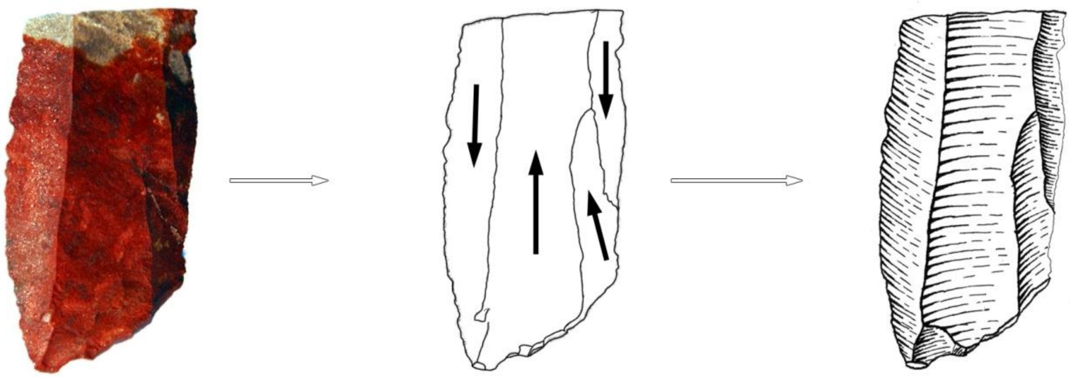
Preliminary analysis of the Howiesons Poort lithics at Klipdrift Shelter:

A *chaîne opératoire* approach



Master's thesis
by
Nikolai Rypdal Tallaksen
Student number: 168991

University of Bergen
Department of Archaeology, History, Culture and Religion
May 2012

Acknowledgements

I thank my supervisor Christopher Henshilwood and Karen van Niekerk for the great opportunity to participate in an exciting project including several excavation seasons at Klipdrift and Blombos, and for their support and guidance. Their commitment to archaeology and their enthusiastic teaching has made the time in South Africa and the process of writing this thesis a memorable experience. Sara Wurz is thanked for her excellent tutoring in lithic analysis both in the field and during my stay at IZIKO. Additionally she is thanked providing valuable commentary for all earlier drafts of my thesis.

Francesco d'Errico and the rest of the French part of the TRACSYMBOLS are thanked for the invitation to the conference in Les Eyzies, for their hospitality, and for the opportunity to present some of my preliminary findings. Michel Lenoir at the University of Bordeaux 1 is thanked for taking time to demonstrate knapping techniques, and for clarifying several technological aspects that would otherwise have been unknown to me.

The members of the TRACSYMBOLS excavation teams in 2010 an 2011 are thanked for exciting and fun experiences and in this regard special thanks are due to my co-students Cornelia Albrektsen and Magnus Haaland. Thanks for the numerous months we have spent together in the field and in Cape Town as "team-supreme", for your enthusiastic, encouraging spirits, and for all the fun. Additionally Magnus deserves thanks for assistance in several technical issues encountered during the process of writing this thesis.

Sven Ouzman and Wilhelmina Seconna at the IZIKO museum, Cape Town, have been of outmost assistance giving me access to material and working-facilities at the museum. Stein-Erik Lauritzen and Vigdis Irene Clausen Hope is thanked for use of laboratory facilities and equipment used for my heat-treatment experiment at the Faculty of Mathematics and Natural Sciences at the University of Bergen. Torunn Saunes at the AHKR institute deserves special thanks for her efforts in handling several administrative issues and problems, and for her support. The AHKR institute at the University of Bergen and the European Research Council (ERC) are thanked for financial support, enabling me to participate in fieldwork and the at TRACSYMBOLS conference in Les Eyzies.

Last but not least Solveig Stornes is thanked for her proof-reading, comfort and endless contributions, personally as well as academically, this thesis could not have been written without your support.

Any errors that remain are the sole responsibility of the author.

Nikolai Rypdal Tallaksen

Bergen 13.05.2012

Abstract

In this thesis I analyse the lithic assemblage from one selected stratigraphic unit at Klipdrift Shelter, South Africa. A *chaîne opératoire* approach was chosen to document the lithic production process. I conclude that the lithic assemblage can be characterised as a Howiesons Poort occurrence, but that it also shares traits with other assemblages characterised as pre-Howiesons Poort. On typological and technological grounds the assemblage closely resembles the "pre-HP" identified in the "Jeff"-layer at Diepkloof. I further demonstrate that the lithic reduction at the site was aimed at producing blades and bladelets using marginal soft hammer percussion as is observed at Klasies River, Rose Cottage Cave, Sibudu Cave and Diepkloof Rock Shelter. There is not a separate reduction strategy for bladelet production, nor is there any indication of a separate flake industry as suggested for parts of the HP at Klasies (Villa et al. 2010) and at Diepkloof (Porraz et al. 2008). Technological traits in the form of platform preparation are consistent with observations made in other HP contexts, while the typological corpus of the Klipdrift assemblage deviates somewhat from what is observed for the 'classical' HP as very few geometric backed artefacts occur. Two reduction configurations are recognised in the Klipdrift Shelter assemblage, but it is at this stage uncertain whether they are separate configurations or different stages of the same strategy. Similar reduction configurations have also been described in the HP layers at Rose Cottage Cave (Soriano et al. 2007). On the grounds of the technological analysis I argue that the artisans at Klipdrift Shelter possessed mental capacities that, at least to some extent, are shared with humans today and can be characterised as modern.

Norsk sammendrag

I denne avhandlingen tar jeg for meg steinredskapene og avslagsmaterialet fra ett utvalgt stratigrafisk lag ved Klipdrift Shelter, Sør-Afrika. Jeg har benyttet meg av en *chaîne opératoire* metode for å best mulig dokumentere de ulike teknologiske valgene og reduksjonssekvensene i materialet. Det blir konkludert med at steinmaterialet kan knyttes til Howiesons Poort-fasen av afrikansk mellomsteinalder. Både typologisk og teknologisk ligger materialet tett opp mot hva har blitt beskrevet som pre-Howiesons Poort ved lokaliteten Diepkloof Rock Shelter. Et av hovedmålene med reduksjonsprosessene ved Klipdrift Shelter har vært å produsere flekker og mikroflekker gjennom marginal, direkte bløt teknikk. Dette samsvarer med observasjoner fra andre Howiesons Poort-lokaliteter som Klasies River, Rose Cottage Cave, Diepkloof Rock Shelter og Sibudu Cave (Delagnes et al. 2006; Rigaud et al. 2006; Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010). Reduksjonssekvensene benyttet til flekkeproduksjon ved Klipdrift Shelter er også de samme som har blitt brukt til mikroflekker. Det blir konkludert med at det ikke eksisterer en egen reduksjonssekvens knyttet til produksjon av avslag, selv om dette er dokumentert tidligere ved andre Howiesons Poort lokaliteter som Klasies River og Diepkloof Rock Shelter (Porraz et al. 2008; Villa et al. 2010). På typologisk grunnlag avviker materialet fra Klipdrift Shelter noe fra det som er beskrevet som ”klassisk Howiesons Poort”, hvilket hovedsakelig grunner i at det er funnet få segmenter og flekker med enderetusj. Til tross for dette viser plattform preparasjonen klare likheter med Howiesons Poort. Det er registrert to typer reduksjonssekvenser knyttet til flekkeproduksjon ved lokaliteten, men det er på dette stadiet for tidlig å si om de er separate sekvenser eller ulike steg i den samme sekvensen. Begge formene for reduksjon er forøvrig observert ved Rose Cottage Cave (Soriano et al. 2007). Jeg argumenter på grunnlag av teknologiske observasjoner for at materialet fra Klipdrift Shelter henspeiler en form for atferd som er gjenkjennelig hos moderne mennesker.

Table of contents

List of Figures

List of Tables

1. Introduction

Klipdrift Shelter is situated in a steep rock face overlooking the rough coastline of De Hoop Nature Reserve, on the Southern Cape, South Africa. The shelter is adjacent to the larger cave (Klipdrift Cave) and has been excavated since February 2011. Klipdrift Shelter, a part of the excavation programme within the TRACSYMBOLS project, contains archaeological deposit rich in lithic material characterised as belonging to the Howiesons Poort (HP) sub-stage of the Middle Stone Age (MSA).

The HP has been at the forefront of archaeological inquiries in southern Africa for the past two decades due to its unusual repertoire of lithic and cultural material, that stands in contrast to the typology and technology of the other MSA sub-stages. Additionally, the HP material culture is associated with modern human behaviour because of the abstract engravings found on ostrich eggshell at the Diepkloof Rock Shelter (Henshilwood et al. 2002; Parkington et al. 2005; Henshilwood et al. 2009; Texier et al. 2010). The appearance of markers of symbolic thinking in the HP that follows those associated with the earlier Still Bay (c. 75 – 70 ka), has lead to an intensive focus on what governs diachronic changes and trends in material culture. A series of behavioural inferences have been made based on the information available from this sub-stage (Ambrose and Lorenz 1990; McCall 2006; Minichillo 2006; McCall 2007; McCall and Thomas 2012).

Although acknowledged and described for some time our knowledge of the variability present during the HP remains limited. The industry has to a large extent been defined solely on typological grounds by the presence of backed segments, blades and notched pieces. This picture is slowly changing as new sites, excavated in a meticulous fashion using modern techniques, are studied in larger detail showing the variability actually manifest during the HP (Wurz 1997; Wurz 1999; Wurz 2000; Delagnes et al. 2006; Rigaud et al. 2006; Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010; Mackay 2011). Still, our understanding of the technological aspects of the HP is only limited to a few sites. Detailed descriptions of HP contexts are needed to construct a clearer picture of the industry in its own right and its relationship to preceding and subsequent technologies. As one of few new HP occurrences of the last decade the Klipdrift Shelter assemblage has much potential to contribute to our understanding of this sub-stage of the MSA. In this thesis, through a detailed technological description and analysis of one selected stratigraphic unit from Klipdrift shelter, I contribute towards further clarification of aspects of the technology in the HP.

1.1. Aims and research questions

In this thesis I describe and interpret the lithic material from one stratigraphic unit at Klipdrift Shelter, Layer PBE. I have chosen to analyse the assemblage using a *chaîne opératoire* approach. This method is chosen for its flexibility and suitability to describe an entire lithic assemblage, and its potential for revealing technological choices made by the HP artisans at the site. Since this is the first presentation of any lithic material from Klipdrift shelter and no dates for the assemblage have been published, the overarching goals have been first, to identify the typological and technological affinity of the lithic assemblage placing it in a temporal and geographical context. This will be done through comparing it to other well documented HP sequences. The second is to investigate what behavioural inferences can be made on the basis of the lithic material from one selected unit at Klipdrift Shelter. Third, I examine and try to understand the steps that these ancient artisans took in the procurement, reduction, modification and discard of lithic material associated with the site.

To further investigate these overarching goals, more specific questions are needed:

(1) Which raw materials are present in the assemblage at Klipdrift Shelter, and where were they sourced?
(2) Is there a selection for certain types of raw materials at the site, and are there different patterns visible across different lithic categories?
(3) What characterises the reduction sequences, are there one or several methods and configurations of reduction, and what are the aims of these reduction configurations?
(4) Are there any characteristic technological choices related to the planning and preparation of the lithic reduction?
(5) Can the individual decisions made and the technological choices provide any insights into the cognitive abilities of the HP artisans?

By answering these questions it will be possible to compare the lithic material from Klipdrift Shelter to other HP occurrences and determine whether the Klipdrift Shelter assemblage should be considered as a HP techno-tradition, and at the same time document variability present within the HP industry. Through describing the assemblage from typological, metrical and technological perspectives, interpretations of the variability, manifest in the KDS assemblage and the HP generally, can be made. In this respect the Klipdrift Shelter material has a potential to provide new insights and data for clarifying and enhancing our understanding of the Middle Stone Age generally and the Howiesons Port sub-stage specifically.

1.2. Thesis structure

Chapter 1 is the introduction where I lay out the scope of the thesis. The chapter is separated into three parts, first where I explain the general background for this analysis, second I expand on the research questions. In the third part I describe the structure of the thesis.

The necessary historical background for the MSA generally and the HP more specifically, is outlined in chapter 2. This provides the temporal and geographical context for this thesis. After the brief historical background a more detailed description of four selected HP sites is given; Klasies River Mouth/Main Site, Rose Cottage Cave, Diepkloof Rock Shelter and Sibudu Cave. The focus here is to provide a comparative perspective to the material described from Klipdrift Shelter which is presented in chapter 5. The site descriptions are confined to the following categories:

(1) A brief description of the location, chronological sequences and dates of the deposits.
(2) A description of the choices in raw material procurement and use at the site.
(3) A description of the reduction and preparatory strategies recognized in the assemblage.

Subsequently I give a brief metrical description of the blade products at all the sites combined. A detailed summary of the retouched component of the HP assemblages is summarised for all the four sites combined.

In Chapter 3 the theoretical and methodological framework of the *chaîne opératoire* approach is presented. This overview gives an understanding of the method's potential for extracting information from an entire lithic assemblage, and how this approach is well suited for use in the MSA generally, and the Klipdrift Shelter assemblage specifically. At this site large parts of the assemblage can be characterised as waste products from lithic reduction. Using the *chaîne opératoire* methodology it was possible to extract information on several aspects of pre-historic society - through tracing the decisions made on raw material procurement, primary reduction, use, maintenance and discard. The chapter is sectioned into the following three parts:

(1) Background: provides brief historical perspectives on lithic analysis in general and the *chaîne opératoire* specifically.
(2) Theoretical considerations regarding the *chaîne opératoire*: here I explain how behavioural inferences can be made on the grounds of the steps taken by these pre-historic artisans in the process of producing stone tools ranging from raw material acquisition until the final discard of the lithic implements. By structuring the technological systems on different levels, reconstructing the succession of mental operations and technical gestures (Sellet 1993), it can be possible to achieve an overlap in horizons of understanding between the modern researcher and the pre-historic artisan (Sørensen 2006).
(3) The *chaîne opératoire* methodology: in this section some of the specific methods often associated with the *chaîne opératoire* are outlined. These include: raw material analysis, cortex analysis, reduction sequences, experimentation and replication, refitting, diacritical analysis and use modification and discard.

In Chapter 4 I provide the context and setting for the ongoing excavation at Klipdrift Shelter. Here a short background for the TRACSYMBOLS project is given and the site's geographical location and surroundings are described. After this, an explanation of the site mapping, stratigraphy and excavation protocol follows. This lays a foundation for the selection criteria chosen for my lithic analysis which is the last part of chapter 4.

The results from the analysis of the PBE unit at Klipdrift Shelter are presented in chapter 5. The structure of this chapter follows the steps of the *chaîne opératoire* and is divided into the following sections:

(1) Raw materials in the Klipdrift Shelter assemblage: here the individual lithic raw materials are quantified, described and graphically illustrated. After the description of potential sources in the surroundings of the site a short section on experimental heat treatment of lithic raw material is included.
(2) Cortex analysis: this section describes and quantifies the types and amounts of cortex in the PBE assemblage at Klipdrift Shelter. This section is included to provide additional information on raw material sourcing and reduction strategies.

(3) Typological description of the lithic assemblage: here the different classes of lithic products are described and quantified. The lithics are placed in categories derived from the sampling criteria outlined in chapter 4. The lithic categories in the assemblage composition are: blades and flakes, cores and retouched pieces. The remaining lithics are sorted into: chunks, chips, flake fragments and trimming flakes based on the criteria set in chapter 4.

(4) Metrical descriptions: here the measurements of blade and flakes widths and thickness are provided for a further comparison with the material described in chapter 2. A discussion of these results is provided in chapter 6.

(5) Platform characteristics: all platforms in the assemblage have been measured and studied for evidence of preparation. This data will be used to determine amount and type of platform preparation. Additionally technique and knapping tools is discussed, adding to the information on artisan skill levels and their ability for planning depth.

(6) Reduction sequences: This section summarises the information obtained through all the former sub-chapters to reconstruct, as far as possible, the reduction strategies practised at Klipdrift Shelter.

Finally, in chapter 6**,** the material presented from other HP sites will be discussed in relation to the results observed at Klipdrift Shelter. The discussion draws on the theoretical framework outlined in chapter 3 and I use this to discuss behavioural inferences based on raw material acquisition and use during the HP generally, and how this compares with the results from Klipdrift Shelter. The technological, typological and metrical traits described in chapter 5 are used in a discussion of Klipdrift Shelter's cultural and technological relationship to the sites described in chapter 2.

In Chapter 7 I provide a summary and conclusion relating to the results of my thesis, and briefly line out future potentials .

2. The African Middle Stone Age and the Howiesons Poort

This chapter will provide a general context for the material presented later in the thesis. The background for the Middle Stone Age (MSA) in southern Africa will be described briefly, expanding on the temporal, geographical, typological and technological aspects of the Howiesons Poort. A focus on lithic technology is chosen for limitation, due to the scope of the thesis Four sites have been **selected** as reference for describing the material culture of the Howiesons Poort. Through the description of the sites technological aspects like raw material acquisition and use, types and the reduction sequences will be described in detail. This will provide the reader with the sufficient background for the presentation of the material from Klipdrift Shelter presented in chapter 5, and the following discussion in chapter 6.

2.1. The Middle Stone Age sequence

The Middle Stone Age (MSA) was first defined by Goodwin and Van Riet Lowe (1929) and is often placed in between ~300 ka and 50-40 ka (Lombard in press).

Goodwin had earlier proposed a dual division of the African Stone Age into the Early Stone Age(ESA) and the Later Stone Age(LSA), where industries belonging to the ESA was categorised by core-based technologies, and the latter by the presence of flake-based technologies (Wurz 1997). A few years later Goodwin and Van Riet Lowe(1929:95) notes :

> "With the accumulation of material directly resulting from the more intensive study of the archaeological field, it was forced upon our notice that we were dealing, in South Africa, with a series, not of two, but three main invasions, either of a migratory or of a purely cultural type".

This led them to propose a three-fold division of the Stone Age and the ESA, Middle Stone MSA and LSA was established. Goodwin and Van Riet Lowe (1929) further divided the MSA into what they termed "industries" and "variations", where "industries" point to well described clearly defined material culture, and "variations" point to the more ambiguous or less defined cases. Among the complexes defined as industries were the Glen Grey Falls and the Still Bay, while the Pietersburg and the Howiesons Poort were termed as variations. At the time when Goodwin and Van Riet Lowe constructed their MSA sequence, the Howiesons Poort shelter and Peers Cave were the only described sites containing Howiesons Poort artefacts (Stapleton and Hewitt 1927; Goodwin and Peers 1953; Wurz 1997).

The type-based view and a Eurocentric tendency to compare the MSA with the LSA and Upper Palaeolithic material has led to a dramatic underscoring of the MSA variability (McCall 2006), rather than studying the period in its own right (McBrearty and Brooks 2000; Wurz 2002). By constructing trait lists, measuring the level of “modernity”, derived from other geographical and temporal contexts, the MSA have for some time been classified and defined on the wrong basis. The focus has however changed during the last two decades towards a more African approach, and new sites and analysis are greatly improving our understanding of the variability manifest in the MSA material. Especially a shift from the descriptive type-based analysis towards the study of technology has provided great insight into the lithic variability actually present in the MSA material culture. Many of the MSA assemblages are not dominated by monolithic retouched “types”, but rather the production of predetermined blanks that are tools in their own right (Wurz 2002).

Some of the reasons for the increased interest in studying the South African MSA lies in the concern with the origin of our species and the appearance of modern human behaviour onstructing a theoretical framework for what constitutes modern human behaviour, how it can be traced in archaeological material and whether it is present in the MSA has been a central part of the archaeological debate during the last decades (Klein 1995; Klein 1998; McBrearty and Brooks 2000; Deacon and Wurz 2001; d'Errico 2003; Henshilwood and Marean 2003,2006; Mellars 2007; Henshilwood and Dubreuil 2009; Henshilwood and Dubreuil 2011). One suggestion for a definition of modern behaviour that has been widely adopted was formulated by Henshilwood and Marean (2006:9) as:

> “…behaviour that is mediated by socially constructed patterns of symbolic thinking, actions, and communication that allow for material and information exchange and cultural continuity between and across generations and contemporaneous communities”

Today the general consensus leans towards MSA origins for modern human behaviour, although some still argue for a later appearance. Archaeological material generally associated with modern human behaviour has been uncovered at several sites across Africa. Shell beads (d'Errico et al. 2005; Bouzouggar et al. 2007; d'Errico et al. 2008), abstract engravings on ochre and ostrich eggshell (Henshilwood et al. 2002; Parkington et al. 2005; Mackay and Welz 2008; Henshilwood et al. 2009; Texier et al. 2010; d’Errico et al. 2012), bone tools (Henshilwood et al. 2001; d'Errico and Henshilwood 2007; Backwell et al. 2008; d'Errico et al. 2012b) and composite tool production and hafting (Lombard 2006; Lombard 2007; Wadley et al. 2009; Wynn 2009; Lombard and Phillipson 2010; Lombard 2011) are some of the technological and symbolical innovations associated with modern human behaviour, now recognised in the material from MSA sites. The use of pigments have also been widely applied as circumstantial evidence for body decoration and painting e. g (Watts 2009), hence symbolism, and although the deliberate production of paint is documented at Blombos Cave at ~100 ka (Henshilwood et al. 2011), there are also possible functional explanations for some of the ochre present in MSA contexts (Wadley 2005; Lombard 2006; Rifkin 2012).

The gradually more popular application of technological lithic analysis in Southern African archaeology and the study of reduction sequences have contributed towards drawing a more diverse picture of what we know about cognitive capabilities and behaviours during the MSA. Subsequent to Goodwin and Van Riet Lowe's (1929) initial definitions several new attempts have been made to construct a clearer picture of the MSA sequence (Sampson and Deacon 1976; Volman 1981; Singer and Wymer 1982; Wurz 2002; Lombard in press).

Much of the material associated with modern human behaviour is evident in the Still Bay and sub-ceding Howiesons Poort industries and a considerable amount of energy has been directed towards these two MSA sub-stages in order to clarify their relation, appearance and subsequent disappearance. The distinctive typologies associated with both periods have raised questions regarding technological change and continuity and what drives innovations in material culture.

A general problem with many of the early excavations containing the Still Bay and Howiesons Poort industries is that the material in many cases has been excavated in a less than ideal way. In addition, the materials from some of these excavations are generally understudied and lack the required sampling detail to do in-depth analysis necessary to move beyond descriptive typology.

2.2. The Howiesons Poort sub-stage

The name of the Howiesons Poort industry was first used by Stapleton and Hewitt after the excavation of a small rock shelter of the same name near Grahamstown in the Eastern Cape (Stapleton and Hewitt 1927). The industry was defined by the presence of crescent-shaped large segments, obliquely backed blades, unifacial and bifacial points, burins and "gravers" (Stapleton and Hewitt 1927; Goodwin and Van Riet Lowe 1929; Deacon 1995). These types, and specifically the backed segments, became the defining type or "*fossil directeur*" of the Howiesons Poort industry in general, a conception which to a large extent still stands today.

In the early days of archaeology the focus on types as markers for ethnic groups or cultures dominated the research. As a result, the presence of typical MSA markers together with forms, such as microlithic elements more often associated with the Wilton of the LSA or the European Upper Palaeolithic led to the interpretation that the Howiesons Poort was a transitional stage between the MSA and the LSA:

> "Still Bay and Neo-anthropic elements appearing side by side and in the same deposits, thus throwing the road open for the Later Stone Age. The Howiesons Poort variation thus forms a strong link between the Middle and Later Stone Ages as the Fauresmith did between the Earlier and Middle" (Goodwin and Van Riet Lowe 1929:101)

There were at the time very few sites containing Howiesons Poort material and well established stratigraphic sequences were lacking. Interestingly, however, the sequence at Peers Cave excavated in 1927 and 1928 clearly showed that the Howiesons Poort was interstratified with other MSA material, thus clearly not transitional to the LSA (Goodwin and Peers 1953). Despite this Goodwin and Van Riet Lowe (1929) still stuck to their interpretation although they must have been aware of the interstratification since they commented on the methodical and detailed excavations at Peers Cave (Goodwin and Van Riet Lowe 1929:126).

2.3. The Howiesons Poort Sites, material and technology

The Howiesons Poort is now recognized in a variety of sites spread over large parts of southern Africa south of the Zambezi river: Peers Cave (Goodwin and Peers 1953), Nelson Bay Cave (Klein 1972; Deacon 1978; Deacon 1979), Klipfonteinrand (Volman 1981), Boomplaas (Deacon 1979), Border Cave (Butzer et al. 1978), Montagu Cave (Keller 1973), Umhlatuzana (Kaplan 1989), Apollo 11 (Vogelsang et al. 2010) and Klein Kliphuis (Van Rijssen and Avery 1992; Mackay 2006; Orton and Mackay 2008; Mackay 2011; Mackay 2011b) are some of the described occurrences (Figure 1). A detailed review of all these sites would be futile, and outside the scope of this brief background. Four sites have been selected for a more thorough review in this thesis, as there have been published extensive and detailed technological descriptions of the lithic material. These sites are: Diepkloof Rock Shelter (from now on Diepkloof), Sibudu Cave (from now on Sibudu), Rose Cottage Cave (from now on Rose Cottage), and Klasies River Mouth/Main site (from now on Klasies).

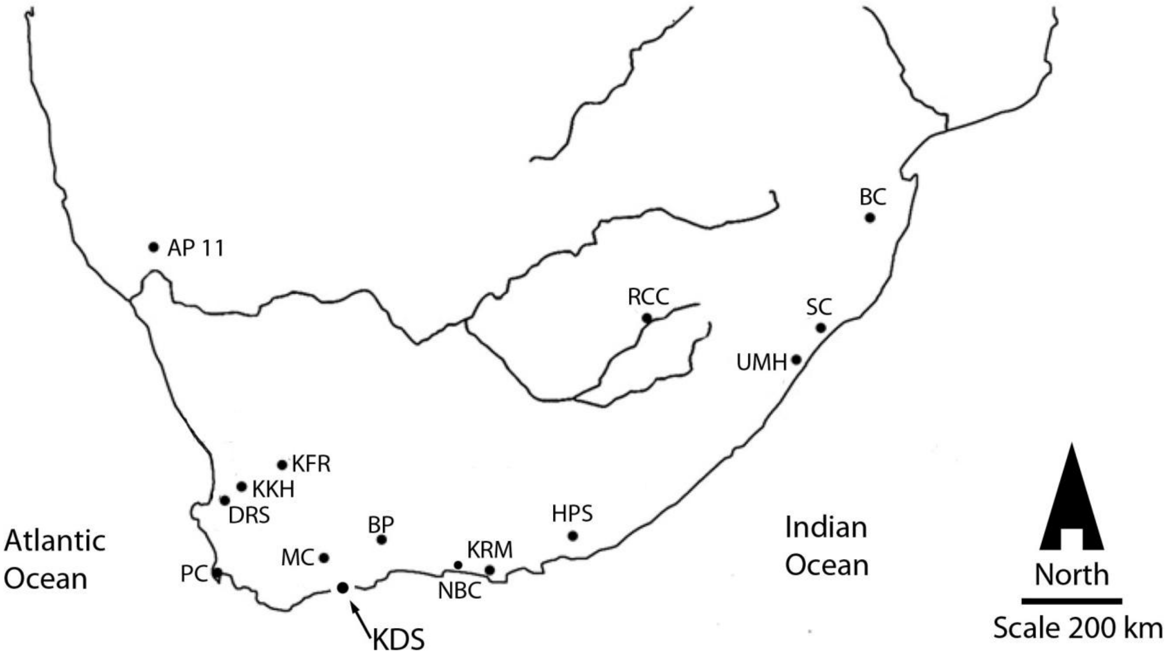


Figure 1 Location of Klipdrift Shelter (KDS) and other key HP sites mentioned in the text: AP 11=Apollo11, DRS=Diepkloof Rock Shelter, KKH=Klein Kliphuis, KFR=Klipfonteinrand, PC=Peers Cave, MC=Montagu Cave, BP=Boomplaas, NBC=Nelson Bay Cave, KRM=Klasies River Mouth/Main Site, HPS=Howiesons Poort Shelter, RCC=Rose Cottage Cave, UMH= Umhlatuzana, SC=Sibudu Cave, BC=Border Cave. Modified from (Mackay 2011:1431).

Klasies River Mouth/Main site

Klasies situated on the Tsitsikamma coast is probably the most used reference site for South African MSA in general, and also for the Howiesons Poort (Singer and Wymer 1982; Deacon 1989; Deacon 1992; Wurz 1997; Wurz 1999; Wurz 2000,2002; Deacon and Wurz 2005; Villa et al. 2010).

Klasies is in reality not one site, but rather a large complex consisting of several caves. The main site itself consists of two individual caves (Cave 1 and Cave 2) and two overhangs (Cave 1A and Cave 1B), with a 20 meters deep, well stratified MSA sequence (Wurz 2002:1002). Cave 4 and 5 are found a few kilometres to the east. The first excavations at Klasies was conducted by Singer and Wymer during two seasons in 1966/1967 and one season in 1968, whereas their findings were fully published in 1982 (Volman 1981:310; Singer and Wymer 1982). Subsequent excavations were conducted from 1984 by H. J. Deacon and this was aimed at confirming the stratigraphic integrity and sequence from the Singer and Wymer excavations (Deacon and Geleijnse 1988). Klasies has provided one of the longest stratified sequences of MSA material, facilitating a sequencing of sub-stages based on lithic technology and types (Wurz 2002). The following sub-stages are present in the Klasies lithic sequence: MSA I, MSA II, Howiesons Poort, MSA III/post Howiesons Poort, and MSA IV (Wurz 2002). This sequence is of importance in clarifying the chronology of the MSA but does not show the transition between the Still Bay and the Howiesons Poort. The only indications of a Still Bay industry at the site is manifested through a few bifacial points, probably related to layers at the bottom of the Howiesons Poort, but not recovered in *situ* (Wurz 2000). The most recent dates obtained for the Howiesons Poort at Klasies give a date of 65.5±2.6 ka for some of the lower Howiesons Poort deposits (SW layer 20) and 57.9±2.3 ka for the start of the MSA III (SW layer 9) (Jacobs et al. 2008; Villa et al. 2010).

The Howiesons Poort at Klasies is marked by a significant increase in the use of non-quartzite raw materials (Wurz 2000,2002; Villa et al. 2010), from negligible proportions in the MSA I and MSA II sub-stages to 27 % in the Singer and Wymer sample and 33% in the Deacon sample during the Howiesons Poort (Singer and Wymer 1982; Wurz 2000,2002). The non-quartzite materials are: Silcrete, quartz, hornfels and chalcedony in order of decreasing frequency (Villa et al. 2010). The most used raw material is quartzite if the whole assemblage is considered, however, within the retouched component the amount of non-quartzite fine grained materials rise to 58%. It is argued that the increase in the use of fine grained raw materials are connected to the production of backed artefacts (Wurz 2000). The quartzite and quartz in the assemblage are of local origin (Villa et al. 2010). Singer and Wymer (1982) classified the silcrete and the quartz in their sample as non-local and "exotic". Deacon and Deacon (1999) points to the Longkloof about 20 kilometres away as a source for the silcrete, while the silcrete source is described as unknown by Villa et al. (2010).

