



**THE TERMINAL PLEISTOCENE OF KLIPFONTEINRAND ROCK SHELTER  
IN THE CEDERBERG**

THESIS PRESENTED BY

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This dissertation is submitted as an academic requirement for the fulfilment of an MSc in the Department of Archaeology, University  
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## DECLARATION

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Sincerely,

Signed by candidate

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Kyla Catherine Pelton Bluff

This thesis focuses on Klipfonteinrand Rock Shelter in the eastern Cederberg, during the Late Pleistocene period (22.3 – 13.4 cal kyr BP), and specifically the materials analysed after the completion of excavations at the site. The study aims, firstly, to unpack changes in the composition of the archaeological assemblage of Klipfonteinrand during Marine Isotope Stage 2 (MIS 2), by analysing variation in the abundance and composition of lithics, ostrich eggshell, marine shell, charcoal, ochre, bone and roof spall from the site; and, secondly, to situate these changes in the context of changes in palaeoenvironments and patterns in the use of nearby and more distant archaeological sites. Results display a hornfels-dominant lithic assemblage, with a distinctive silcrete-rich Robberg-like industry during the period 22.3 – 16.3 cal kyr BP, categorised by micro-bladelets and bipolar cores. Ostrich eggshell fragments undergo variation in thickness in relation to variation in environmental and climatic changes, and also contain a handful of decorated fragments that mirror a sample from Boomplaas during a similar time period. *Donax serra* dominates the marine shell assemblage, which peaks in number between 16.6 and 15.9 cal kyr BP, at the time of rapid sea level rise across the subcontinent. Links are drawn between Klipfonteinrand and sites further afield such as Elands Bay Cave, based on the movement of hornfels from the interior to the coast and marine shell from the coast to the interior at the time of sea level rise. Roof spall is smallest and most abundant during colder periods, and charcoal and bone are most abundant then too. Red ochre is the most frequently occurring colour, with ochre having been ground most frequently in the younger levels between 14.4 – 13.4 cal kyr BP. These results are drawn together and Klipfonteinrand Rock Shelter is contextualised in a larger framework of MIS 2 archaeology and palaeoenvironments, on a local, regional and inter-regional scale. The various materials recovered from the excavation show specific diachronic patterns and suggestions are made about lithic technologies, craft and design, and complex landscape use of Late Pleistocene hunter-gatherers. The overarching purpose of this is to attempt to gain a better understanding of human behaviour during the environmentally unstable time period presented.

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**ABBREVIATIONS**

<b><sup>14</sup>C yr BP</b>	Uncalibrated radiocarbon years
<b>Ka</b>	Thousands of years, calibrated
<b>APK</b>	Appelboskraal
<b>BC</b>	Border Cave
<b>BMP</b>	Boomplaas
<b>BNK</b>	Byneskranskop
<b>DRS</b>	Diepkloof Rock Shelter
<b>EBC</b>	Elands Bay Cave
<b>ESA</b>	Early Stone Age
<b>FAR</b>	Faraoskop Rock Shelter
<b>HRS</b>	Hollow Rock Shelter
<b>KFR</b>	Klipfonteinrand Rock Shelter
<b>KKH</b>	Klein Kliphuis
<b>LGIT</b>	Last Glacial-Interglacial Transition
<b>LGM</b>	Last Glacial Maximum
<b>LSA</b>	Later Stone Age
<b>MIS</b>	Marine Isotope Stage
<b>MKB</b>	Melkhoutboom
<b>MRS</b>	Mertenhof Rock Shelter
<b>MSA</b>	Middle Stone Age

<b>NBC</b>	Nelson Bay Cave
<b>OES</b>	Ostrich Eggshell
<b>OSL</b>	Optically Stimulated Luminescence
<b>PL8</b>	Putslaagte 8
<b>RCC</b>	Rose Cottage Cave
<b>SEH</b>	Sehonghong
<b>SRZ</b>	Summer Rainfall Zone
<b>TMS</b>	Table Mountain Sandstone
<b>UMH</b>	Umhlatuzana
<b>UPK</b>	Uitspankraal
<b>WRZ</b>	Winter Rainfall Zone
<b>YRZ</b>	Year-round Rainfall Zone

Stratigraphic Unit Names Used in this Document:

<b>MTB/HF</b>	Mottled Tan Brown / Historical Fill
<b>RWHF</b>	Reworked Hearth Feature
<b>LBS</b>	Light Brown Silt
<b>CMSS</b>	Compact Mottled Silty Sandstone
<b>CRAG</b>	Charcoal Rich Ashy Grey
<b>WORS</b>	Whiteish Orange Rubified Silts
<b>MOSS</b>	Mottled Orange Silty Sandstone
<b>ROCSS</b>	Red Orange Compact Sandy Silt
<b>GOS</b>	Gritty Orange Sand
<b>CWS</b>	Consolidated White Silt
<b>LBSS</b>	Loose Brown Sandy Silt
<b>CBSS</b>	Compact Brown Sandy Silt
<b>BORL</b>	Blackish Organic-Rich Lamination
<b>COWGAL</b>	Creamy Orange White Gritty Ash Layer
<b>ORL</b>	Orange Rubified Lense

Meta-strat Unit Names:

<b>LWBS</b>	Laminated White Brown Series
<b>OB</b>	Orange Band
<b>WS</b>	White Series
<b>BB</b>	Black Band
<b>BWBS</b>	Black, White and Brown Series

## GLOSSARY OF LITHIC ARTEFACT TYPES

(From Deacon, J. 1984, unless stated otherwise)

### **Bladelet**

A narrow parallel-sided flake with a length greater than twice the maximum width and a width of less than 12mm. Bladelets are commonly made on quartz or silcrete and occur most abundantly in Late Pleistocene microlithic assemblages assigned to the Robberg Industry in the southern Cape. They occur also in Holocene assemblages but in much smaller numbers.

### **Bladelet Core**

Cores with one, and occasionally more, platforms from which parallel-sided flakes of bladelet dimensions have been systematically struck. Damage along the striking platform can resemble scraper retouch.

In the southern Cape they are commonly made on quartz, silcrete and, occasionally, fine-grained quartzite. They occur most frequently in Late Pleistocene microlithic assemblages but are also found in Holocene ones.

### **Bipolar Core**

The bipolar reduction process begins with a pebble or nodule being placed on an anvil and oriented with the maximum dimension held vertically between thumb and forefinger. An elliptical hammerstone is used to split the pebble or nodule. This pebble or nodule is known as the bipolar core (Barham 1987).

### **Core-Reduced Piece**

Core reduced pieces are residues of cores that can no longer be flaked. They are usually quadrilateral in plan form with a chisel-like striking platform that is often curved and are made in a variety of raw materials. They differ from flat bladelet cores in the lack of regularly shaped bladelet flake scars. They differ from *pièces esquillées* in having no crushing along the chisel-like striking platform. They are usually less than 25mm long.

Core reduced pieces may be found in any LSA assemblage, but are most common in those dating to the Late Pleistocene.

### **Outils Esquillés**

Quadrilateral in plan view, and lenticular in profile, with opposed striking platforms that are chisel-like in profile (Barham 1987)

### **Radial/Discoïd Core**

A method using centripetal flaking of a core to remove a series of flakes around core perimeters (Barham and Mitchell 2008).

### **Platform Core**

Platform cores have more than two faces and are not defined by the plane of intersection of two surfaces. Removals do not need to be on the broad surface of the core and are often on narrow surfaces. One or more well organized and well developed striking platforms with three or more contiguous, successful removals from the corresponding knapping surfaces must be recognizable. Reduction often proceeds around the edge of the striking platform but this must not be circulating. Double and multiple platforms are possible and end products may be flakes or blades. The removal angles are steeper than 45° and often close to 90°. The striking platforms typically show persistent use and may be cortical, plain or prepared (Conard et al 2004).

### **Rotated Core**

Multidirectional cores usually have several flat surfaces that are used as striking platforms. Flakes are removed from several different directions on these kinds of cores. Multidirectional cores must be turned or rotated to remove flakes from the different striking platforms and as such, are sometimes called rotated cores. (Andrefsky 2005)

### **Scraper**

Scrapers are usually made on flakes or flake fragments, but core types are found. They are characterised by two main features: a flat ventral surface that is unretouched and a convex working edge that has been deliberately shaped by secondary retouch. Subsequent utilisation results in the removal of smaller flakes along the working edge that steepens

the angle between the ventral surface and the working edge so that it can range between 30 and over 90 degrees. Scrapers differ from adzes in having this convex working edge rather than a straight or concave one.

### **Backed Artefact**

An artefact blunted with abrupt retouch, including microlithics, bladelets and segments, with an opposing sharp cutting edge. Abrupt retouch is most commonly effected by pressing the edge of the margin against a hard anvil with either the ventral or dorsal surface uppermost.

### **Naturally Backed Knife**

Large D-shaped, side-struck flakes with an evenly convex, step-flaked margin. Most distinctive at the end of the Pleistocene in which large tools predominate, many of them clearly hand held (Parkington and Yates, date unknown). Often characteristic of the Oakhurst Industry.

### **Notch**

An artefact, usually a biface or retouched piece, that has been notched in some manner so that it can be more easily attached to a handle or shaft. It is believed that bifaces with notches were used as projectiles (Conard et al 2004).

### **Miscellaneous Retouched Piece**

Miscellaneous retouched pieces form a loose category for tools that show sustained formal retouch, but which do not fall into any of the commonly made formal tool classes. The retouch may be of the flat invasive kind extending over between one and two-thirds of the dorsal and/or ventral surface of the tool, or it may be steep retouch on a piece that does not conform to other attributes required to place it in the scaper class, or it may have sustained retouch that has notched the working edge. Miscellaneous retouched pieces are an extension of the utilised flake class in the sense that they have similar sub-classes, but the retouch is more deliberate and extends over a larger portion of the tool. They are made on all raw materials and are found in assemblages of any age.

### **Wingnut**

Distinctive flakes twice as wide as they are long, likely relating to the post-Robberg reduction of cobble cores.

Klipfonteinrand Rock Shelter (32.072°S, 19.13°E) is located in the eastern Cederberg region of the Western Cape, South Africa (Figure 1.1). A series of excavations at Klipfonteinrand was carried out in 2011 and 2012 under the supervision of Dr Alexander Mackay through the University of Wollongong, Australia. Post-excavation analysis began in 2011 and became the focus of this Master's dissertation in 2013. The aim of this study is twofold: first, to understand changes in the composition of archaeological assemblages during Marine Isotope Stage 2 (MIS 2), by analysing variation in the abundance and composition of lithics, ostrich eggshell, marine shell, charcoal, ochre, bone and roof spall from the site; and second, to situate these changes in the context of changes in palaeoenvironments and patterns in the use of nearby and more distant archaeological sites.

Throughout this thesis, a number of general themes will be addressed. First, the material contents of Klipfonteinrand are analysed, and the contextualisation of the site is discussed. The primary object of this is the lithic assemblage that dates to immediately before the Last Glacial Maximum (LGM), during the LGM, and immediately after it (altogether ~23,000 – 13,000 years ago). The lithic analysis, although broad, is undertaken in order to identify technological changes at this site. Second, interior-coastal connections are explored, and the idea that one site is not an isolated place occupied through time, but rather connected to other sites more broadly, is discussed. Third, Klipfonteinrand is compared with other archaeological sites in southern Africa on a material and occupational basis. Fourth, this is situated within the framework of palaeoenvironmental changes that took place during the time period referred to above, and the way in which these changes may have affected the archaeology of the sites discussed. Fifth, the concept of continuity and discontinuity within archaeological frameworks is explored and the difficulty of dealing with this is problematised. These key themes are addressed on a spatial level (across southern Africa) as well as through time.

Some of the key problems that arise in this thesis, and that are dealt with in later chapters, are the discontinuity of deposit build-up in rock shelters (reflecting 'episodicity' and occupational hiatuses) and the impact that this can have on interpreting a site; the issue surrounding coastal-interior connections of knowing whether these were based on the migration of single groups or rather networking and trade events between multiple groups; and that the conclusions drawn from the results presented can only be based on general trends, as the samples and assemblages analysed are only of a small portion of the excavation as a whole.

