**University of Alberta**

# The Ostrich Eggshell Beads of Mlambalasi rockshelter, southern Tanzania

by

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**Abstract**

Objects of personal adornment are among the earliest signs of modern human behaviour. The first standardized ornamental artifacts in Africa are ostrich eggshell (OES) beads. Their use can be traced to at least 50,000 years ago, and they are present at many archaeological sites from the later Middle Stone Age to historic times. Excavations at Mlambalasi rockshelter, Iringa, yielded a number of these OES beads. Previous studies of variability have focused on the threshold between hunting and herding peoples in southern Africa, and demonstrated a steady change in external bead diameter over time. My findings indicate that this trend of diameter change is also present in East Africa, and extends well into the Later Stone Age (LSA). My analysis also suggests that Mlambalasi may have been a short-term, repeatedly used, campsite for a small family who made and wore OES beads in the LSA and more recent times.

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# Chapter 1: Introduction

> "Far from being mere ephemera, then, beads and other forms of ornament have a great deal to tell us about the evolution of human cognition, as well as the social and demographic conditions experienced by ancient human groups," (Kuhn and Stiner 2007b:43)

Until recently, relatively little was known about the evolution of modern humans. Current evidence indicates that anatomically modern humans evolved approximately 200,000 years ago in Africa. Despite resembling modern people in appearance, the technology of these early people was similar to that of their non-modern counterparts living in Europe around the same time, the Neanderthals.

Neanderthals were the sole inhabitants of Europe for several hundred thousand years; they produced Middle Paleolithic (MP) artifacts which include a flake-based lithic technology with a low percentage of formal tool categories (Klein 2000). Basic retouched tools include scrapers and points (Klein 2000). Approximately 40,000 years ago, MP assemblages are suddenly replaced by Upper Paleolithic (UP) culture, created by modern humans. Sites with UP culture have evidence of blade technology, bone and ivory tools, long-distance exchange networks, structured use of domestic space, art and personal adornment (McBrearty and Brooks 2000:492).

These modern behaviours arrive together with anatomically modern humans in Europe approximately 40,000 years ago. Some can also be found at some African sites dating to over 300,000 years ago, such as the blades in Acheulean deposits from the Kapthurin Formation, Kenya, or the obsidian exchange networks from the Middle Stone Age at Porc-Epic, Ethiopia (McBrearty and Brooks 2000:496,515). These modern signals appear and disappear over several hundred thousand years, until they become widespread and commonplace between 40,000 and 50,000 years ago. These early modern advances appear to facilitate a migration out of Africa around this time, and the ancestors of these early people come to occupy every corner of the globe.

One of the sure signs of modern human behavior is personal ornamentation. The Paleolithic evidence for this typically comes in the form of pendants and beads. The earliest accepted personal ornaments, perforated marine shells, are from the African Middle Stone Age (MSA), the sub-Saharan equivalent of the MP, and are approximately 75,000-80,000 years old (d'Errico et al. 2009:16051). Ostrich eggshell (OES) beads are the earliest standardized personal ornaments. The oldest OES beads have been recovered from Mumba Rock Shelter, northern Tanzania, and are direct dated to 52,000 BP (McBrearty and Brooks 2000:522).

## 1.1 *Research Questions*

For my thesis, I analyzed an assemblage of OES beads. The beads were recovered from historic/Iron Age and Later Stone Age (LSA) occupations at Mlambalasi, a rockshelter in southern Tanzania, during excavations in 2010. The LSA is the equivalent of the UP for this study region, and the Iron Age introduces the use of iron smithing and smelting around 3,000 years ago. At the onset of this project I was unaware of what, if any, information could be obtained from the study of OES beads. As my work progressed, my research questions became more apparent. I became interested in the similarities or differences that may exist between my dataset and those from different times and places, specifically the diameter variation from southern African sites as old as 3,000 years. Finding relatively little in the way of previous research, I also wanted to search for diachronic trends within the Mlambalasi beads which may also be present but unstudied in other assemblages.

My research questions then are as follows:

- What can the OES beads tell about Mlambalasi and/or the people who occupied it?
- How do Mlambalasi's beads relate to those from other sites?
- Are there other characteristics which may vary through time, besides external diameter?

I will revisit these questions in Chapter 8, and determine if I was able to find appropriate answers.

### *1.2 Chapter Summaries*

The first chapter is an introduction to the thesis. It gives the context of my research, and outlines the research questions involved in my work. There is also a brief summary of each chapter.

Chapter 2 is a review of the evidence and arguments about the origins of modern human anatomy and behaviour. Genetic and archaeological evidence indicate that the most plausible model is a combination of the Recent African Origin and Hybridization and Replacement models. The earliest signs of both physically and behaviourally modern humans are found in Africa. Sites which have continuous occupation during the transition to behavioural modernity in the MSA (between 350,000 and 40,000 years ago) are difficult to locate due to harsh environmental conditions which left large areas of the landscape inhospitable to humans and animals alike. After leaving Africa, genetic research shows that modern humans interbred with at least two unique groups of hominids: Neanderthals and Denisovans (Reich et al. 2010). These two hominid groups do not appear to have exhibited the same modern behaviours as humans.

The third chapter contains a summary of the evolutionary use of symbolism, and the earliest ornamental artifacts. The Social Brain Hypothesis, which links primate neocortex and social group size, suggests that effective communication is one of the ways in which early modern humans were able to flourish. The use of personal ornaments is one medium for symbolic communication. These types of artifacts first appear during the Middle Stone Age/Middle Paleolithic between 40,000 and 135,000 years ago in the form of perforated natural shells (d'Errico et al. 2009:16051). The first fully shaped, standardized personal ornaments are OES beads; the oldest is from Mumba Rock Shelter, Tanzania, and dates to 52,000 BP (McBrearty and Brooks 2000:522).

Ethnographic accounts of OES bead use and manufacture are contained in Chapter 4. There are numerous ethnographic studies of African hunter-gatherer communities (e.g. Lee 1979; Shostak 1976; Silberbauer 1981), particularly from around the Central Kalahari Desert. The ethnographic accounts which contain descriptions of the bead manufacture process bear striking similarities. In particular, most accounts mention that perforations were drilled before beads were strung onto sinew and ground to their final shape with a smooth stone. These steps can be compared to archaeological evidence to estimate if beads were made by the same steps in the past.

Chapter 5 is a literature review of the published studies of OES beads. While they are present at many African Stone Age sites, an in-depth analysis of the beads is rare. I found 11 publications which have detailed research into OES beads. Most of these focus on the bead diameter change through time, as shown in southern African hunting/herding assemblages over the last 3,000 years. I draw strongly upon many of these works to guide my own analysis.

An outline of my OES analysis is found in Chapter 6, along with a description of the fieldwork which produced the assemblage. I was part of the excavations at Mlambalasi, Tanzania, in 2010. A two by three metre trench was excavated, part of which overlapped with the previous 2002 test excavations by P. Msemwa, and the 2006 test excavations by P. Willoughby. A total of 70 OES whole and partially formed beads were recovered in 2010; of these, 36 can be confidently attributed to a primary context. I recorded up to 31 characteristics for each bead.

The last content chapter, Chapter 7, reviews the interpretations of the OES bead data. Of particular interest is the comparison with southern African assemblages. While there is a similar trend of diameter change, with smaller beads being generally younger, the change is much more gradual at Mlambalasi. Also of interest is the lack of OES beads in association with the human remains recovered from the site. It is unclear what, if anything, this implies. Finally, I consider the most significant contribution of the OES bead data to be its implication about site function and occupation intensity. Based on the hypotheses of Jacobson (1987a) and Wadley (1989), Mlambalasi's OES bead data suggests that it may have been a short-term, repeatedly used, camp where a small kin related group lived while away from the larger band.

The final chapter, Chapter 8, revisits my research questions and presents my interpretations of their answers. I also outline my recommendations for future research into OES beads.

### *1.3 Summary*

This thesis is focused on an assemblage of OES beads from Mlambalasi, Tanzania. Decorative beads such as these are among the earliest signs of behavioural modernity in human evolution. This analysis will prove useful in the interpretation of Mlambalasi, and will add to the comparative study of OES beads from Stone Age contexts.

## Chapter 2: An Overview of Modern Human Origins

The origin of behaviourally modern humans is an unresolved topic in palaeoanthropology. Current debate centers on the origin, age and nature of the transition to behavioural modernity. This chapter outlines the models and evidence being used in an effort to understand the evolution of modern humans.

### *2.1 Competing Models of Human Evolution and Dispersal*

There have been four major hypotheses regarding the origins and dispersal of anatomically modern humans or *Homo sapiens*: Multiregional Evolution, Assimilation, Recent African Origin, and Hybridization and Replacement. Each of these models takes a slightly different view on the origins of our own species and their interaction with other contemporary hominids. In light of recent genetic and fossil evidence, the most likely model is some combination of a Recent African Origin and Hybridization and Replacement.

Multiregional Evolution is the least accepted of the models and has been largely abandoned in recent years. It suggests that there was a single migration out of Africa by *Homo erectus*, likely prior to 800kya, and that these early people then evolved directly from physically and behaviourally archaic people into modern ones (Thorne and Wolpoff 1992:83; Aiello 1993:74; Frayer et al. 1993:42). This model requires significant gene flow between the world's populations to create the homogenous physical traits present today, and to guard against speciation (Aiello 1993:74). New dating techniques, genetic analysis and archaeological evidence show the Multiregional model to be implausible (Stringer 2002:564).

The Assimilation model was created by integrating the Multiregional model with new genetic and archaeological evidence (Stringer 2002:564). It was first proposed in the late 1980s by former supporters of Multiregional Evolution in an attempt to combine Multiregionalism with genetic evidence (Smith et al. 1989). Assimilation maintains, like the Multiregional model, that modern humans arose directly from the preceding populations. However, it explains the genetic evidence for a recent African origin by arguing that Africa's Middle Pleistocene populations were so much larger than those in Europe or Asia, that gene flow out of Africa alone would cause a predominance of African genes in modern people worldwide (Stringer 2002:565). This would also help explain the fossils which show transitional characteristics between Neanderthal and modern humans (Aiello 1993).

The Recent African Origin model suggests that physically modern humans arose in Africa within the last 100,000 to 200,000 years, and dispersed around the world replacing all preceding populations with little or no interbreeding (Klein 2008:268). Stringer is the creator and strong supporter of the Recent African Origin model. This model is also sometimes termed "Out of Africa 3", as modern humans were the third hominid dispersal from Africa (Klein 2008:267).

The Hybridization and Replacement model was created by Bräuer (1984) who was convinced that some fossils in Europe show evidence of both modern human and Neanderthal characteristics as a result of interbreeding, but also accepted an African origin for *Homo sapiens*. The major difference between this and the Recent African Origin hypothesis is the amount of interbreeding with archaic humans. The Hybridization and Replacement model suggests a significant amount of interbreeding with modern humans and existing hominid populations in Europe and Asia, while the Recent African Origin argues for little or none (Stringer 2001:71).

### *2.2 Genetic Research into Modern Human Origins*

Recent genetic studies indicate that the most likely model of human evolution and dispersal is a cross between the Recent African Origin and Hybridization and Replacement ones. Prior to the late 1980s, the models of human origins were supported using fossils and artifacts. However, a landmark article by Cann et al. (1987) proposed that Africa could be shown to be the genetic origin for all living people. Their article was the first to examine the mitochondrial DNA (mtDNA) sequence as means to explore the origin of behaviourally modern humans (Lahr and Foley 1998:142).

Cann et al. (1987) used mtDNA variation in living people to show that there is a recent common African ancestor for all living human populations, must more recent than *Homo erectus*. Previous studies of relatedness through nuclear DNA were unsuccessful. Nuclear DNA is recombined during reproduction, and children inherit DNA from each parent; mitochondrial DNA exists outside the nucleus and is passed directly from mother to child during reproduction (Cann et al. 1987:31). The non-recombinant nature of mtDNA makes it an ideal tool for tracing human maternal ancestry (Cann et al. 1987:31). Any mutation in the mtDNA is therefore a function of time and unrelated to reproduction. This replaced the use of non-coding DNA (junk DNA) which was originally used to reflect human genetic history through time sensitive mutations.

Through a comparison of the mtDNA sequences of 147 individuals, Cann et al. (2007) identified differences both between and within geographical areas. They found that the intra-group variation existing in the African individuals was equal to the inter-group variation between Africans and any other group (Cann et al. 1987:33). This is to say that all sampled areas outside Africa appear to be a subset of African mtDNA. This strongly suggests that all living humans have an African origin (Cann et al. 1987:35).

Using known dates of first entry, Cann et al. (1987) estimated the age of the last common ancestor. They calculated the differences between regional populations and compared these with migration dates (30kya for New Guinea, 40kya for Australia and 12kya for North and South America). Using these rates, Cann et al. (1987:34) estimated that mtDNA mutates at a rate of 2-4% every million years. With this estimate, all 133 mtDNA types found in this study shared a last or most recent common ancestor between 140,000 and 290,000 years ago (Cann et al. 1987:34). As mtDNA is a record of matrilineal descent, this common ancestor came to be unofficially nicknamed *Mitochondrial Eve* as a reference to the biblical first woman.

Subsequent mtDNA research has come to generally similar conclusions about a recent African origin (e.g. Vigilant et al. 1991; Ingman et al. 2000).

Ingman et al. note that the mtDNA of individuals from Africa show a distribution that is consistent with population stability, while all other geographical areas show distributions with evidence of recent population expansion (2000:711). This would be expected with a recent African origin.

Since this early work, genetic evidence has provided incredible insights into the lives of early modern humans. It is now generally accepted that the last common ancestor between Neanderthals and humans lived approximately 500kya (Green et al. 2006; Hublin 2009; Endicott et al. 2012). The two lineages then parted ways for a time, with the ancestral group for Neanderthals in Europe containing from 3,000 to 12,000 individuals (Green et al. 2006:335), and the ancestral group for modern humans in Africa estimated to contain between 3,700 and 10,000 individuals (Green et al. 2006:334; Kassmann et al. 2001:156).

Thanks to genetic research, it is also known that once these two groups encountered each other again there was significant contact. The extent of this contact and degree of admixture is still uncertain, but it is now understood that Neanderthals contributed to modern human genetic diversity. Pinhasi et al. (2011), using a draft sequence of the Neanderthal nuclear genome, found 1-4% of genetic contribution from Neanderthals to modern Eurasian populations. Yotova et al. (2011) found that modern non-African populations have 9% Neanderthal derived segments in their X-chromosome. These findings indicate that after their exodus from Africa, modern humans encountered and interbred with Neanderthals.

In intriguing developments from the last two years, a third hominid group was identified which appears to have interacted with modern humans. Excavations at Denisova Cave, Siberia, yielded a juvenile finger bone and a young adult molar from layers which have been radiocarbon dated by associated cultural material to between 16,000 and 50,000 years ago (Reich et al. 2010:1059). This means that these hominids likely co-existed and crossed paths with Neanderthals and modern humans.

The genetic distinctiveness of this third hominid group was discovered by accident, as these were assumed to be remains of either Neanderthals or modern humans. MtDNA analysis suggested that this individual from the group, unofficially named Denisovans, last shared a common ancestor with Neanderthals and modern humans approximately 1,000,000 years ago (Reich et al. 2010:1055). Full DNA sequencing indicated that the Denisovans diverged 640,000 years ago from Neanderthals, and 804,000 years ago from modern Africans (Reich et al. 2010:1055). Reich et al. (2010) consider the Denisovans to be a sister group to Neanderthals.

Reich et al. (2010) found that there are possible genetic contributions from Denisovans in modern populations. While Neanderthals contributed genetically to modern Eurasians, Denisovans did not (Reich et al. 2010:1059). Present-day Melanesians do however have genetic contributions from Denisovans, but not from Neanderthals (Reich et al. 2010:1059). This implies that Denisovans, like Neanderthals, must be considered in the understanding of modern human evolution.

*2.3 Middle Stone Age and Middle Paleolithic*

The spread of modern culture is very apparent in the European archaeological record due to its association with different looking hominids. Neanderthals had survived the unforgiving cold environment for several hundred thousand years with their Middle Paleolithic (MP) culture. MP assemblages are characterized by flake based lithic technology with few formal tool categories (Klein 2000). Suddenly, MP culture is eclipsed by a well-developed Upper Paleolithic (UP) culture, associated with the first anatomically modern humans in Europe. These UP assemblages have new and distinctive developments such as blade technology, composite tools, long-distance exchange networks, structured use of domestic space, art and personal adornment (McBrearty and Brooks 2000:492). Appearing in Eastern and Southern Europe as early as 45,000-50,000 years ago and spreading towards the Atlantic, modern humans and their UP culture are found throughout Europe by 35kya (Anikovich et al. 2007; Mellars 2006). This makes the distinction in Europe very straightforward; MP culture was made by Neanderthals, and UP culture was made by humans.

In Africa, the transition to modern culture is more complicated. The time between approximately 350,000 and 40,000 years ago is known as the Middle Stone Age (MSA) in sub-Saharan Africa, and is roughly analogous to the MP in North Africa and Europe (Klein 2008). Assemblages from the MP and MSA are often technologically similar, but the former is produced by Neanderthals, and the latter is produced by anatomically modern humans and their direct predecessors (McBrearty and Brooks 2000:529-530).

Unlike the relatively static European MP culture, the sub-Saharan MSA seems to be more dynamic. Modern behaviours which first appear in the European UP are present in the early MSA, such as blade technology (McBrearty 2007; McBrearty and Brooks 2000); these modern assemblages sometimes precede their European counterparts by several hundred thousand years (McBrearty and Brooks 2000). The presence of these modern traits in the MSA is sporadic, appearing and disappearing until the Later Stone Age (LSA), the African equivalent of the UP, begins approximately 40,000 years ago. The LSA assemblages, like those from the European UP, contain blades and bladelets, organic tools and decorative artifacts (McBrearty and Brooks 2000:490-491). This is in stark contrast to the European archaeological record in which the MP shows no robust evidence of UP-like developments.

These behavioural indicators suggest that modern human culture arose first in Africa, and spread to Europe, insinuating that Neanderthals were not on the same behavioural/technological trajectory as modern humans. Some suggest that Neanderthals lacked the advanced cognitive processes possessed by early modern humans. This is another very contentious topic in palaeoanthropology, with some trying to downplay the technological sophistication of the Neanderthals, and others equating it with our modern capabilities. Today, researchers are trying to understand why two sub-species which were similar enough to interact, interbreed, and produce the same MP/MSA technology took such drastically different courses.

*2.4 What is Modernity?*

The traits which indicate behavioural modernity in the archaeological record are not universally agreed upon. The traditionally used characteristics were created to describe the suite of behaviours which appear as a package in the European UP. These often include blade technology, expanded exchange networks, formalized tool categories and the appearance of art (Willoughby 2005:82). Since these are contrasted with MP culture, it is relatively easy to identify and define the differences. However, this classification may not be suitable for African sites where these modern traits do not appear as a suite, but accumulate throughout the MSA.

McBrearty and Brooks (2000:492) argue that modern behaviour should not be defined from a Euro-centric bias. They outline the intangible concepts which define modernity, which include abstract thinking, future planning, behavioural/economic/technological innovativeness and the use of symbolic behaviour. Ways to identify these concepts archaeologically, adapted from McBrearty and Brooks 2000:492, can be found in Table 2.1.

These archaeological signatures defined by McBrearty and Brooks (2000) bear many similarities to the traits originally identified for the European UP, in particular the use of art, jewelry and personal adornment. This use of non-utilitarian objects, whether for symbolic communication or pure aesthetics, seems to be unique to modern humans. A presence of decorative artifacts is one of the characteristics which are often used to distinguish between Neanderthal and modern human occupations in Europe. The presence of ornaments strongly

Table 2.1. Archaeological signatures of modern human behaviour, adapted from McBrearty and Brooks 2000:492.

| | |
|---|---|
| Ecology | • Range expansion into previously unoccupied areas<br>• Increased diet breadth |
| Technology | • New lithic technologies: blades, microblades, backing<br>• Standardization and formal tool categories<br>• Hafting and composite tools<br>• Tools from organic, or previously unused materials<br>• Special purpose tools<br>• Increased number of tool categories<br>• Geographic/temporal variation in tool categories<br>• Greater control of fire |
| Economy and Social Organization | • Long-distance raw material acquisition and exchange networks<br>• Curation of exotic materials<br>• Scheduling and seasonality in resource exploitation<br>• Site reoccupation<br>• Intensification of resource extraction, especially aquatic and vegetable resources<br>• Group/individual identification through artifact style<br>• Structured use of domestic space |
| Symbolic Behaviour | • Regionally specific artifact styles<br>• Self adornment (e.g. beads and ornaments)<br>• Use of pigment<br>• Notched/incised objects (bone, eggshell, ochre, stone)<br>• Representative images and sculptures<br>• Burials with grave goods (e.g. ochre, ritual objects) |

indicates that the site was occupied by modern humans. There are some French and Spanish sites which may have evidence putting Neanderthals in association with symbolic artifacts, including Grotte du Renne (d'Errico et al. 1998), La Ferrassie (Zilhão 2007), Saint Césaire (Zilhão 2007), Cueva de los Aviones (Zilhão et al. 2009), and Cueva Anton (Zilhão et al. 2009).

However finds from these sites are regarded with skepticism, and are not well accepted as evidence of Neanderthals having modern behaviour. Sites which claim to have Neanderthal occupations with modern behaviours are under continual scrutiny, and some have been disproven in recent years. At the Grotte du Renne, behaviourally modern tools and ornaments were found in association with Neanderthal remains. Recent advances in radiocarbon dating allowed for a re-examination of archaeological finds from the site. Higham et al. (2010) found significant variation in dates among finds from the same levels. This indicates stratigraphic mixing, and means that the association between Neanderthal remains and modern artifacts cannot be certain (Higham et al. 2010). Benazzi et al. (2011) re-examined deciduous molars from Grotta del Cavallo, Italy. These teeth were originally classified as being Neanderthal, and were found in association with UP deposits (Benazzi et al. 2011:525). Using microtomographic analysis, the teeth have now been classified as modern human (Benazzi et al. 2011).

Whether or not the other Neanderthal occupations associated with modern artifacts will stand up to such intense examination remains to be seen. For now, the production and use of art, ornaments and jewelry is one of the traits accepted as being uniquely human. A further discussion of ornaments and symbolism is found in Chapter 3.

*2.5 Locating Appropriate Sites*

Although genetic, fossil and archaeological evidence point to Africa as the place where physically and behaviourally modern humans originated, there are very few African sites which have continuous occupation through the appropriate time (Willoughby 2009). Early people seem to have gone through a population bottleneck, and only a very small number of these early people survived. This idea was first put forth by Harpending et al. (1993) to explain the limited genetic diversity among living people. This genetic bottleneck is often linked to the onset of cold, dry glacial conditions, which created a harsh and unstable environment (Stringer 2002). This bottlenecking process is supported by the limited amount of genetic diversity within the modern population (Ingman et al. 2000). Klein (2008:271) suggests that the breeding population responsible for all modern humans was reduced to no more than 10,000 individuals. Large areas of the landscape would be left unoccupied during such a bottleneck, making sites with evidence of continuous occupation very difficult to locate.

Finding archaeological sites with continuous occupation through this time is difficult. It is necessary to locate areas in which people could have survived these cold, dry glacial conditions. These regions would have had stable temperatures and consistent plant availability.

In order to reconstruct Pleistocene environments, sediment cores were taken from three lakes in Africa: Lake Tanganyika, Lake Bosumtwi, and Lake Malawi (Cohen et al. 2007; Scholz et al. 2007). These sediment cores provide records of climate change from 135,000 to 70,000 years ago (Scholz 2007:16416). As lake sediments accumulate, they trap terrestrial pollen and diatoms which fall to the lake floor. Plants and diatoms are both very sensitive to changes in the environment, and can be analyzed to give an approximation of the climate. The fossilized pollen can be microscopically identified to a particular plant or tree species. By analyzing the relative abundance of each type of pollen, researchers can make approximations of the local flora.

Through a combined analysis of diatoms and fossilized pollen, researchers can make a relatively accurate assessment of past environmental conditions. Environmental reconstructions suggest that some parts of East Africa, including possibly the Iringa highlands in southern Tanzania (my study area), may have been a refugium where early humans could have survived the last glaciation (Cohen et al. 2007; Finch et al. 2009; Mumbi et al. 2008; Scholz et al. 2007; Willoughby 2012).

### *2.6 Summary*

More light has been shed on the origin of modern humans in recent years, but the debate is far from being resolved. The two most plausible models (Hybridization and Replacement, and Recent African Origin) both agree that there would be evidence of the transition to modernity in Africa. Physically modern people have been identified in Africa starting approximately 200,000 years ago, but these early people were not behaviourally modern (Klein 2008:268).  The markers of modern culture which appear as a package in the European Upper Paleolithic first appear sporadically in Africa (McBrearty and Brooks 2000). Further developments on the topic are hindered by a lack of sites with continuous occupation throughout this transitional time.

## Chapter 3: Early Symbolic Ornaments and their Significance

The use of symbolic adornments to communicate social data is ingrained in modern human society. It is such a common part of daily life that the decoding of the symbolic information is often automatic and unconscious. Kuhn and Stiner (2007b:42) write:

> "As an obvious example, a gold ring worn on the fourth finger of the left hand tells people in certain cultures that the wearer is married and should be dealt with accordingly. Likewise, displaying the membership badge of a particular fraternal organization or religious society might invite someone to approach a stranger as though he or she were already an acquaintance. Even the apparently simple aim of making oneself 'look good' is sending a message to someone we hope will consider us attractive or at least attentive to our appearance".

This mode of communication is uniquely complex in humans. As it is such a crucial part of modern behaviour, and exploring the origins and development of symbolic communication is likewise crucial to the study of modern human evolution.

The use of personal ornamentation, such as beaded jewelry or pendants, is one of the most accepted indicators of modern human behaviour (e.g. d'Errico et al. 2009; Henshilwood and Marean 2003; Kozlowski and Sacchi 2007; Kuhn and Stiner 2007a; McBrearty 2007; White 2007). The tradition of donning ornaments has been used continuously by culturally modern humans for tens of thousands of years. In this chapter I will outline explain the link between symbolism and social complexity, and summarize the earliest uses of personal ornamentation.

*3.1 The Social Brain Hypothesis and Symbols*

One way to examine modern human behaviour is by contrasting it with animal behaviour. The Social Brain Hypothesis examines the physical and behavioural differences between humans and other primates. It was originally developed to explain why primates have a larger than expected brain size for their body size (Dunbar 2003:163). As it turns out, it's not that the entire brain of primates is proportionally larger than those of other mammals, but rather an expanded neocortex which accounts for most of the size difference (Dunbar 2003:163). Mammal neocortices account for approximately 10-40% of total brain volume, while in primates the neocortex accounts for 50-80%, and human have a minimum of 80% volume from the neocortex (Dunbar 2007:91). This part of the brain, in humans, is responsible for higher brain functions such as understanding language, making long term plans and processing emotions (Coolidge and Wynn 2009:14).

Analysis of several primate characteristics revealed a link between neocortex size and number of members in a social group. As primate group size increases, so does the neocortex ratio (Dunbar 1998, 2003, 2007). This relationship is thought to be a by-product of social complexity. As the size of a complex social group increases, so do the number of factors to be considered when making decisions (Gamble et al. 2011:116). This is a feature present in primate groups, which have a complex and structured hierarchy (Dunbar 1993:682). It is not applicable to other types of animal groups such as birds or herbivores, which can have very large groups with no complicated social structures.

Among many primates, relationships are forged and maintained through social grooming practices (Dunbar 1998, 2003). These relationships allow primate societies to have more effective survival and reproduction strategies (Dunbar 2007:92). The upkeep of these associations, and thus the upkeep of the larger group size, is achieved through social grooming. This requires physical contact and can only be performed on one individual at any given time.

In the wild, the maximum time spent grooming by primates takes up 20% of the day (Dunbar 2003:173). Based on social group size, if modern people used these same methods of social maintenance, we would spend more than 40% of our days engaged in social grooming behaviour (Dunbar 1993:688, 2003:174). This does not appear to be the case. Ethnographic studies of both pre and post industrial cultures show that modern people, like primates, spend on average 20% of their time engaged in social upkeep (Dunbar 2003:174).

Since humans maintain larger social networks than other primates, but spend an equivalent amount of time performing social maintenance, we must be using more effective methods than social grooming. Social grooming could be ratcheted up through several key evolutionary levels which would finally result in modern human behaviour. Each increase in communication requires less time and effort, while reaching a larger audience. The pinnacle of effective communication, according to Coward and Gamble (2008) takes place through symbolic objects.

The lowest form of social maintenance is social grooming. Social grooming requires direct physical contact with another individual who is in close physical proximity. The biggest drawback with this mode of communication is that one can only groom a single individual at a time (Coward and Gamble 2008; Dunbar 1993). This time constraint puts an immediate cap on the total number of relationships which can be maintained in a day. Even if a primate is cognitively capable of keeping track of a greater number of relationships, social grooming limits the size of maintainable alliances (Dunbar 1993:687). When a group grows too large, the neglected relationships cannot function effectively and the group will eventually fission (Dunbar 1993:687).

The ability to communicate through physical signaling (or gesture) is slightly more advanced than social grooming. This step between social grooming and vocalization is not specified in the literature I consulted, however I think it is important to elaborate upon here. Gesture requires only that the recipient be within sight, rather than within reach. This type of communication could include a signal such as a smile, wink, nod or wave. Gesture is used extensively today in accompaniment with language; a large portion of our communication is non-verbal (Coward and Gamble 2008:1973). The two major benefits of gesture are that the audience could consist of more than one person, and the signals could be performed at a distance. While the limiting factor for social grooming was time, here it is the field of vision.

Communication through auditory cues is the next level of social interaction (Coward and Gamble 2008; Dunbar 1993). This type of communication does not necessarily imply the use of language, but could include vocalizations such as laughing or grunting. In more complex interactions, vocal grooming could include conversations or group singing (Dunbar 1993:689). This mode of interaction has several benefits. Like with gesture, vocalization can communicate with a large group rather than a single individual. Improving upon gesture's limitations, no direct sight line to the speaker is required to receive an auditory message. Perhaps most importantly, vocalization frees the hands and body for multitasking. Speaking can be combined with almost any activity, such as foraging, which makes it extremely efficient (Dunbar 1993:689).

Finally, the peak of social communication is the use of symbolism (Coward and Gamble 2008). Symbolic objects give people the ability to communicate across space and through time (Coward and Gamble 2008:1973). The audience does not need to be within reach, sight or earshot, but can be hundreds of kilometres or thousands of years away. There is no longer a single time at which the message is transmitted; a symbolic object can communicate years after its creation, such as the Inuit Inukshuk (Coward and Gamble 2008:1973). Inukshuk are present throughout the Arctic, and serve functions such as marking the presence of paths, animal migration routes and caches (Coward and Gamble 2008:173). Their creation was a way to communicate concepts to future travelers.

There are three major benefits of wearing symbolic ornaments as a means of communication. First, by donning an ornament, communication is effortless (Kuhn and Stiner 2007b:42). The ornament, assuming it is worn in a visible location, can be read by one person, or one hundred people, with no additional exertion (Kuhn and Stiner 2007b:42; Wobst 1977:322). The communication may even be made without the wearer's knowledge, for example if the wearer is observed from behind. Second, through wearing a symbolic object, the message it conveys can be received some distance away, in much the same way as gesture or speech (Kuhn and Stiner 2007b:42; Wobst 1977:327). This would be particularly useful in determining whether an unknown individual is a potential friend or enemy from a safe distance (Kuhn and Stiner 2007b:42). Finally, symbolic ornaments transmit information which can make social interactions less stressful and more predictable (Kuhn and Stiner 2007b:43; Wobst 1977:327). For example, members of a group can observe how closely someone is adhering to their social norms and ideology instantly, without having to monitor behaviour (Wobst 1977:327). One could also identify social standing or economic differentiation through symbolic decoration, and interact accordingly.

### *3.2 Who is the Audience?*

In order for a symbolic message to convey its meaning, it must be received. The social data stored in a symbolic ornament is most useful when interpreted by the appropriate audience. The target audience for this type of communication is argued to be socially distant, but culturally similar strangers (e.g. Gamble 1998; Kuhn and Stiner 2007; Wobst 1977). Through an examination of the typical social groups encountered, it is possible to estimate how effective symbolic communication with each group would be.

The most socially intimate people are sometimes referred to as a household, but are not necessarily restricted to genetically related kin. These people are contacts whom a person considers important, and has significant direct communication with (Gamble 1998:434). This group often includes members of a nuclear family, spouses and close friends. With these socially intimate people, direct (often verbal) communication is the most effective way of sharing information. Using symbolic communication with this level of familiarity is more costly than beneficial (Wobst 1977:323). Any information that symbolic ornaments can be used to express, these people would likely already know, therefore using symbols to communicate with this group would be most costly than beneficial.

Slightly more socially removed than the household are more distant relatives and acquaintances. These people make up the “Effective” and “Extended” networks, as described by Gamble (1998:434-436). Such groups form the material and emotional support networks which make daily life possible (Gamble 1998:434). People from these networks would easily be able to decode symbolic ornamental information, but the message could be more easily transmitted through other modes (Kuhn and Stiner 2007b:42; Wobst 1977:324-325).

The people farthest socially removed from an individual are strangers from foreign cultures. Any symbolic meaning would probably be lost on this group, as they would not have the social constructs to decode culturally specific symbolic messages (Kuhn and Stiner 2007b:42; Wobst 1977:325). Therefore, this group seems unlikely as the intended recipients for this type of communication.

The most likely audience for whom symbolic communication is intended is virtual strangers from the same culture. These people are likely not directly familiar with the wearer, but they would be able to decode the transmission, and would otherwise not have access to the information through other channels (Kuhn and Stiner 2007b:42; Wobst 1977:325). Using symbolism to communicate with this group seems to most efficiently balance the costs and benefits of symbolic communication. The larger this category of culturally similar strangers, the more efficient symbolism becomes in comparison to other forms of communication (Wobst 1977:326).

### *3.3 The Earliest Portable Decorative Objects*

From an evolutionary perspective, large group size and use of symbolic communication should be linked. The Social Brain Hypothesis indicates that effective modes of communication are required to sustain large, complex group sizes. Analysis of symbol use suggests that it is most effective as communication when there is a large group of strangers from the same culture who are encountered frequently. The earliest uses of ornamentation then may be indicative of the social milieu of Paleolithic society. Along with other lines of evidence, the first uses and subsequent evolution of personal ornamentation is an important part of understanding the early development of modern human behaviour.

