et al. is the last glacial/interglacial transition dating from around 19,000 to 12,000 BP. A decrease in afromontane forest and an increase in woodland and arboreal bushland indicate warmer and more humid climate during this time period. An increase in aquatic pollen, the appearance of *Typha*, and the abundance of planktonic species indicate that the lake rose due to an increase in fresh water. However, the persistence of swamp environments near the coring site suggests that the lake level remained low until approximately 13,500 BP (Vincens et al. 2005: 157).

The time period from 12,100 to 5,500 BP is known as the "Holocene humid period" when warmer and wetter conditions were prevalent in the area. Locally, it is characterized by the maximum abundance of arboreal taxa in the pollen record, resulting in a more wooded environment around the lake. The lowest amount of aquatic pollen in the sequence, as well as results from the diatom analysis, points to a large, deep lake at this time period that may have overflowed into Lake Tanganyika (Barker et al. 2002:303; Delvaux et al. 1998:400; Vincens et al. 2005:158).

The late Holocene period (5,500 – 550 BP) sees a retreat of forested conditions away from the lake, as indicated by a decrease in arboreal pollen and an increase in grasses. A return to high levels of aquatic pollen indicate a return to low lake levels, while diatom analysis suggests that during this period lake levels remained low and may have dried up on occasion (Barker et al. 2002:303; Vincens et al. 2005:158).

2.2 Site History

The research area that this study is concerned with is located in the Songwe River Valley in the Rukwa Rift Valley which is part of the Western of Albertine Rift Valley in Southwestern Tanzania (Willoughby 2001; Willoughby and Sipe 2002). The northern Songwe River is fed from the Poroto Mountains and the Mbeya Volcanic Highlands and flows on a north-northwest course. The middle region of the river forms a large gorge that separates the Mbeya District to the east and the Mbozi District to the west. Several alluvial terraces are located within this gorge and contain a number of artifacts attributed to the MSA and LSA (McBrearty et al. 1984). The Songwe River then continues on to drain into the southern portion of Lake Rukwa, a shallow soda lake that lies in between Lake Tanganyika to the north and Lake Nyasa to the south (Willoughby 2001).

Initial research in the Songwe area by Willoughby began in 1990 with an extensive survey of the area in order to assess its potential for future archaeological research. Several new sites and localities were identified as well as the rediscovery of several previously recorded sites including a major chert quarry, outside of the

Songwe area, originally discovered in 1959. Known as Chamoto Hill, the chert found at the quarry is light in colour with white and yellow variants being most common. However, none of the Chamoto Hill chert has been discovered in Songwe area assemblages that come from approximately 70 km to the west. Alternatively, quartz is the dominant raw material in the Songwe River area comprising 91.5% of the raw material in LSA assemblages. However, there is a more local quarry at the MSA site of IdIu19. Approximately half of MSA artifacts are quartz with the remainder made up of chert, quartzite, and volcanic materials.

All sites found in the area can be attributed to the MSA, LSA, or Iron Age. Figure 2.4 shows the geographical locations of these sites as well as lists the culture that archaeological materials recovered from these sites are attributed to. During the survey, 9,609 artifacts were recovered through surface collection and test excavations (at IcIu4) with approximately two thirds belonging to the MSA. A number of the surface collections from MSA sites discovered during the survey (IcIu2, IcIu3, IcIu4, IdIu19, IdIu20, and IdIu21) formed the basis of the MA research of Miller (1993), which will be used in this thesis for comparative purposes.

In 1995, fieldwork shifted from survey and exploration to excavation of two sites: IdIu17 and IdIu22 located at 8° 43′S, 33° 12′E in an area locally known as Mapogoro (Figure 2.6 and 2.7). This area is known for its numerous volcanic rockshelters with surface scatters indicating that they were used prehistorically (Willoughby and Sipe 2002:210). Initial excavations at IdIu17 used arbitrary 10 cm levels but the excavation was suspended after the discovery of an intrusive burial at 80 cm below datum. A second test pit was then excavated to the 80 cm level in order to determine the orientation of the burial. At this point, all excavation at IdIu17 was halted and the focus was shifted to the site of IdIu22. Several samples were taken for dating purposes from the excavations at IdIu17, including a bone sample from the intrusive burial. However, the bone sample could not be dated due to a lack of collagen. Charcoal samples from the first test pit at a depth of 20-30 cm provided a date of 1810 ± 50 BP, while another sample from the 50-60 cm level returned a date of only 380 ± 50 BP. A charcoal sample was also taken from the second test pit from the 50-60 cm level with a date of 1920 ± 50 BP (Willoughby and Sipe 2002:212-213).

IdIu22 is situated in a farmer's field and is separated from IdIu17 by a large volcanic boulder believed to be the back wall of a collapsed rockshelter. All of the test pits at the site contained LSA age artifacts with only a small number of Iron Age ceramics present in test pit 5. Only two stratigraphic units were observed during the excavations: a black surface plough zone from farming activities, and a brown archaeological fill present throughout each test pit. In addition, IdIu22 is remarkable for the high density of artifacts collected (15,000 per m^3).

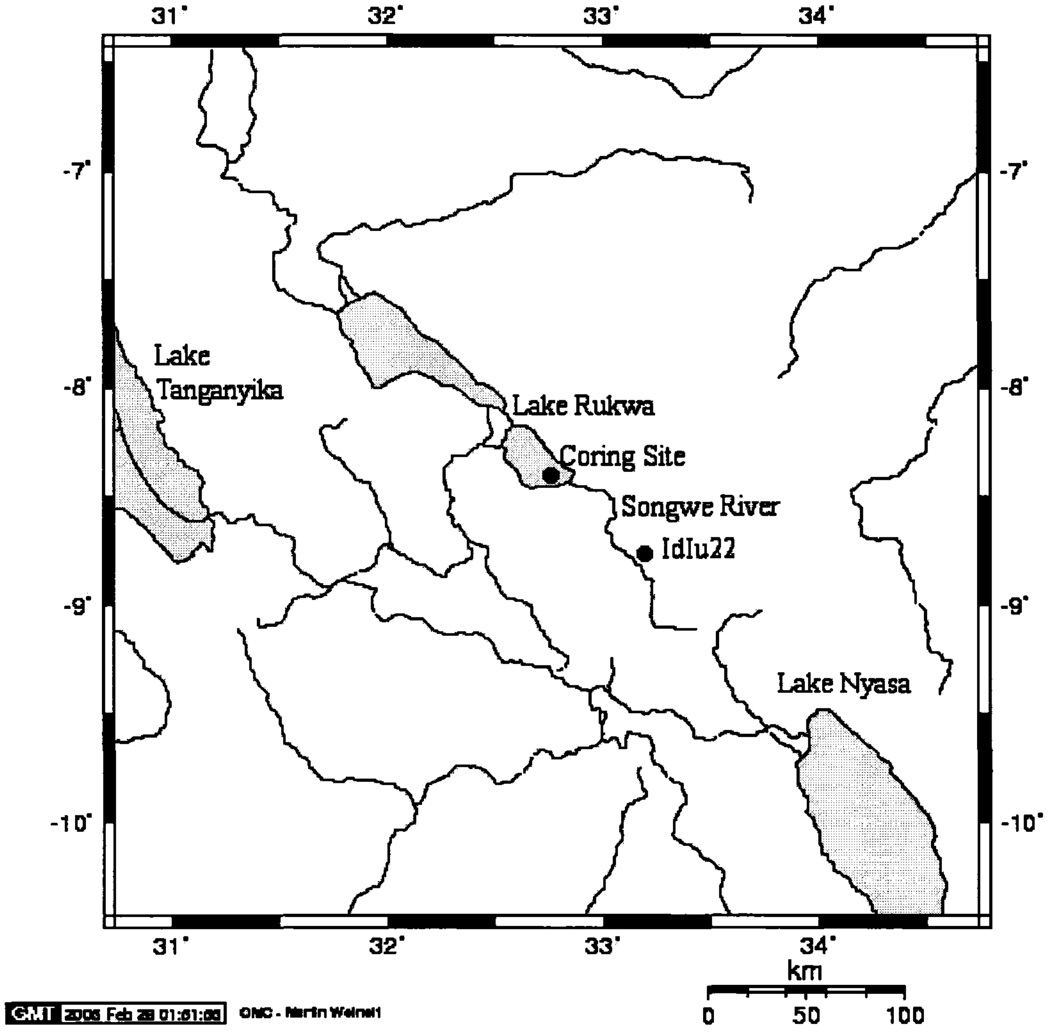
The first of six test pits was excavated in 1995 and is located directly south of the rockshelter that divides IdIu17 and IdIu22 (Figure 2.5). Arbitrary 10 cm levels were used and the unit was excavated to a depth of 1 m. Measurements were made on 10,570 artifacts from test pit 1, with an additional 4,891 small angular fragments weighed and collected as bulk samples per level. This would be the only test pit to be excavated during the 1995 season with the remainder (test pits 2-6) being excavated in 1997 using arbitrary 5 cm levels instead of 10 cm because of the density of material being recovered.

Test pits 2 and 3 were located 7 m downhill from test pit 1 and were excavated to depths of 125 cm and 90 cm respectively. There were 12,311 artifacts measured from test pit 2, and 12,934 from test pit 3. Test pit 4 was excavated in between these two units and was dug to a level of 145 cm where what was believed to be either bedrock or a large roof fall made further excavation impossible. This unit contained the highest number of artifacts collected and measured with 21,358 and was the focus of Sipe's (2000) MA thesis.

Test pits 5 and 6 were both excavated away from the main excavation area in an attempt to find the boundaries of the site. Test pit 5, which was excavated to the southwest, was dug to a level of 90 cm and contained 2,765 artifacts. The final test pit was excavated a few meters directly south of test pit 3 to a depth of 70 cm with 2901 artifacts. Both test pit 5 and 6 were excavated down to sterile sediments.

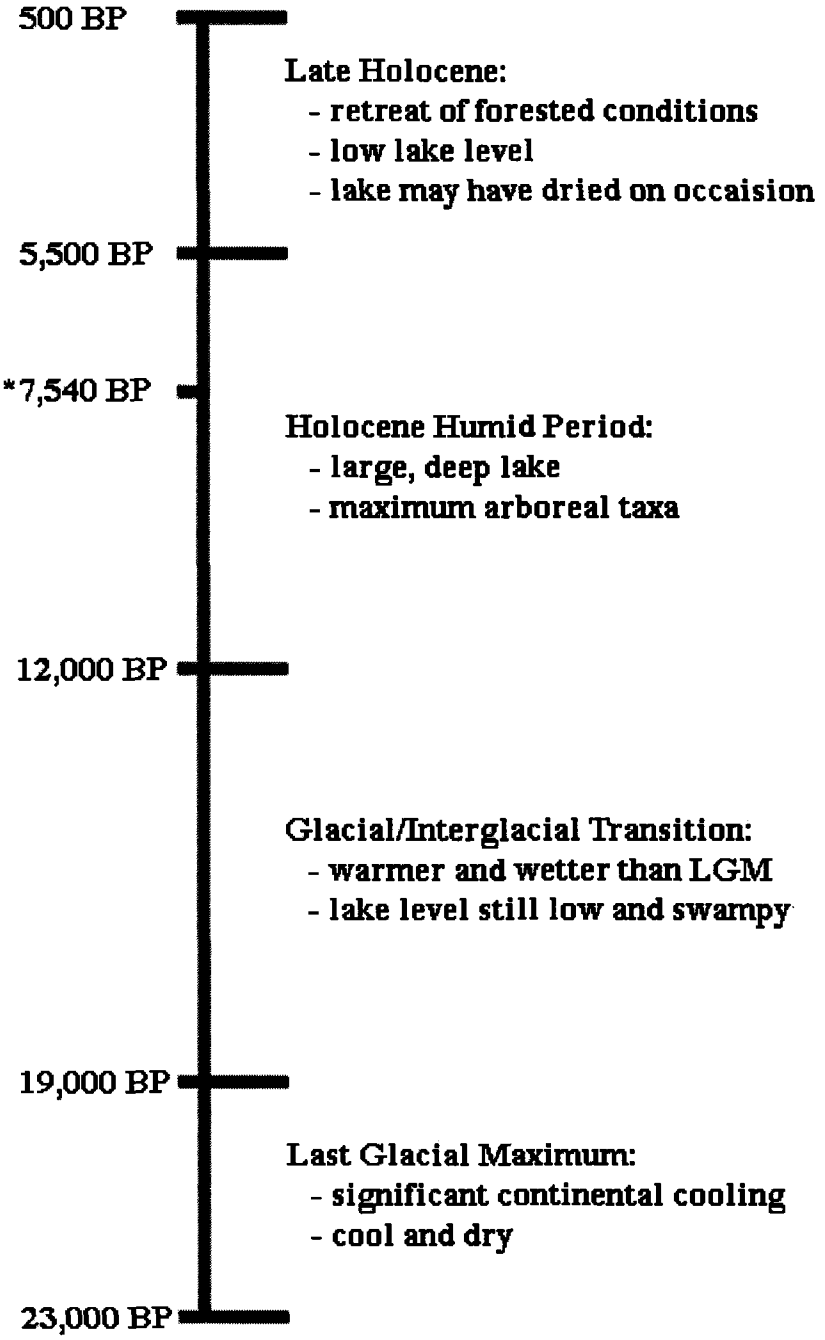
Dating of the occupation at IdIu22 has proven difficult due to the lack of charcoal and other datable materials. However, two bone fragments from test pit 1 were submitted to Isotrace at the University of Toronto for accelerator radiocarbon dating. One of the fragments from the 60-70 cm level contained no usable collagen for dating and therefore no date was obtained. The second sample from the 50-60 cm level contained a small amount of collagen and was dated to 7540 ± 280 BP. Due to the fact that the site has been attributed to the LSA, and the high reliance on the microburin technique in the upper levels, a Holocene date was deemed to be accurate (Willoughby & Sipe 2002: 213). This interpretation is based on the fact that the microburin technique is believed to be a Holocene invention as it usually appears in the later stages of the LSA (Van Noten 1977:35-36) and is very rare in earlier LSA and MSA assemblages with backed tools (Ambrose 2002:12). However, the lower levels of the site may also include the Terminal Pleistocene.

Figure 2.1 Map of the Songwe Area Showing the Lake Rukwa Coring Site



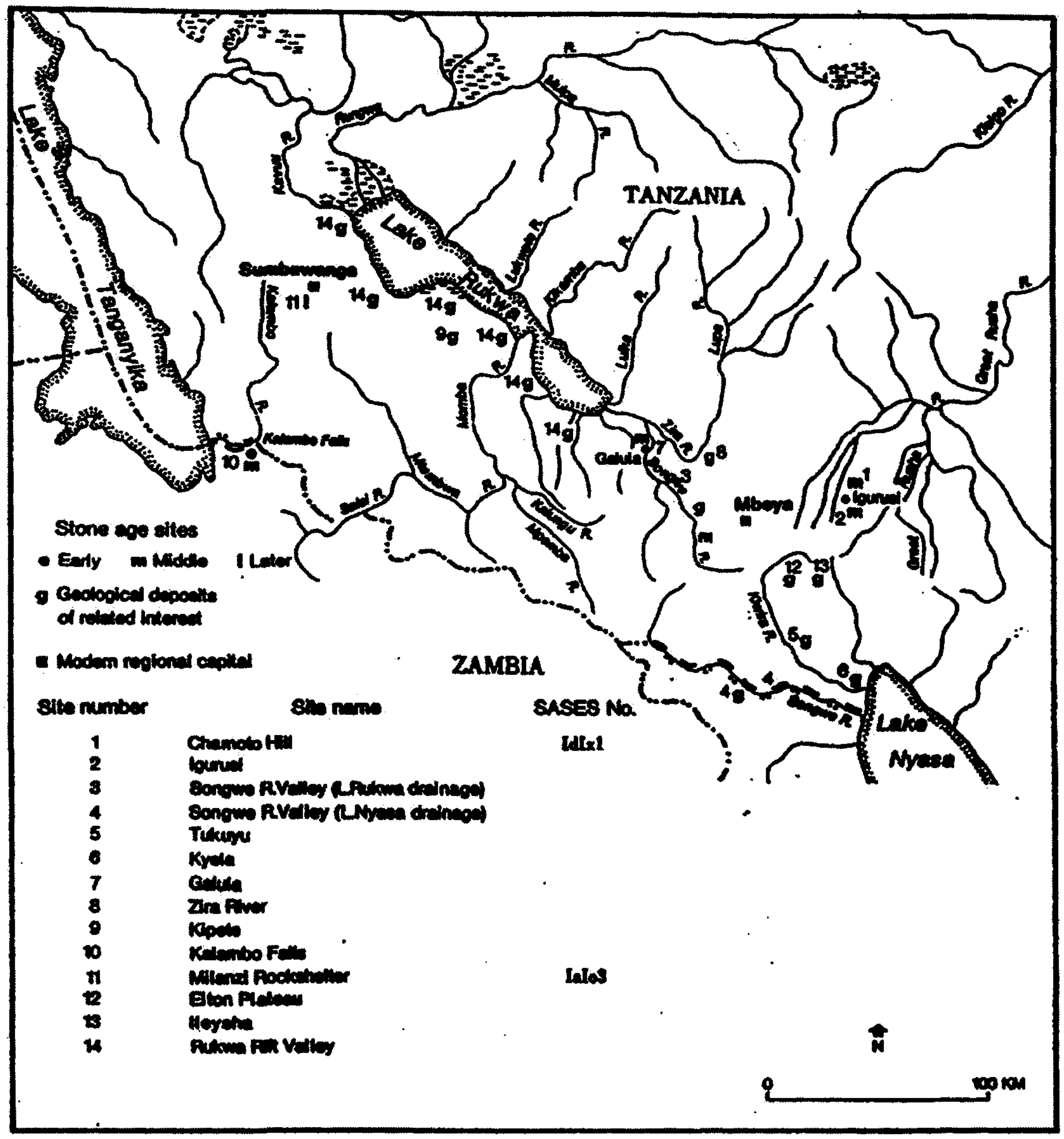
Produced from http://www.aquarius.geomar.de/omc/

Figure 2.2 Timeline of past environmental conditions for the Lake Rukwa area



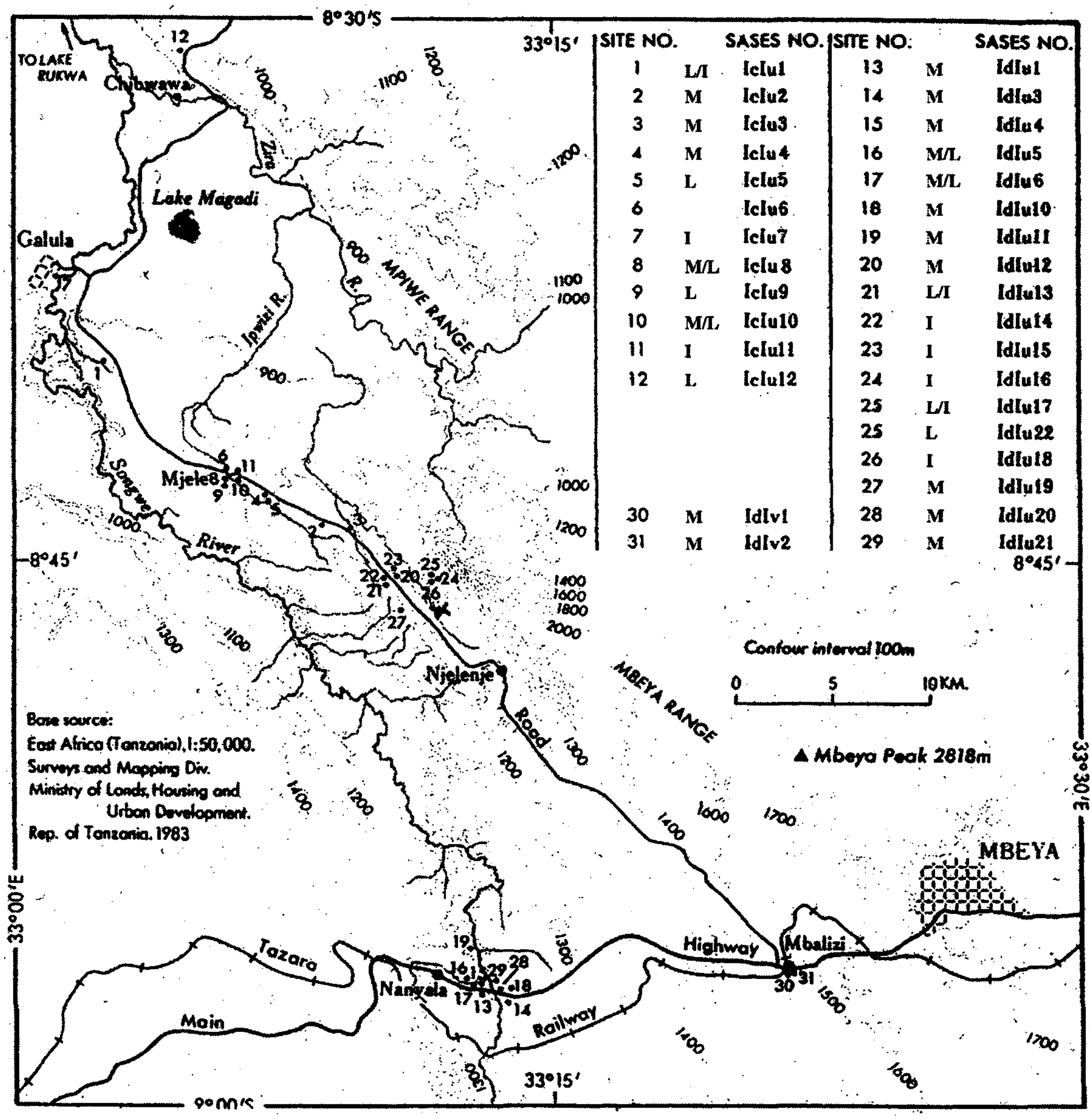
* Radiocarbon date (± 280 BP) from bone collagen taken from the 50-60cm level in test pit 1, IdIu22.