The Howiesons Poort lithic assemblage at Klasies is dominated by blade products. In the Howiesons Poort Lower, blades and blade fragments represent 77% of the assemblage and blade and bladelet cores are the most common core types. However, there is also evidence of a possible flake industry coexisting with the blade industry in the mid-Howiesons Poort (Villa et al. 2010:641). From a technological analysis it is suggested that blade production was not always initiated at the site, too few cortical blades are present in the assemblage and blades with bilateral crests or blades underlying a crested blade are absent. The use of natural convexity to initiate knapping is also excluded as there are too few blades with cortical ends (Villa et al. 2010:643). Villa et al. (2010) does not exclude the possibility that parts of the reduction sequence was done *ex-situ,* although there is evidence that in some cases it was done *in-situ*. The modest amount of cores in the assemblage, compared to the blades, could also suggest that blade blanks were introduced to the site (Villa et al. 2010).

When comparing blade products from the quartzite and non-quartzite components it is evident that the reduction sequence has been the same for both groups. Distribution in blade width is different due to the fact that silcrete is a finer raw material than quartzite and for that reason can be reduced to thinner blades, a feature that is also manifest in the smaller silcrete cores in the assemblage (Villa et al. 2010:645).

The production of blade blanks was performed by marginal percussion indicated by thin platforms, lipped butts and abrasion and trimming of the exterior platform surface. Further evidence suggests removal was done using a soft stone hammer indicated by the overhang on the contact point, crushing, shattering of the bulb or dorsal face of the impact point, and the presence of two contact points (Villa et al. 2010).

There are, as mentioned, significant changes in the lithic technology at Klasies over time. Gradual shifts in raw material use is evident by the increased use of quartz in Howiesons Poort middle compared to Howiesons Poort lower, resulting in the reduction of blade width. The preference of quartzite as a raw material in the upper Howiesons Poort results in an increase in width and gradually more internal percussion towards the end of the Howiesons Poort (Villa et al. 2010).

Rose Cottage Cave

This cave in the Eastern Free State was first excavated in 1943 to 1946 by Malan, and again in 1962 by Beaumont, none of which were published. In addition the material lacked stratigraphic integrity (Wadley 1991; Soriano et al. 2007:683). New excavations were performed in 1987, 1989, 1991 and 1997 by Harper and Wadley to a depth of 2 metres. The site contains material from a pre-Howiesons Poort industry, Howiesons Poort, post-Howiesons Poort and the LSA (Wadley and Harper 1989; Soriano et al. 2007). The Howiesons Poort assemblage is characterized by blade production aimed at producing blanks for backed segments typical of the Howiesons Poort (Soriano et al. 2007). The assemblage, however, consists of a much larger amount of backed blades and obliquely backed blades than at Klasies (Wadley and Harper 1989).

Samples taken by Jacobs et al. (2008) give an Optically Stimulated Luminescence (OSL) range of between 69±3 ka and 54±5 ka.

At Rose Cottage, contrasting to some of the evidence from Klasies, the raw materials used are of strictly local origin and the assemblage consists of more than 90% opaline throughout the

Howiesons Poort, which can be found at approximately 8 to 10 kilometres from the site. There are a minimal presence of volcanic tuff, hornfels, milky quartz and fine grained quartzite. Percentages of opaline are just below 90% in the other MSA sub-stages (Soriano et al. 2007).

Similar to Klasies the main reduction sequences at Rose Cottage aimed at producing blades which, in fragmented and whole, constitutes 90% of the sample (Soriano et al. 2007). There are flakes present in the assemblage but the lack of systematic production in some cases, and close similarity to blade production in others leads the authors to conclude that the flakes are connected to the initiation or maintenance of blade production (Soriano et al. 2007:686). The size of the cores and the length of cortical blades indicate that the core blanks collected by inhabitants of Rose Cottage have been small, generally less than 6 cm (Soriano et al. 2007).

In contrast to Klasies the amount of cortical blades is abundant at Rose Cottage, signalling that the initiation of the knapping probably took place at the site. The cores also retain cortex on the back, and the platforms are in many cases (20-30%) also cortical. Knapping did in some cases start with creating core surface convexity through cresting (elaborate shaping), but more often "the slightly rounded cortical ridges of small opaline nodules" were followed (Soriano et al. 2007:687). Soriano et al. (2007) distinguishes between two distinct progressions in the continuation of debitage based on blade types and core characteristics; (1) serial removals of blades from a single striking platform that gradually progresses both forward and laterally onto one of the sides of the core, gradually increasing the length of the removals, depending on the orientation of the striking platform. And (2) blades were removed along the entire flaking surface arching/plunging over a distal cortical part of opposite platform, which in most cases is used only to correct distal convexity. This second configuration represents a later phase of debitage, gradually decreasing the blade size as debitage advances (Soriano et al. 2007:687).

To maintain the core sides a "second generation crested blades" were removed towards the back of the core using the debitage surface as a platform. Distal convexity was restored by small removals from an opposite platform (Soriano et al. 2007:688). There is little evidence of platform rejuvenation, but it does occur, mostly the platforms are plain and cortical.

Platform preparation is evident as abrasion or scraping of the platform edge, or removals of small flakes to remove overhang, mostly in the direction of the flaking surface (85%). Faceting of the platforms occurs, but is rare (5.2%). Cores are abandoned when the debitage surface is reduced to 20-25 mm, or when hinge fractures have altered the surface (Soriano et al. 2007:688).

There are strong indications that a soft stone hammer has been used as knapping tool at Rose Cottage. This is supported by the presence of highly localised impact point and a presence of partial fissuring on platforms. The fissure is not a complete circle as would be expected from a hard stone hammer. The overhang on some platforms also indicate a stone hammer, and the range of exterior platform angle also support this (Soriano et al. 2007:690-691).

Diepkloof Rock Shelter

Excavations at Diepkloof located some 180 kilometres north of Cape Town, began in 1998, based on initial test-pits dug in the seventies and eighties, and revealed a sequence with a depth of 3.5 metres (Porraz et al. 2008:106). The sequence spans over a great period of time and includes both MSA and LSA deposits. The material has been divided into six complexes by Rigaud (2006) where complex 1 is LSA, complex 2 is the youngest MSA deposits, characterized by unifacial points, complex 3 is of Howiesons Poort type dominated by backed pieces and the presence of abstract engravings on ostrich eggshell (Parkington et al. 2005; Porraz et al. 2008; Texier et al. 2010). Complex 3 also includes a pre-Howiesons Poort industry dominated by laminar products, notched pieces and denticulates, this industry has not been named but is confined to the stratigraphic layer "Jeff". Complex 4 is characterised by Still Bay points, while the final complex is currently not described (Rigaud et al. 2006; Porraz et al. 2008). Therefore the Diepkloof sequence is one of few that can shed light on the transition from the Still Bay to the Howiesons Poort.

There has been some controversy surrounding the dates for both the Still Bay and the Howiesons Poort at Diepkloof. The Howiesons Poort was dated by OSL to between 78±8 ka and 56± ka (Jacobs et al. 2008), but Thermo Luminescence (TL) dates gives dramatically older ages. The Still Bay to Howiesons Poort transition is placed at 93±8 ka (Tribolo et al. 2009), which, if correct, dramatically changes the picture of the timing of both these industries.

The lithic products associated with the Howiesons Poort and the preceding layer "Jeff" at Diepkloof is dominated by the use of fine grained raw materials such as silcrete, hornfels and quartz. More than 50 % of the retouched component at the site generally consists of silcrete (Rigaud et al. 2006), while as much as 70% of the artefacts from "Jeff" are in silcrete. Quartzite and quartz account for 25% of the assemblage (Porraz et al. 2008). The quartz and quartzite in the assemblages are of local origin while the silcrete is defined as non-local and is rare in the sites surroundings, as fine grained silcrete is absent within a radius of 40-50 km of the site (Porraz et al. 2008:109).

The reduction sequence followed by the artisans at Diepkloof resembles the traits from other Howiesons Poort contexts, but it is described in general terms for the whole sequence rather than the Howiesons Poort specifically. Silcrete is the preferred raw material for blade and bladelet production, and flakes have been produced by repeated convergent uni-facial flaking, or by uni- or bifacial discoidal working (Rigaud et al. 2006:841). The use of direct hard hammer percussion is recognised in the production of flake debitage, while direct percussion with a soft hammer was preferred for production of blade and bladelet debitage. Both forms of debitage are connected to the same reduction sequence, where the flakes are a result of initial shaping of a thick flake or angular blocks of silcrete. The use of uni-polar technique with an organic (soft) hammer was used to obtain a short series of fairly standardized blade products, some are also made using bi-polar technique which has resulted in less standardised products (Rigaud et al. 2006:841).

The technological traits seen in the pre-Howiesons Poort assemblage at Diepkloof in layer "Jeff" does also have some interesting traits and have been described in detail by Porraz et al. (2008). Here one main type of reduction sequence is recognised, aimed at producing blade products. Natural convexities on block blanks have been used to initiate flaking, and often crossed removals have been used to correct convexities, this occurs in all stages of production, and cresting is absent (Porraz et al. 2008:111). The widest face of the blocks is used for reduction, and the entire volume has not been systematically exploited resulting in a use of only a sub-volume restricted by a surface of reduction (parallel core) (Porraz et al. 2008:111). At the same time some exceptions are evident; the thick laminar products with trapeze cross sections, as well as a few cores indicates a "passage from the widest face of the core to its narrowest face" (Porraz et al. 2008:111). Both uni-directional and bi-directional production occurs, while faceting of the platforms is very rare, most platforms (75%) are plain. Abrasion and blunting is the most common type of platform preparation (60% of the laminar products), and points towards the use of a soft stone hammer. This is further supported by the marginal form of reduction, and impact marks such asfissuring, ripples and scars on ventral sides of blades (Porraz et al. 2008:111).

Sibudu Cave

Sibudu Cave is situated approximately 40 kilometres north of Durban, overlooking the Tongati river (Wadley and Jacobs 2006). Like Diepkloof, Sibudu is one of the sites that potentially can tell us more about the transition between the Still Bay and the Howiesons Poort, as the MSA sequence at the site includes; a pre Still Bay phase, Still Bay industry, Howiesons Poort industry, post-Howiesons Poort phase, and a late and final MSA-phase (Wadley and Jacobs 2006). The first excavation at the site was done in 1983 by Mazel in the form of a small test trench, further excavations were started in 1998 led by Wadley (Wadley and Jacobs 2006). The excavations are ongoing, and so far they have yielded an assemblage rich in backed pieces, especially segments connected to the Howiesons Poort phase (Delagnes et al. 2006; Wadley and Jacobs 2006; Wadley 2008; Wadley and Mohapi 2008; Lombard 2011). The duration of the Howiesons Poort at Sibudu has been estimated to be approximately three thousand years and is dated to between 64.7±1.9 ka and 61.7±6.5 ka (Jacobs and Roberts 2008; Jacobs et al. 2008; Wadley 2008).

Raw materials vary over time, but the most common in the assemblage as a whole are; Dolerite, hornfels and quartz, in decreasing order of appearance, and formal tools have been made in all raw materials (Delagnes et al. 2006). The dolerite appears in close proximity to the site, so does the quartz. The source of the hornfels for the Sibudu assemblage is still not determined with certainty, but similar material occur along the north bank of the Black Mhlasini River 20 km from the site (Wadley 2008).

Although raw material usage vary over time there are no significant changes in manufacturing processes recorded throughout the Sibudu Howiesons Poort sequence; “The lithic production of all raw materials in all layers is dedicated to the production of blades” (Delagnes et al. 2006:45). The production of blades have been “straight forward” with little preparation of the cores, natural ridges have been followed to produce elongated products, rather than creating ridges through cresting, although some partial and unilateral crested blades are present (Delagnes et al. 2006:45). The platforms of the blades were often prepared by abrasion which is used to argue for the employment of tangential percussion using a soft hammer (Delagnes et al. 2006:46). Of the blade blanks 15%, (n=35) were made into backed tools, other retouched classes are not described in detail from Sibudu.

2.4. Metrical data on the blade width during the Howiesons Poort

The production of blades is something that is shared by all the HP sites described above. Using data published from three of these sites, Klasies, Rose Cottage and the “Jeff” layer at Diepkloof it has been possible to construct comparative data for further use in the discussion in chapter 6 (Figure 2).

All sites show similar modality although the distributions in width vary somewhat, both over time and between the sites. In the Klasies lower-HP the mode peaks at 12-13 mm, while the perspective changes in the HP-middle, peaking at 10-11 mm. In the upper part of the HP the pattern changes to 16-17mm (Villa et al. 2010:643). At Rose Cottage the peak of the uni-modal distribution is at 10-11 mm in the EMD layer, and at 8-9 mm in the somewhat younger MAS layer (Soriano et al. 2007:691). The “Jeff” layer at Diepkloof matches layer named EMD at Rose Cottage with a peak at 10-11 mm (Porraz et al. 2008:115). The variations in widths are explained as a consequence change in use of raw materials (Villa et al. 2010) and are not meant as an example of variability. Rather than comparing the blades on basis of their metrical measurements this comparison is made to illustrate the mode of the blade production at the different sites.

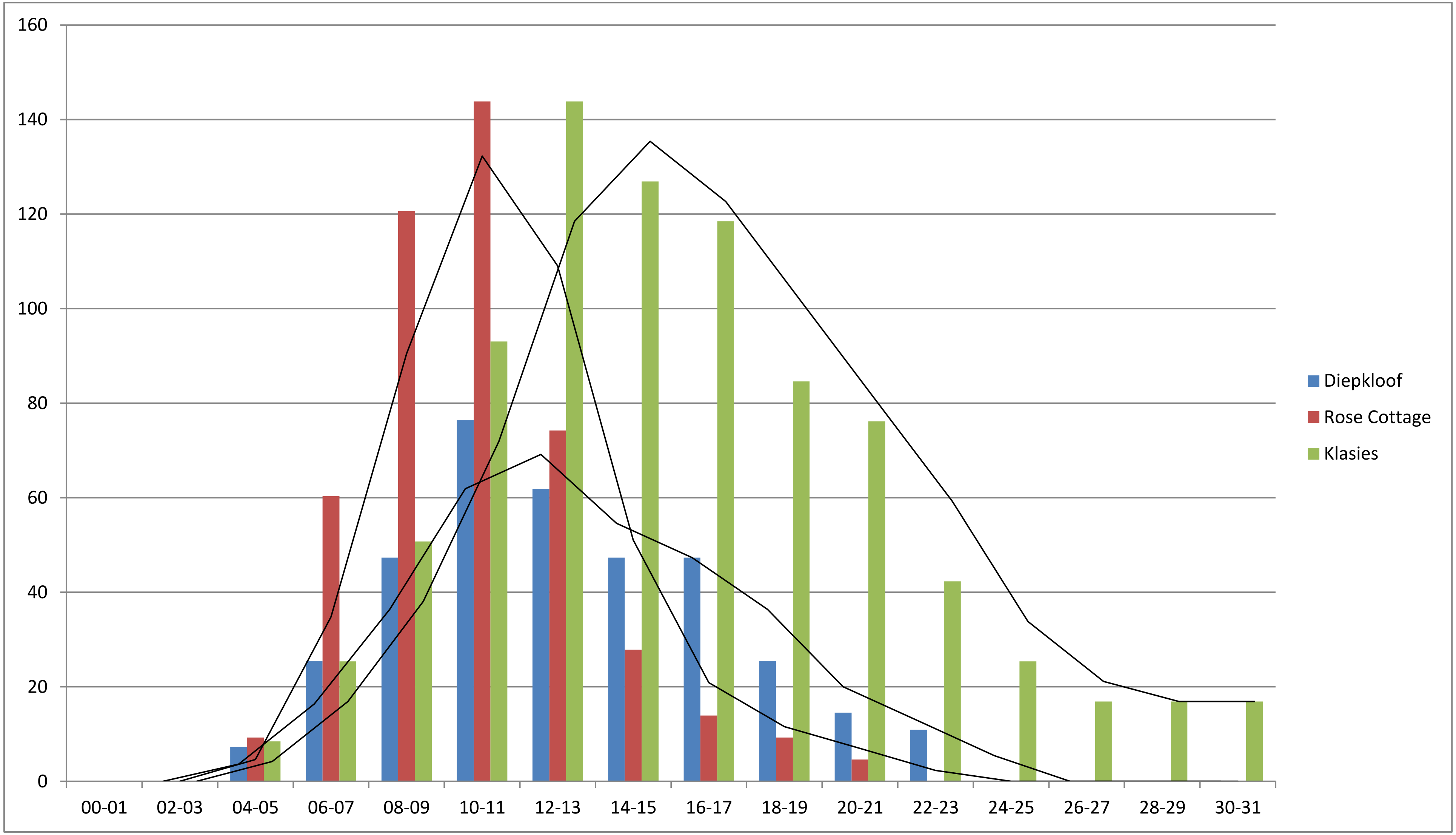


Figure 2 Showing the uni-modal distribution of blade widths at three HP-sites. Size categories on the x-axis are displayed in millimetres. Modified from (Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010)

2.5. The Retouched component of the Howiesons Poort

In the MSA the assemblages are generally characterized by the lack of retouch (Wurz 2000), and although more frequent during the Howiesons Poort, retouch comprise small parts of the assemblages. The most common type of retouch in the Howiesons Poort are the backed blades and segments (Wurz 2000,2002; Delagnes et al. 2006; Soriano et al. 2007; Wadley 2008; Villa et al. 2010), either by backing along the entire back, or obliquely backed ends. The "crescent" shape is common, but "trapezes" and other geometric forms also occur. While the segments are the only "formal" retouched artefact group of the Howiesons Poort, retouch also occur in an "informal" way as notched pieces, denticulates, scaled pieces, burins and pieces with edge damage resulting from use (Wurz 2000; Soriano et al. 2007; Langejans in press).

There are not many publications discussing the notched pieces and denticulates of the Howiesons Poort but Wurz (2000) provides a short description and interpretation. In the samples from Klasies notched pieces are not as common in the Howiesons Poort as in other MSA sub-stages, and three types are recorded; "break-out notches", "complex notches" and "wood-work notches" (Wurz 2000:88). The latter category implies that the retouch occurs as a result of heavy use for wood-work, maybe from shaping wooden shafts or stakes (Wurz 2000:88). The other categories of notched types may have been a result of heat-spalling, post depositional causes or other unknown modifications. Another explanation is that the notched pieces were intended as "snap-off" blanks for making segments (Singer and Wymer 1982), an hypothesis countered by the presence of platforms or proximal parts, and that segments are made on whole blade blanks at Klasies River (Wurz 2000). In most Howiesons Poort contexts the backed artefacts are the dominating retouched type. At Diepkloof this is the case for the "classical" Howiesons Poort, however the layer "Jeff" displays a different pattern. Here the retouched component consists of 19% denticulates and 51% concave/notched scrapers (notched pieces).

The *fossiles directeurs* of the Howiesons Poort; the backed pieces, are clearly a result of deliberate shaping designed for one certain or several purposes. They are made from whole blade blanks and the platform is often preserved (Wurz 2000). In some cases naturally blunt portions are left un-backed, but at Klasies half the sample of backed pieces are backed along the entire lateral (Wurz 2000; Villa et al. 2010). At Rose Cottage there is a clear preference for blanks without cortex (Soriano et al. 2007:695).

The segments have been described as being as standardized as similar types found in the LSA (Wurz 1999; Wurz 2000), and used to argue for symbolic behaviour in the Howiesons Poort (Deacon 1989; Wurz 1999). What dictates the amount of standardisation is debated (Bamforth and Finlay 2008; Bar-Yosef and Van Peer 2009; Wurz 2010). Studies from Sibudu show that the segments does not display standardization in coefficient of variation when the whole sample is considered, but within the distinct raw material classes separated standardisation can be seen (Wadley and Mohapi 2008). This is further used to argue that there is an element of intent or choice when selecting the raw materials for the segments. Fine raw materials can be used for smaller and finer segments, arguably used as arrowheads (Wadley and Mohapi 2008; Lombard and Phillipson 2010; Lombard 2011), and that the shape and size of the backed pieces are more likely to be a result of functional requirements and choices rather than stylistic trends and symbolism (Wadley and Mohapi 2008).

Through micro residue analysis it has been proved that segments were hafted, using complex mastic recipes (Lombard 2007; Lombard 2008; Wadley et al. 2009), and that different recipes of mastic are associated with different raw materials (Lombard 2011). It has also been suggested that the segments, based on different designs, could have been hafted in at least four different ways; either transversely, diagonally, back to back or longitudinally (Pargeter 2007; Lombard and Pargeter 2008).

The Howiesons Poort segments have been interpreted as inserts for spears (Deacon 1989; Deacon 1992; Villa et al. 2010)**.** Even though there is currently no direct evidence for the use of projectile points in the MSA (Shea 2006) the smallest quartz Howiesons Poort segments has clearly been hafted, and fit within the metrical values of ethnographic arrowheads (Shea 2006; Wadley and Mohapi 2008; Lombard 2011).

Scaled pieces, also called *Outil écaillés* or *pièces esquillées,* occur in small quantities at Klasies, Sibudu and Rose Cottage (Singer and Wymer 1982; Wurz 2000; Soriano et al. 2007; Langejans in press). The function and use of scaled pieces from the Howiesons Poort have been debated. Among the interpretations is that the pieces were used as wedges or "chisel-adzes" (Singer and Wymer 1982), others suggest that they are by-products or the result of extended core reduction (Wurz 2000). In a study of micro residues on ten *pièces esquillées* from Sibudu, Langejans (in press) conclude that the pieces could be depleted bi-polar cores, but that they were also probably used in bone processing or utilised with a bone hammer, indicated by the presence of bone and other animal related residue on the used edges.

2.6. Summary

The Howiesons Poort toolkit bears several similarities to Later Stone Age microlithic industries like the Wilton, and was therefore earlier considered a transitional sub-stage between the MSA and the LSA (Goodwin and Van Riet Lowe 1929; Clark 1959). This assumption has been countered as several sites containing Howiesons Poort artefacts have been found interstratified within the MSA. We have seen that raw material acquisition and use during the Howiesons Poort is highly varied. It has often been argued that the Howiesons Poort is characterised by the use of non-local raw materials, and that this have been as an argument for the existence of trade networks and modern behaviour (Deacon and Wurz 1996) or increased foraging range and trade (Ambrose and Lorenz 1990). However, from the case studies presented it appears that many of the fine grained raw materials used are actually of local origin, or that the source have not been located. What is clear is that there is a marked increase in the use of fine grained raw materials associated with the Howiesons Poort and that this needs further explanation. This will be discussed in chapter 6.

The Howiesons Poort technology is characterised by systematic production of blades for the purpose of making backed pieces and segments. The blanks are made using marginal direct percussion with a soft stone hammer, in some cases an organic percussor could have been used. The cores usually display uni-directional removals of blade products, and removals from sides and distal part of the core are mostly done to correct the convexity of the core surface. There are also examples of bi-directional removals from two opposing platforms. There is little evidence of advanced pre-shaping of the cores, and the initiation of the debitage was rather by following natural ridges along the thin part of the core than by cresting, although this also occurs infrequently.

Some of the "*fossiles directeur*s" of the Howiesons Poort are the backed artefacts that occur as segments and trapezes (Wurz 1997; Wurz 1999; Wurz 2000; Soriano et al. 2007; Villa et al. 2010; Mackay 2011). Notched artefacts also occur in significant quantities (Wurz 2000,2002; Porraz et al. 2008), they seem to be especially dominant in the "Jeff" layer at Diepkloof (Porraz et al. 2008). The backed artefacts have been interpreted as indicators of hunting equipment either as insets for spears (Deacon 1989; Deacon 1992; Villa et al. 2010), arrowheads (Lombard 2005; Lombard 2011), or possibly both (Pargeter 2007). It is also argued that not all backed pieces have been used as hunting equipment, but possibly as cutting tools (Soriano et al. 2007).

3. Theoretical and methodological background for the *chaîne opératoire*

In the last chapter I provided an historical background for the MSA and the Howiesons Poort sub-stage. I have shown how the perception and chronology of the MSA have changed over the last century, and how new archaeological sites have contributed to our understanding. This chapter will provide an outline of a theoretical and methodological framework for interpreting the lithic assemblage from Klipdrift Shelter. The framework for analysis chosen for this thesis is the *chaîne opératoire,* and the first part of this chapter describes its historical background. After a short historical review I expand upon the levels of theoretical understanding and explain how information of pre-historic behaviour can be extracted from a lithic assemblage using the *chaîne opératoire*. The second part of this chapter highlights how the decision steps taken by the pre-historic artisan can be traced through the methodological steps of raw material procurement, reduction sequences, use, maintenance and discard.

3.1. Background

Stone tools' ability to fascinate is not new. For as long as there has been an interest in prehistory, stone tools have been at the centre of attention among pre-historians and other enthusiasts. One reason for this is the preservation of stone and at many sites stone tools are the only remaining sources of information. The question is, how can these apparently "frozen in time" objects transmit information of past peoples and societies in an informative way? How can one use the lithics as proxies for understanding past culture and life-ways, or even behaviour?

In the early days of archaeology and lithic analysis, stone tools were assigned names derived from interpreted function and morphological traits like "hand-axe", "scraper", "burin" and so on. The initial goals of this typological structuring in lithic classification were to sort the archaeological material in comparable groups to construct chronologies over time and space as for example the initial sequencing of the African MSA by Goodwin and Van Riet Lowe (1929). Although useful in a broad context it does not inform sufficiently on behavioural development or social aspects of pre-historic societies. Classic typology led to assumptions that morphological classes were connected to separate cultural or ethnic groups, and that shifts in the typology was connected with "invasions of new groups" (Goodwin and Van Riet

Lowe 1929:96). Although not necessarily wrong, the presumption is pre-emptive as there are several other possible explanations for change in material culture, for example natural constraints like; resource intensification and change in subsistence strategies due to changing climate or depletion of suitable raw materials, which are issues that will be discussed in chapter 6. There are also complex social aspects that need to be considered when interpreting material culture, such as behaviour, style and symbolisms role in dictating tool morphology.

To achieve an understanding of these issues, it is necessary to construct a theoretical and methodological framework for mapping the physical component as well as the mental processes and social interactions connected to the production of material culture (Bar-Yosef and Van Peer 2009). The *chaîne opératoire* approach has been argued to facilitate all these facets (Crabtree 1982; Pelegrin 1990; Dobres and Hoffman 1999; Inizan et al. 1999; Dobres 2000; Shea 2011). By reading material culture, in this context lithics, as dynamic aspects in a larger social setting, retracing production sequence, from raw material acquisition, reduction, modification, use and finally discard it is possible to develop an understanding about social practice and inter-personal relations in prehistoric society (Inizan et al. 1999; Andrefsky 2005). The ultimate goal is to achieve an overlap in horizons between the researcher and the pre-historic artisan (Sørensen 2006), and as such the method must be flexible to accommodate the individual sites and contexts. It does not completely replace the typological approach but serves as a complimentary method for extracting an increased amount of information from the entire lithic assemblage, rather than from selected typological groups.

The concept of the *chaîne opératoire* arose in France during the first part of last century and has its roots in the sociological theories of Marcel Mauss (Inizan et al. 1999). However, the French anthropologist Leroi-Gourhan was the first to use the actual term, it in the 1940`s (Inizan et al. 1999), and also the first to "systemize the analysis of technical activities with reference to the notion of a chain of operations" (Sellet 1993:107). Since the 1980`s the *chaîne opératoire* has been increasingly applied as a methodological and theoretical framework for the study of material culture in archaeology (Sellet 1993). Especially in European Palaeolithic studies the method has been a watershed in our knowledge of past technologies and behaviour. In southern African contexts the use of the *chaîne opératoire* is relatively new, but different incarnations of the method is increasingly improving our understanding of technology in the Middle Stone Age (Wurz 1997; Wurz 1999; Wurz 2000,2002; Villa et al. 2005; Delagnes et al. 2006; Soriano et al. 2007; Villa et al. 2009; Villa et al. 2010; Mackay 2011).

The *chaîne opératoire* is not a unique method for inferring behaviour in lithic analysis. During the 1970`s similar approaches to lithic analysis developed independently in the United States. The reduction sequence or operational sequence (Bar-Yosef and Van Peer 2009) and the behavioural chain (Schiffer 1972) are both based on the same approach of analysing lithics technologically where the entire life cycle of the lithic artefacts is considered, rather than selected types. Although similar, there are important differences in the scopes of the two approaches (Tostevin 2011). The reduction sequence approach for example is clearly focused on lithic assemblages only, while the *chaîne opératoire* is a framework for analysing and organising material culture and technology in a broader sense. The *chaîne opératoire* has also been successfully applied to other types of material culture than lithic assemblages, from the Palaeolithic to modern times. An in-depth discussion of the differences between the reduction sequence and the *chaîne opératoire* approaches (see Bar Yosef & Van Peer 2009 and Tostevin 2011) is beyond the scope of this thesis. It is , however, important to note that there are other methods that address the same issues as the *chaîne opératoire* approach, but from slightly different theoretical and methodological perspectives.

3.2. Theoretical considerations regarding the *chaîne opératoire*

> "(…) archaeology is based on the study of material culture, on the analysis of artefacts, which are the products of human intelligence. The discipline can only be enriched by attempts to lay bare, to understand, the psychological and motor mechanisms that subtend these productions" (Inizan et al. 1999:100).

The aim of a *chaîne opératoire* approach is to structure the technological systems present in an archaeological assemblage. The method operates on three levels: The artefacts, the actions and the mental concept (Sørensen 2006). Through studying the material culture it should be possible to reconstruct the "succession of mental operations and technical gestures, in order to satisfy a need, according to a pre-existing project" (Perles 1987 in Sellet 1993:106).

The mental operations, technical gestures and pre-existing project are also discussed by Pelegrin (1990) and can be segmented into sequences of cognitive and sensorimotor operations in stone tool production (Pelegrin 1990; Inizan et al. 1999).

The first cognitive step is the ability to construct a mental picture of the desired product devising a *conceptual scheme*. This can be described as the ideal solution among different options (Inizan et al. 1999). To reach the goal envisioned it is necessary for the artisan to construct an *operative knapping scheme*, which is; how to go about to get there (Inizan et al. 1999). The result of the knapping is dependent on three factors; the *knowledge,* the *know-how* and *skill* (Figure 3) (Pelegrin 1990; Inizan et al. 1999; Bamforth and Finlay 2008).

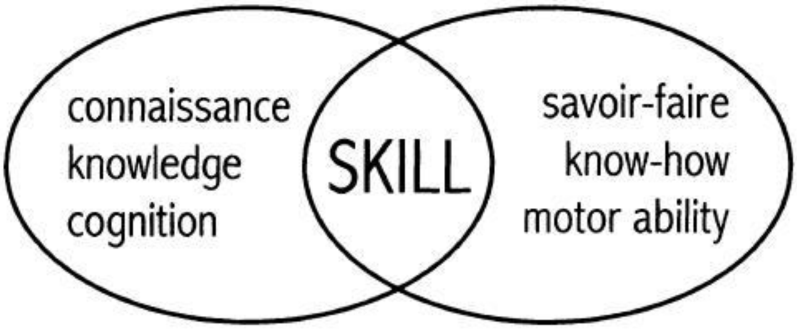


Figure 3 Skill is manifested in the transition between *knowledge* and *know-how* (Bamforth and Finlay 2008:3)

Knowledge is connected to both the *conceptual* and *operative knapping schemes*, and has also been referred to as *connaissance* or cognition (Bamforth and Finlay 2008). The concept can be described as the artisans' theoretic knowledge of how to proceed to reach his goal. *Know-how* on the other hand is the ability to assess the ongoing knapping situation and adapt the *mode* accordingly using habituated motor abilities (Pelegrin 1990). The *know-how* increases with experience, and enables the artisan to overcome difficulties and mishaps during the reduction sequence (Pelegrin 1990). While the *knowledge* is something that can be transmitted through explanation, either demonstrating through actions or orally, the *know-how* can only be learned through practice. The *skill* is closely related to the *know-how*, but should not be seen as the same as it is manifest, both through the ability to devise a *mental concept,* and through the execution of the *operative scheme.* As such, the skill can be found in the area in between *knowledge* and *know-how* (Bamforth and Finlay 2008:3).