The earliest ornamental artifacts fall into a category called "Portable Palaeoart" (Bednarik 2001:171). Portable palaeoart first appears, contentiously, in the Lower Palaeolithic/Old Stone Age, in the form of manuports, engraved artifacts and possible figurines (Bednarik 1995; 2001). Among the earliest of these decorative finds are the Tan-Tan figurine from Acheulean levels in Germany (Bednarik 2003:405) and the Berekhat Ram pebble from Acheulean levels in Syria (Bednarik 2003:409; d'Errico and Nowell 2000:125). Both of these appear to be naturally formed stones whose anthropomorphic properties were exaggerated through modification (Bednarik 2003; d'Errico and Nowell 2000). There are also proposed beads from the Acheulean, although they are not widely accepted. In particular the *Prosphaera globularis*, a type of spherical sea sponge, has been suggested as Acheulean beads from archaeological sites in France and England (Rigaud et al. 2009:26-27). None of these Acheulean-age finds are widely accepted as evidence of modern cognition, as they are highly debated and irregular occurrences.

By the MSA, geometric engravings can be found at a number of sites in sub-Saharan Africa. Notched faunal bones and/or incised ochre have been reported from Blombos Cave, Hollow Rock Shelter, Klasies River, Sibudu Cave, Apollo 11 Cave, Border Cave and Ishango (Cain 2006:675-676). Several hundred pieces of engraved OES fragments, possibly from OES water containers, are known from Diepkloof rockshelter (Parkington et al. 2005:487; Texier et al. 2010:6180).

These incised geometric patterns may be decorative and symbolic, but do not appear to have been made for display on the body. Beads (including pendants) are considered to be the earliest artifactual evidence of body ornaments (Conard 2005:311; Henshilwood 2007:124; Vanhaeren 2005:526). The earliest accepted evidence for beads comes in the form of perforated marine shells (d'Errico et al. 2009:16051). Several sites across Africa and the Middle East claim to have perforated shell beads dated to between 40,000 and 135,000 years old (d'Errico et al. 2009:16051).

*3.4 Perforated Shells from Africa*

The most famous of the MSA perforated marine shells come from Blombos Cave, South Africa. Blombos Cave is located 300 kilometres east of Cape Town, on the coast of the Indian Ocean. The MSA levels at Blombos Cave revealed 41 perforated *Nassarius kraussianus* shells (d'Errico et al. 2005:8). The upper levels of the MSA sequence are dated by optically stimulated luminescence (OSL) to 75,000 years old, and dated by thermoluminescence (TL) to a mean of 77,000 years old (d'Errico et al. 2005:3,6). Each shell in the assemblage is from an adult specimen of an approximately similar size, which suggests these shells are not from a random accumulation (Henshilwood 2007:127). Microscopic analysis of the perforations shows evidence of use-wear, suggesting that these shells may have been strung onto cordage (Henshilwood 2007:127). This is further evidenced by the location of the *in situ* shells, 33 of which were found in small groupings of two to 12 beads (d'Errico et al. 2005:9).

Less well known, but slightly older than the Blombos shells, are the perforated shells from a site in Morocco. Taforalt (or the Grotte des Pigeons) is located approximately 40 km from the modern day Mediterranean coastline and boasts 10 metres of stratified deposits (Bouzouggar et al. 2007:9965). The 13 recovered shells belong to the *Nassarius gibbosulus* species, and bear perforations similar to those observed in the Blombos shells (Bouzouggar 2007:9966). Four dating techniques including accelerator mass spectrometry (AMS), TL, OSL and Uranium-series were used to determine that the horizon containing the perforated shells is approximately 82,500 years old (Bouzouggar et al. 2007:9966).

Three other sites in Morocco (Rhafas, Ifri n'Ammar, and El Mnasra I) also have perforated marine shells from MP levels (d'Errico et al. 2009:16053). The context and dates of these shells however seem to be less secure than those at Taforalt. Additionally, the low number of finds (only eight from all three sites combined) suggests that using these shells as evidence of MP beads may be hasty.

The use of shells as ornaments may not have been restricted to marine shells. Pieces of pierced opercula from terrestrial gastropods (land snails) were found in MSA levels at Porc-Epic Cave, Ethiopia (Assefa et al. 2008). Porc-Epic Cave is perched atop a limestone escarpment in the southeastern part of the country (Assefa et al. 2008:746). Three opercula were direct AMS dated to between 33,000 and 43,000 years old; obsidian hydration dates from associated lithics were between 61,000 and 77,500 years old, which suggests the AMS dates may be a minimum age (Assefa et al. 2008:746-747). While opercula can be naturally perforated by predators, the authors feel convinced that these are artifactual ornaments given their association with each other. Overall, 419 unbroken opercula were recovered, 71 of which were found in a 10cm spit of a 50cm$^2$ quadrant (Assefa et al. 2008:753). Additionally, two pieces found were connected by sediment, with their perforations directly in line with one another (Assefa et al. 2008:750-751). This seems to indicate that land snail opercula may have been used in the MSA/LSA as ornaments.

### *3.5 Perforated Shells from Outside Africa*

Africa is not the only continent which has early perforated shell ornaments. Artifacts have been recovered from the Near East which are similar to the shell beads discussed above in appearance, but slightly younger. Finding early beads in this area makes intuitive sense, as this would have been a corridor of migration out of Africa.

Both Ksar ‘Akil in Lebanon and Üçağizli Cave in Turkey are dated to the early Upper Palaeolithic and have perforated mollusc shells from a variety of species (Kuhn et al. 2001:7642). Ksar‘Akil is a rockshelter which has 19 metres of Palaeolithic deposits. It is located several kilometres inland from the Mediterranean, and serves as the type site for the Upper Palaeolithic in the northern Levant (Kuhn et al 2001:7641). Approximately 250 kilometers north of Ksar‘Akil is Üçağizli Cave. This site sits near the Mediterranean coast approximately 15 kilometers from the Asi River mouth. The modern portion of Üçağizli Cave site is a remnant of a larger collapsed cave. The excavatable portion contains three metres of Upper Palaeolithic deposits (Kuhn et al 2001:7642).

There is some doubt about the ornamental nature of the perforated shells at Ksar'Akil and Üçağizli Cave, especially since the food species and potential decorative species overlap (Kuhn et al. 2001:7642). The perforated shells, however, are fairly small, and would have provided minimal food value (Kuhn et al. 2001:7643). Their low nutrition value is especially important when considering that each site is located several kilometers from the closest collection point. The shells were therefore transported some distance before being deposited, which would not be cost-effective if they were a food resource with such low value. Adding merit to the argument that these assemblages are not food waste is the decorative qualities of the molluscs. There appears to be some selectivity in the collection of these shells. Those which bear perforations are relatively rare varieties with arresting patterns or bright colours (Kuhn et al. 2001:7642). If the perforated shells were collected for food, they would be expected to have a more random accumulation.

Perforated shells have also been recovered from Skhūl and Qafzeh, Israel, in layers dating to between 90,000 and 135,000 years ago, and from and Oued Djebbana, Algeria in layers dating to between 35,000 and 90,000 years ago when occupied by early modern humans (d'Errico and Vanhaeren 2007:277; Vanhaeren et al. 2006:1785). Similar to the Moroccan sites discussed above, there are only seven specimens across the three sites, and the context of the finds is somewhat unclear (d'Errico and Vanhaeren 2007; Vanhaeren et al. 2006:1785). For these reasons, these shells are less well known and less accepted as evidence of Middle Paleolithic beads.

### *3.6 OES Beads*

Although they are not quite as old as the shell beads listed above, OES beads may still have the potential to yield significant information about the development of early modern humans. OES beads have been reported from archaeological sites across South and East Africa, China (Wang et al. 2009) and India (Mellars 2006b), the oldest dating into the MSA (d'Errico et al 2008:2676). They are referred to as "the most common of all Stone Age ornaments," (Wadley 1993:276). OES is incredibly durable and is readily preserved in the archaeological record. It tends to retain its structure and organic properties longer than most other archaeological samples (Brooks et al. 1990; Freundlich et al. 1989). The longevity of its organic content makes ancient OES a suitable candidate for both amino acid racemisation and radiocarbon dating. This is especially useful in tropical climates where other organic archaeological materials, such as fauna and flora, are unable to withstand harsh taphonomic circumstances.

The earliest OES bead is currently attributed to Mumba Rock Shelter, northern Tanzania. Three beads were recovered from Layer V, which contains both MSA and LSA lithic technology (McBrearty and Brooks 2000:522). These beads were initially suspected to be intrusive from Bed III which dates between 30 and 37kya (McBrearty and Brooks 2000:522). Direct dating by amino acid racemization was performed on two of the three beads, with one indeed appearing to be intrusive.  The second bead however revealed a date of ca. 52,000 BP (McBrearty and Brooks 2000:522).  This places the oldest directly dated OES bead firmly in the MSA.

The second oldest OES beads come from Enkapune Ya Muto rockshelter, located in the Kenyan Rift Valley.  Also known as Twilight Cave, this site contains more than five metres of stratified deposits (Ambrose 1998:380).  The DBL1 layer from which the OES beads were recovered was dated by several methods.  Obsidian hydration dating provided an age of 35,348 BP, and radiocarbon dates taken from unmodified OES confirm this date, with a range of 37,000-39,900 BP (Ambrose 1998:382).  The beads however were not dated directly.  These dates indicate that Enkapune Ya Muto's beads may be from the early Later Stone Age, extremely close to the Middle Stone Age threshold.

Although OES beads are not the most ancient, they hold unique properties that the marine shell beads do not.  One of the most impressive characteristics of OES beads is their standardization.  Completed beads have a general disc shape, and usually have a maximum diameter under 2cm.  This is true for beads from the Paleolithic to the present.  The standardization is particularly impressive when considering that the forms of OES beads are entirely imposed.  Unlike marine shell beads, which retain their natural outer shape, the shape and size of the OES bead is in the hands of the maker.  There is ample opportunity for stylistic choices to influence the size and shape of the bead, yet they are remarkably consistent.  This homogeneity of OES bead size and form has been argued by to represent an advanced mental template, and perhaps indicate a standardized exchange system (Bednarik 2001:176; Vanhaeren 2005:542).

### *3.7 Summary*

The use of personal ornaments as a medium of communication is a unique feature of modern human behaviour. According to the Social Brain Hypothesis, group size and neocortex ratios are linked, with humans having the largest of each. Primates maintain their alliances through social grooming which takes up approximately 20% of their day. Humans have developed more effective modes of social maintenance, the pinnacle of which is symbolic communication. The rise of symbolic personal ornaments in the archaeological record therefore is linked to the social environment of Paleolithic people. The first undisputed personal ornaments appear in the MSA/MP as perforated shells, typically marine molluscs. OES beads are first found towards the MSA/LSA boundary, and have interesting similarities from the earliest examples to ethnographic cases. The next chapter will review the use and manufacture of OES beads from ethnographic accounts.

# Chapter 4: Ethnographic Accounts of OES Bead Manufacture and Use

The use of OES is documented among many traditional, hunter-gatherer communities from Africa. Although rarely hunted for their meat, ostriches are prized for their eggs, as is mentioned in the ethnographic literature (e.g. Lee 1984:23; Shostak 1976:258; Silberbauer 1981:227). These eggs can be used as a food resource, emptied for use as water containers, or broken to make beads. The cultural studies which provide the data for this chapter have been carried out over the past hundred years. Some of these ethnographies may appear shockingly out-dated for an academic research project, however it is their firsthand documentation of daily life that provides invaluable insight.

From these modern accounts, it may be possible to infer information about beads found in archaeological assemblages. Ethnographic data is proposed by Deacon and Deacon (1999:130) to be suitable for archaeological inference because of the assumed retention of traditional hunting and gathering lifeways. Wadley (1989:43) likewise suggests that drawing parallels between archaeological data and ethnographic inference is preferable to models constructed by western scholars. A very recent work by d'Errico et al. (2012) found evidence of what they label San material culture which dates to 20,000 years ago. This indicates the incredible cultural continuity that can exist in some communities, and the interpretive value it may provide to archaeological research. Of course no modern culture can be a direct analogy for our early human ancestors, but ethnographic accounts may be used cautiously to provide some insight. This chapter will review the ethnographic literature from Africa which references the use of OES, and the manufacture and use of OES beads.

In the following descriptions, I will refer to the ethnographic participants with a number of different, possibly conflicting, terms. In order to avoid promoting any inappropriate labels, in lieu of the general term *Bushman* I will use the term *San* to refer to the language family of the region. My intent is not to promote any stereotypes which may be present, especially in early publications, but to focus on the descriptions of OES bead making.

### *4.1 OES as Water Containers*

Intact, whole OES have been observed as water containers in ethnographic studies among several groups including: Berg Damara, Herero (Hahn et al. 1966), and San (Lee 1979:276; Marshall 1976b:77; Shostak 1976:258, 1981:96). Each empty OES weighs approximately one pound, and can hold two pounds of liquid, making it a highly effective way to carry or store large amounts of water (Marshall 1976b:77). Individual water containers may have designs scratched into them to make them identifiable (Marshall 1976b:77). Lee (1979:276) observed from his study of !Kung San participants in northern Botswana, that each OES water contained required an hour of work to prepare and lasted approximately two years.

OES fragments from broken water containers were sometimes made into OES beads (e.g. Silberbauer 1981:227). An ethnographic account by Shostak (1976:258, 1981:96-97) suggests that OES water containers are scarce, and she relayed a story in which the participant was punished as a child for breaking the containers while fetching water. This story seems to suggest that a broken water container is undesirable, and may be turned into beads as a last resort to save the resource. In a different account, Marshall (1976b:77) writes that there is a surplus of OES, and unneeded whole eggs are broken to be used in beadwork. Whether or not OES beads were originally parts of water containers would likely vary from region to region, based upon availability.

*4.2 OES Beads and !Hxaro*

OES beads have been used in Africa from the Middle and Later Stone Ages into historic times, and they are described as the oldest San ornamental industry (Bleek 1928:9; Schapera 1930:66). They are a favoured item in *!hxaro*, a kin-based, intragroup gift exchange system (Marshall 1976:308; Smith and Lee 1997). In fact, the word *!hxaro* is used synonymously in some communities as the term for OES beadwork (Mitchell 2003:36). Lee writes that OES beadwork was the most frequently used *!hxaro* items, traded by both men and women (Lee 1984:98). A valued *!hxaro* item may travel as far as several hundred kilometres in only two years, being gifted several times along the way (Lee 1984:99).

I found some reference to the trade value of OES beads in relation to other goods, and the time required to make a string of beads. In an extremely brief mention of equivalent value, Marshall (1976b:306) writes that a string of OES beads is a fair trade for an *assegai*, or spear. She does not elaborate on the length of the string, or details of the assegai, so unfortunately this account has little value.  In a far more descriptive account, Lee writes that 5 hours worth of bead making can be traded for a flint and steel kit, 10 hours for a basin and spoons, and 15 hours for a pot (Lee 1979:276).  Lee does not explain how many beads could be manufactured by a skilled bead maker in those allotted times, but this gives an idea of the relative value of OES beads in relation to other valued items.  From the account of bead making times recorded by Silberbauer (1981:227), five hours of work could produce a maximum of approximately 473 finished OES beads, which is enough to create a single string approximately 83cm long.  The descriptions by Marshall (1976), Lee (1979) and Silberbauer (1981) may not be entirely compatible since they describe different cultural communities, but they can serve as a rough estimate of the relative value of OES beads.

### *4.3  OES Beads as Decoration*

Listed in the ethnographic literature are many decorative uses for OES beads.  A simple string of beads is only one of the many ways in which OES beads have been used as decoration (e.g. Figure 4.1).  These items may consist of a single bead, such as those worn decoratively in the hair of men or women (Bleek 1928:9; Driberg 1923:59; Schapera 1930:66; Stow 1905:139), or thousands of beads like the estimated 4,000 required to make a single skirt (Silberbauer 1965:50).  Table 4.1 is a list of ethnographic objects either made from, or adorned with OES beads, showing the wide range of uses.

None of the ethnographic accounts I found discuss the intrinsic value of OES beaded ornaments to the participants, or the personal significance of wearing them.  Hahn et al. (1966:89) speculate that OES beads appear to be status related, writing that distinguished women appear to wear more strings of beads.  It would be expected that higher status people may own a higher number of non-utilitarian objects.  Additionally, beads may carry some sentimental value.  Hollis (1909:73) and Bleek (1929:10) both write that daughters inherit the OES beads of their mothers.  This also seems intuitive that the possessions of a loved one would carry emotional importance, and is likely related to the decorative object as a whole rather than the individual beads.

### *4.4  Manufacturing OES Beads*

Although some ethnographic publications mention or depict OES beads and/or their manufacture, rarely are more than several sentences devoted to their descriptions.  The following accounts are all extremely brief, and demonstrate slight nuances, but together they show striking similarities in manufacture and use.  I have grouped the ethnographic references by region.  It is clear that there is an over-representation of studies from Namibia and Botswana.  This is not through any personal bias, but is based on the locations of previous research, and discussions of OES beads.  The Kalahari Desert, which is centered on Namibia and Botswana, has been a trendy area in which to study indigenous African communities, due to the high number of groups who retain traditional lifestyles.

### 4.4.1 South Africa

In the late 1800s and early 1900s, Dunn (1931) studied the San from South Africa, south of the Orange River. He described the bead making process as being executed by women (Dunn 1931:70). Small lithic drills, often made of black shale, were used to drill holes in the OES (Dunn 1931:71). Dunn does not make note of the type of material the pierced OES is then strung onto, but writes that grooved stones were then used to grind the strung fragments into roughly shaped beads (Dunn 1931:42). Once the string of OES beads was reduced enough, it was rubbed along the groove of the stone until an exact size and shape was obtained (Dunn 1931:70).

### 4.4.2 Namibia

Stow (1905) studied the Abwata of southern Africa, prior to the 1900s. In the region of Damaraland, the northern most area he studied, Stow documented the production of OES beads. Damaraland is located near the western coast of present day Namibia. Stow (1905:139) writes that the OES fragments are boiled, and then placed into cool water to soften the hard shell. The fragments are then broken into suitably small pieces and pierced with a small stone drill made from either flint or agate (Stow 1905:139). The perforated fragments are rubbed, polished, and finally threaded (Stow 1905:139). Stow's (1905) account is unique in that it is the only description which names men as the beadmakers, and describes the beads being shaped individually.

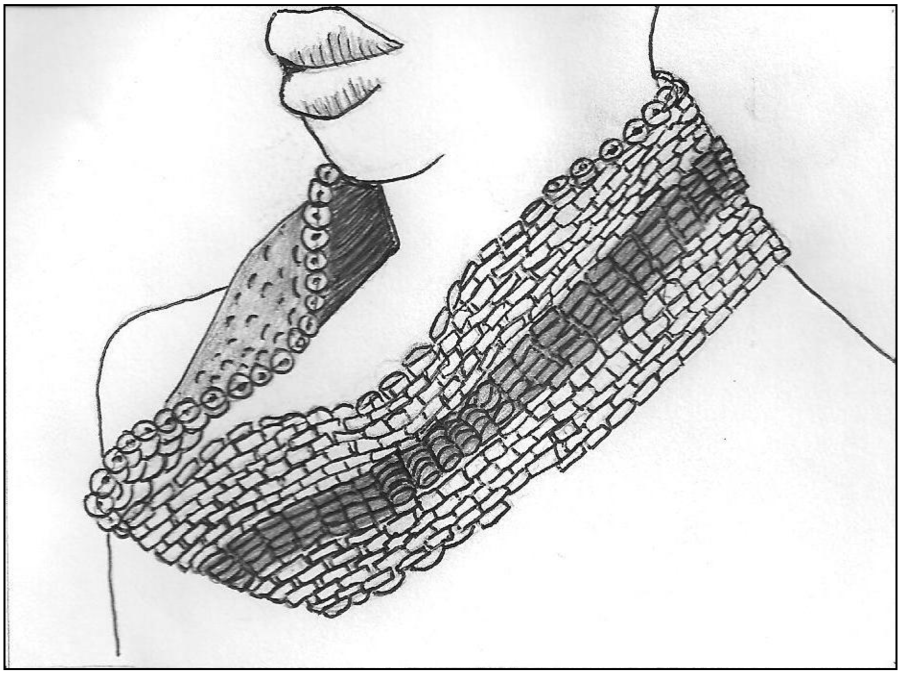

Figure 4.1. An OES bead headband, being worn here as a necklace, adapted from Marshall 1976b:304.

Table 4.1. Ethnographically documented uses for OES beads.

| Item | Reference(s) |
|---|---|
| Apron | Bleek 1928:10, Clark 1970:184, Hahn et al. 196:89, Silberbauer 1965:50, 1981:227, Stow 1905:46, Van der Post and Taylor 1984:63 |
| Armband | Silberbauer 1981:227 |
| Baby Harness | Silberbauer 1981:227 |
| Bag | Van der Post and Taylor 1984:83 |
| Belt | Dunn 1931:36, Stow 1905:139, Schapera 1930:66 |
| Bracelet | Driberg 1923:63, Dornan 1925:88-89, Hollis 1909:28, Marshall 1976b:304, Schapera 1981:66, Stow 1905:46, Tanaka 1980:42-43, Theal 1910:56, Van der Post and Taylor 1984:63-64 |
| Calabash (musical instrument) | Stow 1905:559 |
| Coronet | Silberbauer 1981:227 |
| Decorative Squares | Silberbauer 1981:227 |
| Fillet | Stow 1905:46, Dornan 1975:88 |
| Girdle | Stow 1905:46 |
| Headband | Driberg 1923:63, Dornan 1925:88-89, Hollis 1909:28, Marshall 1976b:304, Schapera 1930:66, Schapera 1981:66, Stow 1905:46, Tanaka 1980:42-43, Theal 1910:56, Van der Post and Taylor 1984:63-64 |
| In Hair | Bleek 1928:9, Driberg 1923:59, Schapera 1930:66, Stow 1905:139 |
| Necklace | Dornan 1975:88, Driberg 1923:63, Hollis 1909:28, Hahn et al. 1966:58, Schapera 1930:66, Tanaka 1980:43 |
| Nose Ornament | Stow 1905:46, Theal 1910:56 |
| Skirt | Silberbauer 1965:50 |
| Powder Box | Jacqz 1976:72, Silberbauer 1965:50 |
| Pouch/Satchel | Silberbauer 1981:227 |

In the Namibian Central Kalahari, Bleek (1928) studied the Naron. She spent time conducting interviews in the Sandfontein area, between 1920 and 1922 (Bleek 1928:I). Bleek writes that OES beads are made by women, but worn by women, children, and young men alike (1928:9). The OES is broken into small fragments with a stone, then the fragments are pierced with an iron awl and threaded onto a strip of sinew (Bleek 1928:9). The string is laid on the beadmaker's thigh or a piece of hide, and a horn is used to break off any rough edges (Bleek 1928:9). Finally, some tree fibre is twisted between the beads, making the string rigid, and the edges are ground with a grooved stone (Bleek 1929:9).

Hahn et al. (1966) describe several groups from southwest Africa. In particular they describe the Berg Damara from the Hereroland area, Namibia, based upon research conducted in the late 1800s and early 1900s (Hahn et al. 1966:39, 78). The description of OES bead making among the Berg Damara is very brief, and consists of only a single sentence. In their description, the OES is pierced, strung onto sinew, and smeared with animal fat before being trimmed and ground with a stone (Hahn et al. 1966:58). Hahn et al. (1966) do not comment on the role of the fat, but from other accounts (e.g. Stow 1905; Wingfield 2003) it may serve to soften the shell while grinding. Alternatively, it may add colour or a desirable sheen to the finished beads. This is the only account I came across that has the manufacture step of applying fat to the beads.

Marshall (1976b) documented the bead making process among the Ju/'hoansi of the Nyae Nyae area, Namibia. Her documentation consists of a single photograph and caption.  In the ethnographic photo (Figure 4.2), a woman uses a metal borer attached to a stick, which she rubs between her palms to drill a hole in a fragment of OES (Marshall 1976b:305).  The woman sits on a hide, with the OES fragment sitting atop a smooth stone between her splayed legs.  It is not possible from the photo to determine if the shell is lying convex side up or down. In the brief description, Marshall (1979b:305) writes that once the perforation is made the fragments are strung tightly onto a cord and rubbed with a stone until the jagged edges are smoothed.

Lee (1984) studied the Ju/'hoansi of the Dobe area, on the border of Namibia and Botswana from 1963-73.  Though his ethnographic account does not include a description of OES bead manufacture, Lee's work includes a photo of a group of women in the process of making beads (Figure 4.3).  From his photo it is possible to determine that OES pieces were first perforated and strung together. The string of OES was then rested against the thigh, of the bead maker (only women are pictured) and rubbed with a stone to create a final smoothed shape.  It is unclear whether the unfinished OES beads were trimmed prior to being ground with a stone.  The three women in the photo who are grinding the strings of beads are each using their right thigh as a platform, perhaps as a learned technique or as a result of right handedness.  The grinding process appears to be producing significant amounts of white powder, presumably from the powderized OES. This white dust is visible on the thigh and hands of the women.

The ethnographic work of Schapera (1930) also describes the bead making process.  He studied the Khoisan in the Central and Northern Kalahari Desert and

Figure 4.2. Old /Gam of the Ju/'hoansi, drilling a hole in a piece of OES, adapted from Marshall 1976b:305.

Figure 4.3. /Xai /Xai woman, shaping a string of OES beads, adapted from Lee 1984:97.

the northern part of southwest Africa in the early 1900s (Schapera 1930:3, 30). Schapera notes that OES bead making is strictly a women's activity (1930:145). The OES pieces are broken into small fragments and then softened in water (Schapera 1930:66). The softened fragments are drilled with a stone or iron borer, threaded onto a strip of sinew, and the edges are trimmed with a piece of horn (Schapera 1930:66). Finally, soft bark is twisted between each piece to make the string of beads rigid, and a soft stone is rubbed against the beads to make the edges smooth (Schapera 1930:66).

### 4.4.3 Botswana

Silberbauer (1965) describes the manufacture and use of OES beads amongst the *G/wikhwena* of the central Kalahari Desert, Botswana. He writes that fragments of OES are drilled and threaded onto a thong (Silberbauer 1965:50). The string of beads is then "drawn repeatedly through a groove in a stone" (Silberbauer 1965:50) to give them a rounded shape. Silberbauer (1965:50) also notes that most of the beadwork is done by women.

In a second account by Silberbauer (1981), he describes a slightly different bead making process among the *G/wikhwena*. This work was undertaken between 1958 and 1966. He notes that the beads are made from pieces of broken OES water containers (Silberbauer 1981:227). The central perforation is first drilled by twirling a metal awl between the palms; this takes around 30 seconds (Silberbauer 1981:227). Approximately 120-150 perforated pieces are string together onto a strip of sinew, and placed against a firm surface (Silberbauer 1981:227). The strung beads are rubbed with a soft stone for approximately 20 minutes, until the string of beads resembles a cylinder and each bead is a uniform disc (Silberbauer 1981:227).

Van der Post and Taylor (1984) studied San groups from the Kalahari Desert including the !Kung, Kua, and !Xõ. In 1982 they filmed and documented various aspects of daily life, including the making of OES beads. Once an OES water container was broken, the pieces were collected by women to be made into beads (Van der Post and Taylor 1984:83). The pieces were further broken into more suitably sized fragments of approximately onecm square (Van der Post and Taylor 1984:88). Using a metal awl with a wooden handle, the central perforation is drilled within seconds by rolling the handle between the palms (Van der Post and Taylor 1984:88). A large number of these perforated OES discs are threaded onto a piece of sinew, and the rough edges are chipped off with a piece of antelope horn (Van der Post and Taylor 1984:88). Finally, the string of beads is laid along a grooved piece of wood, and rubbed with a soft stone; the finished products are less than 0.5cm in diameter (Van der Post and Taylor 1984:88).

In a more recent study, Wingfield (2003) observed the manufacture of OES beads in the urban centre of D'Kar, and the more remote Kgalagadi District, Botswana in 2001. His goal was to demonstrate the similarities and differences in the chaines operatoires between regions and how these may be masked archaeologically (Wingfield 2003:56). Since Wingfield's (2003) publication is focused solely on the description of OES bead manufacture, he goes into far greater detail than any other ethnographic account I have found.

Wingfield (2003) begins with a description of beadmaking at D'Kar. He writes that the manufacture he observed here took place on a farm, during slack times when there was little work or chores (Wingfield 2003:56). Two or three women gather and sit in the shade of a particular tree near the main farmhouse (Wingfield 2003:56). Since this site was habitually returned to, Wingfield was able to find large numbers of OES beads on the ground (2003:56). Most of the OES was purchased from a craft shop in town, however occasionally the broken eggshell from an ostrich hatching would be used (Wingfield 2003:56).

He describes seven steps in the OES beadmaking of D'Kar women (Wingfield 2003). First, the women use their thumbs to break large pieces of shell into smaller chunks for drilling (Wingfield 2003:56-57). The women then get out a metal drill on the end of a stick, and a small piece of carpet. The OES fragment is placed on the carpet with the concave side up, and the metal drill is twirled into the OES with the palms (Wingfield 2003:57). The carpet serves as friction against the OES, so that it does not spin while being drilled (Wingfield 2003:57). Wingfield (2003:57) notes that the women do not drill all the way through the fragment, but only until they reach the cuticle layer. Once a number of these preforms are made, they are punched through with a metal awl to finish the perforation (Wingfield 2003:57). Using the plastic threads from sacks of maize, the women make their own twine and string the beads onto it (Wingfield 2003:57). The rough edges of the strung beads are then trimmed off with a pair of metal nailclippers (Wingfield 2003:57). The string is then laid against a plank of wood, one end is fastened with a nail and the other is held taught (Wingfield

2003:57). Using a sharpening stone (made in China) and water for lubrication, the beads are rubbed smooth (Wingfield 2003:57). Once they reach a suitable shape, they are rinsed to remove any ground eggshell (Wingfield 2003:57). Finally, the beads are strung onto a new piece of plastic twine, and an OES "button" is added to the end to fasten the loop (Wingfield 2003:57).

The bead making process observed by Wingfield in the Kgalagadi District used essentially the same manufacture stages as recorded in D'Kar, but with slight alterations which may not be archaeologically recoverable. The OES beads made here are purchased several times a year by a craft collective (Wingfield 2003:57), to be sold presumably as tourist items. The difference in tools used seems to be related to the availability of modern materials. Rather than making plastic twine from maize sacks, people in Kgalagadi used twine made from animal sinew (Wingfield 2003:58). The horn of a springbok replaced the nailclippers for trimming rough edges, and saliva was used in lieu of water as a lubricant for grinding (Wingfield 2003:58). The grind stones were so worn from the increased friction that some of them bore a bead shaped groove (2003:58). The only difference in manufacture technique was that the Kgalagadi applied animal fat to the drills, so that their hands wouldn't blister while drilling (Wingfield 2003:58).

### 4.4.4 Uganda

Driberg (1923) lived and worked with the Lango of Uganda in the late 1800s and early 1900s. In this region of Uganda, there are no ostriches, however the people studied here did have OES bead ornaments (Driberg 1923:59).

Driberg (1923:63) describes that the beads were either imported from northern groups, or had been passed down from previous generations who had access to OES. These and other ornaments were sometimes strung with giraffe's hair (Driberg 1923:63).

*4.5 Similarities among Manufacturing Accounts*

There is a general outline for OES beadmaking that is consistently reported through these ethnographic accounts, although each demonstrates slight differences. The two accounts by Silberbauer, 1965 and 1981, were recorded from the same *G/wikhwena* group, but bear slightly different descriptions; I suspect the process he observed for his 1981 publication was nearly identical to that observed for his 1965 work, as it was among the same people no more than several decades removed. This suggests to me that every observation of the bead making process may be described differently, even if the manufacture techniques are similar. With this in mind, I compiled the consistently mentioned manufacture techniques summarized above, as well as others too short to summarize, into a table to note the similarities among the ethnographic accounts (Table 4.2).

There are striking similarities among the ethnographic works, even though they are taken from different indigenous groups in separate geographic locations. Most references describe bead making as a women's activity, although beads may not be exclusively worn or traded by women. Most works also note that a strip of

Table 4.2. Ethnographically documented OES bead manufacture steps.

| *Manufacture Technique* | *Reference(s)* |
|---|---|
| Beadmaking done by women | Bleek 1928:9; Dunn 1931:71; Lee 1984:98; Hahn et al. 1966:58, Schapera 1930:145, Silberbauer 1965:50, Van der Post and Taylor 1987:83, Wingfield 2003:56 |
| Beadmaking by men | Stow 1905:139 |
| OES softened in water/saliva (either before drilling or during shaping) | Schapera 1930:66, Stow 1905:139, Wingfield 2003:57 |
| Lithic drill | Dunn 1931:71, Schapera 1930:66, Stow 1905:139, Theal 1910:56 |
| Metal drill | Bleek 1928:9; Marshall 1976b:305; Schapera 1930:66; Silberbauer 1981:227; Van der Post and Taylor 1984:88; Wingfield 2003:57 |
| Drill/Awl with wooden handle | Marshall 1976b:305; Van der Post and Taylor 1984:88; Wingfield 2003:57 |
| Rough edges trimmed | Bleek 1928:9; Hahn et al. 1966:58; Schapera 1930:66; Van der Post and Taylor 1984:88; Wingfield 2003:57-58 |
| Grooved stone for shaping | Dunn 1931:42; Silberbauer 1965:50 |
| Threaded with sinew | Bleek 1928:9; Hahn et al. 1966:58; Schapera 1930:66; Silberbauer 1981:227; Van der Post and Tanaka 1980:42; Taylor 1984:88; Wingfield 2003:58 |
| Threaded with hair | Driberg 1923:63 |
| Threaded then twisted with bark | Bleek 1928:9; Schapera 1930:66 |
| Soft stone for shaping | Hahn et al. 1966:58; Lee 1984; Marshall 1979b:305; Schapera 1930:66; Silberbauer 1981:227; Van der Post and Taylor 1984:88; Wingfield 2003:57,58 |
| Shaped while strung | Bleek 1928:9; Dunn 1931:70; Hahn et al. 1966:58; Lee 1984; Marshall 1979b:305; Silberbauer 1981:227; Van der Post and Taylor 1987:88; Wingfield 2003:57,58 |
| Shaped before being strung | Stow 1905:139 |

sinew was used to string beads together. Several of the accounts note that the pierced OES fragments were trimmed prior to their final shaping.