Figure 2.3 Map of Southwestern Tanzania



Site number	Site name	SASES No.
1	Chamoto Hill	IdIx1
2	Igurusi	
3	Songwe R.Valley (L.Rukwa drainage)	
4	Songwe R.Valley (L.Nyasa drainage)	
5	Tukuyu	
6	Kyela	
7	Galula	
8	Zira River	
9	Kipete	
10	Kalambo Falls	
11	Milanzi Rockshelter	IaIe3
12	Elton Plateau	
13	Ileysha	
14	Rukwa Rift Valley	

Figure 2.4 Map of Archaeological Sites in the Songwe area



SITE NO.		SASES NO.	SITE NO:		SASES NO.
1	L/I	Iclu1	13	M	Idlu1
2	M	Iclu2	14	M	Idlu3
3	M	Iclu3	15	M	Idlu4
4	M	Iclu4	16	M/L	Idlu5
5	L	Iclu5	17	M/L	Idlu6
6		Iclu6	18	M	Idlu10
7	I	Iclu7	19	M	Idlu11
8	M/L	Iclu8	20	M	Idlu12
9	L	Iclu9	21	L/I	Idlu13
10	M/L	Iclu10	22	I	Idlu14
11	I	Iclu11	23	I	Idlu15
12	L	Iclu12	24	I	Idlu16
			25	L/I	Idlu17
			25	L	Idlu22
			26	I	Idlu18
			27	M	Idlu19
30	M	Idlv1	28	M	Idlu20
31	M	Idlv2	29	M	Idlu21

M = MSA, L = LSA, I= Iron Age

Figure 2.5 Plan View of IdIu22

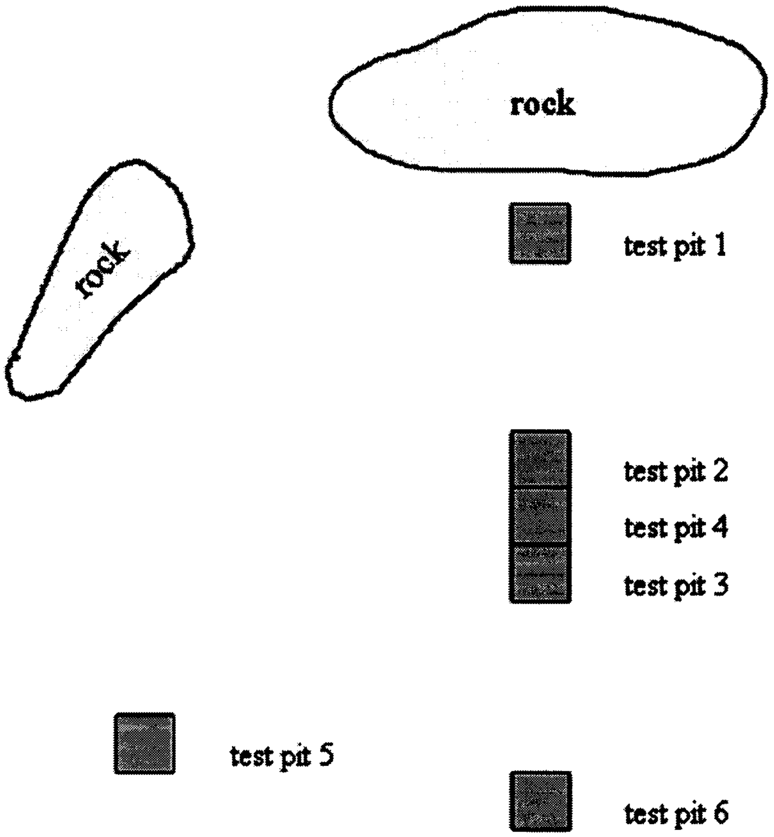


Figure 2.6 Mapogoro Rockshelters

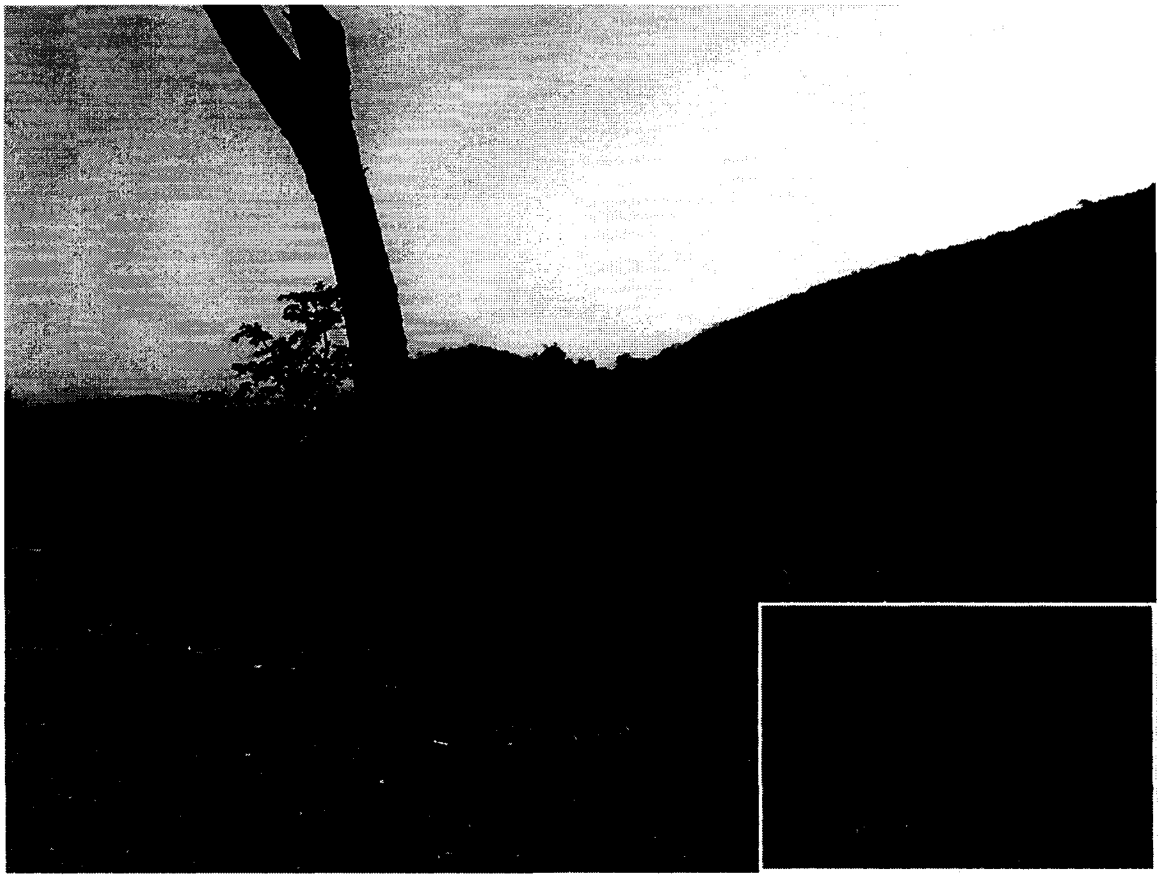
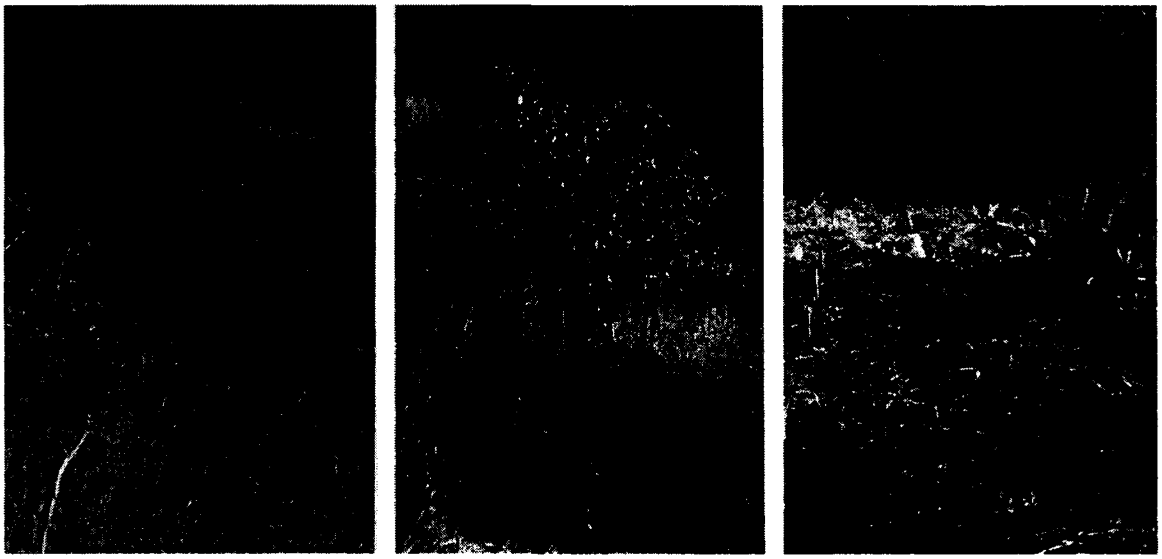


Figure 2.7 IdIu17 and IdIu22



IdIu17 IdIu17(above) and IdIu22 (below) IdIu22

Chapter 3 – Methods and Objectives

Given that the artifactual remains from IdIu22 are almost exclusively lithics, a macroscopic approach to lithic analysis was chosen. Typological and technological analysis in this area is important to place the site in a cultural context as absolute dating techniques cannot be used. Given that certain aspects of lithic typology and technology are specific to a certain culture or time period it is then possible to place a site in culture historic sequence using a standardized classification system (Mehlman 1989) for comparison with other sites of a similar time period. Using these data, it is then possible to answer questions on past human behaviour as seen through the archaeological record. While lithic analysis may be limiting in the information it can provide, it is still possible to answer such questions as what activities took place at a site, how long a site was occupied for, how far were the inhabitants traveling between sites. However, in the absence of organic materials, this sort of analysis can only provide a small piece to the puzzle of past human behaviour at IdIu22.

3.1 Objectives

The objectives of this thesis are to build upon preliminary results presented by Sipe (2000) in her analysis of a single test pit (test pit 4) at IdIu22. Typological and technological analysis of the remaining test pits, as well as the site as a whole, will focus upon lithic manufacturing techniques and behaviours. In addition, comparisons with other East African sites will help place IdIu22 in the relative culture history of the area with emphasis on technological and typological change from the MSA to the LSA. Immediately following will be an analysis of the lithic remains from IdIu22 with respect to ideas on mobility and site use with emphasis on raw material availability and utilization, lithic reduction, assemblage variability, as well as statistical measures of evenness and richness. This analysis will use the data presented in the previous sections and chapters in an attempt to reconstruct the past behaviour of the inhabitants of the site.

3.2 Methods

As was mentioned in the previous chapter, excavations at IdIu22 began in 1995 with the initial test pit located adjacent to the volcanic boulder believed to have been the back wall of a collapsed rockshelter. The unit was excavated using arbitrary 10 cm levels to a depth of 1 m below datum. The remaining five test pits were excavated in 1997 with test pits 2, 3, and 4 located approximately 7 m downhill from test pit 1. Test pit 5 was placed west of the main site and the final test pit was excavated a few meters south of 2, 3 and 4. Excavations revealed a densely occupied site with artifact concentrations reaching 15,000 per m^3 (Willoughby and Sipe 2002). Artifacts were sorted and classified according to Mehlman's (1989) classification and entered into a database using the statistical program SPSS.

Mehlman's classification is of particular use to the Songwe area assemblages as it incorporates both the MSA and LSA in a standardized typology which facilitates comparisons between the time periods. This is unlike the Middle and Upper Paleolithic in Europe where two separate classification systems exist, making comparison difficult. The classification is comprised of 27 tool types and 105 subtypes, which are listed in Table 3.1. Both MSA and LSA artifacts use the same categories but are differentiated through typological and technological characteristics. The MSA is characterized by larger artifacts, peripheral flaking, and a dominance of scrapers, retouched points, bifacial pieces and peripheral cores. The LSA, conversely, is characterized by microlithic assemblages dominated by small, backed pieces and a preference for platform and bipolar cores.

The tool types, or trimmed pieces, category is made up of 10 tool types including: scrapers, backed pieces, points, burins, bifacially modified pieces, becs, composite tools, outils écaillés, heavy duty tools, and other tools (Figure 4.11). Scrapers are defined by having a retouched edge with an angle averaging between 30° and 90°, but usually fall with the range of 45° to 70°. Backed pieces, however, exhibit retouch greater than 80° and usually approaching 90°. Most, but not all, backed pieces are microlithic in size. Points have convergent edges retouched unifacially or bifacially that form a point and generally display a retouch angle of less than 45°. Burins are defined by the presence of one or more well defined burin scars. A bifacially modified piece is defined as any artifact that exhibits bifacial retouch along an edge but cannot be easily categorized as a point or core. Becs are defined by two short lines of steep retouch forming a robust point or projection. Composite tools are retouched pieces exhibiting two or more characteristics of other tool types. For example, a burin combined with a scraper edge, or a backed piece combined with a scraper edge would both be considered composite tools. Outils écaillés are flakes that display crushing and stepped flaking on the flake margin and are believed to be related to bipolar flaking. The heavy duty tools category is made up of large cutting tools such as biface/pick or core chopper. Lastly, the other/sundry tool types category is comprised of retouched tools and tool fragments that cannot be easily placed within the above categories (Mehlman 1989:128-140).

The five core types defined by Mehlman (1989) in his typology are: peripherally worked, patterned platform, intermediate, bipolar, and amorphous (Figure 4.5 and 4.6). Peripherally worked cores are usually worked on both faces on a single edge and extends at least one-third of the way around the core. Patterned platform cores come in a variety of shapes and are defined by the striking platform with flakes being struck at close to a 90° angle. Bipolar cores are characterized by distinctive crushing or battering at either end. Intermediate cores exhibit more than one of the above characteristics such as a platform/peripheral core or platform/bipolar core. Amorphous cores are determined to be cores by the presence of negative flake scars but cannot be placed in any of the above categories (Mehlman 1989:140-148).

The five debitage and seven non-flaked tool categories are relatively self explanatory. Debitage is comprised of: angular fragments, specialized flakes (burin spall, tool spall), flakes, blades, and Levallois flakes, while the non-flaked types are: hammerstone, anvil stone, pestle rubber, polished axes, stone discs, sundry groundstone, and manuport (Mehlman 1989:148-154).

Previous analysis of the site was conducted by Sipe (2000) who conducted a typological and technological analysis of test pit 4. The goal of finding a transitional MSA/LSA assemblage was not realized as it was determined that the entire sequence excavated at of IdIu22 belonged to the LSA. Typological analysis led to the conclusion that the site may be of early LSA age due to the presence of some MSA characteristics at the site. Finally, Sipe concluded that IdIu22 represents an intensively occupied site mainly used for stone tool manufacture. However, her results remain preliminary until analysis of the rest of the site is conducted.

3.3 Typological Variables

Artifacts at the site were sorted using Mehlman's (1989) typology. Artifacts for each of the test pits were first broken down into their general categories (tools, cores, debitage) and compared to other similar MSA and LSA sites. More detailed analysis breaks down these categories into their respective types and subtypes. Individual tool types and subtypes are compared to each other and to other sites with a focus on the main tool types found at the site: scrapers and backed pieces. Core types and debitage will also be broken down and similarly analyzed. All of the above variables will be examined by excavated level in order to assess any typological change through time that may have occurred at the site.

Raw material analysis will be included alongside typological analysis. Raw material frequencies will also be examined level by level in order to assess any change in raw material selection through time. In addition, individual artifact types will be analyzed with respect to raw material to attempt to identify any relationships that may be indicative of raw material preference in the manufacturing process.

3.4 Technological Variables

The technological variables discussed in this chapter were applied to different classes of artifacts depending on the circumstances. Whole and utilized flakes, as well as blades, were analyzed for Toth type, plan form, dorsal flake scar pattern, and number of dorsal scars. Technological variables for tools include retouch intensity and retouch angle, while core variables are cortex cover and number of visible flake scars. In addition, size and weight measurements were examined for all three categories of artifacts.

The amount of cortex on the dorsal surface of a flake or tool is used by archaeologists to determine the relative stage of production (Andrefsky 1998:102-104; Odell 2004:126-127). The rationale for this interpretation is that flakes taken off early in the reduction stage will have more cortex remaining than a flake from the later stages of production. This study will use the classification by Toth (1982:73-75) to relate the amount of cortex on the platform and dorsal surface of flake debitage as an indication of the relative stage of reduction.

There are six main categories (or Toth Types) and are represented graphically in Figure 3.1. Type I flakes are categorized by the presence of cortex on both the platform and entire dorsal surface and are usually the first flake taken off of a core. Type II flakes have cortex on the platform with some cortex on the dorsal surface. These flakes are usually taken off in the early stages of unifacial flaking. Type III flakes show full cortex on the platform with no cortex on the dorsal surface and are created by unifacially flaking a cobble with little cortex remaining on the face, and can also be produced through bipolar flaking using a hammer and anvil. Toth Type IV flakes have no cortex on the platform and full cortex on the dorsal surface of the flake and is usually the first flake removed in the initial stages of bifacial flaking. Type V flakes are taken off in the early stages of bifacial flaking after the Type IV flake has been removed. The final type, Type VI, exhibits no cortex remaining on either the platform or the dorsal surface and is indicative of late stages of production where there is little to no cortex remaining on the core.

The planform variable involves the overall shape of flakes or tools as seen from above. The five different plan form categories are convergent, parallel, divergent, intermediate, and circular.

Analysis of dorsal scar pattern can indicate the particular mode of reduction that a flake underwent by categorizing them into the following categories: radial, same platform simple, same platform parallel, opposed platform, transverse, and plain. For example, flakes from a prepared platform core would most likely fall under the 'same platform simple' or 'same platform parallel' categories while radial or Levallois technology would produce flakes classified under the 'radial' category.

The number of dorsal scars is related to reduction intensity and flaking method, as flakes with higher dorsal scar counts would have been worked to a higher degree than flakes with fewer dorsal scars. However, this result may also be affected by flaking method and dorsal scar pattern. Production of blades on formal blade cores, for instance, may produce blades with relatively few dorsal flake scars compared to flakes prepared from another type of core.

Size measurements of length, breadth, thickness, and weight were taken for flakes, tools, and cores and are all measured in millimeters with weight being measured in grams.

Trimmed pieces are also measured for angle of retouch and retouch intensity. Retouch intensity falls under one of three categories: marginal, semi-invasive, and invasive. Retouch angle is attempts to distinguish possible uses for tools based on their angle of retouch. Mehlman (1989:129) defines a scraper edge as consisting of unifacial retouch forming an angle between 35° and 90°. Very steep retouch (>80°), however, indicates a core edge or backed piece.

Reduction intensity of cores was measured using a combination of the amount of cortex measured and the number of observable flake scars. Cores with little to no cortex remaining would have been reduced to a higher degree than cores exhibiting higher amounts of remaining cortex. Similarly, cores with higher counts of observable flake scars would have been used to a higher degree than those with relatively few scars.

Using the typological and technological data that are presented in the following chapters, an analysis of mobility and site use will be conducted from a macroscopic approach. Areas of interest include assemblage diversity, evenness and richness statistics, as well as raw material availability and exploitation. Assemblage diversity as well as the evenness and richness statistics focus on the number and types of tools found at a site in relation to the activities that occurred on site. Both the evenness index and artifact richness are calculated using the number of tools in relation to the number of tool types represented in an assemblage. In addition, comparisons will be made to other LSA and MSA sites examining changing settlement patters through time and space.

3.5 Review of Comparable Sites

The main source of comparison for this paper will be Mehlman's (1989) research at Nasera Rockshelter to the north of Olduvai Gorge and Mumba Cave, located on the eastern part of Lake Eyasi, both in northern Tanzania (Figure 3.2).

Mehlman's data come from both his own excavations at these sites as well as previously excavated material from Mumba in the Kohl-Larsen collections, which were originally excavated by Ludwig Kohl-Larsen's wife, Margaret, in the 1934-1936 (Mehlman 1989:11).

The earliest of Mehlman's MSA assemblages is attributed to the Sanzako Industry (Mehlman 1989:183-186), which gets its name from the Hadza word for Oldeani Mountain on the northern end of the Eyasi Basin. Excavated from Bed VI-B at Mumba, the Sanzako Industry is characterized by a high frequency of bifacially modified pieces and heavy duty tools. This is contrasted with a relatively low occurrence of formally retouched points. It is distinguished from the overlying Kisele Industry by exhibiting a lower rate of the Levallois technique and retouched points with an increased amount of side and concave scrapers, bifacially modified pieces and heavy duty tools.

The overlying layer of VI-A at Mumba is attributed to the Kisele Industry (Mehlman 1989:200-201), mentioned above, which is also present at Nasera in levels 12-17 and 18-25 and gets its name from a prominent hill located to the south of that site. In the Kisele Industry, retouched points, bifacially modified pieces, and unstandardized scrapers are most common throughout while heavy duty tools are relatively rare. With respect to core technology, radial cores are frequent while bipolar technology is rare. The main differences between the Kisele at Mumba as compared to Nasera is the relatively less frequent use of the Levallois technique and a higher frequency of heavy duty tools at Mumba. At both localities, quartz is the dominant raw material.

Mehlman (1989) recognizes two intermediate MSA/LSA assemblages at both the Mumba and Nasera localities as they appear to exhibit characteristics from both MSA and LSA assemblages. The Mumba Industry (Mehlman 1989:272-273) is present at Mumba Bed V and Nasera levels 8/9-11, and is characterized by large backed pieces and retouched points. Radial, bipolar, and platform cores are all well represented. The Nasera levels are most similar to the lower levels of Bed V at Mumba, while the upper V levels exhibit characteristics that are more LSA-like. Backed artifacts are the most frequent, while points are nearly absent. Peripheral and platform cores are very similar in number while bipolar cores are the most dominant. Blades, however, are rare.

The other intermediate industry that Mehlman recognizes is the Nasera Industry (Mehlman 1989:318-321) corresponding to Nasera levels 6 and 7 as well as Mumba Lower Bed III. The main difference between this and the Mumba Industry is in the relative frequencies of points to backed pieces, which is reversed. Points are more common while backed pieces are smaller and infrequent. Scrapers dominate these assemblages with convex edged scrapers being the most common type. With respect to cores, bipolar cores are most frequent followed by peripheral and platform. The Nasera Industry also exhibits few blades.

The first of Mehlman's LSA industries is the Lemuta Industry (Mehlman 1989:368-386) which was originally defined at Olduvai Gorge and is classified as an early LSA assemblage that is Pleistocene in age rather than Holocene. Present only at Nasera in levels 4 and 5, the Lemuta assemblage is fully LSA with very few MSA hallmarks present. Radial and Levallois reduction has all but disappeared and bifacial retouch and formally retouched tools equally as rare. While LSA types are present in earlier industries, it is the great extent to which these types are produced that is significant. Mehlman believes that this evidence that stone tool manufacturers have developed a technology that is ideal for working small locally available quartz cores with a focus on small, mass produced stone implements that can be inset into handles and arrow shafts (Mehlman 1989:368).

Following the Lemuta Industry is a gap of approximately 10,000 years in the archaeological record at Nasera which separates the Lemuta from the Silale Industry (Mehlman 1989:387-389), which Mehlman classifies as a typical mid-Holocene LSA industry. Microlithic backed pieces and convex scrapers dominate the assemblage with curved backed pieces, geometric crescents, and straight-backed pieces being the most common of the microliths. The artifacts from the Silale Industry are more standardized in their size than those from the Lemuta. In addition, geometric microliths are smaller overall, being 10 mm shorter and 4 mm narrower on average than those belonging to the Lemutan Industry. More than half of the cores are bipolar while others tend to be small platform cores.

At Mumba Middle III, Mehlman (1989:400-404) has an LSA assemblage of indeterminate industry. Small sample size and typological attributes prevented Mehlman from accurately placing this assemblage within the Lemuta or Silale industry and therefore was to remain unclassified.

The final two industries discussed by Mehlman (1989:404-441) are both LSA assemblages and contain Kanyasore pottery, which is believed to date to approximately 5000 years ago (Mehlman 1989:406). Regarding the lithic material, the Olmoti Industry shares most of its tool types with the preceding Silale Industry with the only significant differences occurring in the relative proportions of the various tool types. Scrapers are more numerous than backed pieces and there is a decline in the number of small convex scrapers, an increase in concave scrapers and a decline in the overall numbers of backed microliths. The Oldeani Industry, conversely, is noted for its abundance of backed microliths as well as a wide range of geometric microliths and the dominance of small convex scrapers over other scraper types.

Two of Kusimba's studies (Barut 1994; Kusimba 1999) on hunter-gatherer land use will be used for comparison purposes. The first (Barut 1994), published under her own name, uses MSA and LSA assemblages from Lukenya Hill and Nasera to examine changes in land use patterns from the MSA to the LSA. The Lukenya Hill assemblages are located in Southern Kenya above the Athi Plains (Figure 3.2). The landscape exhibits numerous rockshelter and open air sites containing abundant stratified MSA and LSA sites. Kusimba uses four assemblages from this area in her study: GvJm16A, GvJm16B, GvJm22E, and GvJm22F. GvJm16A and GvJm16B are separated by rockfall with the former being attributed to the MSA with informal scrapers, points, and bifacial pieces dominating. Quartz is also the most abundant raw material for that assemblage. GvJm16B is attributed to the LSA and is dominated by crescents, curved backed blades, and convex end scrapers. Both assemblages have low artifact densities and most likely accumulated over a long period of time. Both GvJm22E and GvJm22F are high density LSA assemblages dominated by microliths. The two assemblages are recognized as two separate LSA industries and may represent two separate periods of intensive occupation at the site.

By examining raw material usage at the sites Kusimba was able to assess land use and mobility patterns. The MSA inhabitants at Lukenya Hill were relatively sedentary with a reliance on locally available raw materials, little investment in retouch, and no obvious selection of raw materials for specific tools or uses. In contrast to the MSA assemblages, the LSA component of the site was dominated by exotic obsidian that seems to be selectively used for specific purposes (Barut 1994:66).

The Nasera assemblages are from a rockshelter site in the Eastern Serengeti overlooking the Serengeti Plains and the Angata Kiti Valley. Assemblages at the site come from seven excavated units and are attributed to the MSA, Naseran industry (transitional MSA/LSA), and the Lemutan (fully LSA). The MSA assemblages span a long period of time and are comprised of informal scrapers, bifacial discs and points made preferentially from chert. The intermediate Naseran assemblages are comprised of both MSA and LSA artifacts containing scrapers, points and backed pieces. The Lemutan artifacts are fully LSA and are dominated by backed microliths, small convex end scrapers, as well as bipolar and blade cores (Barut 1994:46-65).

In the MSA, Nasera groups appear to be highly mobile and use the site on a periodic, short-term basis. Naseran and Lemutan LSA settlements at Nasera appear to be more intense and long-term. Importing of exotic chert, however, still occurred alongside intensive use of local raw materials during the LSA (Barut 1994: 66-67).

Kusimba's (1999) second study involves only LSA assemblages from Lukenya Hill. These sites were divided into two groups based primarily on raw material use and typology but are also separated by time. The earlier Group 1 sites of GvJm46, GvJm62 and GvJm19 date to 20,000 years or earlier and are dominated by local vein quartz with high proportions of quartz artifacts. Typologically, these sites are scraper based with a high reliance on bipolar reduction. The inhabitants of Group 1 sites put little effort in retouching quartz tools as most are of an expedient nature with little attention to design or shape. Use of exotic obsidian and chert, however, was maximized with a high reliance on bipolar reduction and more intensive retouch with obsidian appearing in the assemblage mostly as tools. Kusimba believes that these older Group 1 sites represent a longer term occupation with reduced mobility and, therefore, more restricted access to exotic raw materials.

The Group 2 sites of GvJm16 and GvJm22, dating to 10,000 years or earlier, have moderate quantities of quartz and higher proportions of chert and obsidian artifacts. Typologically, these sites differ from Group 1 sites in that they have a higher proportion of microliths with smaller numbers of other tools such as burins, points, and becs. Reduced reliance on locally available quarts and more liberal use of obsidian and chert is indicative of greater access to exotic raw materials. Kusimba sees this as evidence that the Group 2 sites represent a period of greater mobility where the inhabitants moved more widely around the Lukenya Hill area (Kusimba 1999: 174-192).

In addition to the above studies, Miller's (1993) study of MSA assemblages from the Songwe area will be used for comparison purposes and to examine any changes that may have occurred in the Songwe region from the MSA to the LSA. Miller's data came from surface collections from six sites throughout the area determined to be of MSA age (IcIu2, IcIu3, IcIu4, IdIu19, IdIu20, and IdIu21).