Klipfonteinrand is situated close to several other significant archaeological sites, including

Diepkloof Rock Shelter, Elands Bay Cave, Faraoskop Rock Shelter, Hollow Rock Shelter, Klein Kliphuis, Mertenhof Rock Shelter, Putslaagte 8, and Reception Shelter (See Figure 1.2) (Parkington 1980, Manhire 1993, Mackay 2010, Orton et al. 2011, Porraz et al. 2013, Parkington et al. 2013, Högberg 2014, Mackay, Sumner et al. 2014, Mackay, Jacobs et al. 2015, Will, Mackay et al. 2015). The majority of these sites fall within a 20 km radius of Klipfonteinrand, with Elands Bay Cave and Diepkloof Rock Shelter situated approximately 80-100 km to the west, and Reception Shelter approximately 78 km to the north-west.

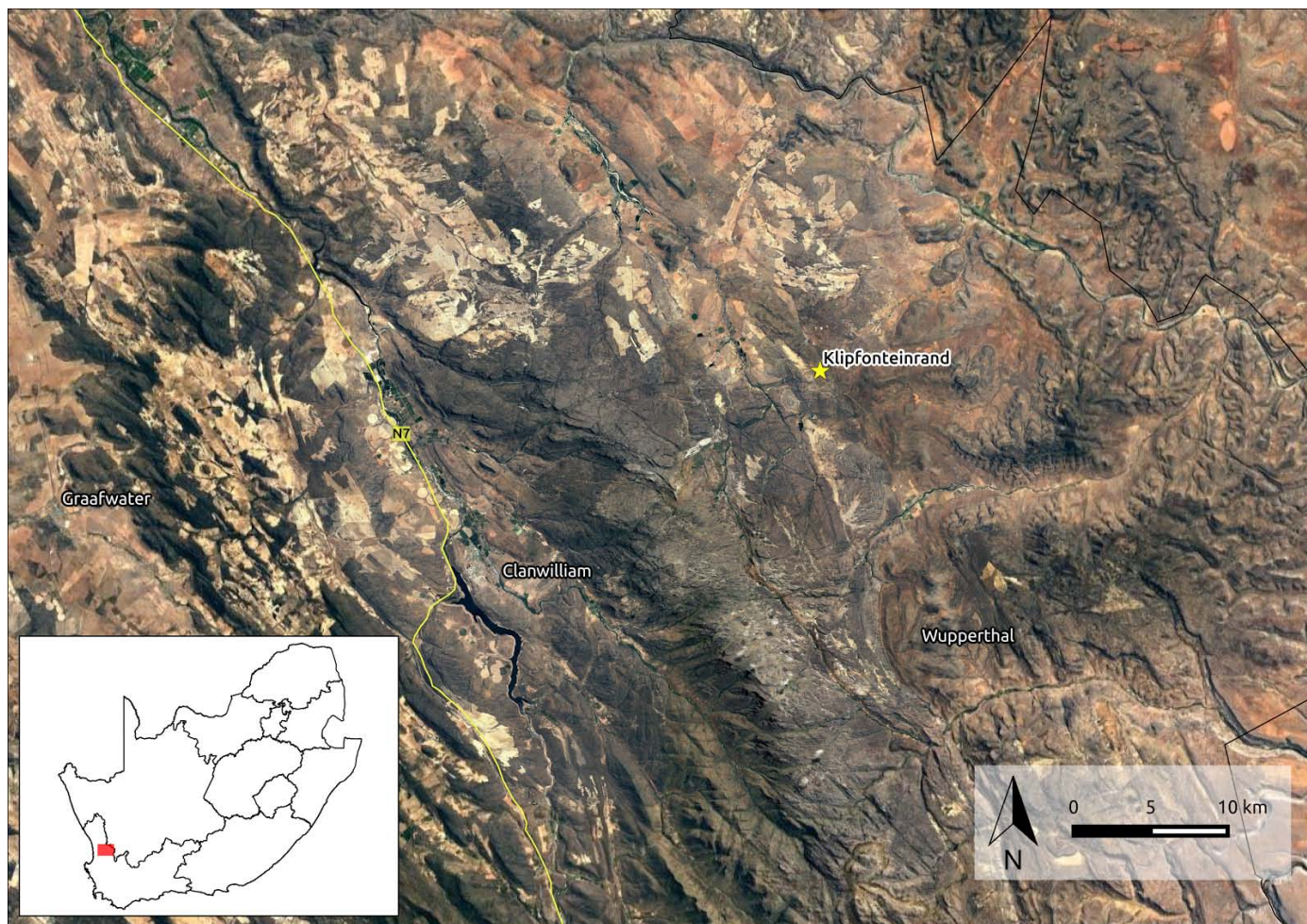


Figure 1.1. Location of Klipfonteinrand in relation to the town of Clanwilliam and the N7 highway, indicated in the Western Cape Province.

The area being studied, the eastern Cederberg, and surrounding western and southern Cape coast, have been occupied for roughly 1 million years. *Homo sapiens* evolved during the later Middle Pleistocene, the specific date of which is currently contested but between 200,000 and 100,000 years ago (Jerardino and Marean 2010, Marean 2015). The period between this point in time and the start of the Holocene at approximately 11,000 years ago is significant for understanding how modern humans have evolved. Our complex behavioural and cultural traits all developed during this time, and are associated with the development of cognition and 'modernity' (Deacon and Deacon 1999, Marean et al. 2014). This area of Africa is particularly interesting in

terms of human origins, because while the rest of the continent experienced great climatic variability during various periods

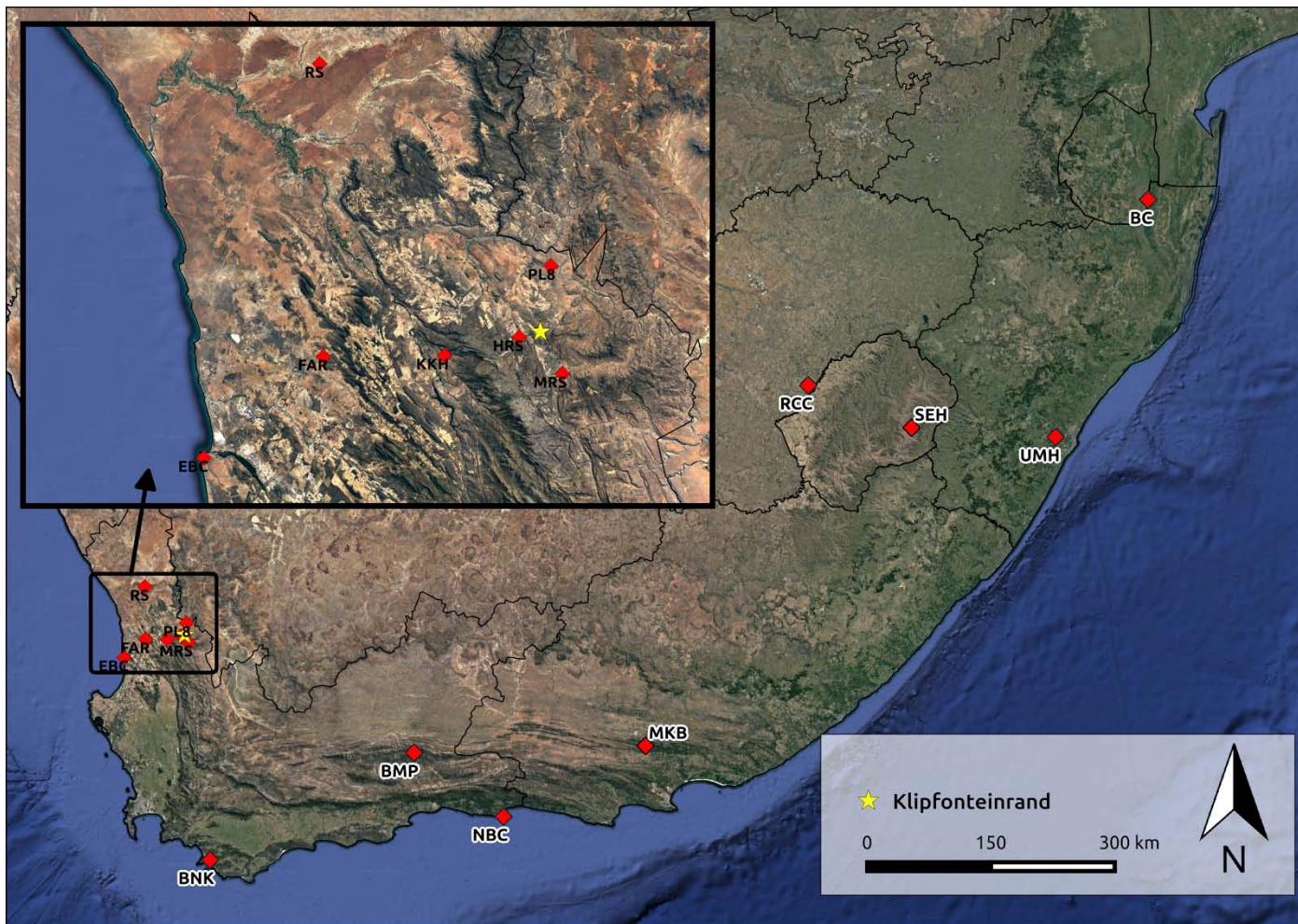


Figure 1.2. Satellite map of specific sites surrounding Klipfonteinrand and within the rest of the southern African region (please see Abbreviations Glossary for full site names).

of glacial maxima and marine transgressions, small pockets of southern Africa could sustain thriving human populations. Studies done along the West Coast have shown that the evolution of humans during the Middle and Later Stone Age depended largely on rich and varied resources (especially the more focussed and successful exploitation of coastal resources), optimal environmental patterns, and the types of adaptive responses that humans had to pressure and population stress (Parkington 1984, 1986, 1988, 2008, Klein et al. 2004, Steele and Klein 2005/2006, Högberg 2016). Another good example of one of these pockets is further away on the Cape south coast where extensive research has been conducted for the period between 160-50,000 years ago (Bar-Matthews et al. 2010, Marean et al. 2014). It has been suggested that the unique environmental and resource-rich nature of this area was what helped to sustain small populations of *Homo sapiens* that took advantage of the rich marine shellfish resources along the coast, large game on the open coastal plains, and smaller fauna abundant in the shrubland of the Fynbos and Succulent Karoo Biomes (Henshilwood and Marean 2003, Marean et al. 2007, 2010).

Additionally, carbohydrate-bearing plants like geophytes within the highly diverse Cape Floral Region are known as having been a common food source for hunter-gatherers during both the Middle and Later Stone Age (Deacon and Deacon 1999, Parkington 2001b, de Vynck et al. 2016). All these resources together (and their availability at different times during the year) would have offered mobile hunter-gatherers a varied diet of protein- and carbohydrate-rich foods.

The time period under consideration for this particular body of research is the terminal Pleistocene of MIS 2, which occurs between ~25 - 11 ka<sup>1</sup> (Hanvey & Lewis 1990, Lewis & Hanvey 1993, Lewis 1996, Carr 2006, Rector & Verelli 2010, Meadows & Baxter 1999, Barham and Mitchell 2008) and the transitional period to MIS 1 up to ~11 ka. Archaeologically, this takes place during the Later Stone Age (the precise start of which is still contested but which lasted from roughly 40 ka until historical times), the final cultural period of southern African hunter-gatherer peoples after the evolution of human ancestors through the Early Stone Age (the start of which is also ambiguous, but has been pushed back to 3.3 mya (McPherron et al. 2010, Harmand et al. 2015) until ~250 ka) and the Middle Stone Age (250 ka to ~40 ka). The Later Stone Age is characterised as having a mixture of various types of lithic industries as well as better-preserved organic materials (Goodwin and van Riet Lowe 1929, J. Deacon 1982, Barham and Mitchell 2008), and is significant in that it holds key evidence for the final stages of the modernisation of humans in terms of behaviour, adaptation to major environmental changes, technological advancements and symbolic development (Deacon, J. 1982, 1984, Barham and Mitchell 2008). Following the Later Stone Age, research has been done on the more recent historical past and particularly toward the understanding of Khoi-San ethnographies to inform the more distant past (Bleek and Lloyd 1911, Bleek and Lloyd 1924, Bleek 1935, Wiessner 1984, Deacon and Dowson 1996). Up until a century ago, hunter-gatherer groups still lived in southern Africa and practiced a relatively modest and traditional way of life, offering great insight into this ancient lifestyle. Today, we must use the historical and prehistoric material remains of their subsistence in order to understand our evolution as a species.