Recognising these mental and physical processes can be used as a reference when comparing the modern and the pre-historic mind. As we recognise mental processes and motor actions shared with our ancestors we can, ideally, close the gap between "us" and "them".

This provides us with an understanding of how knapping is connected to the individual artisan's cognitive and motor ability, however, it does not in itself provide us with a sufficient basis for interpreting the broader social contexts in which the technical and mental procedures were implemented (Edmonds 1990:58). The aim of a *chaîne opératoire* analysis is to use the understanding of the individual steps of tool production to investigate alternative strategies available to the pre-historic artisan and compare this to the choices made (Edmonds 1990). In this way it is possible to recognise the individual in the material and investigate the dynamics between the constraints (put upon the artisan of natural and societal character) and the possibility for individual problem solving (agency).

The step by step procedure of the *chaîne opératoire* allows us to investigate the variability displayed through different individuals' approaches to perform various tasks. By pointing out the variability, either within an assemblage or between assemblages, one can potentially recognise the artisans' manoeuvrability within the socially constructed framework of a group or a culture. Additionally, the variability can help us identify group boundaries and the existence of frameworks for transmission of style: "The uniform distribution of basic technical methods within a particular geographic distribution, for example, may indicate the use of oral teaching tradition and the imposition of a rigid framework of "know-how" (Bar-Yosef and Van Peer 2009:116).

3.3. The *chaîne opératoire* methodology

The first part of this chapter has been dedicated to explaining the historical and theoretical background for the *chaîne opératoire* approach. This second part aims to show how the approach can be utilised when interpreting a lithic assemblage. Previously we have seen how the method can be used to describe and interpret pre-historic behaviours through a lithic assemblage and that this is done through a step-by-step methodology considering the entire sphere of stone tool production from raw material acquisition, reduction, modification, use and discard. The description of the methodology will follow the sequence of the *chaîne opératoire*. The production of stone tools starts with the process of acquiring suitable raw materials, and this is also the starting point for archaeologists trying to reconstruct and understand the decision steps taken by the artisan when producing the stone tools.

Raw material acquisition and use

The ordering of physical and mechanical constraints on lithic tool production starts with understanding the role of the raw materials utilized. In order to make any interpretations it is necessary to determine what raw materials are present in the assemblage and group them accordingly. The colours and quality should also be determined, and if possible in what state the raw material was when introduced to the site (Sellet 1993). The aim of such a procedure is to determine the amount of effort invested in the procurement of the raw materials used at a given site. Procurement strategies can inform on group mobility, exchange networks and seasonal movement, but can also reflect style or tradition through preferential use of certain raw materials (Dobres and Hoffman 1999; Inizan et al. 1999; Wurz 1999; Wurz 2010).

Determining the provenance of the individual raw materials is dependent on several factors. Pre-historic people could have collected their raw materials at both primary and secondary geological sources (Minichillo 2006), and additionally the raw materials could have been introduced indirectly through trade (Sellet 1993). In either case determining the location and distance to the geological occurrences is a necessary first step before drawing any conclusions regarding behaviour (Inizan et al. 1999). This can be done trough surveying the area and sampling occurrences of raw materials for comparison to the archaeological assemblage.

There are several methods available for determining geological provenance for primary deposits of raw material. Geochemical methods are very precise, but demand expensive equipment and can in some cases be destructive (Odell 2003; Andrefsky 2005). Because of this visual characterisation is more often employed. Colour texture and density of the raw materials are criteria that can be used for comparison between the archaeological assemblage and a modern sample (Odell 2003).

A primary source that matches the archaeological sample does not automatically indicate procurement of the raw material for use at the site. Rivers dissecting the landscape will be potential sources for secondary depositions of raw material as rivers the cut into primary sources and transport the raw materials over vast areas. Also alluvial gravels transported by ancient rivers can be such a source (Minichillo 2005). It is almost impossible to determine where a secondarily deposited raw material has been sourced in the pre-history, as it is spread over large areas and at distances far away from the primary source: "As these deposits are secondary, sourcing methods fail to pin-point the location from which they were collected" (Minichillo 2006:362).

Caution is also advised as landscapes change constantly over time. Although raw materials could seem exotic or cannot be found locally today it does not necessarily mean that this was the case during the MSA. Primary sources could have been depleted after thousands of years of exploitation, and secondary sources could have moved or been covered as rivers and beaches shift over the millennia. Many potential sources of raw materials for coastal sites could also be submerged today, as fluctuations in sea levels have been dramatic during the MSA (Minichillo 2006; Chase 2010; Compton 2011).

The mentioned biases to determining raw material sources cannot be emphasised enough, and is certainly one of the problematic issues of tracing behaviour through the *chaîne opératoire*. If the natural constraints for determining pre-historic choices cannot be mapped, all behavioural inferences made regarding artisan agency will be weakened.

Local, non-local and exotic are terms often repeated when discussing distance to raw material sources and there has been ambiguity tied to the use of the terms non-local and exotic (Minichillo 2006). While non-local clearly states the absence of the material in the local area, exotic is a less tangible definition. It could mean that the source is either non-local, local but rare or possibly unknown (Minichillo 2006). Mixing these definitions could lead to wrong interpretations about raw material provenance and use.

Additionally, accurate knowledge of the locations of lithic sources exploited and the distance to these are essential before making any inferences to human behaviour (Ambrose 2006). There is no set standard for what should be considered as the foraging range of hunter-gatherer groups and classed as local. Gamble (1995) refers to Australian hunter-gatherers in a desert environment and sets the limit at >40 kilometres. Minichillo (2006) mentions that non-local is typically considered as >20 to 50 kilometres away from a primary source. Kelly (1995)on the other hand argues that foraging range depends on too many factors to be generalised to all contexts, but that: “A 20 to 30-kilometer round trip appears to be the maximum distance hunter-gatherers will walk comfortably in a day in a variety of habitats” (Kelly 1995:133). A more detailed discussion on the implications of distance to raw materials during the HP period will be given in chapter 6.

Cortex analysis

Cortical analysis is relevant to understanding both raw material provenance and reduction sequences as will be discussed in the following section. Assessing the type of cortex can be of great value when determining whether the raw materials present in the assemblage is sourced at a primary or secondary deposit, as the cortex reflect the type of erosion the lithics has been exposed to. Three main categories of cortex types often found in lithic assemblage are; (1) natural cortex with surfaces displaying erosion consistent with weathering as would occur on outcrops and cliff-faces, and (2) cobble cortex that display erosion consistent with water rolling, either resulting from water transport in rivers or wave activity on beaches. These two types of cortex are usually recognisable by smooth, rounded edges and sometimes "pockmarks" from impact with other rocks. Finally, (3) a type of cortex that is more difficult to recognise is the chemically altered surfaces. This type of cortex can be the result of heat treatment (intentional, or not), association with, for example, acidic or coloured sediments just to mention a few. Presence of the first type of cortex can point to a primary geological context for the raw material; the second type indicates a secondarily deposited raw material source, while the third can occur on all types or raw material regardless of original source.

Cortex analysis can also be used to determine the place in the reduction sequence of a lithic, for example if a lithic retains large amounts of cortex it can be interpreted as an early removal (Odell 2003; Andrefsky 2005). Different procedures for recording amount of cortex, however, often makes comparisons between assemblages problematic (Sullivan and Rozen 1985; Amick and Mauldin 1989). This issue will be further discussed in chapter 5.

Reduction sequences

After establishing the different types of raw materials in an assemblage and their geological provenance the next natural step in a *chaîne opératoire* analysis is to study the reduction sequences practiced at the site. There are several methods available to the researcher, but some of the most common and informative are; refitting, diacritical analysis and experimental reconstructions of reduction sequences.

Experimental knapping and Fracture mechanics

Experimental studies have been an essential part of acquiring an understanding of the physical and mental requirements in stone tool production. By replicating pre-historic knapping, researchers gain knowledge and understanding of how different raw materials react to different *modes* of knapping, which technical skills are required, and what constraints exist in the mechanical properties of raw materials. At the same time, modern reference to the individual pieces in pre-historic reduction sequences can enable more precise technological classification (Crabtree 1982; Whittaker 1994; Odell 2003).

By systematically reconstructing the different characteristics seen in the archaeological material the modern knapper will "link minds" with the pre-historic artisan. For example when encountering problems in the knapping process that inhibit progress, the solution can provide explanations for certain products existing in an archaeological assemblage and provide insight into the ability for problem solving and step-by-step planning in pre-history. Understanding the choices made by the artisan and being able to recognise and replicate this is of outmost value for the modern researcher. The different techniques, tools and mode of applied force leaves different "signatures" on the lithic debitage, and can be recognized through replication or knowledge of fracture mechanics. The bulb of percussion, for example, can tell us with some degree of reliability whether direct or indirect percussion has been used, if the percussor was a soft or hard material and whether it was made from an organic material or stone. The amount of platform preparation is often used to argue for planning depth (Crabtree 1982; Whittaker 1994; Odell 2003; Soriano et al. 2007; Soriano et al. 2009; Villa et al. 2009; Villa et al. 2010). There are of course several important considerations to take into account when using replicated material as a reference for archaeological material. Some critics argue that modern replication only indicates how the tools, or in this case the reduction sequences, could have been made and not how they were actually made (Andrefsky 2005:9; Bar-Yosef and Van Peer 2009).

Refitting

If time and material allows, a refitting of the lithic material can be one of the most rewarding methods for technological analysis (De Bie 2007; Bar-Yosef and Van Peer 2009). In essence this means piecing together all the fragments from an assemblage gradually reconstructing the original reduction sequence. Refitting is closely connected to replication studies as the ability to recognize, reconstruct and refit is also dependent on an in-depth understanding of fracture mechanics, and the ability to recognise the individual pieces´ place in the reduction sequence. The method can also be successfully utilised to verify conclusions drawn from experimental knapping studies (Andrefsky 2005). Refitting holds potential for mapping past behaviours by reconstructing mental schemas and recognising different steps taken when problems are encountered during the reduction sequence.

Not all assemblages are suitable for refitting. Incomplete assemblages, either because of coarse excavation and sampling, or when only parts of a site are excavated, often lack the necessary level of detail to perform a refitting. Additionally, the researcher must consider whether the information that can possibly be extracted is worth the time invested, as refitting is an exercise that requires much time and optimal working facilities.

The latter is an essential point when doing a *chaîne opératoire* analysis in general. The approach is a flexible one and the specific methods utilised can be modified to fit the sample studied. What is important to keep in mind is the goal of the analysis, and modify the methodology to answer your specific questions accordingly. As such it is possible to include elements of typology, technological studies, macro-fracture analysis and metrical classification for statistical presentation of the material.

Diacritical analysis

Another method for organising and analysing the reduction sequences in an assemblage is through diacritical analysis also termed "dynamic technological classification" (Sørensen 2006). This method aims to; count, orient and chronologically classify all removals visible on an artefact (Sellet 1993:108). These markers can be dorsal scar ridges, bulbs of percussion, and amount and type of platform preparations to mention a few. Through this procedure it is possible to organise all the parts of the assemblage after where the individual lithics belong in the reduction sequence. The benefit of this method compared to an actual refit is that it can recognise individual removals provenance without having access to the entire reduction sequence, as could be the case with preliminary studies of material from ongoing excavations.

Sellet (1993:108) argues that because this method is aimed at recognising patterns in core reduction, the cores, or bifaces, should be considered a primary source of data because they show us the complete technological stage and that flakes only show a limited part of the reduction sequence. Although important, it can be argued that the cores only show us the last technological stages of reduction which may not be representative of the technology present at the site as a whole. For example interpretations of heavily reduced cores may lead to the conclusion that only bladelets were produced at a site while, in fact, this is only a manifestation of extended raw material exploitation. Additionally, assumptions drawn from the last removals on a core could indicate that the reduction sequence ended when the core morphology led to hinge fractures and premature terminations of removals, while this actually could be a result of a child's play with an already discarded core (Hogberg 2008).

These two examples clearly illustrate the necessity to use a dynamic and multifaceted approach when interpreting reduction sequences in a lithic assemblage. The broad framework of the *chaîne opératoire* allows the selection of suitable methods required to answer specific questions.

For any kind of analysis to be possible some type of typological sorting will be necessary to group the individual lithic pieces in understandable and comparable entities. Although typological in essence, the grouping can be founded in technological understanding rather than derived from interpreted use. As long as the classification criteria is well defined and clearly linked to the defined method, technological types should be valid (Bar-Yosef and Van Peer 2009:107). Often when dealing with assemblages that are not complete (for either of the reasons mentioned above), knowledge of fracture mechanics, recognising traits on the individual lithic objects, knowing their provenance in the reduction sequence also enable recreating the decision steps made by the artisan (Sørensen 2006).

Use modification and discard

The ultimate step of the *chaîne opératoire* is directed at the products resulting from a lithic reduction process. I formulate it this way because it would not suffice to say that the focus is towards the end product, but rather towards the technological understanding of how they come about, are used and discarded. It is the dynamic life of the stone tool that is at the centre of this method (Sellet 1993). Studying which types of blanks have been selected for use, what characterises these, what sort of modifications have been made to them to perform certain functions, and ultimately at what stage they have been discarded or replaced.

Mapping variability in strategies of blank production and selection is a useful tool for identifying specific industries, as the typology does. The difference lies in the resolution of this variability. While the typology rests on our perception of the items shape, technological classification focuses on the variability in the method used to reach these types, reflecting artisan's agency and skill.

4. Site description and excavation procedure

The previous chapter outlined the theoretical and methodological framework of the *chaîne opératoire* approach to lithic analysis. In this chapter I describe the Klipdrift Shelter site and surroundings to provide a context for the following lithic analysis. A brief outline of the TRACSYMBOLS project is included to explain the background for the excavation. Furthermore, a detailed description of the excavation procedure is given to show that the material used in this analysis is suitable for a detailed technological analysis. The last part is dedicated to describing the specific criteria chosen for classifying the lithic material used in my analysis.

4.1. Site description and project background

The TRACSYMBOLS project

The excavation of Klipdrift Shelter was initiated in 2010, as the latest addition to the TRACSYMBOLS project. The project is funded by the European Research Council under the European Union's Seventh Framework Programme ERC grant agreement (www.tracsymbols.eu). One of the key goals of the project is to examine modern human behavioural development and how this was affected by palaeo-climatic changes in Africa and Europe between 180 kaa and 25 ka. The project is directed by Professor Christopher Henshilwood as principal investigator (PI) based at the Department of Archaeology, History, Cultural Studies and Religion (AHKR) at the University of Bergen (UiB), and the University of the Witwatersrand. Professor Francesco d'Errico based at the University of Bordeaux is co-PI. Together they have established a team for interdisciplinary researchers with various backgrounds in palaeo-climatic research and archaeology.

Description of the Klipdrift Shelter and surrounding area

The Klipdrift complex is situated on the southern coast of South Africa in De Hoop Nature Reserve, approximately 300 kilometres East of Cape Town (Figure 1). The complex consists of two sites; Klipdrift Cave, and Klipdrift Shelter.

The sites are part of the same cliff-face with an outlier of quartzite separating them (Figure 4). Klipdrift Cave is situated at 23 metres above present sea level, whereas Klipdrift Shelter lays somewhat lower at 18 metres above sea. Part of the original deposit in the sites was probably washed away during the mid Holocene high water stand, and it is estimated that at least 50%

of the original deposit is now eroded away (unpublished excavation permit application). The remaining deposit in Klipdrift Shelter is sloping at an angle of circa 30 degrees and is truncated (Figure 5). The deposits are however well preserved in a clear stratigraphic sequence.

Figure 4 Satellite photo of site and surroundings (Google Earth)

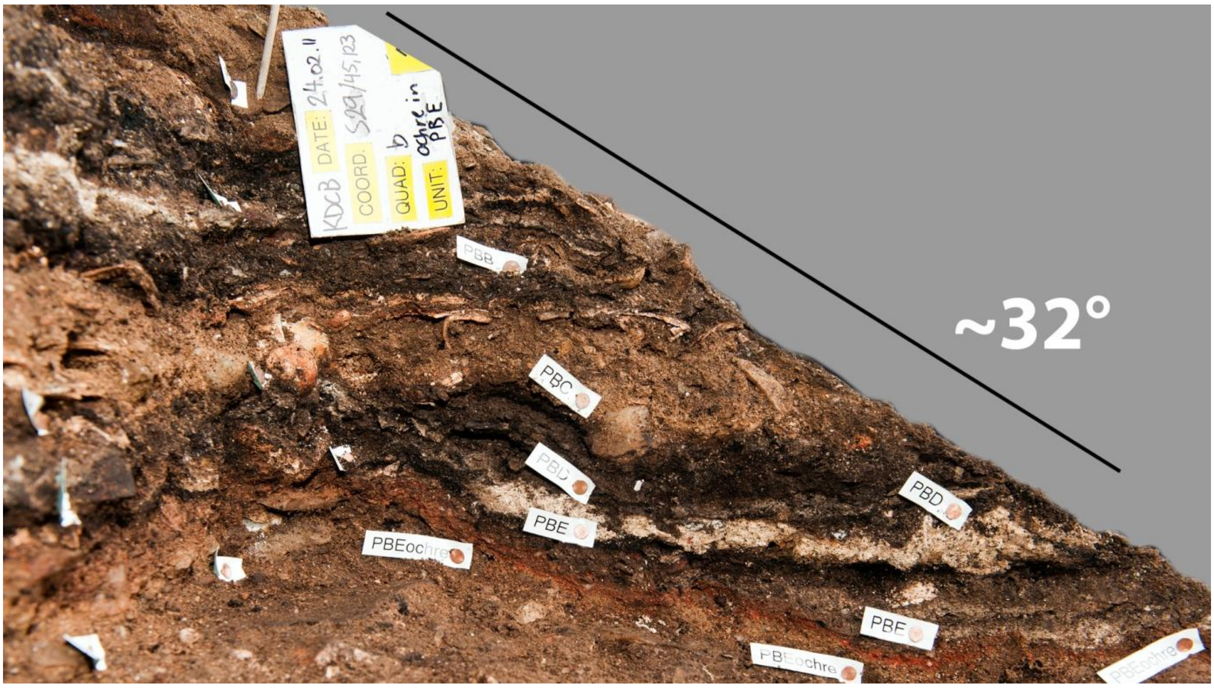


Figure 5 Showing the truncation of the sediments and the angle of the surface

The excavations of the Klipdrift Complex started in October 2010, with a six weeks excavation of the Klipdrift Cave. In February and March the following year Klipdrift Shelter was excavated for six more weeks, which has provided the material for this analysis. The excavations have continued through another season in February and March 2012 that will provide more material for future analysis, but is not included here due to the scope of the analysis.

4.2. Excavation procedure

Mapping the site

The difficult access to the site posed initial challenges for the excavations, and large parts of the first season was dedicated to constructing secure platforms to work from, and to protect the deposits as much as possible. It was also necessary to construct a 20 metres long cableway to transport equipment in, and the finds out. Additionally, the site is not accessible from the beach during high tide, which necessitated the construction of a bolted escape route up the cliff face from the site. The difficulty of accessing the site, other than complicating the excavation, could be one reason for the pristine preservation of the sediments. To enable precise recording and mapping of the site extent and sediment surfaces, a numerical and an alpha-numerical grid system was devised. The numerical system increases towards north and east on an x and y-axis. This system corresponds to a spatial value assigned to each artefact plotted using a total station, making it possible to analyse the material spatially. To avoid excavating squares with negative values the origin of the numerical system is placed further south-west than the caves extend. The alpha-numerical system uses letters from A to Z on the Y-axis, and numbers from 1 and upwards on the x-axis increasing towards south-east (Figure 6).

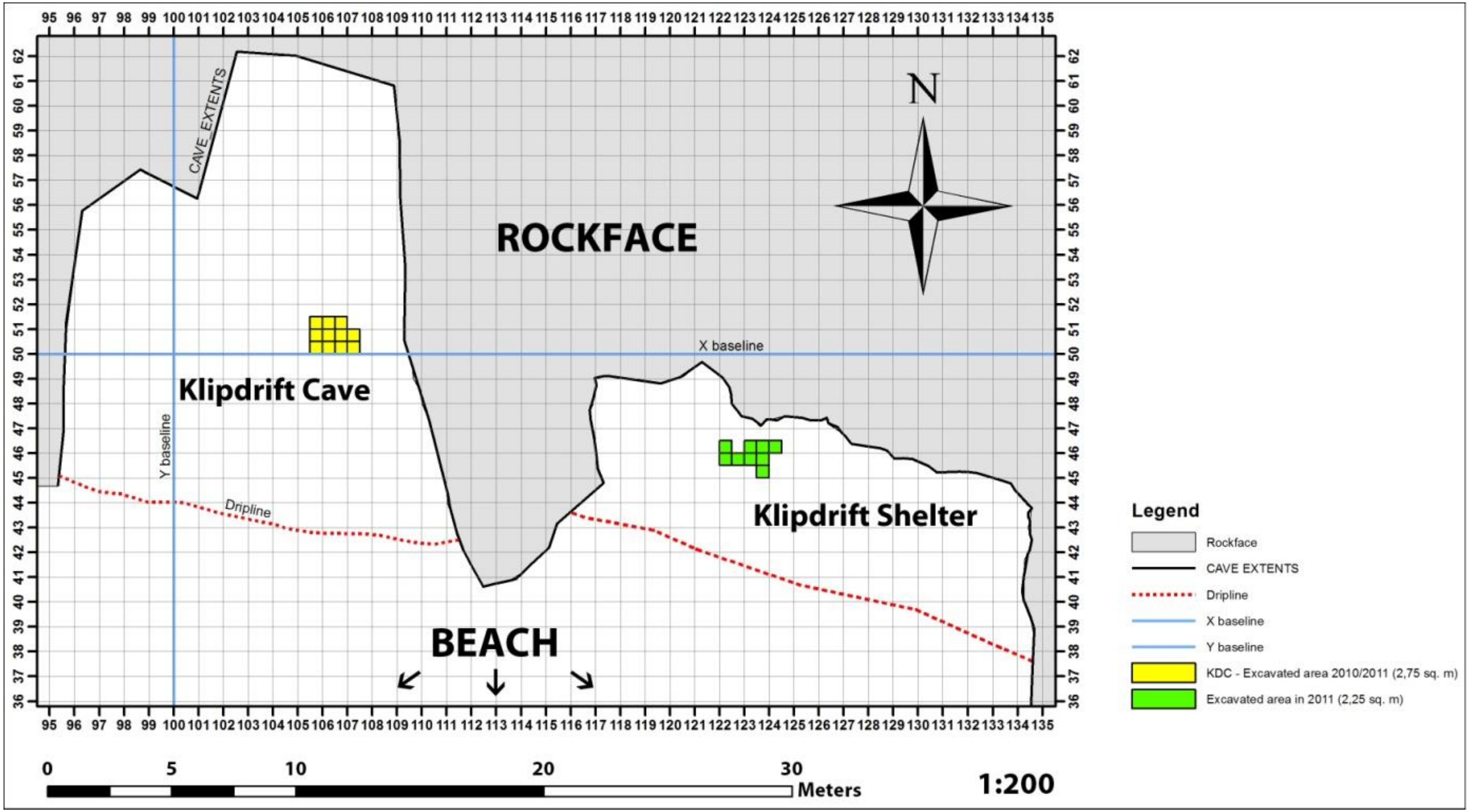


Figure 6 Site map showing excavated quadrants in Klipdrift Cave and Klipdrift Shelter (2011 by Magnus Haaland)

The grid system enables the division of the site surface into square metres and a further sub-division into 50 by 50 cm quadrants. The alpha numerical values in the grid identify the square metres, and the quadrants are named a, b, c and d in a linear fashion starting in the north-west corner.

Stratigraphy and excavation procedure

The individual quadrants are excavated following the individual culture-stratigraphic units as closely as possible. The total-station is used to map each stratigraphic surface in accordance with the x and y values of the grid, and a z value which indicates height above sea level (calculated from a set and measured datum point). Each stratigraphic unit is named alphabetically with three characters to enable future sub-divisions. When the material for this thesis was selected in March 2011, just over two square metres had been opened for excavation; uncovering nine stratigraphic units (Figure 7 and 8).

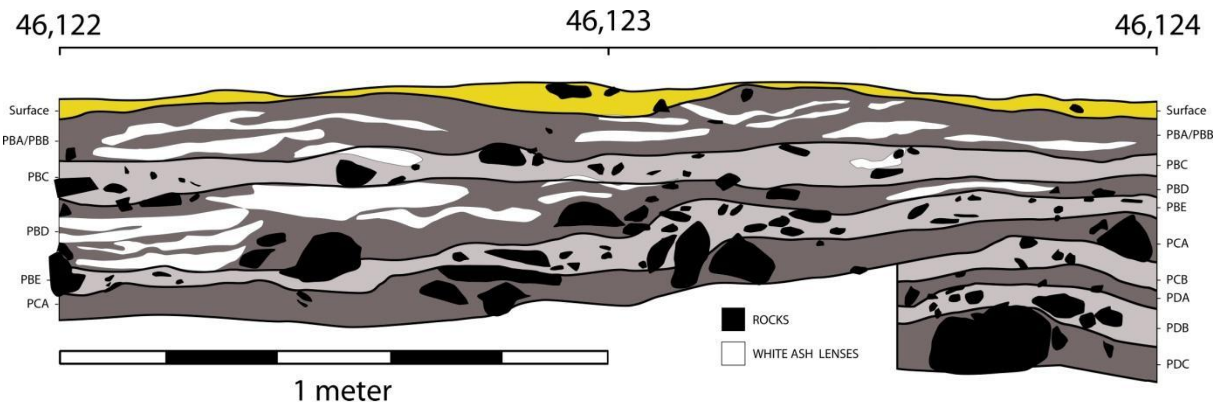


Figure 7 Klipdrift Shelter stratigraphy (2011 by Magnus Haaland).

All lithics that are larger than 20 mm are plotted and bagged separately and allocated a number that assigns the individual piece to a place on the grid and stratigraphic unit it belongs to. A description of the artefact is included in a record sheet together with all other findings from the same unit. Additionally, every artefact is given a unique number (e. g. KB484) that increases chronologically and that is independant from the stratigraphic units. This system enables each artefact`s stratigraphic and in-field description to be retrieved easily at a later stage when for example analysing the assemblage.

For this analysis it was considered important to study and quantify the small debris to precisely document the use of different raw materials, and to recognise technological traits in the material. This was possible since all extracted sediments are sieved through both a 3.5 mm and a 1.5 mm mesh.

The PBE stratigraphic unit, which is the focus of this study, had been excavated in four of the nine quadrants mentioned, limiting the sample to one square metre, stretched out on a line of two metres (Figure 8). Although the extent of the excavation is limited, the lithic density is very high, which has been the main reason for limiting the analysis to only one stratigraphic unit. After recording and extracting the lithics as described above, they were washed or cleaned carefully to enable a more thorough study.

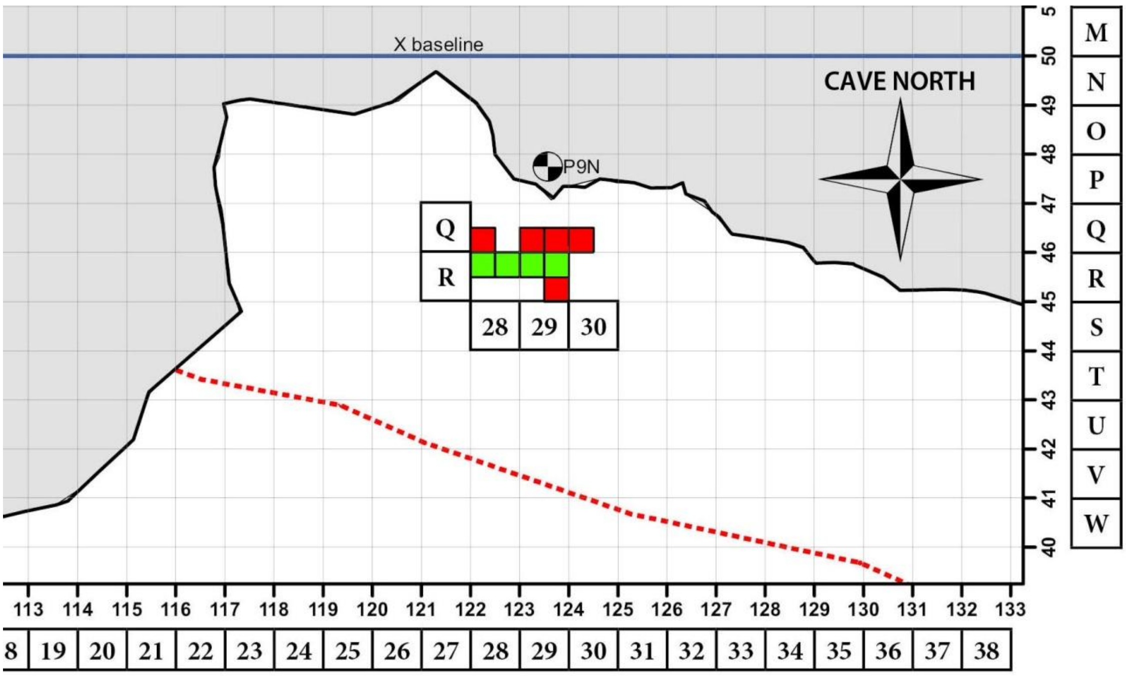


Figure 8 Klipdrift Shelter map showing quadrants where PBE has been reached (2011 by Magnus Haaland).

4.3. Sampling strategy

Criteria for lithic analysis

During six weeks in February and March 2011 I separated the lithic material from the sediments, sorted and analysed the sample. This was done at the IZIKO museum in Cape Town. Photographs and drawings of selected lithics were also made. The retouched component and cores were re-analysed for six weeks in November 2011.

Refitting lithics is often regarded as one of the primary and most informative methods in a *chaîne opératoire* analysis. However, this method was considered to be outside the scope of this thesis as the time was limited. The technological analysis and study of reduction sequences is therefore based on a combination of metrical, morphological and diacritical classification. Technological analysis have been performed on HP assemblages in other South African sites the last decade (Wurz 1997,2002; Delagnes et al. 2006; Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010; Mackay 2011) and metrical classification criteria for this analysis has thus been selected, as far as possible, to facilitate comparison to material from the sites described in chapter 2.

The debitage has been sorted into classes for further analysis and is presented and discussed in Chapters 5 and 6 respectively. The following debitage classes are used in this study:

(1) Blades, bladelets and blade fragments (proximal, medial and distal). Blades were defined as specimens with lengths at least twice their widths. On blade fragments the cross section and profile were used for classification. A triangular or trapeze cross section or parallel dorsal scars and edges can be used to classify a blade section in the optimal phase of reduction (Villa et al. 2010:636). The same classification criteria applied to bladelets as they were not separated from the blade category. Both categories were combined in the assemblage composition, hence also the metrical study. The production of bladelets follows the same reduction and preparatory stages as the blade production, and was thus considered the same product regardless of size. However, an arbitrary limit of 10 mm width is used to separate the two classes when discussing the cores.

(2) Flakes were defined as any piece larger than 20 mm with a platform removed from a core, and does not fit with the criteria set for blades. Pieces that were clearly a result of flaking, but that do not have a platform due to fragmentation were classified as flake fragments. Flake fragments were included in the assemblage composition for raw material and cortex counts, but not in the metrical analysis. The same procedure has been used for chunks (angular pieces larger than 5 mm) and chips (angular pieces smaller than 5 mm). Complete and proximal flakes smaller than 20 mm were classified as trimming flakes, though they may be by-products of both flake and blade production or core management.