Table 3.1 Breakdown of Types and Subtypes in Mehlman's (1989:128-154) Classification

Trimmed Pieces:
1 – scrapers (1-23)
2 – backed pieces (24-34)
3 – points/ perçoirs (35-37)
4 – burins (38-40)
5 – bifacially modified pieces (41-43)
6 – becs (44)
7 – composite tools (45-48)
8 – outils écaillés (49)
9 – heavy duty tools (50-52)
10 – other tools (53-56)

Cores:
11 – peripherally worked (57-60)
12 – patterned platform (61-68)
13 – intermediate (69-73)
14 – bipolar (74-75)
15 – amorphous (76)

Debitage:
16 – angular fragments (77-81)
17 – specialized flakes (82-83)
18 – flakes (84-87)
19 – blades (88-91)
20 – Levallois flakes (92-93)

Non-Flaked Types:
21 – hammerstone (94)
22 – anvil stone (95-97)
23 – pestle rubber (98-99)
24 – polished axes (100-101)
25 – stone disc (102-103)
26 – sundry ground/polished (104)
27 – manuport (105)

Figure 3.1 Toth Types

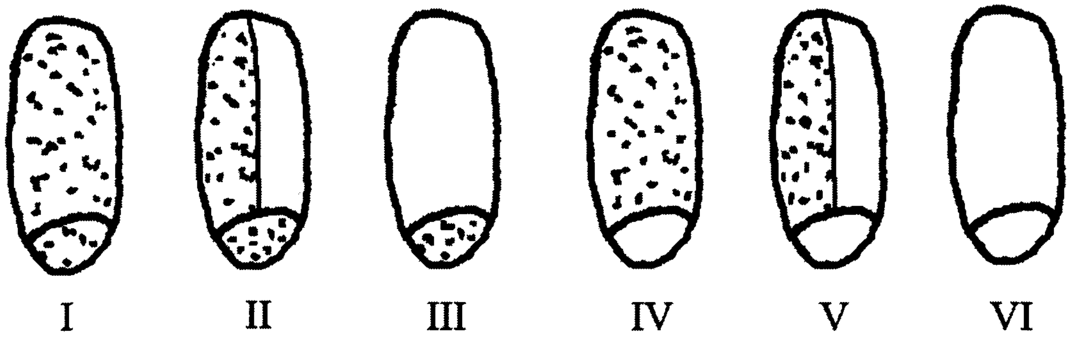
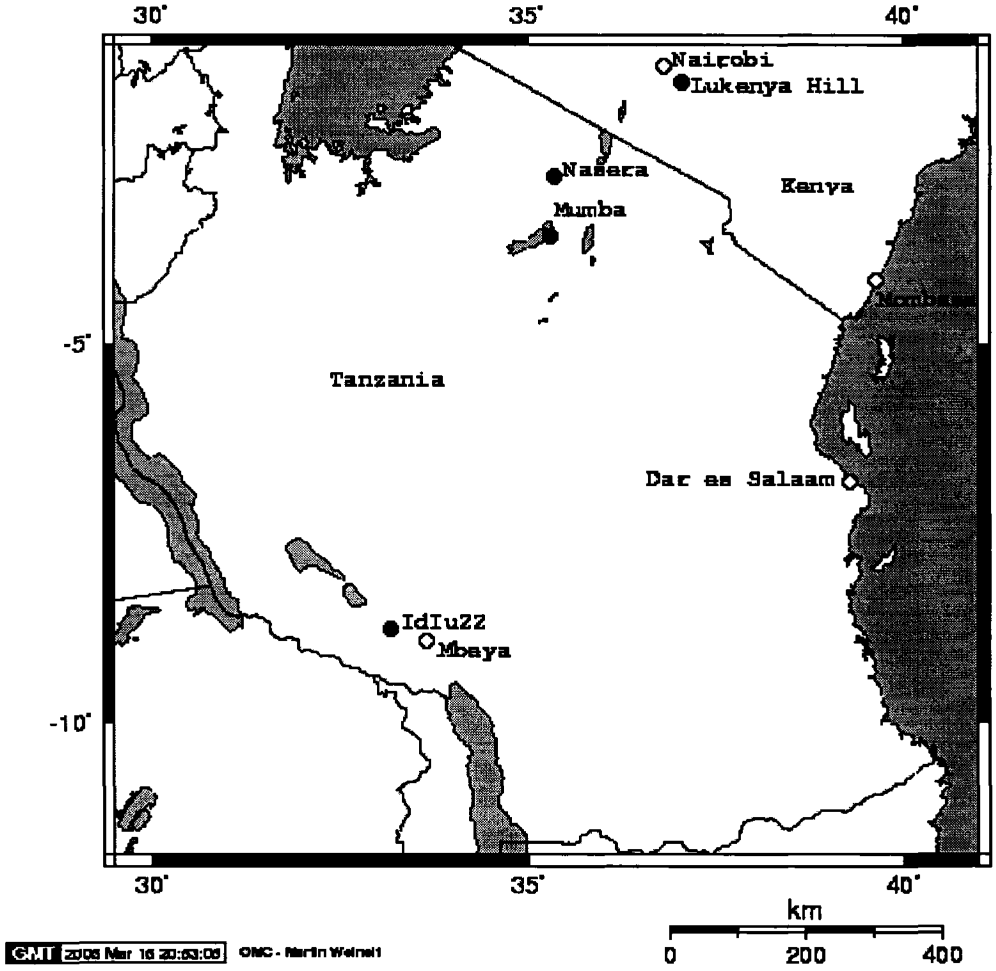


Figure 3.2 Map of comparable sites



Produced from http://www.aquarius.geomar.de/omc/

Chapter 4 – Typological Analysis

The following analysis of the site IdIu22 presents the typological distributions of artifacts at the site and seeks to compare these data with similar sites using a standardized typology by Mehlman (1989). Data will be presented on each of the six test pits as well as the site as a whole. In addition, the test pits will be examined level by level in an attempt to recognize any temporal patterns that may be present. Raw material distributions will also be discussed with an effort to identify any patterns with respect to raw material preferences.

4.1 Raw Material Distributions

The raw material distributions for IdIu22 and each of its six test pits are presented in Table 4.1, with Figure 4.1 showing the distribution for the entire site. Quartz dominates each of the test pits and accounts for 60.76% of the collected pieces for the entire site. Quartzite and chert/flint are the second and third most abundant materials, making up 24.39% and 13.27% of the total respectively. Volcanic artifacts were rare at 1.5% of the total, with the remaining categories of 'obsidian', 'other metamorphic', and 'other sedimentary' counting for less than a tenth of a percent of total artifacts combined.

Quartz also dominates Miller's MSA surface collections from the Songwe region, but to a lesser extent than IdIu22, with 46.2% of total artifacts collected. Chert comprises 25.3% and is followed by quartzite at 15.4%. Like IdIu22, obsidian was exceedingly rare with only one piece being found in Miller's collections and only 4 pieces for all of IdIu22.

Similar patterns can be seen at all of Mehlman's sites (Table 4.2), with quartz being most abundant followed by quartzite and chert/flint. Quartz also appears to have been utilized to a greater extent in the LSA than in earlier sites. In Mehlman's MSA sites quartz accounts for 79.77% of artifacts with quartzite and chert/flint comprising 5.60% and 9.29% respectively. In the LSA, however, quartz is by far the most abundant raw material making up 94.12% of the collected artifacts while chert/flint is at 4.78% and quartzite drops off to less than a percent at 0.41%.

With respect to Kusimba's sites at Lukenya Hill, IdIu22 is more similar to the earlier Group 1 sites in its raw material distribution. For example, Kusimba's Group 1 site at GvJm46 is comprised of 91.6% quartz artifacts with quartz making up only 45.7% of the artifacts at the Group 2 site of GvJm22. Chert and Obsidian are significantly more abundant at the latter comprising 32.9% and 20.8% of the assemblage respectively as opposed to 5.1% and 3.1% at GvJm46.

The majority of artifacts at IdIu22 were made from local raw materials as quartz and quartzite are abundantly available in the area. The need for higher quality exotic raw materials may have been low as the microlithic technologies of the African LSA could be successfully made on quartz (Kusimba 1999:174). Thus, the inhabitants of IdIu22 could rely on an abundant and dependable supply of local lithic raw materials.

4.2 General Artifact Categories

The following is a discussion of the distribution of the general artifact categories for IdIu22, which are comprised of: trimmed pieces, cores, debitage and groundstone (Table 4.3). Debitage dominates the site, making up the majority of artifacts recovered from each of the test pits. However, the relative frequencies for the remaining test pits differ noticeably from the previous analysis of test pit 4 done by Sipe (2000). Debitage makes up 88.11% (n=18,819) of test pit 4, which is less than the 93.58% (n=9892) for test pit 1 but more than the other test pits. The remaining test pits (tp2, tp3, tp5, tp6) range from 67.49% (n=1866) in test pit 5 to 72.22% (n=8891) in test pit 2.

The frequencies of trimmed pieces, or tools, also seem to differ with test pit 1 and test pit 4 having a much lower percentage of trimmed pieces than the rest of the site. The lowest percentage is in test pit 1 with trimmed pieces making up 3.86% (n=408) of collected artifacts followed by test pit 4 with 9.26% (n=1978). The percentages of trimmed pieces increase sharply for the remaining test pits and range from 22.91% (n=2820) in test pit 2 to 27.59% (n=763) in test pit 5.

Of particular note are the apparent differences between test pit 2, test pit 3 and test pit 4 (see Figure 4.2). Located directly north and south of test pit 4, both test pit 2 and test pit 3 have considerably higher percentages of trimmed pieces and even outnumber test pit 4 with respect to trimmed pieces despite having only slightly more than half the amount of total artifacts in each test pit. The difference in total count of artifacts in test pit 4 as compared with test pit 2 and test pit 3 is due entirely to the increased amount of debitage collected as the remaining artifact categories have similar counts.

The remaining categories are evenly represented across the site with cores ranging in frequency from 2.53% (n=267) in test pit 1 to 4.85% (n=134) in test pit 5. The groundstone category shows low frequencies comprising less than a tenth of a percent of collected artifacts in each of the test pits. Due to the low frequency of groundstone items they will be excluded from comparisons with other sites.

Data from the combined test pits at IdIu22 were compared with Miller's (1993) MSA collections as well as Mehlman's (1989) MSA, Intermediate MSA/LSA and LSA collections and can be seen in Table 4.4. In comparison with Mehlman's sites, the tool category at IdIu22 outweighs them all considerably especially the LSA assemblages with 15.62% at IdIu22 compared with 2.18% for Mehlman's LSA. The percentage of cores at IdIu22 is nearly identical to that of Mehlman's LSA collections, while both the intermediate MSA/LSA and LSA collections show a greater proportion of debitage than IdIu22. Miller's MSA collections show the highest percentage of tools and cores with 25.54% and 16.7% respectively and the lowest percentage of debitage at 57.76%.

When looking at the progression from the MSA to LSA at Mehlman's sites the percentage of tools and cores decreases through time while debitage steadily increases. The same pattern can be seen with the Songwe collections with higher percentages in Miller's tool and core categories but with a much lower amount of debitage than is seen at IdIu22.

The relative frequencies of tools, cores and debitage were examined level by level to see if there is any change over time, and the results for the two largest test pits (tp2 and tp3) can be seen in Figure 4.3. While these frequencies seem to fluctuate more in tp2, the remaining test pits show a consistent ratio over time suggesting little or no change in the general categories throughout the test pits.

In addition, the general categories were tested against raw material types to see if there was any pattern present (Figure 4.4). For each of the categories the raw material distribution was nearly identical to the overall distribution of raw materials at the site. It would appear that there is no observable trend with respect to general categories and raw material to suggest a preference for any raw material type.

4.3 Core Types

Frequencies of core types for IdIu22 are presented in Table 4.5 for the individual test pits as well as the site as a whole. The most abundant core type at IdIu22 and in each of the six test pits is patterned platform which comprise 56.16% of all cores at the site. The most common patterned platform cores in each of the test pits are traditional blade/bladelet cores or 'pyramidal/prismatic single platform cores' and 'divers single platform cores' (Figure 4.5).

Bipolar cores are the second most common core type comprising 28.86% of the total. The bipolar flaking technique is well suited for small pieces of quartz, which are more than abundant at IdIu22, and is the only option for quartz platform cores that have become too small to flake otherwise (Mehlman 1989:147).

Peripherally worked cores are the next most abundant with 11.78% of the total, with amorphous cores and intermediate cores following at 2.36% and 0.85% respectively. Peripheral cores are considered to be a hallmark of the Middle Stone Age (Mehlman 1989:368), where radial or Levallois cores are most abundant, and are considerably less common at IdIu22 than the patterned platform and bipolar cores more associated with the Later Stone Age.

While peripherally worked cores are still present at IdIu22 there is a clear shift in core types from the earlier MSA sites in the Songwe region. At Miller's MSA sites, peripherally worked cores are the most abundant ranging from 40.7% at IdIu20 to 84% at IcIu4. Patterned platform cores are the next most abundant ranging from 9.6% at IcIu4 to 44.4% at IdIu20. Amorphous cores reach their highest amount at IdIu21 with 15.8% of the total while the remaining types only contribute a small amount to the totals (Miller 1993:89).

This shift in core types is quite noticeable in Mehlman's sites as can be seen in Figure 4.7. Peripheral cores dominate the MSA collections and decrease over time with bipolar cores being the dominant type in the LSA closely followed by patterned platform cores. Mehlman (1989:368) believes that the change in core technology represents an attempt to maximize the use of the locally available raw materials.

The relative frequencies of core types by level was examined for IdIu22 and the results for test pit 2 and test pit 3 can be seen in Figure 4.8. No discernable pattern can be seen level by level as frequencies remain similar throughout.

The relationship between core types and raw material was examined and presented an interesting result (Figure 4.9). All but one core type have similar distributions that mirror the overall raw material distribution with quartz dominating followed by quartzite, chert/flint and volcanic. Amorphous cores, however, are dominated by chert/flint, followed by volcanic and with only small amounts of quartz and quartzite. While the overall number of amorphous cores is low compared to the other types, this result can still be considered significant. This pattern may be related to the method with which the inhabitants of the site were acquiring chert. At IdIu22 chert can be found locally in little pockets within the volcanic rock that could be extracted if needed. The inhabitants would be attempting to takes flakes of chert off these cores any way possible with no particular pattern resulting in an amorphous core. Figure 4.6 is an example of one of these amorphous cores where chert was taken from the surrounding volcanic rock.

4.4 Tool Types

At IdIu22, scrapers and backed pieces are the most abundant tool types comprising 91.06% of all tools at the site combined. The relative frequencies of these two tool types is considered by many to be of importance. Brooks (1984) and Jacobson (1984), who have both found sites in Southern Africa dominated by scrapers and backed pieces, suggest that they represent different site functions. A site dominated by backed pieces is said to be hunting-related, while a scraper dominated site is more of a residential site dedicated to food processing. This is based on the assumption that backed pieces and microliths are used as projectiles for hunting while scrapers are used in food and hide preparation.

Mehlman (1989) states that backed pieces will outnumber scrapers in Holocene LSA assemblages, while in earlier industries scrapers are the dominant tool type. IdIu22 falls into the former category with backed pieces clearly outnumbering scrapers with 69.62% of the total tools compared to 21.43% for scrapers. As is expected, the opposite is true for MSA assemblages in the Songwe region where scrapers are the more abundant tool type (Miller 1993:55-56).

This pattern can also be seen when looking at the progression of Mehlman's sites from the MSA to LSA (Figure 4.10). In his MSA sites, scrapers dramatically outnumber backed pieces with scrapers comprising 40.60% (n=395) of the total tools compared with only 0.72% (n=7) for backed pieces. In fact, at the site of Mumba, Level VI-B, not even a single backed piece was collected. Backed pieces increase slightly during the intermediate MSA/LSA and drastically increase in the LSA. Scrapers are outnumbered in Mehlman's LSA levels, but not nearly to the extent as is seen at IdIu22. The two types are nearly balanced with scrapers accounting for 38.72% of tools and backed pieces accounting for 39.72%.

4.4.1 Backed Pieces

Backed pieces, including microliths, are a technology that increases substantially during the LSA and is seen in one form or another until very recently when metal trade goods became easily accessible or until Iron Age peoples entered the area (Clark 1977:127). As Mehlman (1989:368) states, the production of microliths was a technological innovation that allowed the easy mass production of stone implements that could be used for a wide variety of functions especially as insets to hafted tools. Described by some as a "pull-out plug-in" technology, the presence of a large number of microliths in an assemblage may represent discarded or used implements that were easily replaced by new ones (Neeley 2002:50).

The main advantage to microliths is the wide range of uses in which they can be employed, such as: cutting implements, drills, gravers, points and point barbs, as well as many other uses. Historic and archaeological examples from the San Bushmen suggest that backed microliths were mounted in pairs, or as a single insert, to act as a cutting implement of an arrowhead to hunt game. These forms of arrowheads may not have been enough to take down an animal, but the addition of poison to the tip would make them very effective (Ambrose 2002:16; Clark 1977:141-146; Deacon 1984:288). It is thought that microliths from African LSA sites would have served a similar purpose. This could explain why there is a marked decrease in points and bifacial technology in the LSA with the possibility of geometric microliths replacing formally retouched points.

Geometric microliths (crescents, triangles, trapezes), and possibly truncated pieces, are associated with the microburin technique of producing microliths (Henry 1974:390). The microburin technique is demonstrated in Figure 4.12. This technique produces microliths by taking a blade or bladelet, creating a notch and subsequently snapping it. The resulting segment that is produced is then retouched into a desired form leaving the microburin as a waste product. Therefore, one would expect to see a relationship between the geometric microliths and microburins as the presence of microburins in an assemblage is direct evidence that microliths are being produced on site. However, it is noted that unretouched bipolar flakes may have served a similar purpose and used as substitutes as inserts for hafting in composite tools (Mehlman

1989:146). This could be a contributing factor as to why there is a noted increase in bipolar technology at both IdIu22 and Mehlman's LSA sites, as was seen above.

As was mentioned previously in this chapter, backed pieces are the most abundant retouched tool type at the site comprising 69.62% of all tools at IdIu22. The distributions of backed pieces for IdIu22 can be seen in Table 4.7. The most abundant type is divers backed (microburins) with 31.22% of the backed pieces. Truncations are the next most abundant comprising 30.07% of backed pieces and the geometric microliths make up 18.64% when considered as a group. Curved backed and straight backed pieces comprise 9.50% and 8.19% respectively, with the remaining types (angle backed, backed awl, and backed fragment) only contributing less than 5% combined. The high percentage of microburins and geometric microliths suggests that the microburin technique was frequently practiced at IdIu22.

Comparison to Mehlman's LSA sites (Figure 4.13) revealed some slight differences with IdIu22. The distributions for the geometric, curve backed and straight backed pieces were similar, with the differences being with the truncations and divers pieces. Mehlman's LSA sites show a low percentage (6.07%) of truncations while they represent a considerable portion (30.07%) at IdIu22. Divers pieces make up a much higher percentage (69.29%) of backed pieces at Mehlman's LSA sites than they do at IdIu22 where divers pieces are almost half (33.61%) that of Mehlman's.

Geometric microliths, truncations and microburins were analyzed by level to see if there was any change in the relative distributions through time and can be seen for test pit 2 and test pit 3 in Figure 4.14. Overall, the results were conflicting with test pit 2 showing a slight increase in the percentage of microburins over time, while test pit 3 shows a decline in microburins and an increase in truncations in the upper levels. The remaining test pits were also analyzed to try and reconcile this problem and also returned conflicting results. Test pit 4 showed an increasing percentage of microburins over time while test pit 1, test pit 5, and test pit 6 showed no discernable pattern. Therefore, it cannot be said that there is any observable trends in the relative frequencies of backed pieces over time at IdIu22.

An analysis of backed pieces by raw material was also conducted for IdIu22 (Figure 4.15), with no significant results. Similar to other tool types and the overall distribution of raw materials at the site, each of the backed pieces were manufactured primarily on quartz and quartzite with the remaining categories only contributing a small amount. Therefore, there is no evidence that the inhabitants of IdIu22 were selecting for a particular raw material when manufacturing backed pieces.

4.4.2 Scrapers

Of the 23 scraper types in Mehlman's typology, all except two are found at IdIu22: sundry double end scrapers, and divers (miscellaneous) scrapers. Distributions for scraper types at IdIu22 can be seen in Table 4.8. Circular scrapers are the dominant type at the site with 34.79% of collected scrapers, followed by concave scrapers with 12.98%, convex end scrapers with 12.17% and concavities with 9.55%.

In Mehlman's analysis, he grouped the scrapers into the following groups: small convex scrapers (type 1), convex end (types 2-6), convex side (7-9), sundry end (10-12), sundry side (13-14), concave/notch (15-17), and divers/fragment (18-23).

Using these categories, Figure 4.16 shows the distribution of scrapers from Mehlman's sites compared to IdIu22. When comparing the LSA sites to IdIu22, it is clear there are some differences. The category of 'convex end scrapers' is clearly the most abundant at IdIu22 with 'concave/notches' following far behind. At Mehlman's LSA sites 'divers/frag' and 'small convex scrapers' clearly dominate. The interesting part of this result is that along with backed microliths, small convex scrapers dominate Mehlman's LSA assemblages (Mehlman 1989: 368) and are almost completely absent from IdIu22 comprising only 0.24% of the scrapers at the site.

The distributions for scraper types by raw material show no observable patterns except for one type, small convex scrapers, which are made exclusively on quartz (Figure 4.17). However, considering the extremely small overall percentage of this type (0.24%) it is not considered important. The remaining types show similar raw material distributions to that of the overall raw material at the site. Therefore, it cannot be said that a particular raw material was preferred for any of the scraper types.

Scraper types were examined by level for each of the test pits and no discernable pattern was found. Convex end scrapers are the most abundant type at IdIu22 throughout each of the test pits followed by 'concavity/notch'.

4.4.3 Other Tool Types

Compared with the scraper and backed pieces categories, the remaining tool types only make up a fraction of the total tool percentage at IdIu22 and their distributions can be seen in Figure 4.18. Combined, these tool types comprise less than 10% of all retouched tool types at IdIu22 with becs being the most abundant at 3.00% of retouched tools followed by bifacially modified pieces at 2.66% and burins at 1.97%. Points are also extremely rare at IdIu22 at only 0.60% of the retouched tools. These results are not surprising, however, as Mehlman (1989:183, 201, 368) states that retouched points and bifacial retouch are more indicative of the MSA and become exceedingly rare in the LSA.

A detailed comparison to other MSA and LSA sites was not conducted for these types due to the low contribution to the overall assemblage. However, a quick comparison was conducted and IdIu22 does resemble Mehlman's LSA sites where bifacial retouch and points do not make up a considerable number of tools, as is mentioned above.

No pattern can be seen when examining the raw material distributions for these types. In addition, the low percentages of these types made it difficult to recognize any discernable patterns in relative tool types by level. While still present at IdIu22, these types are relatively insignificant compared to the dominance of scrapers and backed pieces at the site.