Klipfonteinrand lies within the Cape Floral Region and very near the interface between the Cape Fynbos and the succulent Karoo biomes (Mucina and Rutherford 2006) (Figure 3.3), making it an area potentially (and certainly historically) sensitive to palaeoenvironmental fluctuations because of the diversity of the region resulting from these two vegetation biomes. The study period encapsulates the major marine transgression at the end of MIS 2, which, although Klipfonteinrand is an inland site (roughly 80 km from the current coastline), may have informed the relationships between interior and coastal populations (Parkington 1977, Compton 2011). These

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<sup>1</sup> ka = thousands of years before present. Cal kyr BP is used for all calibrated radiocarbon and other calendric chronometric ages. Uncalibrated radiocarbon years, when used, are presented as <sup>14</sup>C yr BP. mya = millions of years before present.

factors combine to make Klipfonteinrand an interesting lens through which to view human behavioural variability, adaptations and responsiveness.

The 2011/2012 excavations at Klipfonteinrand comprised two trenches (the northern 5m<sup>2</sup> and the southern 4.5m<sup>2</sup>) (Figure 1.3). The larger of the two near the mouth of the shelter (northern trench) contains strata of predominantly Middle Stone Age (>30 ka) association. The trench against the rear wall of the shelter (southern), with strata dating 22.3k - 13.4k cal kyr BP and >60 ka, provides the data for this thesis. The focus was placed onto the younger part of the sequence of three squares from the southern trench, numbered 8, 9 and 10, as these had the best stratigraphic resolution of the site. Squares 8 and 9 have been radiocarbon dated, while square 10 is matched to 8 and 9 stratigraphically.

All ages presented in this thesis for Klipfonteinrand are AMS radiocarbon determinations, given as median calibrated age rounded to the nearest 100 years (95.4% probability), and presented as 'cal kyr BP' - or calibrated thousand years before present. Calibrations of radiocarbon determinations were made using OxCal 4.2 ([Bronk-Ramsay 2009](#)) and the Southern Hemisphere terrestrial calibration curve SHCal13 following [Hogg et al. \(2013\)](#). This was performed for all the radiocarbon ages from other sites discussed in this thesis as well (the technique used and the year that the date was taken notwithstanding). The quality and reliability of the dates available for the other sites discussed here is variable, as several determinations were made decades ago. However, this is an uncontrollable factor and therefore all dates have been calibrated to at least standardise the output. It should be noted that when making comparisons between sites based on their age that this is general and only possible with the dates that are available. It is impossible to have complete reliability across the board.

## 1.1 THESIS SUBJECTS

Klipfonteinrand has a range of materials that is analysed at a broad level in this study, including lithics, marine shell, ostrich eggshell, charcoal, ochre, bone and roof spall. The lithic assemblage is analysed in order to gain an understanding of the industrial changes that took place in this local area between 22 - 13 ka, and to confirm whether these industries fit with those from other sites in the southern African region. Lithics and marine shell are analysed collaboratively to present the hypothesis of coastal-interior connections at the time of rapid sea level rise. Ostrich eggshell is studied in order to ascertain whether it is possible to use this material to determine environmental variations, including water availability and vegetation changes, and roof spall to determine a possible link between rock exfoliation and temperature changes and/or human presence. Charcoal, bone and ochre are included to gain an understanding of site usage and occupational

episodes, as well as site taphonomy.

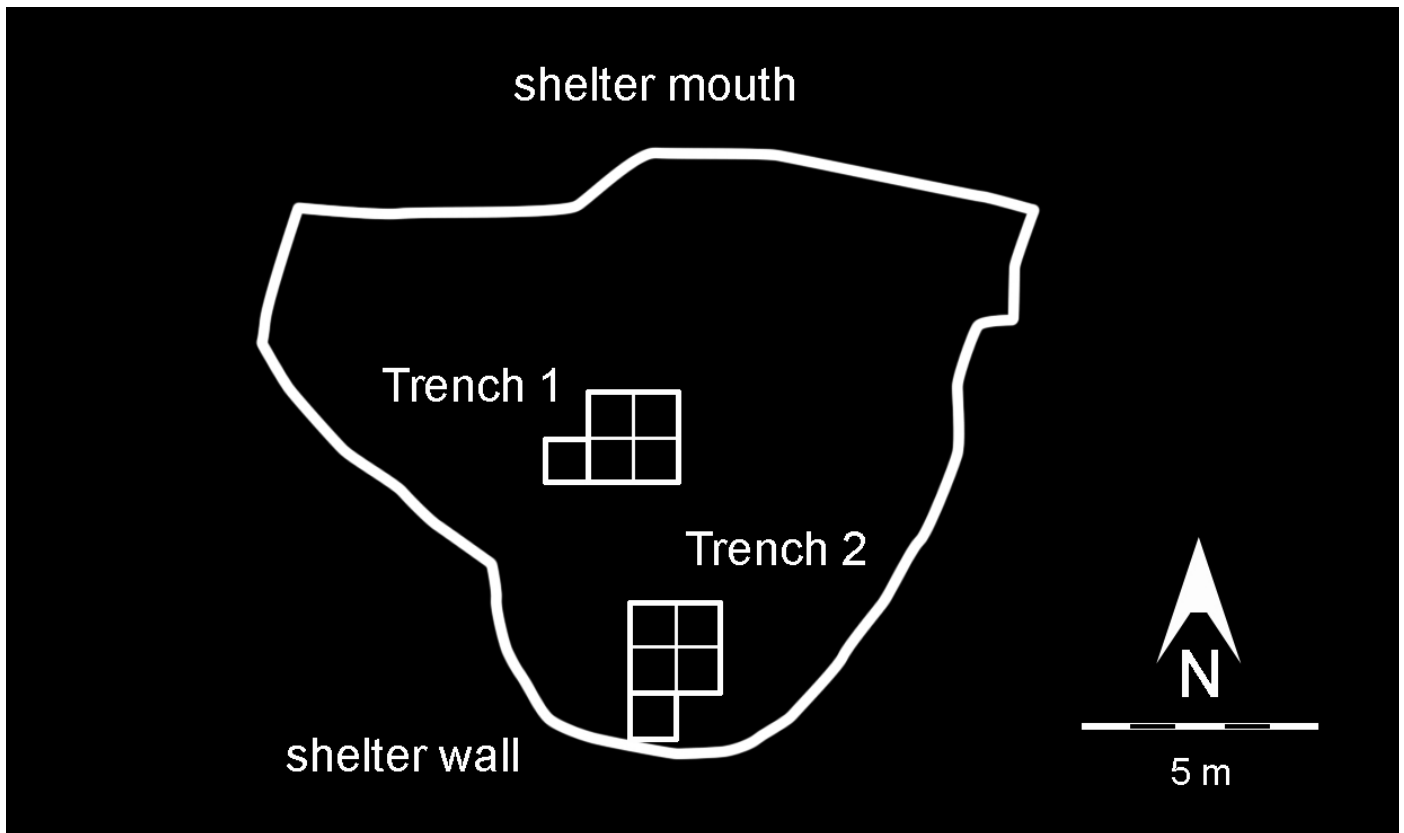


Figure 1.3. Annotated diagram of aerial view of Klipfonteinrand with northern and southern trenches indicated.

In summary, the goal of this project is to gain an understanding of the ways in which changes in the environment during MIS 2 impacted the region, locally and regionally, and, beyond this, the behaviour of hunting-and-gathering groups of people occupying the region. One of the major patterns that is observed is the movement between the coast and the interior of the west coast of South Africa at the time of rapid sea level rise, demonstrated by the appearance of interiorly-sourced lithic material at the coast, specifically hornfels (Parkington 1990, Orton 2006), and marine shell inland. The study of these patterns is to determine whether connections can be drawn between groups inter-regionally based on lithic and non-lithic material, and to situate Klipfonteinrand within the broader context of archaeological sites of this time period.

## 1.2 THESIS OUTLINE

The following chapter provides a summary of the contemporary climate and environment in the study region, as well as a background of the site itself and the excavations and other research that has been done there in the past. Chapter 3 is a review of the literature of both the environmental (current and historical) and archaeological information relevant to the study site and region, organised within a framework of the three rainfall zones recognised in southern Africa (Winter,

Year-round and Summer Rainfall Zones). Chapter 4 explains the methodological approach used in this project, and the results of these analyses are presented in Chapter 5. Chapter 6 discusses the results in relation to the specific expectations, as well as the broader archaeological and environmental framework outlined in previous chapters. Finally, Chapter 7 concludes the project as a whole by reflecting on the outcomes of the objectives set out initially.

## 2.1 CURRENT CLIMATE AND ENVIRONMENT OF THE CEDERBERG

The Cederberg Mountains are located roughly between 210 - 130 km north of Cape Town. The farming towns of Clanwilliam and Citrusdal lie to the west. They are significant archaeologically for their Middle Stone Age and, more abundantly, Later Stone Age sites, but also environmentally: these ranges fall within the Cape Floral Kingdom (a World Heritage Site) and have a very high plant species diversity ([Conservation South Africa](#)). A large portion of the Cederberg has been designated a Wilderness Area, and is therefore largely untouched by recent human activities. Furthermore, these mountains are located on the border of the Cape Fynbos and the succulent Karoo biomes, thereby transitioning between the two different vegetation and geology zones. It is likely that Middle and Later Stone Age people would have chosen to inhabit this region for the richly diverse floral and faunal species that it offers, as well as the availability of water sources from the Olifants, Doring, Biedouw, Jan Dissels and Brandewyn rivers (Figure 2.1). The geophytes that grow in the mountainous regions near the Olifants River valley, requiring a good amount of water, can grow to be quite large but it is the subterranean and nutrient-rich bulb or 'corm' that hunter-gatherers sought, also known as an Underground Storage Organ ([Procheş et al. 2005](#), [de Vynck et al. 2016](#)). These corms are of the genus *Watsonia* and *Chasmanthe*, whereas on the sandy flat plains of the sandveld, the genus *Gladiolus* and *Moraea* are more common corm-bearing plants ([Parkington 1977](#)). The plants are easily visible throughout the year, however the corms are not necessarily available or edible all the time; the visibility of the plant above ground allows for people to ascertain the point at which the corm is ripe and edible underground (this is when the plant's leaves begin to die) ([Parkington 1977](#), [Youngblood 2004](#), [Marean et al. 2014](#), [de Vynck et al. 2016](#)). Given that geophytes are increasingly reproductive after the fire season in southern Africa, it has been suggested that "farming with fire" was a means of managing the productivity of geophytes for hunter-gatherers during the Stone Age ([Deacon and Deacon 1999: p98](#)). These potato-like bulbs provide a carbohydrate-rich energy source, with several species having been exploited during the Stone Age as shown by evidence from sites such as Byneskranskop, Faraoskop, Klasies River and Melkhoutboom ([Deacon 1976](#), [Klein 1981](#), [Manhire 1993](#), [Deacon 1995](#)).