All above descriptions of bead making mention the use of either a lithic or metal drill. This drill, sometimes described as being attached to a wooden handle, is used to pierce the small fragments of OES for suspension. The majority of the ethnographic accounts describe the drilling process taking place with a metal piercing instrument. This is likely due to the fact that most, if not all ethnographic participants described above had access to metal. By definition, LSA bead makers would not have had access to metal. While metal instruments simply did not exist in the LSA, these early people still managed to perforate the OES. I can only assume that available materials must have been used for the job such as bone, wood, horn or stone. Although the tool may have been different, I imagine the process is still likely to have involved drilling or punching through an OES fragment.

All descriptions indicate that beads are ground to obtain their final disc shapes. The references which describe the tool used for grinding all name it as a soft stone, occasionally describing it as having a worn groove. In the work by Wingfield (2003), the stone had been imported from China and handed out by the craft collective as part of the bead making toolkit. Stones suitable for grinding beads, however, should be available throughout the indigenous regions.

*4.6 Summary*

The use of OES has been documented in ethnographic research. They have been used as water containers, as decorative beads, and as *!hxaro* trade gifts. Through a review of ethnographic accounts of bead manufacture, it is possible to find similarities between cultures. These similarities could possibly be used to make archaeological inferences. This will be explored in Chapter 7 which deals with the interpretation of data from Mlambalasi.

## Chapter 5: Previous Studies of OES Beads

OES appears to have been used as a craft material wherever ostriches are found, including Africa, China (Wang et al. 2009), and India (Mellars 2006b); despite their abundance, relatively few in depth studies of OES beads have been performed. In past works, OES analysis has rarely moved beyond quantification (e.g. Beck 1931; Louw 1969; Smith and Lee 1997); Jacobson (1987a:55) notes "most archaeologists have been content simply to count or even weigh the number of pieces conforming to the different stages of manufacture (complete, incomplete, etc),". These types of publications have not been included in my review as they add nothing to the comparative study of OES beads; for my research I must draw upon structured and in-depth analysis of OES beads both as a guide for analyzing my own assemblage and for making inter-site comparisons. In this chapter I will summarize the previously published analyzes of OES beads. These will be laid out chronologically, from the earliest to the most recent.

### *5.1 Beck 1928*

The earliest comprehensive work which could be used towards OES bead analysis is by Beck (1928). Beck studied beads from around the world and sought to create a system of uniform descriptions for all archaeological beads. His 1928 article in *Archaeologia* was later published into a book: Classification and Nomenclature of Beads and Pendants. Beck's work contains thorough descriptions and sketches of terms and classifications. With the number of categories and sub-categories of each characteristic, tens of thousands of unique beads can be described.

The bead characteristics are described in meticulous detail. He begins his article by defining the bead terminology to be used. Beck then makes four general divisions by form, perforation, material and decoration. Where necessary, he has included sketches to illustrate the descriptions. The only area of classification lacking from Beck's system is color. Beck had prepared, but was unable to publish, a colour guide to accompany his article (Beck 1928:52). He writes that the cost of reproducing the colors with precision was too great, and he worried they would fade over time anyway (Beck 1928:52). He discusses possible solutions, including a chart with 100 colour swatches. This problem is easily solved today with the Munsell Color chart commonly used by archaeologists to describe soil and sediment colors. Even without a color classification scheme, Beck's system is amazingly complete in its categories for bead types.

The amount of work that went into Beck's 1928 publication is astounding. His descriptions and categories create an incredibly complex classification scheme. For example, Beck (1928:51-52) describes 11 main perforation types and nine sub-types. I suspect that this complexity is the reason his system is not widely used, especially in Paleolithic ornaments which vary considerably less than more modern beads. Beck's system seems better suited for describing beads and pendants from later periods where they become much more variable.

*5.2 Plug 1982*

The first genuine example of OES bead analysis is by Plug (1982). In it she describes levels one to 18 of an assemblage from the Bushman Rock Shelter, South Africa. The site has a deep stratigraphic sequence which includes LSA layers, the lowest of which is dated to 12,950 BP, and undated MSA layers below (Plug 1982:57). Bushman Rock Shelter is one of the relatively few African Upper Pleistocene sites with good bone preservation (Plug 1982:57). The site yields bone tools which share some characteristics with stone tools (Plug 1982:57), so understandably the focus of Plug's research in this case is the bone tools, and the OES beads are rather briefly described.

Plug's analysis is quite impressive, especially given that there was no previous OES bead research to guide her. She analyzed several characteristics of the 217 recovered OES beads, as well as 102 other modified pieces of OES. Beads were recovered from the first 17 of the 18 levels described, with dates ranging from 9,570 BP for level two, to 12,950 BP for level 18 (Plug 1982:57). Plug writes that there is a preference for trimming blanks before drilling in the upper layers, and a preference for drilling before trimming in the lower layers (Plug 1982:60). She then describes the aperture shapes as they relate to direction of drilling (Plug 1982:60). Over 71% of the apertures were drilled from the internal surface, 2% drilled from the external, with 27% being undetermined (Plug 1982:60). Seventy-two percent of the perforations are biconical, 26% conical, and 2% cylindrical (Plug 1982:60). Finally, Plug recorded the mean external and aperture diameters. She writes that the aperture diameters had a mean of 1.9mm, completed beads had a mean diameter of 5.3mm, and incomplete beads had a mean of 8.8mm (Plug 1982:60-61).

Overall, Plug's analysis of the OES beads is surprisingly thorough for her time. My only disappointment is that Plug neglects to describe the criteria with which she assessed the direction of drilling. Interestingly, beads were recovered from deep into the MSA layers at Bushman Rock Shelter (Plug 1982:62). Unfortunately, she goes into no further detail about the MSA beads in this article, and I am unable to locate any further mention of these MSA beads from Bushman Rock Shelter. In an article published some years earlier, Louw (1969:43) suggests the beads found in the MSA layers were the result of mixed sediments. Even with these minor issues I find Plug's (1982) analysis extremely useful.

*5.3 Jacobson 1987a, 1987b*

The earliest comparative studies of OES bead variability is by Jacobson (1987a,b). Whereas Plug's (1982) article focused on the description of site stratigraphy and lithic and bone finds, Jacobson's work is focused solely on the beads. Oddly, he does not cite or acknowledge Plug's article. I suspect that journals were not as readily accessible then as they are now, and he was probably unaware of the work by Plug. Regardless, Jacobson's work is a landmark study as the first published analysis of the inter site variability in OES beads.

Jacobson (1987a:55) draws his data from 18 assemblages spanning seven archaeological sites in central Namibia. The sites analyzed are the Lower Numas Cave, Orabes Lower Shelter, Zais, Eros, Geduld, Wortel and the Kuiseb sites

(Jacobson 1987a:55-56). These sites are from a variety of environments including open air, shell middens and caves (Jacobson 1987a:55-56). Based on both absolute dating techniques, the assemblages range from 150 to 4,840 BP (Jacobson 1987a:55). The Zais site is undated, but contained a microlithic industry and is believed to be of "pre-herder age" (Jacobson 1987a:55). The data analyzed by Jacobson (1987a, 1987b) bridges the time from LSA hunter/gatherers to recent Iron Age herders.

In his article, Jacobson (1987a) aims to determine whether there are differences in OES bead diameter, and what these differences might mean. The idea for his research came from a colleague who stated in casual conversation that OES beads from younger sites appear to have greater diameters than those from older sites (1987a:55). Jacobson (1987a:56) suggests that these differences, if confirmed, could be indicative of either stylistic evolution or concurrent ethnic styles. Jacobson believes that OES beads are more suitable for stylistic analysis than lithic artifacts. He writes: "is the variability of the morphology of any one tool, for example scrapers (backed, convex, side, end, etc.) functional or stylistic? A definite advantage of beads is that they have been made from a uniform raw material over the entire subcontinent and can thus be used in comparative studies with some confidence," (Jacobson 1987a:57). It seems safe to say that Jacobson considers OES bead variation to be indicative of style.

Using the associated lithic and ceramic assemblages, Jacobson (1987a, 1987b) creates three categories to describe the former occupants of his sites. These categories are based on the observed differences between site assemblages, and are used only as a heuristic device. Type I is representative of a classic South African LSA assemblage: microlithic toolkit, no pottery (Jacobson 1987a:56). Jacobson (1987a:56) suggests that Type I people practiced pre-herder, hunter-gatherer lifeways. Type II assemblages are also characterized by microlithic toolkits, but with the addition of small potsherds (Jacobson 1987a:57). The people associated with Type II assemblages are transitional between hunter-gatherer and herder lifeways (Jacobson 1987a:57). Finally, Type III represents assemblages with abundant ceramics, but few (if any) formal lithic types (Jacobson 1987a:57). These three types are meant to generally correspond to chronological periods, with Type I being the oldest and Type III being the most recent and representing people who specialized in herding.

Jacobson (1987a, 1987b) records two characteristics for each bead: maximum diameter and completeness of production. The completeness variable seems to have been included only to determine which bead diameters to include in the mean calculation. Jacobson (1987a:55) decides not to include broken beads unless they exhibit signs of wear, as the diameters of the beads are decreased during production. If beads broken during the production process were included in diameter calculations the data could be skewed towards larger diameters (Jacobson 1987a:55).

Using these maximum diameter measurements Jacobson is able to identify a trend among his three assemblage types. He recognizes seven Type I sites with a mean maximum diameter of 5.0mm and a range of 3.0 to 7.5mm (Jacobson 1987a:57). The two Type II sites have a mean maximum diameter of 5.4mm and a range of 3.0 to 15.0mm (Jacobson 1987a:57). Finally, the nine Type III sites have a mean of 6.7mm and a range of 4.0 to 13.5mm (Jacobson 1987a:57, Jacobson 1987b:175). His data demonstrates an increase in diameter from Type I to III. Jacobson writes that there appears to be a threshold diameter of 7.5mm, with no beads larger than this in Type I assemblages (Jacobson 1987a:57). However, rather than all beads growing in diameter from early to later assemblages, post-herder beads demonstrate a wider range of variability in diameter (Jacobson 1987a:57).

Jacobson (1987a) suggests ways to infer site function from OES bead artifacts. I find his explanations assumptive and gender biased, but nonetheless they provide some interesting food for thought. He suggests that incomplete beads would not be expected at kill sites, as women would not have been present (Jacobson 1987a:57). Here, Jacobson is making assumptions about gender roles with men as the sole hunters and women as craft specialists. This may be the case in ethnographically researched societies (though he does not cite any), but it cannot be applied to Palaeolithic people without strong inference to support it.

I find Jacobson's ideas about site function and occupation intensity to be more compelling. He writes that at small scale or short term sites (such as meat processing, transit camps or single family camps), completed beads would be expected but incomplete beads would be unlikely (Jacobson 1987a:57). Larger scale or long term camps such as base or aggregate camps should yield the greatest variability in bead production (Jacobson 1987a:57). This seems like a much more plausible scenario than making assumptions about gender roles. I will elaborate further about this in Chapter 7.

Jacobson's (1987a, 1987b) articles are landmark studies for OES bead researchers. They are the first to make the connection between bead diameter and chronological change. Unlike Plug's (1982) article which only reports data, Jacobson's articles move to interpretation. I appreciate that he includes a section describing his method for data collection and the reasons behind his approach. Jacobson's method is used by subsequent researchers, and in my own analysis.

### *5.4 Smith et al. 1991*

Following in Jacobson's (1987a, 1987b) inter-site comparisons of OES beads, Smith et al. (1991) compared assemblages from several sites around the south-western Cape of South Africa. The purpose of their project was to determine whether the hunting and herding assemblages represented different cultures, or seasonal strategies of the same group (Smith et al. 1991:71). Although their article does not focus solely on analysis of the beads, Smith et al. (1991:74) recorded the external diameter and aperture widths from the Witklip site and compared those to the nearby, contemporary assemblages from the sites of Kasteelberg A, B, and C.

Witklip is described as a small, granite rockshelter on the Vredenburg Peninsula in the South Western Cape of South Africa (Smith et al. 1991:71). The Witklip site was test excavated in 1987, and again in 1990 (Smith et al. 1991:71). The matrix consists mostly of a shell midden divided by thin layers of ash (Smith et al. 1991:72). Radiocarbon dating on charcoal samples range from 330 ± 45 BP for upper layers to 1860 ± 50 BP in lower layers (Smith et al. 1991:72). The comparison data was excavated previously, so the sites of Kasteelberg A, B and C are not described. The dates for the Kasteelberg sites are listed as ranging from c.100 BP to c.3000 BP (Smith et al. 1991:74-75).

Smith et al. (1991:74) measured the maximum diameter (after Jacobson 1987 a,b) and maximum aperture of 740 beads. Also published are the mean, range, standard deviation and statistical significance for each assemblage (Smith et al. 1991:74). The OES beads ranged from 3.3 to 11.2mm in diameter, with apertures ranging in mean from 1.6 to 3.0mm (Smith et al. 1991:75). Smith et al. (1991) separate the data not only by site, but also by approximate age.

Scatterplots and significance calculations both show noteworthy differences between earlier and later assemblages. In the case of Witklip, the assemblages were consistent with Jacobson's (1987 a, 1987b) findings, that OES bead diameter is greater in more recent assemblages. The mean external diameters of beads in the Witklip site decrease consistently as the age increases (Smith et al. 1991:75). OES beads from the Kasteelberg A and B sites however reveal the opposite pattern. The Kasteelberg data shows that more recent assemblages of OES beads have smaller diameters than those of earlier beads (Smith et al. 1991:75). The Witklip data therefore corresponds to Jacobson's (1987a:57) finding that bead diameters are smaller in earlier periods. The Kasteelberg data however, directly contrasts Jacobson (1987a, 1987b), by revealing larger beads in earlier periods (Smith et al. 1991:75). The Kasteelberg

C assemblage has only a single time period present and was not able to be analyzed in this way.

Smith et al. (1991:89) conclude that the cultural material from Witklip and Kasteelberg represents different ethnic groups rather than a single group with seasonal subsistence strategies.  Not only do the OES bead assemblages show significant differences, but there are also differences in the lithic toolkits, faunal assemblages and ceramic indexes (Smith et al. 1991:89).  Although not explicitly stated here as such, these ethnic groups are indicated to be the Khoekhoe and the San (Sadr et al. 2003:27; Smith et al. 1999:88-89). Smith et al. (1991:86) decide that Witklip represents a hunter-gatherer industry as it has a low number of potsherds, but a high incidence of flaked stone tools and small bovids. In contrast, Kasteelberg has few formal lithics, high numbers of ceramics and few small bovids, and it becomes classified as a herder industry (Smith et al. 1991:87). This would mean that the different ways in which OES beads change over time is linked to ethnicity.

I have a comment with the collection method of Smith et al. (1991). They write that 84 of their OES beads from Witklip site came when sorting matrix from 3mm mesh sieves (Smith et al. 1991:74). They further state that although 144 OES beads were recovered in total, only those from the 3mm sieves were analyzed (Smith et al. 1991:74). Their reasoning for this is that the comparative assemblages (in this case Kasteelberg A,B, and C) were likewise recovered with 3mm mesh sieves (Smith et al. 1991:71). The recorded bead diameters range from 3.3 to 11.2mm (Smith et al. 1991:75). While I understand the decision to match the quality of their comparison collections, I wonder what bearing this collection method would have on the data analysis. I also wonder if data from this study could be reliably compared to other assemblages.

The quality and depth of data analysis by Smith et al. (1991) is excellent, so I have only a few concerns. The analysis by Smith et al. (1991) mentions variables other than external diameters of the OES beads, unfortunately they do not go into any detail. They write: “the beads were mostly small, generally with single conical perforations, only a small number being completely reamed through. Some also bore traces of red pigment” (Smith et al. 1991:74). Smith et al. (1991) do not comment further on the number of beads with this red pigment, or whether other artifacts from the same levels had similar coloring. Also absent is an explanation of what the non-conical perforations were, what percentage of the total assemblage the conical perforations were or what “completely reamed through” refers to (Smith et al. 1991:74). It would be interesting to know whether these characteristics also vary between sites. Given that the research of Smith et al. (1991) covers a wide range of topics, I find their analysis of the OES assemblages to be complex and satisfying.

### *5.5 Yates 1995*

In a subsequent study, Yates (1995) is able to strengthen the findings of both Jacobson (1987a, 1987b) and Smith et al. (1991). This work is published as an appendix an article by Smith et al. (1995). It is apparent from the references list that Yates is a Master’s student who is studying this data for his thesis. Yates’

(1995) analysis played an integral part of the article. He analyzed data from Geduld, one of the sites previously analyzed by Jacobson (1987a, 1987b). Geduld is a cave site located on the north bank of the Ugab River, Namibia (Smith et al. 1995:4-5). Excavations took place between 1978 and 1986 under the direction of Jacobson (Smith et al. 1995:5). Stratigraphic sequences were intact with radiocarbon dates ranging from modern in the upper layer to 2300 ± 50 BP in the lowest layer (Smith et al. 1995:6).

OES beads were recovered from every level of excavation and were analyzed for changes around the hunting/herding threshold (Yates 1995:18). Overall Yates analyzed 239 complete and 65 incomplete OES beads using digital calipers (Yates 1995:17). Yates recorded maximum diameters and minimum apertures to the nearest tenth of a millimetre (Yates 1995:17). Based on the associated finds in each level, Yates divided the beads roughly into five assemblages. The first three assemblages (level one, level two to four, level five and six) include varying proportions of pottery and domestic animal bones (Yates 1995:17). The fourth assemblage (level seven) contains pottery but no domestic faunal bones, and the fifth assemblage (levels eight to 14) contains neither pottery nor domestic fauna (Yates 1995:17). The analyzed beads were compared between these five assemblages with the idea that they represent the transition from hunting and gathering to herding (Smith et al. 1995).

Yates concludes that there are statistically significant changes in OES bead maximum diameters and apertures by depth (Yates 1995:17). The mean maximum diameters for beads from the pre-pottery and pre-herding assemblage are 4.6 ± 0.8mm, 5.5 ± 0.8mm for the pre-herding assemblage, and 6.1 ± 0.9mm for the herding and ceramic assemblage (Yates 1995:17). Yates notes that the diameters remain large in the upper levels, although there is not the steady increase seen in the lower levels (Yates 1995:17). The aperture diameters also show corresponding changes with depth (Yates 1995:17). The mean minimum diameters of beads from the pre-herding and pre-pottery assemblage is 1.9 ± 0.3mm, 2.1 ± 0.3mm for the pre-herding assemblage, and 2.3 ± 0.3mm for the herding and ceramic assemblage (Yates 1995:19). Similar to the case for external diameters, the aperture diameters also stay larger in the upper levels, but do not show the same growth (Yates 1995:17).

The significant changes in both external and aperture diameters seem to correspond with the domestic faunal bones. This suggests that changes in bead size, at Geduld, may relate to the introduction of herding (Yates 1995). Yates confidently states that "Geduld indicates that the first changes in ostrich eggshell bead sizes throughout southern Africa can definitely be associated with the appearance of pottery. Geduld also reveals that the nature of the change may differ from region to region," (Yates 1995:17).

Yates analysis is empirical and statistically thorough. He describes his methods and findings in detail. It would have been nice to see whether there are more characteristics which change through time. The variables chosen were, of course, based on the previous work of Jacobson (1987 a, 1987b) and Smith et al. (1991), so Yates analysis for this article was understandably limited. He did an excellent job of analyzing the selected characteristics. I draw from this work by Yates (1995) in my own analysis.

### *5.6 Smith et al. 2001*

The next article is a continuation of the work by Smith et al. (1991, 1995). Having established the different cultural characteristics between hunter-gatherer and herder sites, Smith et al. (2001:23) explore whether the same variation exists adjacent the previous study area. Furthermore, Smith et al. want to test whether these characteristics can be used as evidence of site integrity at open air sites (2001:23).

For this study Smith et al. (2001) examined the site of Bloeddrift 23. Bloeddrift 23 is located on a river terrace above the Orange River, in the Northern Cape province of South Africa (Smith et al. 2001:24). The present location is approximate 300m from the river, and a radiocarbon sample returned a date of 355 ± 15 BP (Smith et al. 2001:24).

This study makes a brief comparison to data from Jakkalsberg. The Jakkalsberg site is, like Bloeedrift 23, an open air site (Smith et al. 2001:23). It is located approximately 30 kilometres upstream from Bloeddrift (Smith et al. 2001:23). The comparison data from Jakkalsberg was collected previous and the site is not described in this article. Due to the open nature of these sites and their close proximity to the river, it is unclear whether they represent a single, undisturbed occupation or overlapping successive re-occupations (Smith et al. 2001:24).

The data recorded by Smith et al. (2001) was obtained by mapping and measuring surface artifacts and features from Bloeddrift 23 *in situ*. No finds were collected or removed from site. Selected artifacts and features such as hearths, OES beads, manuports and decorated pottery were individually plotted, sketched and/or measured (Smith et al. 2001:25).

Overall, Smith et al. recorded 153 OES beads and 806 OES fragments (Smith et al. 2001:26). Four of these OES fragments are believed to be from water containers (Smith et al. 2001:26). Of the 153 beads, 126 were measured for maximum diameter and minimum aperture width with digital calipers (Smith et al. 2001:26). The maximum diameters ranged from 3.4 to 11.8mm (Smith et al. 2001:26). The mean diameter of the assemblage is 7.6 ± 1.6mm, and the mean aperture is 2.6 ± 0.6mm (Smith et al. 1991:26). This mean diameter would place the OES beads into the range that previous studies attributed to a herding occupation (e.g. Smith et al. 1991, 1995).

For the Jakkalsberg site, it is unclear whether Smith et al. (2001) made their own analysis or used data from a previous publication. The 375 OES beads from Jakkalsberg have a range in diameter of 2.6 to 10mm, with a mean between 5 and 6mm (Smith et al. 2001:32). Jakkalsberg has over 20% of beads in its assemblage smaller than 5mm in diameter, while Bloeddrift 23 shows only 4% (Smith et al. 2001:32). Based on the previous research, the Jakkalsberg site should be older than the Bloeddrift 23 site.

Ultimately, Smith et al. (2001) conclude that Bloeddrift is a generally intact, herder site. Due to its location on the river terrace, the edge of the site is being eroded and gradually washed into the river by floodwaters (Smith et al. 2001:24). Evidence of the site's integrity comes partially from the presence of 13 hearth features (Smith et al. 2001:26). Smith et al. (2001:29) write that the ash contained in the hearths was intact suggestion they became recently exposed from erosion. The fact that these hearths were found on the same horizon adds to the argument that they were contemporaneous (Smith et al. 2001:29). Analysis of the hearth layer shows a lack of formal lithic tools, abundance of small to medium sized bovids, significant numbers of potsherds, and OES beads with diameters larger than 5mm (Smith et al. 2001:32). Smith et al. (2001:32) suggest that Bloeddrift is mainly a herder site, with hunter-gatherer artifacts scattered around the periphery.

One of the most interesting parts of the article by Smith et al. (2001) is its interpretation of the number of strings the recovered beads came from. Smith et al. (2001:28) used two ethnographically collected strings of OES beads to experimentally test how well a bead maker can control bead diameter. The first strand of beads was two metres long and contained approximately 1200 beads (Smith et al. 2001:28). From this string, 138 beads were chosen at random and measured for their maximum diameter (Smith et al. 2001:28). The second string contained 57 beads, all of which were measured (Smith et al. 2001:28). It is assumed that each string was either created by a different artisan or by the same artisan at two separate times (Smith et al. 2001:28).

Using size grades of 0.25mm increments, Smith et al. (2001:31) graphed the diameters for each string. The graph shows that the beads from each string are quite tightly clustered around particular size classes. Smith et al. (2001:28) describe that, given this evidence, a bead maker "can control over 75% of the outside diameter of the beads to within 0.5mm, and over 92% to within 1mm". With this reasoning, any beads that have diameters which are different by several millimetres must have been made on different strings (Smith et al. 2001:28). Ethnographic descriptions of manufacture methods are described in Chapter 4. Smith et al. conclude that "one third of the beads from the site could come from a minimum of two strands," (2001:28).

This article by Smith et al. (2001) is the necessary next step in OES bead analysis. The previous articles with Smith as the lead author (Smith et al. 1991, 1995) established a regional sequence, and this article explores how this data can be used in new ways. Although this article does not focus entirely on the OES beads, I appreciate how it uses the beads in conjunction with the other site data such as ceramic, faunal, and lithic analysis. I consider my own research to be influenced highly by the works of Smith et al. (1995, 1999, 2001).

### *5.7 Sadr et al. 2003*

In 2003, Sadr et al. (2003) published an article testing the conclusions of Smith et al. (1991). Their research goal was to see if Smith et al.'s (2001) findings would hold up in a group of sites more tightly clustered in time and space (Sadr et al. 2003:28). The data for this analysis is based on excavations of six sites near Kasteelberg (Sadr et al. 2003:27). Rather than an attack on the previous findings, this article appears to be a continuation of the research; two of the original authors of the 1991 article (Andrew Smith and Karim Sadr) are also authors of this one.

Sadr et al. (2003) re-evaluate the previous findings that Witklip and Kasteelberg represent hunter-gatherers and herders respectively. Their main concern with the previous work is that the sites analyzed by Smith et al. (1991) were scattered over a large geographical range and "at least three and a half millennia," (Sadr et al. 2003:27-28). Sadr et al. (2003:28) write that this seemed appropriate at the time, but more recent studies show unexpected variability among local LSA sites. In this study, Sadr et al. (2003) consider evidence from lithics, ceramics, faunal bones, OES beads and radiocarbon dates.

Six sites were excavated on the Kasteelberg Hill, South West Cape (Sadr et al. 2003:28). The hill reaches a peak elevation of 50m, and the sites are all with 400m of one another (Sadr et al. 2003:28). All sites contain deposits dating to at least 1000 AD (Sadr et al. 2003:28).

Sadr et al. (2003) agree with Smith et al. (1991) that there are indeed two sets of unique assemblages. The presumed hunter-gatherer assemblages have dramatically more lithics and less potsherds than the presumed herder assemblages (Sadr et al. 2003:28-29). The supposed hunter-gatherer artifacts show a greater variety of formal tool types, lending further credence to the division (Sadr et al. 2003:29). There are also significant differences in the evidence of faunal resources. The expected herder assemblages have a higher incidence of marine resources such as seal and marine shell, while the hunter-gatherer assemblages have a higher incidence of terrestrial resources, such as steenbok and bovid (Sadr et al. 2003:30).

The re-analysis of the OES bead diameters by Sadr et al. (2003) reveals interesting results. Reconstructing the average bead diameters for Smith et al. (1991), Sadr et al. (2003:31) concluded that the average measurements were all within a generally consistent range of between 6 and 7mm. However, the pre-ceramic layers of the six newly excavated sites reveal average OES bead diameters of less than 5mm (Sadr 2003:31). Sadr et al. (2003:31) write that this indicates that differences in diameter are reflective of change over time, rather than differences in cultural practices.

While there are significant differences between the two assemblage types, there is also a striking similarity. An intensive faunal analysis shows the presence of domesticated stock at all of the newly excavated sites (Sadr et al. 2003:28-29). This would be expected with the proposed herder assemblages; however, domestic faunal remains in the proposed hunter-gatherer assemblages would be categorically inconsistent. This evidence is in conflict with the findings by Smith et al. (1991) that one assemblage represents an occupation of hunter-gatherers.

The Witklip and Kasteelberg assemblages are concluded to represent herder-forager adapted cultural groups (Sadr et al. 2003:27). Witklip is decided to be a transient camp of mobile herders and foragers who focused on terrestrial resources, while Kasteelberg represents a more sedentary camp of herders and foragers who relied on marine resources (Sadr et al. 2003:31).

Sadr et al. (2003) conclude their article by explaining that the interpretation of differences between the sites is ongoing. They are still unclear about the relationship between the people at the inland and marine oriented sites (Sadr et al. 2003:31). Sadr et al. (2003:31) offer that these people were divergent groups perhaps related through trade, that the sites represent seasonal variants of the same community or even the evolution of lifeways of a single group. They do however seem confident in their statement that “there are no clear stylistic differences between the ceramics or ostrich eggshell beads in these two sets of sites to suggest they were occupied by people of different cultural groups,” (Sadr et al. 2003:31).

*5.8 Orton et al. 2005*

To extend the geographical range of this research even further, Orton et al. (2005) studied sites in the Northern Cape, South Africa. The purpose of this study was to identify whether the patterns identified by Smith et al. (1991) and Sadr et al. (2003) can be found in the Namaqualand coast (Orton 2005:24).

Orton et al. (2005) focus their study on two sites: Rooiwal Hollow (RH) and Rooiwal Midden (RM). These are both open air, midden sites approximately 300m from the shoreline, excavated as part of a cultural resource management program (Orton et al. 2005:24). RH has four distinct areas which are radiocarbon dated to between 1895 BP and 2060 BP (Orton et al. 2005:25). RM, located slightly east of RH, radiocarbon dates to 580 BP (Orton et al. 2005:27). This site appears to consist of a single occupation (Orton et al. 2005:27).

Excavations of the sites yielded comparable, but contrasting, material. The midden portion of RH consisted of at least 10 species of shellfish (Orton et al. 2005:25). Based on the variable weathering and content of the shellfish deposits, Orton et al. (2005:25) are able to identify three separate occupations at RH which are similar in age but were not concurrent. The RH faunal remains also suggest three occupations based on rock lobster mandible sizes (Orton et al. 2005:25). The lithic assemblage of RH is dominated by quartz and cryptocrystalline silica, and the typological classification implies that they are all from the same industry (Orton et al. 2005:26). In contrast, the RM site revealed highly fragmented shellfish remains with at least seven species present which appear to be from a single occupation (Orton et al. 2005: 28). Analysis of the rock lobster mandibles at RM shows a wider range of sizes (including larger sizes) than those at RH (Orton et al. 2005:28). This suggests a different collection strategy, and thereby a different reliance, on these marine resources between sites. The lithic assemblage at RM is high in quartz but lacks the cryptocrystalline silica component seen in RH (Orton et al. 2005:28). Despite the differences in raw material, the lithic industries from the two sites are "surprisingly similar" (Orton et al. 2005:298). The final difference in assemblages is pottery, which is present at RM but absent from RH (Orton et al. 2005:29).

A total of 256 OES fragments and 28 OES beads were recovered from the two sites (Orton et al. 2005:27-29). The five beads recovered from RH have a mean external diameter of 3.78mm and a range of 3.3 to 4.2mm (Orton et al. 2005:27). The mean aperture diameter is 1.60mm with a range of 1.15 to 1.90mm

(Orton et al. 2005:27). While there was no evidence of onsite manufacture, there were 254 pieces of unmodified OES recovered, four of which appear to be from the mouth of OES flasks (Orton et al. 2005:27). Orton et al. (2005:27) demonstrated that the density of unmodified fragments was not high enough to be from an ostrich nest scatter, concluding it was likely brought to the site by human activities. Of the 23 beads recovered from RM, 21 were intact enough to have measurements recorded (Orton et al. 2005:29). The mean external diameter is 5.70mm with a range of 4.35 to 7.95mm (Orton et al. 2005:29). The mean aperture diameter is 2.08mm with a range of 1.65 to 3.25mm (Orton et al. 2005:29). These differences in external diameter correspond well with the radiocarbon dates for each site; the smaller beads are from the earlier occupation(s), while the larger beads are from the later. It also supports the faunal, ceramic and lithic analysis which suggest distinct but closely related time periods.

Orton et al. (2005:29) conclude that due to the small number of researched sites on the Namaqualand coast, they cannot assess whether or not the previous findings of Smith et al. (1991) and/or Sadr et al. (2003) apply. RM and RH appear to fall into both the hunter gatherer and herder categories of the previous studies. The range of OES diameters from the RM site would fall into Smith et al.'s (1991) range of hunter gatherer beads (Orton et al. 2005:30). It is implied however from the pottery present and the radiocarbon date of the RM assemblage that it is more likely from a herder occupation. The faunal remains do not lend themselves to the conclusions by Sadr et al. (2003), as there are a high number of seal bones at RM, but an equal proportion of bovid remains at each site (Orton et al. 2005:30). The lithic assemblages indicate that there was no abrupt change in lithic technology with the introduction of herding practices (Orton et al. 2005:31).

While this article by Orton et al. (2005) is ultimately inconclusive, it exposes that the patterning of OES beads is far from being well understood. By testing the findings of Smith et al. (1991) and Sadr et al. (2003), this article is working towards an understanding of the variability in diameters. I hope to continue in the spirit of this research with my analysis of OES beads from Mlambalasi.

### *5.9 Kandel and Conard 2005*

Kandel and Conard's 2005 article creates a method for analyzing the manufacture of OES beads as a way to evaluate an assemblage. They introduce the term *production value* describing it as "a heuristic term...to quantify the degree to which a group of beads has reached the endpoint of manufacture," (Kandel and Conard 2005:1713). The scale of production values ranges from zero, a possibly unmodified piece of OES, to 12, a finished, broken bead (Kandel and Conard 2005:1713). The production values alternate between broken and unbroken artifacts. For example, Stage three is described as a "complete, partially drilled blank", and Stage four as a "broken, partially drilled blank" (Kandel and Conard 2005:1714). Their reason for creating this analysis is Jacobson's (1987a) premise that recovery of particular production stages relates to site activities and length of occupation (Kandel and Conard 2005:1713). If Jacobson's model is correct, production value should be related to other analysis such as lithic, faunal and ceramic (Kandel and Conard 2005:1715).

Kandel and Conard (2005) apply their production value analysis to data from the Geelbek Dunes of the Western Cape, South Africa. The Geelbek Dunes of today are highly mobile sand dunes, however in the past this area was far more stable and was covered in a "low, scrubby brush," (Kandel and Conard 2005:1711). Twenty-three sites were excavated revealing deposits which range from MSA to modern (Kandel and Conard 2005:1711). These sites are all open-air localities (Kandel and Conard 2005:1715).