Table 4.1 Raw Material Distributions (n)

	Quartz	Quartzite	Chert/Flint	Volcanic	Other	Totals
tpl	8456	115	1711	280	8	10570
tp2	6417	3987	1721	175	11	12311
tp3	8718	2380	1712	114	10	12934
tp4	10179	8410	2426	329	14	21358
tp5	2206	191	337	26	5	2765
tp6	2202	244	432	20	3	2901
Totals (%)	38178 (60.76%)	15327 (24.39%)	8339 (13.27%)	944 (1.50%)	51 (0.08%)	62839 (100%)

Figure 4.1 Raw Material Distribution, IdIu22

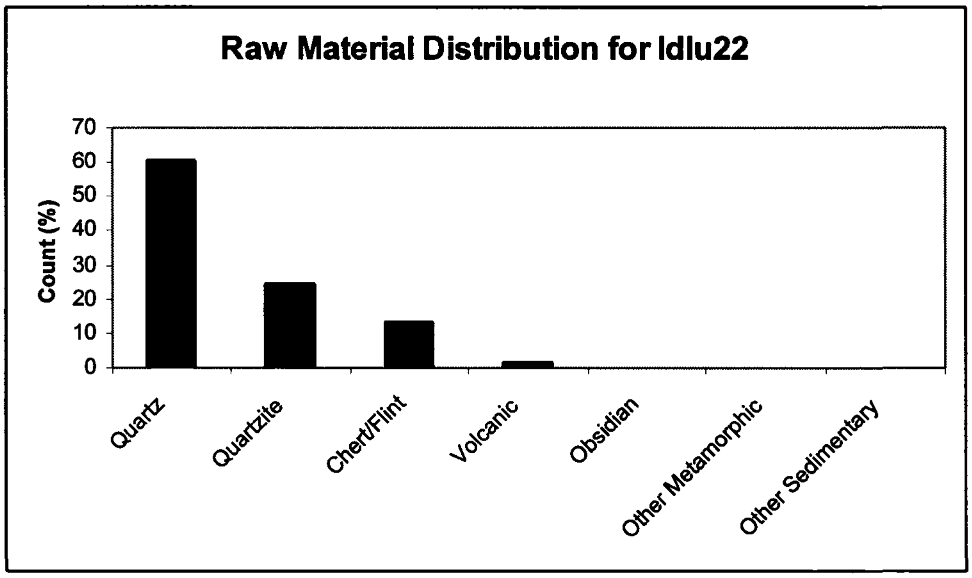


Table 4.2 Comparative Percentages of Raw Materials

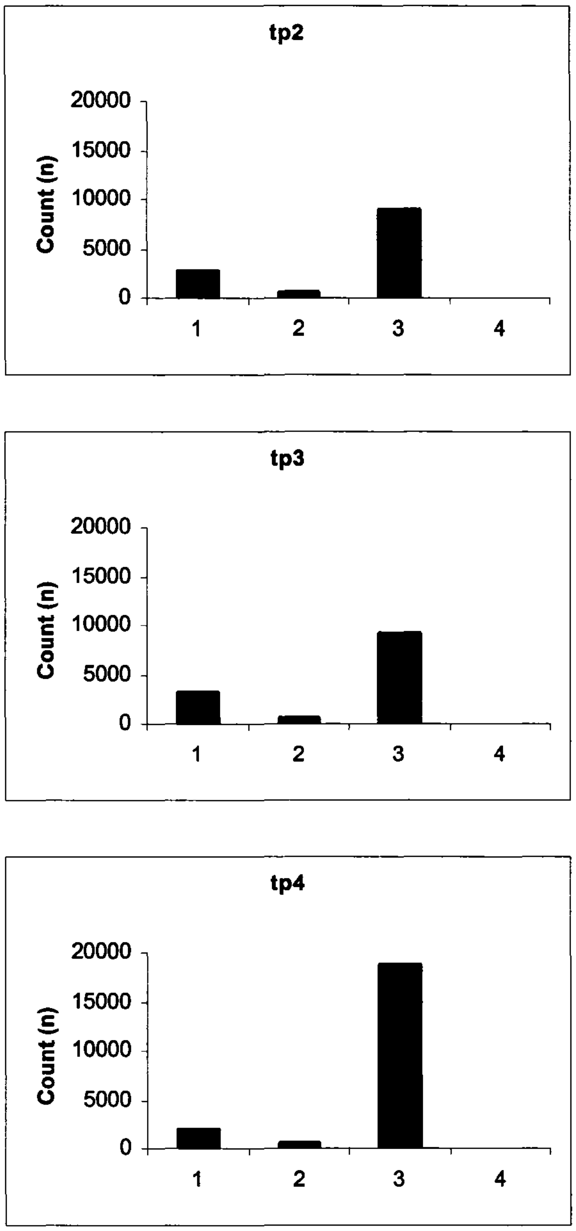
	Quartz (%)	Quartzite (%)	Chert/Flint (%)	Other (%)
MSA (*Mehlman)	79.77	5.60	9.29	5.34
MSA/LSA(*Mehlman)	89.87	4.28	4.15	1.70
LSA (*Mehlman)	94.12	0.41	4.78	0.70
MSA (Miller)	46.2	15.4	25.3	12.94
LSA (IdIu22)	60.76	24.39	13.27	1.58

* Average of Mehlman's sites. (MSA – Sanzako and Kisele Industries, MSA/LSA – Mumba and Nasera Industries, LSA – Lemuta and Silale Industries)

Table 4.3 General Artifact Categories for IdIu22 test pits (n/%)

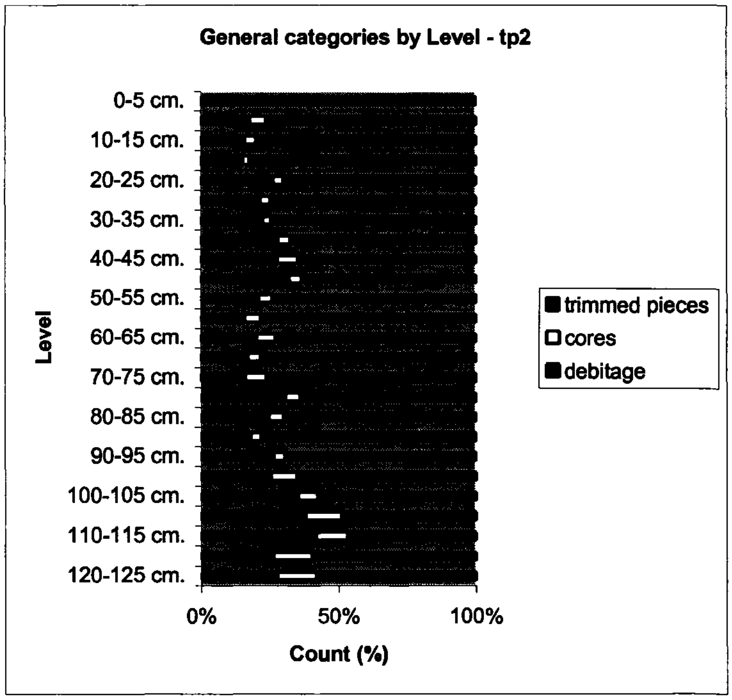
	Trimmed Pieces		Cores		Debitage		Groundstone		Totals
	N	%	N	%	N	%	N	%	
tp1	408	3.86	267	2.53	9892	93.58	3	0.03	10570
tp2	2820	22.91	596	4.84	8891	72.22	4	0.03	12311
tp3	3170	24.51	568	4.39	9192	71.07	4	0.03	12934
tp4	1978	9.26	551	2.58	18818	88.11	11	0.05	21358
tp5	763	27.59	134	4.85	1866	67.49	2	0.07	3680
tp6	678	24.04	125	4.60	2098	71.32	0	0.03	2901
Totals	9817	15.62	2241	3.57	50757	80.77	24	0.00	62839

Figure 4.2 General Artifact Categories for tp2, tp3 and tp4 at Idlu22



1 = trimmed pieces; 2 = cores; 3 = debitage; 4 = groundstone

Figure 4.3 General Categories by Level, IdIu22 tp2 and tp3



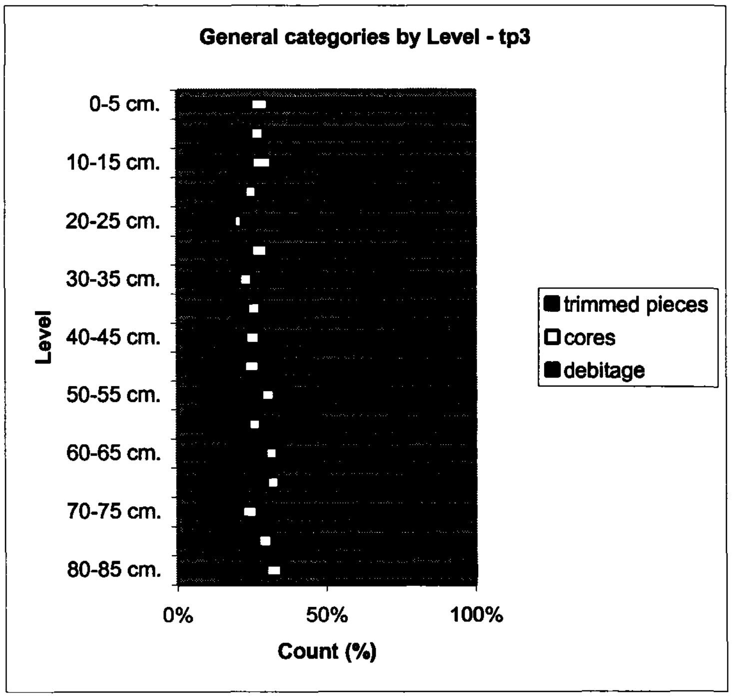


Figure 4.4 General Categories by Raw Material, IdIu22

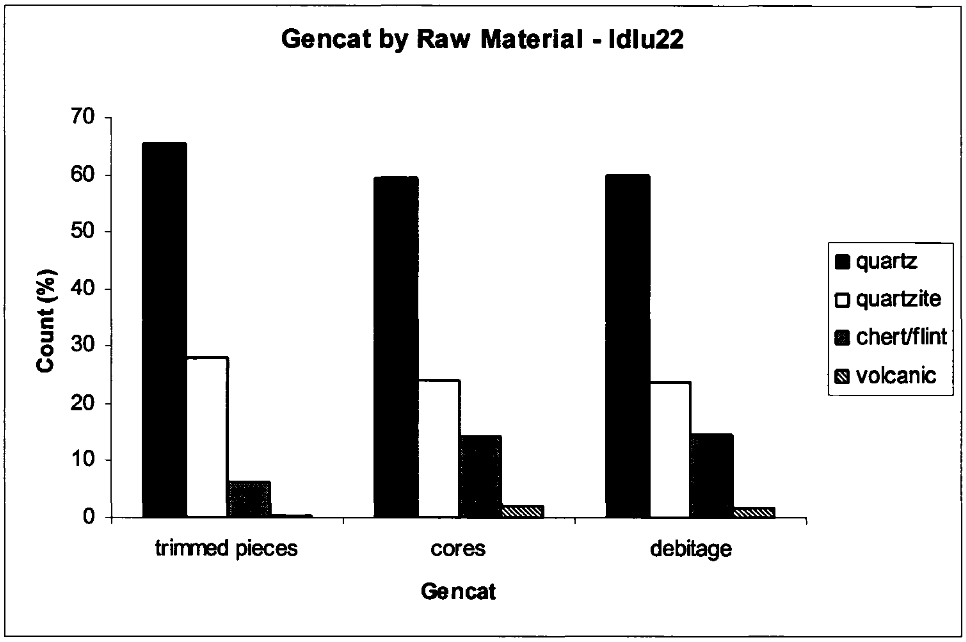


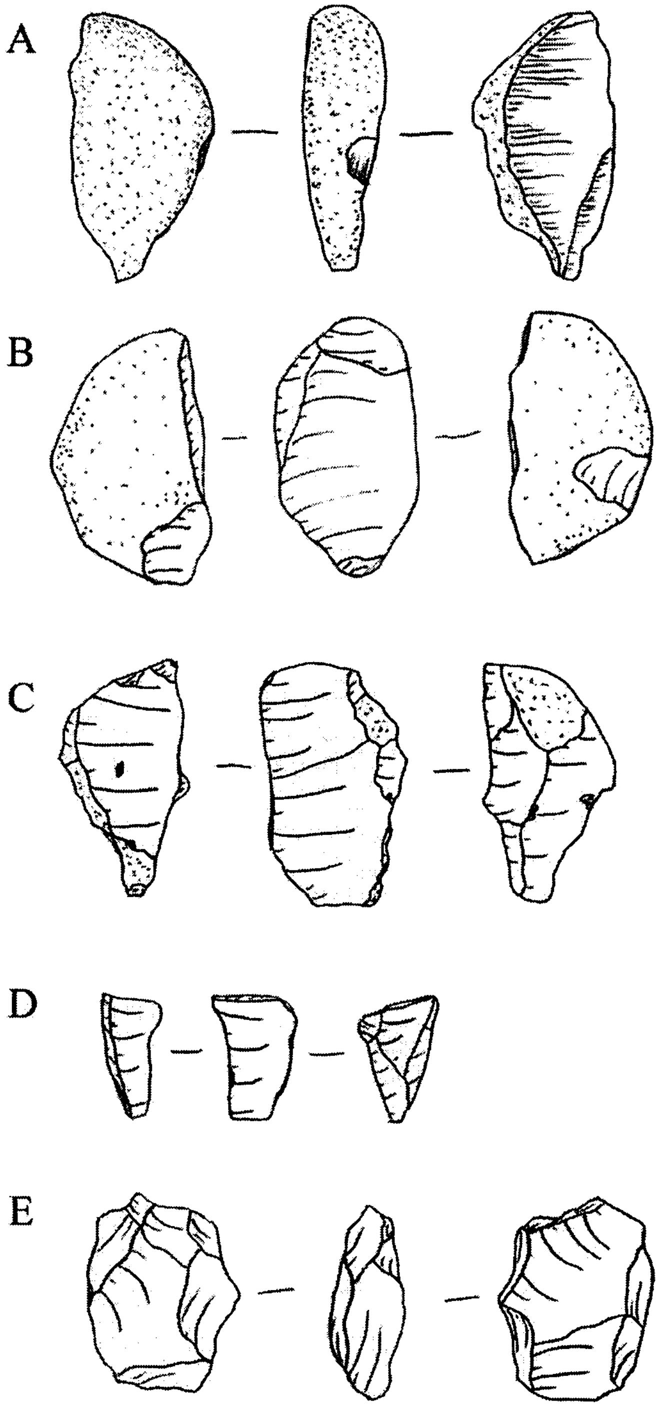
Table 4.4 Site Comparison of General Categories (n/%)

	LSA		MSA		MSA		Intermediate MSA/LSA		LSA	
	IdIu22		Miller		Mehlman		Mehlman		Mehlman	
	N	%	N	%	N	%	N	%	N	%
Tools	9817	15.62	668	25.54	973	9.77	1650	4.00	852	2.18
Cores	2241	3.57	437	16.70	1487	14.94	5232	12.68	1407	3.60
Debitage	50757	80.77	1511	57.76	7495	75.29	34369	83.32	36856	94.22

Table 4.5 Percentage of Core types for IdIu22 (n/%)

	Peripheral		Patterned Platform		Intermediate		Bipolar		Amorphous	
	N	%	N	%	N	%	N	%	N	%
tp1	58	21.7	180	67.4	0	0.0	25	9.4	4	1.5
tp2	60	10.1	324	54.4	6	1.0	182	30.5	24	4.0
tp3	48	8.5	260	45.8	6	1.1	247	43.5	7	1.2
tp4	73	13.2	405	73.5	3	0.5	56	10.2	14	2.5
tp5	13	9.7	54	40.3	0	0.0	66	49.3	1	0.7
tp6	12	9.6	36	28.8	3	2.4	71	56.8	3	2.4
Total	264	11.8	1259	56.2	18	0.8	647	28.9	53	2.4

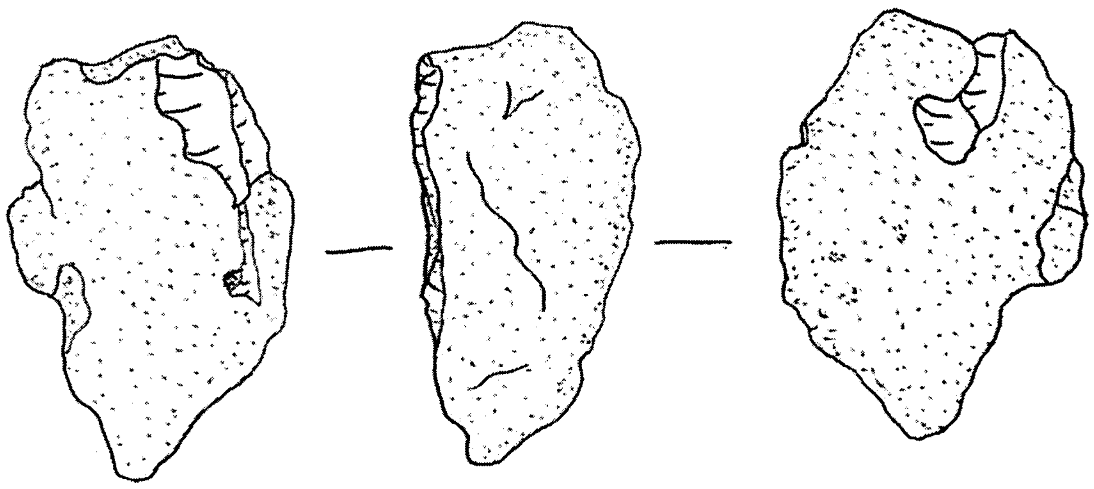
Figure 4.5 Core Types, IdIu22 tp3



A,B – Bipolar; C – Divers Single Platform; D – Pyramidal/Prismatic Single Platform; E – Radial/Biconical

Illustrations by S. Garcin

Figure 4.6 Amorphous Core, IdIu22 tp3



Illustrations by S. Garcin

Figure 4.7 Core Types for Mehlman's Sites

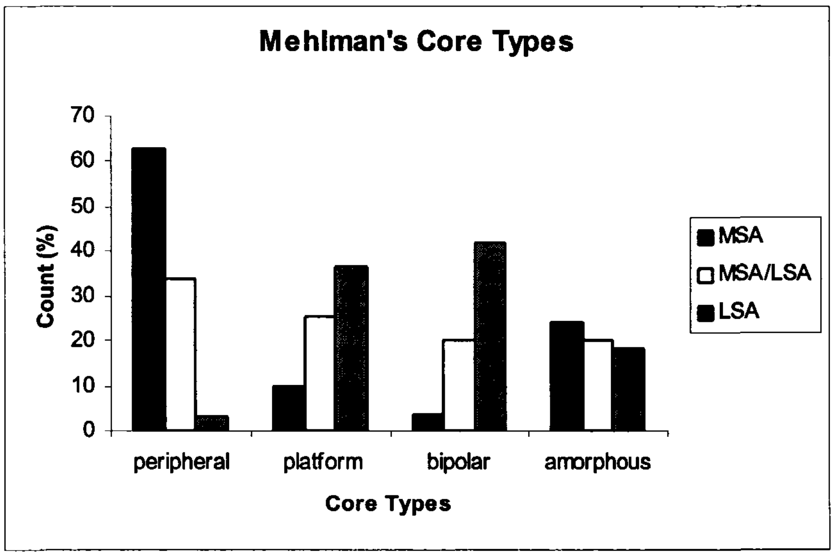


Figure 4.8 Cores by Level, IdIu22 tp2, tp3

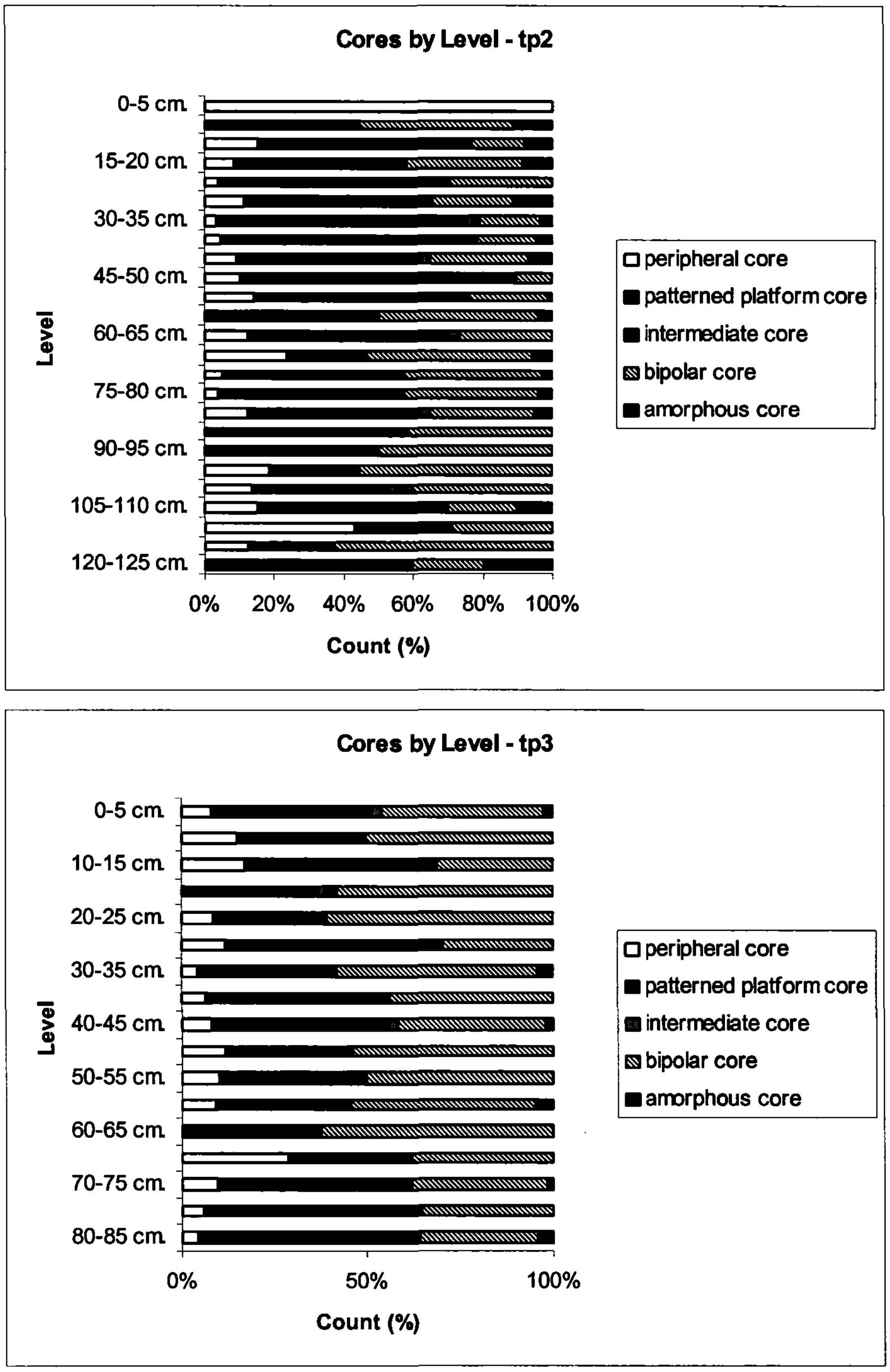


Figure 4.9 Core Types by Raw Material, IdIu22

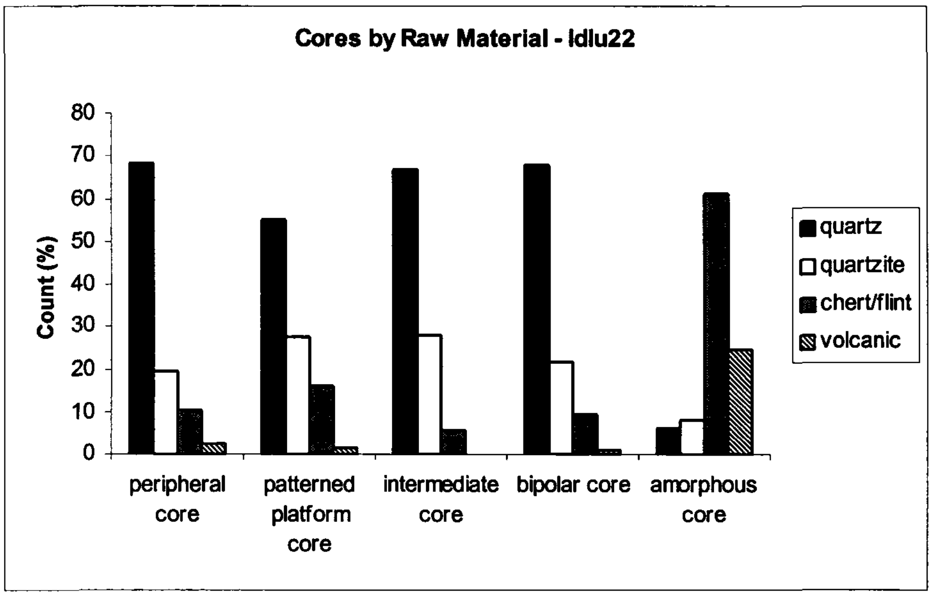


Table 4.6 Tool Types for IdIu22 (n/%)

	tp1		tp2		tp3		tp4		tp5		tp6	
	N	%	N	%	N	%	N	%	N	%	N	%
Scrapers	126	31.0	645	22.9	569	17.9	487	24.6	144	18.9	133	19.6
Backed pieces	225	55.3	1989	70.5	2324	73.3	1312	66.3	538	70.5	447	65.9
Points	3	0.7	8	0.3	26	0.8	5	0.3	11	1.4	6	0.9
Burins	30	7.4	35	1.2	38	1.2	63	3.2	13	1.7	14	2.1
Bifacially Modified	3	0.7	70	2.5	130	4.1	25	1.3	13	1.7	20	2.9
Becs	12	2.9	63	2.2	65	2.1	71	3.6	38	5.0	46	6.8
Composite Tools	3	0.7	4	0.1	3	0.1	5	0.3	1	0.1	2	0.3
Outils ecailles	0	0.0	0	0.0	12	0.4	2	0.1	5	0.7	9	1.3
Heavy duty Tools	5	1.2	6	0.2	3	0.1	8	0.4	0	0.0	1	0.1
Total	407		2820		3170		1978		763		678	