## 2.2 INTRODUCTION TO KLIPFONTEINRAND ROCK SHELTER

Klipfonteinrand is situated on Bushmansklouf Wilderness Reserve on a large north-west/south-east running ridge of Table Mountain Sandstone in the Cape Fold Belt. The Cape

Fold Belt mountain range is of the late Paleozoic age mostly made up of sandstones and shales, reaching a maximum height of 2325 m. The range forms a parallel series of 1000 km running from the Cederberg to Port Elizabeth (Shone and Booth 2005). Klipfonteinrand occurs within the sedimentary rocks of the Table Mountain/Bokkeveld Supergroup, bordering the Karoo Supergroup

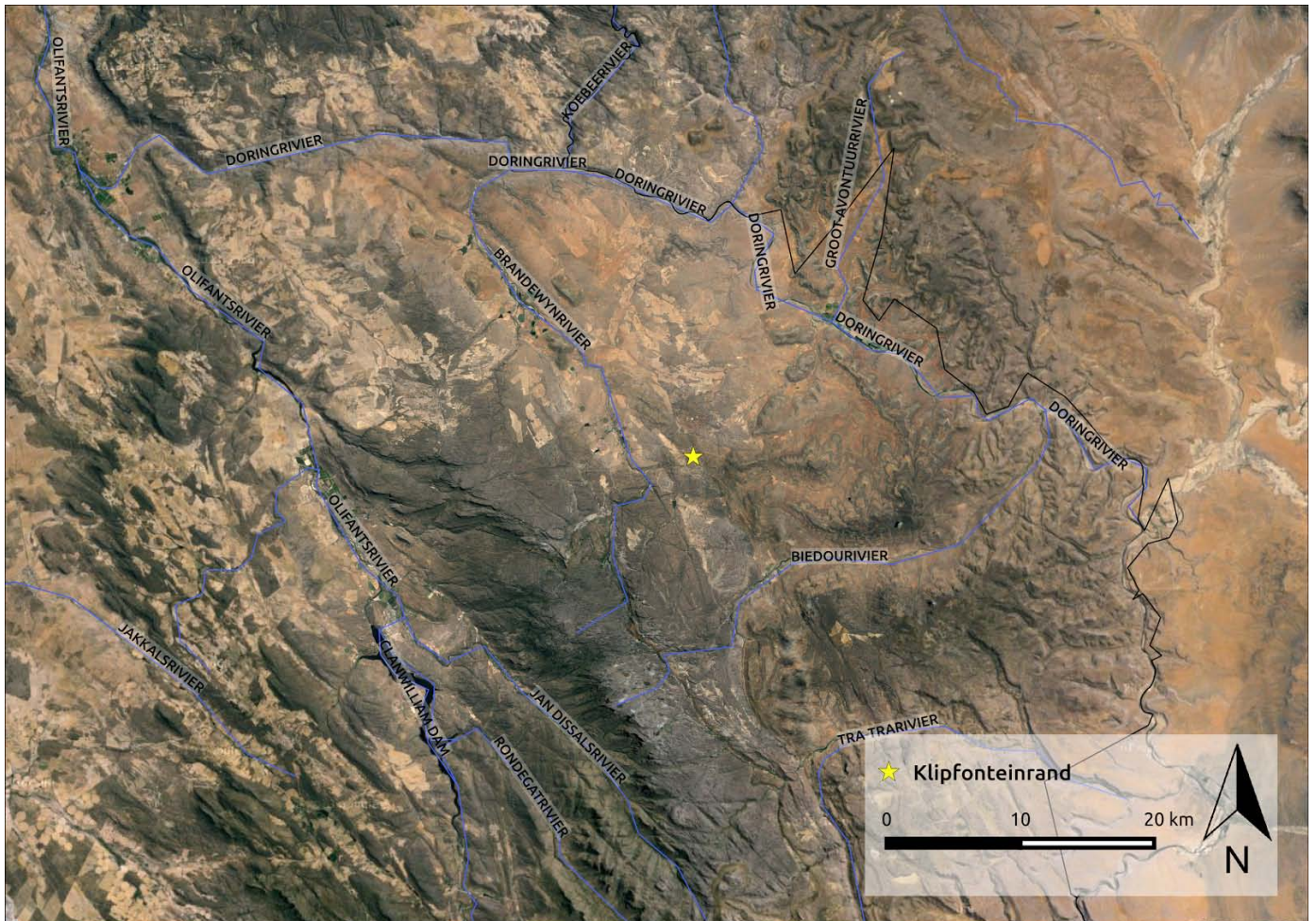


Figure 2.1. Satellite map indicating river systems around Klipfonteinrand.

where shales are dominant (Cloetingh et al. 1992, Compton 2004). Here, the geology impacts the local vegetation drastically, providing a clear boundary between the Cape Fynbos and the Karoo succulents. Several species of plants are found around the site: *Rhus undulata*, *Rhus dissecta*, *Leonotis leonurus*, *Dodonea angustifolia* and a few grasses (Nackerdien 1989), and flowering and other intermittent species come up in the wet season. Faunal species in the area include a wide range of mammalian and reptilian species, including grey rhebuck, klipspringer, tortoises, snakes, rodents, insects and a rich diversity of bird life, as well as leopard in the higher mountainous regions (Cederberg Conservancy 2015).

Water availability has always been a driving factor influencing the migration and settlement of people. In terms of present-day water availability at Klipfonteinrand, there is not much in the immediate vicinity and no water seems to pool in front of the shelter even after heavy rains,

although some shallow pools have been observed about 5 km upstream (Mackay 2015 pers. comm.). There is a natural spring at Salmanslaagte which is 1 km north west of Klipfonteinrand, but the nearest sources of reliable water are the Brandewyn River about 5 km west and the Doring River, roughly 13 km northeast as the crow flies. Historically, water availability was likely highly variable through time and responsive to the several fluctuating periods of aridity and humidity that will be discussed later in this thesis.

The rock shelter itself is roughly 6 m high at its mouth and 4 m at the rear. It measures 13.5 m from the drip line to the back wall and 18 m across the front (Mackay 2011). The site has a well-defined sediment body with a weak sediment trap formed by loose rock fall at the north of the site. The deposit presently slopes quite steeply from the rear to the front, although it is not known whether this slope existed in antiquity or whether it is recent. The site was first archaeologically excavated in 1969 by Prof. John Parkington, and the notes in his field diary suggest that the farmer of the time had previously removed sediment from the shelter for his kitchen garden. This has implications not only for the present slope, but for the possible truncation and integrity of the upper parts of the sequence.

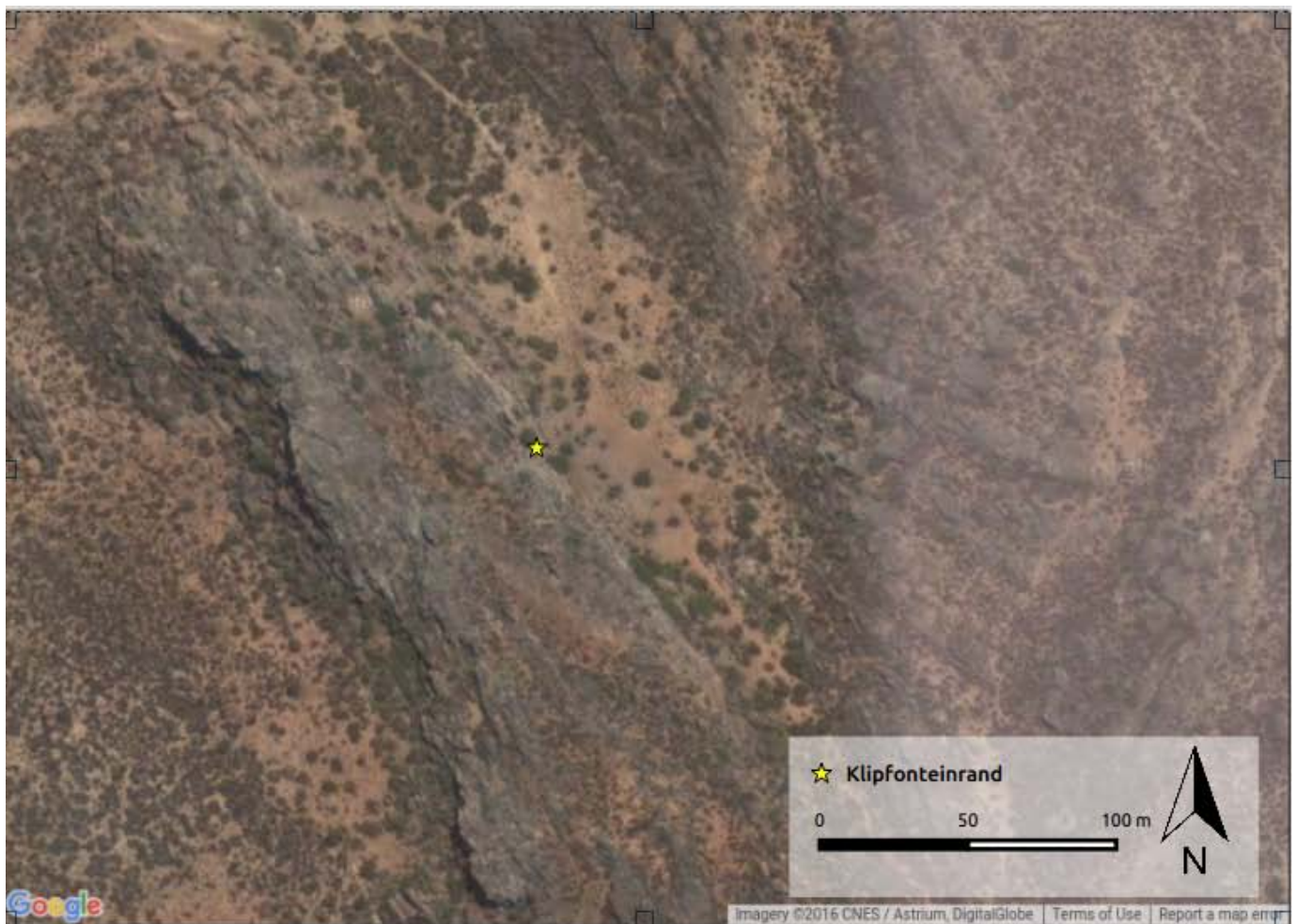


Figure 2.2. Close-up satellite image of the topography around Klipfonteinrand.

### 2.3 RESEARCH AND EXCAVATIONS AT KLIPFONTEINRAND

As mentioned, the first excavations at Klipfonteinrand took place in 1969, lead by John Parkington and Cedric Poggenpoel (see [Mackay 2013](#) for a detailed description of this excavation). Parkington's team excavated a substantial area of the cave, and revealed a brief Later Stone Age sequence and a more substantial underlying Middle Stone Age deposit. Only towards the front of the site did excavations continue to bedrock; towards the rear, excavations did not extend below 300 mm deep. No deposit that postdates 2000 <sup>14</sup>C yr BP was found at Klipfonteinrand in 1969: the likely reason for this was the aforementioned removal of a large amount of sediment from the shelter. The sequence identified during Parkington's excavation begins at roughly 3000 <sup>14</sup>C yr BP ([Thackeray 1977](#)).

In 1989, [R. Nackerdien](#) conducted an excavation for an Honours degree at the site adjacent to Klipfonteinrand (called Klipfonteinrand 2), which brought a better understanding of the kloof and both of the rock shelters. Siyakha Mguni, a previous employee of Bushman's Kloof Wilderness Reserve, conducted several surveys and research projects ([Mguni 1997, 2013](#)) in the area surrounding Klipfonteinrand (as well as Klipfonteinrand itself, which also contains a large number of rock paintings) between 2005 and 2010, and studied the site during his PhD and tenure at the Wilderness Reserve.

In 2011, a new excavation of Klipfonteinrand was initiated under the direction of Dr. Alex Mackay. The team began by removing sediment adjacent to the deepest section of Parkington's 1969 trench, as well as opening a second fresh trench. The goal was to obtain a sequence comparable to the 1969 excavations. Using a Total Station, we laid out a 2x3 m grid to mark out the limits of a preliminary trench positioned near the mouth of the shelter, immediately grid south (rear-ward) of Parkington's deep sounding. Each team member was assigned a 1x1 m square that was excavated following visible stratigraphy wherever present and otherwise in arbitrary 30 mm 'spits'. Each of these aggregate units was recorded as a Context that was assigned to a Stratigraphic Unit, depending on changes in sediment colour, texture and inclusions. Visible stratigraphy was notably poorly preserved in this initial excavation area (Figure 2.3).



Figure 2.3. Photograph indicating southern section of northern trench.

Finds were piece plotted in space with their positional coordinates being recorded using a Total Station, with different size cut-offs for different classes of material; 20 mm for stone artefacts, ostrich eggshell (excluding beads) and ochre, 30 mm for bone, and 50 mm for non-cultural stone (roof spall). All observed pieces of marine shell and ostrich eggshell beads were plotted regardless of size. Samples of charcoal for radiocarbon dating were also plotted, and triplicate sediment samples were taken from all contexts in one square. Once a context was completed, sediments were dry-sieved using 3 mm and 1 mm sieves, and artefacts recovered were bagged separately.