(3) Cores are defined by having a striking platform and when two or more negative removals of either flakes or blades are visible on the active surfaces. Pieces with evidence of removals without having a platform or where origins of removals cannot be determined were classified as core fragments.

(4) Retouched pieces were grouped in one category regardless of whether they were flakes or blades; this was, however, included in their description. Criteria for typological classification

for the retouched pieces follow (Wurz 2000) as such the retouched classes in the assemblage, and are defined as: Segments, backed pieces, notched pieces or denticulates.

Retouch was defined as both formal and informal edge modification on specimen, resulting from anthropogenic factors. Recognizing retouch has been done using a hand held loupe with 10x magnification, and in some cases low-powered microscope.

Maximum width, length, thickness and weight was measured on all proximal and complete flakes larger than 20 mm, and on all blades and bladelets regardless of size. On blade fragments only width and thickness was recorded as it is difficult to estimate original length. Platform length and width has been measured when intact on flakes, blades, bladelets and blade fragments. The type of platform was described and categorised as; plain, faceted, shattered or split. Bulb of percussion and type and extent of platform preparation has also been recorded. All retouched pieces were measured with the same criteria mentioned above. Cores and core fragments were classified by the direction of last removals and number of platforms e.g. single platform core, parallel platform core or opposing platform core. The core length, thickness and weight were recorded, and when possible the width and length of removals was measured.

Chunks, chips and flake fragments were excluded from the metrical analysis, but were studied for cortex, raw material and technological traits indicating reduction strategy.

5. Material description

In this chapter I describe the lithic material from Klipdrift Shelter. The description follows a *chaîne opératoire* approach. First I explain the raw material composition at the site, then the lithic products from typological, metrical and technological approaches. The material presented in this chapter lays the foundation for the discussion in chapter 6.

5.1. Raw materials at Klipdrift Shelter

A range of different raw materials are present in the Klipdrift Shelter lithic assemblage. The most common raw materials are quartzite (37.7%, n=1442) followed by quartz (37.6%, n=1436) and silcrete (24.5%, n=937). Other raw materials are present, but in very small quantities, limited to only a few pieces: quartz crystal (0.03%, n=1), chert (0.08%, n=3), calcrete (0.05%, n=2) and hornfels (0.03%, n=1) (Figure 9 and Table 1).

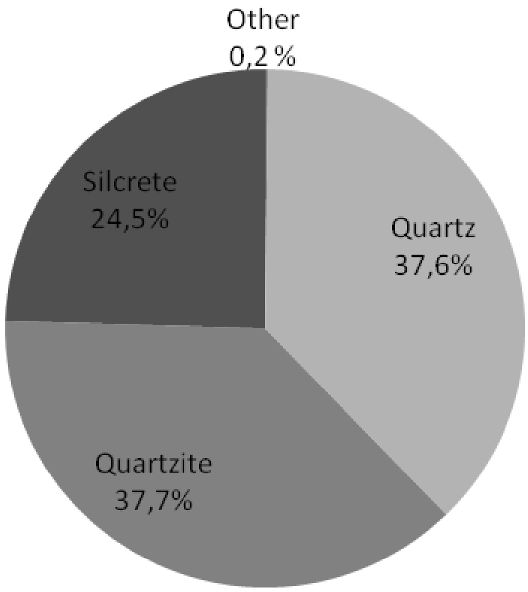


Figure 9 Raw material distribution in the complete Klipdrift Shelter assemblage.

Raw material	Number	%
Other	6	0,2
Quartz	1436	37,6
Quartzite	1442	37,7
Silcrete	937	24,5
Total	3821	100,0

Table 1 Material distribution in the complete Klipdrift Shelter assemblage.

The colours of the quartzite range from white and light grey to dark grey, brown, green, and red. Most common is a medium grey which constitutes approximately three fourths of the sample, while the second most common is a dark grey variant. White, red, brown and green are relatively rare and constitute less than 10%, except in the blade category where white constitutes 16%, (n=10). Why there are higher amounts of white quartzite in the blade category is interpreted as a consequence of this material' finer texture and flakeability, rather than being connected to colour. A detailed study of the implication of colour is beyond the scope of this study, but could be a fruitful approach for future studies.

High quality is this analysis regarded as materials that are fine grained, and that are homogeneous in structure, this affects the materials mechanical properties and decides whether or not they are suitable for knapping (Crabtree 1982; Whittaker 1994; Inizan et al. 1999; Odell 2003; Andrefsky 2005).

A variety of qualities is displayed in the quartzite component; some pieces are homogenous with fine grains, while other types are coarser grained with inclusions and seams. Quartzite cobbles are readily available on the beach below the caves, however, the quality or flakeability of this material is variable. High quality quartzites in all ranges of colours were recorded in the assemblage, though this variation and quality is not present at today's beach below the site. This relationship will be discussed further in chapter6. In coastal conglomerates only a few kilometres west of the site, several more varieties of quartzite in different colours and qualities are available. Much of the lithic material in the assemblage could also have been sourced from the shelter walls which are comprised of a light grey variant of mediocre quality.

Quartz comes in a number of varieties, but differences are harder to distinguish than with other raw materials found at the site. Mainly, the sample can be separated into two different types; one milky white which is the most common and constitutes 86%, (n=1098), while a smoky grey constitutes 14%, (n=175). The milky white type often has seams or patches of a rust-red colour. Quartz cobbles can be found in the coastal conglomerates, and occasionally along the beaches in close proximity to the site. There are also quartz veins in the parent rock of Klipdrift Shelter which could possibly have been used as a source. One piece of crystal quartz found in the deposit is of unknown provenance.

Silcrete displays the largest variety in colour; ranging from deep red, orange, brown, yellow to dark brown, grey and green. Some silcrete lithics display several colours and have different hues in between these colours. In my analysis the colour categories of Silcrete have been generalised to red, yellow, brown, green, white and grey. Grey is the most common in all classes of the sample (48-52%), followed by brown (30-36%) and red (9-19%). In the retouched component the grey decreases to 38%, the brown to 29%, while red increase to 33%.

Primary deposits of silcrete can be found along the entire Cape Fold Mountains (Roberts 2003), and whereever rivers disect this belt seccondary deposits can be expected (Minichillo 2005:84,2006). This includes the area around Klipdrift Shelter. It has, however, not been possible to confirm the occurrence of silcrete in secondary deposits in proximity to Klipdrift Shelter despite a number of searches in the area. Silcrete outcrops can be found in-land west of the Potberg Mountain approximately 40 km in a straight line north-west of the Klipdrift Shelter, this material did not match the colours or the texture observed in the Klipdrift Shelter assemblage.

The use of heat to alter the mechanical properties, and colour, of lithic raw materials has been proven in the Still Bay industry at Blombos Cave (Mourre et al. 2010), and at Pinnacle Point, possibly as far back as 160 ka (Brown et al. 2009). It is therefore not unlikely that this has also been practised in the HP.

To test the implications of possible heat alteration in the Klipdrift Shelter assemblage silcrete that was sourced in the Potberg area was experimentally heat treated using a kiln where temperatures could be controlled. After applying a temperature of ~350° Celsius for 10 hours a notable change in colour and mechanical properties was manifest (Figure 10 and 11).

It could be argued that heating of lithic raw materials could have been accidental as overlying hearths could affect deposited materials. This can however easily be tested:

> "After the removal of a flake from unheated silcrete, the scar surface will have a rough, dull texture. If a silcrete piece had been heat treated first, then the scar surface will have a smooth, glossy appearance" (Mourre et al. 2010:660)

The gloss can be recognised using non destructive methods like visual characterisation (Mourre et al. 2010) or by using maximum gloss analysis (Brown et al. 2009). The mentioned gloss could also easily be recognised when flaking away the dull surface of the treated materials sourced at Potberg area (Figure 11).

A discussion on heat treatment implication on behaviour will follow in the next chapter. It is briefly mentioned here to illustrate that heat alteration is one factor that needs to be addressed when discussing raw material provenance based on colour, homogeneity and flakeability.

Figure 11 Experimentally heat-treated silcrete from the Potberg area. Upper row; before treatment.

By separating the different classes in the assemblage composition into groups of raw material, some interesting patterns appear. Among the chunks, chips, flake fragments and trimming flakes (Figure 12a), the raw material distribution is relatively similar to the pattern observed in the overall composition. The pattern is also quite similar within the flake component (Figure 12b), here the majority of the flakes are in quartzite (40% (n=58)), followed by silcrete (33% (n=48)) and quartz (27% n=39)). The distribution within the blade category changes the perspective seen in the overall assemblage (Figure 12c). There is a clear selection for silcrete (54.8% (n=210)) followed by quartz which constitute 28.5% (n=109). The otherwise most common raw material quartzite represents only 16.7% (n=64). In the retouched category only fine grained raw materials are present, dominated by silcrete which constitute 82%, (n=24), while the rest (14%, n=4) is represented by quartz. There is no quartzite among the retouched lithics (Figure 12d).

Figure 10 Change in colour and texture through heat alteration, from left; untreated, treated and treated and flaked.

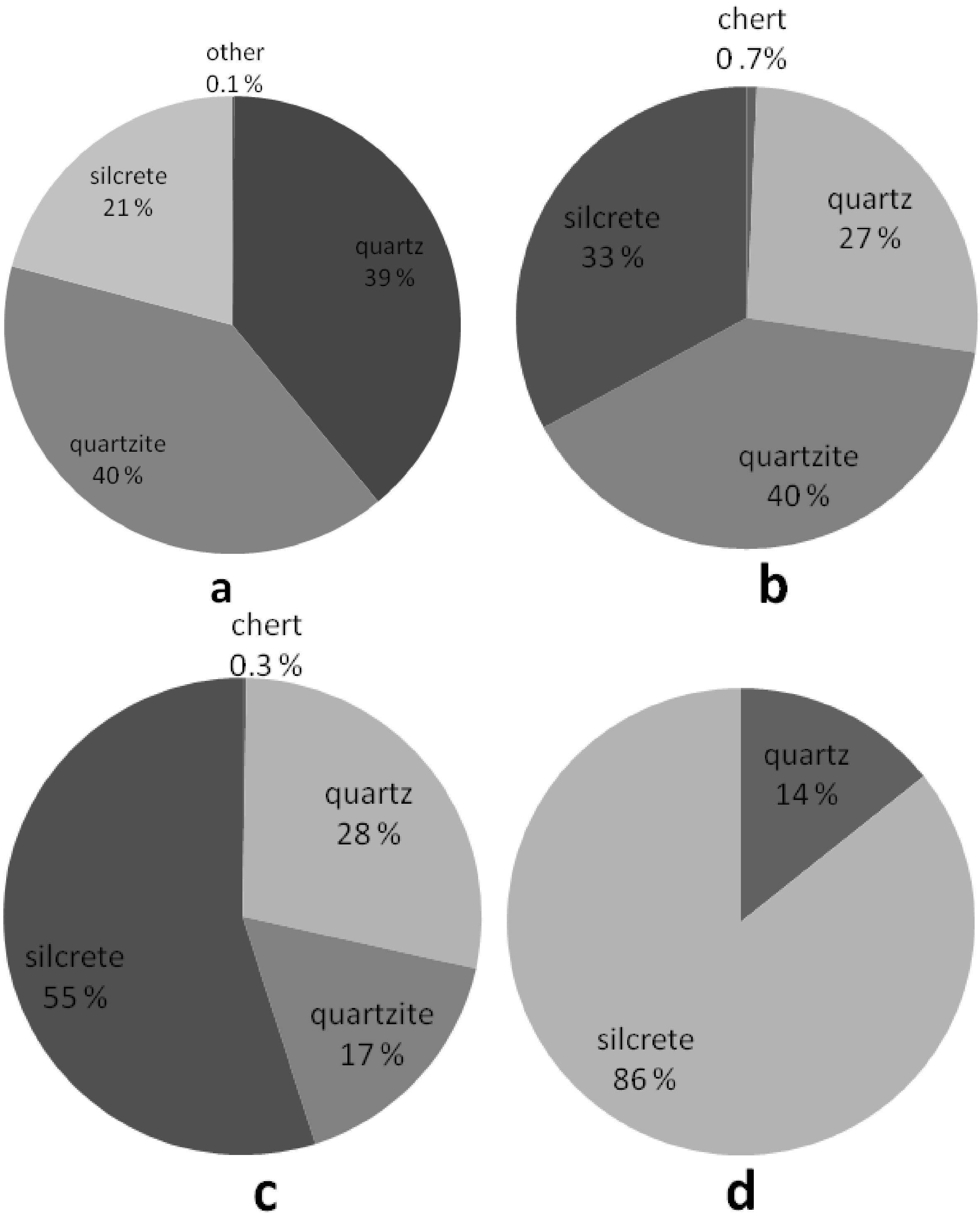


Figure 12 Raw material distribution separated in categories; a= Chunks, chips, flake fragments and trimming flakes, b= Flakes, c= blades, d= retouched lithics. Percentages are rounded off.

5.2. Cortex analysis

Cortex, or the surface of lithic raw material, can be an important source of information in a technological analysis. It can give information on where raw materials have been sourced based on type of cortex, and it can be used to identify specific agendas related to reduction sequences.

The cortex recorded in the Klipdrift Shelter lithic assemblage consists of two main types here labelled cobble cortex and natural cortex (Figure 13). The first is cortex resulting from heavy water rolling erosion and is typically seen on beach or river cobbles. Natural cortex is a result of weathering erosion as seen on rocks from cliff faces or outcrops (Figure 13). In the total assemblage 82.3%, (n=3144) of the lithics, debitage included, does not have any cortex, and only 2%, (n=88) have more than 75% cortex on the dorsal surface. When looking at the amount of cortex in the different raw material classes the pattern is quite similar for all raw materials (Figure 14-16).

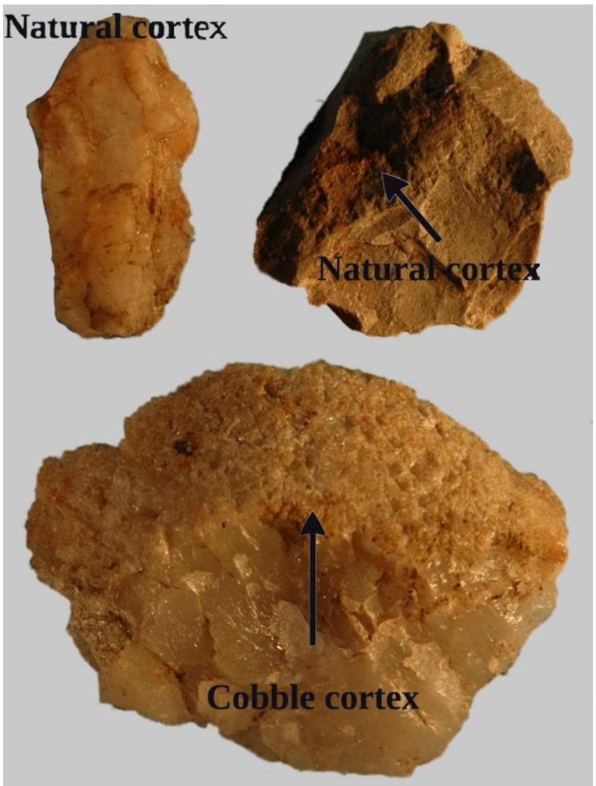


Figure 13 Illustrating the difference between natural cortex and cobble cortex

Distributions between cobble and natural cortex are almost identical when comparing the silcrete and the quartz component, while the quartzite shows a different pattern in cortex distribution (Figure 14-16); here the amount of natural cortex is considerably higher.

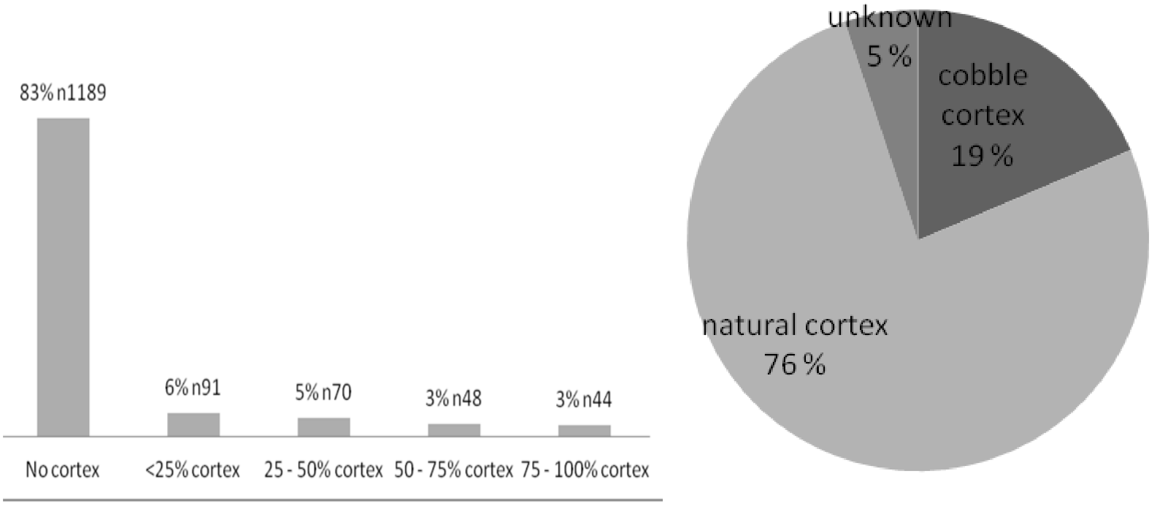


Figure 14 **Quartzite cortex amount and type.**

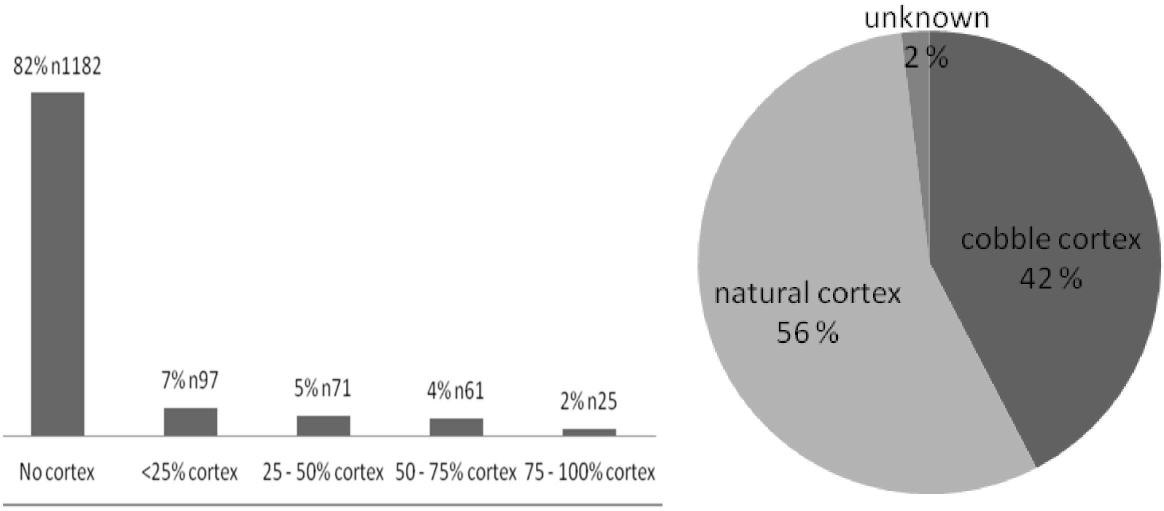


Figure 15 **Quartz cortex amount and type**

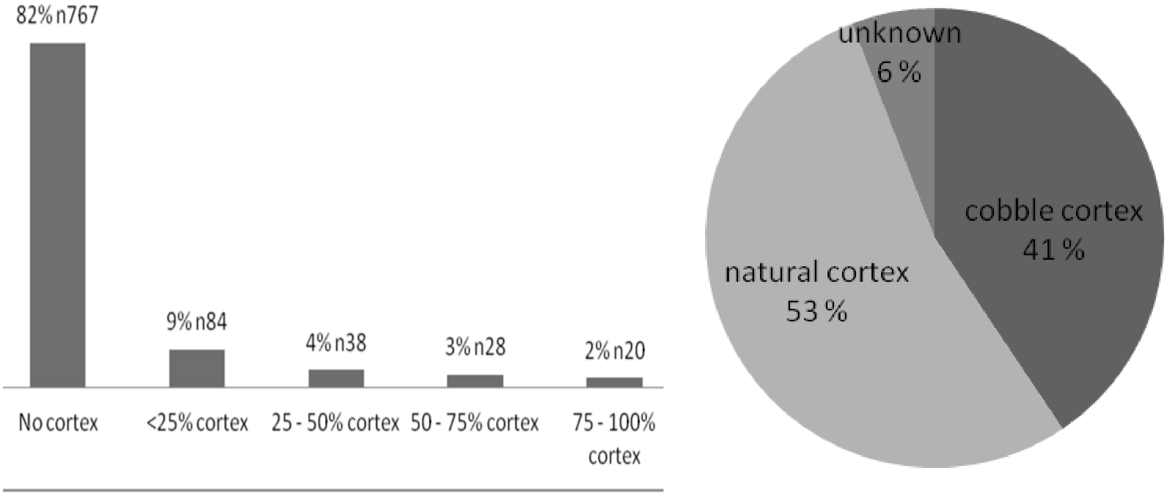


Figure 16 **Silcrete cortex amount and type**

Within the blade and blade fragments component the amount of cortical pieces is relatively low. Of the 386 pieces recorded 80%, (n=309) does not have any cortex at all, and blades showing more than 75% cortex is even lower than in the general assemblage, at 0.5%, (n=2). Separating the blades into raw material classes changes the cortex distribution somewhat. The silcrete and the quartz components are similar with 80.2%, (n=170) and 84.4%, (n=92) without any cortex respectively, while the quartzite component is 71.9%, (n=46) non-cortical.

The flakes in the assemblage show different results. Here the majority of the material has cortex. 62%, (n=90). Most of the pieces with cortex in the assemblage (38%, (n=55)) belong in the <25% cortex category. Between the raw material classes there is not much differentiation, but the quartzite component has somewhat larger quantities of cortex (69%, (n=40)). The type of cortex recorded confirms the pattern from the general sample where natural cortex is especially frequent in the quartzite component, whereas there is a majority of cobble cortex in the silcrete component and equal amounts in quartz.

5.3. Typological description of the lithic assemblage

The assemblage composition

As described in chapter 4 the assemblage has been separated into classes for further analysis (Table 2), and lithic products belonging to the different groups will be described shortly. Large parts of the assemblage has, as explained in chapter 4, not been recorded with the same level of detail as the blades, flakes, cores and retouched categories. The remaining lithics not belonging in any of these groups have been classified into the following; Chunks, chips, flake fragments and trimming flakes. These are mostly waste products resulting from primary reduction or core maintenance or are simply unidentifiable because of fragmentation. Their size and morphology vary a great deal and detailed descriptions of this class are therefore futile. As we have seen in the raw material analysis they can still contribute information, and the relative quantities of debitage products in relation to the other assemblage categories (Figure 18) can contribute to understanding of raw material use, and technological choices made during the HP at Klipdrift Shelter. This will be elaborated on in chapter 6.

Categories	Number	%
Chunks	540	14,1
Chips	570	14,9
Flakes	146	3,8
Trimming flakes	524	13,7
Flake fragments	1621	42,4
Blades	42	1,1
Proximal blades	129	3,4
Medial blades	145	3,8
Distal blades	66	1,7
Cores	5	0,1
Core fragments	5	0,1
Retouched	28	0,7
Total	3821	100,0

Table 2 Assemblage composition in the PBE unit at Klipdrift Shelter.

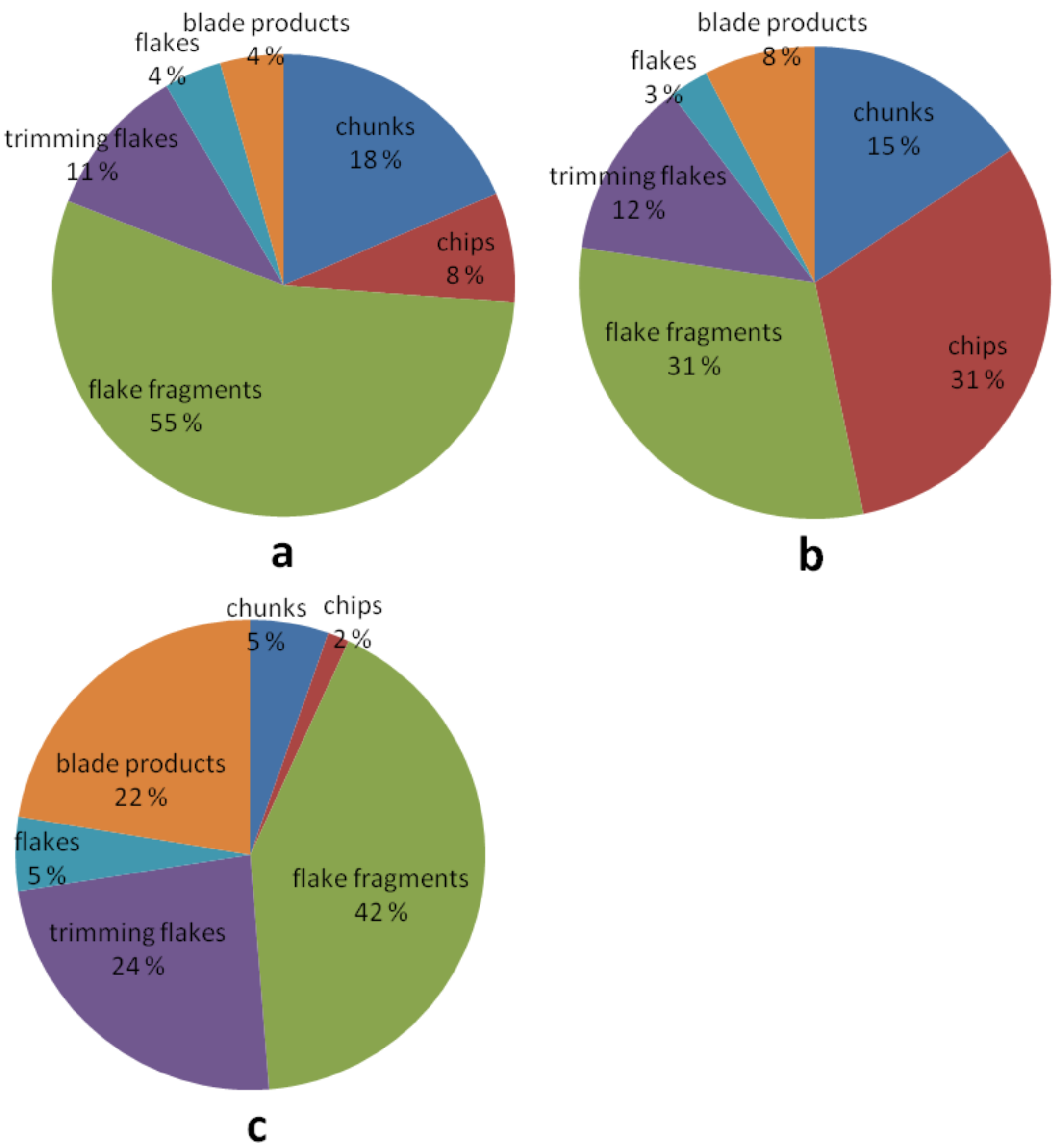


Figure 17 The individual categories of the assemblage composition divided into groups of raw materials; a=quartzite, b=quartz and c=silcrete.

Blades and flakes

The amount of complete blades in the total assemblage is relatively low (1.1%, (n=42)), but when the blade fragments are included the amount increases to 10.1%, (n=386) (Table 2). Bladelets are also included in the blade category as explained in chapter 4. A discussion on whether there is a separate reduction sequences connected to blade and bladelet production will be discussed in chapter6.

The blades in the assemblage occur in several different forms and lengths, but most have a triangular or trapeze-shaped cross section; the laterals of the blades are not always straight. No crested blades have been detected in the assemblage; a few blades however retain some evidence of the preparation strategy practised at the site, these types of blades show multi-directional removals creating a ridge, almost like cresting. The difference is the amount and size of these removals. Instead of removing several small flakes creating a zig-zag ridge, only a few larger removals have been made to correct the core surface convexity and to create a ridge for the next removal to follow (Figure 18a and b). In other cases the natural ridges on the core has also been utilized, as shown in Figure 18c.

The blades show that two types of reduction configurations were practiced at the site; a uni-directional configuration displayed by uni-directional dorsal scars on blades (Figure 18e and 21a, b, c), and a bi-directional reduction sequence recognised by traits like; straight lateral edges and dorsal scars coming from two opposing platforms (Figure 18d and 21d). It is still too early to say for certain whether these two reduction configurations are part of the same reduction strategy, or if they are separate. A refitting analysis could in the future clarify this.

The flakes in the assemblage display great variability in shape and size, and as we have already seen there is a higher amount of cortex connected to the flake category than what is seen among the blades. On observational grounds the flakes are interpreted mostly as waste products connected to the production of blades, further justification for this will be give in chapter 6.

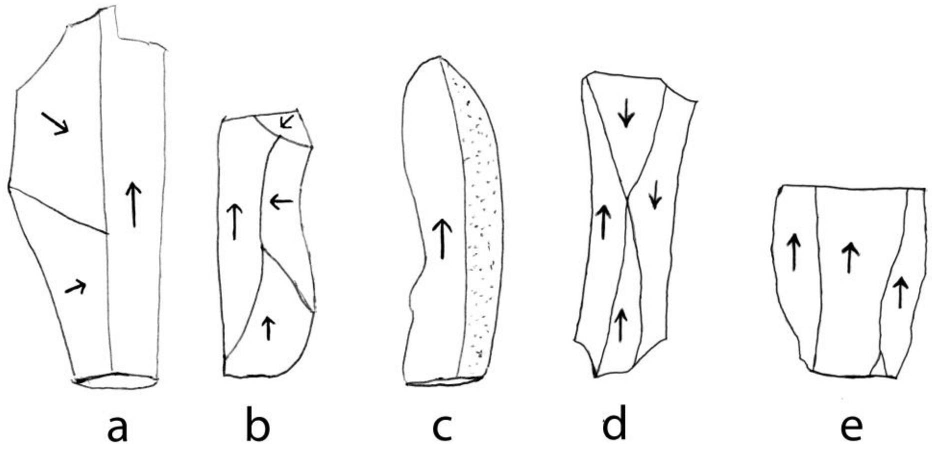


Figure 18 Schematic illustration of blade reduction strategies.

Retouched lithics

Like many MSA assemblages, the formal tool component at Klipdrift Shelter is small. Of the total assemblage 0.7%, (n=28) of the lithics are retouched. Blanks selected for retouch are almost exclusively blades, but a few flakes are also represented (Table 3). The retouch is classified as both formal and informal which is categorized by whether the retouch is a result *of* use, or if it is deliberately modified *for* use. The different classes and frequency of retouched lithics are summarised in Figure 19.