Figure 4.10 Tool Types for Mehlman's Sites

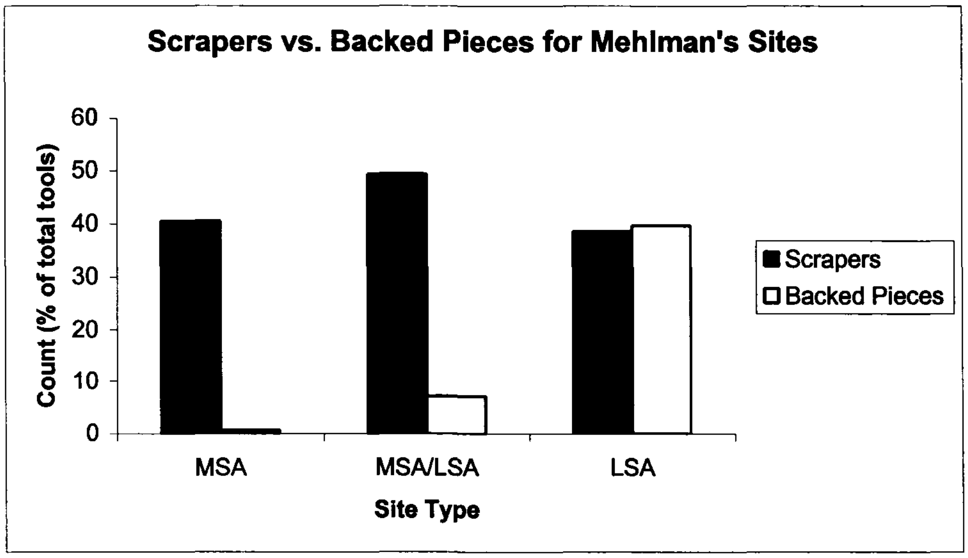
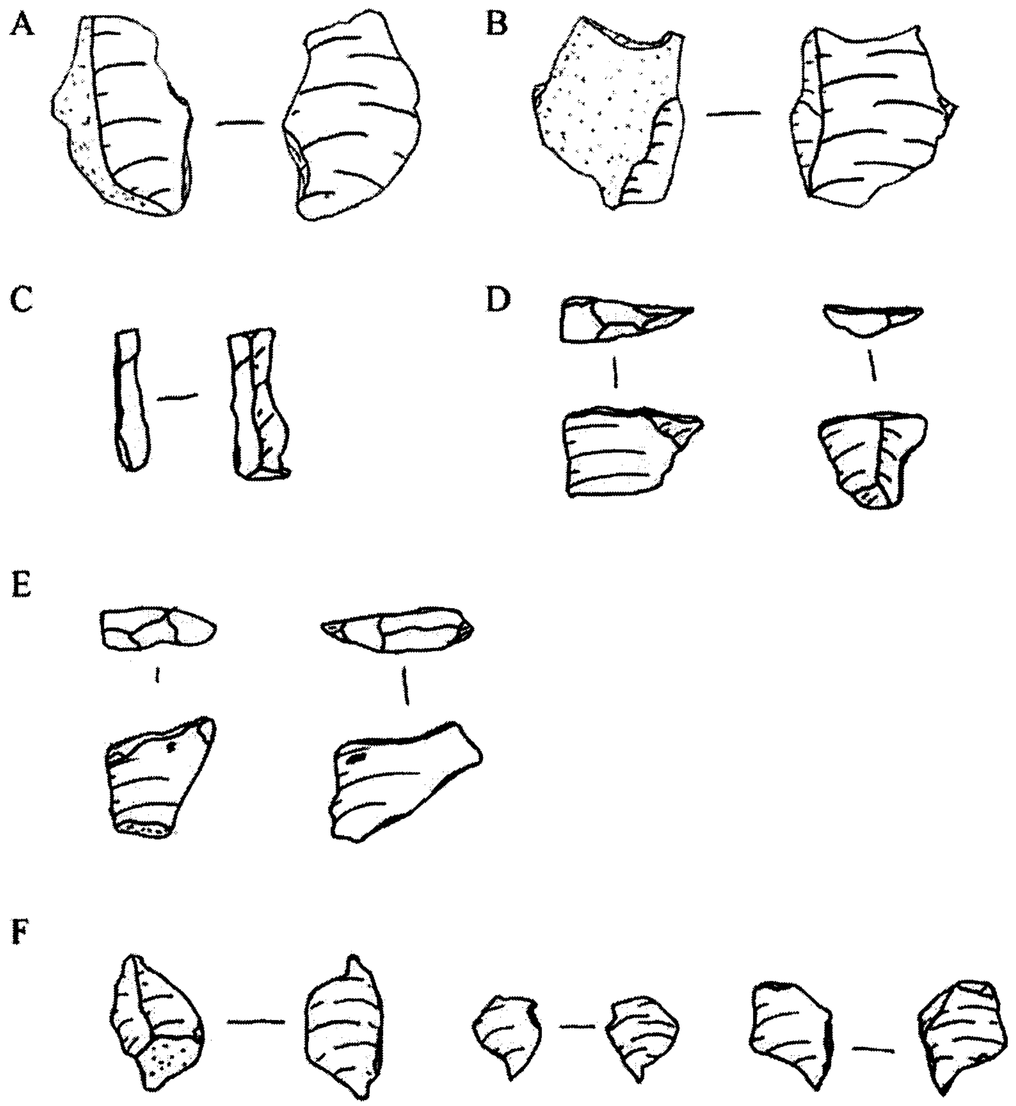


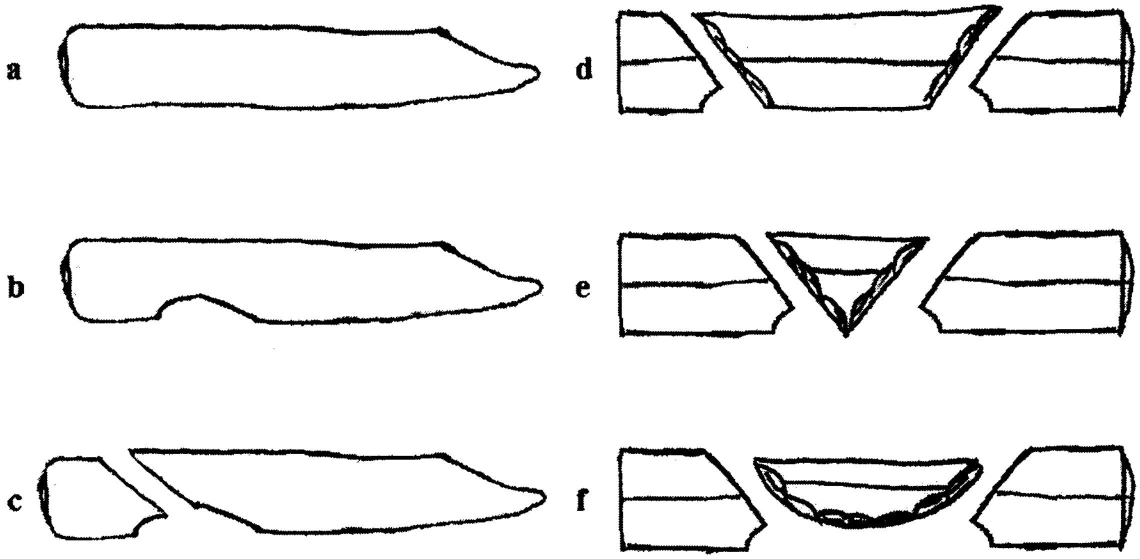
Figure 4.11 Tool Types, IdIu22 tp3



A – Concave Scraper; B – Concavity; C – Straight Backed; D – Orthagonal truncations; E – Oblique Truncations; F – Divers Backed (microburins)

Illustrations by S. Garcin

Figure 4.12 Demonstration of the Microburin Technique



The microburin technique begins with a blade (a), adding a notch (b), and subsequently snapping it creating a microburin and microlith (c). Common geometric microliths produced from this technique include trapeze (d), triangle (e), and crescent (f). Based on Tixier (1974:17), Inizan et al. (1992:69).

Table 4.7 Backed Pieces, IdIu22

Type:	N	%
crescent	482	7.05
triangle	289	4.23
trapeze	503	7.36
curve backed	649	9.50
straight backed	560	8.19
orthagonal truncation	721	10.55
oblique truncation	1225	17.92
angle backed	109	1.59
divers backed	2134	31.22
backed awl	137	2.00
backed fragment	26	0.38
Total:	6835	100

Figure 4.13 Backed Pieces, Mehlman and IdIu22

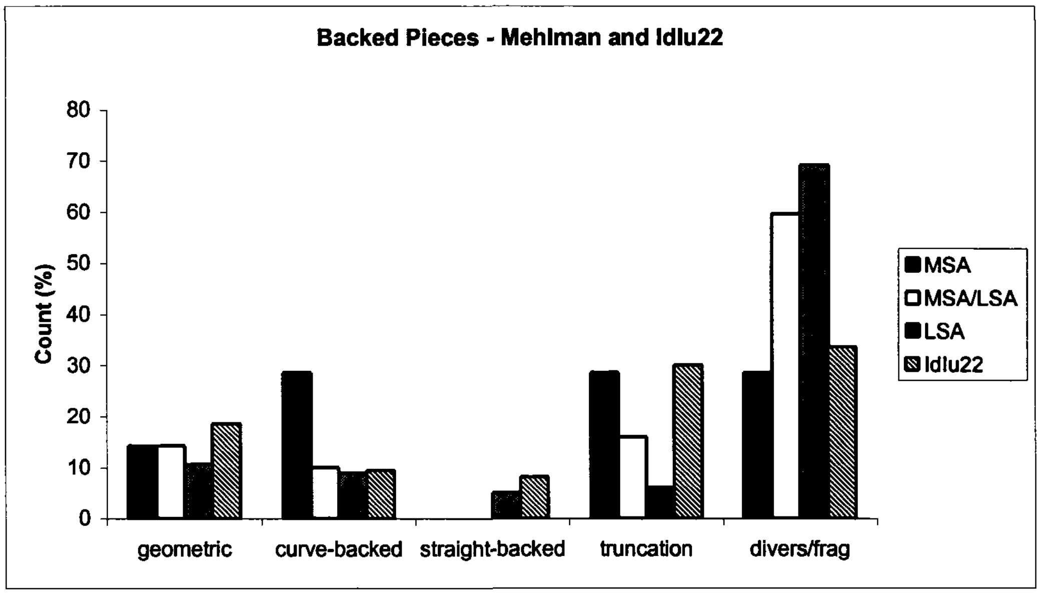
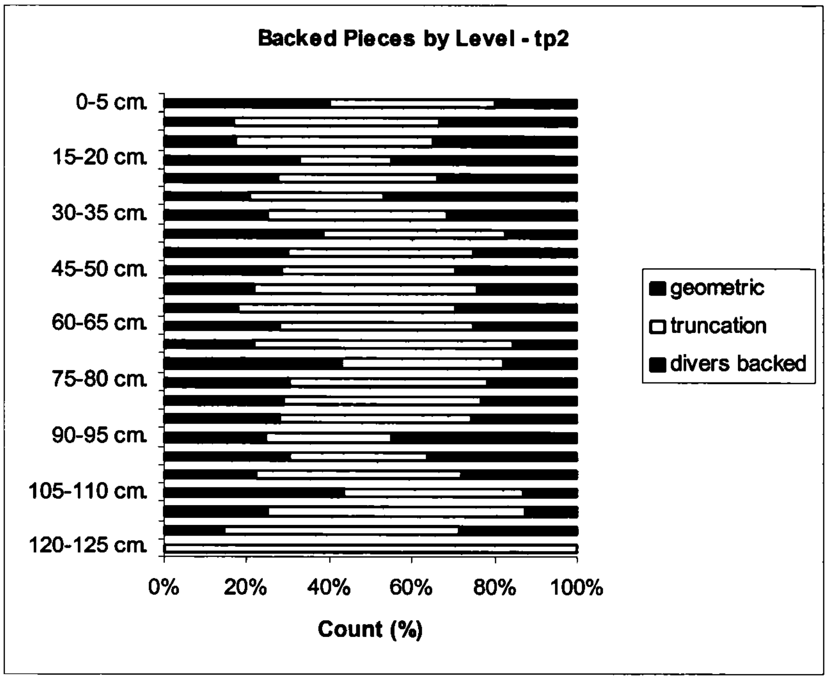


Figure 4.14 Backed Pieces by Level, IdIu22 tp2 and tp3



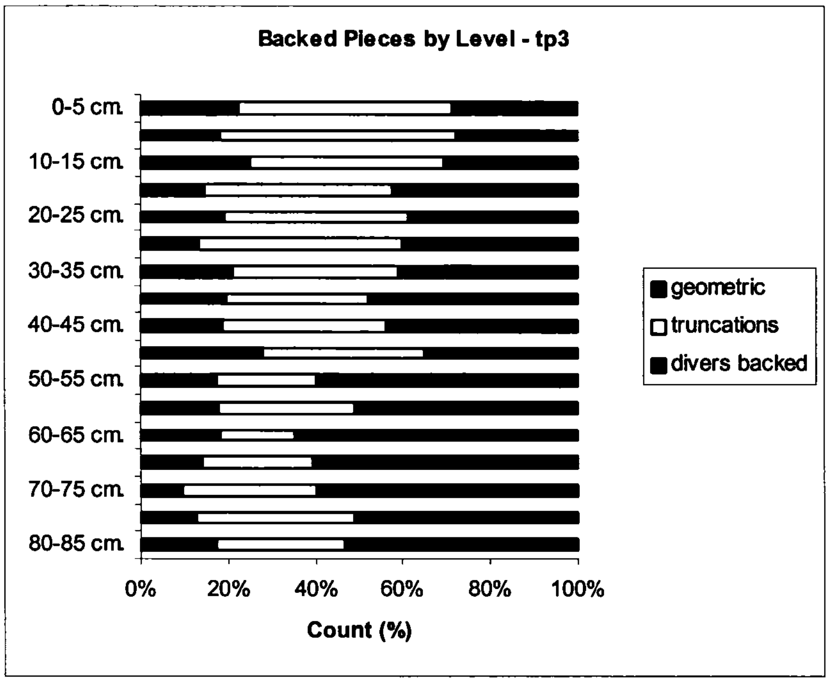


Figure 4.15 Backed Pieces by Raw Material, IdIu22

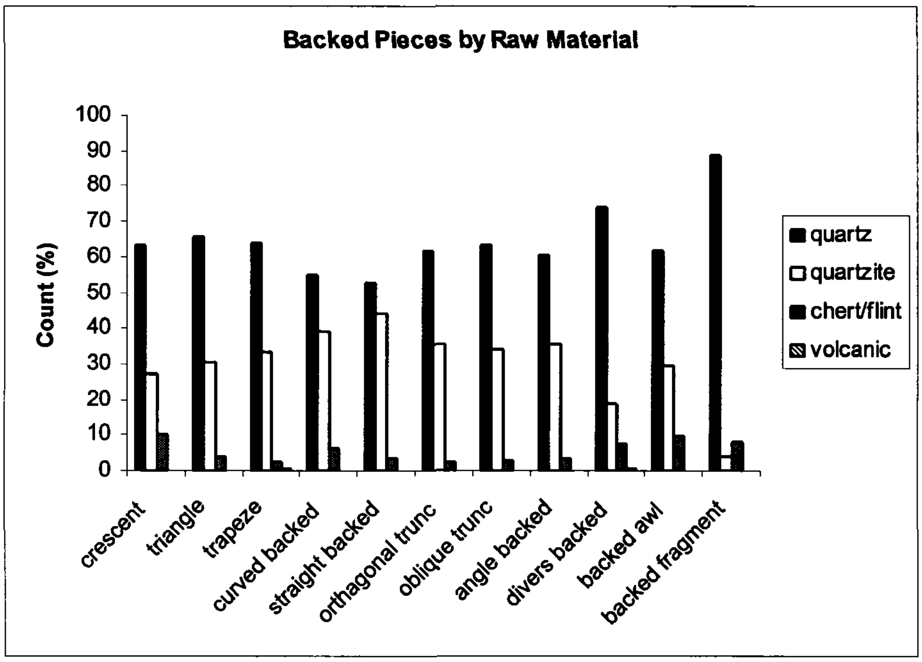


Table 4.8 Scrapers, IdIu22

Type:	n	%
small convex scraper	5	0.24
convex end scraper	256	12.17
convex double end scraper	1	0.05
convex end and side scraper	24	1.14
circular scraper	732	34.79
nosed end scraper	74	3.52
convex side scraper	101	4.80
convex double side scraper	8	0.38
nosed side scraper	21	1.00
sundry end scraper	83	3.94
sundry end and side scraper	26	1.24
sundry side scraper	110	5.23
sundry double side scraper	29	1.38
concave scraper	273	12.98
concavity	201	9.55
notch	5	0.24
sundry combination scraper	6	0.29
convex end and concave combination scraper	15	0.71
convex side and concave combination scraper	36	1.71
convergent scraper	84	3.99
scraper fragment	14	0.67
total	2104	100

Figure 4.16 Scraper Types, Idlu22 and Mehlman

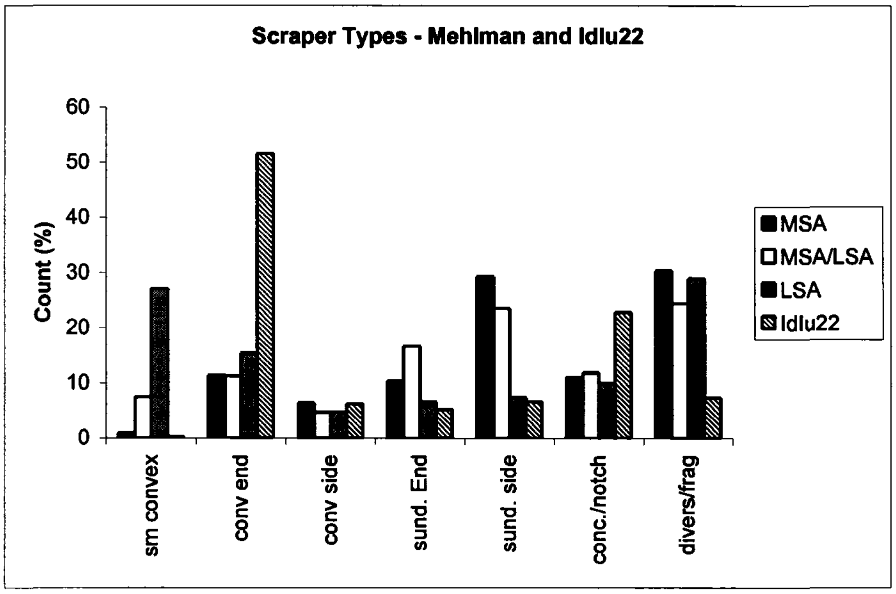


Figure 4.17 Scrapers by Raw Material, Idlu22

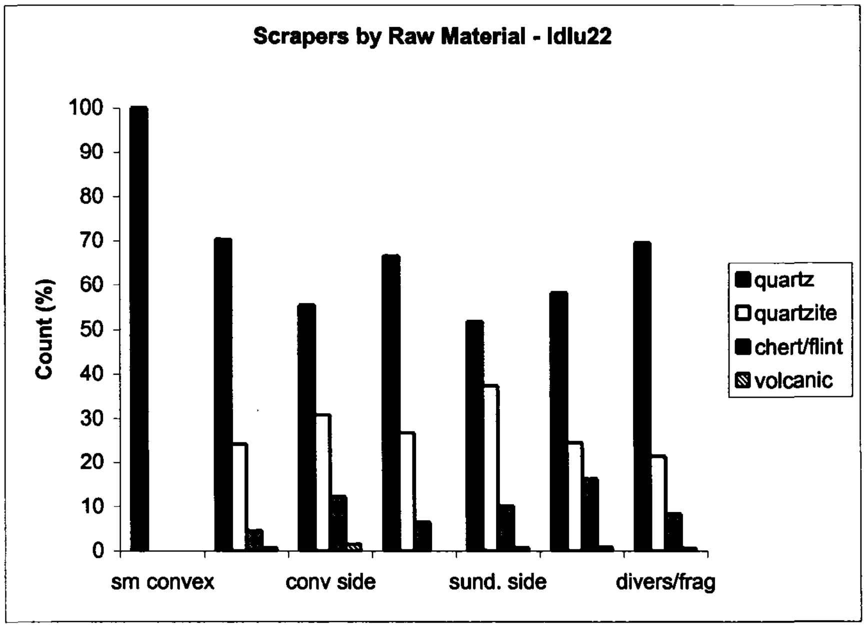
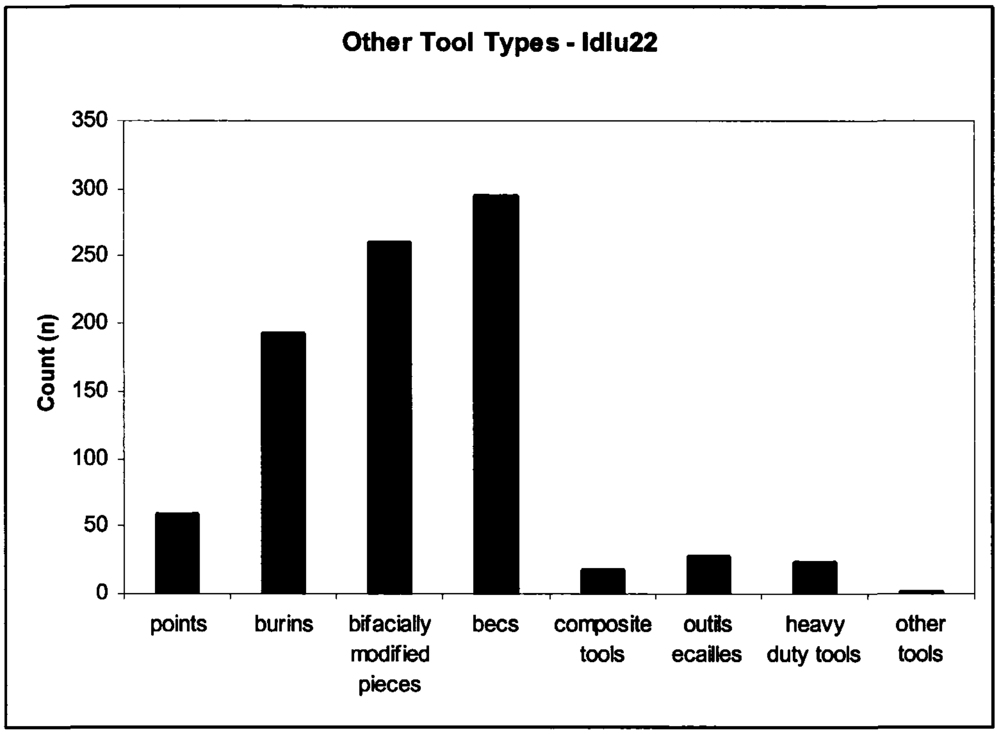


Figure 4.18 Other Tool Types, IdIu22



Chapter 5 – Technology, Site Use, and Mobility

The following chapter presents data on technological aspects of lithic production at IdIu22 by looking at specific features on flakes, tools and cores. Whole and utilized flakes, as well as blades, were analyzed for Toth type, plan form, dorsal flake scar pattern, and number of dorsal scars. Technological variables for tools include retouch intensity and retouch angle, while core variables are cortex cover and number of visible flake scars. In addition, size and weight measurements were examined for all three categories of artifacts. Using these results, as well as those from the previous chapter, a discussion of possible site use and mobility patterns for the inhabitants of IdIu22 will follow.

5.1 Toth Type

Toth type for whole and utilized flakes was examined for each of the six test pits as well as the site as a whole (Figure 5.1). As a whole, IdIu22 is clearly dominated by Toth Type VI, with 54.40%, followed by Type III at 21.13% and Type VI with 15.17%. The presence of each of the six Toth Types at IdIu22 indicates that all stages of lithic reduction took place to some degree. The high percentage of type VI flakes is indicative of intensive reduction as they represent the later stages of reduction where flakes and cores have little to no cortex remaining (Toth 1982:75). As is mentioned by Sipe (2000) in her analysis of IdIu22 test pit 4, the presence of Toth Type III may be an indicator of bipolar reduction. Accounting for almost 25% of Toth types for whole and utilized flakes, bipolar flaking must have been common at IdIu22, which is not surprising considering it is a hallmark of the LSA (Mehlman 1989:368).

There is a notable difference when comparing IdIu22 to Miller's (1993) MSA sites in the Songwe region, as they are dominated by Types V at 28.6% and VI at 40.1%, with a much smaller proportion, only 10.4%, of Type III flakes. This could, perhaps, be due to different flaking techniques practiced in the MSA where radial flaking/Levallois is more common (Mehlman 1989:368).

Toth type was examined by raw material to see if there was any observable pattern. For each type, quartz is the dominant raw material. Quartzite and chert/flint are the next most abundant with chert outnumbering quartzite for types I, II and V. The remaining raw materials contribute only a small fraction of the total even when combined into one group. No pattern can be seen as the distribution for the individual types closely mirrors that of the raw material distribution for whole flakes. Therefore, any pattern seen is a result of raw material availability rather than any conscious selection of raw material type.

Toth type was also examined level by level in order to recognize any changes in the types through time. No change in pattern was observed as the percentages of Toth types remained consistent.

5.2 Plan Form

The data for the planform variable for whole and utilized flakes are presented in Figure 5.2. The distributions for planform varied for each of the six test pits. Divergent was the most abundant category at all but test pit five, where parallel was dominant. For the remaining test pits, parallel and convergent were the next most abundant with circular and intermediate making up only a small portion of the total. The dominant planform for the site as a whole is divergent at 39.18% of the total, followed by parallel at 27.55% and convergent at 25.91%. The remaining categories were far less abundant with circular at 6.66% and intermediate at only 0.68%.

The relative frequencies of planform remained consistent when examined level by level at IdIu22 with little to no change through time. With respect to raw materials and planform, there is no observable pattern as the distribution matches the general raw material distribution at the site with quartz clearly being the most abundant followed by quartzite and chert/flint for the categories of 'convergent' and 'parallel'. However, Chert/Flint slightly outnumbers quartzite for the 'divergent', 'intermediate', and 'circular' categories.

The results obtained by Miller (1993) for his MSA assemblages differed considerably from that of IdIu22. The distribution of planform for his flakes was more evenly distributed through the five categories. In addition, the most abundant planform was circular at 23.3% followed closely by intermediate at 20.7%. At IdIu22, these two categories were the least abundant, contributing only 7.34% combined. This discrepancy is most likely due to differences in flake production. As Miller (1993: 67) states, flakes with a circular planform are consistent with radial flaking of disc cores. These differences are not unexpected as it has been explained previously that radial flaking is a hallmark of the MSA that decreases considerably in the LSA in favour of different technology and flaking techniques, and these differences are reflected in the planform data.