In the second season of excavations toward the end of 2011, a second southern trench was opened toward the rear of the shelter, this one comprising five additional 1x1 m squares. The reason for this was the observation of water movement across the surface towards the shelter mouth after the rainy season. This water movement impacted the front trench and may have affected the position and preservation of the archaeological materials in antiquity. This area in the rear was immediately south of the limits of Parkington's 1969 excavations. The major difference between this new trench and the front trench was the presence of visible stratigraphy and the better preservation of organic materials including ostrich eggshell, marine shell, charcoal, bone, ochre and stone tools. Stratigraphic units in this part of the deposit were, however, often small and discontinuous, and were affected by bioturbation from moles and termites, the former being particularly active in the upper sediments (Figure 2.4). Additionally, the presence and definition of stratigraphy notably attenuated away from the rear of the cave towards the front trench. The absence of clear visible stratigraphy in the front trench appears to be a continuation of this process.



Figure 2.4. Photograph of the western section of the southern trench, indicating variegated stratigraphy with bioturbation.

Excavations at Klipfonteinrand continued for three more seasons until bedrock was reached in both trenches, and ceased in October 2012. Once excavation had been completed, a series of radiocarbon assays on piece plotted charcoal was made for the rear trench (See Table 2a for radiocarbon dates). These ages bracket the formation of this part of the Klipfonteinrand sequence in a series of pulses between ~22 ka and ~13 ka, thus covering most of MIS 2. Due to the discontinuous nature of the strata in the rear trench noted above, the strata here were aggregated into a series of units or 'meta-strata' (See Figure 2.5 for annotated section figure; see Table 2b for the relationship between context, strata and meta strata). These meta-strata comprise only those contexts with sound stratigraphic positions, and thus principally those towards the rear of the shelter. The meta-strata for the rear trench include the following units: Laminated White and Brown Series (LWBS: 13.4 - 14.4 cal kyr BP); Orange Band (OB: 15.9 - 16.6 cal kyr BP); White Series (WS: 16.3 - 17.4 cal kyr BP); Black Band (BB: 17.6 - 18.0 cal kyr BP); Black, White and Brown Series (BWBS: 18.4 - 22.3 cal kyr BP). It is the archaeological composition of these units that constitutes the present masters project. This thesis makes use of both the piece plotted and aggregate (eg. sieve-derived) data.

Table 2a. Klipfonteinrand <sup>14</sup>C Dates

Sample No.	Sample Type	Elevation	Origin	Lab Code	Tech.	Strat. Context	Square	Strat Unit	Meta- Strat	Association	Min-Max	Raw Date	Calibrated Date	±
703	Charcoal	1000.287	Seattle	D-AMS 001836	ams	396	9	wors	LWBS	oakhurst	13384-13703	11723±52	13530	70
386	Charcoal	1000.076	Seattle	D-AMS 002439	ams	274	8	lbs	LWBS	hrnf macrolithic	14003-14425	12303±41	14230	130
424	Charcoal	1000.061	Seattle	D-AMS 003797	ams	291	8	rwhf	OB	robberg	15897-16314	13439±56	16170	100
438	Charcoal	999.989	Seattle	D-AMS 003798	ams	291	8	rwhf	OB	mix HM Robberg	16087-16555	13584±58	16370	110
828	Charcoal	999.939	Seattle	D-AMS 001837	ams	463	9	crocs	WS	hrnf macrolithic	16275-16766	13722±49	16560	130
481	Charcoal	999.966	Seattle	D-AMS 002440	ams	318	8	owss	WS	sts - testing lower limits of oes - bearing layers	16885-17407	14131±61	17200	120
858	Charcoal	999.88	Seattle	D-AMS 003799	ams	485	9	lbss	BB	robberg	17606-17979	14656±55	17840	90
876	Charcoal	999.832	Seattle	D-AMS 001838	ams	502	9	borl	BB	robberg	17637-18039	14706±65	17900	100
686	Charcoal	999.744	Seattle	D-AMS 002440	ams	390	8	cmss	BWBS	mix HM Robberg	18355-18710	15309±65	18590	80
736	Charcoal	999.658	Seattle	D-AMS 002441	ams	406	8	cmss	BWBS	robberg	18389-18739	15342±65	18620	80
920	Charcoal	999.636	Seattle	D-AMS 003800	ams	544	9	yswcl	BWBS	robberg	18902-19276	15871±59	19130	100
924	Charcoal	999.593	Seattle	D-AMS 001839	ams	549	9	dgmch	BWBS	robberg	21829-22294	18232±71	22100	120

FINAL

<b>LWBS</b>	13.4-14.4 cal yr BP
<b>OB</b>	15.9-16.6 cal yr BP
<b>WS</b>	16.3-17.4 cal yr BP
<b>BB</b>	17.6-18.0 cal yr BP
<b>BWBS</b>	18.4-22.3 cal yr BP

META-STRATUM	DESCRIPTION	CALIBRATED AGE (cal kyr BP)	ASSOCIATED STRATIGRAPHIC UNITS	DEPTH/ VOLUME
<b>LWBS</b>	Laminated White Brown Series	13.4 - 14.4	lbs, rmtbh, wgss, wors, boss, cwiss, ccwbs, moss1, cwos, cros, cpos, cbss	318 mm/ 0,954 m <sup>3</sup>
<b>OB</b>	Orange Band	15.9 - 16.6	rwhf, rocss, gos	96 mm/ 0,288 m <sup>3</sup>
<b>WS</b>	White Series	16.3 - 17.4	owss, cmss, cws, crocs, mcws, gwos, mbos, lbms, mbogs	137 mm/ 0,411 m <sup>3</sup>
<b>BB</b>	Black Band	17.6 - 18.0	cmss, lbss, cbss, borl	85 mm/ 0,255 m <sup>3</sup>
<b>BWBS</b>	Black, White and Brown Series	18.4 - 22.3	cmss, lbss, cbss, borl, cmss, lwa, orl, wahf, yma, cwa, oyph, mcmss, lcwa, wabfs, cowgal, gbcfl, ahwr, yswcl, dgmch, bmss, robs, robs2, robs3, robs4	209 mm/ 0,627 m <sup>3</sup>

Table 2b. Description of relevant meta-strata and their associated stratigraphic units. Average depth of meta-strata in section is indicated in millimetres. Volume of meta-strata is indicated in cubic metres, based on sediment removed from three 1 by 1 m squares (8, 9 and 10).

As can be seen by the series of discontinuous raw dates in Figure 2.5 below, possible occupational hiatuses occur at Klipfonteinrand, specifically at the start of BWBS between 18,232±71 and 15,871±59 <sup>14</sup>C yr BP, and again at the end of OB and beginning of LWBS (between 13,439±56 and 12,303±41 <sup>14</sup>C yr BP). This is represented by the minimal deposit build-up between these time periods: deposit accumulates when the site is occupied (therefore there is a wider gap between 12,303±41 and 11,723±52 <sup>14</sup>C yr BP for example), but does not accumulate when the site is not occupied for long time periods, or when people visited episodically. Note that very little deposit has accumulated between 13,439±56 and 12,303±41 <sup>14</sup>C yr BP, a period of more than 1100 years, indicating very infrequent use of the shelter during this time.

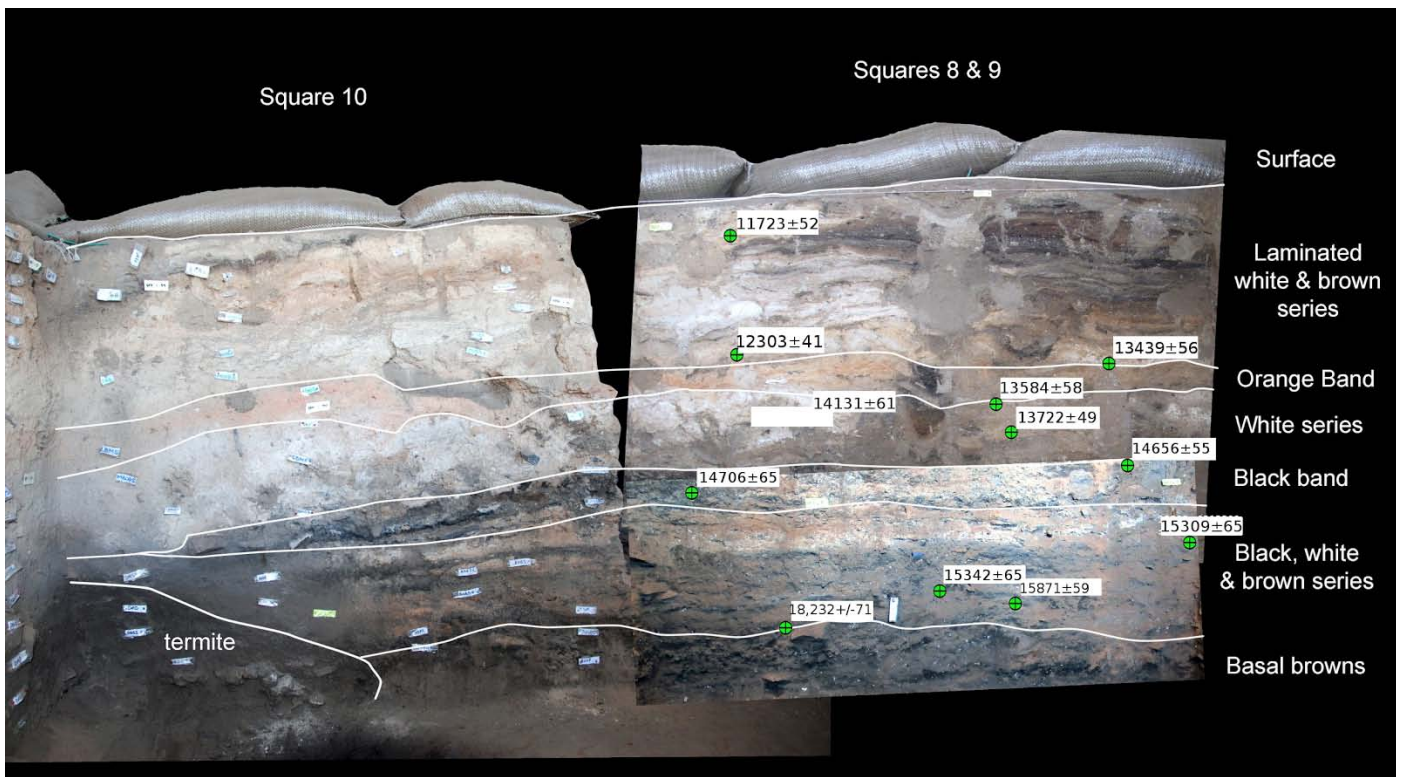


Figure 2.5. Annotated diagram of the southern section of the rear trench, indicating raw (uncalibrated) radiocarbon dates along with meta-strata.



Figure 2.6. Looking south toward Klipfonteinrand with talus slope in the foreground.



Figure 2.7. View from Klipfonteinrand facing north-east. No water seems to pool in front of, or close to, the shelter.

This chapter synthesises research on the environment and archaeology of southern Africa through MIS 2 (~ 29 - 12 ka) which includes the Last Glacial Maximum centered around 21 ka. The focus of the chapter is on the Winter Rainfall Zone in which Klipfonteinrand is situated, but the environment and archaeology of the Summer and Year-Round Rainfall zones are also briefly discussed. The focus of the archaeological sections is principally on changes in occupation, technology and ornaments. There is minimal discussion of changes in aspects such as the composition of faunal assemblages, as, while these are important to address, they are beyond the scope of this thesis.