Overall, 1045 OES beads from seven sites were analyzed. Of these, 277 were completed beads (Kandel and Conard 2005:1716). In addition to the production value, Kandel and Conard (2005:1715) recorded a minimum of 14 other attributes of each completed OES bead, although most of this data is not published here. The mean external diameter of the finished beads is 3.16mm, with a maximum diameter range from 3.8 to 7.8mm (Kandel and Conard 2005:1716). The mean aperture diameter for the finished beads is 1.55mm (Kandel and Conard 2005:1716).

Production values were calculated for four of the seven sites (Kandel and Conard 2005:1716). The other three sites had fewer than 10 OES beads each, and were not considered to be statistically relevant (Kandel and Conard 2005:1716). The sites of Pottery, Shelly, Nora and Toaster yielded production values of 9.08, 6.26, 3.91 and 7.82 respectively (Kandel and Conard 2005:1716-1717).

Six OES beads were sampled for radiocarbon dating. Surprisingly, the largest bead tested (7.40mm external diameter) returned the oldest date of 3,670 ± 30 BP (Kandel and Conard 2005:1719). While this falls within the hunter gatherer range reported by Smith et al. (1991), it opposes the findings of Jacobson (1987a, 1987b) and Yates (1995). This once again demonstrates that more research into OES bead diameters is needed.

Kandel and Conard (2005) conclude their article by saying that analysis is still underway. Some initial lithic and faunal analysis supports Jacobson's model of site activity and intensity; other analysis seems to oppose his model (Kandel and Conard 2005:1720). Kandel and Conard (2005:1720) do say that the small beads (less than 5mm external diameter) are associated with pre-pottery, hunter-gatherers. It is unclear however who created the large OES beads, although at least one (the 7.40mm diameter, radiocarbon dated bead) was also made by hunter-gatherers (Kandel and Conard 2005:1720). Kandel and Conard (2005:1720) write "these results indicate that the chronology of small vs. large beads cannot be viewed as universal,". More research is required to understand the variability among OES beads.

### *5.10 Orton 2008*

In 2008, Orton published an article which refined Kandel and Conard's (2005) production stages for OES beads. In this article he notes the various ethnographic bead making strategies, and incorporates them into a comprehensive scheme. Orton distinguishes his stages from Kandel and Conard's (2005) by using roman numerals rather than numbers (2008:1766). There is an important difference between Kandel and Conard (2005) and Orton's (2008) production stages. This difference is that Orton (2008) describes alternative pathways for bead manufacture. Pathway one beads are perforated prior to having their outer diameter shaped (Orton 2008:1766); Pathway two beads are shaped into circular forms before having the aperture drilled (Orton 2008:1766).

There is a distinction between the number of production stages in Kandel and Conard (2005) and Orton's (2008) systems. While Kandel and Conard outline 12 production stages (2005), Orton (2008:1766) developed seven stages with the first being a "modified OES fragment" and the last was a "completely ground" bead. Rather than alternating between broken and unbroken beads, Orton leaves them as the same stage, followed by either an "a" for unbroken, or "b" for broken (Orton 2008:1766). Orton's (2008) work incorporated a new stage not included by Kandel and Conard (2005). Stage VIa and VIIb are described as having their external edges "partly ground" (Orton 2008:1766). This stage exists somewhere between Kandel and Conard's Stages 9 and 11.

Orton (2005) applies his production stages, along with traditional OES bead analysis, to five bead rich sites in the Northern Cape of South Africa. Three of the sites (Jakkalsberg L, M, and N) are located within the floodplain of the Orange River, northwestern Richtersveld (Orton 2008:1770). This is the same area discussed above in a study by Smith et al. (2001). All three are open air sites, with radiocarbon dates ranging from 4,500 to 1,740 BP (Orton 2008:1770). The remaining two sites (KN2005/067 and SK2005/057A) are located on the

Namaqualand coast, south of the Jakkalsberg sites (Orton 2008:1770). Both are open air sites, and currently undated (Orton 2008:1770). KN2005/067 is located north of the Swartlintjies River, while SK2005/057A is located south of the Buffels River (Orton 2008:1770). Each of these five sites are described as bead factories (Orton 2008:1770).

A total of 2,065 OES beads were analyzed from the five sites. The external diameter for completed beads ranged from 2.80 to 7.05mm (Orton 2008:1773). The three sites with radiocarbon dates showed a change in external diameter, with smaller beads being older (Orton 2008:1773). By far the largest number of recovered beads were broken during manufacture, and left unfinished (2008:1771). There are relatively few beads present in the initial stages of manufacture, and only one site (KN2005/067) showed evidence of Pathway 2 manufacture (Orton et al. 2008:1771).

Orton makes several interpretations using the OES bead data. The five sites vary between long term and short term sites, but all have evidence of bead manufacture (Orton 2008:1771). This is in opposition to Jacobson's (1987a) model of bead manufacture and site intensity. Orton (2008:1771) suggests that unfinished beads may have been taken from place to place, to be completed when there was time. This would mean that OES bead manufacture could potentially take place at any site where people had spare time. Orton also notes that large beads are present in assemblages, but in small numbers and only in completed form (Orton 2008:1771). With no early production stages evident, Orton (2008:1771) believes that the low frequency of large beads means they may have been acquired through an infrequent trade partner. He also writes about the size of OES beads during their early stages of manufacture. The JKB N site has larger and more variably sized blanks, while JKB M has smaller and more consistently sized pieces (Orton 2008:1771). He suggests that these differences may relate to the skill of the bead maker, with the larger blanks allowing for more error during drilling and shaping (Orton 2008:1771).

While I consider Orton's (2008) article a prime example of OES bead analysis, he does not actually come to any conclusions. He instead has a balance of analysis and interpretation. His descriptions of manufacture stages are clear and thorough, and he explains the importance of each. His tables and figures are empirical and well presented. Rather than focusing on what the OES bead analysis reveals about the particular sites sampled, he uses his analysis towards the creation of new interpretations. I appreciate that Orton (2008) is trying to provide future OES bead researchers with new tools for analysis. I draw strongly from this article in my own research.

### *5.11 Wang et al. 2009*

The final article I will summarize is unlike the previous works based on its geographic focus. While the previous research was conducted on OES beads from Africa, the article by Wang et al. (2009) analyzes beads from China. They use the traditional OES bead analysis, as outlined above, in order to assess their assemblage. While they didn't provide any advancement in the analysis of OES beads, their article provides evidence that this analysis is applicable outside Africa.

The site analyzed by Wang et al. (2009) is Shuiddongo (SDG), located near the junction of the Yellow River and the Great Wall. SDG was excavated between 2003 and 2008 by the Institute of Vertebrate Palaeontology and Palaeoanthropology from the Chinese Academy of Sciences and Ningxia Provincial Institute of Archaeology (Wang et al. 2009:3887). The upper layers of sediments at the site have been OSL dated to 12,000 ± 1,000 BP (Wang et al. 2009:3893). This date is slightly older than the African OES beads which were discussed above.

In total, Wang et al. (2009:3891) analyzed 109 OES fragments, four of which were completed, unbroken beads. All fragments appear to correspond to Pathway 1 manufacture, with the aperture being drilled prior to the outer shaping (Wang et al. 2009:3891). Most stages of manufacture were present, with 50% of the assemblage being Stage I (Wang et al. 2009:3891). Wang et al. (2009) recorded the external and aperture diameters of the assemblage. The external diameters of Stages IVa to VIIb range from 1.52 to 3.74mm (Wang et al. 2009:3893). The aperture diameters for the same stages ranged from 0.62 to 2.32mm (Wang et al. 2009:3893).

An intriguing part of the article by Wang et al. (2009) is its discussion of the direction of perforation. Other authors mentioned that perforating drilling often takes place from the inside of the OES (e.g. Plug 1982; Kandel and Conard 2005; Orton 2008), however they went into no further detail of why this may be the case.  Wang et al. (2009) analyzed the microstructure of OES and performed experimental drilling.  As demonstrated in their scanning electron microscope photos, the outer surface of an OES is relatively uniform, making it slippery (Wang et al. 2009:3890-3891).  The inner surface of an OES however is composed of softer material, and has regular indentations rather than a smooth surface (Wang et al. 2009:3890).  In their experimental drilling, Wang et al. (2009:3890) discovered that the drill was more likely to slip, and more likely to break the OES upon perforation when drilled from the outside rather than the inside.  They conclude that early humans must have learned this through experimentation, and chose to drill from the inside to minimize breakage (Wang et al. 2009:3890).

Perhaps the most interesting part of Wang et al.'s (2009) analysis was marred by their data presentation.  Most of the discussion of OES beads at African sites has revolved around the maximum external diameters of the finished beads, and how they differ through time and from site to site.  Unfortunately, Wang et al. (2009) did not publish the diameters of finished beads.  Instead, due likely to the low number of finished beads, they grouped their mean external diameters and reported Stages V, VI and VII together (Wang et al. 2009:3893). For unexplained reasons, they report the means of Va, VIa and VIIa together, and Vb, VIb and VIIb together.  This makes it impossible to compare their findings to those in Africa as the standard is to report only Stage VIIa.  Interestingly, while the inclusion of unfinished beads likely skews the results larger than they should be, the means are still significantly smaller than those reported from African sites.

This could be related to the OSL date of 10,000 BP, but without standardized data it will be impossible to make connections with African assemblages. Wang et al. (2009) conclude that the knowledge gained from this study adds to the understanding of the culture at the SDG site.

### *5.12 Summary*

These 12 published works reviewed above cover the previous research and methods of OES bead analysis. It is not yet understood why OES beads vary through time and by region, although it has become clear that they do. The most commonly analyzed characteristic of OES beads is the external diameter. In southern Africa over the last 3,000 years, there is a general trend of smaller bead diameters from older sites/levels, and larger diameters from younger ones. This has yet to be tested on assemblages from other regions, or other time periods. Hopefully, my research can help expand the published datasets, thereby contributing to an understanding of the use of OES beads and their role in the evolution of modern behaviour.

# Chapter 6: Fieldwork and Methods

The following chapter outlines the collection and analysis of data for my thesis. The excavation which yielded the bulk of my data was conducted in the summer of 2010. All analysis took place at the University of Alberta between 2010 and 2012, with the collections generously provided on loan from the Division of Antiquities, Ministry of National Resources and Tourism, Government of Tanzania. In this chapter I provide a summary of the fieldwork which obtained the beads, and an outline of the characteristics used in my analysis. A table of raw data can be found in Appendix A, and a photographic record can be found in Appendix B.

## *6.1 Fieldwork Background*

Mlambalasi (or HwJf-02) is a granite rockshelter located approximately 50 kilometers west of Iringa City on the road to Ruaha National Park, in the southern highlands of Tanzania. This rockshelter is locally known as the place of the last stand of Chief Mkwawa, 19$^{th}$ century leader of the Wahehe, who avoided capture from the German army by hiding out and eventually killing himself at the site in 1898 (Willoughby 2009:308). A memorial to Chief Mkwawa is found below the cliff which the rockshelter sits on.

The site was first shown to Dr. Willoughby in 2005 by the District Cultural Officer for Iringa Rural, Ms. Joyce Nachilima (Biittner et al. 2007:63; Willoughby 2009:308). Dr. Willoughby began her research in Iringa with the intention of documenting MSA and LSA archaeology in a series of rockshelters and open air sites.  An initial surface survey of Mlambalasi showed evidence of Later Stone Age and Iron Age artifacts under the shelter, with Middle Stone Age artifacts on the southwest slope.  This seemed a very promising location for Dr. Willoughby to meet her goals.

In 2006, Dr. Willoughby and her graduate students returned to excavate two test units at HwJf-02, one under the shelter and one on the southwest slope (Biittner et al. 2007:62).  Unfortunately, the stratigraphy of the test unit on the slope was not intact, and it appeared that erosion was responsible for the jumble of MSA, LSA and Iron Age artifacts.  The unit excavated under the covered portion of the shelter however revealed well stratified deposits.  Dr. Willoughby and her team identified a sequence of Iron Age, microlithic LSA and macrolithic LSA layers with good organic preservation (see Figure 6.1).  Also recovered from the test unit under the shelter were human remains.  These remains were determined to be from the lower half of a single individual, perhaps representing an intentional burial (Biittner et al. 2007:64).

After completion of the 2006 field season, it was learned that a previous test excavation had been conducted at Mlambalasi by Dr. Paul Msemwa in 2002. Dr. Msemwa is the current Director of the National Museum in Dar Es Salaam. The intact stratigraphy of the 2006 test unit, and a photo of the 2002 test unit (Msemwa 2002:11), suggested that the two excavations had not overlapped, but were likely very close to each other.

Dr. Willoughby planned a 2010 field season at HwJf-02 for further excavation.  I had the opportunity to join her project, which became named the

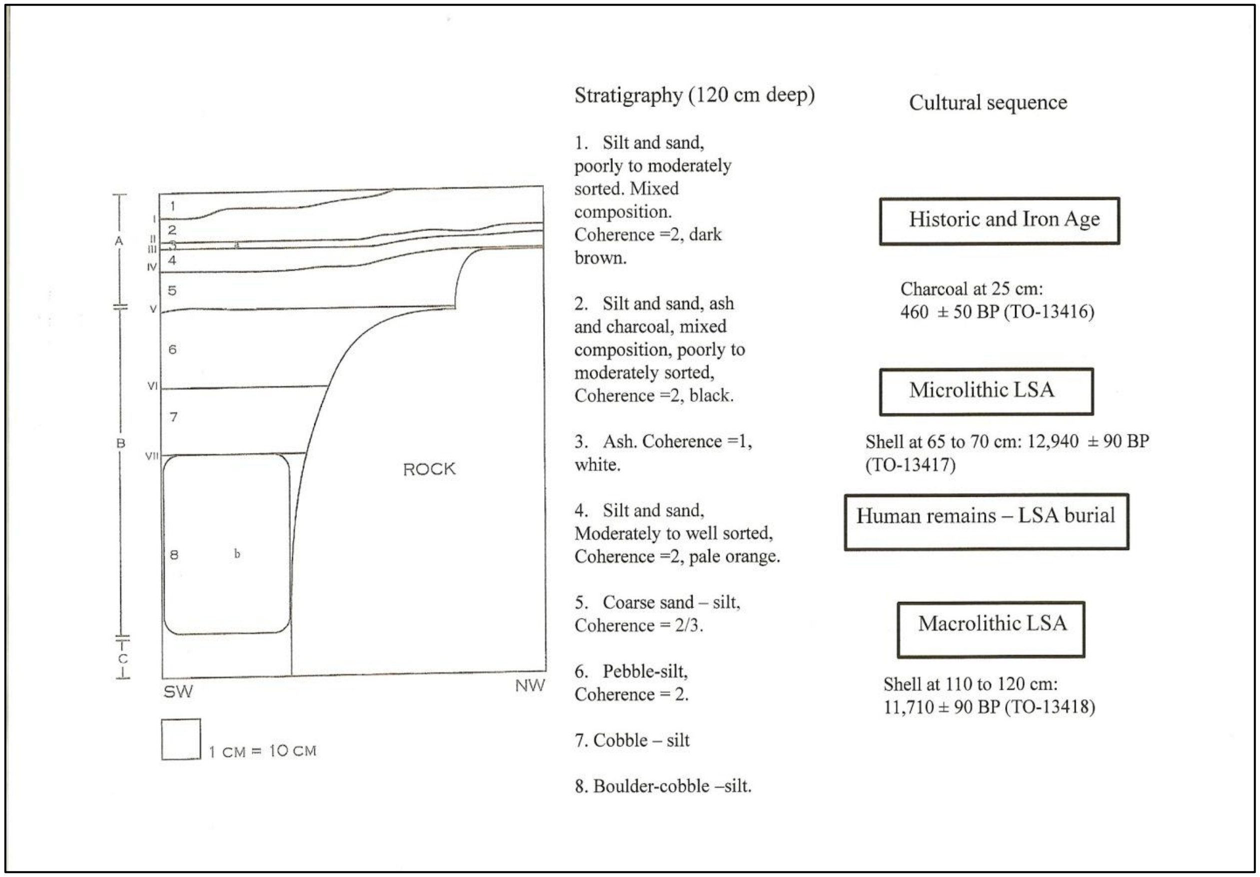


Figure 6.1. Stratigraphic profile from 2006 excavations at HwJf-02, image by K. Biittner.

Iringa Region Archaeological Project (IRAP). The focus of the 2010 excavation was to recover the upper portion of the human remains found in 2006, and to determine how the 2002 and 2006 test pits relate to each other. My personal goal was to find more of the OES beads (only two of which were recovered during the 2006 season).

*6.2 2010 Fieldwork*

The IRAP team arrived at HwJf-02 on July 8, 2010. A site datum was established at UTM 36797668E 9139529N (7°46.447 S, 35°41.997 E). Over the next few days, the rockshelter was mapped (Figure 6.2) and an excavation grid was laid out with the help of a total station. Twenty one-metre square units were identified, under the rockshelter overhang, as being suitable for excavation.

Excavations began on July 10, 2010 when three 1 metre square units were opened (shown in yellow in Figure 6.2). Our team decided to use a checkerboard pattern for the units, so excavators would have enough room to work without crowding from adjacent units. Due to the soft matrix, on July 24, 2010 we halted excavation of the three units and opened three adjacent units (shown in blue in Figure 6.2) to create a two by three metre trench. This helped to stabilize the unit walls and prevent accidental collapse.

Levels were excavated in arbitrary 10cm spits, with depths measured by the totalstation. The use of arbitrary levels was determined to be the best excavation strategy as there is very little difference in sediment texture and colour

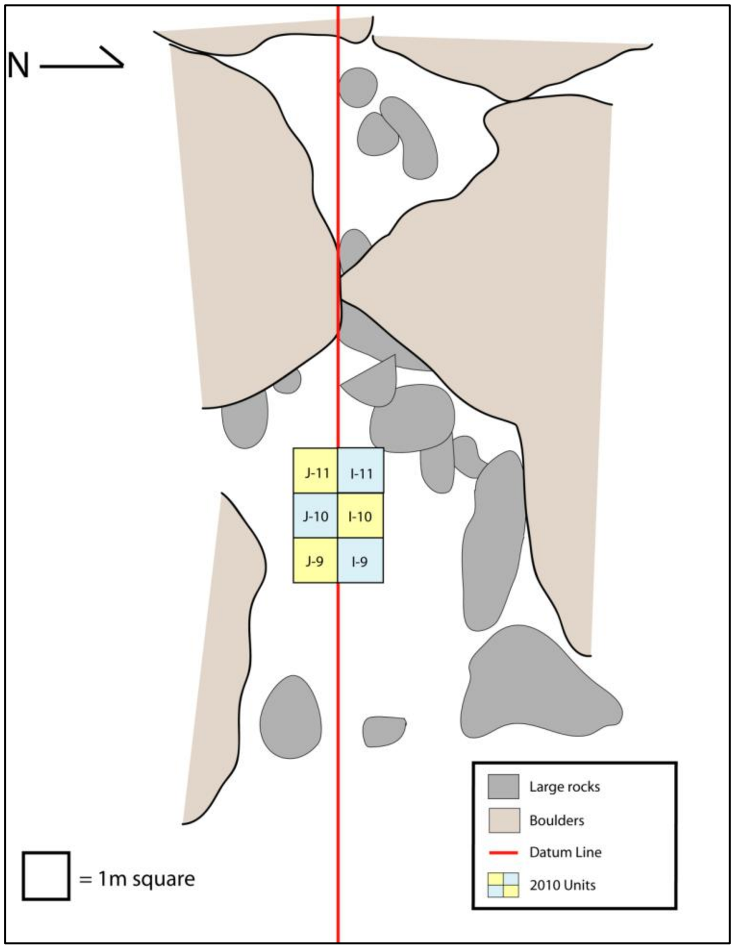


Figure 6.2. Map of HwJf-02 with 2010 excavation units.

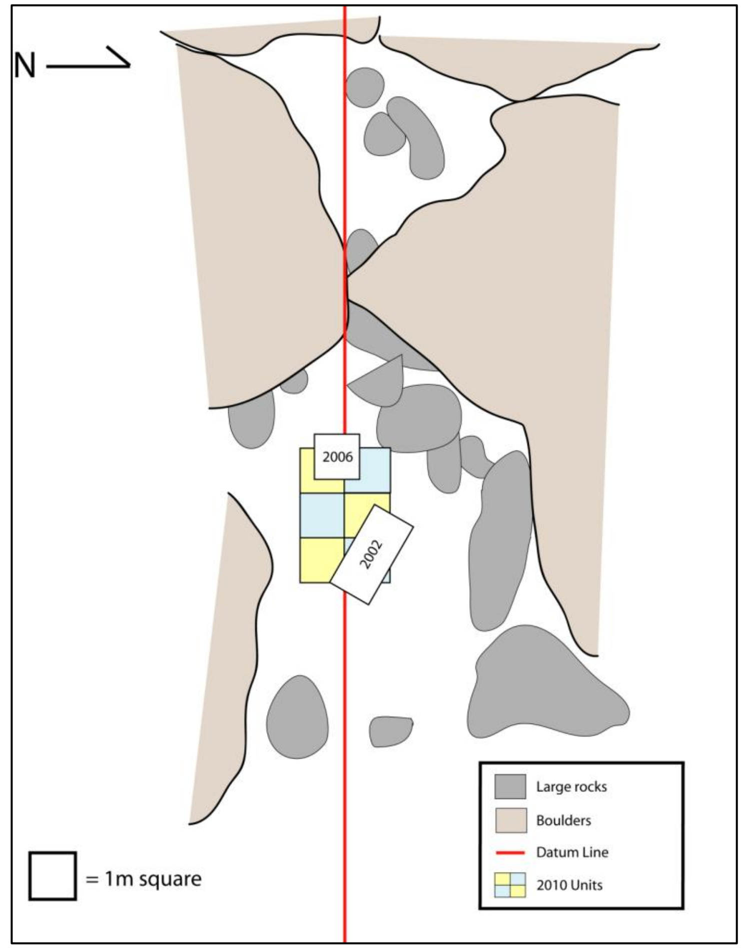


Figure 6.3. Map of HwJf-02 with locations of 2002 and 2006 excavation units.

between levels. Each level of a unit was divided into quadrants (northwest, northeast, southwest, southeast). The finds from each quadrant were sorted and collected separately. This was done to give a finer resolution for recovered data. The matrix was very soft and unconsolidated, and the depth in relation to the site datum was easily altered by the bodyweight of the excavator(s). It is unlikely that the division of levels is precise, but they give a rough estimate of the relative depths of finds.

Initially, all matrices were put directly into *karai* (metal headpans) for hand sorting. Our team quickly recognized that screening the matrix would make it easier to do a thorough sort, and to recover small finds. From the second day onwards, all matrix was sifted through a 1mm screen prior to sorting in *karai*. While a slightly larger mesh, or a set of nested screens, would have been preferable, the onemm screen was the only one available from the market in Iringa.

*6.3 Previous Test Units*

As mentioned above, one of the goals of the 2010 field season was to locate the two previous test units. Both Msemwa's 2002 and Willoughby's 2006 test units were re-identified, based on differences in sediment colour and density (see Figure 6.3). Where possible, the disturbed and undisturbed sediments were excavated and sorted separately. A stratigraphic profile of the 2010 excavation is provided in Figure 6.4.

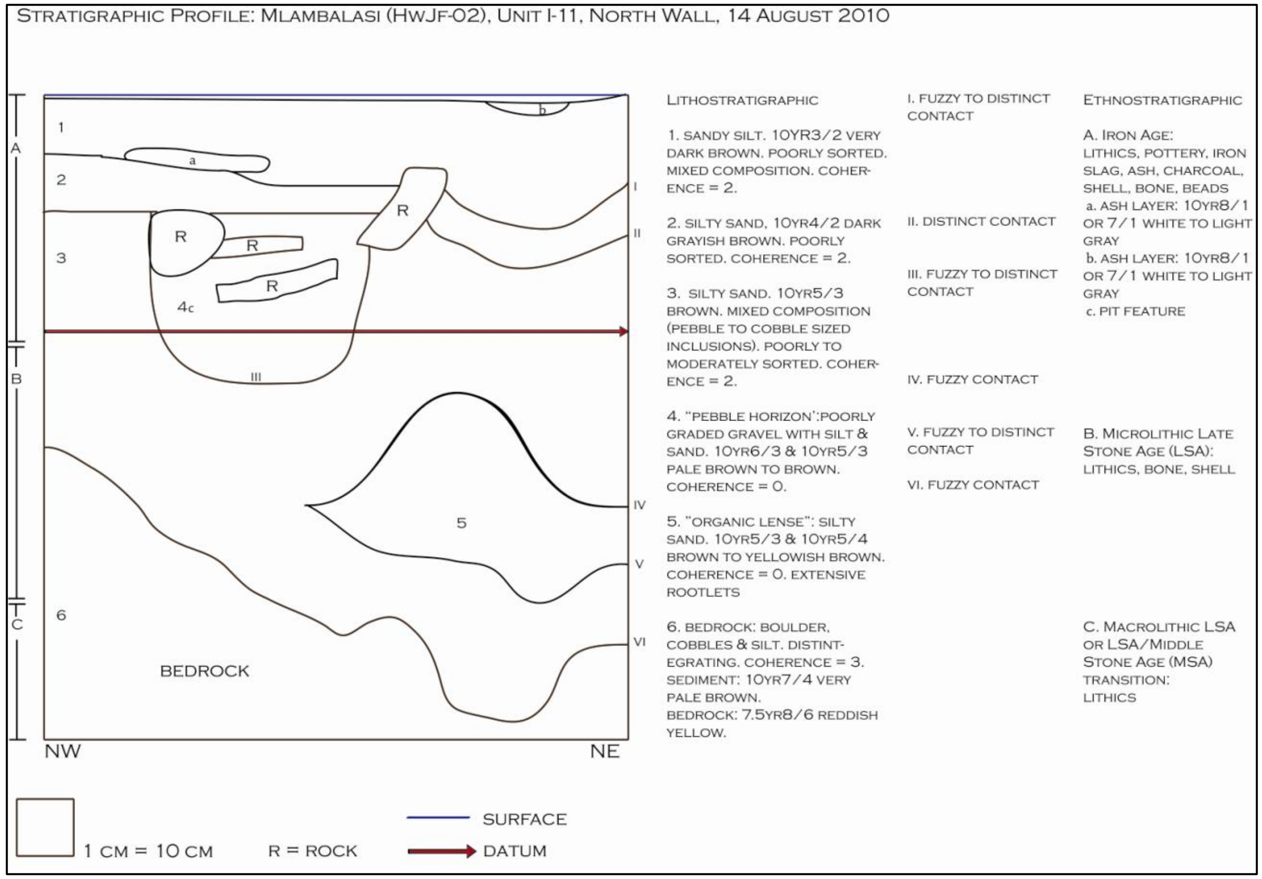


Figure 6.4. Stratigraphic profile of HwJf-02 from 2010 excavations, image by K. Biittner.

Disturbed matrix from the 2002 test pit was identified in units I-9, J-9 and I-10. Excavators noted loose sediment with fewer finds as evidence of backfill. Unit I-9 was determined to be almost entirely disturbed, and all finds should be considered to be from a disturbed context until 73cm below surface. A distinct portion of unit J-9 was identified to be the edge of the 2002 unit, and finds from that portion were collected separately. Finally, the exact edges of the previous unit were not determined in unit I-10, however the excavators estimate that the northeast and southeast quadrants are disturbed, and thus finds from these do not have a reliable depth. Marking the bottom of the 2002 test unit were modern materials, notably plastic water bottles, food remains, paper and string. The water bottles, interestingly the same brand used by our team (Maji Africa), were date stamped indicating production in April 2002. This was taken as verification that the 2002 test unit had been reliably located.

The 2006 unit was identified in units I-11 and J-11. The majority of J-11 consisted of disturbed sediment from the previous test pit, which was identified within the first 10cm of excavation. Identification was made possible through a colour change of 10YR 5/2 to 10YR 4/2 for the disturbed and intact matrix respectively. In addition to the colour differentiation, there was a distinct different in the density of the matrix. The 2006 backfill was very loose and unconsolidated, while the intact matrix was much more dense and tightly compacted. The 2006 unit, based on its 1m square dimension, should have extended approximately 10cm into the southern portion of unit I-11. This disturbance was not evident in unit I-11 until 40cm below surface, when an otherwise pervasive rocky horizon was suspiciously absent. At that depth, excavators began separating finds based on intact versus disturbed stratigraphy. Finds from the southwest and southeast quadrants of unit I-11 from Surface to Level 5 should be analyzed carefully, as they may not have reliable depth.

It was expected that, in addition to disturbed sediment, previous units would be indicated by few or no artifactual finds. This was not the case. While we were able to locate both previous units, significant finds were recovered from each. We later learned that the 2002 excavation collected only a sample of the artifacts encountered, so recovering finds from that unit was not unexpected, however the numerous finds from the 2006 test unit were startling. The 2006 unit was expected to have contained very few finds, if any.

There are three intuitive explanations for the presence of high numbers of artifacts in the refilled 2006 test unit. First, during the backfilling process, surface or baulk artifacts could have been inadvertently dropped into the unit. In 2006, backdirt was placed directly onto the surface sediment of the rockshelter. It seems possible that some of the surface was used to refill the unit, as there was no way to distinguish between intact surface sediment and backdirt. Similarly, artifacts could have been bumped loose from the baulk during refilling and been distributed throughout the backdirt. Second, the 2006 collection could have been less than 100%. This would be expected for small finds, as no screening methods were used in 2006. Finally, there could have been significant movement of sediments between 2006 and 2010. Any one of these, or a combination of all three, could be the culprit.

*6.4 Recovered Beads*

The 2010 field season recovered approximately 250 kg of finds during 21 days of excavation. Despite initially high hopes of a larger excavation trench, the rich density of finds, and intensive work involved in washing and counting the artifacts/ecofacts, only permitted completion of these six units. Recovered materials include lithics, human bones, faunal bones, slag, pottery, terrestrial snail shells, and beads.

Previous field seasons recovered three beads from HwJf-02. The report by Msemwa mentions the recovery of a single bead from Mlambalasi in 2002, from 10-20cm below the surface (2002:12). He describes this bead as being "European" (Msemwa 2002:14), which I interpret to mean probably glass or plastic, rather than OES. Two OES beads were recovered in 2006, and will be included in the analysis alongside the 2010 OES beads.

A total of 124 beads and beadmaking materials were recovered from Mlambalasi in the summer of 2010. These can be grouped by material into OES (70), glass/plastic (51), and unknown (3). Five of the 70 OES artifacts were fragments which showed no signs of drilling, but were collected as potential raw material for beadmaking. Fifty-nine of the finds are completed beads, 3 are partially formed, and 3 are completed and broken. Of the 70 total OES artifacts recovered in 2010, only 36 can be confidently attributed to an undisturbed context. Details regarding levels, units and quadrants in which the OES artifacts were found can be found in Appendices A and B.

*6.5 Analysis*

Upon return to Canada in September of 2010, I began analysis of the Mlambalasi collection. Dr. Willoughby has been permitted to bring Tanzanian collections on loan to the University of Alberta for a number of years, and has always returned the previous material at the earliest opportunity. This afforded me the luxury of having the beads present while working on my thesis.

The taphonomic circumstances of the site are such that many recovered finds are coated in a layer of hardened calcium carbonate, often obscuring the surface of an artifact. I consulted several researchers by email who have expertise in working with OES beads (including Dr. Andrew Kandel and Dr. Jayson Orton). The consensus was that OES is remarkably sturdy, and that I should attempt to clean the beads so their data may be gathered.

Prior to any analysis or cleaning, I took a photographic record of the beads. Any prolonged handling of the OES artifacts was conducted while wearing latex gloves, to minimize the transfer of skin oils to artifact surfaces. Where necessary for analysis, I removed the sediment coating from the OES artifacts using tools including paintbrushes, wooden skewers, plastic toothpicks and even dental implements when absolutely required. This work was carried out under a low magnification, binocular microscope, to allow me to be as delicate and accurate as possible during cleaning. I did not use any water or rinse solutions. All variables, other than percentage cemented, were recorded after artifact cleaning.

My analysis involved both quantitative and qualitative methods, with a focus on description. This largely descriptive approach is well aligned to the general IRAP goal, to document the development of early modern humans in Iringa, and to the work of other team members. Furthermore, this descriptive approach is very similar to the previous studies of OES beads (as outlined in Chapter 5) and I was able to apply many of their analysis techniques in my research. Given the limited variables studied in previous work, I felt it necessary to examine whether there are characteristics in addition to outer diameter and aperture diameter which can be used to create regional or chronological sequences.

The following is an outline of the 31 variables which I used in my analysis. Where necessary I elaborate on the procedures used to assess each variable. I made an effort to explain my characteristics with sufficient detail that they could be used by other researchers. None of these methods required equipment beyond a set of digital calipers, a digital scale, and a Munsell Soil Color book. These supplies are readily available in an archaeology lab setting.

It is necessary to clarify the terms I will be using when describing the structure of OES. In reference to the parts of OES beads, there is no standard terminology. For an outline of the terms I used when referring to parts of a bead, see Figure 6.5. There are three main parts of an avian egg: eggshell, albumen, and yolk (Li-Chan and Kim 2008:2). The portion of the egg from which beads are created is the eggshell. Ostrich eggshells are creamy white in colour with variable gloss and texture which are influenced by the diet of the ostrich (Kandel 2004:384; Prynne 1963:81).

There are three major layers of the eggshell which are important to my study of OES beads: cuticle, palisade, and mammillary (see Figure 6.6). The cuticle is the most external layer of an eggshell and is composed of two parts: an outer organic layer and an inner mineralized layer (Dauphin et al. 2006:1763; Li-Chan and Kim 2008:4). The cuticle is very thin, between ten and thirty micrometres, and repels both water and microbes (Li-Chan and Kim 2008:4,8). Dauphin et al. suggest this cuticle layer is not visible in the cross section of ostrich eggshells (2006:1763), I am however able to clearly identify the cuticle under a low magnification, although not with the naked eye. Underneath the cuticle is the palisade layer (Li-Chan and Kim 2008:3). This layer has a spongy appearance, but is structurally very sturdy (Li-Chan and Kim 2008). In fact, in my data set there are several instances in which this portion of an OES bead is the only part preserved. Finally, the innermost portion of the eggshell is the mammillary layer. In an ostrich eggshell, the palisade layer is noticeably thicker than the mammillary layer (Dauphin et al. 2006:1763). When viewed in cross-section, this layer appears as a series of tightly bunched, vertical pillars; when viewed from the inner surface of the OES, the tips of the individual mammillary cones are visible.