5.3 Dorsal Flake Scar Pattern

Analysis of dorsal flake scar pattern can indicate the particular mode of reduction that a flake underwent. Results for IdIu22 are presented in Figure 5.3. The distribution for dorsal scar pattern is dominated by 'same platform, simple' at 70.37% followed by 'same platform, parallel' at 12.93%. The frequency of radial flake scarring was only 6.94%. This result indicates that platform cores were common at IdIu22 and is consistent with Mehlman's (1989:368) assessment that platform approaches to core reduction is indicative of the LSA and, in fact, appears during the intermediate MSA/LSA.

When examined level by level, no observable trends were seen with respect to dorsal scar pattern. In addition, no pattern was evident with respect to dorsal scar pattern and raw material. Dorsal scar pattern and raw material distributions are presented in Table 5.3.

In comparison, results obtained by Miller for his MSA sites show evidence of a reliance on radial flaking with 41.3% of the total having a radial dorsal scar pattern. Opposed platform was his lowest category with only 2.8% and the remaining categories were distributed evenly ranging from 8 to 14%.

5.4 Number of Dorsal Scars

Data for dorsal scars are presented in Figure 5.4. The majority of flakes at IdIu22 have only one or two dorsal flake scars with 41.45% having one and 35.72% having two. Three flake scars was the next most abundant, but only made up 10.63% of the total.

No change in pattern was seen level by level with respect to dorsal flake scars, although an interesting pattern was observed with respect to raw material distribution. For flakes with zero or only one flake scar, quartz is the dominant material followed by quartzite and then chert/flint, which reflects the overall distribution of raw materials at the site. As the number of dorsal scars increases, so does the proportion of chert/flint with a corresponding decrease in quartzite. Chert/flint even outnumbers quartz for flakes with 5 dorsal scars.

The low number of flake scars for flake debitage at IdIu22 suggests an early stage of reduction. However, it has been noted that a variety of factors can influence dorsal scar counts, including: size, raw material, flaking pattern, and type of artifact being made (Andrefsky 1998:106). Figure 5.5 shows the relationship between dorsal flake scars and dorsal scar pattern at IdIu22. The scar pattern 'single platform, simple' accounts for 92.39% for flakes with a single dorsal scar and 67% of flakes with two dorsal scars. As the number of dorsal scars increase, so does the frequency of radial flaking, ranging from 0.27% of single flake scars to 80.27% of flakes with seven dorsal scars. It is obvious from this result that the dorsal scar variable is influenced more by the flaking pattern rather than the reduction stage.

5.5 Blades

Data on whole and trimmed/utilized blades from IdIu22 are presented here as blades represent an important part of the LSA lithic technology. Compared to flakes, blades are exceedingly rare at IdIu22 numbering only 524 for whole blades and 14 for trimmed/utilized blades. Blade talon fragments are surprisingly more common than whole blades numbering 1165. In contrast, flakes are considerably more abundant numbering 16,634 for whole flakes and 1450 for utilized flakes. This is surprising considering that traditional blade and bladelet cores are the most abundant type at IdIu22. It is possible that blades were highly sought after for manufacturing microliths and for use in composite tools and thus do not appear in high numbers. Willoughby (2001:11) also believes that the more abundant blade talon fragments represent the broken haft ends of composite tools that were being replaced on site. Like flakes, the majority of blades represent late stage lithic reduction with 61.90% belonging to Toth type VI, and 16.00% to type V (Figure 5.6).

A considerable difference between flakes and blades occurred with the planform variable. The data for flakes presented a more even distribution across the most abundant categories (Figure 5.2), whereas blades were dominated by the 'parallel' planform with 66.73% (Figure 5.7). 'Convergent' is the next most abundant with 21.00% followed by 'divergent' at 12.27%. The remaining categories of 'intermediate' and 'circular' were not observed on blades.

The majority of blades, 58.92%, show two dorsal scars followed by one scar at 18.40% and three at 13.75% (Figure 5.8). The most abundant scar pattern observed was 'same platform, parallel' comprising 69.14% of the total followed by 'same platform, simple' at 21.93%. This also represents a difference with the results for whole and utilized flakes, where 'same platform, simple' was the most abundant followed by 'same platform, parallel'. These results are consistent with reduction of a patterned platform blade core where blades would be struck off the core parallel to one another producing flakes typically with 2 flake scars and a ridge running down the middle.

Not unlike flakes, there were no observable patterns with respect to change through time or raw material preference.

5.6 Size Measurements

In order to compare easily with Miller's results, size measurements of whole flakes, blades, and trimmed pieces were classified using the same system. All size measurements are presented in millimeters and weights are given in grams. The results for length, breadth and thickness of whole flakes, trimmed pieces and blades are presented in Figures 5.10 – 5.12.

The distribution for flake size is skewed towards smaller size with over 80% of flakes showing both length and breadth below 20 mm. The largest category in each case was category 2, comprised of flakes between 10 and 20 mm. The mean length for all flakes was 15.90 mm, and the mean breadth was 14.20 mm. Similar results are seen with respect to trimmed pieces. Over 80% of trimmed pieces are less than 20 mm in length and breadth with mean values of 16.36 mm and 13.78 mm for length and breadth respectively.

The distribution for thickness is skewed towards the smallest category, with 93.76% of flakes and 95.63% of trimmed pieces measuring less than 10 mm. Mean values for thickness of flakes and trimmed pieces are 5.25 mm and 5.12 mm respectively.

With respect to weight, the largest category for both flakes and trimmed pieces is category 1 (0-5 g). 92.67% of flakes and 93.98% of trimmed pieces fall within this group with mean weights of 1.90 g for flakes and 2.05 g for trimmed pieces.

By definition, blades are typically twice as long as they are wide, and this holds true for IdIu22. Figures 5.10 – 5.12 show the size differences between flakes and blades at the site. On average, blades are longer, less broad, and thinner than flakes, with mean length, breadth and thickness of 20.63 mm, 9.70 mm, and 4.63 mm respectively. Blades are also, on average, lighter than flakes at IdIu22 with a mean weight of 1.22 g.

Overall, blades exhibit more characteristics of an 'end product' than flakes. The data for dorsal scar pattern, number of scars, planform, as well as size measurements are evidence of planning and forethought in order to produce a workable 'end product'. Blades would have been produced with the idea in mind that they would eventually be turned into microliths for possible use in hafted tools and arrows.

In comparison, Miller's artifacts are larger in every aspect, which is to be expected as it is one of the main characteristics distinguishing the MSA from the LSA. 97.1% of trimmed pieces and 92.1% of flakes are over 20 mm in length, whereas the majority of artifacts at IsIu22 fell below 20 mm. Breadth is similar, with 94% of trimmed pieces and 91.3% of flakes over 20 mm wide. Mean values only for flakes at Miller's sites are nearly twice as much as seen at IdIu22 with values over 30 mm for each of his sites (Miller 1993:147).

The most abundant category for flake thickness at Miller's sites is category 2 (5-10 mm) and category 3 (10-15 mm) for trimmed pieces. This is in contrast to IdIu22, where the majority of the artifacts fell under category 1 (0-5 mm). Values for mean thickness at Miller's sites were around 10 mm, double that at IdIu22.

The data for weight was more diverse at Miller's sites, unlike IdIu22 where over 90% of all artifacts falling under the smallest category (0-5 g). The majority of Miller's artifacts were heavier than 5g, with category 2 (5-10 g) being the largest for flakes, and category 3 (10-15 g) being the largest for trimmed pieces (Miller 1993:65).

Overall, artifacts at IdIu22 are much smaller and lighter than those at Miller's MSA sites in the same region. This difference in size and weight reflects a cultural change from the MSA to the LSA. Moving away from the larger MSA artifacts, LSA peoples moved to a technology that was effective in working small, locally available raw materials (Mehlman 1989:368).

5.7 Tools

5.7.1 Scrapers vs. Backed Pieces

A comparison of size for flakes, scrapers, and backed pieces is presented in Table 5.5. Mean values for scrapers are larger in every aspect than values for both flakes and backed pieces, and backed pieces have the lowest mean values overall. Raw material choice also had little to no effect on size and weight measurements for scrapers and backed pieces.

5.7.2 Retouch Intensity

Retouch intensity for 99.67% of scrapers and 99.96% of backed pieces fall within the 'marginal' category (Table 5.6). In fact, bifacially modified pieces and *outils écaillés* are the only tool categories at IdIu22 that show considerable percentages of pieces with 'semi-invasive' retouch. In addition, only 6 pieces (all bifacially modified pieces) at the site show intensive retouch. Typically, marginal retouch would mean that these tools could be classified as 'casual' rather than 'formal' tools. However, Mehlman states that assemblages dominated by quartz typically have more tools that fall within the 'casual' category simply based on the difficulty of observing these characteristics on quartz (Mehlman 1989:128). Therefore, the lack of intensive retouch of tools at IdIu22 does not discount these artifacts as 'formal' tools.

5.7.3 Retouch Angle

Mehlman (1989:129) defines a scraper edge as consisting of unifacial retouch forming an angle between 35° and 90°. Very steep retouch (>80°), however, may indicate a core edge or backed piece. The data for retouch angle at IdIu22 is presented in Figure 5.14. 73.53% of scrapers fall within the definition with the remaining artifacts being between 20° to 30°. As is expected, the majority of backed pieces, 94.41%, have a retouch angle of 90°

5.8 Cores

5.8.1 Size/Weight

Size and weight measurements for cores at IdIu22 are measured in millimeters and grams and are presented in Figures 5.15 and 5.16. As is seen in the graphs, there was only slight variation between different core types with amorphous cores being the largest overall while bipolar and patterned platform being the smallest. Size dimensions for all core types overlap considerably with each other indicating little variation in size depending on core type. Overall, cores at IdIu22 are extremely small with mean values for size dimensions all being less than 30mm. However, this has more to do with the size of available raw materials than with reduction intensity. In addition, there were no observable patterns with respect to raw material preference and size and weight measurements.

5.8.2 Reduction Intensity

In order to determine reduction intensity on cores at IdIu22, the amount of cortex and the number of observable flake scars were measured for each core. For most cores, only a small amount of cortex remained with 92.46% of all cores having less than 50% of cortex remaining. Cores with no cortex at all comprised the largest category with 23.57% of all cores at the site. With respect to core reduction, only a quarter of all cores are reduced to the point where there is no cortex remaining. Perhaps due to the extremely small size and abundance of raw materials available, there was no effort made to intensively reduce each core as it would be easy to pick up a new piece when the small size of the core became difficult to manage.

Cores at the site do not exhibit high numbers of flake scars. The most abundant category is 4 flake scars with 17.14%, followed closely by 6 at 15.49% and 5 flake scars at 14.73%. Only 10.67% of all cores at IdIu22 have more than 10 visible flake scars. However, given the extremely small size of cores at IdIu22, the low number of flake scars may be more indicative of the limitations of reducing small cores rather than intensity of reduction. As was previously stated, the abundance of locally available raw material means that intense reduction of cores and economizing behaviour is unnecessary.

5.9 Mobility and Site Use

The following section is a macroscopic approach to analyzing the lithic remains at IdIu22 with respect to ideas on mobility and site use. It will use the data presented in the previous sections and chapters in an attempt to reconstruct the past behaviour of the inhabitants of the site.

5.9.1 Forager and Collector Models

Mobility and site use is a popular topic in hunter-gatherer archaeology, and one of the most famous articles on this area is Binford's (1980) description of foragers and collectors. Many of his observations come from his work with the Nunamiut of north-central Alaska who he classifies as collectors. Collectors, by Binford's observations, are organized groups that seek to supply themselves with specific resources through logistically planned task groups. They are characterized by the storage of food and their task specialization. Foragers, however, move between different areas of critical resources and typically gather food resources daily with no food storage. Foragers are mostly observed within equatorial forests and display high residential mobility. In essence, forager groups move to where the resources are, while collectors bring the resources to the group.

Binford defines two specific site types associated with the forager model: the residential base, and the location. The residential base is where the manufacturing, processing, and maintenance activities occur and is generally associated with some critical resource, such as water or lithic raw materials. The location is a short-term occupation where specific tasks or functions are carried out with a small number of tools being used and discarded. The collector model adds three additional site types to the list: the field camp, stations, and caches. The field camp is a temporary base for a group conducting a specific task and would be occupied longer than a location. Stations are sites where information is collected about a specific task. Finally, a cache is a storage location away from the base camp. All these site types would, in theory, be represented by differing archaeological assemblages.

While this may be a good basis for interpretation of past hunter-gatherer adaptations, there are some that are wary of associating archaeological remains with modern and historic ethnographic data (Kusimba 2005: 338-341; Parkington 1984: 170, 1998: 27). Kusimba states that replacement and change is the underlying theme in the history of hunter-gatherers while Parkington stresses that modern hunter-gatherers should be taken as the end point on a trajectory of change. That being said, it would be an understatement to say that the contributions of modern and historical accounts, as well as data provided by ethnoarcheology, has greatly enhanced the understanding of past hunter-gatherer societies.

The following analysis on mobility and site use at IdIu22 will not rely directly on the foragers and collectors model but will take into account various aspects such as the differing site types and how they may be represented archaeologically.

5.9.2 Assemblage Diversity, Site Use, and Mobility

The presence or absence of specific tool types at a site can be used to predict possible activities that were conducted at the site. Sites dominated by scrapers tend to be viewed as residential camps where food processing and manufacturing occurred. Conversely, sites dominated by microliths are viewed as being hunting-related (Kusimba 1999:178). However, while the functions for scrapers and microliths most likely differed, each artifact type would have had multiple functions. Microliths, in particular, are believed to have had a wide range of functions including: projectile tips, cutting implements, and even plant processing tools (Ambrose 2002; Clark 1977; Neely 2002). Therefore, a site that contains, or is dominated by microliths is not necessarily primarily hunting related, as these versatile tools could have been used for a wide range of activities.

Generally speaking, microliths are an incredibly adaptive strategy for the uncertainties of hunter-gatherer life. Their small size means they are easily transported from site to site providing a toolkit for a wide range of activities without the need to carry many or large objects. This technology also solves problems of raw material availability. Their ease of manufacture means that they can be produced quickly, and in large numbers where access to raw material is reliable and then easily transported to areas of uncertain or low raw material availability (Neely 2002:46). Microlithic technologies, therefore, are extremely advantageous to highly mobile societies where transport of large toolkits is difficult. However, that does not mean that sedentary societies cannot benefit from these same characteristics.

Assemblages are more than just a few specific tools, and by examining the overall diversity of artifacts in an archaeological assemblage, researchers can get an idea of site use and mobility. Shott (1986) used data he gathered from the ethnographic literature to show the presence of an inverse relationship between assemblage variability and mobility Figure 5.18. To do this he used data on winter mobility expressed in days spent in a main wet season residence camp. The number of days spent in the winter camp was directly proportional to technological diversity and he concluded that as mobility decreases, diversity in the archaeological assemblage will increase. Therefore assemblage variability should decrease as mobility increases, and it would be expected that short term, activity-specific sites would show low assemblage diversity. This is precisely what was discovered by Price (1978) at Mesolithic sites in the Netherlands. He defines a scale of site types from small extraction camps characterized by a limited range of artifact types to large aggregation camps exhibiting high artifact counts and high assemblage diversity.

The site of IdIu22 can be described as a large, fairly diverse assemblage. Although it is dominated by scrapers and backed pieces, which comprise more than 90% of the assemblage, 24 tool types and 87 subtypes are represented with a total of 62,839 artifacts. This would suggest that a wide variety of activities may have taken place at the site and that IdIu22 was intensively or repeatedly occupied over a considerable period of time.

There are a number of statistical approaches to evaluating the degree of assemblage variability and how it relates to site use and mobility, two of which are discussed below. However, one problem with diversity analysis is how sample size affects diversity. As sample size increases so does artifact diversity which makes it difficult to determine if the results are a true reflection of site use activities or due solely to sample size effects. This is especially problematic when comparing sites with differing sample sizes.

5.9.3 Evenness Index and Artifact Richness

The evenness index is used in order to measure how evenly tool types are represented in an assemblage. The index ranges from 0.0 to 1.0 with a result of 1.0 meaning all types are equally represented, while a result of 0.0 indicates that assemblage is made up of only one type. It is believed that an assemblage that has a high evenness index indicates a generalized site where a wide array of activities, represented by a wide variety of tool types, would have taken place. Conversely, a low evenness index value indicates a specialized site where only a limited range of activities took place, such as a hunting camp (Andrefsky 1998; Chatters 1987; Odell 1996, 2004).

The evenness index was calculated for 14 tool types (Table 5.7) at IdIu22 and compared to Mehlman's (1989) LSA assemblages using the following formula:

$$E = \frac{\sum\left(\frac{n_i}{n}\right)\left(\log\frac{n_i}{n}\right)}{\log s}$$

where: n_i = number of artifacts for each type
n = total number of artifacts for all types
s = number of artifact types

The results of this calculation are presented in Figure 5.19. The evenness value for IdIu22 is the second lowest of the group at 0.67 with Mumba Middle III, an LSA assemblage of indeterminate industry, as the lowest at 0.38. The value for IdIu22 may be low due to the large numbers of scrapers and backed pieces at the site. As has been previously mentioned, however, geometric microliths and backed pieces are an expedient technology with multiple uses and therefore eliminate the need for multiple tool types. For example, the uses of geometric microliths as projectiles or as inserts in cutting tools would reduce the need for formal points or cutting implements reducing the diversity of the assemblage and lowering the evenness value despite the possibility for a wide range of activities to be performed. Unfortunately, there is a lack of evidence of anything other than tool manufacturing at the site, but the potential for a wide range of activities is present.

Artifact richness is a similar method designed to measure site type with relation to artifact diversity. Like the evenness index, an assemblage rich in types is believed to have also been rich in activities and vice versa. To calculate richness the number of tool types versus number of tools collected, converted to $\log^{10}$, are plotted on a graph and analyzed using linear regression techniques. Those sites that fall below the regression line are seen as being less rich compared to those that fall above (Odell 1996, 2004).

Richness values for both types (lower line) and subtypes (upper line) are presented in Figure 5.20. From the graph, it appears that Nasera 3B is the richest site, while Mumba Middle 3 is the least rich located well below the line. IdIu22 falls just under the line for both types and subtypes indicating that IdIu22 is slightly less rich than expected compared to the other sites. This result is confusing, however, as IdIu22 is comprised of an extremely large number of artifacts spread across 24 types and 87 different subtypes and exhibits more artifacts, types, and subtypes than any of the other sites listed. This result could be due in part to the extremely high sample size at IdIu22 and the limited number of types.

5.9.4 Raw Material Availability and Mobility

The availability of suitable raw materials with which to produce a specific lithic technology is understood to be related to hunter-gatherer settlement patterns and mobility. Raw materials that are not locally available can be procured through trade with neighbouring groups or as part of a group's movement and can indicate the level of mobility of a specific group. Exotic raw materials that are procured as an embedded part of a group's mobility tend to show up in archaeological contexts in similar proportions to locally available materials with little emphasis on retouch or curation. Materials that have been procured through purposeful expeditions will exhibit more indications of curation and intensive use and usually show up in the archaeological record in an exhausted state (Barut 1994; Kusimba 1999; Nelson

1991; Morrow and Jeffries 1989). Relatively sedentary groups, however, tend to rely more on locally available raw materials that are used more expediently with little emphasis on retouch (Barut 1994; Kusimba 1999; Parry and Kelly 1987).

Barut (1994) uses raw material use to assess mobility and land use patterns for MSA and LSA cultures in two localities of Eastern Africa: Lukenya Hill and Nasera. For her Lukenya Hill assemblages she concludes that the MSA inhabitants were relatively sedentary with a reliance on locally available raw materials, little investment in retouch, and no obvious selection of raw materials for specific tools or uses. The LSA component, conversely, is dominated by exotic obsidian that seems to be selectively used for specific purposes. This result would seem to suggest that the LSA groups were more mobile with increased access to exotic raw materials.

Nasera MSA groups appear to be highly mobile and use the site on a periodic, short-term basis. Naseran and Lemutan LSA settlements at Nasera appear to be more intense and long-term indicating a more sedentary way of life. Importing of exotic chert, however, still occurred alongside intensive use of local raw materials during the LSA (Barut 1994).

In a later publication, Kusimba (1999) also assesses land-use and mobility patterns for a number of LSA assemblages from the Lukenya Hill area. Separated into two groups, they are distinguished primarily by typology. Group 1 sites are dominated by scrapers, with a high reliance on local vein quartz for artifacts. Bipolar reduction is common with little attention to retouch or curation of artifacts made from locally available material. In addition, exotic materials such as chert and obsidian appear to have been conserved. Group 2 sites, conversely, have only moderate amounts of local quartz artifacts and higher proportions of chert and obsidian artifacts. With respect to mobility and land use patterns it was concluded that the group 2 sites represented peoples who moved more widely around the area with increased access to exotic raw materials as opposed to the group 1 people who relied heavily upon locally available raw materials due to reduced mobility. Her explanation as to the reasons for the differing mobility patterns came from analogy with Kalahari hunter-gatherers and the influence of water availability on mobility. More humid conditions leading to more abundant resources allowed the earlier groups the advantages of a rich resource base in the local area whereas more arid conditions meant that the later group 2 peoples needed to travel more widely across the landscape exploiting resources in a wider area and, thus, a higher probability of coming in contact with exotic lithic resources (Kusimba 1999: 184-185).

Following along similar lines, the data from IdIu22 would suggest a population that was not highly mobile. Local raw materials dominate the site with a reliance on quartz and quartzite, which account for over 85% of all artifacts at the site (Figure 4.1). No evidence of raw material preference was observed, as it appears the inhabitants of IdIu22 were using whatever was available to them locally. In addition, trimmed pieces are of an expedient nature with over 99% of all tools showing only marginal retouch. The majority of cores still have some cortex remaining with very few visible flake scars indicating fairly low reduction intensity. Finally, the sheer number of artifacts collected from the site (62,839) suggests intensive, long-term occupations.

Miller's (1993) MSA assemblages from the Songwe region show a similar reliance on locally available raw materials. Quartz was the most abundant raw material at 46.2% of the total. Trimmed pieces also showed little signs of retouch with 94% of tools belonging to the "marginal retouch" category. Thus, like IdIu22, it would appear that based on raw material procurement, MSA peoples in the Songwe region were not highly mobile.

The inhabitants of IdIu22 are situated on a reliable source of workable raw materials for their particular technology. The use of small pieces of locally available chert shows that they value high quality, fine-grained materials but perhaps due to their reduced mobility have less access to exotic materials. It has also been previously mentioned that LSA technology is optimal for working with small, locally available pieces of quartz (Mehlman 1989:368), and therefore access to high quality raw material may not have been necessary. The location of IdIu22 allows the inhabitants the security of a raw material source where they can produce tools without the worry of exhausting the raw material source. They can also produce large amounts of microliths and backed tools for easy transport to other areas where raw material availability may not be as reliable. In addition, based on the environmental reconstruction discussed in chapter 2, the site may have been inhabited during what is called the "Holocene humid period" and, therefore, during a period of increased access to water and other vital resources. This would reduce the need to travel widely across the landscape in search of food and water allowing for a more restricted mobility pattern.