### 3.1 FLUCTUATING SEA LEVELS

Before discussing palaeoenvironments, it is necessary to note changes in sea-level through the study period and their potential effects on the archaeological record. As mentioned, MIS 2 includes the Last Glacial Maximum, a time during which global eustatic sea levels were lower than present levels by up to 120 - 135 m (Clark and Mix 2002, Lambeck et al. 2002, Peltier 2002). Substantial exposure of the continental shelf during this time, especially on the southern coast of South Africa (Fisher et al. 2010, Compton 2011), meant that the distance between the coast and interior was greater than it is today. On the south coast, for instance, the exposed area of shelf may have shifted distance to shore for sites that are currently coastal by more than 100 km (Fisher, Bar-Matthews et al. 2010). On the west coast, however, the continental shelf is more restricted, and the effects of sea level changes would have been less dramatic. The distance to shore from the current coastline probably increased by a maximum of around 40 km during the height of the Last Glacial Maximum (Porraz, Parkington et al. 2013). Subsequent rises in sea level were probably quite rapid (Compton 2011, Lambeck et al. 2012), and a rise of ~45 m from 19 - 11 ka would have moved the coastline to within 25 - 30 km of present (Porraz, Parkington et al. 2013), while subsequent warming established the present shoreline (80 km away) by the start of the Holocene (~11 ka).

### 3.2 SPATIAL FRAMEWORK - RAINFALL ZONES & THEIR MODERN ENVIRONMENTS

The spatial framework used in this study is based on the rainfall zones in southern Africa (Chase and Meadows 2007). Southern Africa has been divided into three major rainfall zones: the Winter Rainfall Zone in the western region, the Year-round Rainfall Zone in the western to central region,

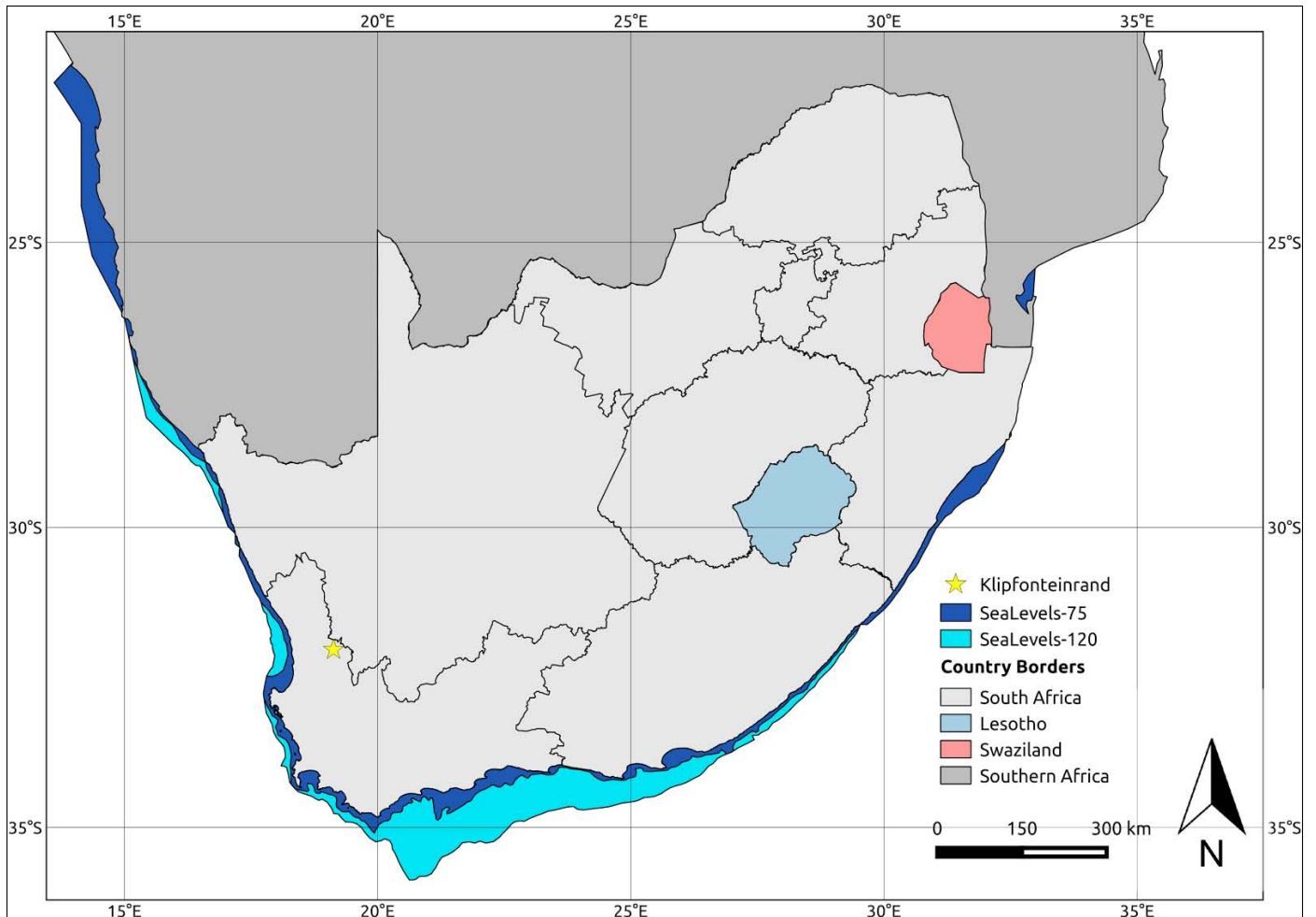


Figure 3.1 Sea levels during MIS 2 off the coast of southern Africa.

and the Summer Rainfall Zone in the remaining central to eastern regions (Figure 3.2). These designations are based on the season during which the majority (>66%) of rain falls. Several factors influence the way that southern Africa responds to climatic changes: its position in relation to the major circulation patterns occurring in the southern hemisphere (including the lat/long Tropical Temperate Trough [TTT]), ocean currents and variegated topography and altitudes (with major mountain ranges like the Cape Fold Belt, and Drakensberg Escarpment). The TTT links the tropics to midlatitude circulation and is a series of cloud bands that run from the northwest to the southeast (Harangozo and Harrison 1983). The TTT controls rainfall and results in much of this falling during the austral summer (Tyson and Preston-White 2000, Hart et al. 2012, Macron et al. 2014). The Westerlies are prevailing winds travelling from west to east and are strongest in the Southern Hemisphere, supplying the west coast of South Africa with warm equatorial waters and winds (Meteorology Glossary 2016). Influenced by these factors, climates vary across the different regions, characterised by different rainfall patterns (leading to the major rainfall zones) as well as vegetation biomes and faunal habitats (Cook et al. 2004, Davis and Joubert 2011).

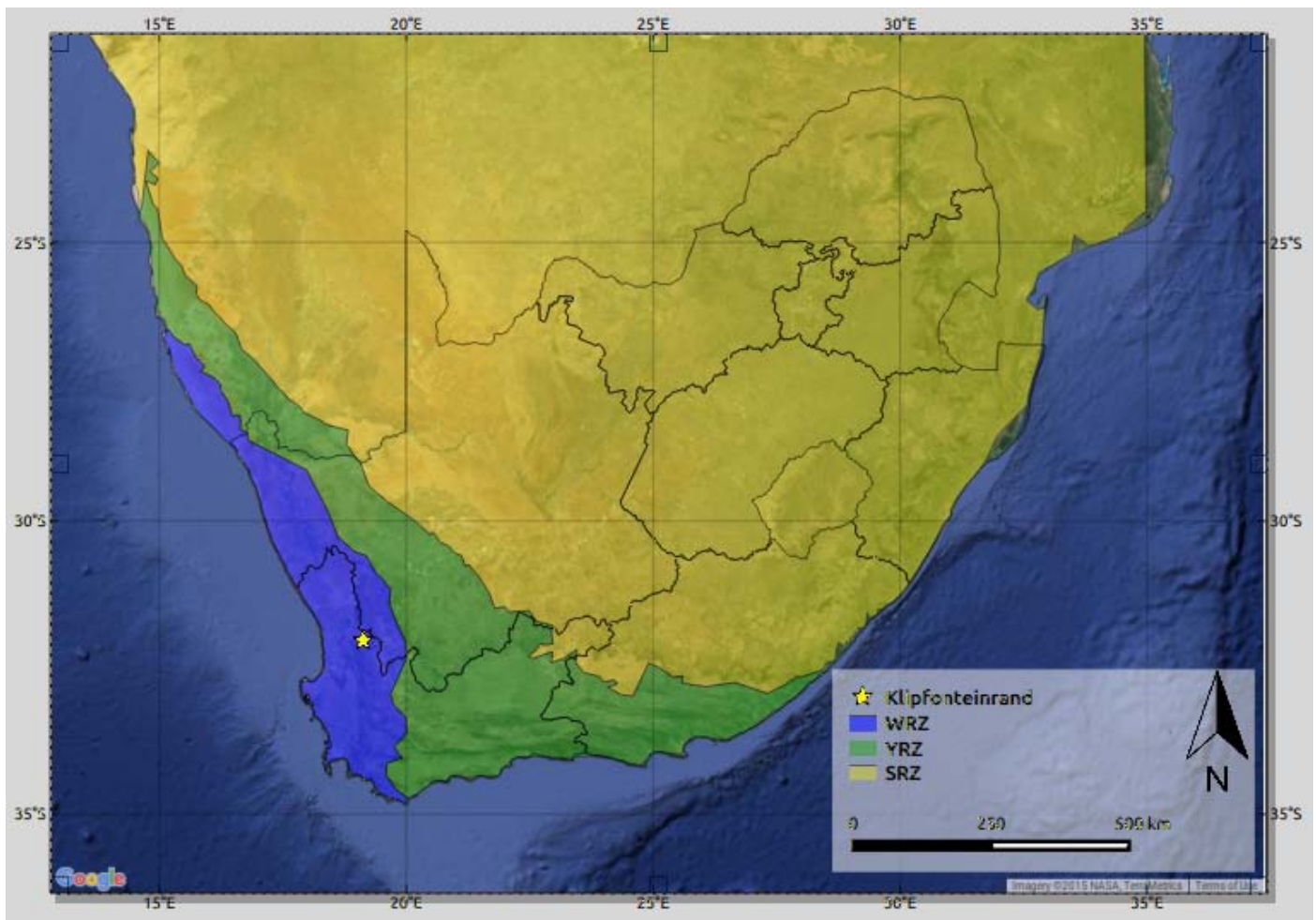


Figure 3.2 Rainfall zones of southern Africa, indicating Klipfonteinrand within the Winter Rainfall Zone.

### 3.2.1 WINTER RAINFALL ZONE

In contrast to much of the sub-continent, the Western Cape of South Africa typically receives 66% of its rain during the winter months between April and September. The climate is Mediterranean (warm to hot, dry, sunny summer and mild rainy winter) (Chase and Meadows 2007, Truc et al. 2013).

Rain hits the Western Cape (Winter Rainfall Zone) and is affected by pressure systems and their location during specific seasons. The high pressure system just off Cape Town during the winter months brings rain, whereas in summer months it switches to a low pressure system, resulting in less rain and lower humidity. Temperature is affected by pressure systems as warm or cold fronts are introduced (Reason and Rouault 2005, Chase and Meadows 2007).

Rainfall is also influenced by the topography and altitude of the region: the mountain ranges known as the Cape Fold Belt divert the rainfall from the high pressure system over specific areas (for example, Newlands in Cape Town, or Villiersdorp in the Overberg, or the Cederberg interior). The topography and altitude (2000 m above sea level) of the Cederberg mountains, specifically, influence the higher level of rainfall here than in the low-lying Sandveld (Mackay 2009). Another big factor influencing rainfall in the Winter Rainfall Zone is the latitude and longitude of the TTT:

trade winds between the Tropic of Capricorn and 60°S affect the southern peninsula (Todd et al. 2004).

Presently, the coastal Winter Rainfall Zone is frost free, with a mean monthly minimum temperature for the coldest month being between 0°C - 10°C (SA National Biodiversity Institute 2015). If frost does occur, it is light and does not last long. Strong coastal winds prevail and poor soils derived from the Table Mountain Group (Cape Supergroup) hold a distinct group of plant species in this particular region. The Karoo Winter Rainfall Zone, however, receives a light frost during winter months, with a mean monthly minimum temperature for the coldest months lying between -5°C to 5°C. This area collectively receives summer rainfall in the eastern section - receiving approximately 300 - 700 mm of rainfall per annum (Davis and Joubert 2011), has mineral-rich soils (SA National Biodiversity Institute 2015), and is semi-arid and prone to drought, with xeric scrubland as opposed to grassland (Partridge 1997).