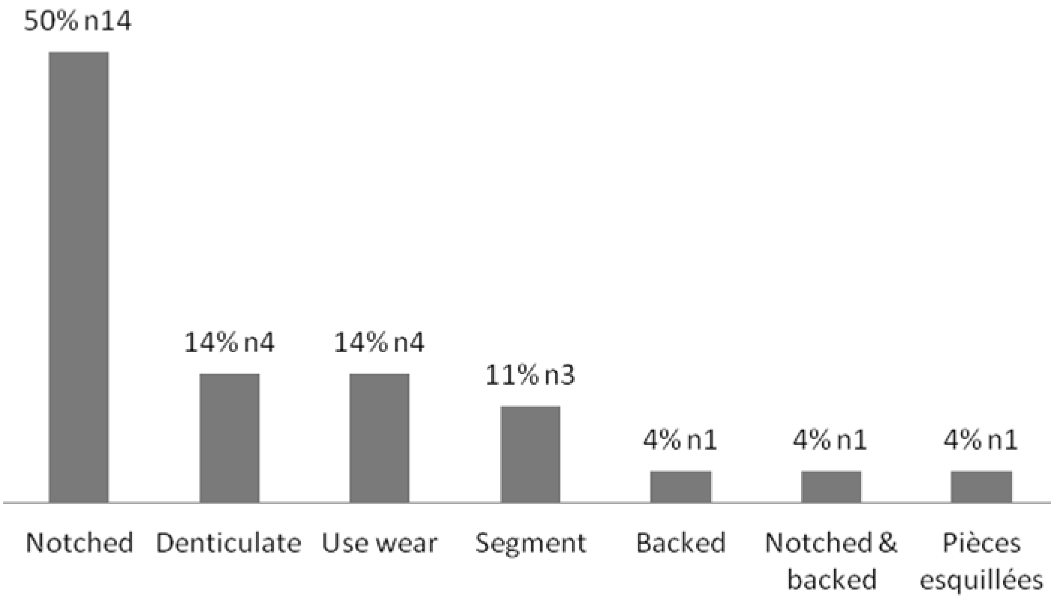


Figure 19 Percentages and number of different retouch types.

Retouch types	Blades (n)	% of blades	Flakes (n)	% of flakes	Total (n)	% of total
Notched	11	48	3	60	14	50
Denticulates	4	17	0	0	4	14
Use wear	3	13	1	20	4	14
Segments	3	13	0	0	3	11
Notched & backed	1	4	0	0	1	4
Backed	1	4	0	0	1	4
Pièces esquillées	0	0	1	20	1	4
Total	23	82	5	18	28	100

Table 3 Types of retouch divided by type of blank

Notched pieces

The most common retouched type in the assemblage are notched pieces 50%, (n=14) (Figure 19). The pieces display one or several concave notches, mostly on blade lateral edges. They do however also occur on flakes or proximal and distal ends of blades (Figure 20 and 21). There is some variety in the types of notches registered in the assemblage. Length, depth and number of notches vary; in almost all cases the notches consist of small removals or spalls coming from the ventral side of the piece moving towards the dorsal. Some notches also display more working, or possibly heavier use-wear recognised by the presence of several minute step fractures inside the notch. These are described as "complex notches". Other notches are more likely to result from one or a few simple removals; these are termed "simple notches". The category of notched pieces belongs to the "informal" retouch type as it is probable that it results from heavy use, possibly as scrapers in woodwork (Wurz 2000). Some pieces however are likely to have been carefully retouched and shaped for a specific use as the notches are clearly a result of deliberate shaping as illustrated by the fine notch in Figure 20a and 21a.

That the notched pieces could have several uses and use-phases is illustrated by the notched quartz flake in Figure 20p and 21l. This flake is clearly a core surface renewal flake that had some form of secondary use. As we can see it has been taken off the face of a core to work around several stepped and hinged removals on the core surface, but has later been notched on the distal part.

Segments and backed pieces

Among the formally retouched pieces are the classic segments and backed pieces most often associated with the HP (Figure 20a-e). Although there are no intact segments in the PBE unit some fragments have been recorded. These are all made on blades with at least two dorsal scar ridges and one side of the piece has been finely retouched to an almost 90 degree angle, by flaking from both the ventral and the dorsal side. A type of bi-polar technique where the segment has been placed on an anvil and retouched with a hammer could also have been used in some cases. This can be interpreted from the presence of negative bulbs of percussion from both ventral and dorsal side in the same removal scar. As all the segments found are fragments it is difficult to estimate their original size and shape, but at least one (Figure 20a and 21a) can be described as a crescent-shaped segment as one entire edge is retouched. This segment also has a deliberately shaped "simple" notch that is interpreted as the result of knapping rather than use wear, since the retouch consists of evenly spaced consecutive small removals without any internal step fracturing. Of the segments found, two are in silcrete, and one is in quartz.

Two retouched pieces can be described as backed but are not segments as such. The first (Figure 20d and 21d) is a straight blade where the proximal part has been backed and the distal part is broken off, possibly post-depositionally. Both edges are left sharp but the backing has partly removed the platform and the bulb of percussion, effectively thinning the piece. Another piece is backed in a similar way (Figure 20e and 21e) but has additionally been notched on both edges shaping it as a strangulated blade. The blank used in both cases are straight red silcrete blades with parallel edges and two dorsal ridges.

Pièces esquillées

This lithic category is somewhat more obscure and less well defined than the previously mentioned and as we saw in chapter 2 there exist several interpretations of their origin and possible use. In the Klipdrift Shelter assemblage there is one piece which has fallen under this category (Figure 20o). This piece in milky white quartz shows evidence of several removals on both dorsal and ventral side, but the platform is intact. The removals on both sides can suggest that this piece has had a secondary function as a core for bladelets. Another interpretation could be that it is a by-product of core surface renewal, as it displays several earlier removals on the dorsal side consistent with blade production. There is also a small notch present on the distal end possibly indicating several different use-phases. As there has been done no residue or use-wear analysis no conclusions about possible function will be made here.

Use-wear

Use-wear analysis is not part of this thesis and interpretations of this group of retouch will not be made. The pieces in this category all show some kind of edge modification through use. Use-wear is present also on many of the other categories of retouched lithics and is manifest as; blunting and gloss on edges, chipping as a result of heavy use, and in some cases, which can be seen in Figure 20k and 21k, it can be manifest as minute flaking resulting either from use or fine re-sharpening.

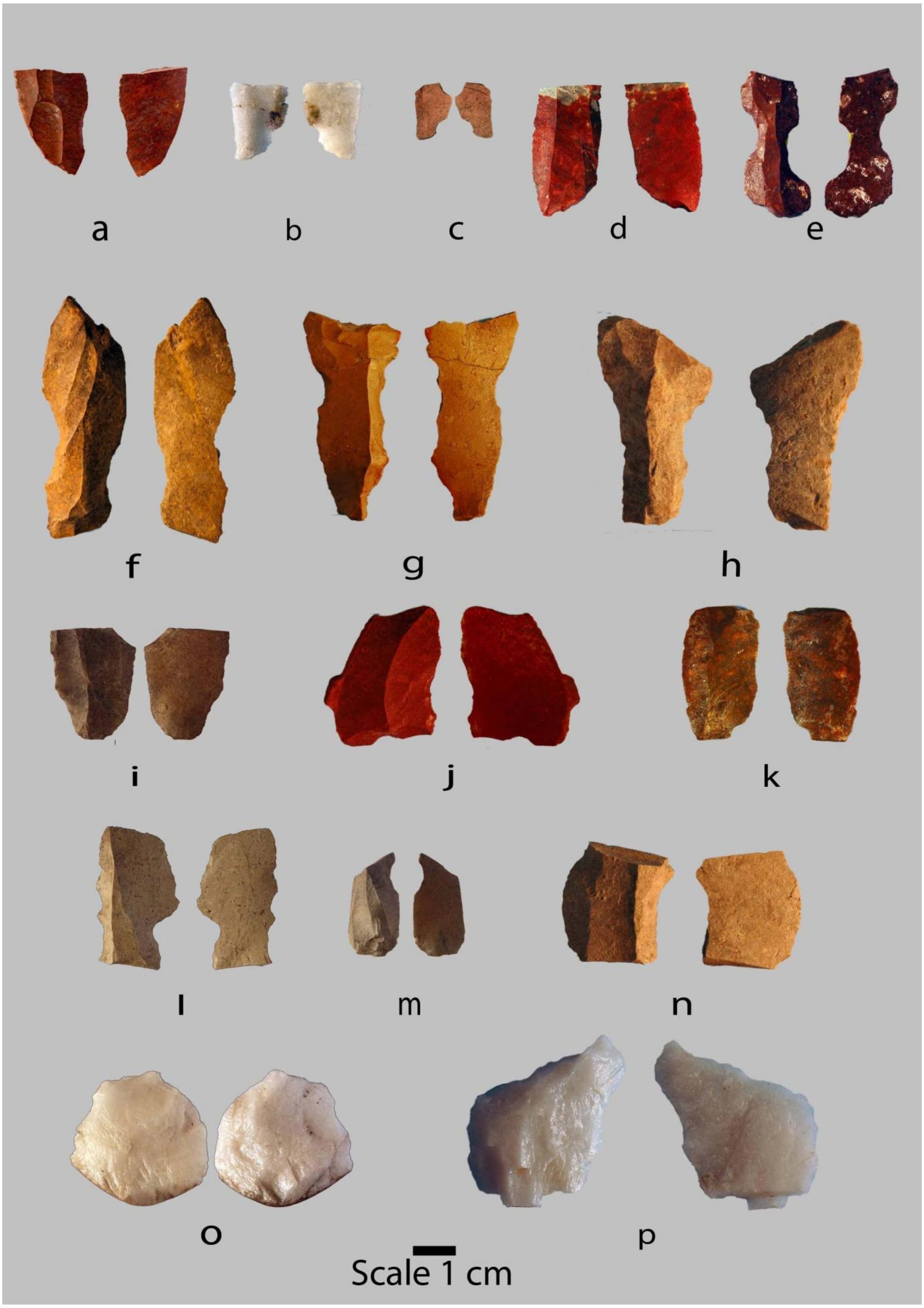


Figure 20 Photography of selected retouched lithics. a-c: segments, d & e: Backed blades, f – n: Notched and denticulated pieces, o: pèce esquillé, P notched core fragment.

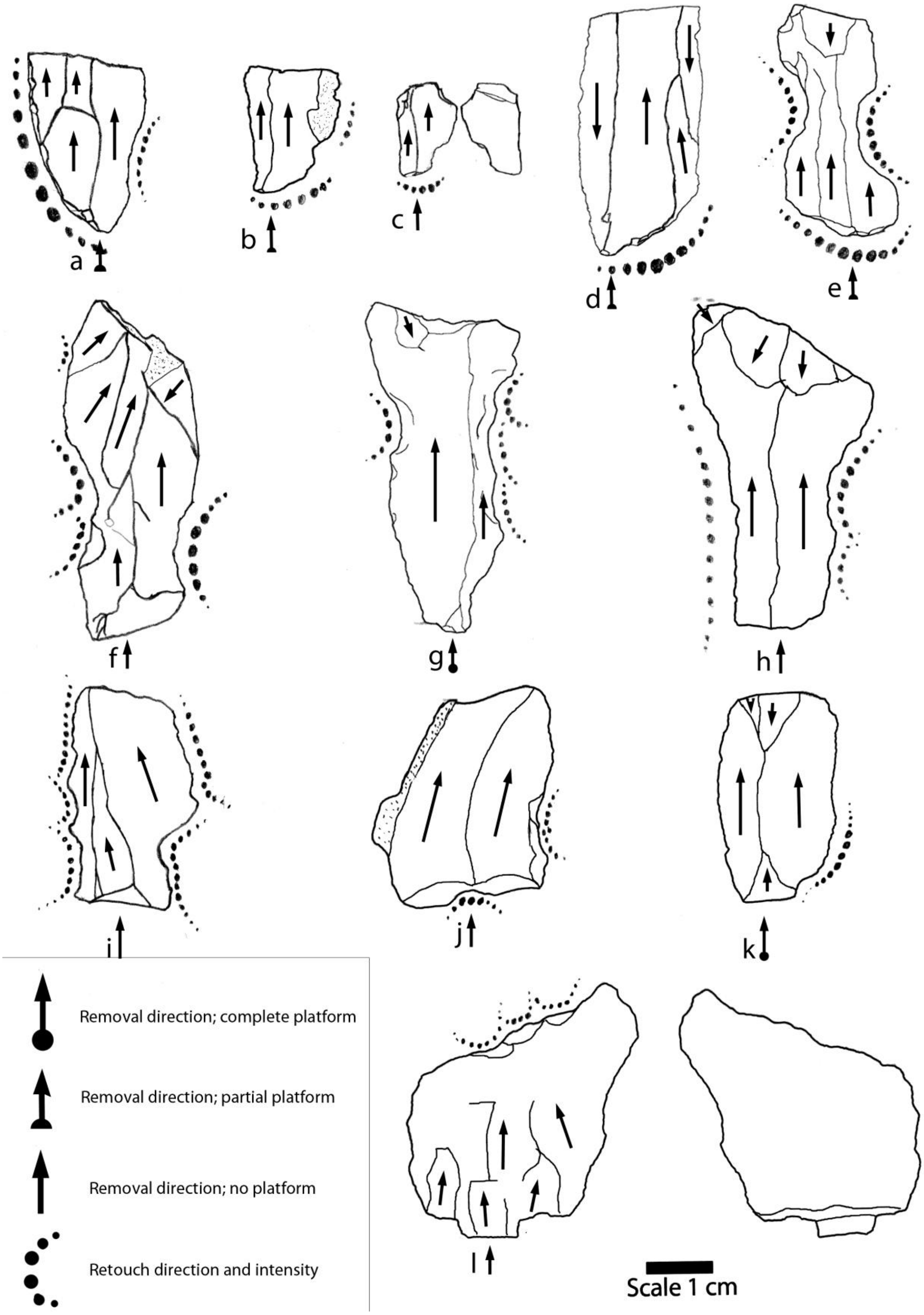


Figure 21 Schematic drawing of selected retouched lithics, reader is referred to figure 20 for individual descriptions.

Cores

There are five cores in the PBE assemblage, two in quartz and three in silcrete. They are all small and show evidence of thin small laminar removals (bladelets). Only one core (KB698) has a previous negative removal consistent with larger blade removals, overlapped by bladelet removals. All the cores are uniform in type with the main removals coming from one platform. Removals originating from opposite the platform and from the sides of the cores are more arbitrary in shape and dimensions. These seem to have been made to correct the convexity of the core surface and platform angles. As such the cores can be described as uni-directional blade/bladelet cores. In all cases the platforms are plain, some with natural cortex indicating that the cores are made on blocks or chunky flakes rather than cobbles. It is also possible that the surfaces are not actually cortical but show remnants of surface prior to possible heat treatment as explained above.

Some of the cores will now be described individually. The number given to the core is the unique number assigned during excavation.

KB484 (Figure 23 and 25): Small bladelet core in very fine brown-red silcrete. Flake scars on the core have a lustrous shimmer which contrasts the otherwise dull un-flaked surfaces. The platform and the back of the core seem to have natural cortex, or possibly cortex that remains from an earlier sequence of removals. It does not have the shimmer which is present on the negative scars, possibly indicating that the core was flaked after heat treatment (Brown et al. 2009; Mourre et al. 2010). All removals are made from the same platform and opposite the platform the faces of the core converge in a chisel-like point that seems to have a hinge break. This could indicate that the core was originally made on a large "chunky" flake. 9 ridges are visible around the core consistent with 7 bladelet removals, ¾ of the core face has been utilised. There is some minute preparation present on one side of the core corresponding with the type of preparation seen on many of the platforms in the blade component of the assemblage.

KB607 (Figure 24 and 26): Medium sized core in fine vein quartz. Platform and back has natural cortex consistent with the use of a block-like blank rather than a pebble. The core shows removals from one distinct platform and from opposite the platform and sides of the core. There are negative scars of six similarly shaped bladelet removals from the main platform, three flake-like removals from the opposing platform and two larger flake-like removals from the side of the core. The bladelet removals originating from the main platform are interpreted as the intended removals based on the amount of platform preparation still visible on the core, and the seemingly standardised manner of the removal. The removals seen on the sides and opposite the platform are random in shape, lack preparation, and seem to be made to maintain core surface convexity and angle of the platform.

KB698 (Figure 22): Small core in fine shiny grey silcrete with coarse inclusions and some natural cortex still visible on the platform. Scars from the core face are indicative of bladelet production. There is also some evidence of earlier larger blade removals on this core, but the scars are overlapped by later removals and platform preparations. The exterior surface of the platform has been extensively prepared by abrasion evident in the presence of small step flake scars, and additionally the platform has negative scars evidencing platform rejuvenation. The hinged removals on the exterior platform have been made to remove overhang and restore the exterior platform angle. There is also one negative removal visible from opposite the platform. This large and flake-like removal looks like it is intended to maintain the convexity of the core face.

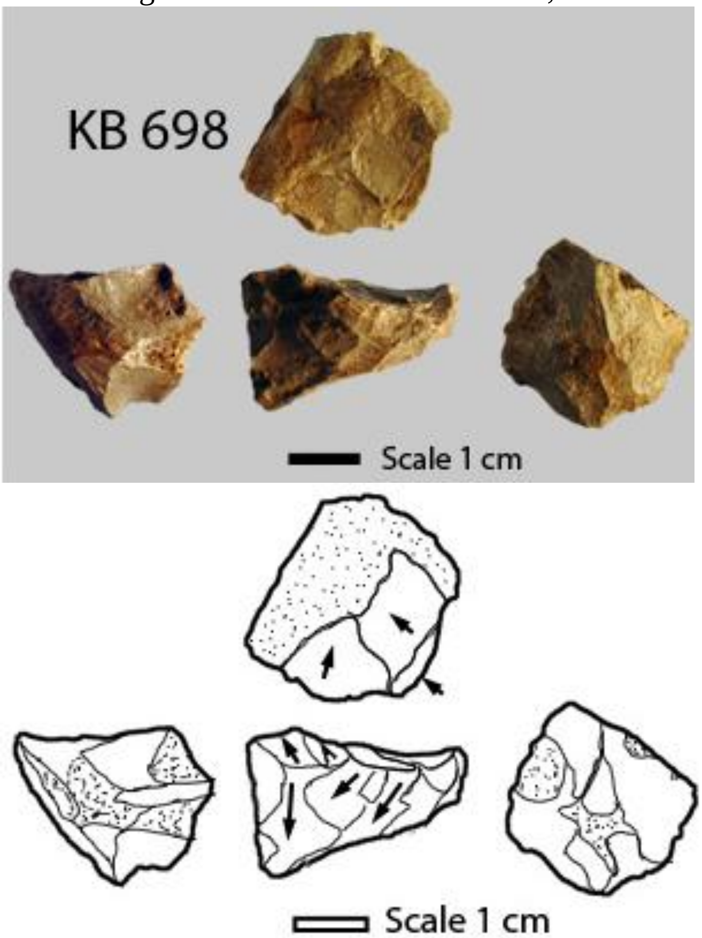


Figure 22 Core KB698

KB752 (Figure 23 and 25): Very small bladelet core in fine grey silcrete with six removals originating from the same platform recurrently. The platform is cortical or weathered in some way and the back of the core has a smooth curve and could be the ventral side of a chunky flake.

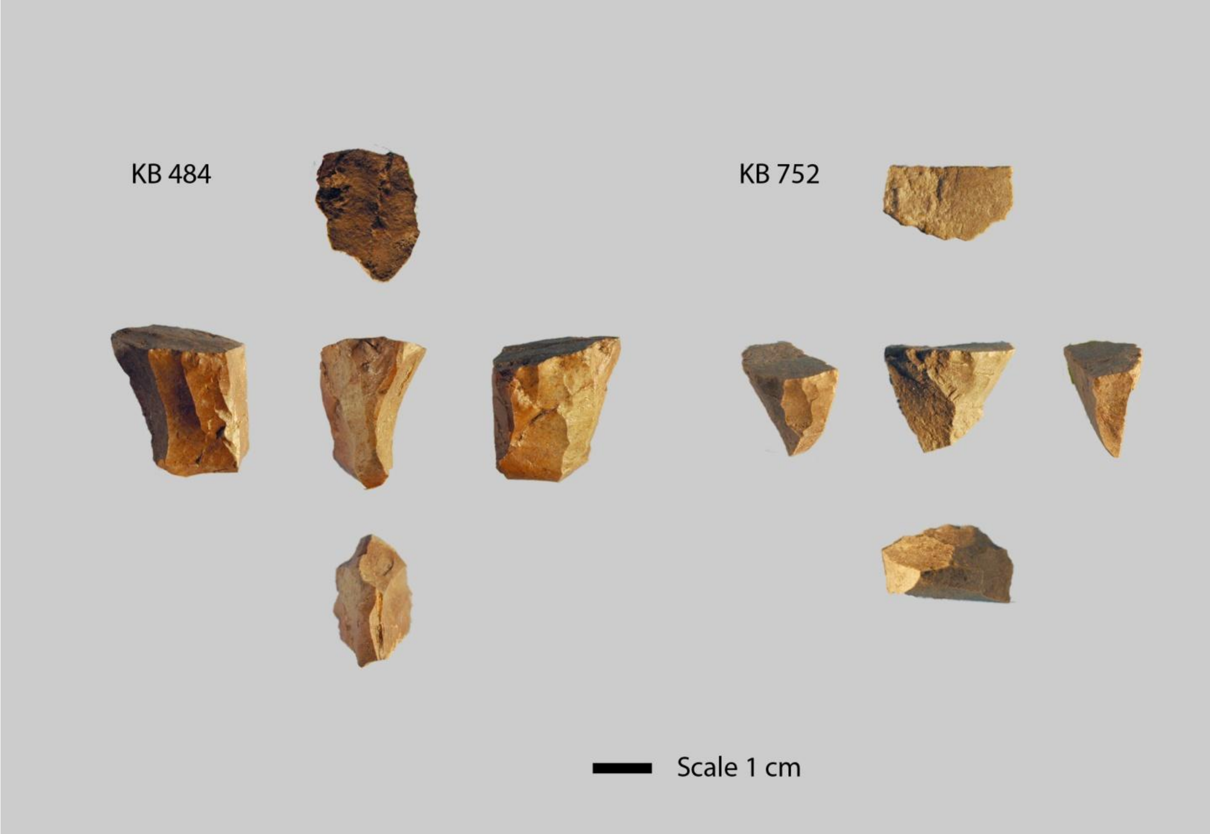


Figure 23 Cores KB484 and KB752

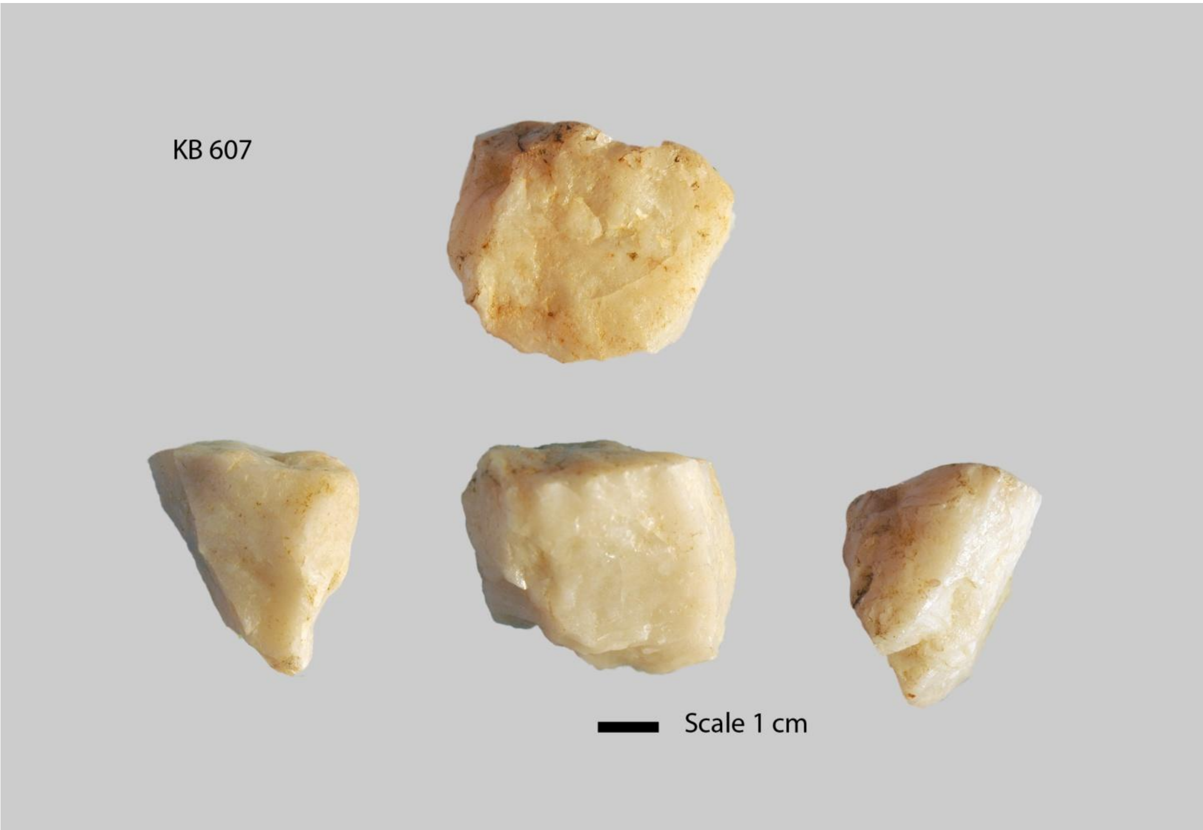


Figure 24 Core KB607

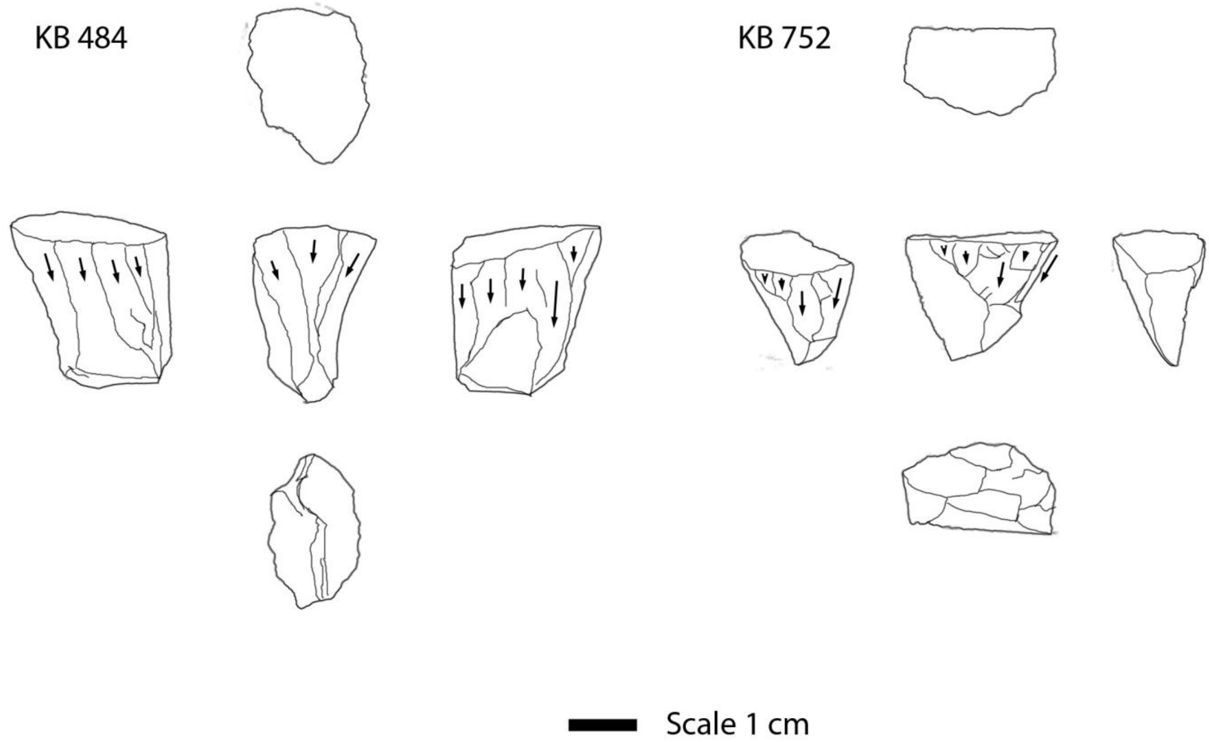


Figure 25 Schematic drawing of Cores KB484 and KB752

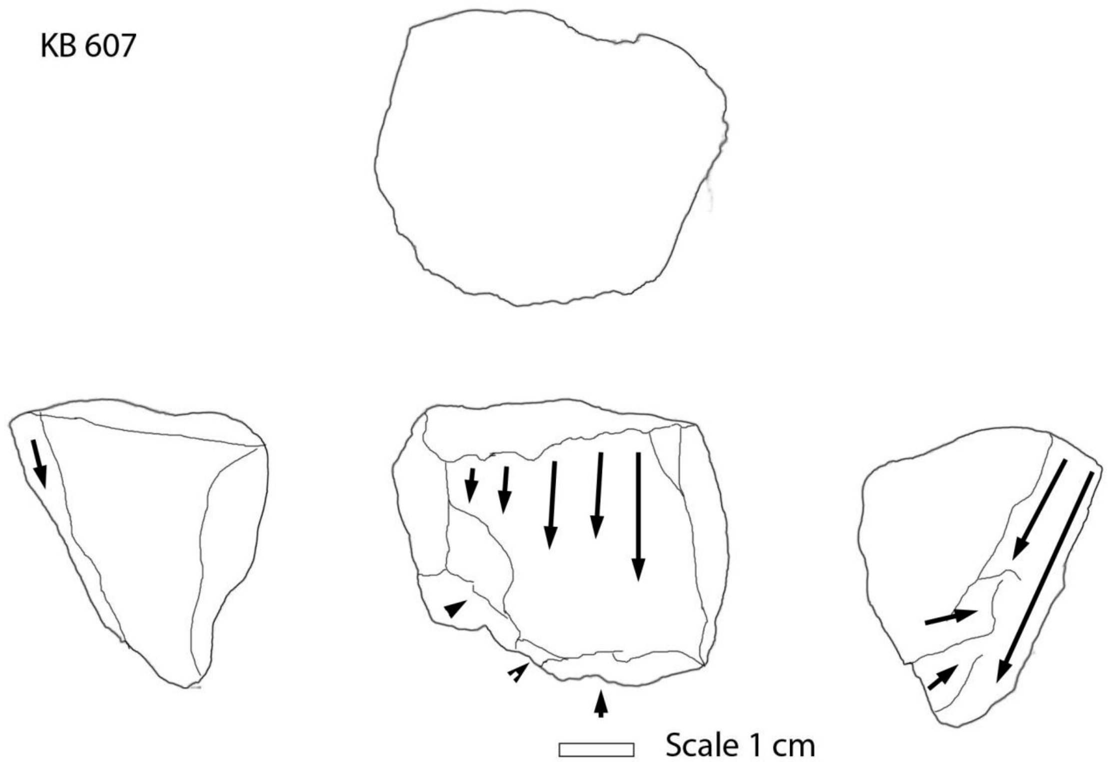


Figure 26 Schematic drawing of core KB607

5.4. Metrical description

The general length of the blades in the sample is difficult to estimate as this category is rather fragmented. Measuring the complete blades could give a bias towards shorter blades as these are less likely to break during production or post-depositionally. To provide comparative metrical data on the blade component the width and thickness has been used, as the lateral edges usually are preserved. The width of the blades and blade fragments in the sample gives a mean of 9.73 mm (CV= 43.2) but we can see a great variability between the raw materials used. The quartz component corresponds almost completely with the overall mean (9.74 mm (CV=41.4)) (Figure 28), while silcrete is slightly less wide on average (9.32 mm (CV=42.6)) (Figure 29). Quartzite is distributed differently. Not only are there less blades in quartzite, but they are also metrically different with a mean width of 11.09 mm (CV=45.2) (Figure 27).