Figure 5.1 Toth Type (n = 18,084)

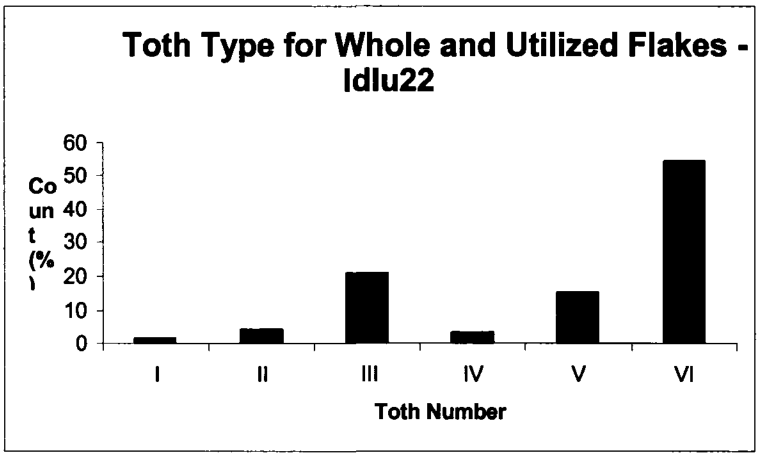


Table 5.1 Raw Material Counts and Percentages for Toth Type (n = 18,084)

	Quartz N	Quartz %	Quartzite N	Quartzite %	Chert/Flint N	Chert/Flint %	Other N	Other %
I (n=325)	137	42.15	79	24.31	91	28.00	18	5.54
II (n=767)	328	42.76	188	24.51	228	29.73	23	3.00
III (n=3821)	2062	53.96	1064	27.85	657	17.19	38	0.99
IV (n=589)	273	46.35	159	26.99	135	22.92	22	3.74
V (n=2744)	1275	46.47	574	20.92	834	30.39	61	2.22
VI (n=9838)	5494	55.84	2082	21.16	2038	20.72	224	2.28
Total(n=19176)	9569	50.00	4146	21.62	3983	0.77	386	2.01

Figure 5.2 Plan Form

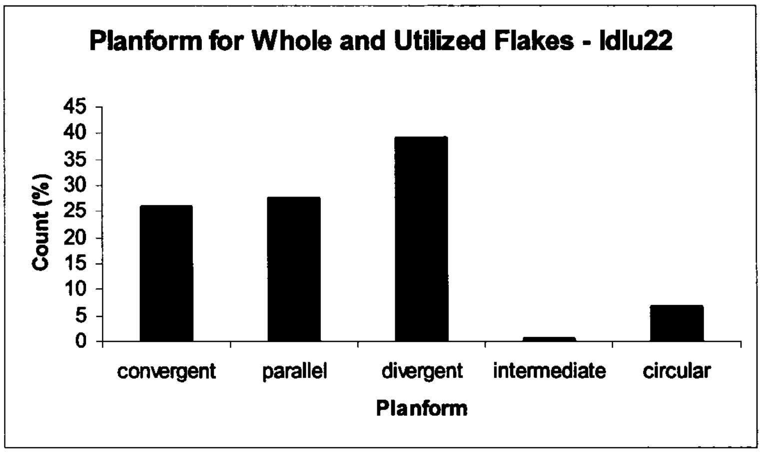


Table 5.2 Raw Material Counts and Percentages for Plan Form

	Quartz N	%	Quartzite N	%	Chert/Flint N	%	Other N	%
Convergent (n=4686)	2357	50.30	1313	28.02	911	19.44	105	2.24
Parallel (n=4983)	2866	57.52	1126	22.60	915	18.36	76	1.53
Divergent (n=7085)	3600	50.81	1479	20.88	1833	25.87	173	2.44
Intermediate (n=123)	60	48.78	27	21.95	34	27.64	2	1.62
Circular (n=1204)	683	56.73	201	16.69	290	24.09	30	2.49
Unknown (n=3)	3	100	0	0	0	0	0	0
Totals (n=18084)	9569	52.91	4146	22.93	3983	22.02	386	2.13

Figure 5.3 Dorsal Scar Pattern

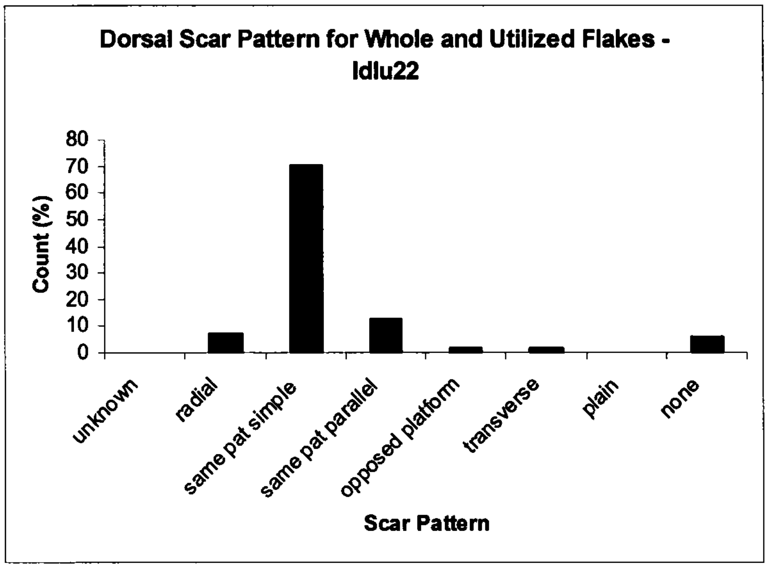


Table 5.3 Dorsal Scar Pattern and Raw Material Distribution (n/%)

	Quartz		Quartzite		Chert/Flint		Other	
	N	%	N	%	N	%	N	%
Unknown (n=1)	0	0	0	0	1	100	0	0
Radial (n=1256)	556	44.27	250	19.90	411	32.72	39	3.10
Same Plat Simple (n=12726)	6869	53.98	2863	22.50	2738	21.52	256	2.01
Same Plat Parallel (n=2338)	1409	60.27	484	20.70	410	17.54	35	1.50
Opposed Platform (n=374)	166	44.39	116	31.02	87	23.26	5	1.34
Transverse (n=320)	125	39.06	105	32.81	84	26.25	6	1.88
Plain (n=14)	6	42.86	0	0	6	42.86	2	14.28
None (n=1055)	438	41.52	328	31.10	246	23.32	43	4.08
Total (n=18084)	9569	52.91	4146	22.93	3983	22.02	386	2.13

Figure 5.4 Number of Dorsal Scars

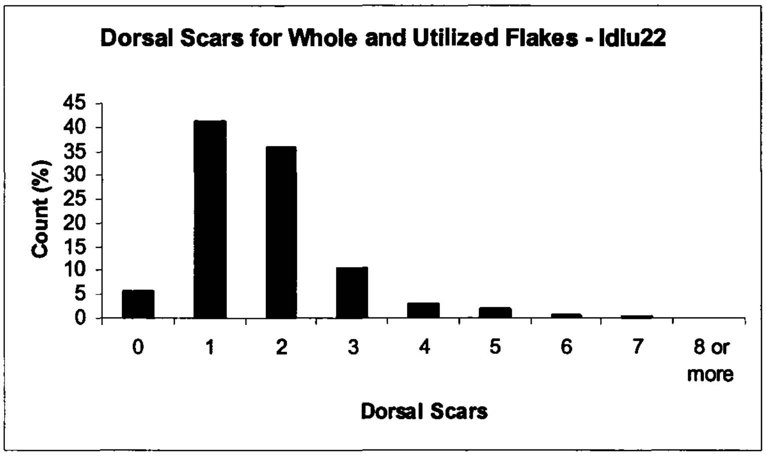


Table 5.4 Number and Percentages of Dorsal Scars and Raw Material

	Quartz N	%	Quartzite N	%	Chert/Flint N	%	Other N	%
0 (n=1056)	436	41.29	328	31.06	249	23.58	43	4.07
1 (n=7495)	4101	54.72	1868	24.92	1398	18.65	128	1.71
2 (n=6460)	3527	54.60	1392	21.55	1411	21.84	130	2.01
3 (n=1923)	1007	23.37	361	18.77	504	26.21	51	2.65
4 (n=573)	255	44.50	107	16.67	201	35.08	10	1.75
5 (n=367)	139	37.87	67	18.26	147	40.05	14	3.81
6 (n=147)	75	51.02	18	12.24	51	34.69	3	2.04
7 (n=46)	21	45.65	2	4.35	16	34.78	7	15.22
8+ (n=17)	8	47.06	3	17.65	6	35.29	0	0
Total(n=18084)	9569	52.91	4146	22.93	3983	22.02	386	2.13

Figure 5.5 Dorsal Scars by Scar Pattern

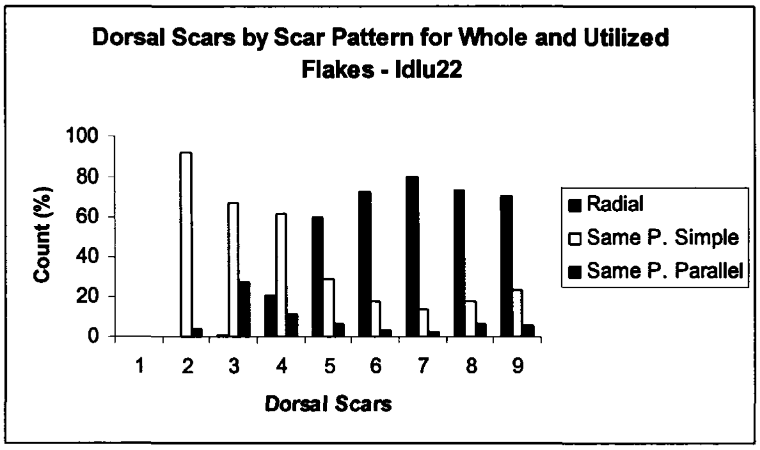


Figure 5.6 Toth Type for Whole and Utilized Blades

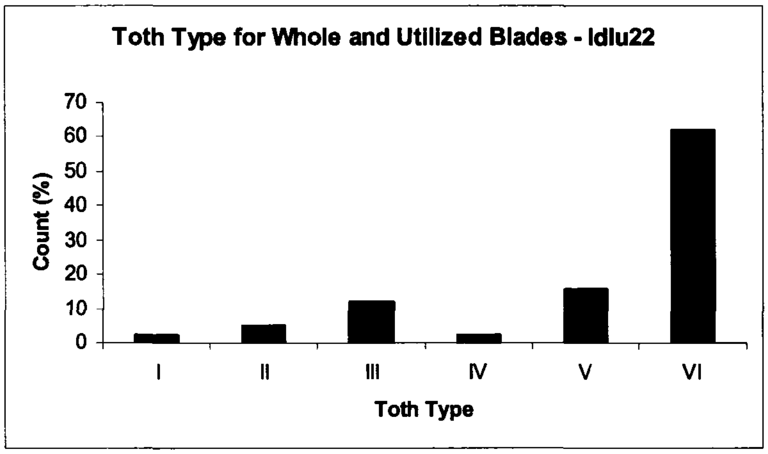


Figure 5.7 Planform for Whole and Utilized Blades

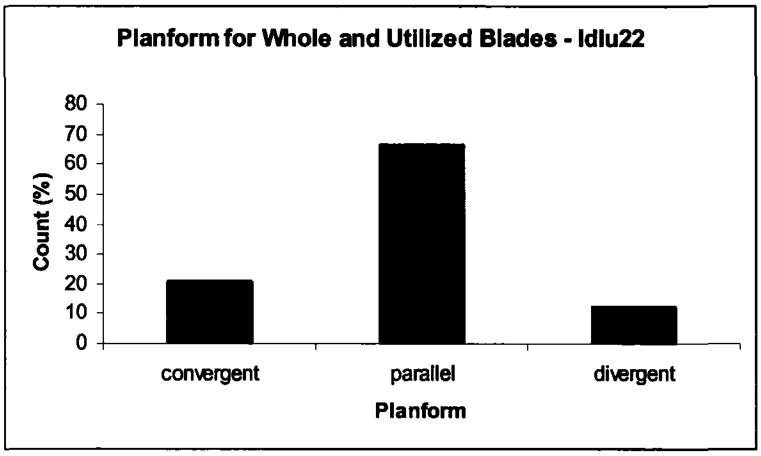


Figure 5.8 Dorsal Scars for Whole and Utilized Blades

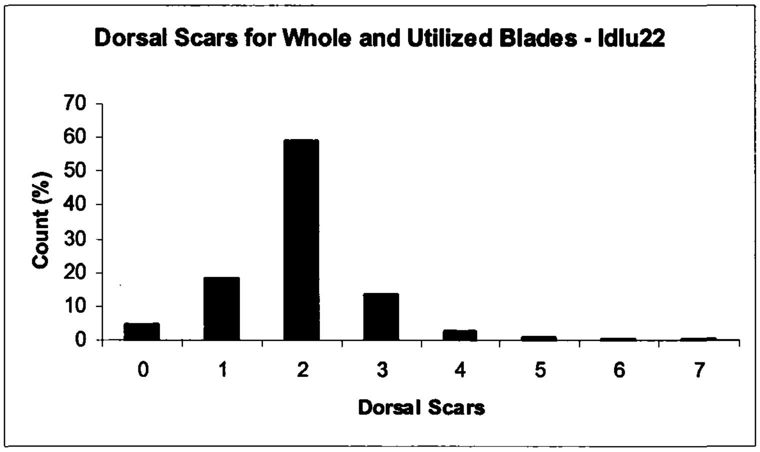


Figure 5.9 Scar Pattern for Whole and Utilized Blades

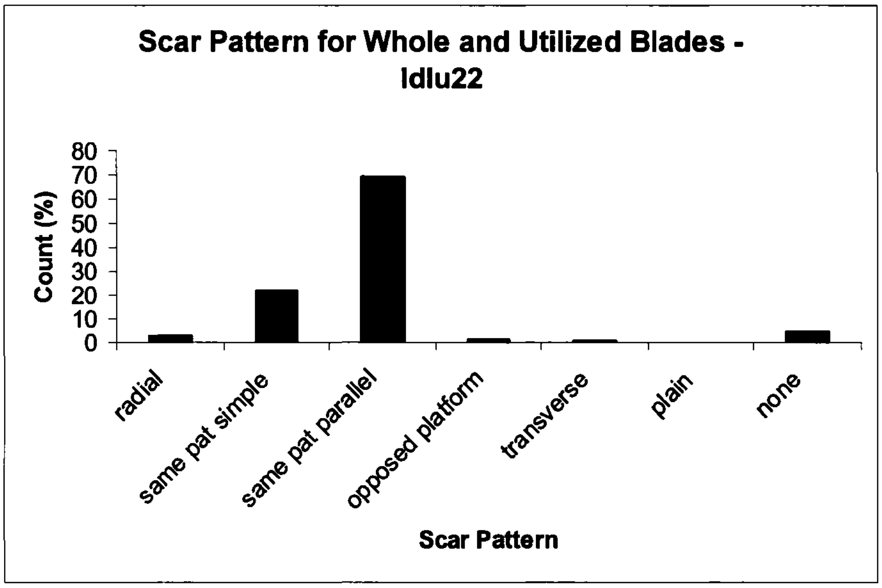


Figure 5.10 Artifact Length

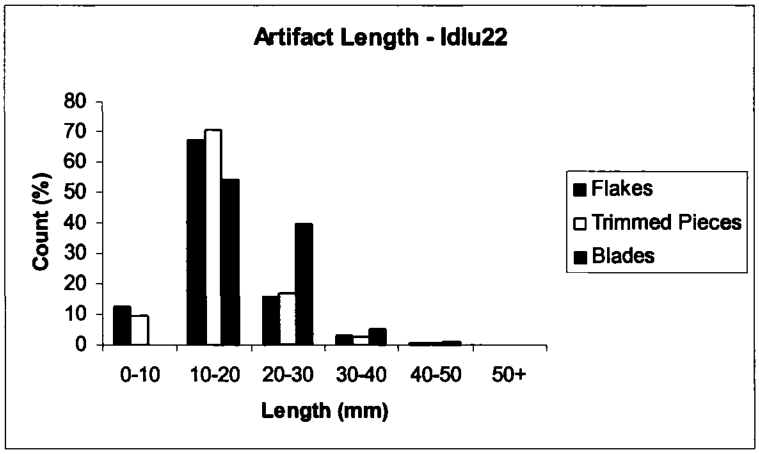


Figure 5.11 Artifact Breadth

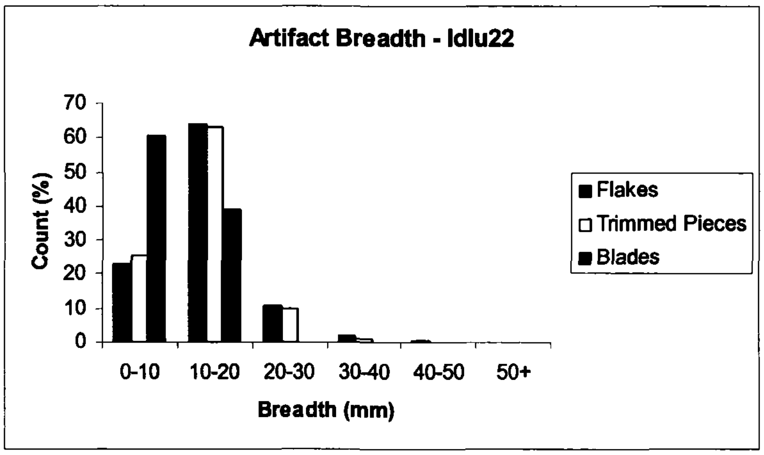


Figure 5.12 Artifact Thickness

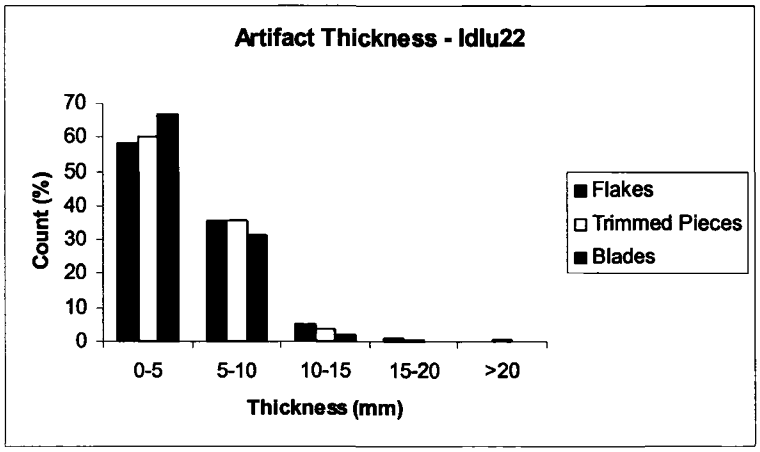


Figure 5.13 Artifact Weight

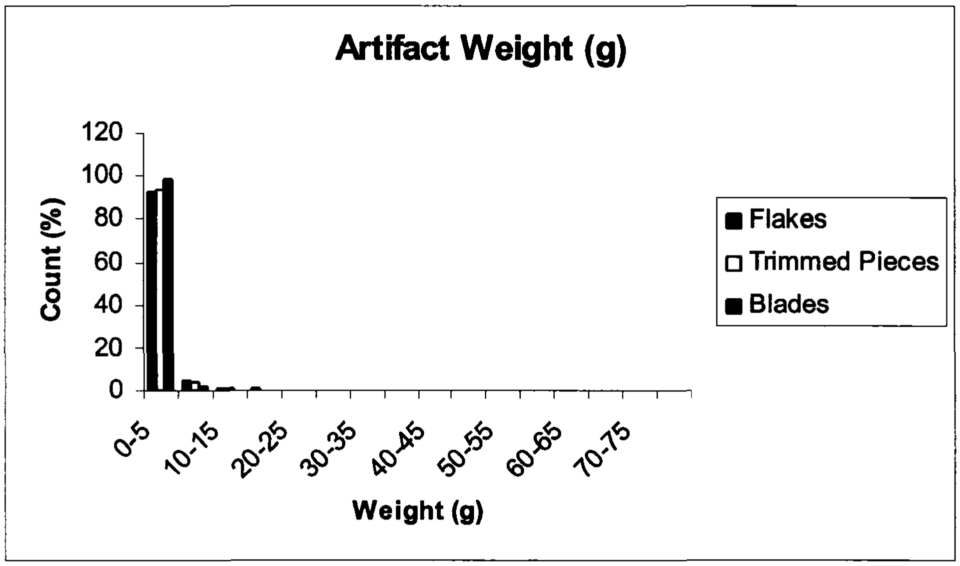


Table 5.5 Mean Size and Weight Measurements for IdIu22

	Mean Length	Mean Breadth	Mean Thickness	Mean Weight
Flakes (n=18084)	15.90	14.20	5.25	1.90
Blades (n=538)	20.63	9.70	4.63	1.22
Trimmed Pieces (n=9817)	16.36	13.78	5.12	2.05
Scrapers (n=2104)	20.71	19.19	6.87	3.77
Backed Pieces (n=6835)	14.47	11.64	4.35	0.90

*All measurements in mm, weight in g

Table 5.6 Retouch Intensity for Trimmed Pieces

	Marginal		Semi-invasive		Invasive	
	N	%	N	%	N	%
Scrapers	2097	99.67	7	0.33	0	0
Backed Pieces	6830	99.96	3	0.04	0	0
Points	57	96.61	2	3.39	0	0
Burins	193	100	0	0	0	0
Bifacial Pieces	137	52.49	118	45.21	6	2.30
Becs	294	99.66	1	0.34	0	0
Composite Tools	18	100	0	0	0	0
Outils Ecailles	17	60.71	11	39.29	0	0
Heavy Duty Tools	0	0	3	100	0	0
Other Tools	1	100	0	0	0	0
Total	9644	98.46	145	1.48	6	0.06

Figure 5.14 Angle of Retouch

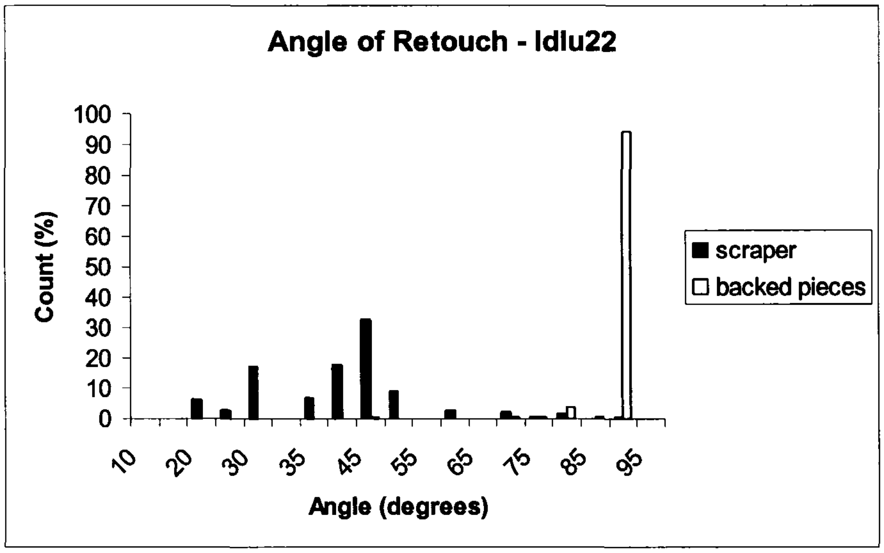
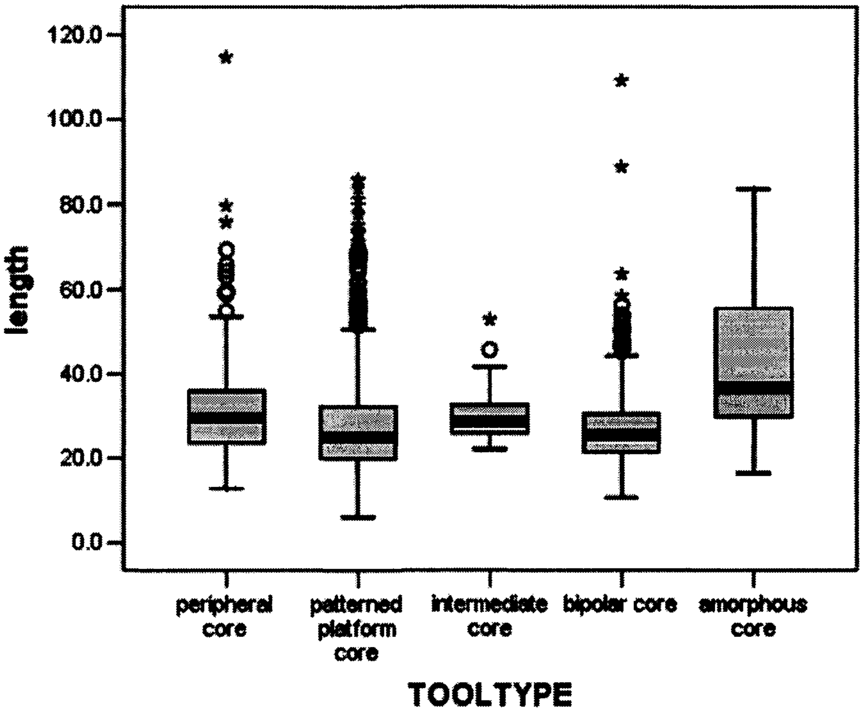


Figure 5.15 Summary of Measurements for Core Types



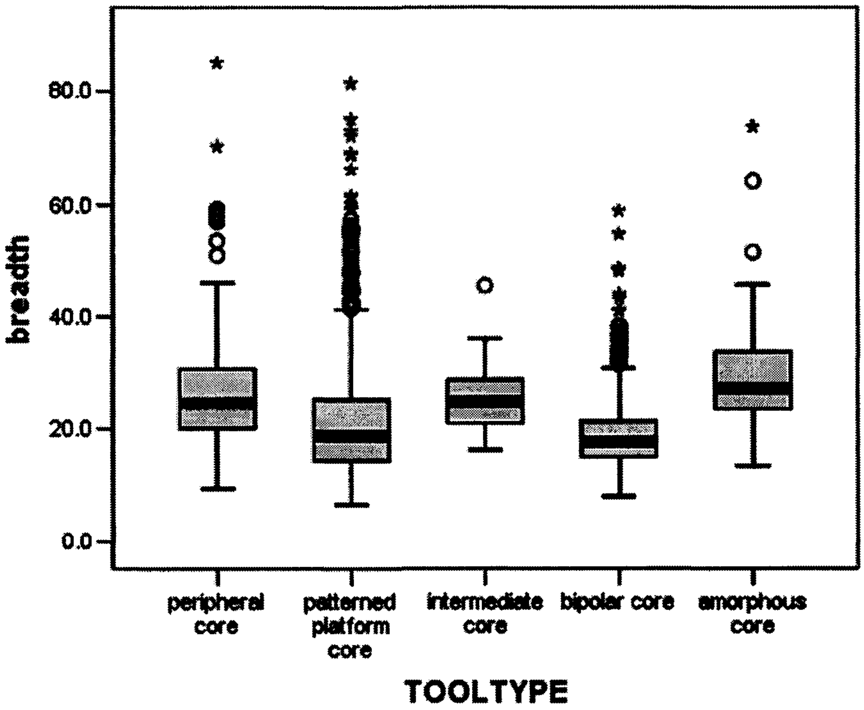
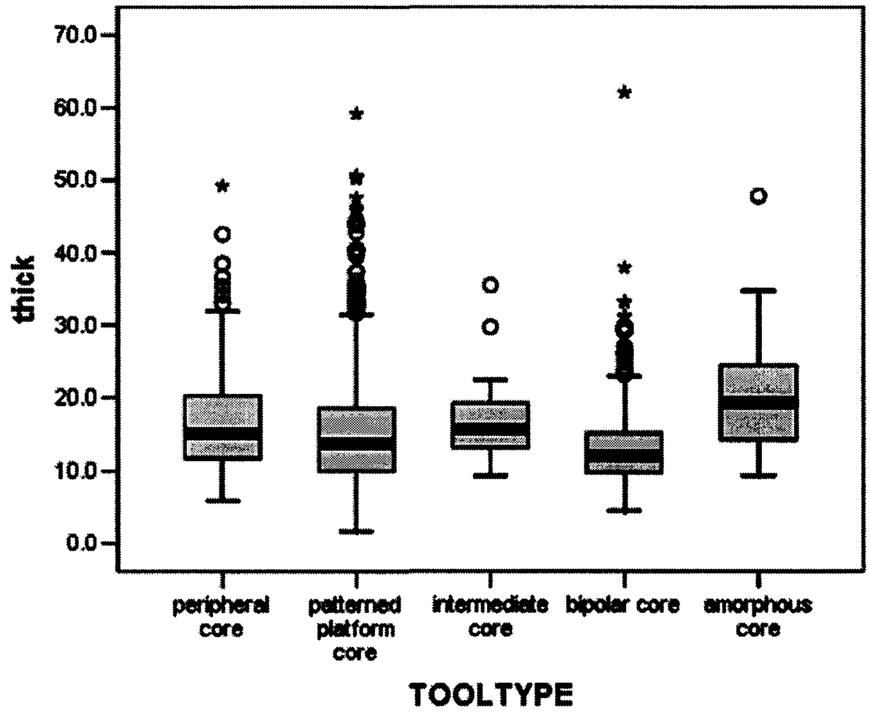