Average humidity in the Winter Rainfall Zone averages between 61% to 80% over the course of a year (Davis and Joubert 2011). It is driest in December (dropping below 51%) and most humid in July (exceeding 95%) (Cedar Lake Ventures Inc. 2013). June experiences the highest rainfall, whereas February the least. Humidity, deriving from moisture from the Indian Ocean, is therefore quite low in the western Interior (Davis and Joubert 2011).

The Fynbos Biome is situated in the Winter Rainfall Zone and some parts of the Year-round Rainfall Zone in the western regions of southern Africa. This Biome occupies roughly 71,337 km<sup>2</sup> which is 2.7% of southern Africa (Rutherford 1997) and is made up of fynbos, renosterveld and strandveld vegetation types, which are shrubby, small-leaved plants that regenerate through fire. Fynbos, or in English “fine bush”, is endemic to the Western Cape of South Africa, and is closely linked to the adjacent drier Succulent Karoo Biome in the Year-round Rainfall Zone to the east, both of which are part of the Cape Floristic Region (Rebelo et al. 2006, Rutherford et al. 2006, Goldblatt and Manning 2000a). The Fynbos Biome has the highest number of species and vegetation types of any other southern African biome, with the greatest level of endemism and much variation in soil types in this region (Rutherford et al. 2006, Bergh et al. 2014).

Despite the dominance of winter rain, fynbos vegetation also withstands long, dry and hot summer months. This, coupled with the topographic heterogeneity and soil fertility of the region, results in the diversity of vegetation in this region (Cowling et al. 1996). Leaves must be hardy (and absorb the maximum of a minimal amount of available moisture during summer months) and able to withstand low humidity when necessary. The structure of these plants is designed to maximise surface area to absorb this moisture (for example long reeds of the Restionaceae family, flat wide leaves of Proteas or silver leaves of the *Leucadendron argenteum* species reflect UV in order to retain moisture).

[Parkington \(1977\)](#) makes a case for the historical movement between the sandy lowveld plains and the mountains near the Olifants River valley in order to make use of the flowering of geophytes to determine the edibility of their corms, as well as other species at different times of the year. This will be discussed further in later chapters. The modern Winter Rainfall Zone is largely dominated by C3 plants of the Fynbos Biome (which are designed to photosynthesise in cold wet climates). Edaphic controls over much of the region coupled with the resilience of the fynbos mean that vegetation changes through time are generally subtle ([Carr, Chase et al. In Press](#)). The significant plant families of this area are of the Ericaceae, Proteaceae, Restionaceae and Asteraceae families, while the Biome has significant levels of diversity and endemism.

Geologically, the main rock types supporting fynbos vegetation are sandstone, quartzite, granite, gneiss and limestone - while several large mountain ranges comprising quartz bands result in nutrient-poor soils ([Rutherford 1997, Rutherford et al. 2006](#)).

### 3.2.2 YEAR-ROUND RAINFALL ZONE

In the Year-round Rainfall Zone, moisture derived from easterly and westerly weather systems results in rainfall throughout the year. This region experiences the convergence of both the high and low pressure systems related to the TTT, and thus receives input from both summer and winter systems ([Chase and Meadows 2007, Truc et al. 2013](#)). Moisture is also pulled north-south by the latitudinal TTT, and approximately 600 - 800 mm mean annual precipitation and 33-66% winter rainfall ([Lancaster 1979, Meadows and Baxter, 1999, Chase and Meadows, 2007](#)) is common. November - March is the hot wet season, with July being the coolest and driest month.

The average humidity of the Year-round Rainfall Zone is 51 - 70% ([Davis and Joubert 2011](#)). Its vegetation is tropical along the coast as it receives more all-year rainfall. The Forest Biome, where the archaeological sites of Nelson Bay Cave and Boomplaas are located, is very small (568 km<sup>2</sup>). It is surrounded by the Fynbos Biome, and is situated on the south-east coastline between Mossel Bay and Jeffreys Bay in the Year-round Rainfall Zone. It is characterised by dense thicket shrubs and trees, where large amounts of moisture can accumulate from frequent rainfall ([Cowling et al. 2006](#)).

### 3.2.3 SUMMER RAINFALL ZONE

A large proportion of southern Africa experiences summer rainfall with more than 66% of the annual rain falling during the summer months. During summer the high-pressure system in the Indian ocean results in the convergence of the easterlies and westerlies bringing moisture to the eastern part of the sub-continent ([Cook et al. 2004, Chase and Meadows 2007](#)). Migrations of the Intertropical Convergence Zone (ITCZ) are also responsible for bringing monsoonal rain to the

tropics in the summer months (Chase and Thomas 2007). The temperature in this rainfall zone ranges between 6.5°C - 24.4°C (Truc et al. 2013).

Average humidity is lowest in winter (August) when it drops below 27%, and highest in summer (January) when it exceeds 93%. Typically, humidity ranges from 22-96% over the course of a year. Rainfall occurs mostly in December and is least likely to occur in July (weatherspark.com - Cedarlake Ventures Inc.). Humidity is highest in the eastern regions and derives from moisture from the Indian Ocean (Davis and Joubert 2011).

The vegetation of the Summer Rainfall Zone is dominated by the Savanna and Grassland Biomes (Mucina and Rutherford 2006). The Grassland Biome encompasses an extensive area (349,174 km<sup>2</sup>) within the fine-textured soils of the Summer Rainfall Zone, around the interior highlands Drakensberg area (Cowling et al. 1997, Rutherford 1997, Rutherford et al. 2006). This Biome is “fire-driven” (Rutherford et al. 2006) and is characterised mainly by montane grasslands and shrublands, with woodlands and forests in some areas (Rutherford 1997). It is similar in climate to the Savanna Biome but has lower temperatures (Rutherford et al. 2006). The Savanna Biome encompasses more than half of southern Africa (1,436,713 km<sup>2</sup>). This Biome is also “fire-driven” (Rutherford et al. 2006); the area is arid and rain-free for up to 8 months of the year. The Biome is dominated by C4 grasslands (which are designed to photosynthesise in warm, dry climates) ranging to tall woodland taxa where more moisture occurs (Huntley 1982).

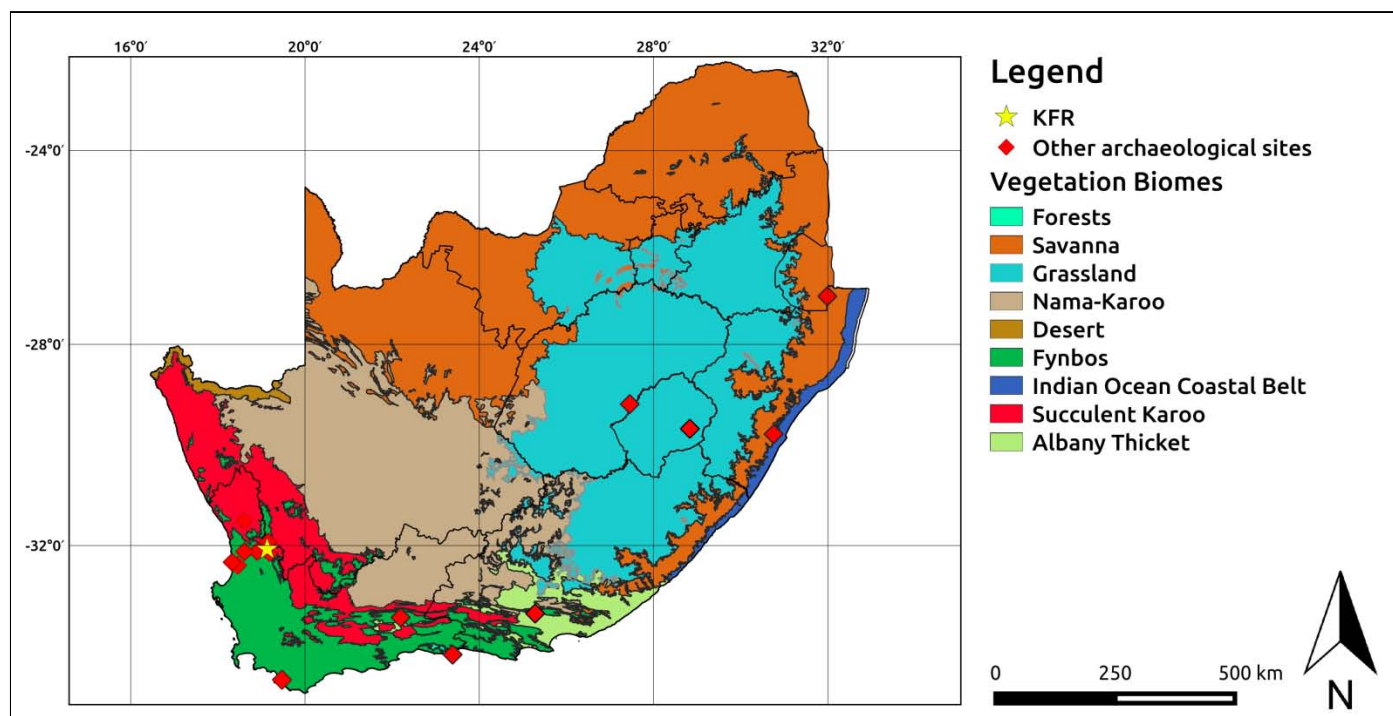


Figure 3.3 Vegetation biomes of southern Africa, indicating Klipfonteinrand on the border of the Fynbos and Succulent Karoo Biomes.

### 3.3 PALAEOENVIRONMENTAL CHANGES IN THE RAINFALL ZONES DURING MIS 2

#### 3.3.1. WINTER RAINFALL ZONE DURING MIS 2

The Winter Rainfall Zone during MIS 2 was climatically unstable. Several factors (including rapid sea level rise and changes in the ITCZ) combined to result in short bursts of climate variability. Overall, available data suggest that the MIS 2 period was generally cooler and more humid than present, albeit with similar C3 shrubland vegetation remaining dominant throughout (Cohen et al. 1992, Cowling et al. 1999, Meadows and Baxter 1999, Parkington et al. 2000, Scott and Vogel 2000, Scott 2003, Chase and Meadows 2007, Scott and Woodborne 2007, Rector and Verelli 2010, Chase et al. 2011, Scott et al. 2012). Southern Namaqualand, north of Reception Shelter, appears to have been far more moist than present up to 20 ka (Chase and Meadows 2007, Chase 2010). Phytolith samples from Klein Kliphuis also support wetter conditions up to 20 ka (Mackay et al. 2010). Temperatures in the southwestern Cape Winter Rainfall Zone were probably several degrees cooler on average than at present (by up to 8 - 10°C cooler than presently during winter months - [Boelhouwers 1999, Boelhouwers and Meiklejohn 2002]). At Elands Bay Cave between 17.0 - 9.1 cal kyr BP (Pta 4321; Pta 1829), there is evidence of an increase in browsing mammals, indicating more moisture (Rector and Verelli 2010). Woodland and afro-montane taxa (Cowling et al. 1999; Parkington et al. 2000) from MIS 2 levels at Elands Bay Cave, as suggested by charcoal remains and pollen analysis, imply a “significantly extended winter rainfall season” in this area (Chase and Meadows 2007:116). At Byneskranskop on the south coast of the Winter Rainfall Zone, micromammalian faunal remains suggest that temperatures between 15.8 - 14.3 cal kyr BP (I-7948) were cooler than present, moving into a warmer period round 11.4 - 10.8 cal kyr BP (Pta-1587). During this overall period, vegetation appears to have been grassy on flat lands with some low-lying scrubland and a moderate amount of moisture (Schweitzer and Wilson 1983).