The same pattern is visible when looking at the thickness distribution. The mean thickness on all blade fragments regardless of raw material is 2.87 mm (CV=65.5). For silcrete (Figure 32) and quartz (Figure 31) respectively the mean thickness is 2.91 mm (CV=64.4) and 2.34 mm (CV=57.9) while the quartzite blade fragments have a mean of 4.6 mm (CV=49.5) (Figure 30).

Flakes are not directly comparable to the blade category as described in chapter 4 they were recorded using a slightly different procedure. Only flakes larger than 20 mm were measured with the same detail as the blades, as a result the mean thickness and widths are not directly comparable. However, the measurements can be used to check for internal deviation within the samples and between raw materials. The flake mean width, all raw materials considered, is 23.92 mm (CV=36.5).

Most of the retouched lithics are rather large and wide with a mean width of 17.42 mm, (CV=35.6). The mean is slightly skewed by the larger width of the few flakes in the retouched component. Still, when considering only the blades the mean is still at 16 mm, (CV=28.1). This is considerably higher than the mean blade width registered in the rest of the assemblage.

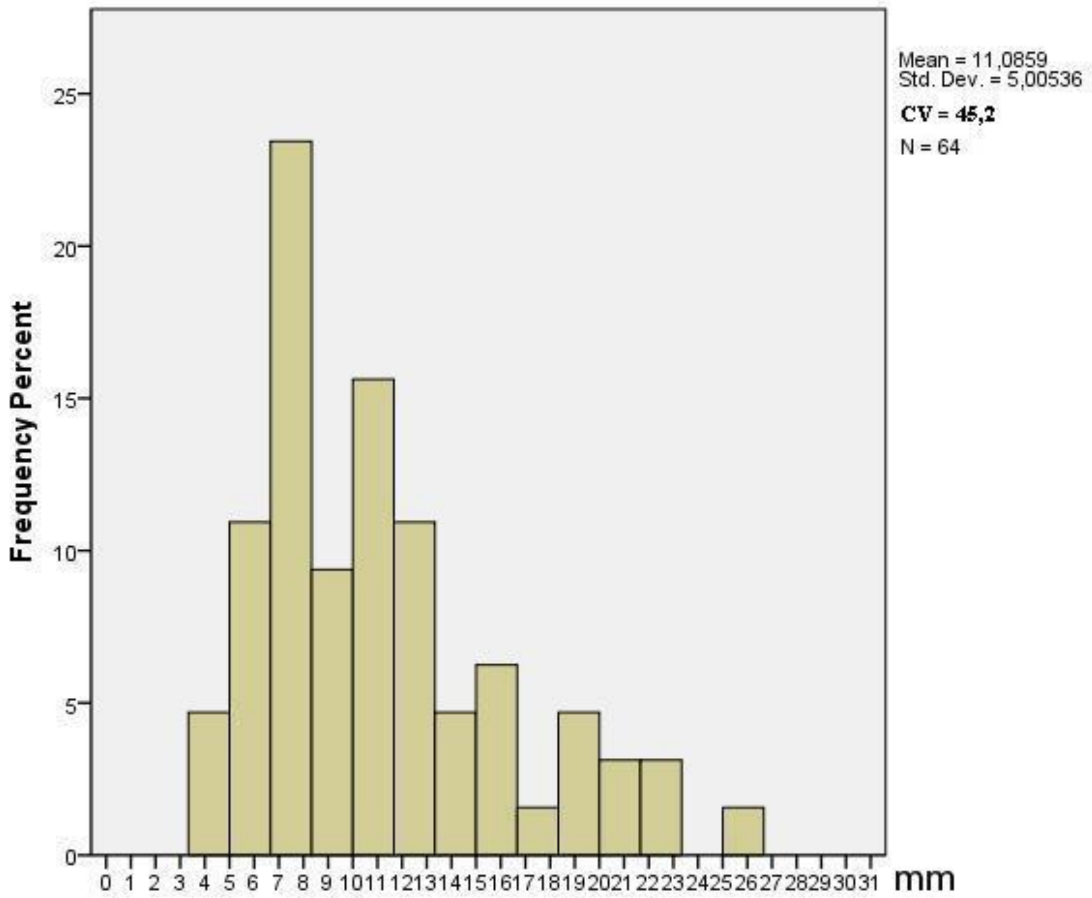


Figure 27 Quartzite blade width

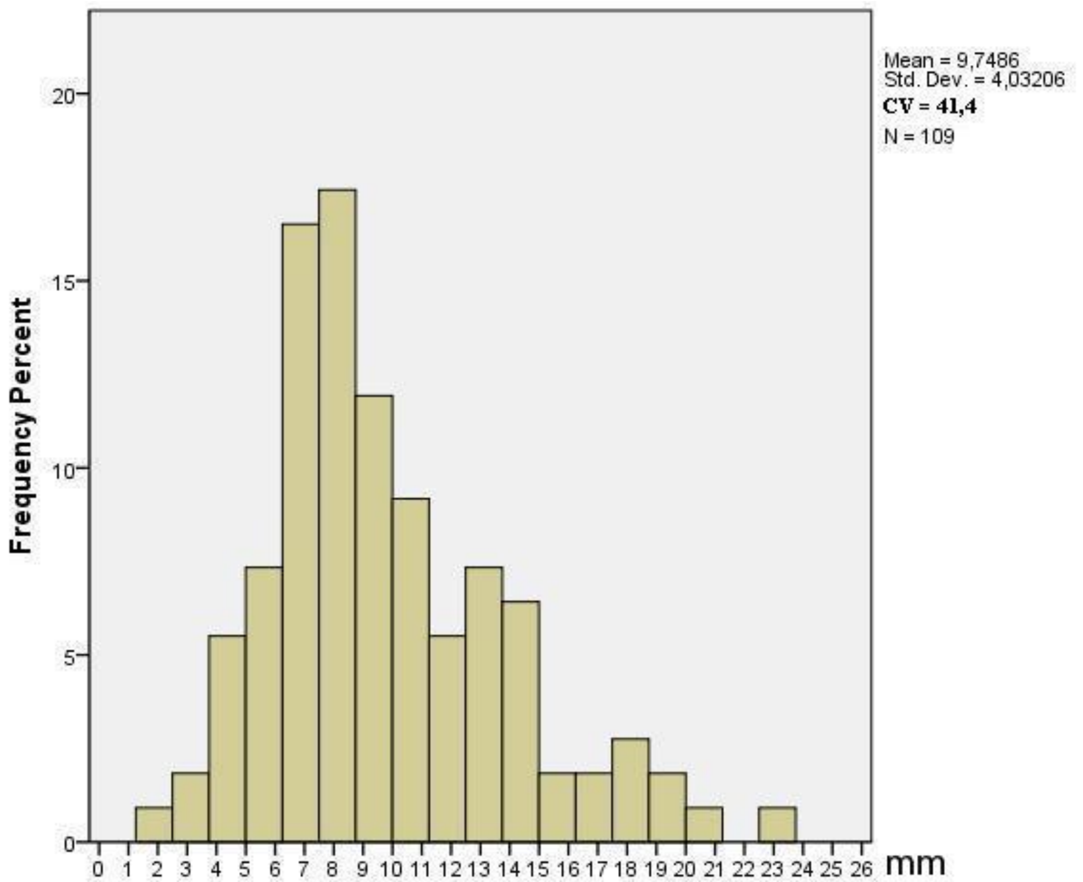


Figure 28 Quartz blade width

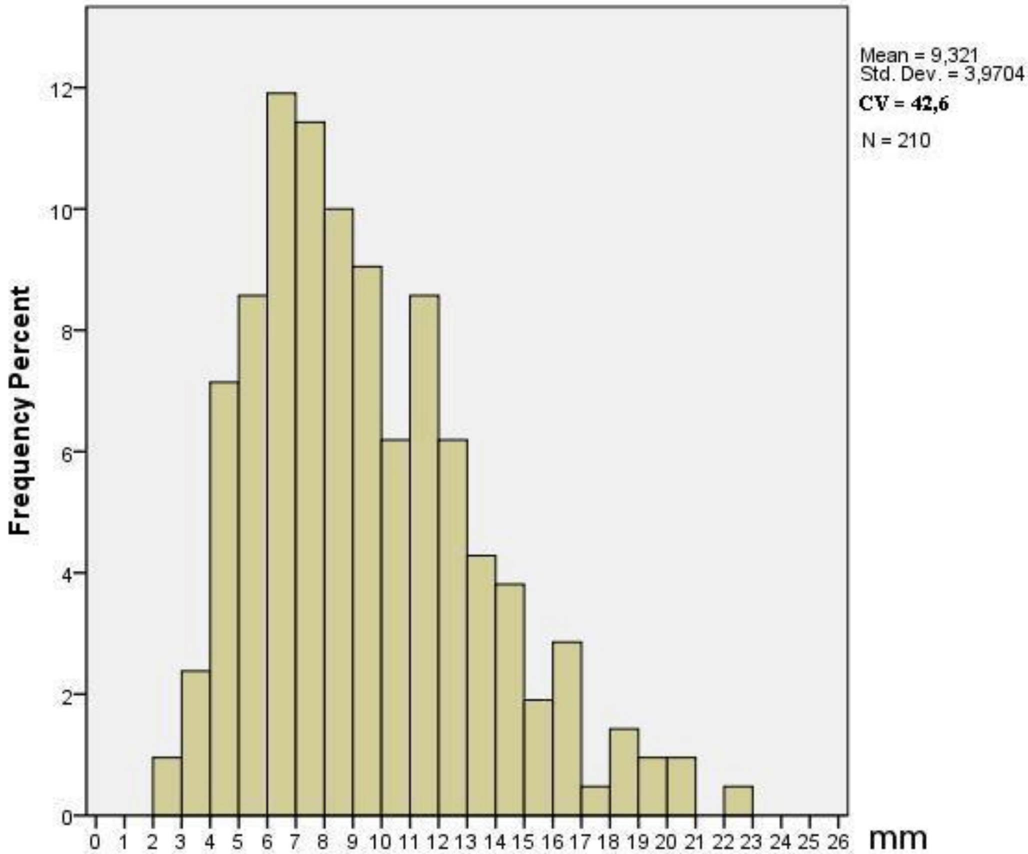


Figure 29 Silcrete blade width

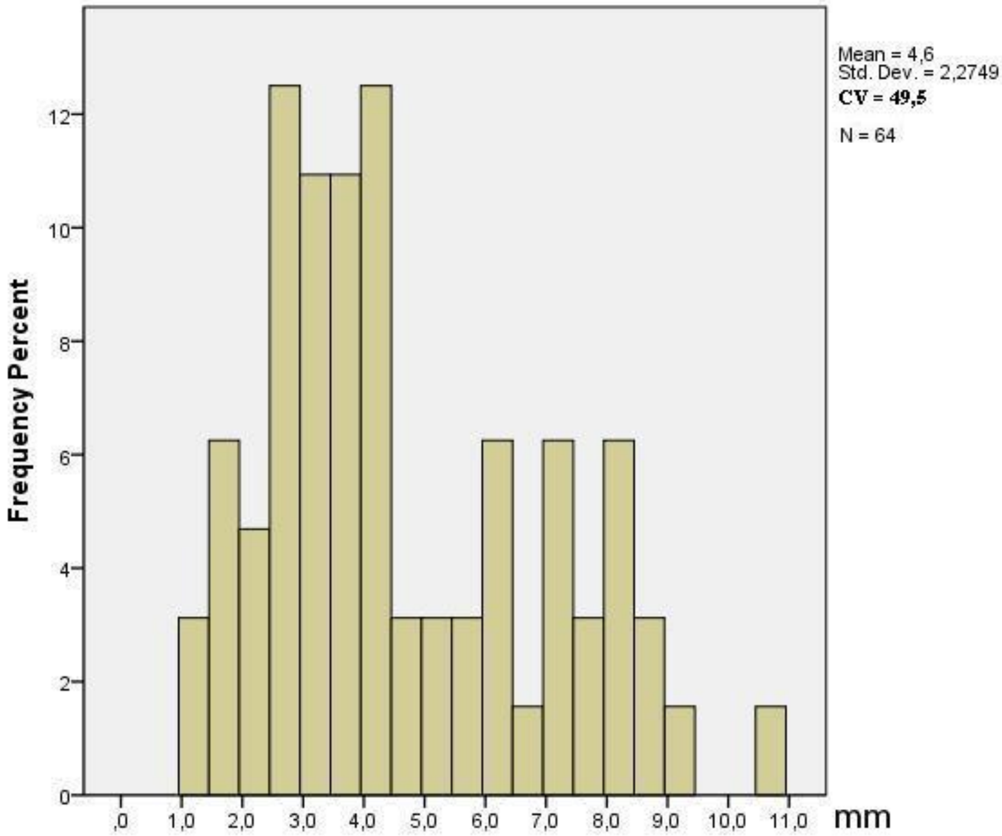


Figure 30 Quartzite blade thickness

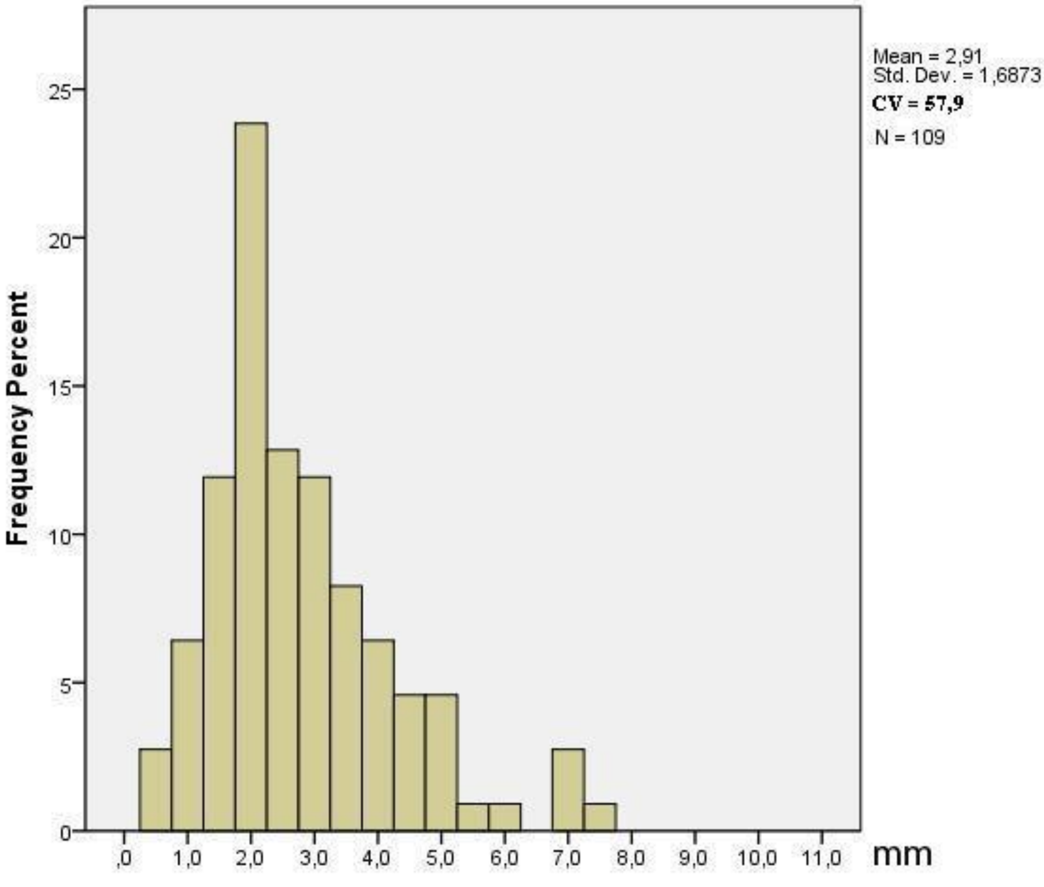


Figure 31 Quartz blade thickness

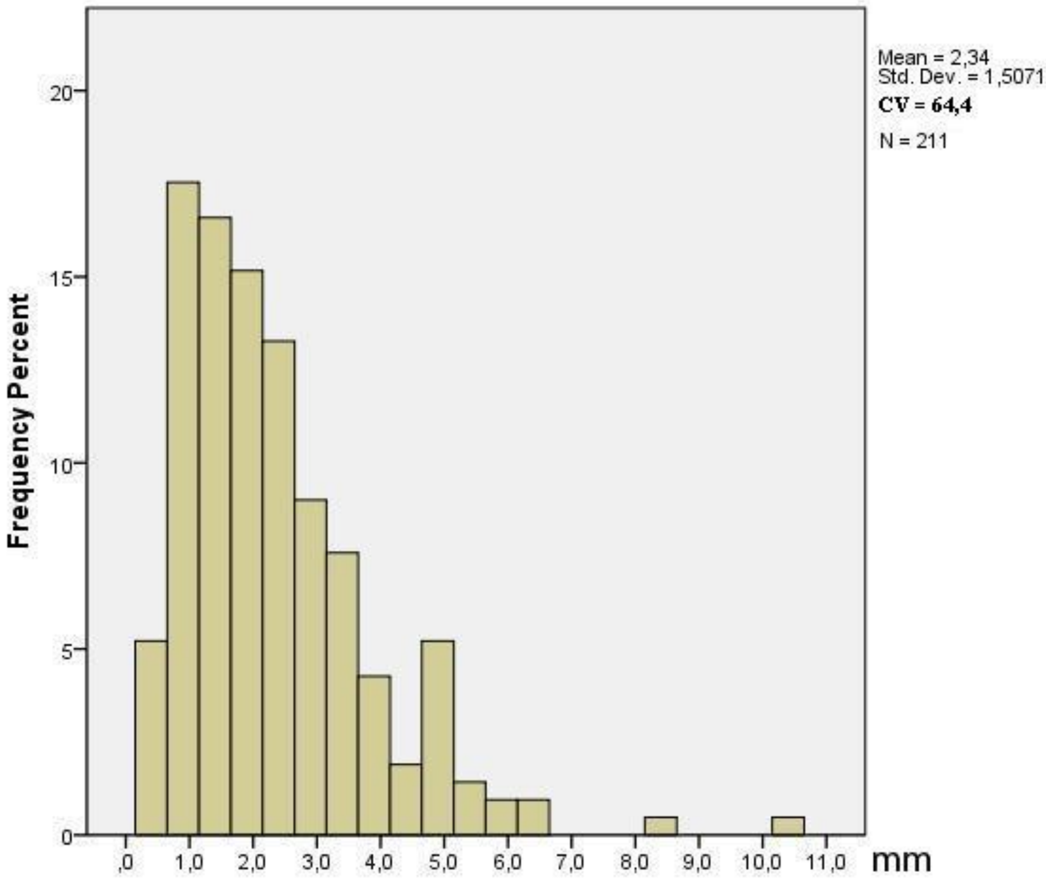


Figure 32 Silcrete blade thickness.

5.5. Platform characteristics

Most of the platforms recorded in the assemblage are plain; 80.6%, (n= 175) and 86.8% (n= 144) for the blades and flakes respectively (Table 4), which is in correspondence with the observations made on the cores. Rarely, faceting also occurs; 8.6% (n= 15) and 6.9% (n= 10) for blades and flakes respectively. Mean platform thickness is limited to 1.86 mm when both blades and bladelets are considered. Flake platform thickness is dramatically higher with a mean of 5.52mm, nevertheless the results are somewhat biased as no flakes smaller than 20mm are included in the technological analysis.

Blades platform type	**Quartzite (n)**	**%**	**Quartz (n)**	**%**	**Silcrete (n)**	**%**	**Total**	**%**
broken	0	0,0	0	0,0	2	2,0	2	1,1
faceted	0	0,0	2	4,1	13	12,7	15	8,6
plain	24	100,0	41	83,7	76	74,5	141	80,6
shattered	0	0,0	6	12,2	10	9,8	16	9,1
split	0	0,0	0	0,0	1	1,0	1	0,6
Total	24	100,0	49	100,0	102	100,0	175	100,0
Flakes platform type	**Quartzite (n)**	**%**	**Quartz (n)**	**%**	**Silcrete (n)**	**%**	**Total (n)**	**%**
broken	0	0,0	1	2,6	0	0,0	1	0,7
faceted	3	5,2	2	5,1	5	10,6	10	6,9
plain	54	93,1	32	82,1	39	83,0	125	86,8
shattered	1	1,7	4	10,3	3	6,4	8	5,6
Total	58	100,0	39	100,0	47	100,0	144	100,0

Table 4 Platform types divided by raw material displayed in the blades (upper) and flakes (lower).

There is a high amount of platform preparation registered in the sample. The preparation consists of abrasion in the form of rubbing or minute step flaking on the dorsal part of the platform (Figure 33b). This seems to have been done to remove overhang from previous removals and to shape the platform for more predictable laminar removals. These forms of preparation also strengthen the platform, and facilitates the use of marginal percussion (Porraz et al. 2008). This is also illustrated by the distribution of the platform preparation; in the blade category 62.9% (n=110) and in the flake category only 28.1% (n=41) has some form of preparation. Hence, there is a considerably larger amount of preparations connected with the production of blades and bladelets than with flake production.

A small number of the platforms are shattered or broke off, accompanied by the presence of fissuring on platforms and bulb scars, the latter is illustrated in Figure 33a. This could indicate what kind of percussor has been used. Several suggestions or interpretations of percussion type exist in the literature. Previously the presence of weak or nonexistent bulb of percussion together with an overhanging lip was interpreted as marks of indirect percussion (Singer and Wymer 1982; Deacon and Deacon 1999). This idea has been contested (Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010), and the presence of fissuring, shattered platforms, and punctuated impact points together with the weakly pronounced bulb of percussion and a lip is in later studies interpreted as evidence for the use of a soft stone hammer (Figure 33). In accordance to these studies, the same interpretation is made at Klipdrift Shelter. However, there might well be a coexistence of other modes in the assemblage, as not all platforms display neither fissuring nor shattering.

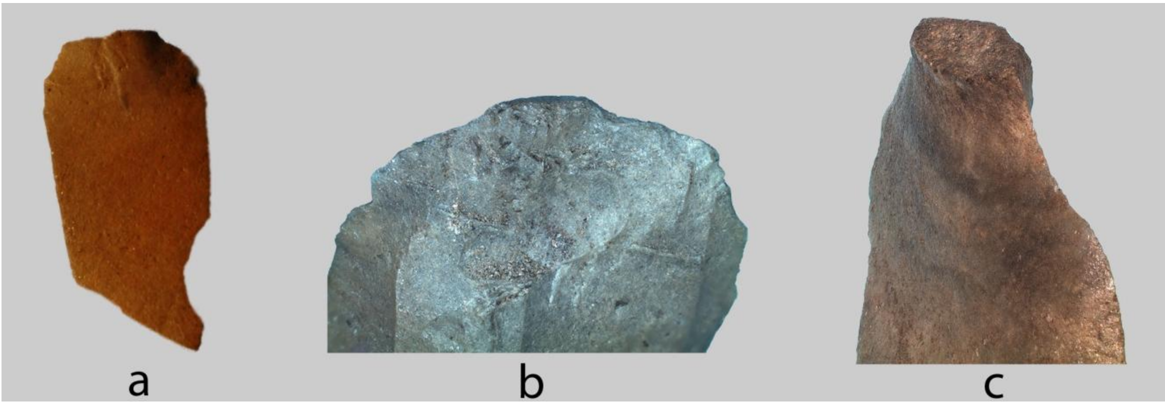


Figure 33 Illustrating preparation strategies and tool signatures; a=bulb scar, b=preparation in the form of minute step flaking and abrasion (rubbing) and c=plain platform with lip and no bulb of percussion.

5.6. Reduction sequences

Through the analysis presented above it has been possible to reconstruct some parts of the reduction strategies practised at Klipdrift Shelter. The progression of lithic reduction will be summarised below.

There is a clear preference for fine grained raw materials, especially evident in the blade component of the lithic sample. The source of these raw materials is not clear and will be discussed further in the next chapter. Silcrete can be found at a distance of 40 kilometres from the site. Quartz of high quality is available in small quantities in close proximity to the site and in the parent rock of the site itself, and it is likely that this accounts for large parts of the assemblage. Quartzite is available in abundance at the site and along the nearby beaches. Though, it is uncertain if this is the source for the lithic material found at the site, as much of the local quartzite is of mediocre quality.

Cortex in the sample tells us that raw materials were procured both from primary and secondary sources. The relatively low percentages of cortical products, especially in the blade component of the material, suggest that some reduction may have taken place outside the shelter. This could be a bias for determining how knapping was initiated, as there is a possibility that elaborate shaping, like cresting, took place elsewhere.

Descriptions above give some evidence of the selection of core blanks at Klipdrift Shelter. As the cores show; blanks where the platform was naturally flat were often chosen. The evidence of initial core shaping is not conclusive but from flakes and blades analysed it appears that the first removals followed natural ridges along one surface, rather than creating ridges by constructing crests. As we have seen, there is also some evidence of multi-directional removals interpreted to correct core surface convexity. These removals seem to have been used in all stages of reduction and can thus also have been used in setting up the core (primary shaping). No crested or partially crested blades have been identified in the assemblage.

Lithic production at Klipdrift Shelter was aimed at producing blade and bladelets, which of some have been modified into segments, backed pieces and notched pieces. A discussion of the interpretation that the Klipdrift Shelter is aimed towards blade production follows in chapter 6.

The cores in the assemblage show different configurations of blade production. In some cases, reduction is restricted to one surface e. g. KB 607 (Figure 24 and 26). In other cases e. g. KB 752 and KB 484 (Figure 23 and 25) the removals of blades or bladelets have been done on more than one surface systematically reducing the volume of the core, which can be described as a semi-rotational reduction. The back of the core is usually un-flaked and retain some cortex or natural, un-flaked surface.

As the reduction sequence has progressed the core surface convexity has repeatedly been corrected by flake or blade removals originating from an opposite platform or from the side of the core. This procedure has been possible to recognise through analysing the blades where dorsal scars indicate multi-directional removals (Figure 18a and b, Figure 21e, f and h), and some of the cores where small uneven correctional removals have been made (Figure 24 and 26). Removals observed on the cores corresponds with the interpretation that the intended removals are made uni-directionally, and that removals originating from other platforms were made in order to maintain core surface convexity and platform angles, rather than for removing desired products. Some of the blades also indicate a possible second configuration of core reduction where blades have been removed in a bi-directional fashion (Figure 18d and 21d). As we have seen this is evident from some of the blades having straight profiles and parallel edges and where dorsal scars show previous removals from an opposite platform. It is at this stage still unclear whether the two configurations are separate reduction strategies, or different stages of the same configuration. The retouched lithics, and especially the segments and backed pieces are usually made on straight, thin blades with two parallel dorsal ridges and parallel lateral edges.

6. Discussion

Interpretations regarding behavioural traits of the HP have often been made on the basis of continuity and change in lithic assemblages, the appearance and disappearance of certain traits such as typological aspects or patterns of raw material procurement. In this analysis only one stratigraphic unit (PBE) is considered, somewhat limiting the potential of drawing overarching explanations about the HP in general. Rather than confirm or dismiss interpretations of behaviour the emphasis here is to consider the potential of using the *chaîne opératoire* approach for a small sample, attempt to place this sample in a temporal and cultural context, as well as identifying variability manifest in the technologies. An important part of this chapter will be to discuss whether the Klipdrift Shelter assemblage should be regarded as HP, and why.

In the last chapter I have described the assemblage using a *chaîne opératoire* approach to clarify the assemblage raw material composition, and describe the reduction sequences in terms of technological traits and metrical data. In this chapter I will discuss the Klipdrift Shelter assemblage in the context of other HP sites discussed in chapter 2.

6.1. Behaviour in the Howiesons Poort

The analysed lithic assemblage at Klipdrift Shelter, debitage included, consists mostly of quartzite. However, studying the raw material composition of the different lithic classes revealed interesting patterns. Raw material composition of the retouched lithics is not similar to that of the general assemblage. The majority of retouch occurs on silcrete blades, and in a few cases on quartz. Blades are additionally mostly made in silcrete or quartz. There are no retouched pieces in the otherwise most common raw material, quartzite. As shown in chapter 2, there is a clear preference for fine grained materials in the HP, which is evident all the four sites described (Wurz 2000,2002; Rigaud et al. 2006; Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010). The results from Klipdrift Shelter indicate otherwise; this is in need of explanation.

Group mobility and trade networks

Raw material acquisition and use during the HP have often been linked to social organisation. It has been argued that the increase in fine grained raw material usage during the HP is a result of climatic deterioration when expansion of social networks took place to facilitate information sharing, risk reduction and group boundary maintenance (Deacon 1989; Deacon and Wurz 1996). The exchange between groups resulted in a desire to add value to the lithic products through rarity and quality of raw material, and adding symbolic value through imposition of style, as is observed ethnographically (Wiessner 1983).

Ambrose and Lorenz (1990) also use climatic change to argue for the changes seen in lithic raw material procurement just before the onset of the HP They ascribe the increase in fine grained raw materials to two reasons: (1) Increased mobility due to climatic deterioration at the onset of MIS 4. With colder and presumably more arid climate lower primary productivity and increased resource variability in space and time, resulted in increased foraging ranges and thereby access to better raw materials through the pursuit of other resources (Ambrose and Lorenz 1990; Ambrose 2006). They further proposed that the raw material procurement patterns were related to (2) the adaption of a system for information and resource exchange between groups to minimise risk (Ambrose and Lorenz 1990). These arguments were based on the lithic foraging patterns recognised in the Klasies lithic assemblage. This interpretation might be problematic as it can be questioned whether the fine grained raw materials used in the HP were actually non-local, and reflected larger foraging ranges.

As I have briefly explained in chapter 2, researchers differ when attempting to determine the sources of silcrete used at Klasies. According to Singer and Wymer (1982) the silcrete in the assemblage is non-local, while Deacon and Deacon (1999) describes a potential source at Langekloof approximately 20 kilometres away . Villa et al. (2010) on the other hand state that the source is unknown. Minichillo (2006) refers to Malan (1991) and Roberts (2003) who document that silcrete in fact is available in alluvial gravels, and as secondary deposits in nearby river beds and on beaches in proximity to Klasies. Minichillo (2006) also underlines the importance of not underestimating potential landscape change and fluctuating sea levels at coastal sites as an important aspect when estimating site to source distances. As a result he argues that the assumption of increased foraging ranges should be dismissed since the sources of raw materials are actually unknown. He suggests that a more likely explanation is that the increased use of fine grained raw materials could be related to the intensification of raw material sourcing rather than increased range. Minichillo (2006) further emphasises the necessity of a model where time investment in locating raw materials should replace the increased foraging range theory, while underlining that this does not conflict with the interpretations of possible increase in material exchange through development of networks (Minichillo 2006:363).

Ambrose (2006) on the other hand argues that the pattern of non-local raw material foraging can be seen at other sites as well as Klasies, and that some of these sites lie inland and therefore should not be biased by fluctuations in sea level (Ambrose 2006). The sites referred to by Ambrose (2006) are Border Cave and Diepkloof. However, Ambrose also points out that these sites are not clear examples as site to source distance at Border Cave has been adjusted down from 40 kilometres to 15, and raw material sources remains uncertain at Diepkloof (Ambrose 2006:366). He also questions Minichillo´s (2006) suggestion of a time investment interpretation: "…if silcrete and quartz are so readily available locally, and are actually easier to flake, then there should not be an increase in the time cost of their procurement or processing" (Ambrose 2006:367). This is an oversimplification of Minichillo`s (2006) statement of raw material availability in the Klasies surroundings, and is in fact contradictory to the point Minichillo makes. He stated that raw materials were not "readily available", rather locally available but rare. Intensification in time use was necessary to procure them.