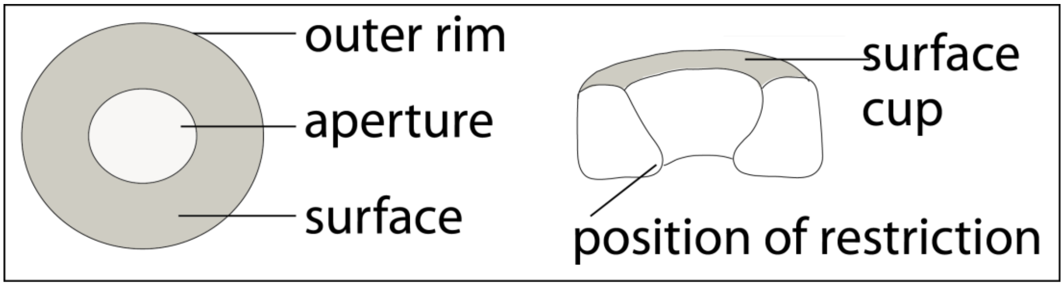

Figure 6.5. Diagram of parts of an OES bead.

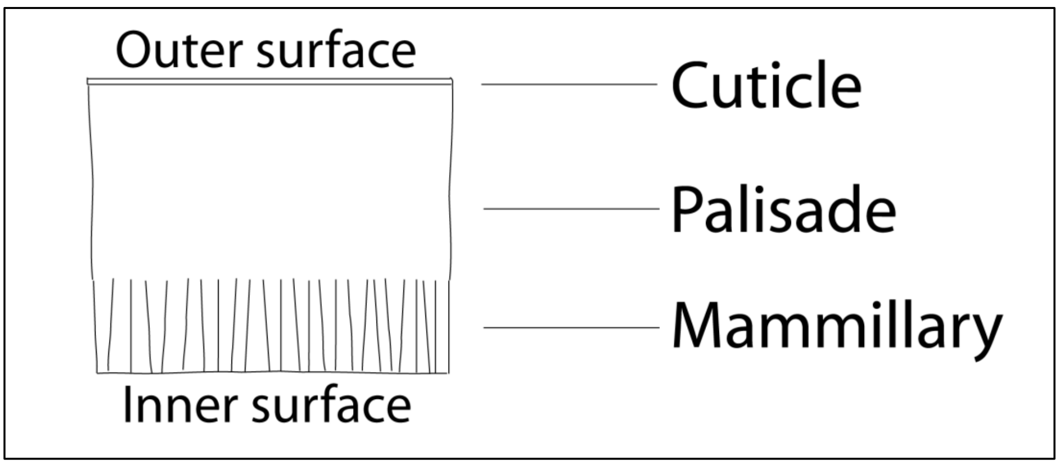

Figure 6.6. Cross section of OES layers.

### *6.5.1 Percentage Cemented*

The first variable I recorded for each bead was surface area covered by hardened sediment. I estimated the percentage of surface area that was covered with hardened sediment which could not be removed by dry brushing. In some cases, the entire bead was covered so that none of the natural surface was visible. This feature is also evident on many of the lithics from HwJf-02. This cementing may be due to water movement through the site during the rainy season, and it is my hope that this data could contribute to the understanding of site taphonomy. This characteristic may also be related to the manufacture or treatment of OES beads.

### *6.5.2 Minimum, Maximum, Min/Max, and Average External Diameters*

Keeping with the original analysis by Jacobson 1987a,b, I recorded the external diameters (see Figure 6.5) of each OES bead. Measurements were obtained with digital calipers, in millimetres, to two decimal places. Yates (1995) recorded only the maximum value for eternal diameter, and described it necessary to take multiple measurements on each bead to determine

the greatest diameter value. I took multiple measurements for each bead, and expanded upon the typical measurements by recording both the minimum and maximum diameters. I used the minimum and maximum diameter values to create a ratio (minimum/maximum). I also used the minimum and maximum values to create an average for each bead.

*6.5.3 Aperture and Aperture/External Diameter*

As employed in analyzes by others (Kandel and Conard 2005; Orton 2008; Orton et al. 2005; Plug 1982; Sadr et al. 2003; Smith et al. 1991; Wang et al. 2009; Yates 1995), I measured the aperture diameter (see Figure 6.7) wherever possible. Plug (1982:60) described taking these measurements by fitting the beads over a series of drill bits of varying thicknesses, mounted in a block of wood. I decided against this technique, initially, as it would not detect minimum and maximum aperture diameters. However I soon discovered that, in practice, taking multiple aperture diameter measurements from OES beads with digital calipers was impractical due to their delicate nature. I ended up taking only a single measurement for each aperture, using digital calipers. For future analysis, I will need to find a more effective way to take aperture measurements. I used the aperture diameter and average external diameter measurements to create a ratio (aperture/external). A similar analysis was applied by Smith et al. (1991) and Orton (2008). A comparison of my data to theirs will be presented in Chapter 7.

*6.5.4 Minimum and Maximum Thickness*

I recorded both the minimum and maximum shell thickness of all OES artifacts. I used these two values to obtain an average thickness for each artifact. Thickness measurements are used by Orton (2008) to show that completed beads are generally thinner, presumably through use wear, than preforms. These measurements could also be used in other analyzes, as OES can vary depending upon factors such as environment and geographic range (Cooper et al.

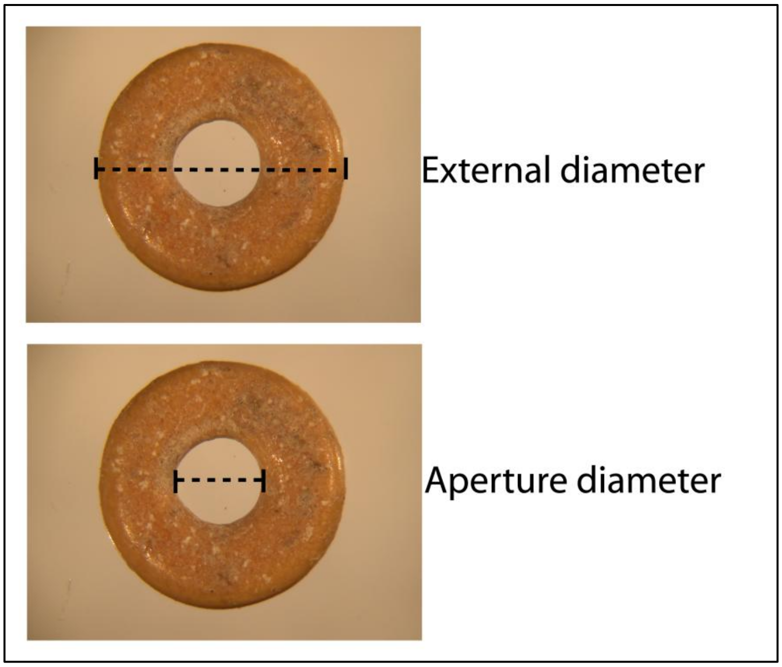

Figure 6.7. Diagram of external and aperture diameters.

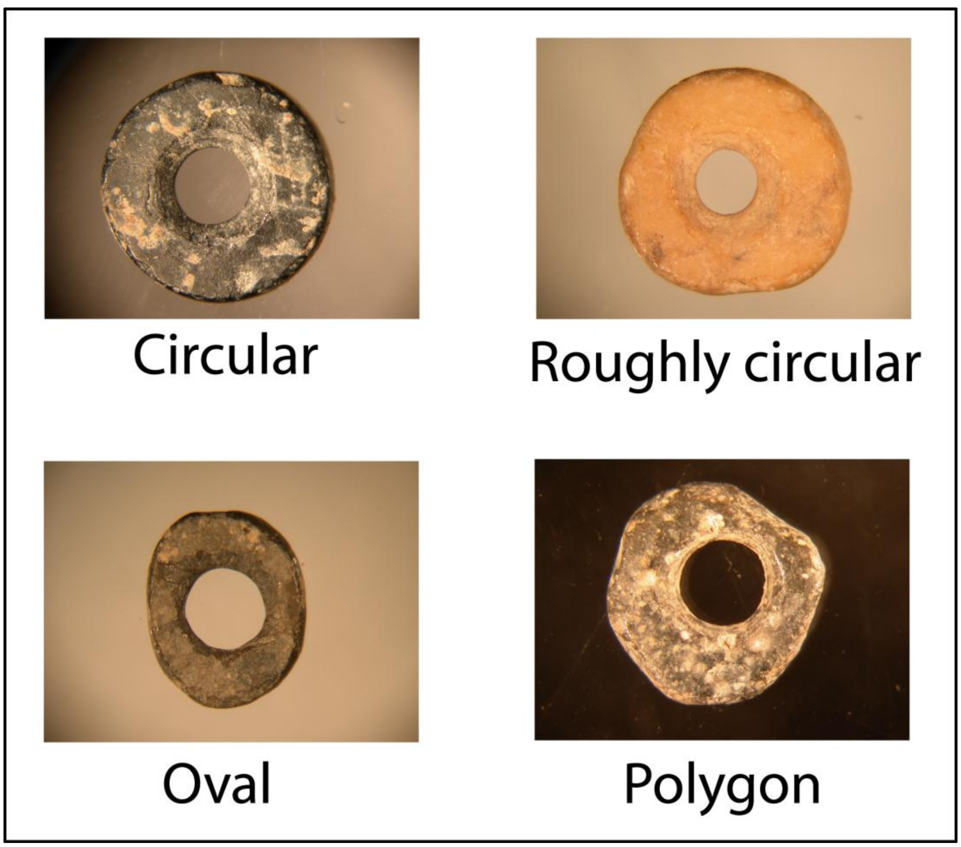

Figure 6.8. Examples of OES bead shapes.

2009:1973). Thickness measurements will be highly influenced by the presence of delamination (see sub-section 6.5.11), and should be considered in conjunction.

### *6.5.5 Weight*

After the research of Wang et al. (2009), I recorded the weight of each OES artifact. Each measurement was recorded on a digital scale, in grams, to two decimal places. This variable was not analyzed further by Wang et al. (2009), however I felt it necessary to record it in an effort to be as thorough as possible.

### *6.5.6 Shape*

I created several categories to describe the outer rim shape of an OES bead: circular, roughly circular, oval, polygon, and unable to determine (see Figure 6.8). This is not a variable which I have encountered in previous research. It became clear after looking through the HwJf-02 assemblage that not all OES beads were intended to be circular. Three of the beads are intentionally completed into an oval shape. Some beads are shaped into near perfect discs, while others had perhaps less attention to detail and appear misshapen. While most of the categories (circular, oval, or polygon) are self-evident, I deemed a bead roughly circular if it had generally rounded edges, but could neither be described as circular nor oval.

### *6.5.7 Munsell Colour*

This characteristic has not been widely used in previous analysis of OES beads. The publication which mentions bead colour, Kandel and Conard 2005, uses broad terms such as beige, light brown, and brown. To describe the colour variable I used the Munsell Soil Color Chart, which is commonly used among archaeologists and readily available in most archaeology laboratories. I recorded the range of colours present on outer surfaces of the OES.

### *6.5.8 Aperture Shape and Position of Restriction*

The aperture shape characteristic was originally described in Beck's 1928 single perforation types, and subsequently referred to in different ways by Kandel and Conard (2005), Plug (1982), and Wang et al. (2009). The more recent publications relate this characteristic to manufacture, referring to the direction of perforation with options such as: drilled from inside of bead, drilled from outside of bead, drilled from both sides (Kandel and Conard 2005:1715; Wang et al. 2009:3889). Orton (2008:1774) notes that use wear significantly alters the shape of an OES bead's aperture; the perforation shape then is not solely a function of the manufacture technique, but is also influenced by the bead being worn.

I prefer to describe the aperture shape based on its cross section, without direct reference to production techniques. With this method, inferences may still be made about production, but they remain separate from objective data. In my analysis, I adopted the aperture shape terminology employed by Plug (1982:60): conical, biconical, cylindrical. See Figure 6.9 for a diagram of these variables.

It was necessary for me to develop a standard with which to judge whether an aperture shape was tapered enough to be deemed conical or biconical, rather than cylindrical. For this I used a visual estimate. When the horizontal width of the cup (shown as A in Figure 6.10) is approximately equal to or greater than the horizontal width of the surface (shown as B), for more than 50% of the aperture circumference, then this perforation is conical. This variable must be assessed on both the inner and outer surfaces of the bead. If both surfaces bear conical perforations, then the aperture is biconical. If neither surface is conical, then the aperture is cylindrical.

The position of restriction variable was mentioned by Plug (1982), and does not appear to have been adopted in subsequent studies. I suspect, however, that this characteristic was used by other researchers in their estimates of the direction of perforation. Again, I prefer to record this characteristic based on a bead's cross section shape, without reference to production. I recorded the position of restriction as being either closer to the inner surface, closer to the outer surface, approximately midway, or unable to determine (due to poor preservation or an incomplete perforation). This variable is difficult to estimate on unbroken beads, as it is not possible to view the bead in cross-section. I attempted to account for this by using the midway category as a default, and only assessed closer to inner or outer surfaces if it was appreciably apparent upon visual inspection.

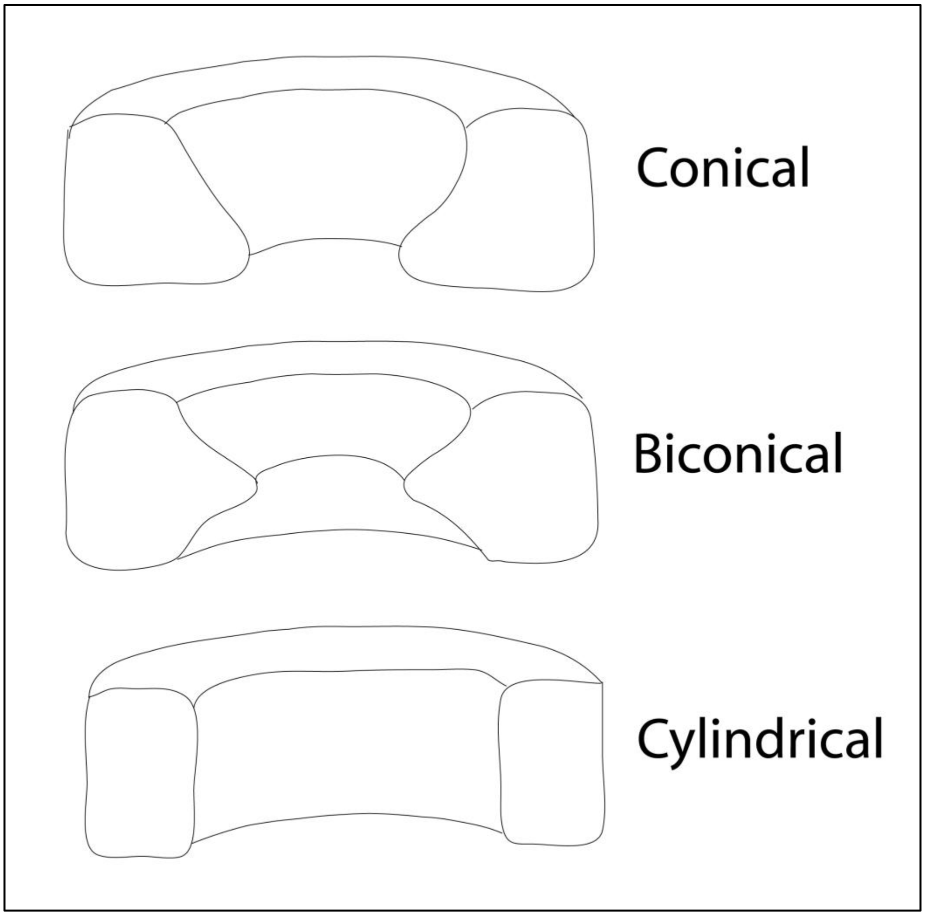

Figure 6.9. Diagram of aperture shapes, drawn in cross-section.

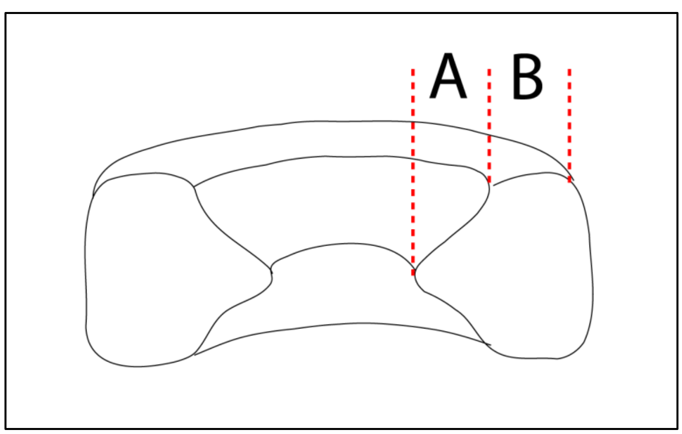

Figure 6.10. Diagram of aperture tapering characteristic, drawn in cross-section.

*6.5.9 Aperture: Center, Chip, Smooth, Striae, Patina*

I employed these five variables to express aperture characteristics. Examples of each are shown in Figure 6.11, with the exception of aperture patina which is difficult to photograph. These variables were recorded to some degree in the work of Kandel and Conard (2005) (general surface patina), Orton (2008) (aperture chipping), and Wang et al. (2009) (patinated wear facets).

The aperture center variable requires a complete or nearly complete bead for its measurement. It refers to whether or not the perforation is generally centered within the shape of the completed, shaped bead. If upon a visual inspection there is a significant bulk of OES around one part of the perforation giving the bead a lopsided appearance, then I described the aperture as uncentered. It is still possible to record this variable on an incomplete bead, as long as some general shaping of the outer diameter has taken place.

The aperture chip, aperture smooth, and aperture patina variables do not require completed beads for their measurement, any preform which has been completely perforated can be assessed. The aperture chip characteristic is on a scale from zero to three (for exact definitions see Appendix A). A rating of three indicates that aperture chipping is strongly present and the cuticle layer of the bead has jagged edges around a completed perforation. A one means that chipping is and weakly present and the chips are smooth dents which extend into the palisade layer. The aperture smooth variable indicates whether or not the aperture rim has a consistently angled arc. When consistently angled for at least 75% of the aperture, I recorded the aperture as smooth. The aperture patina characteristic refers to whether or not there is a slick looking sheen present at the position of restriction, within the aperture.

The aperture striae variable can likewise be applied to a wide range of bead manufacture stages. As long as there is some evidence of drilling, even if only a small dimple, this characteristic can be recorded. Aperture striae are present where there are visible linear scratches or grooves inside the cup of the aperture. This characteristic has not been employed in previous studies. The inspiration for it came when I was presenting preliminary results at the 2011 Society for American Archaeology conference, where it was suggested that some drill materials would leave scratches, while others would leave none. Whether this is verifiable remains to be seen, but I decided to record this characteristic incase it becomes relevant in the future.

*6.5.10 Outer Rim: Chip, Striae, Patina*

These three variables were recorded to describe the outer rim of the bead. They are somewhat referred to in the works of Kandel and Conard (general surface patina), Plug 1982 (trimming), and Wang et al. (2009) (patinated wear facets), and I recorded patina as either present or absent, while chip and striae are on a sliding scale from zero to three (for further elaboration see Appendix A). These variables are only likely to be strongly present on complete or nearly complete beads, as they are likely related to the end stages of production and use wear. The outer rim chip may be present as a series of tiny flake scars

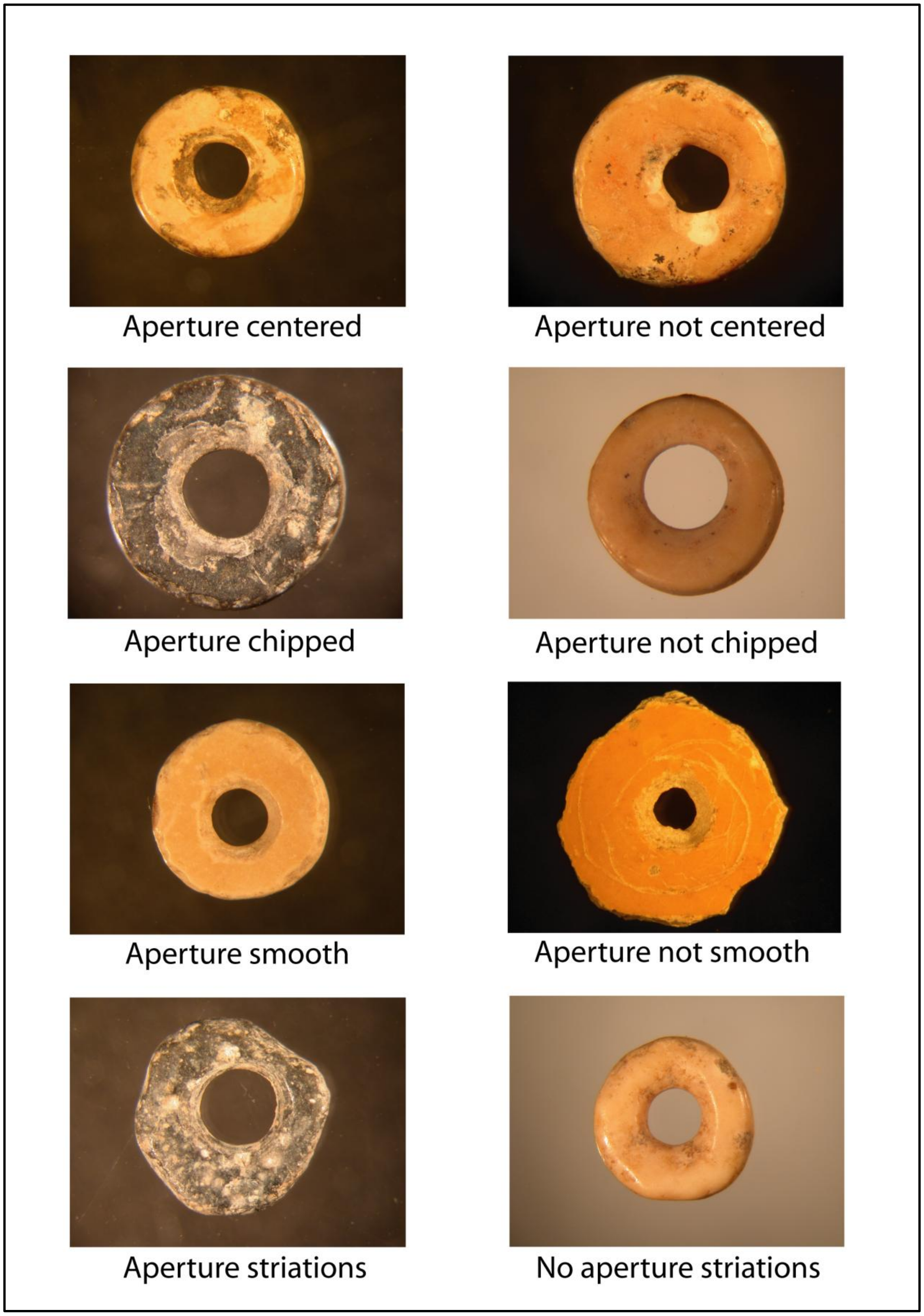


Figure 6.11. Examples of aperture characteristics.

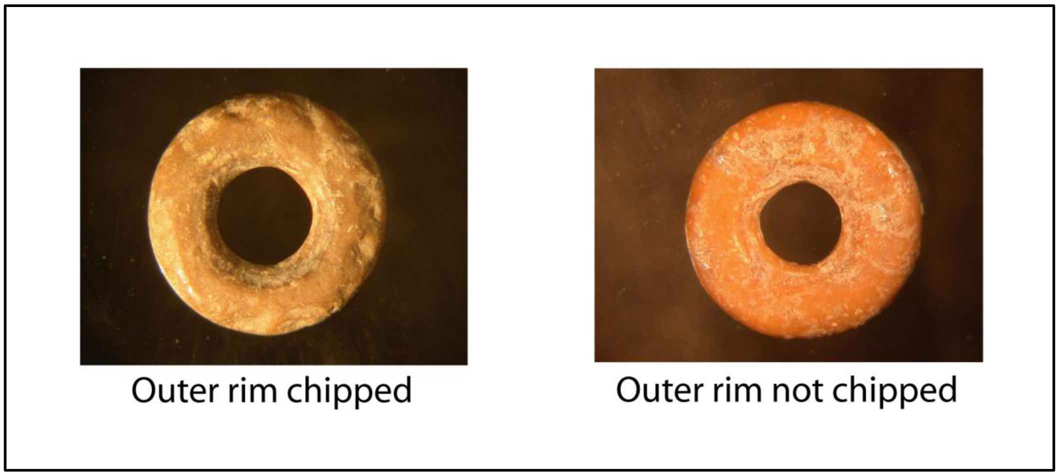

Figure 6.12. Examples of outer rim chipping characteristic.

around the circumference of the bead (see Figure 6.12). Similar to the aperture chip variable, the outer rim chip is strongly present (rating three) when the edges of the cuticle are jagged and sharply visible, and weakly present (rating one) when the chips are smooth dents. The outer rim striae may be present as linear scratches on the outer circumference of the bead, and I recorded their presence as vertical (perpendicular to the outer surface), horizontal (parallel to the outer surface), or both. Finally, the outer rim patina characteristic is present, similar to the aperture patina, when there is a polished or glossy lustre to the bead's outer circumference.

### *6.5.11 Outer and Inner Surface: Patina, Coloured, Stained, Delaminated*

These variables refer to the inner and/or outer surfaces of the OES, and may be recorded for any stage of manufacture. In the case of patina and colouring, I recorded the variables as either present or absent. A surface patina is present, as with the case for aperture and outer rim patina, when there is a slick or glossy appearance on the outer surface. The mammillary layer of the inner surface of an OES generally prohibits it from developing a patina, therefore it seemed unnecessary to record the presence or absence of patina on the inner surface. I deemed that a coloured surface indicates a significant deviation from the regular OES colouring. This colouring can be reproduced through intentional or unintentional heating, a discussion of which is not included in this thesis. Staining is present when there are either patches of residue on the surface of the bead, or observable ochre powder, or both. For the delamination characteristic, I created five descriptive categories ranging from no delamination on either surface, to full delamination of both surfaces.

### *6.5.12 Well Worn*

This variable is qualitative judgement based upon a visual evaluation of a complete, or nearly complete, OES bead. It is admittedly my most subjective and presumptive variable. The term well worn was employed by Orton (2008), however he did not elaborate on the assessment which distinguishes well worn beads from others. I developed my own wear scale, based on the distinction between the cuticle, palisade and mammillary layers, with particular attention to the degree of which the mammillary cones were prominent and defined. Where the visible characteristics of the different layers were nearly absent (e.g. cuticle not delineated, mammillary cones absent or smoothed) I classed the artifact as well worn. When the layers were easily distinguished (e.g. cuticle sharply defined, mammillary cones conspicuous), the bead was not well worn.

### *6.5.13 Production Value*

This variable was developed by Kandel and Conard (2005) and Orton (2008), and employed by Wang et al. (2009). It is an evaluation each OES artifact, which incorporates the ethnographic manufacturing stages for OES beads. This production value is averaged for the entire assemblage, and is intended to provide information about site activities and duration of occupation.

As there are slight nuances between the two methods of analysis, I recorded both in order to be as thorough as possible.

Kandel and Conard (2005) outline 12 production stages in making an OES bead (shown in Table 6.1). Each stage is described, and all are depicted in a photograph (Figure 6.13). Stage 1 is represented by small angular fragments of OES and Stage 12 is a finished bead which has broken after completion (Kandel and Conard 2005). Each even numbered Stage (from 4 to 12) is the broken equivalent of the Stage preceeding (e.g. Stage 5 is a perforated fragment, and Stage 6 is a broken, perforated fragment). The Stages of all OES artifacts are then averaged, giving the production value for an assemblage. The standard deviation is given as an indicator of the uniformity of production values; a lower standard deviation represents a higher degree of regularity (Kandel and Conard 2005:1713).

The method developed by Orton (2008) builds upon the work of Kandel and Conard (2005), and creates a more detailed set of production stages. In order to avoid confusion between his work and that of Kandel and Conard (2005), Orton (2008) uses roman numerals to denote production values. Orton (2008) further divides these stages by using the letters *a* or *b*, which represent whole or broken artifacts, respectively. Additionally, Orton (2008) makes note of two different methods of manufacture, Pathway 1 (see Table 6.2) involves drilling prior to shaping into a disc, and Pathway 2 (see Table 6.3) involves creating the disc shape prior to drilling. Pathway 2 appears to be less frequently used and only alters Stages II-V of the production sequence.

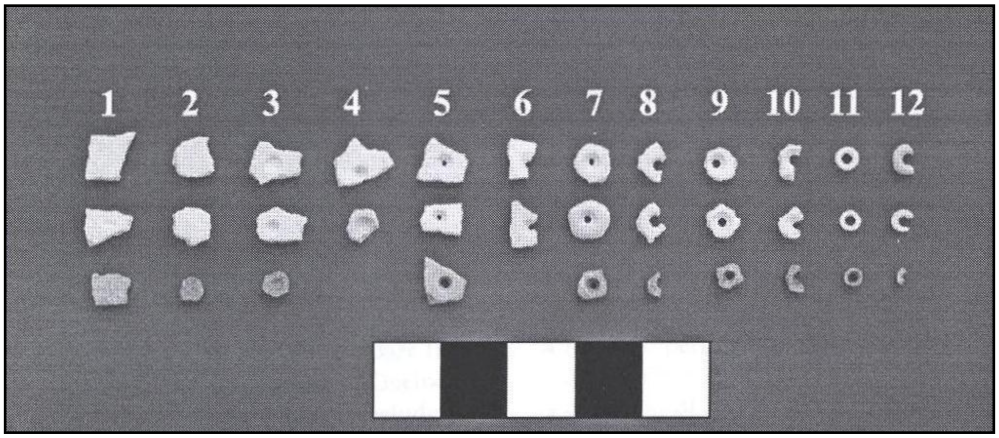

Figure 6.13. Photo of OES bead production stages (adapted from Kandel and Conard 2005:1714).

Table 6.1. Production values, as described by Kandel and Conard (2005).

| Production Stage | Description |
|---|---|
| 1 | Angular blank |
| 2 | Rounded blank |
| 3 | Complete, partially drilled blank |
| 4 | Broken, partially drilled blank |
| 5 | Complete, perforated blank |
| 6 | Broken, perforated blank |
| 7 | Complete, perforated, slightly formed bead |
| 8 | Broken, perforated, slightly formed bead |
| 9 | Complete, perforated, almost bead form |
| 10 | Broken, perforated, almost bead form |
| 11 | Complete, finished bead |
| 12 | Broken, finished bead |

Table 6.2. Production values in Pathway 1, as described by Orton (2008).

| Production Stage | Description |
|---|---|
| I | Modified OES fragment |
| IIa, IIb | Partly drilled, but not yet pierced |
| IIIa, IIIb | Completely drilled |
| Iva, IVb | Partly trimmed edge |
| Va, Vb | Completely trimmed edge |
| VIa, VIb | Partly ground |
| VIIa, VIIb | Completely ground |

Table 6.3. Production values in Pathway 2, as described by Orton (2008).

| Production Stage | Description |
|---|---|
| I | Modified OES fragment |
| IIa, IIb | Partially trimmed edge |
| IIIa, IIIb | Completely trimmed edge |
| Iva, IVb | Partly drilled, but not yet pierced |
| Va, Vb | Completely drilled |
| VIa, VIb | Partly ground |
| VIIa, VIIb | Completely ground |

### *6.6 Summary*

This chapter outlined the methods of collection and analysis of my data. Due to the excavation goal of locating the two previous test units at HwJf-02, a large portion of the recovered OES beads are from a secondary context. As noted in Chapter 5, previous studies of OES beads have recorded a very limited set of variables. In this chapter I laid out 31 possible characteristics which I created and used to describe OES beads and blanks. In the next chapter, I will present the results of my analysis of these variables.

# Chapter 7: Interpretation

This chapter outlines my interpretations of the data I extracted from the OES artifacts.  I attempt to relate this data to Mlambalasi, its past occupants, and their choices and behaviours.  Where possible I use comparable data from around Africa to observe how Mlambalasi's beads are similar to or different from those at other sites.  Of the characteristics discussed in the preceding chapter, I indicate their results here only if they bore intriguing results.  There may still be correlations in my data that I have yet to discover, therefore this is not a summary of every association; I hope this is a jumping off point for further research into OES beads both at Mlambalasi and elsewhere in Africa.

## *7.1  Percentage Cemented*

There is a slight correlation between depth and percentage of cementing of stratigraphically intact OES artifacts (see Figure 7.1).  This type of cementation was also visibly present, though not formally recorded, on lithics from certain levels of Mlambalasi.  Based on the cementation present on OES beads by depth, there seems to be at least a loose correlation with the time since an artifact was deposited.  I am not in a position to speculate on the taphonomic agents behind this cementation; however, members of IRAP believe it to be a result of water movement through the site which deposits calcium carbonate onto artifacts and ecofacts.  This could also be the reason that bones from deeper levels appear fossilized.  This may be a subject for researcher with expertise in this field to investigate further, and I hope this data may be of some benefit.

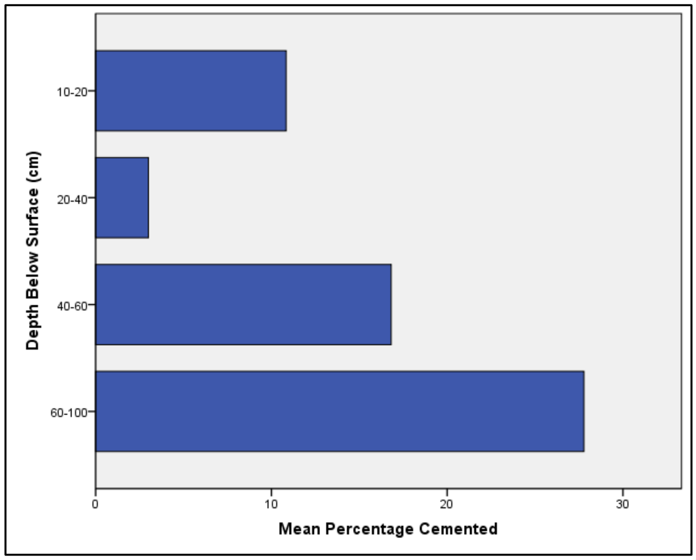


Figure 7.1. Mean percentage of cementation by depth for stratigraphically intact OES artifacts (*n* =36).