Figure 5.16 Summary of Measurements for Core Types



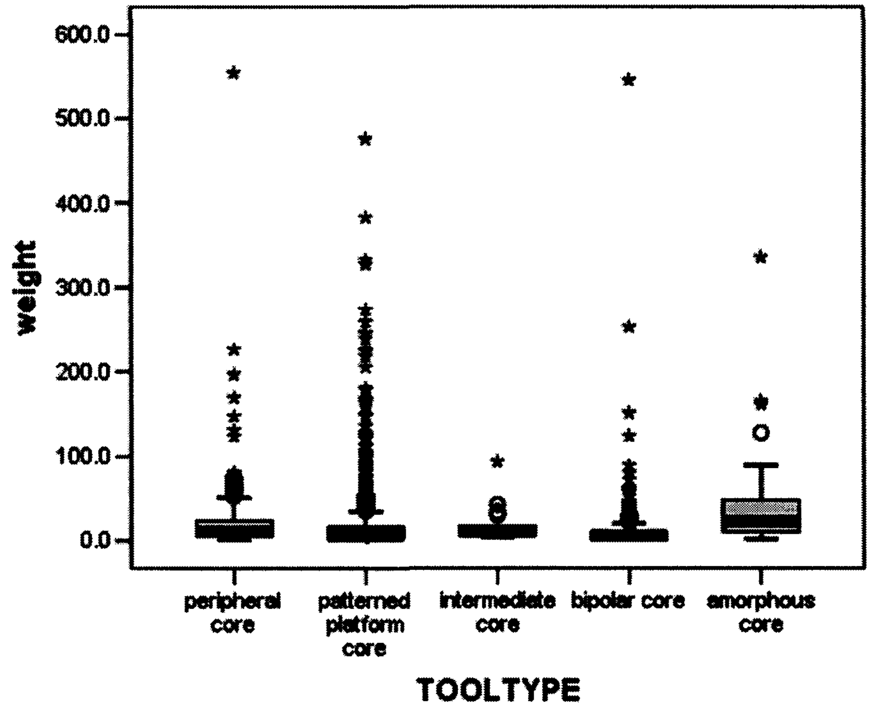


Figure 5.17 Reduction Intensity for Core Types

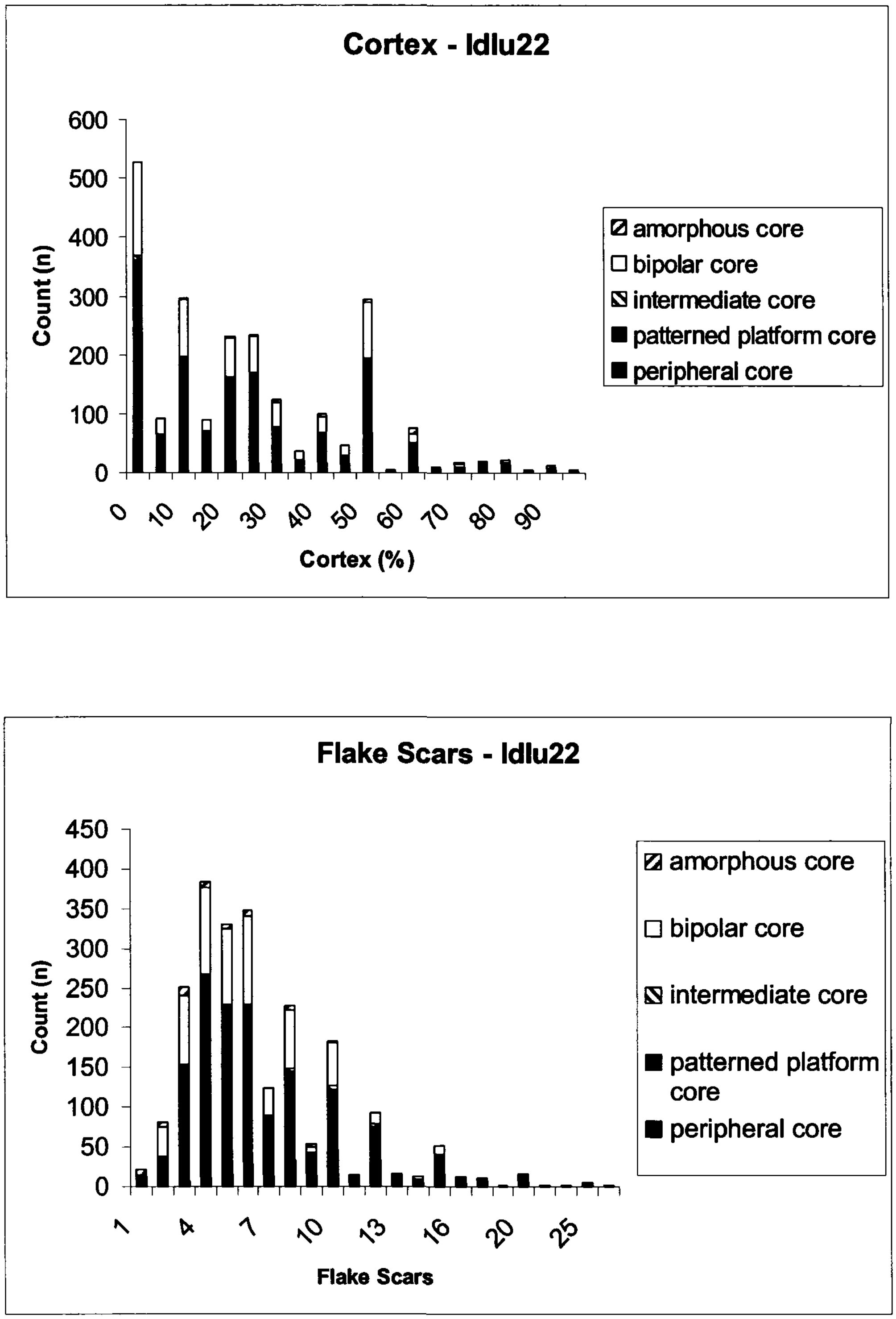
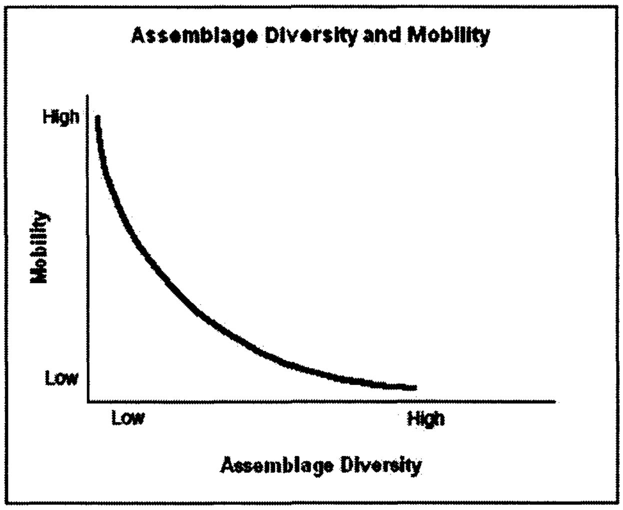


Figure 5.18 Assemblage Variability and Mobility



Adapted from Shott (1986)

Table 5.7 Tool Types used to Calculate Evenness Index

	IdIu22	Nasera 4/5	Nasera 3B	Mumba Middle 3	Nasera 3 with pottery	Mumba Upper 3
Convex Scraper	1222	50	27	52	20	241
Sundry Scraper	248	28	10	0	9	95
Concavity/Notch	479	21	6	0	10	29
Divers Scraper	155	54	16	9	16	106
Geometric	1274	14	10	6	3	132
Backed Pieces	3264	8	35	13	6	91
Points	59	1	1	0	0	4
Burins	193	18	2	0	8	22
Bifacial Pieces	261	13	1	0	0	12
Becs	295	18	2	0	5	24
Composite	18	9	3	0	2	20
Outils Ecailles	28	9	3	0	1	0
Heavy Duty	23	0	0	0	1	0
Other Tools	1	50	22	0	32	84
Evenness Index	**0.67**	**0.87**	**0.79**	**0.38**	**0.79**	**0.79**

Figure 5.19 Evenness Index

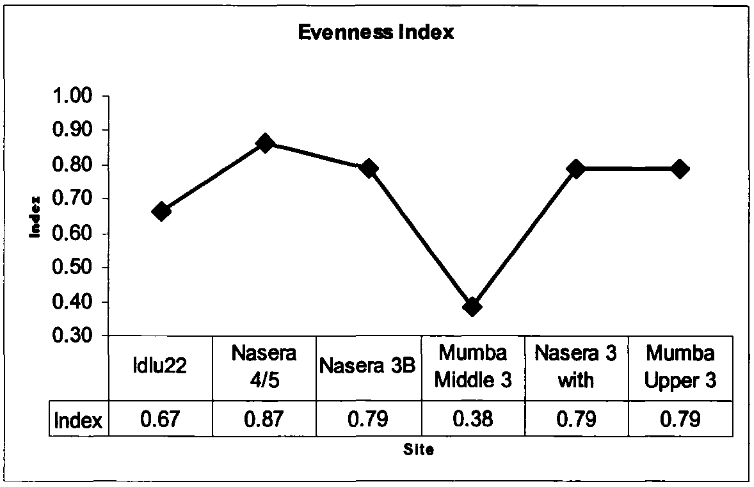
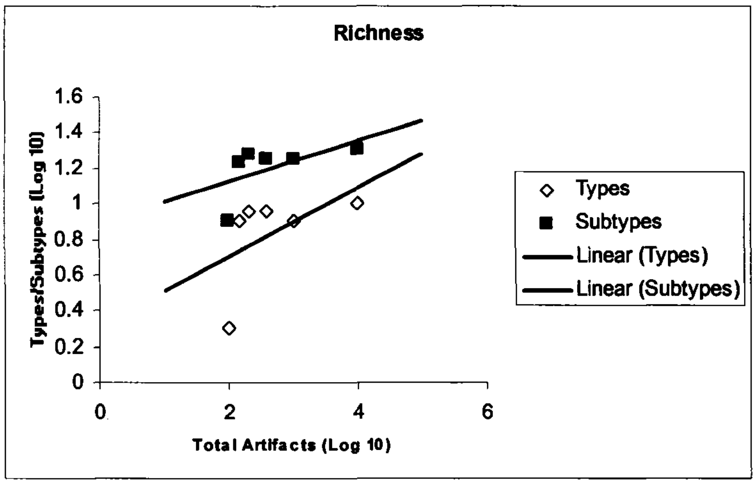


Figure 5.20 Artifact Richness



Sites from left to right: Mumba Middle 3, Nasera 3 with pottery, Nasera 3B. Nasera 4/5, Mumba Upper 3, Idlu22

Chapter 6 – Discussion and Conclusions

The objectives of this thesis were to build upon preliminary results presented by Sipe (2000) in her analysis of a single test pit (test pit 4) at IdIu22 to incorporate all six of the test pits at the site and to use these data to discuss the mobility pattern and site use of the inhabitants. Typological and technological analysis of the remaining test pits, as well as the site as a whole, focused upon a macroscopic approach to lithic manufacturing techniques and behaviours. In addition, comparisons with other East African sites were made to help place IdIu22 in the context of culture historic framework of the area with emphasis on technological and typological change from the MSA to the LSA in the Songwe region. The typological and technological analyses formed the basis of the analysis and discussion on mobility and site use. The use of a standardized typology by Mehlman (1989) meant that comparison was possible between his sites, as well as Miller's (1993) work on the MSA. In addition comparisons were also made, wherever possible, to Kusimba's (Barut 1994; Kusimba 1999) work at Nasera and Lukenya Hill.

6.1 Discussion of Dating and Culture History

Due to a lack of suitable materials for dating, the exact date, or range of dates, for the sequence at IdIu22 is not well known. Radiocarbon dates on a sample of bone from the 50 – 60 cm level of test pit 1 returned a date of 7540 ± 280 BP indicating a Holocene date for the site. It is possible, however, that there is a late Pleistocene component to the site. Based on the frequencies of microburins (a Holocene invention) in test pit 4, Sipe (2000:118) believes that a transitional MSA/LSA date may be present in the lower levels of test pit 4 due to the apparent decrease in the use of the microburin technique in these levels. However, while test pit 4 is the deepest and contained the greatest quantity of artifacts at the site, the number of microburins excavated was surprisingly low throughout the test pit. The highest number of divers backed pieces collected in a single level from test pit 4 was 19 compared to a high of 88 in test pit 2 and 113 in test pit 3 and may provide more reliable results due to increased sample size.

Upon analysis of the other test pits at the site, it is clear that the microburin technique was practiced throughout the occupation (Figure 4.14). The relative frequency of microburins to trimmed pieces in test pit 3 is remarkably steady throughout the test pit with a frequency of 35% at the lowest level of 80-85 cm. However, only test pit 2 comes close to matching the depth of test pit 4 and does reveal a decrease in microburins but with a corresponding decrease in the total number of artifacts as well. It is possible that the apparent decrease in the microburin technique in the lower levels of IdIu22 could be due in part to the corresponding decrease in overall artifacts collected in those layers as the frequency of microburins remains fairly high. The divers backed category accounts for 8.82% of trimmed pieces in the 140-145 cm level of test pit 4 and 13.33% in the 115-120 cm level of test pit 2. Therefore, I believe that the decrease in microburins in test pit 4 is insufficient evidence to suggest a transitional MSA/LSA date for the lower levels at the site.

Sipe (2000) also mentions the frequencies of bipolar and peripheral cores in test pit 4 as more evidence of a possible transitional level at the site. These two core type are seen as indicators of a particular material culture as peripheral cores are considered a hallmark of the MSA while bipolar technology is associated with the LSA (Mehlman 1989: 368). This pattern is only seen in test pit 4 and test pit 1, where peripheral cores outnumber bipolar. When the whole site is considered in this analysis, however, the situation changes. At IdIu22 as a whole, bipolar cores outnumber peripheral comprising 28.9% and 11.8% of all cores at the site respectively. The relative frequencies of these cores were also examined on a level by level basis to see if there was a change through time possibly indicating a transition period in the deepest levels of the site. No pattern at all was seen in test pit 4 and test pit 2 and test pit 3 showed bipolar cores outnumbering peripheral cores throughout. Therefore no transitional period can be seen with respect to core typology at the site.

The relationship of scrapers to backed pieces (including microliths) has been previously mentioned as an important indicator of both past activities as well as culture. With his transitional and fully LSA sites, Mehlman sees a switch in the frequencies of scrapers and backed pieces at his sites through time. With earlier LSA sites the ratio between the two tool types is nearly even, but this relationship changes in Holocene LSA assemblages where backed pieces outnumber the scrapers (Mehlman 1989:386). This pattern is also present at Kusimba's (1999) group 1 and group 2 assemblages, both LSA, at Lukenya Hill. The earlier group 1 assemblages are dominated by scrapers while the more recent group 2 assemblages are dominated by microliths. This pattern is typical of many LSA sites in East and South Africa (Kusimba 1999:177). Based on this line of evidence, it is clear that IdIu22 is of

Holocene age as the dominance of backed pieces over scrapers is present throughout the sequence of the site, extending into the deepest layers of test pit 4.

Technological analysis of IdIu22 also suggests that the site is fully LSA with no transitional layers. Radial flaking and circular planform, considered indicative of the MSA, remain consistently rare throughout each of the six test pits with no changes observed in the deepest levels of the test pits. This pattern is in contrast to Miller's MSA assemblages from the Songwe region where radial flaking and circular planform are the most dominant types further supporting IdIu22 as fully LSA.

Considering the lithic analysis of the site, I believe that the majority of the excavated sequence, if not all levels, at IdIu22 are of Holocene age. The conflicting results as seen by the higher ratio of peripheral cores in test pit 4 and test pit 1 are hard to explain but do not show any pattern that would suggest a transitional layer. In addition, the apparent decrease in the microburin technique in test pit 4 may be more reflective of decreasing sample size with depth than some real typological change. Therefore, while it is still possible that the deepest levels at the site extend into the late Pleistocene the data are not strong enough to be definitive.

6.2 Discussion of Mobility and Site Use

The mobility strategy of the inhabitants of IdIu22 was determined on the availability and use of raw materials at the site. Based on this analysis it is obvious that the population is not highly mobile and not traveling very far out of the local area. This is seen through the near total dependence on locally available raw material. Local quartz and quartzite account for over 85% of all artifacts at the site.

Much of the chert, as well, is locally available as it is known to form in pockets of the local volcanic rockshelter. No chert from the Chamoto Hill chert quarry located approximately 70 km away was found at any of the Songwe area sites. The remaining raw material categories of volcanic, obsidian, other metamorphic, and other sedimentary only make up 1.6% of the total raw material. Remarkably, of the 62,839 total artifacts collected from the site, only 4 were made of obsidian. It would be interesting to learn through sourcing where exactly these pieces originated. Therefore, it is obvious that there is little contact with exotic raw material sources indicating reduced mobility.

The manner in which the raw material is utilized also suggests a population with reduced mobility. Little investment in retouch or curation was observed as over 99% of tools exhibited only marginal retouch. Cores are also treated expediently as the majority of cores at the site still have cortex remaining with few visible flake scars. The inhabitants of the site are exploiting a reliable, locally available source that is suitable for producing a microlithic technology where a large quantity of tools can be made quickly and easily. Their more sedentary nature means there is no need to invest time and effort into creating formally retouched tools when such a key resource is locally available.

Finally, environmental data suggest that the site was occupied during the "Holocene humid period" where the local conditions were warm and wet implying that access to critical resources would not have posed a problem. This reduces the need to travel widely across the landscape in search of patches of critical resources for survival and, in turn, limiting the need for mobility and contact with exotic resources. The scenario at IdIu22 is one of a less mobile population exploiting locally available resources.

With respect to site use, there is little evidence for any activities at IdIu22 other than lithic manufacturing. No organics, faunal material, or hearths were discovered to indicate that the site was being used as a residential base. It is possible that activities such as the processing and cooking of food and hides took place outside of the excavated area or evidence of these activities was not preserved in the archaeological record. Unfortunately, there is a lack of evidence of anything other than tool manufacturing at the site, but the potential for a wide range of activities is present.

Richness and evenness values were calculated and compared to other MSA and LSA sites and both suggested that the range of activities at the site was fairly low, further reducing the possibility that IdIu22 served as a residential base. These values reflected the fact that scrapers and backed pieces are by far the dominant tool types at the site comprising over 90% of all retouched tools. This would indicate a lack of assemblage diversity and, therefore, a lack of activities carried out at the site. However, the multifunctional nature of microliths means that the potential for a number of activities to be carried out is still there as both microliths and scrapers can be used for a variety of functions. Despite this fact there is no evidence for any activity other than tool manufacture at IdIu22 as has been previously stated.

With respect to the lithic manufacturing processes at the site, it is evident that all stages of tool manufacture were taking place from the detachment of initial flakes taken off a fresh core to finished tools. This is seen by the presence of all Toth types at IdIu22, including Toth type I flakes, which are the initial flakes taken off a core indicating the early stages of core reduction. The presence of Toth type III flakes, as well as a large number of bipolar cores, is evidence that bipolar reduction is also taking place at the site. The dominant core technology, though, was patterned platform.

The production and utilization of blades is also a key aspect of the site as blades are an important part of the microburin technique to produce backed pieces. Backed pieces are by far the most abundant tool type at the site and the large numbers of microburins indicate that the production of backed pieces and microliths was important at the site. Remarkably, blades accounted for only a small fraction of the debitage at the site and it is possible that they were selectively taken from the site for use elsewhere or turned into microliths on site. Regardless of this fact, the high percentage of backed pieces, and especially microburins, indicates that this technique of producing backed pieces, which are considered a hallmark of the LSA, was paramount at IdIu22.

6.3 Culture Change in the Songwe River Region

Miller's (1993) analysis of Songwe MSA assemblages was used for comparison purposes and to examine changes in the Songwe area from the MSA to the LSA. The major typological and technological differences were as expected as Miller's sites demonstrated typical MSA characteristics such as: a dominance of scrapers in the trimmed pieces category (especially circular scrapers), a high reliance on peripherally worked cores, radial flaking, and larger artifact size overall. IdIu22, conversely, represents a typical Holocene LSA microlith dominated assemblage with a focus on backed pieces, and platform and bipolar core technology. One area where there were some similarities, however, is in the possible mobility strategies of these peoples. Like IdIu22, Miller's MSA sites show a dependence on locally available raw materials with a lack of exotic raw material in the assemblages. In addition, there is also little investment in extensive retouch of formal tools with 94% classified as having marginal retouch, 5.7% semi-invasive, and only 0.2% displayed invasive retouch. This implies that there is a dependence on local raw material with a corresponding lack of contact with exotic raw materials implying a more sedentary lifestyle.

In order to properly assess transition from the MSA to the LSA, an intact transitional assemblage would need to be excavated. While the discovery of a transitional assemblage from the MSA to the LSA was one of the original goals of the excavations at IdIu22, it was not found. There are, however, a large number of archaeological sites and data to indicate that the Songwe area was consistently inhabited by peoples throughout the MSA, LSA, and into the present day. With any luck an intact transitional assemblage will be discovered in the area as it is a key time period in understanding the development of behaviourally modern *Homo sapiens* in East Africa.

6.4 Discussion on Modern Human Origins

The initial research goal for the site of IdIu22 was to discover a stratified transitional assemblage from the MSA to the LSA in order to better understand the development of modern human behaviour at this time. Unfortunately, no transitional layer was found as IdIu22 appears to be a fully LSA industry. What, therefore, can be said about modern human behaviour from what was discovered at IdIu22?

Aside from the lithic material culture it is difficult to say anything about the behaviour of the inhabitants of the site. Clearly they were producing typical LSA tool types, such as a switch to a blade based industry, which would indicate modern behaviour. However, this is only one small aspect of modern human behaviour. When considering the other aspects of what are typical indicators of modern human behaviour, there is a complete lack of evidence, which may be influenced by the lack of organic preservation. For example, the use of new raw materials such as bone and ivory for tools is considered a hallmark of modern behaviour, but due to the lack of organic preservation at the site it is impossible to tell whether these materials were employed for tool making at IdIu22. In addition, it would be impossible to evaluate the variety and type of game that was hunted near the site. Art and personal adornment items are also absent from IdIu22 as well as evidence of elaborate burials. It is impossible to tell, however, whether this is due to preservation issues or that these practices did not occur at the site.

Unfortunately, with respect to the issue of modern human origins, IdIu22 is less than an ideal site to study these issues. Limitations in the data set and the poor preservation of organic materials makes it difficult to answer some of the questions involved in this debate. For comparative purposes, IdIu22 can serve as a resource for the evaluation of human behaviour in the LSA and the changes that took place from the MSA to the LSA in this area with respect to lithic typology and technology. On its own, however, it is limited in the types of questions that can be answered.

6.5 Conclusion

After analysis of all six test pits at IdIu22, I feel that the site represents an LSA assemblage primarily of Holocene age. The possibility of a late Pleistocene age exists in the lower levels of test pits 2 and 4. However, due to decreasing sample size in the lowest levels, it cannot be said for certain as very little change through time was observed in the other test pits. Only further excavations to similar depths as the deepest test pits will resolve this issue. The inhabitants of IdIu22 appear to be have restricted mobility with a high reliance on locally available raw materials. The primary function of the site is tool production where all stages of lithic reduction took place.

While not meant to be an exhaustive work on LSA lithic technology, this study does provide additional information on the lives and behaviour of behaviourally modern *Homo sapiens* in the Songwe River area. This area is rich in both MSA and LSA sites, and, with further research and the discovery of a stratified, transition MSA/LSA site, may one day provide invaluable information on the origins of modern humans.

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