Information from the sites described in chapter 2; Klasies, Rose Cottage, Diepkloof and Sibudu, can potentially help clarify this issue. There is an amount of variability in the types of raw materials used and in the acquisition patterns displayed at the different sites. The use of fine grained raw material at Diepkloof has recently been clarified somewhat through detailed surveys (Porraz et al. 2008). The quartz and quartzite at Diepkloof are considered local. The silcrete is rare near the site and fine-grained silcrete is absent within 40- 50 kilometres (Porraz et al. 2008).

The picture at Rose Cottage is dramatically different from both former examples. Here the HP assemblage clearly consists of fine grained materials (opaline), but the raw material exploitation pattern is similar through all the MSA sub-stages present (Soriano et al. 2007). This underlines the importance of not under estimating raw materials mechanical properties. The clear dominance of opaline throughout the Rose Cottage MSA sequence clearly shows that the finer raw materials were preferred when available, and that this is not only the case during the HP.

An interesting result from Sibudu is that different raw materials were sourced with different goals in mind. At Sibudu locally available raw materials like dolerite and quartz were predominantly exploited, but hornfels was also used. The source of the latter is uncertain, but possibly within 20 kilometres of the site. The HP segments analysed at Sibudu showed that there is a clear size correlation within different raw material classes, and that different sizes possibly were used for different functions and hafted in different configurations (Wadley and Mohapi 2008).

There could be an increase in the use of fine grained raw materials during the HP because the marginal knapping of thin blades necessitates a fine grained raw material. It has been argued that the blades in quartzite follow the same reduction strategy as seen in the fine grained silcrete at Klasies (Wurz 2002; Villa et al. 2010). It is, however, not stated if the quality between these raw materials was comparable or not. The possibility that raw material choice may have been related to functional parameters provides an interesting future avenue of research.

What leads to change in material culture and how this change should be interpreted is another debated issue in the HP. Climatic correlations are sometimes used in explanatory frameworks that attempt to explain the apparently sudden change in technology of the HP. Another is connected to the debate on style. It has been argued that the HP together with the Still Bay industry reflect brief periods of cultural and technological innovation and that it has been connected to the appearance of modern human behaviour.

Symbolism and modern behaviour

As discussed in chapter 2, the debate on modern human behaviour is one of the key issues in research on the MSA and the HP sub-stage. Modern human behaviour has been defined as:

> "…behaviour that is mediated by socially constructed patterns of symbolic thinking, actions, and communication that allow for material and information exchange and cultural continuity between and across generations and contemporaneous communities" (Henshilwood and Marean 2006:9).

Symbolism is, according to this definition, a prerequisite for modern behaviour, and since symbolism is so closely connected to style in modern societies, it is tempting to infer symbolism from style also in archaeological context (Chase 1991:196). This has been one of the central themes in the stylistic debate of the last thirty years or so (Sackett 1977,1982;

Wiessner 1983,1984; Sackett 1985; Wiessner 1985; Chase 1991; Bar-Yosef and Van Peer 2009; Tostevin 2011).

It has been argued that symbolism could be seen where a style was selected for actively or consciously. Recognising distinctive styles could therefore be argued to indicate a group's intent to symbol to others through selection of an active style e.g. (Wiessner 1983). Though this point is valid in modern ethnographic studies where an artisan can be questioned about his or her intent to communicate symbolism, it is notoriously difficult to trace intent in the archaeological material (Chase 1991; Bar-Yosef and Van Peer 2009; Tostevin 2011).

The imposition of form and standardisation on HP backed segments has been used to argue for symbolic behaviour in the HP (Deacon 1989; Wurz 1999), but gradually the debate concerning symbolism's role in the manifestation of either active or passive style has diminished in the field of lithic studies (Wurz 2010). Currently the symbolic aspect of stone tool production is sought in identifying traditions or conventions that include the ability for planning that is materialised through the imposition of a rigid framework of know-how (Noble and Davidson 1996; Wurz 2008; Bar-Yosef and Van Peer 2009; Wurz 2010; Högberg and Larsson 2011).

As such it is of interest to discuss technological aspects connected to complex cognitive behaviour, which in turn can be described as "modern". Two aspects that are closely linked to this are (1) implications of hafting and the ability for multi tasking and abstract thought, and (2) advanced knapping schemes connected to transmission of knowledge between individuals and across groups and over time.

Hafting and the manipulation of mechanical properties through heating

It is widely accepted that the HP segments were used as both hunting equipment and as domestic tools (Soriano et al. 2007; Villa et al. 2010). It is also argued that they were hafted, either as spears (Deacon 1989; Deacon 1992; Villa et al. 2010), or as projectile points (Lombard and Phillipson 2010; Lombard 2011). Research into the specific use of the HP segments have undoubtedly provided us with a much deeper understanding of the inventiveness and cognitive capabilities of past people, and will probably continue to do so. For the purpose of this thesis the implications of the technologies used to produce the tools is of more importance than whether they were used as projectiles or hand held spears.

The process of using multiple components in the construction of efficient hunting weapons requires the ability for abstract thought and multitasking, usually associated with modern behaviour (Wadley et al. 2009). Analysis conducted on stone artefacts from Sibudu have shown that several ingredients were used to produce mastic during the MSA (Lombard 2005,2006; 2006b; Wadley et al. 2009). It has also been shown that different mastics have been applied to different raw materials in order to accomplish specific tasks (Wadley et al. 2009; Lombard 2011). The ability to consciously combine a range of ingredients and to modify their mechanical or chemical properties through the application of heat can be considered traits that are modern (Wadley et al. 2009; Wynn 2009). These issues will be elaborated further in the light of the following discussion on variability in the Klipdrift assemblage and other HP sites.

6.2. Interpreting the Klipdrift Shelter assemblage

In the last decade there have been a substantial number of publications on a handful of HP sites providing a suitable comparative basis for the Klipdrift Shelter assemblage. The following section will review the material presented in chapter 5, and discuss it in connection to the sites described in chapter 2. Consideration of raw material acquisition and use, assemblage composition, typological corpus and metrical measurements will be used to document similarity and variability between the Klipdrift Shelter assemblage and other well described HP and pre-HP sites.

Implications of raw material acquisition and use

The overall lithic assemblage at Klipdrift Shelter is dominated by quartzite followed by quartz and silcrete. This contrasts with the raw material composition of some debitage classes, the retouched tools and the blades. The first logical explanation would be that the fine grained raw materials were procured at a further distance than the quartzite, and that the high amounts of quartzite present in the assemblage reflects more activity connected to primary on-site reduction. This is supported by looking at the “waste” categories in the assemblage composition (flake fragments, chunks, chips and trimming flakes), where both quartzite and quartz is twice as common as silcrete (Figure 12). In line with this argument, it could also be expected that higher amounts of cortical pieces in the quartzite component of the assemblage, would occur, but, as shown in chapter 5, this is not the case (Figure 14). The cortex occurs in similar proportions in all raw materials.

As Figure 14 also shows, there is clearly a higher percentage of natural cortex manifest in quartzite. This indicates that the quartzite, to a larger extent, was sampled from primary sources like cliff faces, possibly the parent rock of Klipdrift Shelter. The quartz and silcrete was more often procured as cobbles from secondary deposits. Cobbles transported to the site were more likely smaller than the blocks sourced at the site itself, perhaps for practical purposes. If it is assumed that quartzite has been worked at the site to a larger extent than silcrete, the question arises why blades and retouched artefacts occur more commonly in silcrete. An additional question is why no retouched lithics in quartzite occur?

There are several possible explanations for this. First, the silcrete and possibly some of the quartz could be imported to the site as partially processed blanks or possibly as finished tools, and that the silcrete "waste products" in the debitage is a result of modification rather than primary reduction. Second, the quartzite could be overrepresented in the overall assemblage and the debitage because the quality of this material is lower than silcrete and quartz, resulting in larger quantities of refuse than formal products. It is reasonable to argue that the lower quality of the raw material result in more 'waste' products. The lack of retouched quartzite artefacts may be a consequence of sample size - if the sample was larger some retouched pieces in this material may have occurred. There is also a possibility that, if the silcrete was less readily available, the finished products would have been used and modified more extensively. A third possible explanation for the differences in raw material composition of the blades and retouched artefacts is that a separate reduction sequence could have been related to the use of quartzite. It may have been that the aim was not to produce blade blanks for the production of segments or notched pieces. It may have been that, as discussed in chapter 2, a separate flake technology occurs at Klipdrift Shelter, as has been suggested for the mid-HP at Klasies (Villa et al. 2010) and the "Jeff" layer at Diepkloof (Porraz et al. 2008). However, these publications do not mention whether the flake industry is dominated by quartzite.

At Klipdrift Shelter, the fact that quartzite is more common in the flake than in the blade category (Figure 12), may indicate that more primary shaping, preparation and core setup was done on-site within this raw material group. Additionally there is a considerably higher proportion of quartzite flakes with cortex than flakes in other raw materials. This supports the hypothesis that at least some of the reduction connected to quartzite has been done on-site, but does not dismiss the possibility of a separate flake industry.

Whether the quartzite has been subjected to a different flaking strategy can only be tested through experiments with different types of local and non-local quartzite, that are classified in terms of flaking quality. No such studies have been done in South Africa. Creating arbitrary raw material categories is a construct created by the archaeologist. It should be assumed that the artisans at Klipdrift Shelter did not decide which products to make based on geological provenance of raw materials, but rather on quality or other functional requirements. Although quartzite is locally abundant along the Klipdrift Shelter beach, this has not necessarily been the source of all the quartzite found in the assemblage. This is the case with the fine white quartzite described in chapter 5 that constitutes 16% of the quartzite blades. The fine grained quality and homogeneity observed in this raw material could not be located near the site in a recent survey by me but this does not exclude the possibility that it may exist. I argue that caution needs to be taken when assuming that all quartzite should be described as local.

The hypothesis that the silcrete and possibly the quartz to a larger extent have been imported as pre-shaped blanks, cores or finished products, and only modified at the site could possibly be supported by the findings in the assemblage composition (Figure 17). It becomes apparent that the trimming flakes distribute differently between the raw material groups. There are similarities between the quartzite and quartz component, but in the silcrete component trimming flakes are twice as common. This can partially be explained by the natural tendency of quartz to fragment during knapping (resulting in larger quantities of chips and chunks relative to complete trimming flakes). However, there seems to be a higher amount of chips and trimming flakes as opposed to chunks and flake fragments in the silcrete component. Together with the small amounts of cortical pieces this could be interpreted as an indication that this raw material to a some extent was introduced partially prepared, and more and smaller, finer removals were done on-site. This result is consistent with what is reported in the "Jeff" layer at Diepkloof (Porraz et al. 2008:116).

The results seen in the raw material and cortex analysis at Klipdrift Shelter shows that there is a clear preference for fine grained raw materials especially connected to blade and bladelet production, and that the fine grained materials constitutes the entire retouched component. It is argued that this can be partially explained by these raw materials' higher quality, rather than reflecting stylistic choices. The site to source distances of raw materials in the Klipdrift Shelter surrounding does not have sufficient resolution to clearly confirm or dismiss any hypothesis of foraging ranges or the presence of long distance trade. What is clear is that there are indications that primary reduction and shaping of the silcrete appears to have been, at least partially, done elsewhere and that there is a larger degree of on-site exploitation of quartzite. This could indicate the silcretes rarity, either by distance, or in time demanded of exploitation. To further interpret the Klipdrift Shelter assemblages' affinity, I will now discuss the typological variability expressed in the material.

The Klipdrift Shelter typological corpus

The typological corpus of the PBE unit`s lithic assemblage is somewhat limited. Excluding the cores, the retouched component is limited to only 0.7% (n=28) of the total assemblage. Within this category there are mainly two types of retouch present; notched pieces and backed pieces, three of the backed pieces are defined as segments (Figure 20a-e and 21a-e). The backed pieces and segments are, as shown in chapter 2, the typical marker used to identify the HP industry, and are interpreted to be the aim of blade production at many HP sites (Wurz 2000,2002; Delagnes et al. 2006; Soriano et al. 2007; Wadley 2008; Wadley and Mohapi 2008). Its dominance among the retouched category has also been described as a necessity for defining the industry within the HP. The lack of these markers and a dominating amount of notched blades has been argued to indicate a separate transitional industry between the HP and the Still Bay present at Diepkloof (Porraz et al. 2008).

Although segments and backed pieces occur in the Klipdrift Shelter PBE lithic assemblage, the dominating retouched artefacts are the notched blades comprised of one or several notches also often referred to as denticulates, concave/notched scrapers or strangulated blades (Porraz et al. 2008). The retouched component is almost exclusively made in silcrete (86% (n=24)) (Figure 12d), a pattern that is comparable to the "Jeff" industry at Diepkloof (Porraz et al. 2008:109).

On typological grounds it can be said that the Klipdrift Shelter assemblage resembles typical markers seen in the HP, but that the classical segments are not the dominating type. As such, the material from the PBE unit at Klipdrift Shelter shows closer resemblance to the data provided from the analysis of the "Jeff" layer at Diepkloof (Porraz et al. 2008), with a dominance of notched and denticulated pieces and strangulated blades. The lack of segments and backed blades has also made inferences drawn from the implication of hafting futile for this analysis. Although we can assume that hafting has occurred also at Klipdrift Shelter based on the presence of a few segment, there is not sufficient material present to discuss this any further. The low density of retouched lithics as a whole makes it difficult to draw any comparisons to other sites, and the remaining assemblage has therefore been used to provide technological and metrical data for further comparison, in an effort to clarify the Klipdrift Shelter assemblages' temporal affinity.

The assemblage composition

The lithic reduction at Klipdrift Shelter was mainly aimed at producing blades. This conclusion has been based on the observation that only blades showed any kind of modification and use, and on the basis that there are no flake cores present in the assemblage. The amount of blades and blade fragments is relatively low (10.1%) when compared to other HP sites. At Klasies it is reported that 77.7% of assemblage is blade related (Villa et al. 2010:641), and at Rose Cottage about 90% is blade products (fragmented and whole) (Soriano et al. 2007:686). In the "Jeff"-layer at Diepkloof the category described as "laminar products" comprise 50% of the assemblage. Many of the products categorized as flakes and flake fragments at Klipdrift Shelter may also relate to blade production although their metrical values do not classify them as such. There are several stages in the manufacture of blades that will produce debitage that is not twice as long as it is wide; this does not mean that a separate flake industry is present. It is difficult to compare assemblage compositions directly with results from other sites as there are differences in the excavation methodology and recording practises. The high percentage of blade products seen at Klasises relative to Klipdrift Shelter can for example be explained by the elimination of all lithics smaller than 20 mm from Villa´s et al. (2010) analysis.

The assemblage composition further indicates that it is unlikely that there is a separate industry aimed at producing flakes present at Klipdrift Shelter. The flakes clearly have more cortex than the other classes of artefacts. This indicates that these flakes relates to an earlier reduction stage than the non-cortical products. It has also been shown in chapter 5 that there are only minimal parts of the blades in the assemblage that retain any cortex at all.

If there was a separate flake industry present at the site we would expect this to be a more visible component of the assemblage, but flakes occur in similar proportions in all raw materials, and never comprises more than 5% of the total (Figure 17).

The pattern seen in Figure 17 illustrates that the different raw materials are not connected to different reduction strategies, and that the main objective in the reduction sequences at the sites was aimed at the same objective; blade production. The different distributions in the assemblage composition can be explained partly by the different materials mechanical properties and possibly by a larger degree of on-site reduction of quartzite and possibly quartz. In-depth replication studies could clarify the debitage distributions in raw materials with different mechanical properties further.

Metrical comparison of blade widths

It has been argued that the reduction sequences seen at Klipdrift Shelter were aimed at blade production, similar to the general trend noted for HP sites. Blade widths have been published from three of the four sites described in chapter 2. These measurements have been used to display diachronic change over time at both Klasies and Rose Cottage (Soriano et al. 2007; Villa et al. 2010), and at Diepkloof the width distribution is argued to show that there is a reduction continuum (Porraz et al. 2008:113). By combining the data published from these sited with the results from the Klipdrift Shelter sample, presented in chapter 5, the width distributions from the different sites are compared (Figure 34).

The blade width at Klipdrift Shelter is distributed in a uni-modal fashion (Figures 27-32), this is also the case at Rose Cottage, Klasies and Diepkloof (Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010) (Figure 2).

By adding the Klipdrift data to Figure 2 presented in chapter 2 it can be seen that the distribution between the sites is similar in modality but that the Klasies sample is somewhat more skewed to the right (Figure 34). The graph also indicates that the Klasies and Rose Cottage samples have a somewhat more pointed peak, while Diepkloof and Klipdrift Shelter display a wider distribution in widths.

The blade width and thickness present at Klipdrift Shelter is somewhat lower than observed at other HP sites. The variability present between the different assemblages can be interpreted in several ways: The blades produced at Klipdrift Shelter were intended to be lower than intended at other sites, or there could be a difference in the sampling strategy between the different analyses. As mentioned in chapter 4, the Klipdrift Shelter sediments are sieved through both a 3.5 mm and a 1.5 mm mesh, which prevents any lithic debitage from being lost during sieving. In the analyses from Klasies and Rose Cottage the excavation procedure is not described, which makes it difficult to exclude this possible bias

Another problem when comparing sites based on metrical values is that the different raw materials used at different sites could potentially affect the outcome of such analysis. Villa et al. (2010) explains the diachronic changes in the Klasies blade widths by the gradual shift towards an increased use of quartzite. And as such it is reasonable to argue that the variability manifest in the blade width distribution is a consequence of the variability in raw materials utilised.

Both the blade width and thickness illustrate that there is a considerable production of small laminar products at Klipdrift Shelter as well as the other sites described but most of these are not selected for retouch or used enough to produce visible use-wear. The disproportionate relationship between the systematic production of small blades and the retouch of larger blanks is in need of explanation. That all the blades/bladelets distribute in a uni-modal fashion can be indicative that there is not two separate laminar reduction strategies practiced at Klipdrift Shelter with clearly different modes in mind. This leads to more questions about whether the large blanks selected for retouch has been produced elsewhere, or if they are actually part of the same reduction sequence where only a few large blades are produced in the optimal stages of reduction. An experimental study, using observed techniques and relevant raw materials, could be of use in clarifying the width distributions observed in the HP.

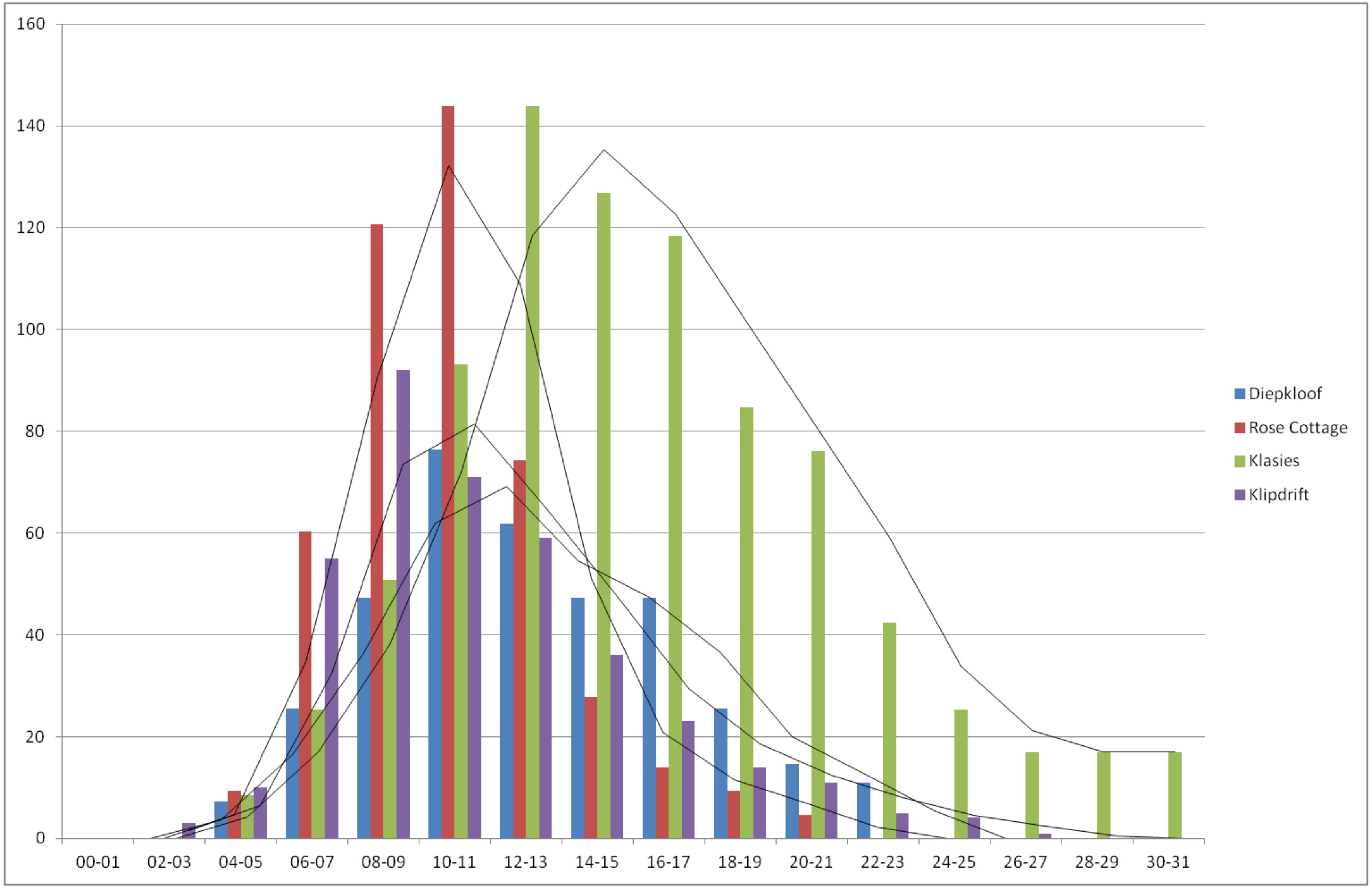


Figure 34 Distribution of blade width in HP and pre HP-sites, some outliers have been excluded for clarity. Size categories are in millimetres, data modified from (Soriano et al. 2007; Porraz et al. 2008; Villa et al. 2010)

Platform characteristics and reduction sequences

One characteristic type of preparation that is recognized in the Klipdrift Shelter assemblage is the use of rubbing, or minute step flaking to shape and strengthen the platforms prior to removals. This has facilitated the successful removal of laminar products and is clearly more often associated with the blade products than the flakes, indicating that more effort and planning has been put into the production of the blades. Alternatively one can argue that this pattern indicates that more specific requirements in shape are connected to the blade production than is the case with the flakes, further supporting the conclusion of the flakes being by-products of blade production.

The use of rubbing and minute step flaking is widely recognised as a preparation strategy practiced during the HP (Wurz 2000,2002; Delagnes et al. 2006; Rigaud et al. 2006; Soriano et al. 2007; Villa et al. 2010). This is also the case in "Jeff" at Diepkloof, where it is also argued to clearly show the intention form the artisan to produce laminar products (Porraz et al. 2008:111).

The lack of flake cores, the distribution of the debitage, and the general lack of used/retouched flakes in the assemblage has lead to the conclusion that there is not a separate flake technology present at Klipdrift Shelter. Additionally, the distribution of blade widths indicates that there is no bladelet industry that occurs separately from the general reduction sequence of blades present.

In chapter 5 I show that two configurations for blade reduction were recognised by studying the blade component. One was a uni-directional blade reduction indicated by the presence of plunging blades e. g. (Figure 20f and g) and blades that only show uni-directional dorsal scars. Additionally, the cores studied, had only one platform. The second bi-directional configuration has been recognised by the presence of straight, wide and thin blades with parallel edges and bi-directional scars e. g (Figure 20d and e and 21d and e), but is not recognised in the core analysis, where opposing platform, when used, are only made to correct the convexity of the core surface. The bi-directional configuration seems to appear less frequently, and it is at this stage still unclear whether the two configurations represent different strategies, or if they could indicate different stages in the same reduction strategy. It appears likely that the two configurations recognized in the Klipdrift Shelter assemblage are comparable to the finds at Rose Cottage, as outlined in chapter 2. While the general reduction sequence is also comparable to the uni-directional reduction recognised at Klasies where opposing platforms were only used for core maintenance (Villa et al. 2010:641). At Diepkloof the bi-directional reduction sequence is described as the most common in the “Jeff” layer (Porraz et al. 2008:111).

When it comes to core and platform maintenance in the HP there seems to be some variability, as described in chapter 2, and elaborate shaping of the cores is limited at most HP sites. At Klasies the lack of crested blades and cortical pieces is used to argue for *ex-situ* preparation while at Rose Cottage cresting occurred especially to correct core convexity. Also blade reduction mostly followed natural ridges on the core blank. In the “Jeff” layer at Diepkloof this initiation of debitage is recognised and no crested blades are reported from this site but a strategy of multidirectional removals is practised in all stages of reduction to correct core surface convexity (Porraz et al. 2008). Generally in the HP and the pre-HP platforms are plain only rarely does faceting or platform rejuvenation occur. This is also the case at Klipdrift Shelter although some exceptions exists e. g. core KB 698 (Figure 22).

In the Klipdrift Shelter assemblage no cresting has been detected and there is a general lack of cortical blades. A few blades however indicate that natural convexities have been utilised to initiate knapping as is seen in both the HP and in “Jeff” at Diepkloof. As argued in chapter 5, a very similar core surface shaping strategy to that described in the “Jeff” layer at Diepkloof is recognised in the Klipdrift Shelter assemblage. Here the core surface is maintained trough multi-directional removals Figure 18a and b). From the evidence presented in chapter 5 and the comparisons mentioned above it could be argued that the Klipdrift Shelter lithic assemblage show some technological traits that are recognised generally in the HP and in the pre-HP at Diepkloof.

Behavioural interpretations of the Klipdrift Shelter Assemblage

The Klipdrift Shelter material holds some potential clues in clarifying the use of local and non-local raw materials, but at this stage no clear conclusions can be drawn to confirm or dismiss behavioural inferences of expanded foraging range as a response to climatic deterioration or the existence of trade networks. The typological corpus of the Klipdrift Shelter assemblage is at this preliminary stage limited, especially with regard to backed pieces and segments. This limits the interpretations drawn from a typological comparison as segments are the most frequently used cultural marker in the HP. Still, the technological markers present in the material at Klipdrift Shelter and in assemblages from other HP sites can be used to describe behaviours that can be considered modern, although not necessarily symbolic. There are some indications that the technological choices made by the HP artisans correspond with mental conceptions that are unique to modern humans today e. g. (Wadley et al. 2009; Högberg and Larsson 2011).

The technological processes involved in the systematic production of blades incorporates many of the elements of step by step planning and the ability to visualise an end product and work accordingly to a mental concept (Pelegrin 1990). However, on its own, systematic blade production cannot be regarded as modern behaviour as it occurred throughout the MSA and in technologies associated with species other than *H. sapiens* (McCall 2006; Villa et al. 2010; Wilkins and Chazan In press). It is the suite of several technological markers that separate the HP industry from earlier blade reduction schemes. There is some variability present in the way HP artisans have worked with lithic materials. There are clear differences in the choices of raw materials, although materials that are fine grained and well suited seems to have been preferred. The ability to adapt to local variations in raw material availability and to adjust knapping techniques according to raw material quality, size and shape seems to be a trait mastered by the HP artisans.

Despite the differences in local variations there seems to be technological and definitely typological standards that govern how lithic products should be produced. The broad application of soft stone hammers and marginal tangential direct percussion together with seemingly standardised methods of platform preparation are traits that do not appear in other MSA blade technologies. This can possibly indicate a shared technical knowledge over time and space. The execution and especially the transmissions of an advanced *schema opératoire* that requires high motor abilities and ability for planning depth requires a high degree of social interaction in transmission over space and time. As such, the knowledge and know-how are complimentary expressions of cognitive and habituated dispositions for learning (Högberg and Larsson 2011). The transmission of this learning is a key aspect in reading behaviour from the lithic artefacts from Klipdrift Shelter. The similarity in the reduction sequences observed at different HP and possibly pre-HP sites like the “Jeff”-layer at Diepkloof indicates that there is some form of transmission of knowledge over time and space.

Heat treatment is another technological trait that has not been studied in the HP. In chapter 5 I discussed that there are indications that some of the lithic material in the Klipdrift Shelter assemblage could have been heat treated. Some of the cores described in chapter 5 show evidence of heating: for example KB 484 shows a large contrast between the plain platform and the flaked core surfaces (Figure 23).

If it can be demonstrated that the surfaces have been flaked after heating, this shows that pre-historic artisans were capable of using heat to alter mechanical properties of raw materials. This has important implications on cognitive abilities as the ability to control fire at stable temperatures for several hours demands a great level of knowledge of wood types and specific fire configurations as noted by Wadley (2009). Additionally, a great deal of planning depth and organisation is necessary to procure sufficient amounts of firewood and to apply it in a controlled fashion to the fire. More detailed analysis is necessary to draw any definite conclusions of whether heat treatment was practised at Klipdrift and other HP sites. It is outside the scope of this preliminary analysis to try any further demonstration.

7. Summary and conclusions

The aim of this thesis has been to describe and interpret the Klipdrift Shelter lithic assemblage through a *chaîne opératoire* approach. The main objective has been to determine the assemblage's temporal and cultural affinity, and to point out behaviours that could be recognised in the lithic assemblage. In order to do so a range of questions were presented in the introduction and the following section summarises the results found.

Behavioural inferences have been drawn from raw material procurement patterns in the HP, and it has been noted that this is based on uncertain evidence. From the material presented in chapter 2 and through the raw material analysis presented in chapter 5 and discussed in chapter 6, I argue that overarching models based on raw material procurement strategies and 'source to site' evidence at this stage is inconclusive. The assumption that HP is characterised by the use of non-local raw materials is a theory that cannot be sustained on basis of the current evidence from Klipdrift Shelter and several other HP occurrences where, either, source locations cannot be verified, or where locally available raw materials are used. What seems to be clear however, is that there is an increased use of fine grained raw materials during the HP sites in general, Klipdrift Shelter included. In this thesis it is suggested that this is more likely connected to the mechanical properties of the chosen materials , rather than a demonstration of selected style by the artisans.

The overrepresentation of quartzite in the general assemblage composition at Klipdrift Shelter is explained by a larger degree primary shaping in this raw material. When looking at the blade category and the retouched component it becomes clear that silcrete and to an extent quartz have been selected for the blade/bladelet production, and that this is grounded on the mechanical properties of these materials.

It is also clear that the reduction sequences at Klipdrift shelter was aimed at producing blades and bladelets, and that these two products belong to the same reduction continuum. This conclusion is based on the observation of the technological processes involved in the production of both. The same types of platform preparations are visible in both classes and the modality in the blade width distribution points towards a single mode.

The existence of a separate reduction sequence for flakes has been discussed and dismissed based on the evidence of a low amount of complete flakes in the assemblage (manifest in all raw materials) and that no flake cores are present. The dominance of quartzite flakes in the assemblage is explained by the more frequent primary reduction of this material *in-situ.*

Some of the retouched objects in the material are possibly not produced on-site as there is a considerable difference in widths between the general blade component and the blades selected for retouch. Also the modality of the general blade product tends towards a different size category than would be expected if the goal was to produce blanks only intended for production of segments, backed blades or notched pieces. This hypothesis is however in need of testing through replication studies to confirm whether or not the larger blanks can in fact be part of the same reduction sequence.