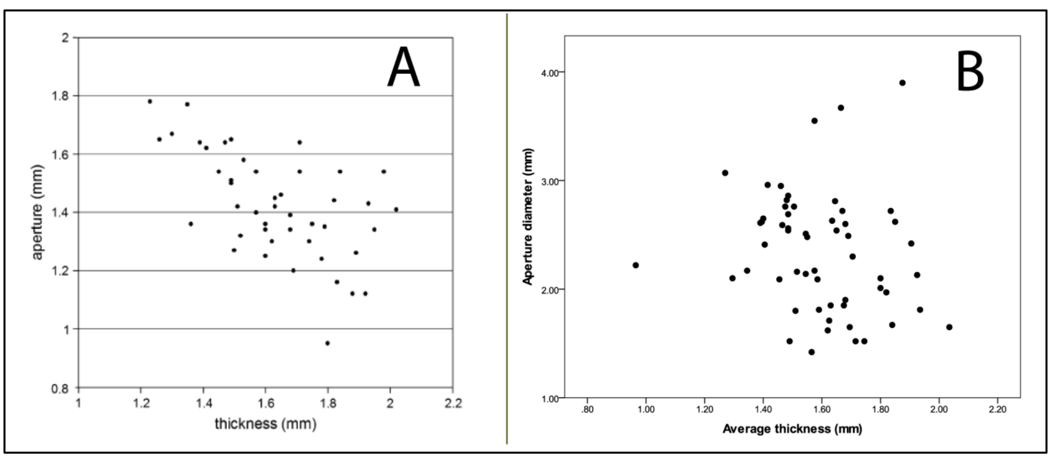


Figure 7.2. OES bead aperture diameter versus thickness: A – Adapted from Orton 2008, B – data from Mlambalasi (*n*=57).

*7.2 Aperture and Thickness*

Orton (2008) suggests a direct relationship between OES bead thickness and aperture diameter. He writes that as a bead is worn, the aperture wears larger and the shell thickness is reduced (Orton 2008:1772). This implies that beads which have been worn for a longer period of time should be apparent through metric measurements.

I compared the thickness and aperture ratios of completed beads at Mlambalasi to the graph published by Orton (2008) with disappointing results (see Figure 7.2). While Orton's graph showed a distinctly linear association between increasing aperture and decreasing thickness, my plot did not show a convincing connection. It is possible that if I had a larger dataset, a pattern may have emerged. It is also possible that there is no direct relationship between the two variables at Mlambalasi.

While Orton's suggestion seems intuitively correct, I suspect there must be other variables to consider which affect the relationship between thickness and aperture diameter. For example, I imagine that the diameter of the drill bit would play a role in the pre-worn aperture diameter. Also, drilling the aperture from both sides would make it appear wider without having been worn. Finally, thickness could be affected by the way a bead is strung. If a single string is used, each bead has maximal surface contact with the beads on either side of it. As they rub against each other, perhaps aided by abrasive material such as sand or ochre, they will naturally wear the bead thin. On the other hand, if a bead is sewn onto a piece of clothing, there would not be the same amount of friction, and therefore a different wear pattern than beads from a single string. These theoretical considerations suggest that aperture diameter and bead thickness may be the result of more than one factor.

*7.3 Presence of Ochre/Residue*

One of the characteristics I recorded in my analysis was the presence of staining on OES artifacts. I use the term staining to indicate that ochre powder or other unidentified residue was present on an OES artifact upon a visual inspection. None of the 13 partially completed beads had staining present, however it was apparent on 21of the 58 completed beads. This translates to approximately 36% of completed beads which have staining present. If sediments were responsible for the staining characteristic, then I would expect it to be equally present on OES artifacts from all stages of manufacture. Likewise it should be present on other finds from the same depositional environment, such as lithics, skeletal remains, and giant land snail shells. Similar staining has not been identified on finds from 2006 or 2010, however several categories of artifacts/ecofacts have yet to be intensively studied. Thus far, completed OES beads are the only finds to bear such staining.

This disparity leads me to believe that the completed beads received staining prior to deposition. As described in Chapter 4, one of the terminal stages of manufacture in ethnographic accounts involves grinding the beads into their final disc shapes with a soft stone. Ochre can have abrasive properties, and could possibly have been used as the soft grinding stone. Ochre could also have been rubbed onto a string of completed beads for decorative purposes. Alternatively, the staining could have accumulated during the wearing of completed beads. Ochre or other residue may have been inadvertently spilled or transferred while a beaded item was being worn.

Using only completed beads from reliable stratigraphic locations (*n*=31), I compared the presence and absence of staining, by depth to search for trends through time (see Figure 7.3). For the purposes of this graph, I merged the separately recorded ochre and other residue into one combined characteristic which indicates that staining of some kind of present. The relative percentages of each category hover around the 50% mark, with 20-30cm below surface being the only exception. There is perhaps a weak correlation between the incidences of staining with increasing depth; however this could easily be the result of a small sample size.

Additionally, I compared the completed beads with staining from reliable stratigraphy (*n* =12) for their different categories of stains (see Figure 7.4). There are relatively equal percentages of ochre powder versus unidentified residue present. It appears that the percentage of stained beads with ochre powder may increase slightly with depth. Again, this could very well be attributed to sample size.

The presence of ochre powder and/or residue on OES artifacts is not a characteristic that I have observed in other research. This makes it impossible to say whether the association between staining and completed beads exists at other African sites. Also, since I was only able to visually identify ochre, the type of

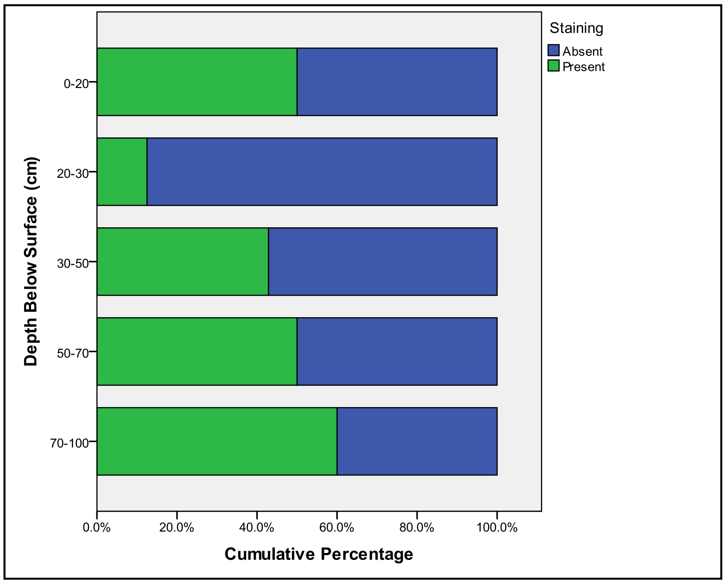


Figure 7.3. Presence of ochre/residue for stratigraphically intact, completed beads (*n*=31) by depth.

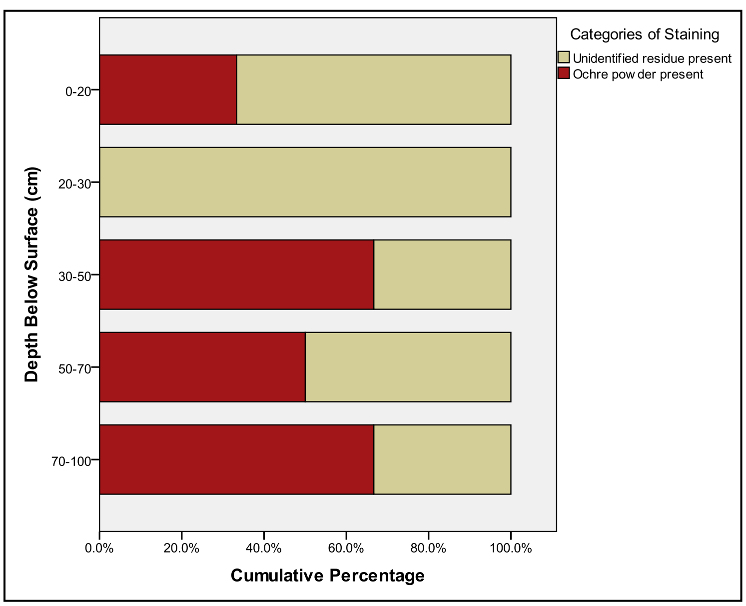


Figure 7.4. Categories of staining for completed beads from reliable stratigraphy with evidence of staining (*n*=12), by depth.

other residue remains unknown. These characteristic could be useful, if further explored, in future OES bead research.

### *7.4 Direction and Shape of Perforation*

One of the steps in producing OES beads is to create a perforation. Ethnographic observation of OES beadmaking indicated that drilling took place from one side until the point of perforation. In some accounts, the bead was then turned over and the aperture was widened by drilling from the opposite side (Orton 2008). Previous archaeological studies of OES beadmaking have noted which surface a bead was initially drilled from, always indicating the innermost surface. It appears that chipping of the cuticle layers surrounding the aperture is taken as evidence for direction of drilling (e.g. Orton 2008:1769). The idea is that when the drill breaks through the cuticle layer from the inside, this creates a distinctive pattern of chipping which is visible around the aperture of a completed bead.

I am not convinced that cuticle chipping alone can be used as an indicator of the direction of perforation. With some experimental drilling of a modern OES fragment using a coarse grained chert flake, I found that the cuticle layer becomes jagged and chipped whether drilling takes place from the inner or outer surface of the OES. Although admittedly, the cuticle chipping is slightly more prominent when drilling is initiated from the inner surface. Further, the OES I bought from a Calgary farmer's market came intact, with just the egg white and yolk removed. The hole which had been made to remove the insides was surrounded by cuticle chipping. As the eggs were whole and unhatched, these drainage holes could only have been created from the outside, which suggests that drilling from the inner surface of the OES cannot be the only reason for cuticle chipping. Finally, the cuticle layer is extremely thin and its edges were often not visible in the Mlambalasi assemblage. It appears that through use, the sharply defined cuticle edges become smoothed and perhaps even worn away. Of the 60 completed beads recovered from Mlambalasi, only 7 (roughly 17%) of these had noticeably defined cuticles. This means that the presence of cuticle chipping could not be assessed for the majority of the assemblage and would not be helpful in determining direction of drilling.

Being unconvinced of the utility of cuticle chipping and its link with direction of perforation, I suggest that the direction of perforation may have a relation to the position of restriction and perforation shape. OES beads drilled from a single side until the point of perforation should bear a conical perforation with a position of restriction closer to the opposite side of the shell. If a bead were drilled from both surfaces equally, I would expect it to have a biconical perforation with a position of restriction approximately equidistant between surfaces. Using these ideas, the position of restriction may specify which surface the majority of drilling took place from, and the shape of the perforation may indicate if drilling was performed from a single side.

I graphed the differing positions of restriction at Mlambalasi by depth as well as for the site overall (see Figure 7.5). For clarity, I excluded those beads for which position of restriction could not be determined due to delamination of one

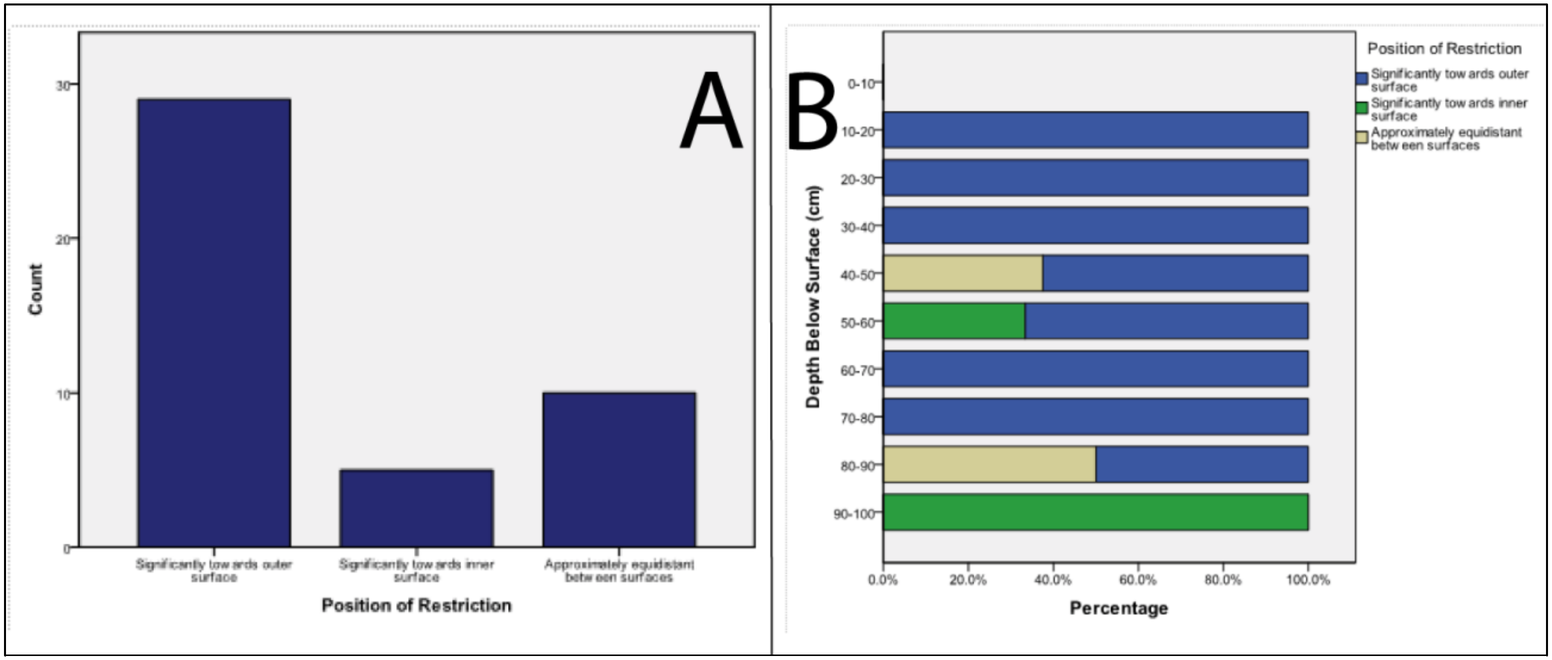


Figure 7.5. Positions of restriction: A – Positions of restriction for all completed beads (*n*=44), B - Positions of restriction for completed beads (*n*=25), by depth.

or both surfaces. Each graph shows that most positions of restriction are found towards the outer surface of the OES of Mlambalasi. This may indicate that beads were preferentially drilled from a single direction, typically the inner surface, at this site. One of the partially made OES beads from Mlambalasi demonstrates this argument, as it has evidence of drilling from the inner surface but is not yet perforated.

Experimentally, I found it significantly easier to begin drilling a hole from the inner surface of the shell. The outer cuticle layer is extremely smooth and hard, while the inner mammillary layer is much softer and more uneven. I found that drilling from the cuticle surface was possible however it was much more difficult to keep the drill in a single spot. Much more pressure had to be applied when drilling from the cuticle layer, without it the tip of the lithic would tend to slide while I was working.

Many additional factors could influence the position of restriction of an OES bead aperture. For example, even if a bead were perforated initially from the inner surface, subsequent rigorous drilling from the opposite surface could possibly create a deceiving position of restriction. In another example, a very thin drilling tool (e.g. a modern style electric drill bit) could be passed entirely through the OES and result in a cylindrical aperture with no obvious position of restriction. Alternatively, with long term use it is possible that the position of restriction could be worn smooth making the aperture appear cylindrical. Further experimental work could help shed light on any connection between position of restriction, aperture shape, and preferred perforation techniques.

*7.5 Bead Production*

OES beads were found throughout the excavation sequence at Mlambalasi, including nine OES artifacts from early production stages. This seems to imply that some small scale manufacture took place at Mlambalasi. However, there was no recovered evidence of small OES chips or grinding stones which would be expected from ethnographic accounts of bead manufacture. Orton (2008:1771) indicates that OES bead blanks were sometimes carried from place to place, to be completed when time permitted. This is also suggested in various ethnographic photos of small leather bags filled with OES beads in various stages of completion. This concept could be used to argue that beads in early production stages could be present at a site without *in situ* manufacture. For example, incomplete OES beads may have fallen on the ground and been accidentally left behind.

There is at least one example from the Mlambalasi assemblage which seems to directly implicate on-site manufacture of OES beads. Figure 7.6 is a partially completed bead which appears to have broken during manufacture. If this breakage had taken place elsewhere, I would expect this piece to have been discarded immediately, not curated and transported to Mlambalasi for eventual deposition. I consider this, along with the other partially formed beads, to indicate that at least some manufacture took place at the site, but on a very limited scale.

Tools used to create bead apertures have yet to be positively identified from Mlambalasi; the best candidates from excavated LSA levels are lithic or

Figure 7.6. Broken, incomplete OES bead, scale inmm.

bone. Most ethnographic accounts of OES bead making were recorded in societies which had access to iron tools. In these cases, an iron tipped drill was typically the preferred method for creating perforations in the OES blanks; I found only four references to lithic drills being used (see Chapter 4). By definition, LSA people would not have had the option of using iron tools. Other hard materials such as stone or bone seem like probably antecedents. The most likely contenders for drilling tools among collected assemblages from Mlambalasi's LSA levels are lithic. I cannot, however, discount that the tools could have been made from materials which did not survive the site taphonomy, were not deposited at the rockshelter, or were uncollected during excavations. These categories may include artifacts made from wood/plant matter, or animal materials such as teeth or horns.

No tools used to grind beads to a circular shape have been identified either. Thousands of lithic artifacts have been collected. However, none of these match the descriptions of bead grinding stones from ethnographic accounts. According to descriptions, these stones should have a low hardness, a distinctive ground stone appearance, and may have a groove worn by repeated use (see Chapter 4). This type of stone would be relatively rare near Mlambalasi, as the overwhelming majority of lithic raw material near the site consists of quartz and quartzite. Such rare stones suitable for grinding were likely curated and probably transported away from the site rather than deposited. For archaeological examples of this type of tool see Figure 7.7.

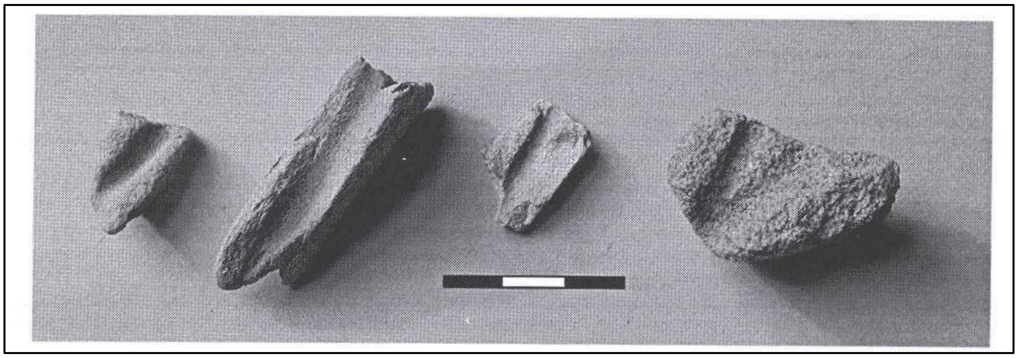

Figure 7.7. Grooved stones from Jakkalsberg, South Africa, Orton 2008:1770 (used with permission of Jayson Orton).

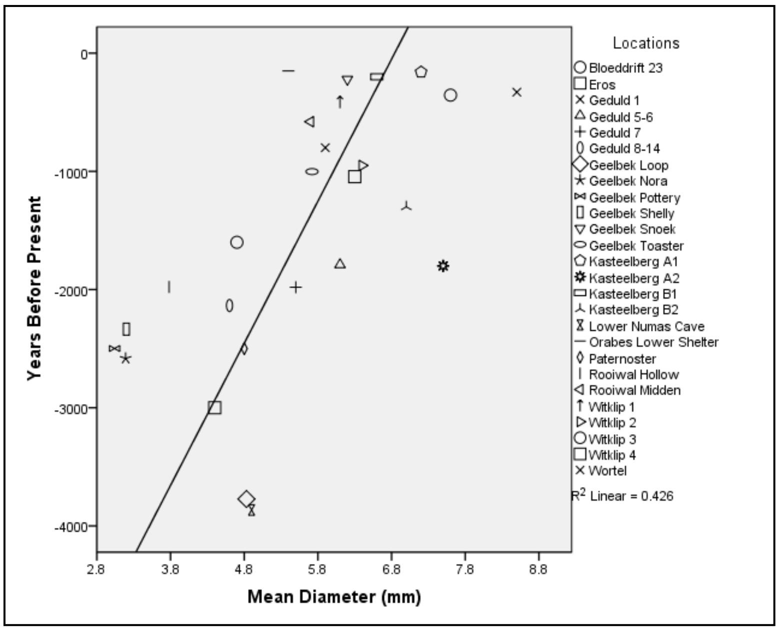


Figure 7.8. Mean OES bead diameters reported from southern Africa, by time (Jacobson 1987a, 1987b; Smith et al. 1991; Yates 1995; Smith et al. 2001; Sadr et al. 2003; Kandel and Conard 2005; Orton et al. 2005).

The majority of the OES artifacts recovered from Mlambalasi (81%) are completed, unbroken beads. There is no intuitive reason why these beads would be purposefully abandoned, and they were not found in a dense grouping which may have indicated caching behaviour. It seems most likely that these beads were discarded accidentally, through loss. Silberbauer (1981) writes that the thread that beads are strung onto (generally sinew) is far less durable than the beads themselves. Once an OES beaded object fell apart the beads begin to fall off; at this point they may be salvaged and restrung into other items (Silberbauer 1981:227). If they go unnoticed, the tiny beads could easily become lost on the ground and incorporated into the archaeological record. This process could account for the presence of completed beads from Mlambalasi, or any archaeological assemblage where they do not occur in high concentrations.

*7.6 External Diameter*

The majority of previous studies on OES bead diameter have been reported from the hunting/herding threshold in southern Africa (see Chapter 5). These studies indicate that there is a shift in OES bead diameter through time, commonly with smaller beads found in older deposits. I compiled data from publications which reported bead diameter along with dates for southern Africa and inputted this data into a scatterplot graph (see Figure 7.8). This trend of diameter reduction from southern African sites from the last 4,000 years is quite apparent, and has been well documented.

Most of these publications report bead diameter for the entire site, however when considering change through time, reporting mean diameters is best suited for sites with a narrow occupation time frame. Mlambalasi has a long history of occupation, which renders a mean diameter for all beads found to be virtually meaningless. AMS radiocarbon dates from the 2006 and 2010 excavations range in age from 141± 24 cal BP (OxA-24623) in upper levels to 14,875 ± 55 cal BP (OxA-24620) in the lowest levels, with OES beads recovered throughout. Excavations did not encounter sterile layers which would suggest periods of site abandonment, therefore the area under the shelter overhang at Mlambalasi appears to have been more or less continuously occupied for the past 15,000 years.

Of the 36 OES artifacts recovered from reliable stratigraphy at Mlambalasi, 31 are completed beads which are therefore suitable for diameter analysis. Calculating the mean bead diameter for each level, the same pattern of decreasing diameter observed in southern African sites appears to be present (Figure 7.9). There is a slight trend towards decreasing diameters in lower levels at Mlambalasi. Comparing the Mlambalasi bead diameters to those from southern Africa is imprecise. There are dates for the upper and lower levels of the Mlambalasi assemblage, but the age of intermediate layers are less certain. In contrast, the southern African beads are from occupations with a narrow range of dates, usually spanning well under 1,000 years. Furthermore, the Mlambalasi dataset (*n* =31) is quite small to serve as an accurate comparison to the hundreds of beads from southern Africa.

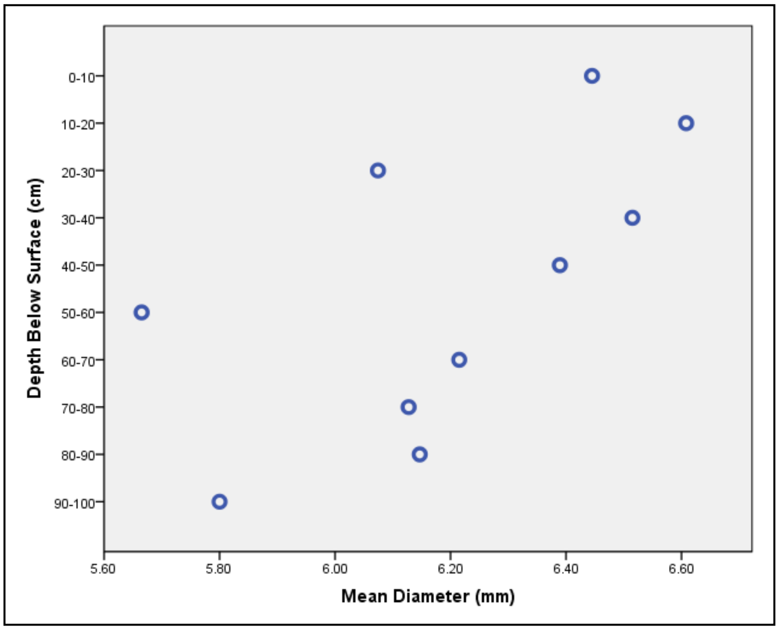


Figure 7.9. Mean OES bead diameters from Mlambalasi, plotted against depth.

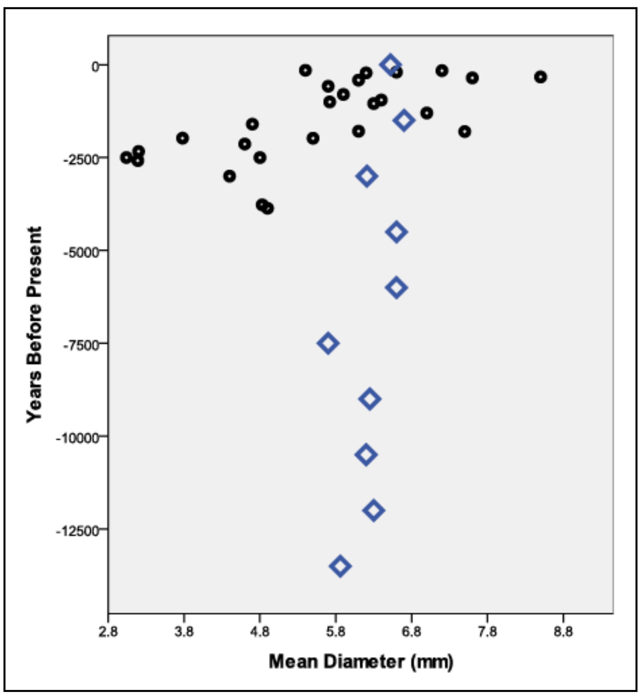


Figure 7.10. Mean OES bead diameters from southern Africa (black) and Mlambalasi (blue), plotted against time.

For purely heuristic purposes I compared the diameter reduction trajectories between the two assuming a steady rate of sediment accumulation at Mlambalasi (see Figure 7.10). There is a distinct difference between the slopes of the best-fit lines of the two data sets. The southern African beads, on average, reduce in diameter a minimum of 4mm over 4,000 years. The Mlambalasi beads, however, remain more constant with a change in diameter of 1mm over 15,000 years.

One of the only comparable sites for Mlambalasi is Mumba Rockshelter, located in northern Tanzania. Excavations at Mumba began in the 1930's, have continued into the present, and reveal a rich archaeological sequence (Gliganic et al. 2012:533). Absolute dates from Mumba's excavation levels have been questioned, especially since the discovery of a possibly transitional MSA/LSA industry.

A portion of the OES beads recovered from Mumba were analyzed by Weiß (2000) for a Master's thesis at the University of Tübingen. The beads in her analysis (*n* =1780), all recovered from geological Bed III, were measured for external diameter. Weiß (2000) recorded the range and mean diameters for the six arbitrary levels which make up Bed III. Each level represents approximately 20cm of depth (Weiß 2000:49).

As with the case at Mlambalasi, uncertain dates hamper the analysis of OES bead diameter change at Mumba. Recently, a re-dating of the site gave an age of 36,800 for the lower levels of Bed III (Gliganic et al. 2012:545). The dates for upper levels of Bed III were less certain, and indicated that it may be as recent as 1,000 years old (Gliganic et al. 2012:545). Therefore, the beads from Bed III may represent occupations over a span of 36,000 years, and there are no reliable dates for intermediate levels.

Figure 7.11 employs data from Weiß's work to illustrate the mean bead diameters by excavation level. Although it is unclear how much time Bed III took to accumulate, there does not appear to be any change in mean bead diameter through 120cm of excavated sediments. This lack of change is confusing, especially when considered in the context of the fast paced changes in southern Africa, and the slow but steady changes at Mlambalasi.

Since the comparison of OES bead diameter change in East Africa is still in its infancy, I cannot confidently speculate on the meaning of this data. It is intriguing that the diameter reduction present over the last 3,000 years in southern Africa is also found at Mlambalasi, but appears absent at Mumba. Also interesting is that the diameter shift found in my data has a markedly slower pace than that seen in previous studies. To me this shows a very high degree of formalization, perhaps indicating a small population using this rock shelter over successive generations. There is simply not enough comparable data to confidently form an explaination for these different results.

### *7.7 Association with Human Internment*

As mentioned in Chapter 6, a near complete skeleton of a single individual was recovered from Mlambalasi. This individual was excavated as a feature, dubbed Feature B-1, as a probable burial. The feature represents an area 1m

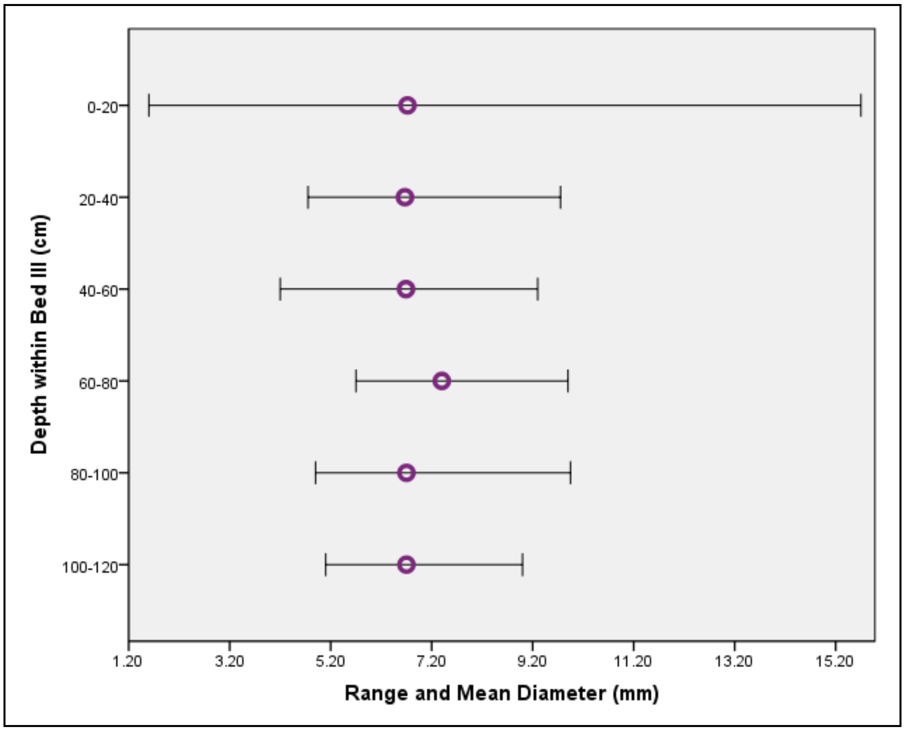


Figure 7.11. Mean OES bead diameters and range, by depth, from Bed III, Mumba.

square by 0.2m deep. Significant effort was made during excavation to recover as many artifacts and human remains as possible from this area, and all matrix was sorted twice before being discarded. Given these precautions, I believe that the bead recovery rate from Feature B-1 is very close to 100%.

Although some beads were recovered from Feature B-1, I only feel confident in attributing one of them to a primary context. As stated in Chapter 6, one of the aims of the 2010 excavation was to identify the locations of previous test units. This led to some necessary overlap between the 2006 and 2010 excavations. Specifically, some portions of the two westernmost areas (Quadrants A and C) were overlapped. Finds from this area were not excavated separately by disturbed versus undisturbed context. Therefore, finds from Quadrants A or C cannot be positively identified as being from a primary context. Interestingly, four of the five OES artifacts found in association with the human remains were recovered in 2010 from quadrants A and C. The lone OES bead which appears to have been recovered in primary context was collected in 2006. It was found in association with the hand/wrist of the human remains (Katie Biittner, personal communication, 2010).

Since only one OES bead can be confidently associated with the human remains, it does not appear that there were OES adornments at the time of internment. This seems to be the case despite evidence that such beads were made and worn by people who utilized the site. There can be many explanations for this lack of beads. I will give a few examples of possible cases. First, it is possible that the person represented in Feature B-1 did not come from a culture which habitually made or wore OES beads. Although beads were recovered from every level of excavation, and there is evidence of *in situ* bead manufacture, this is not necessarily evidence that every group who occupied this rockshelter manufactured and/or used OES beads. So it is possible, although intuitively unlikely, that the B-1 individual's culture was not one which made or wore OES beads.

In an alternative explanation, taphonomic agents could be responsible for the lack of OES beads present. This position assumes that the individual was adorned with beads at the time of interment, and all beads migrated away from the body. I find it option extremely unlikely. The skeleton was extraordinarily fragmentary, with the largest intact fragments being scarcely more than a few centimeters in length. In spite of this, the skeleton remained in relative anatomical position. Rib elements were found in parallel rows, cranial fragments were in a neat circular shape, and arm bone fragments were lying in linear fashion. Very few bones were recovered intact, yet there did not appear to be significant taphonomic movement of bone fragments. If OES beads had been present but were migrated away from the body, I would expect to see a similar pattern of movement in the skeletal fragments. This is not the case. There are taphonomic circumstances which seem to cause movement among sediments, however I do not believe these can be responsible for the lack of OES beads associated with the skeleton.

Third, the skeleton is estimated to represent either a female or small adult male (Sawchuk 2012). If this individual was male, wearing beads may not have been part of his cultural attire. As noted in Chapter 4, beadmaking was described in ethnographies as a task performed by women. Most of the photographs and descriptions of OES ornaments from ethnographies depict them as being worn by women. If this skeleton is indeed that of an adult male, it may be that OES beads were not found in association because they were not a cultural part of his attire.