Comparisons of the HP lithic assemblages from the sites presented in chapter two (Klasies, Rose Cottage, Diepkloof and Sibudu) have also been made in terms of the following:

(1) The typology at Klipdrift Shelter shows clear connections to the HP as well as the “Jeff” layer described as pre-HP at Diepkloof. The main retouched types recognised at Klipdrift Shelter are the notched, denticulated and strangulated blades which also make up the majority of the “Jeff” assemblage. Contrary to the case at the latter assemblage, segments have also been documented at Klipdrift, although in limited amounts, showing clear resemblance to typical HP types like that seen at Klasies, Rose Cottage and Sibudu.

(2) Through a comparison of blade widths similar patterns in modality have been documented between Klasies, Rose Cottage, Diepkloof and Klipdrift Shelter, however there is a significant degree in variability of how the peak of the modality distributes. This does not indicate that the industries are different complexes, but is rather a consequence of the variability manifest in the availability of raw materials with different mechanical properties.

(3) Technological choices related to platform preparation and maintenance of core surface convexities at Klipdrift Shelter show similar traits to all the sites discussed. Especially, the multi directional removal configuration observed at Klipdrift Shelter, explained in chapter 5, resembles the configuration seen in the “Jeff” layer at Diepkloof.

Through these comparisons above I conclude that the Klipdrift assemblage is probably closely related to the pre-HP stage seen at Diepkloof, based on typological and technological findings. Both technological and typological traits also confirms the Klipdrift assemblages’ close relationship to the HP, and it is suggested that although it is possibly an early incarnation of the industry, the Klipdrift assemblage belong to the HP. Exact dating can in the future clarify the relationship further.

The behavioural inferences related to the Klipdrift assemblage were discussed in the last chapter and it was concluded that there are behavioural traits manifest in the Klipdrift assemblage that are shared by modern humans today, but not necessarily exclusive to *H. sapiens*. These traits are:

(1) Advanced preparation in the form of multidirectional surface shaping, and correction of convexity and platform preparation that shows ability for step-by-step planning, and the ability to communicate and transmit knowledge between generations an over time.
(2) Changes in the application of a percussor (hard hammer/soft hammer) indicate the ability to change the mode of knapping according to the desired outcome.
(3) A possible use of heat treatment can be seen as advanced technological planning and the ability to manipulate the mechanical properties of lithic materials through heat.

As it is demonstrated in chapters 2, 5 and 6 these technological traits are shared over time and space as the same markers, unique to the HP, can be found in different geographic areas to different times. The uniform distribution of basic technical methods within a particular geographic distribution, for example, may indicate the use of oral teaching tradition and the imposition of a rigid framework of "know-how" (Bar-Yosef and Van Peer 2009:116).

7.1. Concluding remarks

Through working with this thesis it has become clear to me what potential lays even in a small sample of lithic material. There are of course also limitations when selecting out only a 'still picture' of a larger context, drawing overlaying conclusions about change and continuity becomes difficult and requires multidisciplinary approaches.

There are several avenues of research that has been outside the scope of this thesis to pursue. Replication studies have recently contributed to our understanding of the MSA e g. (Soriano et al. 2009; Mourre et al. 2010) and although many researchers working with HP material at times base their findings on experimental work, this work is often done in other contexts with other raw materials, using different tools than what would have been available to the HP artisan. Using observed techniques and relevant raw materials for the HP is clearly a fruitful path. This could elucidate the distribution patterns observed in the assemblage and provide us with better tools for classifying raw material groups, possibly derived from qualitative selection criteria rather than solely geological provenance.

For the Klipdrift Shelter sample more specifically a refitting of lithic materials would be useful tool. Determining the relationship between the different reduction configurations seen in the blade and core components is one possibility, and it could be of use to clarify which stages of reduction has happened on-site. Also heat treatment of lithic materials has been briefly touched upon in this thesis. Although heat treatment is documented in the MSA (Brown et al. 2009; Mourre et al. 2010), there has not been published any studies on this innovative technological method in connection to HP technology. As described in chapter 5 it should be possible to document and quantify this without much difficulty as several non-destructive and simple procedures are available (Brown et al. 2009; Mourre et al. 2010).

The rich HP assemblage at Klipdrift Shelter holds a huge potential for further investigations. Analysis of larger samples including several stratigraphic units can help clarify the sequence of the HP in southern Africa, and hopefully contribute to our understanding of the diachronic changes seen over time at other sites. My hope is that this thesis can contribute into the larger picture by clarifying the specific technical and mental actions displayed through a small part of the lithic assemblage at Klipdrift Shelter and as such serve as one piece fitting into the larger puzzle.

Literature

Ambrose, S. H. 2006. Howiesons Poort lithic raw material procurement patterns and the evolution of modern human behavior: A response to. *Journal of Human Evolution* 50 (3):365-369.

Ambrose, S. H., and K. G. Lorenz. 1990. Social and ecological models for the Middle Stone Age in southern Africa. In *The Emergence of Modern Humans*, edited by P. Mellars. Edinburgh: Edinburgh University Press.

Amick, D. S., and R. P. Mauldin. 1989. Comments on Sullivan and Rozen's "Debitage Analysis and Archaeological Interpretation". *American Antiquity* 54 (1):166-168.

Andrefsky, W. J. 2005. *Macroscopic Approaches to Analysis*. London: Cambridge University Press.

Backwell, L., F. d'Errico, and L. Wadley. 2008. Middle Stone Age bone tools from the Howiesons Poort layers, Sibudu Cave, South Africa. *Journal of Archaeological Science* 35 (6):1566-1580.

Bamforth, D. B., and N. Finlay. 2008. Introduction: Archaeological Approaches to Lithic Production Skill and Craft Learning *Journal of Archaeological Method and Theory* 15 (1):1-27.

Bar-Yosef, O., and P. Van Peer. 2009. The Chaîne Opératoire Approach in Middle Paleolithic Archaeology. *Current Anthropology* 50 (1):103-131.

Bouzouggar, A., N. Barton, M. Vanhaeren, F. d'Errico, S. Collcutt, T. Higham, E. Hodge, S. Parfitt, E. Rhodes, J. L. Schwenninger, C. Stringer, E. Turner, S. Ward, A. Moutmir, and A. Stambouli. 2007. 82,000-year-old shell beads from North Africa and implications for the origins of modern human behavior. *Procedings of the National Academy of Sciences U S A* 104 (24):9964-9.

Brown, K. S., C. W. Marean, A. I. R. Herries, Z. Jacobs, C. Tribolo, D. Braun, D. L. Roberts, M. C. Meyer, and J. Bernatchez. 2009. Fire As an Engineering Tool of Early Modern Humans. *Science* 325 (5942):859-862.

Butzer, K. W., P. B. Beaumont, and J. C. Vogel. 1978. Lithostratigraphy of Border Cave, KwaZulu, South Africa: a Middle Stone Age sequence beginning c. 195,000 b.p. *Journal of Archaeological Science* 5 (4):317-341.

Chase, B. M. 2010. South African palaeoenvironments during marine oxygen isotope stage 4: a context for the Howiesons Poort and Still Bay industries. *Journal of Archaeological Science* 37 (6):1359-1366.

Chase, P. G. 1991. Symbols and Paleolithic Artifacts: Style, Standarisation and Imposition of Arbitrary Form. *Journal of Anthropological Archaeology* 10:193-214.

Clark, J. D. 1959. *The prehistory of southern Africa.* Harmondsworth: Penguin.

Compton, J. S. 2011. Pleistocene sea-level fluctuations and human evolution on the southern coastal plain of South Africa. *Quaternary Science Reviews* 30 (5-6):506-527.

Crabtree, D. E. 1982. *An Introduction to Flintworking, second edition*. Vol. 28, *Occasional Papers of the Idaho Museum of Natural History*.

d'Errico, F. 2003. The invisible frontier. A multiple species model for the origin of behavioral modernity. *Evolutionary Anthropology: Issues, News, and Reviews* 12 (4):188-202.

d'Errico, F., L. R. Backwell, and L. Wadley. 2012b. Identifying regional variability in Middle Stone Age bone technology: The case of Sibudu Cave. *Journal of Archaeological Science* 39 (7):2479-2495.

d'Errico, F., C. Henshilwood, M. Vanhaeren, and K. van Niekerk. 2005. Nassarius kraussianus shell beads from Blombos Cave: evidence for symbolic behaviour in the Middle Stone Age. *Journal of Human Evolution* 48 (1):3-24.

d'Errico, F., and C. S. Henshilwood. 2007. Additional evidence for bone technology in the southern African Middle Stone Age. *Journal of Human Evolution* 52 (2):142-63.

d'Errico, F., M. Vanhaeren, and L. Wadley. 2008. Possible shell beads from the Middle Stone Age layers of Sibudu Cave, South Africa. *Journal of Archaeological Science* 35 (10):2675-2685.

d’Errico, F., R. García Moreno, and R. F. Rifkin. 2012. Technological, elemental and colorimetric analysis of an engraved ochre fragment from the Middle Stone Age levels of Klasies River Cave 1, South Africa. *Journal of Archaeological Science* 39 (4):942-952.

De Bie, M. 2007. Benefiting from Refitting in Intra-Site Analysis. In *Fitting Rocks: Lithic Refitting Examined. British Archaeological Reports International Series 1596*, edited by U. A. Schurmans and M. De Bie. Oxford: Archaeopress.

Deacon, H. J. 1979. Excavations at Boomplaas Cave – a sequence through the Upper Pleistocene and Holocene in South Africa. *World Archaeology* 10:241-257.

Deacon, H. J. 1989. Late Pleistocene palaeoecology and archaeology in the southern Cape, South Africa. In *The human revolution: behavioural and biological perspectives on the origins of modern humans:*, edited by P. Mellars and C. Stringer. Edinburgh: Edinburgh University Press.

Deacon, H. J. 1992. Southern Africa and Modern Human Origins. *Philosophical Transactions: Biological Sciences* 337 (1280):177-183.

Deacon, H. J., and J. Deacon. 1999. *Human beginnings in South Africa : uncovering the secrets of the Stone Age*. Walnut Creek, CA: Altamira Press.

Deacon, H. J., and V. B. Geleijnse. 1988. The Stratigraphy and Sedimentology of the Main Site Sequence, Klasies River, South Africa. *South African Archaeological Bulletin* 43:5-14.

Deacon, H. J., and S. Wurz. 1996. Klasies River main site, Cave 2: A Howiesons Poort occurrence. In *Aspects of African Archaeology*, edited by G. Pwiti and R. Soper. Harare: University of Zimbabwe Publications.

Deacon, H. J., and S. Wurz. 2001. Middle Pleistocene populations and the emergence of modern behaviour. In *Human roots : Africa and Asia in the Middle Pleistocene*, edited by L. Barham and K. Robson-Brown. Bristol: Western Academic & Specialist Press.

Deacon, H. J., and S. Wurz. 2005. A late Pleistocene archive of life at the coast, Klasies River. . In *African Archaeology: A Critical Introduction*, edited by A. B. Stahl. Oxford: Blackwell Publishing.

Deacon, J. 1978. Changing patterns in the late Pleistocene/early Holocene prehistory of Southern Africa as seen from the Nelson Bay Cave Stone artifact sequence. *Quaternary Research* 10 (1):84-111.

Deacon, J. 1995. An Unsolved Mystery at the Howieson's Poort Name Site. *The South African Archaeological Bulletin* 50 (162):110-120.

Delagnes, A., L. Wadley, P. Villa, and M. Lombard. 2006. Crystal quartz backed tools from the Howiesons Poort at Sibudu Cave. *Southern African Humanities* 18 (1):43-56.

Dobres, M.-A. 2000. Engendering the Chaîne Opératoire: Methodological Considerations” and “A Future for Technology’s Past. In *Technology and Social Agency: Outlining a Practice Framework for Archaeology*. Oxford: Blackwell.

Dobres, M.-A., and C. R. Hoffman. 1999. Introduction: A Context for the Present and Future of Technology Studies. *The Social Dynamics of Technology : Practice, Politics, and World Views. Washington, D.C: Smithsonian Institution Press*:1-19.

Edmonds, M. 1990. Description, Understanding and the Chaîne Opératoire. *Technology in the humanities, Archaeological Review from Cambridge* 9 (1):55-70.

Goodwin, A. J. H., and B. Peers. 1953. Two Caves at Kalk Bay, Cape Peninsula. *The South African Archaeological Bulletin* 8 (31):59-77.

Goodwin, A. J. H., and C. Van Riet Lowe. 1929. The Stone Age cultures of South Africa. *Annals of the South African Museum* 27.

Henshilwood, C., and B. Dubreuil. 2009. Reading the artifacts: gleaning language skills from the Middle Stone Age in southern Africa. In *The cradle of language*, edited by R. P. Botha and C. Knight. Oxford ; New York: Oxford University Press.

Henshilwood, C. S., F. d'Errico, C. W. Marean, R. G. Milo, and R. Yates. 2001. An Early Bone Tool Industry from the Middle Stone Age at Blombos Cave, South Africa: Implications for the Origins of Modern Human Behaviour, Symbolism and Language. *Journal of Human Evolution* 41 (6):631-78.

Henshilwood, C. S., F. d'Errico, and I. Watts. 2009. Engraved ochres from the Middle Stone Age levels at Blombos Cave, South Africa. *Journal of Human Evolution* 57 (1):27-47.

Henshilwood, C. S., F. d'Errico, R. Yates, Z. Jacobs, C. Tribolo, G. A. T. Duller, N. Mercier, J. C. Sealy, H. Valladas, I. Watts, and A. G. Wintle. 2002. Emergence of Modern Human Behavior: Middle Stone Age Engravings from South Africa. *Science* 295 (5558):1278-1280.

Henshilwood, C. S., F. d'Errico, K. L. van Niekerk, Y. Coquinot, Z. Jacobs, S.-E. Lauritzen, M. Menu, and R. García-Moreno. 2011. A 100,000-Year-Old Ochre-Processing Workshop at Blombos Cave, South Africa. *Science* 334 (6053):219-222.

Henshilwood, C. S., and B. Dubreuil. 2011. The Still Bay and Howiesons Poort, 77–59 ka: Symbolic Material Culture and the Evolution of the Mind during the African Middle Stone Age. *Current Anthropology* 52 (3):361-400.

Henshilwood, C. S., and C. W. Marean. 2003. The Origin of Modern Human Behavior: Critique of the Models and Their Test Implications. *Current Anthropology* 44 (5):627-651.

Henshilwood, C. S., and C. W. Marean. 2006. Remodelling the origins of modern human behaviour. In *The Human Genome and Africa Part One: History and Archaeology*, edited by H. Soodyall: Human Sciences Research Council.

Hogberg, A. 2008. Playing with flint: Tracing a child's imitation of adult work in a lithic assemblage. *Journal of Archaeological Method and Theory* 15 (1):112-131.

Högberg, A., and L. Larsson. 2011. Lithic technology and behavioural modernity: New results from the Still Bay site, Hollow Rock Shelter, Western Cape Province, South Africa. *Journal of Human Evolution* 61 (2):133-155.

Inizan, M., M. Reduron-Ballinger, H. Roche, and J. Tixier. 1999. *Technology and terminology of knapped stone*. Nanterre: CREP.

Jacobs, Z., and R. G. Roberts. 2008. Testing Times: Old and New Chronologies for the Howieson's Poort and Still Bay Industries in Enviromental Context. *Goodwin Series* 10 (ArticleType: research-article / Issue Title: Current Themes in Middle Stone Age Research/ Full publication date: December 2008 / Copyright © 2008 South African Archaeological Society):9-34.

Jacobs, Z., R. G. Roberts, R. F. Galbraith, H. J. Deacon, R. Grün, A. Mackay, P. Mitchell, R. Vogelsang, and L. Wadley. 2008. Ages for the Middle Stone Age of Southern Africa: Implications for Human Behavior and Dispersal. *Science* 322 (5902):733-735.

Jacobs, Z., R. G. Roberts, R. F. Galbraith, H. J. Deacon, R. Grün, A. Mackay, P. Mitchell, R. Vogelsang, and L. Wadley. 2008. Supporting Online Material for: Ages for the Middle Stone Age of Southern Africa: Implications for Human Behavior and Dispersal. *Science* 322 (5902).

Kaplan, J. M. 1989. 45000 Years of Hunter-Gatherer History in Natal as Seen from Umhlatuzana Rock Shelter. *Goodwin Series* 6 (ArticleType: research-article / Issue Title: Goodwin's Legacy / Full publication date: Jun., 1989 / Copyright © 1989 South African Archaeological Society):7-16.

Keller, C. M. 1973. *Montagu Cave in prehistory : a descriptive analysis*. Vol. 28, *University of California publications. Anthropological records*. Berkeley: University of California Press.

Kelly, R. L. 1995. *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Washington and London: Smithsonian Institution Press.

Klein, R. 1972. The Late Quarternary Mamalian Fauna of Nelson Bay Cave (Cape Province, South Africa): Its Implications for Megafaunal Extinctions and Enviromental and Cultural Change. *Quaternary Research* 2:135-142.

Klein, R. G. 1995. Anatomy, behavior, and modern human origins. *Journal of World Prehistory* 9 (2):167-198.

Klein, R. G. 1998. Why anatomically modern people did not disperse from Africa 100000 years ago. In *Neanderthals and Modern Humans in Western Asia* edited by T. Akawaza, K. a. Aoki and O. Bar-yosef. New York: Plenum Press.

Langejans, G. H. J. in press. Middle Stone Age pièces esquillées from Sibidu Cave, South Africa: an initial micro-residue study. *Journal of Archaeological Science* (0).

Lombard, M. 2005. Evidence of hunting and hafting during the Middle Stone Age at Sibidu Cave, KwaZulu-Natal, South Africa: a multianalytical approach. *Journal of Human Evolution* 48 (3):279-300.

Lombard, M. 2006. Direct evidence for the use of ochre in the hafting technology of Middle Stone Age tools from Sibudu Cave. *Southern African Humanities* 18 (1):57-67.

Lombard, M. 2006b. First impressions of the functions and hafting technology of Still Bay pointed artefacts from Sibudu Cave. *Southern African Humanities* 18 (1):27-41.

Lombard, M. 2007. The gripping nature of ochre: The association of ochre with Howiesons Poort adhesives and Later Stone Age mastics from South Africa. *Journal of Human Evolution* 53 (4):406-419.

Lombard, M. 2008. Finding resolution for the Howiesons Poort through the microscope: micro-residue analysis of segments from Sibudu Cave, South Africa. *Journal of Archaeological Science* 35 (1):26-41.

Lombard, M. 2011. Quartz-tipped arrows older than 60 ka: further use-trace evidence from Sibudu, KwaZulu-Natal, South Africa. *Journal of Archaeological Science* 38 (8):1918-1930.

Lombard, M. in press. Thinking through the Middle Stone Age of sub-Saharan Africa. *Quaternary International* (0).

Lombard, M., and J. Pargeter. 2008. Hunting with Howiesons Poort segments: pilot experimental study and the functional interpretation of archaeological tools. *Journal of Archaeological Science* 35 (9):2523-2531.

Lombard, M., and L. Phillipson. 2010. Indications of bow and stone-tipped arrow use 64 000 years ago in KwaZulu-Natal, South Africa. *Antiquity* 84:1.14.

Mackay, A. 2006. A Characterization of the MSA Stone Artefact Assemblage from the 1984 Excavations at Klein Kliphuis, Western Cape. *The South African Archaeological Bulletin* 61 (184):181-188.

Mackay, A. 2011. Nature and significance of the Howiesons Poort to post-Howiesons Poort transition at Klein Kliphuis rockshelter, South Africa. *Journal of Archaeological Science* 38 (7):1430-1440.

Mackay, A. 2011b. Potentially stylistic differences between backed artefacts from two nearby sites occupied ~60,000 years before present in South Africa. *Journal of Anthropological Archaeology* 30 (2):235-245.

Mackay, A., and A. Welz. 2008. Engraved ochre from a Middle Stone Age context at Klein Kliphuis in the Western Cape of South Africa. *Journal of Archaeological Science* 35 (6):1521-1532.

Malan, J. A. 1991. *Lithostratigraphy of the Klein Brak Formation (Bredasdorp Group)*, *Pretoria Lithostratigraphic Series*. Pretoria: South African Committee for Stratigraphy.

McBrearty, S., and A. S. Brooks. 2000. The revolution that wasn't: a new interpretation of the origin of modern human behavior. *Journal of Human Evolution* 39 (5):453-563.

McCall, G. S. 2006. Multivariate perspectives on change and continuity in the Middle Stone Age lithics from Klasies River Mouth, South Africa. *Journal of Human Evolution* 51 (4):429-439.

McCall, G. S. 2007. Behavioral ecological models of lithic technological change during the later Middle Stone Age of South Africa. *Journal of Archaeological Science* 34 (10):1738-1751.

McCall, G. S., and J. T. Thomas. 2012. Still Bay and Howiesons Poort Foraging Strategies: Recent Research and Models of Culture Change. *African Archaeological Review* 29 (1):7-50.

Mellars, P. 2007. *Rethinking the human revolution : new behavioural and biological perspectives on the origin and dispersal of modern humans*, *McDonald Institute monographs*. Cambridge, UK: McDonald Institute for Archaeological Research : Distributor : David Brown Bk, Co.

Minichillo, T. 2005. Middle Stone Age Lithic Study, South Africa: An Examination of Modern Human Origins, Department of Anthropology, University of Washington, Washington.

Minichillo, T. 2006. Raw material use and behavioral modernity: Howiesons Poort lithic foraging strategies. *Journal of Human Evolution* 50:359-364.

Mourre, V., P. Villa, and C. S. Henshilwood. 2010. Early Use of Pressure Flaking on Lithic Artifacts at Blombos Cave, South Africa. *Science* 330 (6004):659-662.

Noble, W., and I. Davidson. 1996. *Human evolution, Language and Mind*. Cambridge: Cambridge University Press.

Odell, G. H. 2003. *Lithic analysis*. Edited by C. E. Orser, *Manuals in archaeological method, theory and technique*. New York: Springer.

Orton, J., and A. Mackay. 2008. New Excavations at Klein Kliphuis Rock Shelter, Cederberg Mountains, Western Cape, South Africa: The Late Holocene Deposits. *The South African Archaeological Bulletin* 63 (187):69-76.

Pargeter, J. 2007. Howiesons Poort Segments as Hunting Weapons: Experiments with Replicated Projectiles. *The South African Archaeological Bulletin* 62 (186):147-153.

Parkington, J., C. Poggenpoel, J.-P. Rigaud, and T. P. J. 2005. From tool to symbol: The behavioural context of intentionally marked ostrich eggshell from Diepkloof, Western Cape In *From Tools to Symbols*, edited by F. d'Errico and L. Backwell. Johannesburg: Wits University Press.

Pelegrin, J. 1990. Prehistoric Lithic Technology: Some Aspects of Research: Technology in the humanities, Summer. *Archaeological Review from Cambridge* 9 (1):116-125.

Porraz, G., P. J. Texier, J. P. Rigaud, J. Parkington, C. Poggenpoel, and D. L. Roberts. 2008. Preliminary Characterization of a Middle Stone Age Lithic Assemblage Preceding the `Classic` Howiesons Poort Complex at Diepkloof Rock Shelter, Western Cape Province, South Africa. *Goodwin Series* 10:105-121.

Rifkin, R. F. 2012. Processing ochre in the Middle Stone Age: Testing the inference of prehistoric behaviours from actualistically derived experimental data. *Journal of Anthropological Archaeology* (0).

Rigaud, J.-P., P.-J. Texier, J. Parkington, and C. Poggenpoel. 2006. Le mobilier Stillbay et Howiesons Poort de l'abri Diepkloof. La chronologie du Middle Stone Age sud-africain et ses implications. *Comptes Rendus Palevol* 5 (6):839-849.

Roberts, D. L. 2003. *Age, genesis and significance of South African coastal belt silcretes*. Vol. 95, *Memoir*. Pretoria: Council for Geoscience.

Sackett, J. R. 1977. The Meaning of Style in Archaeology: A General Model. *American Antiquity* 42 (3):369-380.

Sackett, J. R. 1982. Approaches to Style in Lithic Archaeology *Journal of Anthropological Archaeology* 1:59-112.

Sackett, J. R. 1985. Style and Ethnicity in the Kalahari: A Reply to Wiessner. *American Antiquity* 50 (1):154-159.

Sampson, C. G., and J. Deacon. 1976. The Stone Age Archaeology of Southern Africa. *The South African Archaeological Bulletin* 31 (121/122):58-63.

Schiffer, M. B. 1972. Archaeological Context and Systemic Context. *American Antiquity* 37 (2):156-165.

Sellet, F. 1993. Chaine Operatoire; the Concept an its Applications. *Lithic Technology* 18 (1 & 2):106-112.

Shea, J. J. 2006. The origins of lithic projectile point technology: evidence from Africa, the Levant, and Europe. *Journal of Archaeological Science* 33 (6):823-846.

Shea, J. J. 2011. Stone tool analysis and human origins research: Some advice from uncle Screwtape. *Evolutionary Anthropology: Issues, News, and Reviews* 20 (2):48-53.

Singer, R., and J. Wymer. 1982. *The Middle Stone Age at Klasies River Mouth in South Africa*. Chicago: University of Chicago Press.

Soriano, S., P. Villa, and L. Wadley. 2007. Blade technology and tool forms in the Middle Stone Age of South Africa: the Howiesons Poort and post-Howiesons Poort at Rose Cottage Cave. *Journal of Archaeological Science* 34 (5):681-703.

Soriano, S., P. Villa, and L. Wadley. 2009. Ochre for the toolmaker: Shaping Still Bay points at Sibudu (KwaZulu-Natal, South Africa). *Journal of African Archaeology* 7 (1):41-54.

Stapleton, P. a., and J. Hewitt. 1927. Stone implements from a rockshelter at Howieson's Poort near Grahamstown. *South African Journal of Science* 24:574-587.

Sullivan, A. P., and K. C. Rozen. 1985. Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50 (4):755-779.

Sørensen, M. 2006. Hvad skal vi med alle de sten? *Arkæologisk Forum.* 15:40 - 45.

Texier, P. J., G. Porraz, J. Parkington, J.-P. Rigaud, C. Poggenpoel, C. Miller, C. Tribolo, C. Cartwright, A. Coudenneau, R. Klein, T. Steele, and C. Verna. 2010. A Howiesons Poort tradition of engraving ostrich eggshell containers dated to 60,000 years ago at Diepkloof Rock Shelter, South Africa. *Proceedings of the National Academy of Sciences*.

Tostevin, G. B. 2011. Special Issue: Reduction Sequence, Chaîne Opératoire, and Other Methods: The Epistemologies of Different Approaches to Lithic Analysis. Levels of Theory and Social Practice in the Reduction Sequence and Chaîne Opératoire Methods of Lithic Analysis. *PaleoAnthropology* 2011:351-375.

Tribolo, C., N. Mercier, H. Valladas, J. H. Joron, P. Guibert, Y. Lefrais, M. Selo, P.-J. Texier, J.-P. Rigaud, G. Porraz, C. Poggenpoel, J. Parkington, J.-P. Texier, and A. Lenoble. 2009. Thermoluminescence dating of a Stillbay–Howiesons Poort sequence at Diepkloof Rock Shelter (Western Cape, South Africa). *journal of Archaeological Science* 36:730-739.

Van Rijssen, W. J., and G. Avery. 1992. The Late Holocene Deposits at Klein Kliphuis Shelter, Cedarberg, Western Cape Province. *The South African Archaeological Bulletin* 47 (155):34-43.

Villa, P., A. Delagnes, and L. Wadley. 2005. A late Middle Stone Age artifact assemblage from Sibudu (KwaZulu-Natal): comparisons with the European Middle Paleolithic. *Journal of Archaeological Science* 32 (3):399-422.

Villa, P., M. Soressi, C. S. Henshilwood, and V. Mourre. 2009. The Still Bay points of Blombos Cave (South Africa). *Journal of Archaeological Science* 36 (2):441-460.

Villa, P., S. Soriano, N. Teyssandier, and S. Wurz. 2010. The Howiesons Poort and MSA III at Klasies River main site, Cave 1A. *Journal of Archaeological Science* 37:630 - 655.

Villa, P., S. Soriano, N. Teyssandier, and S. Wurz. 2010. The Howiesons Poort and MSA III at Klasies River main site, Cave 1A. *Journal of Archaeological Science* 37 (3):630-655.

Vogelsang, R., J. Richter, Z. Jacobs, B. Eichhorn, V. Linseele, and R. G. Roberts. 2010. New Excavations of Middle Stone Age Deposits at Apollo 11 Rockshelter, Namibia: Stratigraphy, Archaeology, Chronology and Past Environments. *Journal of African Archaeology* 8 (2):185-218.

Volman, T. P. 1981. The middle Stone Age in the southern Cape. PhD, University of Chicago.

Wadley, L. 1991. Rose Cottage Cave: Background and a Preliminary Report on the Recent Excavations. *The South African Archaeological Bulletin* 46 (154):125-130.

Wadley, L. 2005. Putting ochre to the test: replication studies of adhesives that may have been used for hafting tools in the Middle Stone Age. *Journal of Human Evolution* 49 (5):587-601.

Wadley, L. 2008. The Howieson's Poort Industry of Sibudu Cave. *Goodwin Series* 10:122-132.

Wadley, L., and P. Harper. 1989. Rose Cottage Cave Revisited: Malan's Middle Stone Age Collection. *The South African Archaeological Bulletin* 44 (149):23-32.

Wadley, L., T. Hodgskiss, and M. Grant. 2009. Implications for complex cognition from the hafting of tools with compound adhesives in the Middle Stone Age, South Africa. *Proceedings of the National Academy of Sciences*:1-5.

Wadley, L., and Z. Jacobs. 2006. Sibudu Cave: background to the excavations, stratigraphy and dating. *Southern African Humanities* 18 (1):1-26.

Wadley, L., and M. Mohapi. 2008. A Segment is not a Monolith: evidence from the Howiesons Poort of Sibudu, South Africa. *Journal of Archaeological Science* 35 (9):2594-2605.

Whittaker, J. C. 1994. *Flintknapping: Making and understanding stone tools*. 9 ed. Texas: University of Texas Press.

Wiessner, P. 1983. Style and Social Information in Kalahari San Projectile Points. *American Antiquity* 48 (2):253-276.

Wiessner, P. 1984. Reconsidering the behavioral basis for style: A case study among the Kalahari San. *Journal of Anthropological Archaeology* 3 (3):190-234.

Wiessner, P. 1985. Style or Isochrestic Variation? A Reply to Sackett. *American Antiquity* 50 (1):160-166.

Wilkins, J., and M. Chazan. In press. Blade production ~500 thousand years ago at Kathu Pan 1, South Africa: support for a multiple origins hypothesis for early Middle Pleistocene blade technologies. *Journal of Archaeological Science* (0).

Wurz, S. 1997. The Howiesons Poort at Klasies river: from artefacts to cognition. MA, University of Stellenbosch, Stellenbosch.

Wurz, S. 1999. The Howiesons Poort at Klasies River-an argument for symbolic behavior. *South African Archaeological Bulletin* 54:38 - 50.

Wurz, S. 2000. The Middle Stone Age at Klasies River, South Africa. PhD, Departement of Archaeology, University of Stellenbosch, Stellenbosch.

Wurz, S. 2002. Variability in the Middle Stone Age Lithic Sequence, 115,000–60,000 Years Ago at Klasies River, South Africa. *Journal of Archaeological Science* 29:1001-1015.

Wurz, S. 2008. Modern Behaviour at Klasies River. *Goodwin Series* 10:150-156.

Wurz, S. 2010. Middle Stone Age tools from Klasies River main site, conventions and symbolic cognition. In *The cutting edge: stone tools and the evolution of cognition*, edited by A. Nowell and I. Davidson. Boulder, CO: Colorado University Press.

Wynn, T. 2009. Hafted spears and the archaeology of mind. *Procedings of the National Academy of Science U S A* 106 (24):9544-5.