Finally, the OES ornaments may have been removed by human agents. This again assumes that the individual was wearing OES beaded ornaments at or around the time of death. The beads may have been recovered before internment, perhaps by family, friends or looters. Jacobson (1987a:57) cited a personal communication from Wiessner in which she states: "…in the Kalahari at least, amongst the San the possessions of a deceased person are distributed to exchange partners and are not interred with the body,". Hollis (1909:73) and Bleek (1929:10) both write that daughters inherit the OES beads of their mothers, which would necessitate that the beads not be buried with the body. It is unclear whether these ethnographic examples speak to the scarcity and importance of resources in a traditional lifestyle, to ideological beliefs about death, or to the sentimental value of the possessions of a loved one. OES beads may also have been removed by looting activity, presumably by strangers, which occurred sometime after interment.

Any of these reasons, or combinations thereof, may account for the lack of beads recovered from Feature B-1. Of those I discussed above, I find drawn to the explanation that any beads present were removed by group members prior to burial. This is likely due to my western culture bias in which possessions of the deceased are often distributed amongst loved ones. However, it is entirely possible that none of these propositions offer an accurate explanation of the deficiency of OES beads associated with the human interment.

### *7.8 OES Beads and Site Function*

The mere presence of the OES beads at Mlambalasi can have implications about site function. It has previously been suggested that the presence or relative absence of ornaments can be used to determine site activities (Jacobson 1987a; Wadley 1989). Here I will explore how each of these would interpret the data from Mlambalasi.

Jacobson (1987a) suggests that the degree of bead completion in an assemblage should be indicative of activities which took place at a site. He suggests that different activities should have different archaeological representations of OES beads. These suggestions appear to be based on gendered divisions of labour, with women being the sole producers of beads. Jacobson uses the examples of kill sites, short term camps and aggregation camps. Sites where women were generally absent, such as kill sites, or only present for specific purposes, such as meat processing, should have very few completed beads and no incomplete beads (Jacobson 1987a:57). Sites which were occupied for short periods, by small kin groups, completed beads would be expected, along with very few incomplete beads (Jacobson 1987a:57). Presumably the completed beads here accumulated through loss, and there was small scale production by women who occupied the site. Finally, large aggregation sites should yield high numbers of complete, incomplete and broken OES beads (Jacobson 1987a:57). These sites would provide the social atmosphere and spare time during which women would make beads most intensively (Jacobson 1987a:57).

Applying Jacobson's (1987a) proposition, Mlambalasi falls into the short term camp category. The distribution of bead manufacture stages here is skewed towards completed beads. Approximately 81% of the assemblage consists of completed beads, with 8% from early stages of manufacture, 7% from later stages, and 3% completed but broken. Jacobson is probably guilty of assuming too much, especially about gender roles in the LSA. His categorization of Mlambalasi however seems consistent with the preliminary analysis of lithic data from Mlambalasi (Willoughby 2012).

However, there was an extremely high density of lithic finds at Mlambalasi, which may be inconsistent with a short term camp. The 2006 Test Pit 1, a one $m^2$ unit, produced a final tally of 2,666 lithic artifacts (Willoughby 2012:109). It is unclear if this concentration is sufficiently explained by a succession of short term camps. Willoughby believes that the dense accumulation of lithic material indicates that this site was used more intensively. She suggests that such rockshelters which are relatively rare on the landscape would have been used year-round as home bases, in a central place foraging style (Willoughby, personal communication, 2012).

Wadley (1989) used a slightly different approach than Jacobson, and applied ethnographic data from the modern day hunter-gatherer San in southern Africa to derive a model for archaeological site activity. Wadley suggests that the

San activity of trade gifting, or !*hxaro*, would leave an archaeological signature. *!Hxaro* is a kin-based, intragroup exchange system, which often involves the exchange of OES beads (Smith and Lee 1997:52). In fact, the word !*hxaro* is used synonymously as the term for OES beadwork (Mitchell 2003:36).

From the ethnographic data, Wadley (1989) distinguishes between two types of San occupations: dispersals and aggregations. During dispersals, San live in household groups, separated from the larger band (Wadley 1989:43). Life is more conservative at this stage, and the gender roles are relaxed as spouses work closely together to provide for their families (Wadley 1989:43). Ritual behaviour, gift exchange, tool manufacture and even hunting are minimized at this time (Wadley 1989:43). In times of aggregation, San gather with their kin and live together in large groups for several weeks at a time (Wadley 1989:43). Aggregations involve increased ritual activity, gift exchange and socializing (Wadley 1989:43). Social rules, such as gender roles, may be more constraining at this time to avert the social tensions of a large, extended gathering (Wadley 1987:43).

According to Wadley, there should be different archaeological signatures for aggregation sites and dispersal sites. Dispersal assemblages should have high densities of expediently manufactured tools of informal types made from local materials, and low densities of curated artifacts, such as decorative items (Wadley 1989:43). In contrast, aggregation sites should have curated tools with a high degree of standardization, decorative objects, art and ritual items (Wadley

1989:43). If Wadley's assertions are correct, then a site with a high concentration of OES beads may represent a place of aggregation.

One problem with this model is that OES beads do not guarantee that trade is taking place. Mitchell writes that the presence of typical *!hxaro* goods alone is not sufficient for evidence of exchange (2003:38). He notes that, as there is yet no method for establishing the geographic origin of OES beads, it is difficult to say whether beads found at a site were made locally or traded in (Mitchell 2003:38). This problem should be solved in the near future, as there is current, unpublished research on this topic (Stan Ambrose, personal communication, 2010).

I believe that Wadley's (1989) model can be easily adjusted to overcome Mitchell's (2003) criticism by considering OES beads to be an indication of symbolism rather than *!hxaro*. Wadley suggests that societal norms are tightened during aggregations as a way to ease social tensions (1989:43). Moderating social interaction is one of the many functions of symbolic ornaments, as discussed in Chapter 3. Ornaments can be used to dictate proper interactions between people who see each other infrequently, acting as a social lubricant. Aggregations would bring encounters with relative strangers. Using OES beads to communicate at times of aggregation is consistent with the theory that symbolic expression is meant for relative strangers from the same culture, also discussed in Chapter 3.

According to Wadley's (1989) theory, Mlambalasi would fall into the dispersal site classification. Lithic analysis from the 2006 and 2010 field seasons shows high percentages of expediently produced tools from locally available raw materials (Willoughby 2012). This is indicative of a dispersal assemblage, as defined by Wadley. Also, the relatively low density of OES suggests there is very small scale production and/or use of OES beads, in comparison to the hundreds or thousands of beads recovered at other sites.

Mlambalasi could also represent a site at which *!hxaro* was not practiced. After all, not all sub-Saharan African ethnographies note the use of trade gifting, although all report exchange (Mitchell 2003:37). Wadley indicates that certain conditions promote the development of a *!hxaro* system, such as localized resource shortages and small groups of interdependent bands (1989:49). If evidence of *!hxaro* behaviours are absent, it could signify that there was little intergroup visiting, higher emphasis on territoriality and larger year-round band sizes (Wadley 1989:49).

Of course, any ethnographic data should be used with caution when alluding to Stone Age behaviours. Wadley (1989) recognizes that the modern San cannot be a direct inference for Stone Age society. However, she suggests that using such information is preferable to the construction of any Eurocentric ideas (Wadley 1989:43). With this in mind, Wadley's model suggests the Mlambalasi's occupants were small kin groups who had limited need for symbolic behaviour during their time there.

### *7.9 Summary*

The OES artifacts from Mlambalasi have the potential to yield much information. Models which infer site activities from OES data suggests that

Mlambalasi may have been occupied by a small group of related individuals as a short term camp and/or dispersal site. Through analysis of the characteristics recorded, I identified a few with potential correlations. Some of these associations have not been previously researched or recorded, such as the relationship between staining and completed beads. Interestingly, the pattern of diameter change observed in southern African OES beads seems to be present at Mlambalasi, however with distinct nuances. A larger dataset is required to study these characteristics further and determine their meaning in the context of early modern human behaviour.

# Chapter 8: Conclusions

OES beads have the potential to enhance the knowledge about modern human origins. They are present at many Palaeolithic African sites, and are among the earliest forms of personal ornamentation. Relatively few studies have focused on this topic, and I hope my research will help bring to light the importance, and delicate beauty, of OES beads.

## *8.1 A Return to the Research Questions*

At the outset of this thesis, I indicated three main research questions, which I will address here. I hope that by this point it is evident that I was able to extract significant information from my data.

### 8.1.1 " What can the OES beads tell us about Mlambalasi and/or the people who occupied it?"

The Mlambalasi OES beads have much to imply about the site and the people who were there in the past. Perhaps the most obvious interpretation about these past people is that they wore and/or produced OES beads. This is the simplest explanation for the presence of completed and partially completed beads found in the rockshelter. There was, however, no collected evidence of drill implements or grindstones which are tools used in all ethnographic accounts of bead manufacture (see Chapter 4). Additionally, there were no tiny OES chips, or white powdered areas, which would be expected if intensive bead manufacture was taking place on site. Since less than 30% of the site has been excavated, it may not be wise to make assumptions about the degree of bead manufacture taking place. Also, a rockshelter may not have been the ideal location for such activities. All that can be confidently inferred is that there was at least small scale manufacture taking place in or near Mlambalasi.

It also seems likely that beaded items, which sometimes broke and dropped beads, were worn in the shelter. This accounts for the presence of completed beads, as they would likely not be intentionally discarded. The idea that people who occupied Mlambalasi wore beads seems in direct opposition to the human internment found in the shelter that was not associated with beads. If this is indeed the skeleton of an LSA hunter-gatherer, then it seems probably that such useful and prestigious items would be redistributed among living community members.

The people who made OES beads at Mlambalasi had preferential manufacturing methods. In at least 29 of the 44 completed beads, drilling began from the inner surface. This is also suggested by the partially completed beads, one of which only has drilling from the inner surface and no perforation. Experimental tests confirmed that this direction was significantly easier to start from, due to the structure of the egg layers. Another preference in manufacture is that the central perforations are drilled before the outer rims are shaped. This allows for numerous drilled pieces to be strung together and shaped *en masse* rather than individually.

The OES beads at Mlambalasi imply that the people who made/wore them used ochre. This is evidenced by the presence of ochre on approximately 36% of the completed beads, and the absence of ochre on partially completed beads. Ochre powder is also absent on any other finds from the site, implying that its presence was not transferred from the sediment. The ochre may have been employed in the terminal stages of bead manufacture, perhaps as an abrasive stone to grind the beads into their final shape, or as a means to give the beads a desired colour. Alternatively, the ochre may have been transferred to completed beads unintentionally, from the bodies of the wearers.

In my opinion, the most important contribution of the OES bead data is its inferences about site function and occupation intensity. According to the hypothesis of Jacobson (1987a), Mlambalasi represents a short-term camp site, and not a kill site or aggregation camp. This seems to correspond with the other site data. The small to moderate size of the modern overhang would not support the large group sizes expected at an aggregation camp, and the intensive lithic scatters indicate that Mlambalasi was more than an opportunistic kill/processing site. The hypothesis of Wadley (1989) supposes that Mlambalasi characterizes a dispersal site, where small kin groups would live for part of the year while separated from the larger band. There would be more limited need for symbolic behaviour in this situation; this corresponds to the small scale production of OES beads found at Mlambalasi. This also seems to match the lithic data, as Wadley correctly predicts that tools here would be expediently produced from locally available materials.

### 8.1.2 "How do Mlambalasi's beads relate to those from other sites?"

This is a more difficult question to address, given the low numbers of comparable published data. In comparison to the bead diameter research from the hunting-herding sites in southern Africa, Mlambalasi's assemblage is similar. It shows the same change in diameter, with older beads being generally smaller than younger beads. The similarities end there. The southern African bead diameters have a distinct trajectory through time, changing by an average of 4mm over 3,000-4,000 years. The Mlambalasi beads, which may span 15,000 years, stay remarkably stead and only change by approximately 1mm from the lowest to highest levels of excavation. The only other comparable site from which to compare bead diameters is Mumba, Tanzania. This assemblage may span 36,000 years, and has no distinguishable diameter changes through time. Comparing bead diameters from such geographically and temporally distant sites is undesirable, but the best of a bad situation.

In the larger context of modern human evolution, the role of OES bead diameter changes remains unknown. Based on the data from recent southern African sites, Mlambalasi and Mumba, it may be that bead diameters start off steady and change more rapidly through time. This may not be the case at all, but the product of an inadequately small, comparative dataset and an overactive imagination. Before the significance of these changes can be discovered, more assemblages must be analyzed.

### 8.1.3 "Are there other characteristics which may vary through time, besides external diameter?"

As mentioned in Chapter 5, the first OES bead characteristic examined for change through time was external diameter. Its variation was discovered by chance, when a colleague of Jacobson's mentioned that beads from the lower levels seem to be a bit smaller. I find it difficult to believe that the first characteristic examined is the only one which changes, especially with all the possible variation that could exist.

Given the relatively low number of OES beads which I had to work with, it is difficult to find whether any real diachronic trends are present. However, I identified two characteristics which show weak correlations with their recovered depth. These are the presence of ochre (or other unidentified residue), and the position of restriction of bead apertures. In the Mlambalasi assemblage, the completed beads from lower levels more often appear to have ochre/residue than those from higher levels. In reference to the position of restriction, beads from higher levels in the Mlambalasi assemblage were more likely to have a position of restriction closer to the outer surface. The beads which had positions of restrictions closer to the inner surface or equidistant between surfaces were only found in the middle to lower levels. It is impossible to say if these changes exist only in this assemblage, as other published works have not recorded these characteristics.

*8.2 Recommendations for Future Research*

The general lack of comparable data is the greatest obstacle to overcome in the study of OES beads. OES beads are present at virtually all LSA African archaeological sites; this makes the potential bank of excavated unanalyzed data massive. These unanalyzed OES beads are housed in storage rooms around the world, and undertaking a systematic study of all possible data would be time consuming, expensive and perhaps impossible. Therefore, I would encourage future projects to at least report mean external diameters by level, or age.

My concern for OES bead research is the primacy of lithic and faunal analysis in the study of human evolution. Since the focus has traditionally, and rightly so, placed on these finds, OES beads may well have gone unnoticed or uncollected during excavation due to their small size. Our excavation team was specifically looking for OES beads, and I have no doubt that many still went unseen. A second sorting of the matrix often revealed small, overlooked finds. It unexpectedly became somewhat of a prize to find a bead while sorting or excavating and call out *shanga* (the Swahili word for bead); even with everyone sorting with a keen eye for beads, the differential recovery numbers found by different excavators and sorters was staggering.

One of the sorting challenges that I experienced during excavation was visually navigating the matrix to find both large and small artifacts. Through the course of our field season, artifacts were recovered ranging in size from less than 3mm (such as glass beads) to greater than 20cm (such as hammerstones). These finds were nestled in and amongst non-artifactual material of the same size ranges.

I suggest that sorting methods would be more effective for locating small finds, such as OES beads, if the excavated matrix was first put through a dual nested screen (2mm and 15mm) with a dedicated small finds sorter. The plastic and glass beads in the Mlambalasi assemblage range in diameter from 2.36 to 5.56mm, and would be collected in the twomm sieve. Likewise, the OES beads in the Mlambalasi assemblage range in diameter from 4.42 to 8.48mm and would also be collected in the finer screen. The archaeologist(s) responsible for sorting the smaller screen would be looking through a smaller size range, and I believe this would increase their chances of bead recovery. When field conditions permit, using additional screens of varying sizes would be beneficial.

### *8.3 Summary*

The OES beads of Mlambalasi have provided unique insight into the lives of the people who inhabited the rockshelter. With sufficient comparable data, OES beads may have the potential to make contributions to the study of modern human evolution. Despite being silent for up to 15,000 years, the beads of Mlambalasi speak to me.

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# Appendix A

| Bead ID | Percent Cemented | Min. External Diam. | Max. External Diam. | Avg. External Diam. | Min/Max External Diam. | Aperture Diam. | Aperture/ External Diam. | Min. Thick | Max. Thick | Avg. Thick | Weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| J9 1NE #1 (P) | 0 | 6.37 | 6.52 | 6.45 | 0.98 | 1.80 | 0.28 | 1.45 | 1.57 | 1.51 | 0.08 |
| J9 1NE #2 | 0 | 5.10 | 5.79 | 5.45 | 0.88 | 1.30 | 0.24 | 1.92 | 1.96 | 1.94 | 0.07 |
| I10 2NW | 45 | 4.90 | 5.06 | 4.98 | 0.97 | 2.09 | 0.42 | 1.36 | 1.55 | 1.46 | 0.04 |
| J9 2SE/SW | 5 | 7.07 | 7.08 | 7.08 | 1.00 | 2.59 | 0.37 | 1.38 | 1.55 | 1.47 | 0.11 |
| J10 2NE | 5 | 6.89 | 7.14 | 7.02 | 0.96 | 2.62 | 0.37 | 1.81 | 1.89 | 1.85 | 0.14 |
| J10 2SW | 0 | 6.34 | 7.15 | 6.75 | 0.89 | 2.60 | 0.39 | 1.61 | 1.75 | 1.68 | 0.11 |
| J11 2NE (P) | 5 | 7.17 | 7.28 | 7.23 | 0.98 | 3.67 | 0.51 | 1.46 | 1.87 | 1.67 | 0.10 |
| J10 2SE | 5 | 7.78 | 10.20 | 8.99 | 0.76 | | | 1.88 | 2.05 | 1.97 | 0.20 |
| J11 3NE #1 | 0 | 4.68 | 4.91 | 4.80 | 0.95 | 2.76 | 0.58 | 1.33 | 1.68 | 1.51 | 0.05 |
| J10 3NE | 0 | 4.80 | 4.97 | 4.89 | 0.97 | 1.52 | 0.31 | 1.64 | 1.79 | 1.72 | 0.06 |
| J11 3NW | 0 | 5.45 | 5.65 | 5.55 | 0.96 | 2.14 | 0.39 | 1.48 | 1.61 | 1.55 | 0.06 |
| J9 3NW | 0 | 5.39 | 6.03 | 5.71 | 0.89 | 1.62 | 0.28 | 1.57 | 1.67 | 1.62 | 0.07 |
| J11 3NE #2 | 5 | 6.57 | 7.05 | 6.81 | 0.93 | 2.76 | 0.41 | 1.45 | 1.50 | 1.48 | 0.09 |
| J10 3NW | 0 | 6.93 | 7.07 | 7.00 | 0.98 | 2.95 | 0.42 | 1.35 | 1.57 | 1.46 | 0.09 |
| I10 3NW (P) | 0 | 7.75 | 7.79 | 7.77 | 0.99 | 2.82 | 0.36 | 1.47 | 1.49 | 1.48 | 0.13 |
| J9 3SW | 0 | 7.08 | 7.67 | 7.38 | 0.92 | 1.38 | 0.19 | 1.76 | 1.81 | 1.79 | 0.16 |
| I10 3SW | 5 | 9.96 | | | | 3.17 | | 2.13 | 2.23 | 2.18 | 0.27 |
| I10 4SW | 20 | 6.39 | 6.64 | 6.52 | 0.96 | 1.67 | 0.26 | 1.82 | 1.86 | 1.84 | 0.14 |
| J9 5 | 0 | 5.19 | 5.46 | 5.33 | 0.95 | 2.17 | 0.41 | 1.26 | 1.43 | 1.35 | 0.05 |
| J11 5SE #1 | 0 | 5.54 | 5.61 | 5.58 | 0.99 | 1.97 | 0.35 | 1.77 | 1.87 | 1.82 | 0.09 |
| I10 5SW (P) | 5 | 6.36 | 6.47 | 6.42 | 0.98 | 2.13 | 0.33 | 1.89 | 1.96 | 1.93 | 0.11 |
| J11 5SE #2 | 5 | 5.74 | 6.71 | 6.23 | 0.86 | 2.42 | 0.39 | 1.84 | 1.97 | 1.91 | 0.11 |
| I11 5SW #1 (P) | 5 | 6.83 | 6.95 | 6.89 | 0.98 | 2.72 | 0.39 | 1.76 | 1.91 | 1.84 | 0.11 |

**- Artifact found in secondary or uncertain context**

**- Characteristic does not exist for this artifact**

| Bead ID | Shape | Patina | Aperture Shape | Position of Restriction | Aperture Centered | Aperture Chipped | Aperture Smooth | Aperture Striations | Aperture Patina | Outer Rim Chip |
|---|---|---|---|---|---|---|---|---|---|---|
| J9 1NE #1 (P) | 1 | 0 | 5 | 5 | 1 | 0 | 1 | 0 | 0 | 2 |
| J9 1NE #2 | 4 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 3 |
| I10 2NW | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| J9 2SE/SW | 1 | 1 | 5 | 5 | 1 | 1 | 1 | 0 | 1 | 1 |
| J10 2NE | 2 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| J10 2SW | 2 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| J11 2NE (P) | 1 | 0 | 1 | 1 | 0 | 5 | 0 | 0 | 0 | 5 |
| J10 2SE | 9 | 0 | 1 | 9 | 9 | 9 | 9 | 1 | 1 | 9 |
| J11 3NE #1 | 2 | 1 | 5 | 5 | 0 | 2 | 1 | 0 | 1 | 1 |
| J10 3NE | 2 | 1 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| J11 3NW | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| J9 3NW | 3 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 0 |
| J11 3NE #2 | 2 | 1 | 5 | 5 | 0 | 1 | 1 | 0 | 1 | 0 |
| J10 3NW | 1 | 1 | 5 | 5 | 1 | 1 | 0 | 1 | 0 | 1 |
| I10 3NW (P) | 1 | 0 | 5 | 5 | 1 | 2 | 1 | 1 | 0 | 1 |
| J9 3SW | 2 | 0 | 1 | 1 | 0 | 3 | 0 | 1 | 0 | 1 |
| I10 3SW | 9 | 0 | 2 | 2 | 9 | 3 | 9 | 1 | 0 | 9 |
| I10 4SW | 2 | 0 | 2 | 1 | 0 | 2 | 1 | 1 | 0 | 2 |
| J9 5 | 1 | 0 | 2 | 3 | 0 | 0 | 1 | 0 | 0 | 0 |
| J11 5SE #1 | 1 | 0 | 2 | 3 | 1 | 3 | 1 | 1 | 0 | 2 |
| I10 5SW (P) | 1 | 1 | 2 | 3 | 1 | 2 | 0 | 1 | 1 | 1 |
| J11 5SE #2 | 3 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 0 | 2 |
| I11 5SW #1 (P) | 2 | 1 | 2 | 1 | 1 | 3 | 0 | 0 | 0 | 2 |

**- Artifact found in secondary or uncertain context** **- Characteristic does not exist for this artifact**

| Bead ID | Outer Rim Striae | Outer Rim Patina | Colouring | Wear | Staining | Delam. | Orton Production Value | K&C Production Value |
|---|---|---|---|---|---|---|---|---|
| J9 1NE #1 (P) | 3 | 0 | 1 | 1 | 2 | 3 | VIIa | 11 |
| J9 1NE #2 | 1 | 1 | 0 | 0 | 1 | 0 | Iva | 7 or 9 |
| I10 2NW | 1 | 0 | 1 | 2 | 2 | 1 | VIIa | 11 |
| J9 2SE/SW | 1 | 1 | 1 | 2 | 0 | 2 | VIIa | 11 |
| J10 2NE | 1 | 1 | 1 | 1 | 0 | 1 | VIIa | 11 |
| J10 2SW | 1 | 0 | 0 | 1 | 0 | 0 | VIIa | 11 |
| J11 2NE (P) | 0 | 0 | 0 | 1 | 1 | 2 | VIIa | 11 |
| J10 2SE | 9 | 9 | 1 | 0 | 0 | 0 | IIa/b | 3 or 4 |
| J11 3NE #1 | 3 | 1 | 1 | 1 | 0 | 2 | VIIa | 11 |
| J10 3NE | 0 | 0 | 0 | 1 | 0 | 0 | VIIa | 11 |
| J11 3NW | 2 | 0 | 1 | 1 | 0 | 0 | VIIa | 11 |
| J9 3NW | 0 | 0 | 1 | 0 | 0 | 0 | VIIa | 11 |
| J11 3NE #2 | 0 | 1 | 1 | 1 | 0 | 2 | VIIa | 11 |
| J10 3NW | 0 | 0 | 1 | 1 | 0 | 3 | VIIa | 11 |
| I10 3NW (P) | 1 | 0 | 1 | 1 | 2 | 2 | VIIa | 11 |
| J9 3SW | 3 | 0 | 1 | 0 | 0 | 0 | IVa or Va | 7 or 9 |
| I10 3SW | 9 | 9 | 1 | 0 | 0 | 0 | IVb | 6 or 8 |
| I10 4SW | 0 | 0 | 0 | 1 | 0 | 0 | VIIa | 11 |
| J9 5 | 0 | 0 | 0 | 2 | 1 | 0 | VIIa | 11 |
| J11 5SE #1 | 0 | 0 | 0 | 1 | 0 | 0 | VIIa | 11 |
| I10 5SW (P) | 3 | 1 | 1 | 1 | 1 | 1 | VIIa | 11 |
| J11 5SE #2 | 1 | 0 | 1 | 0 | 0 | 1 | VIa | 9 |
| I11 5SW #1 (P) | 1 | 0 | 0 | 1 | 0 | 0 | VIIa | 11 |

- Artifact found in secondary or uncertain context

- Characteristic does not exist for this artifact

| Bead ID | 5Y | 2.5Y | 10YR | 7.5YR | 5YR | 2.5YR | GLEY1 | GLEY 2 | Colour Names |
|---|---|---|---|---|---|---|---|---|---|
| J9 1NE #1 (P) | | | | | | | N 5/ | | Gray |
| J9 1NE #2 | | | 6/3 | | | | | | Pale brown |
| I10 2NW | | | | 2.5/1 | 2.5/1 | | | | Black |
| J9 2SE/SW | 2.5/1 | 2.5/1 | | | | | N 3/ | | Black, Very dark gray |
| J10 2NE | | | | 5/3 | | | | | Brown |
| J10 2SW | | | 8/3 | | | | | | Very pale brown |
| J11 2NE (P) | | | 8/3 | 8/3 | | | | | Very pale brown, Pink |
| J10 2SE | | | 4/2 | 4/1 | | | | | Dark grayish brown, Dark gray |
| J11 3NE #1 | | | | | | | N 2.5/ | | Black |
| J10 3NE | | | 8/4 | | | | | | Very pale brown |
| J11 3NW | | | 4/3, 4/2 | | | | | | Brown, Dark grayish brown |
| J9 3NW | 2.5/1 | | | | | | N 2.5/ | | Black, Black |
| J11 3NE #2 | | | | | | | N 3/ | | Very dark gray |
| J10 3NW | | | | | | | N 3/, N 2.5/ | | Very dark gray, Black |
| I10 3NW (P) | | | | | | | N 4/ | | Dark gray |
| J9 3SW | | | 6/6 | | | | | | Brownish yellow |
| I10 3SW | | | | 2.5/1 | | | | | Black |
| I10 4SW | | | 7/3 | | | | | | Very pale brown |
| J9 5 | | | 7/4, 7/3 | | | | | | Very pale brown, Very pale brown |
| J11 5SE #1 | | | 7/3, 7/4 | | | | | | Very pale brown, Very pale brown |
| I10 5SW (P) | | | | 5/3, 4/3 | | | | | Brown, Brown |
| J11 5SE #2 | | | | 4/3, 3/4 | | | | | Brown, Dark Brown |
| I11 5SW #1 (P) | | | 6/4, 7/4 | | | | | | Light yellowish brown, Very pale brown |

**- Artifact found in secondary or uncertain context**

**- Characteristic does not exist for this artifact**

| Bead ID | Percent Cemented | Min. External Diam. | Max. External Diam. | Avg. External Diam. | Min/Max External Diam. | Aperture Diam. | Aperture/ External Diam. | Min. Thick | Max. Thick | Avg. Thick | Weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I11 5SW #2 (P) | 20 | 8.26 | 8.48 | 8.37 | 0.97 | 3.90 | 0.47 | 1.75 | 2.00 | 1.88 | 0.18 |
| J9 6#2 | 0 | 4.91 | 4.98 | 4.95 | 0.99 | 1.42 | 0.29 | 1.44 | 1.69 | 1.57 | 0.04 |
| J9 6 #1 | 100 | 6.28 | 6.37 | 6.33 | 0.99 | 2.41 | 0.38 | 1.33 | 1.48 | 1.41 | 0.06 |
| J11 6NE #2 | 0 | 5.64 | 5.81 | 5.73 | 0.97 | 1.90 | 0.33 | 1.61 | 1.75 | 1.68 | 0.08 |
| J11 6NE #1 | 50 | 7.63 | 8.19 | 7.91 | 0.93 | 2.77 | 0.35 | 1.48 | 1.50 | 1.49 | 0.13 |
| I11 7SW #1 (P) | 5 | 6.18 | 6.25 | 6.22 | 0.99 | 2.81 | 0.45 | 1.53 | 1.76 | 1.65 | 0.09 |
| J9 8 | 0 | 6.20 | 6.29 | 6.25 | 0.99 | 3.07 | 0.49 | 1.15 | 1.39 | 1.27 | 0.05 |
| I9/J9 9 #1 | 100 | 4.66 | 4.77 | 4.72 | 0.98 | 2.17 | 0.46 | 1.40 | 1.75 | 1.58 | 0.06 |
| I9/J9 9 #2 | 20 | 6.62 | 7.15 | 6.89 | 0.93 | 2.62 | 0.38 | 1.29 | 1.50 | 1.40 | 0.10 |
| I9/J9 9 #3 | 80 | 6.72 | 6.96 | 6.84 | 0.97 | 2.49 | 0.36 | 1.44 | 1.94 | 1.69 | 0.11 |
| I11 9SE | 45 | 8.06 | | | | 1.35 | | 1.76 | 1.89 | 1.83 | 0.13 |
| I11 9SW | 0 | | | | | | | 2.08 | 2.12 | 2.10 | 0.15 |
| I9/J9 10 | 0 | 5.74 | 5.86 | 5.80 | 0.98 | 1.81 | 0.31 | 1.54 | 1.64 | 1.59 | 0.09 |
| 2006 TP1 75-80 | | 5.91 | 6.11 | 6.01 | 0.97 | 2.01 | 0.33 | 1.79 | 1.81 | 1.8 | 0.09 |
| 2006 TP1 45-55 | | 5.67 | 6.18 | 5.93 | 0.92 | 2.56 | 0.43 | 1.45 | 1.52 | 1.48 | 0.05 |
| Feat.B-1 C#1 | 0 | 6.41 | 6.48 | 6.45 | 0.99 | 2.10 | 0.33 | 1.25 | 1.34 | 1.30 | 0.08 |
| Feat.B-1 A#2 | 20 | 6.49 | 6.60 | 6.55 | 0.98 | 1.81 | 0.28 | 1.90 | 1.97 | 1.94 | 0.13 |
| Feat.B-1 C#2 | 0 | 5.89 | | 5.89 | | 2.57 | 0.44 | 1.29 | 1.49 | 1.39 | 0.02 |
| Feat.B-1 A#1 | 5 | | | | | | | 2.09 | 2.19 | 2.14 | 1.07 |
| I11 5SE #1 | 0 | 4.63 | 5.76 | 5.20 | 0.80 | 2.16 | 0.42 | 1.40 | 1.63 | 1.52 | 0.04 |
| I11 5SE #2 | 0 | 7.48 | 7.82 | 7.65 | 0.96 | 2.96 | 0.39 | 1.29 | 1.54 | 1.42 | 0.12 |
| I11 4SE | 20 | 5.65 | 5.93 | 5.79 | 0.95 | 1.71 | 0.30 | 1.52 | 1.73 | 1.63 | 0.07 |

(light green box) - Artifact found in secondary or uncertain context
(grey box) - Characteristic does not exist for this artifact

| Bead ID | Shape | Patina | Aperture Shape | Position of Restriction | Aperture Centered | Aperture Chipped | Aperture Smooth | Aperture Striations | Aperture Patina | Outer Rim Chip |
|---|---|---|---|---|---|---|---|---|---|---|
| I11 5SW #2 (P) | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 0 | 1 | 1 |
| J9 6#2 | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 1 |
| J9 6 #1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| J11 6NE #2 | 1 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 0 | 2 |
| J11 6NE #1 | 4 | 5 | 5 | 5 | 1 | 5 | 1 | 5 | 5 | 5 |
| I11 7SW #1 (P) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| J9 8 | 1 | 5 | 5 | 5 | 0 | 5 | 5 | 5 | 5 | 5 |
| I9/J9 9 #1 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 0 | 1 | 1 |
| I9/J9 9 #2 | 2 | 0 | 5 | 5 | 0 | 1 | 1 | 0 | 0 | 1 |
| I9/J9 9 #3 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| I11 9SE | 5 | 0 | 1 | 1 | 5 | 2 | 0 | 0 | 0 | 5 |
| I11 9SW | 5 | 0 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| I9/J9 10 | 2 | 0 | 2 | 2 | 1 | 2 | 1 | 0 | 1 | 0 |
| 2006 TP1 75-80 | 1 | 1 | 2 | 1 | 0 | 2 | 1 | 1 | 0 | 1 |
| 2006 TP1 45-55 | 4 | 5 | 1 | 1 | 1 | 5 | 0 | 1 | 0 | 1 |
| Feat.B-1 C#1 | 1 | 1 | 5 | 5 | 1 | 2 | 1 | 1 | 1 | 2 |
| Feat.B-1 A#2 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 2 |
| Feat.B-1 C#2 | 5 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| Feat.B-1 A#1 | 9 | 0 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| I11 5SE #1 | 3 | 1 | 5 | 5 | 1 | 5 | 1 | 0 | 0 | 5 |
| I11 5SE #2 | 2 | 1 | 5 | 5 | 0 | 2 | 0 | 1 | 1 | 1 |
| I11 4SE | 1 | 0 | 2 | 1 | 0 | 2 | 1 | 1 | 0 | 1 |

- Artifact found in secondary or uncertain context

- Characteristic does not exist for this artifact

| Bead ID | Outer Rim Striae | Outer Rim Patina | Colouring | Wear | Staining | Delam. | Orton Production Value | K&C Production Value |
|---|---|---|---|---|---|---|---|---|
| I11 5SW #2 (P) | 0 | 1 | 1 | 1 | 0 | 1 | VIIa or VIIb | 11 |
| J9 6#2 | 0 | 1 | 0 | 1 | 0 | 0 | VIIa | 11 |
| J9 6 #1 | 0 | 1 | 1 | 2 | 1 | 1 | VIIa | 11 |
| J11 6NE #2 | 0 | 0 | 0 | 0 | 2 | 0 | VIIa | 11 |
| J11 6NE #1 | 5 | 5 | 1 | 5 | 5 | 4 | Iva/b | 10 |
| I11 7SW #1 (P) | 0 | 1 | 1 | 2 | 0 | 1 | VIIa | 11 |
| J9 8 | 5 | 5 | 5 | 5 | 5 | 4 | VIIa | 11 |
| I9/J9 9 #1 | 0 | 1 | 1 | 2 | 0 | 1 | VIIa | 11 |
| I9/J9 9 #2 | 1 | 0 | 1 | 5 | 0 | 2 | VIIa | 11 |
| I9/J9 9 #3 | 1 | 1 | 1 | 1 | 1 | 1 | VIIa | 11 |
| I11 9SE | 5 | 5 | 0 | 0 | 0 | 0 | IIIb | 6 |
| I11 9SW | 9 | 9 | 0 | 0 | 0 | 0 | Ia | 0 or 1 |
| I9/J9 10 | 0 | 1 | 1 | 2 | 2 | 0 | VIIa | 11 |
| 2006 TP1 75-80 | 1 | 0 | 0 | 1 | 1 | 1 | VIIa | 11 |
| 2006 TP1 45-55 | 0 | 5 | 5 | 2 | 2 | 1 | VIa or VIIa | 9 or 11 |
| Feat.B-1 C#1 | 1 | 0 | 1 | 1 | 0 | 2 | VIIa | 11 |
| Feat.B-1 A#2 | 1 | 0 | 1 | 1 | 1 | 1 | VIIa | 11 |
| Feat.B-1 C#2 | 0 | 0 | 0 | 2 | 0 | 0 | VIIb | 12 |
| Feat.B-1 A#1 | 9 | 9 | 1 | 0 | 0 | 0 | Ia | 0 or 1 |
| I11 5SE #1 | 1 | 1 | 1 | 1 | 0 | 3 | VIIa | 11 |
| I11 5SE #2 | 1 | 1 | 1 | 1 | 1 | 2 | VIIa | 11 |
| I11 4SE | 0 | 1 | 1 | 1 | 1 | 1 | VIIa | 11 |

**- Artifact found in secondary or uncertain context**    **- Characteristic does not exist for this artifact**

| Bead ID | 5Y | 2.5Y | 10YR | 7.5YR | 5YR | 2.5YR | GLEY1 | GLEY2 | Colour Names |
|---|---|---|---|---|---|---|---|---|---|
| I11 5SW #2 (P) | | | 5/2, 4/2 | | | | | | Grayish brown, Dark grayish brown |
| J9 6#2 | | | 8/3, 7/3, 7/4 | | | | | | Very pale brown (x3) |
| J9 6 #1 | | 2.5/1 | | | | | | | Black |
| J11 6NE #2 | | | 7/4 | | | | | | Very pale brown |
| J11 6NE #1 | | | | | | | | | |
| I11 7SW #1 (P) | 2.5/1 | | | | | | N 2.5/ | | Black, Black |
| J9 8 | | | | | | | | | |
| I9/J9 9 #1 | | | 2/1, 3/2 | | | | | | Black, Very dark grayish brown |
| I9/J9 9 #2 | | | | | | | N 4/ | | Dark Gray |
| I9/J9 9 #3 | | | 7/4 | 6/1 | | | | | Very pale brown, Gray |
| I11 9SE | | | 7/4 | | | | | | Very pale brown |
| I11 9SW | | | 6/3 | | | | | | Pale brown |
| I9/J9 10 | | | 8/2, 8/3, 7/4 | | | | | | Very pale brown (x3) |
| 2006 TP1 75-80 | | | 7/4 | | | | | | Very pale brown |
| 2006 TP1 45-55 | | | 8/3 | 6/6 | | | | | Very pale brown, Reddish yellow |
| Feat.B-1 C#1 | | | | | | | N 3/ | 10B 3/1 | Very dark gray, Very dark bluish gray |
| Feat.B-1 A#2 | | | 8/2 | | | | | | Very pale brown |
| Feat.B-1 C#2 | | | 8/3 | | | | | | Very pale brown |
| Feat.B-1 A#1 | | | 7/3, 6/3, 3/2 | | | | | | Very pale brown, pale brown, Very dark grayish brown |
| I11 5SE #1 | | | | | | | | | |
| I11 5SE #2 | | 3/1, 2.5/1 | | | | | | | Very dark gray, Black |
| I11 4SE | | 4/1 | | | | | | | Dark gray |
| I11 5SW #2 (P) | | | 5/2, 4/2 | | | | | | Grayish brown, Dark grayish brown |

**- Artifact found in secondary or uncertain context** **- Characteristic does not exist for this artifact**

| Bead ID | Percent Cemented | Min. External Diam. | Max. External Diam. | Avg. External Diam. | Min/Max External Diam. | Aperture Diam. | Aperture/ External Diam. | Min. Thick | Max. Thick | Avg. Thick | Weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I11 2SW (P) | 0 | 7.24 | 7.55 | 7.40 | 0.96 | 2.61 | 0.35 | 1.32 | 1.46 | 1.39 | 0.13 |
| J11 3NE Ft.2 #2 | 0 | 4.98 | 5.00 | 4.99 | 1.00 | 1.85 | 0.37 | 1.61 | 1.74 | 1.68 | 0.06 |
| J11 1SE Ft.2 | 0 | 5.22 | 5.34 | 5.28 | 0.98 | 1.52 | 0.29 | 1.64 | 1.85 | 1.75 | 0.07 |
| I11 7SE Ft.2 #1 | 20 | 5.23 | 5.44 | 5.34 | 0.96 | 2.22 | 0.42 | 0.86 | 1.07 | 0.97 | 0.05 |
| J11 3SW Ft.2 #1 | 0 | 5.74 | | 5.74 | | 2.87 | 0.50 | 1.48 | 1.65 | 1.57 | 0.02 |
| J11 6 Ft.2 #1 | 0 | 5.62 | 5.86 | 5.74 | 0.96 | 1.85 | 0.32 | 1.45 | 1.81 | 1.63 | 0.08 |
| I11 6SE Ft.2 #1 | 0 | 6.21 | 6.47 | 6.34 | 0.96 | 2.51 | 0.40 | 1.50 | 1.59 | 1.55 | 0.11 |
| I11 9SE Ft.2 | 5 | 6.43 | 6.59 | 6.51 | 0.98 | 2.72 | 0.42 | 1.63 | 1.71 | 1.67 | 0.09 |
| I11 Nwall | 0 | 6.81 | 6.87 | 6.84 | 0.99 | 2.63 | 0.38 | 1.62 | 1.65 | 1.64 | 0.10 |
| J11 4 Ft.2 #1 | 5 | 7.17 | 7.48 | 7.33 | 0.96 | 2.69 | 0.37 | 1.44 | 1.53 | 1.49 | 0.10 |
| J11 3SW Ft.2 #2 | 5 | 7.30 | 7.59 | 7.45 | 0.96 | 3.55 | 0.48 | 1.54 | 1.61 | 1.58 | 0.10 |
| J11 1NE Ft.2 | 0 | 7.75 | 7.79 | 7.77 | 0.99 | 2.48 | 0.32 | 1.45 | 1.65 | 1.55 | 0.12 |
| I11 6SE Ft.2 #2 | 20 | 11.73 | 13.99 | 12.86 | 0.84 | | | 2.17 | 2.30 | 2.24 | 0.66 |
| J11 4Ft.2 #2 | 5 | 15.83 | 21.41 | | | | | 1.88 | 2.00 | 1.94 | 1.25 |
| J11 3NE Ft.2 #1 | 5 | 6.95 | 7.05 | 7.00 | 0.99 | 2.10 | 0.30 | 1.75 | 1.85 | 1.80 | 0.13 |
| I9 1NE | 0 | 5.72 | 5.82 | 5.77 | 0.98 | 1.65 | 0.29 | 1.68 | 1.71 | 1.70 | 0.09 |
| I9 1NW | 100 | 6.81 | 6.86 | 6.84 | 0.99 | 2.30 | 0.34 | 1.65 | 1.76 | 1.71 | 0.12 |
| I9 1SW | 0 | 7.72 | 7.82 | 7.77 | 0.99 | 2.86 | 0.37 | 1.37 | 1.60 | 1.49 | 0.13 |
| I10 3NE | 0 | 5.66 | 5.80 | 5.73 | 0.98 | 1.65 | 0.29 | 2.02 | 2.05 | 2.04 | 0.10 |
| I9 5 | 100 | 6.21 | 6.23 | 6.22 | 1.00 | 2.54 | 0.41 | 1.55 | 1.75 | 1.65 | 0.09 |

**- Artifact found in secondary or uncertain context** **- Characteristic does not exist for this artifact**

| Bead ID | Shape | Patina | Aperture Shape | Position of Restriction | Aperture Centered | Aperture Chipped | Aperture Smooth | Aperture Striations | Aperture Patina | Outer Rim Chip |
|---|---|---|---|---|---|---|---|---|---|---|
| I11 2SW (P) | 1 | 1 | 5 | 5 | 0 | 1 | 1 | 0 | 1 | 1 |
| J11 3NE Ft.2 #2 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| J11 1SE Ft.2 | 1 | 0 | 1 | 3 | 1 | 1 | 1 | 1 | 0 | 0 |
| I11 7SE Ft.2 #1 | 2 | 5 | 5 | 5 | 0 | 5 | 1 | 5 | 0 | 5 |
| J11 3SW Ft.2 #1 | 5 | 0 | 1 | 1 | 5 | 0 | 5 | 0 | 0 | 0 |
| J11 6 Ft.2 #1 | 1 | 0 | 2 | 3 | 1 | 2 | 0 | 0 | 0 | 2 |
| I11 6SE Ft.2 #1 | 1 | 0 | 3 | 3 | 0 | 1 | 0 | 1 | 0 | 2 |
| I11 9SE Ft.2 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 1 |
| I11 Nwall | 1 | 0 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 |
| J11 4 Ft.2 #1 | 1 | 1 | 5 | 5 | 1 | 2 | 1 | 0 | 0 | 2 |
| J11 3SW Ft.2 #2 | 1 | 0 | 3 | 3 | 1 | 1 | 1 | 0 | 0 | 0 |
| J11 1NE Ft.2 | 1 | 1 | 3 | 5 | 1 | 3 | 1 | 1 | 1 | 2 |
| I11 6SE Ft.2 #2 | 9 | 0 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| J11 4Ft.2 #2 | 9 | 0 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| J11 3NE Ft.2 #1 | 1 | 0 | 1 | 1 | 0 | 3 | 0 | 1 | 0 | 2 |
| I9 1NE | 1 | 0 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 2 |
| I9 1NW | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 0 |
| I9 1SW | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 2 |
| I10 3NE | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 |
| I9 5 | 1 | 0 | 3 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |

**- Artifact found in secondary or uncertain context**

**- Characteristic does not exist for this artifact**

| Bead ID | Outer Rim Striae | Outer Rim Patina | Colouring | Wear | Staining | Delam. | Orton Production Value | K&C Production Value |
|---|---|---|---|---|---|---|---|---|
| I11 2SW (P) | 0 | 1 | 1 | 2 | 0 | 3 | VIIa | 11 |
| J11 3NE Ft.2 #2 | 1 | 0 | 1 | 1 | 0 | 0 | VIIa | 11 |
| J11 1SE Ft.2 | 0 | 0 | 0 | 1 | 1 | 0 | VIIa | 11 |
| I11 7SE Ft.2 #1 | 1 | 5 | 1 | 2 | 0 | 4 | VIIa | 11 |
| J11 3SW Ft.2 #1 | 2 | 1 | 0 | 2 | 0 | 1 | VIIb | 12 |
| J11 6 Ft.2 #1 | 1 | 0 | 0 | 1 | 1 | 1 | VIIa | 11 |
| I11 6SE Ft.2 #1 | 0 | 0 | 1 | 0 | 0 | 1 | VIIa | 11 |
| I11 9SE Ft.2 | 1 | 1 | 0 | 1 | 0 | 1 | VIIa | 11 |
| I11 Nwall | 1 | 0 | 1 | 1 | 0 | 0 | VIIa | 11 |
| J11 4 Ft.2 #1 | 1 | 1 | 1 | 5 | 0 | 3 | VIIa | 11 |
| J11 3SW Ft.2 #2 | 0 | 0 | 0 | 1 | 0 | 1 | VIIa | 11 |
| J11 1NE Ft.2 | 0 | 1 | 1 | 5 | 0 | 3 | VIIa | 11 |
| I11 6SE Ft.2 #2 | 9 | 9 | 1 | 0 | 0 | 0 | Ia | 1 or 2 |
| J11 4Ft.2 #2 | 9 | 9 | 1 | 0 | 0 | 0 | Ia | 0 or 1 |
| J11 3NE Ft.2 #1 | 1 | 1 | 0 | 1 | 1 | 1 | Via | 9 |
| I9 1NE | 3 | 0 | 1 | 1 | 1 | 0 | VIIa | 11 |
| I9 1NW | 0 | 1 | 1 | 2 | 0 | 1 | VIIa | 11 |
| I9 1SW | 0 | 1 | 1 | 1 | 0 | 3 | VIIa | 11 |
| I10 3NE | 1 | 0 | 1 | 1 | 0 | 0 | VIIa | 11 |
| I9 5 | 0 | 0 | 0 | 2 | 0 | 0 | VIIa | 11 |

- Artifact found in secondary or uncertain context

- Characteristic does not exist for this artifact

| Bead ID | 5Y | 2.5Y | 10YR | 7.5YR | 5YR | 2.5YR | GLEY1 | GLEY2 | Colour Names |
|---|---|---|---|---|---|---|---|---|---|
| I11 2SW (P) | 2.5/1 | | | | | | N 2.5/ | | Black, Black |
| J11 3NE Ft.2 #2 | | | 5/3 | | | | | | Brown |
| J11 1SE Ft.2 | | | 7/3, 7/4 | | | | | | Very pale brown |
| I11 7SE Ft.2 #1 | | | | | | | | | |
| J11 3SW Ft.2 #1 | | | 8/3 | | | | | | Very pale brown |
| J11 6 Ft.2 #1 | | | 8/3, 8/2 | | | | | | Very pale brown |
| I11 6SE Ft.2 #1 | | | 3/1 | 3/1 | | | | | Very dark gray, Very dark gray |
| I11 9SE Ft.2 | | | 6/4 | | | | | | Light yellowish brown |
| I11 Nwall | | | 4/2, 5/2 | | | | | | Dark grayish brown, Grayish brown |
| J11 4 Ft.2 #1 | | 2.5/1 | | | | | N 2.5/, N 3/ | | Black, Black, Very dark gray |
| J11 3SW Ft.2 #2 | | 8/2 | 8/2 | | | | | | Pale yellow, Very pale brown |
| J11 1NE Ft.2 | | | | | | | N 2.5/ | 10B 2.5/1 | Black, Bluish black |
| I11 6SE Ft.2 #2 | | | | | 2.5/1 | | | | Black |
| J11 4Ft.2 #2 | | | 6/3, 6/4, 5/4 | | | | | | Pale brown, Light yellowish brown, Yellowish brown |
| J11 3NE Ft.2 #1 | | | 7/4 | | | | | | Very pale brown |
| I9 1NE | | | 5/1 | | | | | | Gray |
| I9 1NW | | | 5/4 | 5/4 | | | | | Yellowish brown, Brown |
| I9 1SW | | | | | | | N 2.5/ | | Black |
| I10 3NE | | 4/1, 5/1 | | | | | | | Dark gray, Dark gray |
| I9 5 | | | | 5/4, 5/6 | | | | | Brown, Strong brown |
| I11 2SW (P) | 2.5/1 | | | | | | N 2.5/ | | Black, Black |
| J11 3NE Ft.2 #2 | | | 5/3 | | | | | | Brown |
| J11 1SE Ft.2 | | | 7/3, 7/4 | | | | | | Very pale brown |

**- Artifact found in secondary or uncertain context** **- Characteristic does not exist for this artifact**

| Bead ID | Percent cemented | Min. External Diam. | Max. External Diam. | Avg External Diam. | Min/Max External Diam. | Aperture Diam. | Aperture/ External Diam. | Min. Thick | Max. Thick | Avg Thick | Weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I9 2SE #1 | 90 | 4.32 | 4.42 | 4.37 | 0.98 | 1.52 | 0.35 | 1.32 | 1.66 | 1.49 | 0.04 |
| I10 2NE | 100 | 5.77 | 5.94 | 5.86 | 0.97 | 2.65 | 0.45 | 1.24 | 1.56 | 1.40 | 0.08 |
| I9 2NE | 50 | 6.39 | 6.42 | 6.41 | 1.00 | 2.09 | 0.33 | 1.54 | 1.63 | 1.59 | 0.11 |
| I9 2SE #2 | 80 | 6.10 | 6.62 | 6.36 | 0.92 | 2.54 | 0.40 | 1.43 | 1.54 | 1.49 | 0.08 |
| J11 6 Ft.2 #2 | 0 | | 2.47 | | | 1.50 | | | | | N/A |
| J11 3SE Ft.2 | 0 | 4.71 | 4.80 | 4.76 | 0.98 | 2.25 | 0.47 | 1.26 | 1.35 | 1.31 | 0.03 |

| Bead ID | Shape | Patina | Aperture Shape | Position of Restriction | Aperture Centered | Aperture Chipped | Aperture Smooth | Aperture Striations | Aperture Patina | Outer Rim Chip |
|---|---|---|---|---|---|---|---|---|---|---|
| I9 2SE #1 | 1 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| I10 2NE | 2 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| I9 2NE | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 0 | 1 | 1 |
| I9 2SE #2 | 4 | 1 | 5 | 5 | 0 | 2 | 1 | 1 | 5 | 1 |
| J11 6 Ft.2 #2 | 1 | 0 | 3 | 3 | 1 | 0 | 1 | 0 | 0 | 0 |
| J11 3SE Ft.2 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |

**- Artifact found in secondary or uncertain context** (light green box)

**- Characteristic does not exist for this artifact** (grey box)

| Bead ID | Outer Rim Striae | Outer Rim Patina | Colouring | Wear | Staining | Delam. | Orton Production Value | K&C Production Value |
|---|---|---|---|---|---|---|---|---|
| I9 2SE #1 | 0 | 1 | 1 | 2 | 1 | 1 | VIIa | 11 |
| I10 2NE | 0 | 0 | 1 | 2 | 0 | 1 | VIIa | 11 |
| I9 2NE | 0 | 1 | 1 | 2 | 1 | 1 | VIIa | 11 |
| I9 2SE #2 | 0 | 0 | 1 | 5 | 0 | 3 | VIIa | 11 |
| J11 6 Ft.2 #2 | 0 | 0 | 1 | 1 | 0 | 0 | VIIa | 11 |
| J11 3SE Ft.2 | 0 | 1 | 1 | 5 | 0 | 2 | VIIa | 11 |

| Bead ID | 5Y | 2.5Y | 10YR | 7.5YR | 5YR | 2.5YR | GLEY1 | GLEY2 | Colour Names |
|---|---|---|---|---|---|---|---|---|---|
| I9 2SE #1 | | | 3/2, 3/3 | | | | | | Very dark grayish brown, Dark brown |
| I10 2NE | | | | 5/6 | | | | | Strong brown |
| I9 2NE | | | 4/2 | | | 4/1 | | | Dark grayish brown, Dark gray |
| I9 2SE #2 | | | | | | | N 4/, N3/ | | Dark gray, Very dark gray |
| J11 6 Ft.2 #2 | | | | | | | | | |
| J11 3SE Ft.2 | | | | | | | N 2.5/ | 10B 2.5/1 | Black, Bluish black |

**- Artifact found in secondary or uncertain context**

**- Characteristic does not exist for this artifact**

**Definition of Terms:**

**Bead ID**:
Unique identifying name based on location of find. Eg. I9 6NE Ft.2#3 (P) – Unit I9, Level 6, northeast quadrant, Feature 2, 3rd bead from that location, (P) indicates it was found *insitu* and given a 3-D provenience.

**Percent Cemented**:
Visual estimation of bead surface covered in hardened sediment which cannot be removed by dry brushing, given as a percentage.

**Min. External Diam.**:
Smallest external diameter, given in millimetres to two decimal places.

**Max. External Diam.**:
Largest external diameter, given in millimetres to two decimal places.

**Avg. External Diam.**:
Calculated as (minimum diameter times maximum diameter) / 2, given in millimetres to two decimal places.

**Min/Max External Diam.**:
Calculated as minimum diameter / maximum diameter.

**Aperture Diam.**:
Single measurement of aperture width, given in millimetres to two decimal places.

**Aperture/External Diam.**:
Calculated as aperture diameter / average diameter.

**Min. Thick**:
Smallest thickness, given in millimetres to two decimal places.

**Max. Thick**:
Largest thickness, given in millimetres to two decimal places.

**Avg. Thick**:
Calculated as (minimum thickness times maximum thickness) / 2, given in millimetres to two decimal places.

**Weight**:
Weight, given in grams to two decimal places.

**Shape**:
Visually estimated external shape of bead or blank.

1 – Circular
2 – Roughly circular (rounded shape but not a circle)
3 – Oval
4 – Polygon
5 – Unable to determine (due to delamination or breakage)
9 – No outer shaping

**Patina**:
Gloss or slick sheen on outer surface of OES.

0 – No surface patina
1 – Surface patina
5 – Unable to determine (due to delamination)

**Aperture Shape**:
Visually estimated shape of aperture in cross-section.

1 – Conical
2 – Biconical
3 – Cylindrical
5 – Unable to determine (due to delamination or breakage)
9 – No aperture

**Position of Restriction**:
Visual estimate of the location of narrowest point of aperture.

1 – Significantly towards outer surface
2 – Significantly towards inner surface
3 – Approximately equidistant between surfaces
5 – Unable to determine (due to delamination or breakage)
9 – No aperture

**Aperture Center**:
Visual estimate of whether aperture is in general center of bead's outer rim.

0 – Not centered (significant bulk of bead to one side)
1 – Centered
5 – Unable to determine (due to delamination or breakage)
9 – No aperture

**Aperture Chip**:
Visual inspection of cuticle/palisade damage around aperture edges.

0 – No chipping
1 – Smoothed dents, edges of cuticle not visible
2 – Edges of cuticle somewhat defined
3 – Edges of cuticle sharply defined
5 – Unable to determine (due to delamination)
9 – No aperture

**Aperture Smooth**:
Visual estimate of whether aperture arc is generally consistent for at least 75% of aperture circumference.

0 – Aperture not smooth/consistent
1 – Aperture consistent
5 – Unable to determine (due to delamination or breakage)
9 – No aperture

**Aperture Striae**:
Visual inspection for linear grooving or scratching within the aperture "cup".

0 – No aperture striae
1 – Aperture striae
5 – Unable to determine (due to delamination)
9 – No aperture

**Aperture Patina**:
Visual inspection for a gloss or slick sheen on position of restriction (or within "cup" for incomplete perforations)

0 – No aperture patina
1 – Aperture patina
5 – Unable to determine (due to delamination)
9 – No aperture

**Outer Rim Chip**:
Visual inspection of cuticle/palisade damage around outer rim.

0 – No outer rim chipping
1 – Smoothed dents, edges of cuticle not visible
2 – Edges of cuticle somewhat visible
3 – Edges of cuticle sharply visible
5 – Unable to determine (due to delamination or breakage)
9 – No outer rim shaping

**Outer Rim Striae**:
Visual inspection for linear grooving or scratching around the outer rim.

0 – No outer rim striae
1 – Vertical outer rim striae (perpendicular to cuticle layer)
2 – Horizontal outer rim striae (parallel to cuticle layer)
3 – Both vertical and horizontal outer rim striae
5 – Unable to determine (due to delamination or breakage)
9 – No outer rim shaping

**Outer Rim Patina**:
Visual inspection for a gloss or slick sheen around outer rim.

0 – No outer rim patina
1 – Outer rim patina
5 – Unable to determine (due to delamination or breakage)
9 – No outer rim shaping

**Colouring**:
Visual estimate if surface colour is significantly different from natural OES colour.

0 – Not significantly different from natural OES colour
1 – Significantly different from natural OES colour
5 – Unable to determine (due to delamination or sediment coating)

**Wear**:
Visual assessment of how distinguishable the constituent OES layers are, specifically the edges of the cuticle layer, and the delineation of the mammillary cones.

0 – Constituent parts easily distinguishable
1 – Constituent parts somewhat distinguishable
2 – Constituent parts largely indistinguishable
5 – Unable to determine (due to delamination)

**Staining**:
Visual inspection for surface residue.

0 – No surface staining
1 – Ochre powder present
2 – Other residue present
3 – Both ochre powder and other residue
5 – Unable to determine (due to delamination, breakage or sediment coating)

**Delam.**:
Visual assessment of the degree of degree of surface degredation.

0 – No delamination
1 – Partial delamination of one or both surfaces
2 – Complete delamination of one surface
3 – Complete delamination of one surface, partial delamination of second surface
4 – Complete delamination of both surfaces
5 – Unable to determine (due to breakage)

**Orton**:
Visual assessment of production value, as outlined by Orton 2008. Orton's stages use roman numerals, entered as digits for SPSS.

1a – Polygonal fragment of OES
1b – Broken, polygonal fragment of OES
2a – Signs of drilling, no perforation
2b – Broken, signs of drilling, no perforation
3a – Complete perforation, no outer shaping
3b – Broken, complete perforation, no outer shaping
4a – Complete perforation, outer edges partially trimmed
4b – Broken, complete perforation, outer edges partially trimmed
5a – Outer edges fully trimmed
5b – Broken, outer edges fully trimmed
6a – Main protrusions ground off, no use polish
6b – Broken, main protrusions ground off, no use polish
7a – Completed bead
7b – Broken, completed bead

**K&C Production Value**:
Visual assessment of production value, as outlined by Kandel and Conard 2005.

0 – Indeterminate
1 – Angular blank
2 – Rounded blank
3 – Complete, partially drilled blank
4 – Broken, partially drilled blank
5 – Complete, perforated blank
6 – Broken, perforated blank
7 – Complete, perforated, slightly formed bead
8 – Broken, perforated, slightly formed bead
9 – Complete, perforated, almost bead form
10 – Broken, perforated, almost bead form
11 – Complete, finished bead
12 – Broken, finished bead

**Munsell**: Determination of outer surface colour from the Munsell Colour Chart.

## Appendix B

This is a photographic record of the OES beads recovered in 2010. The photos were all taken with a trinocular microscope at 7.5x magnification, unless otherwise indicated. The bead and blanks range in diameter from 2.47 to 21.41mm; a full list of metric measurements for each piece can be found in Appendix A. Where possible, the OES are pictured from both the external surface of the shell (shown on the left) and internal surface (shown on the right).

*Level 1 (0-10cm b.s.)*

J9 1NE#1

J9 1NE#2

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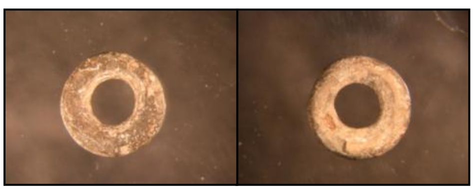
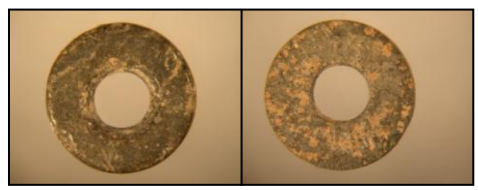
*Level 2 (10-20cm b.s.)*



I10 2NW



J9 2SE/SW

J10 2NE

J10 2SW

J11 2NE (P)

J10 2SE

*Level 3 (20-30cm b.s.)*

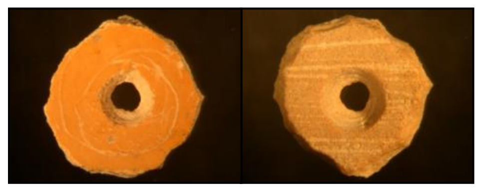
J11 3NE#1

J9 3NW

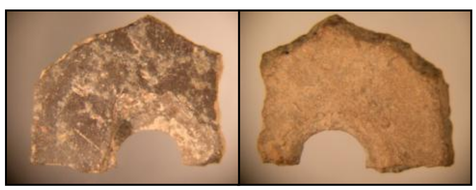
J11 3NE#2

J10 3NW

I10 3NW (P)



J9 3SW



I10 3SW

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*Level 4 (30-40cm b.s.)*

I10 4SW

*Level 5 (40-50cm b.s.)*

J9 5

J11 5SE#1

I10 5SW (P)

J11 5SE#2

I11 5SW#1 (P)

I11 5SW#2 (P)

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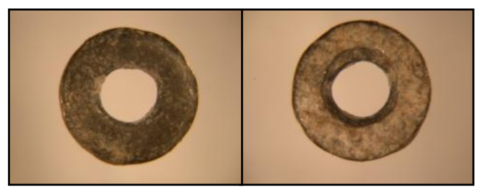
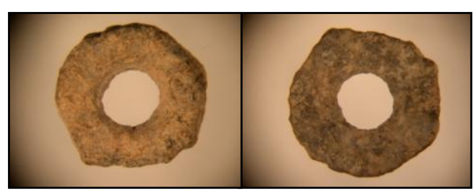
*Level 6 (50-60cm b.s.)*

J9 6#2



J9 6#1

J11 6NE#2

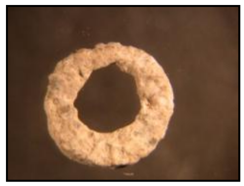


J11 6NE#1

*Level 7 (60-70cm b.s.)*

I11 7SW (P)

*Level 8 (70-80cm b.s.)*

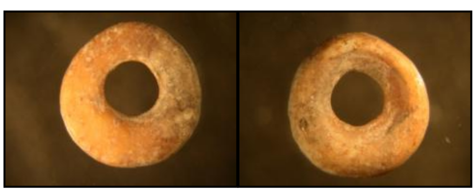


J9 8

*Level 9 (80-90cm b.s.)*

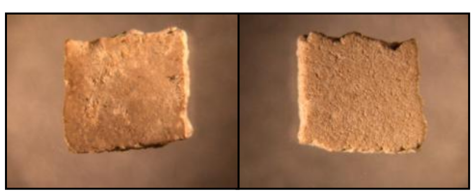
I9/J9 9#1

I9/J9 9#2



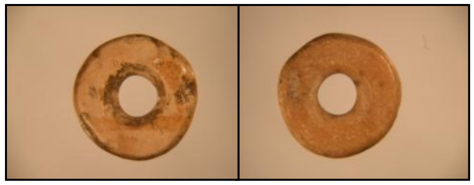
I9/J9 9#3

I11 9SE



I11 9SW

*Level 10 (90-100cm b.s.)*



I9/J9 10

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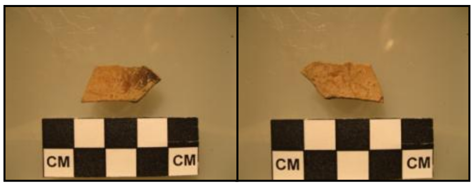
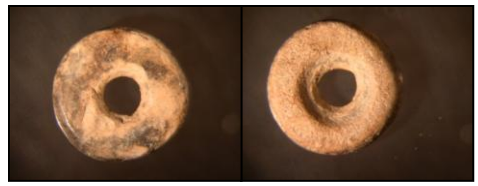
*Disturbed Context*



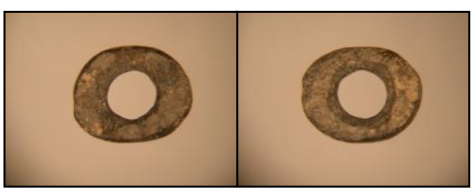

Feat.B-1 A#1 (scale incm)



Feat.B-1 A#2

Feat.B-1 C#1

Feat.B-1 C#2

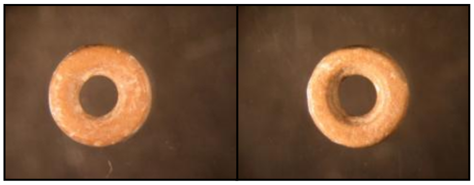


I11 5SE#1

I11 5SE#2

I11 4SE

I11 2SW (P)



J11 3NE Ft.2#2

J11 1SE Ft.2

J11 7SE Ft.2#1

J11 3SW Ft.2#1

J11 6 Ft.2#1

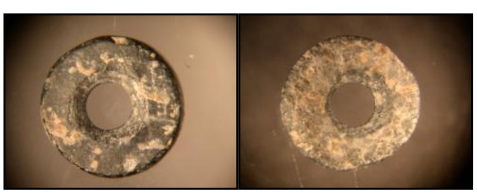
I11 6SE Ft.2#1

I11 9SE Ft.2

I11 N.Wall

J11 4Ft.2#1

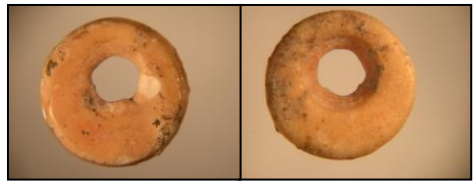
J11 3SW Ft.2#2



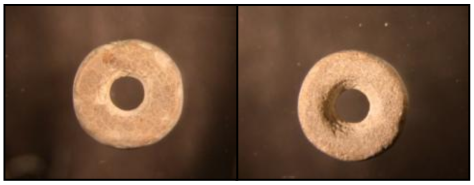
J11 1NE Ft.2

I11 6SE Ft.2#2 (scale incm)

J11 4 Ft.2#2 (scale incm)



J11 3NE Ft.2#1



I9 1NE

I9 1NW

I1 1SW

I10 3NE

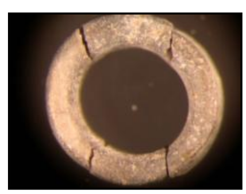
I9 5

I9 2SE#1

I10 2NE

I9 2NE

I9 2SE#2



J11 6 Ft.2#2 (photo taken at 13x mag)

J11 3SE Ft.2