As a comparative example, Butzer (2004) suggests that various spalling events at several MIS 4 - 9 sites in the Winter Rainfall Zone were caused by mechanical- and frost-weathering over the course of time. Although this is not the time period of focus here, these data complement the notion that climate has an effect on the weathering of rocks, and thus spalling events in archaeological sequences can potentially be explained by extreme changes in weather. The sites that Butzer (2004) presents include Elands Bay Cave and Sea Harvest among several others. At these rock shelters, a case is made for both frost-weathering (such as at Elands Bay Cave), and general mechanical-weathering (such as at Sea Harvest). At Elands Bay Cave, Butzer points to a “cool and wet period of woodland expansion at 21 - 17.5 ka...followed by an open vegetation with some bush to c.12.5 ka” (2004: 1772), yet the frost-weathered spalls evident in layers older than

this (>40 ka), and linked to an early Middle Stone Age industry, resulted from an earlier event of frost-shattering that left a substantial amount of rubble (Volman 1984 in Butzer 2004).

### 3.3.2. THE CEDERBERG DURING MIS 2

In the study area of the Cederberg specifically, high-resolution records from the Pakhuis Pass relating to the palaeoenvironment of the MIS 2 are available. These data suggest that MIS 2 began with a period of relative aridity from ~22 - 21 ka (Scott et al. 2012). Environments from 19 - 16 ka were relatively 'moist, cold', with abrupt changes in pollen spectra after ~16 ka featuring a decrease in *Proteaceae* and *Stoebe*-type pollen and an increase in *Dodonaea*, *Olea* and more, which Scott and Woodborne (2007) ascribe to "postglacial warming and drier conditions". At De Rif, also in the Cederberg, Valsecchi et al. (2013) suggest lower soil moisture conditions 15,400 - 14,500 <sup>14</sup>C yr BP. Thereafter, vegetation suggests a steady moisture increase along with warm conditions towards the final glacial-interglacial transition, when another brief arid episode is recorded between 12,700 and 11,500 <sup>14</sup>C yr BP (Quick 2009, Chase et al. 2011, Valsecchi et al. 2013).

The Pakhuis Pass Hyrax midden (Figure 3.4) suggests typical Winter Rainfall Zone vegetation (C3 fynbos shrubland) between 24 - 17 ka, while evidence from fossil pollen-bearing sediments from the Cape Fold Belt mountains (Meadows and Sugden 1993) suggests that there has been little fynbos variation over the last 14,000 years. From the Last Glacial Maximum to present, the Winter Rainfall Zone gradually became drier, while the xeric vegetation of today only became prolific again in the mid-Holocene (Carr et al. 2006).

These fluctuations in climate in the Winter Rainfall Zone, coupled with the rapid rising of sea levels and the richly varied vegetation of the Fynbos biome, must have made for a highly diverse environment to which the people of the terminal MIS 2 needed to adapt. This has undoubtedly influenced the intriguing behavioural patterns seen in the Winter Rainfall Zone archaeological record of this time period, such as coastal-interior migration patterns, networking and exchange of ideas between local groups, and raw material selection and distribution. This will be discussed in more detail in Chapter 6.

### 3.3.3. YEAR-ROUND RAINFALL ZONE PALAEOENVIRONMENT DURING MIS 2

The Year-round Rainfall Zone palaeoenvironment shows a mixture of influences from the Winter Rainfall Zone and Summer Rainfall Zone factors (Chase and Meadows 2007). A cool and dry environment is supported by evidence from Barham and Mitchell (2008), Cowling et al. (1999), Rector and Verelli (2010) and Carr et al. (2006). Temperatures during the Last Glacial Maximum are suggested to have been up to 6°C cooler than present day (Talma and Vogel 1992). The

vegetation during the Last Glacial Maximum was likely to have been dominated by xeric open woodland, suggesting less rainfall than present (Deacon 1979).

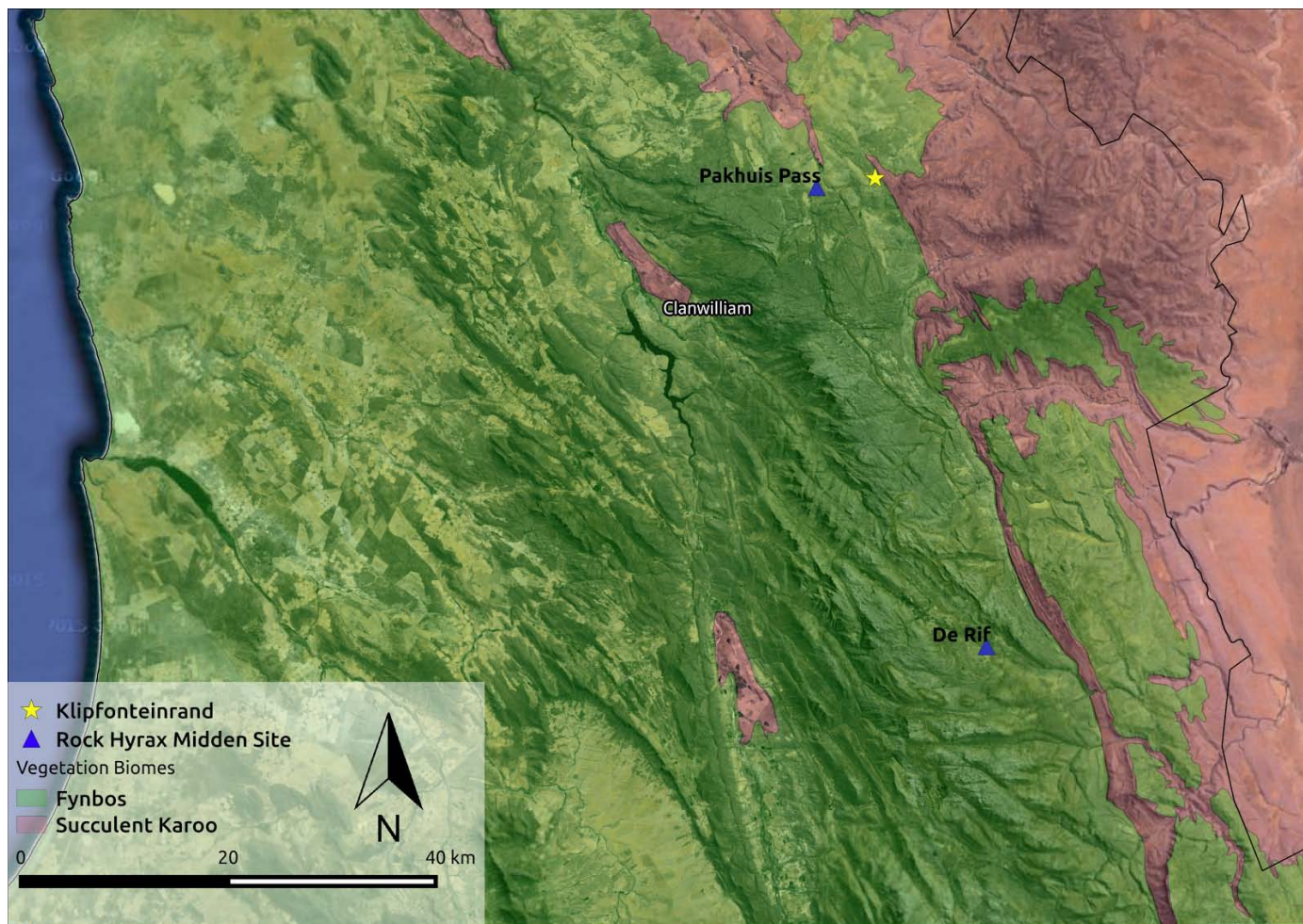


Figure 3.4. Location of Klipfonteinrand in relation to dated Rock Hyrax midden sites, indicating also the proximity of the rock shelter to the Succulent Karoo Biome approximately 500m to the east.

Boomplaas has a strong stratigraphic record that suggests a cooler and drier MIS 2 climate (Deacon, J. 1979, 1995; Klein 1980, 1983; Wadley 1993; Meadows and Baxter 1999). These studies show a more arid grassland environment during the MIS 2 at Boomplaas, with signs of more grazing mammals than browsing, and a lack of tree species: charcoal samples show no woodland taxa, suggesting “harsh” and dry conditions (Wadley 1993:255). There was a later transition (between 14.2 and 13.0 cal kyr BP [Pta-1828; UW-411]) to a more moist, slightly warmer environment with a more equal distribution of browsing and grazing mammals. Marine molluscs near Elands Bay show cooling between 13.2 – 11.2 cal kyr BP (OxA 478; Pta 5824) (Cohen et al. 1992); Parkington et al. (2000: 546) conclude that the Winter and Year-round Rainfall Zones were “out of phase in the colder parts of Pleistocene climatic cycles”, mostly because of the controlling factors of rainfall in these areas. Nelson Bay Cave supports the evidence from Boomplaas with its arid and cold palaeoenvironment: evidence suggests open grassland vegetation with large grazing mammals (suggesting a colder and drier climate in contrast to an earlier interglacial MIS 3, with

fynbos and pollen evidence suggesting humidity, and today's evergreen forest with wetter conditions) (Deacon 1978, Wadley 1993). In the more northern Karoo region, evidence suggests cooler conditions from ~15,200 – 13,600 <sup>14</sup>C yr BP, with warming at around 12,500 <sup>14</sup>C yr BP (Scott et al. 2012:112).

#### 3.3.4. SUMMER RAINFALL ZONE PALAEOENVIRONMENT DURING MIS 2

Southern Africa as a whole was likely to have been slightly cooler than present by 5 - 7°C (Temme et al. 2008, Thackeray 1987) at the start of MIS 2, while the interior of the Summer Rainfall Zone was also cold with dry conditions (Holmgren et al. 2003). This is supported by evidence from Equus Cave in the form of stable isotopes and amino acid racemization in ostrich eggshell (Johnson et al. 1997). Evidence from stromatolites at Urwi Pan in central Kalahari indicate that there was a moisture increase at around 19,400 - 18,600 <sup>14</sup>C yr BP (Lancaster 1979). Pollen records from the Free State near Clarens suggest a progression from humid and swampy conditions round 23,000 <sup>14</sup>C yr BP to a cooler and drier environment until ~19,000 <sup>14</sup>C yr BP, with a dominance of grasses between ~18,000 - 17,000 <sup>14</sup>C yr BP. At ~13,000 <sup>14</sup>C yr BP, moisture and temperatures increased (Scott 1989). Wonderkrater spring mound provides a multi-proxy record of palaeoenvironmental changes between 25 - 11 ka (Scott 1989, 1999, Truc et al. 2013), suggesting that conditions were cooler than present by 5 - 6°C with open grasslands and semi-arid savanna (Scott 1982) in the Summer Rainfall Zone interior. When combined with evidence from Tswaing Crater, roughly 150 km south of Wonderkrater, a rich palaeoenvironmental record is provided: despite hiatuses within both sequences, the overall conclusion is that the Summer Rainfall Zone palaeoenvironment between 33,000 and 11,000 <sup>14</sup>C yr BP was generally cooler than present, with a slight warming phase at 15,000 <sup>14</sup>C yr BP (Scott 1999).

#### 3.4 THE ARCHAEOLOGY OF MIS 2

MIS 2 in southern Africa was a time of fluctuating climatic events and environmental responses, but there is an abundant amount of evidence of the occupation of sites (Mackay et al. 2014), with a record of interesting and “precocious” technological industries (Deacon 1984b) of which the Robberg Industry is a well-known example. The Robberg, occurring at different times across southern Africa, but between a range of 22 ka to 11 ka, is characterised by a majority of small, unretouched bladelets (<25 mm), with lesser occurrences of bladelet cores, scrapers, bipolar cores and small numbers of backed or retouched artefacts (Deacon, J. 1984a, Wadley 1996). Some have argued that the Robberg was a response to the changing environment of the Last Glacial Maximum and the subsequent risk and possible social stress that the conditions of this period, along with growing population density, brought with it (Deacon 1984b, McCall and Thomas

2009). Nevertheless, Robberg assemblages are notably similar across southern Africa, despite the variation of climates, environments and geology. This suggests that the industry is not simply an adaptation to changing environments, but also possibly functional and economic adaptations or culturally stylistic developments (Clark 1999). The instability of the climate possibly also led to greater migration ranges to source food and water and follow migrating herds. This may have resulted in more frequent contact between groups further afield, and thereby the exchange of ideas. This could explain the similarities between Robberg assemblages, despite their distance from one another and the different environment that each is situated in.

Mitchell (1988) has proposed two technological 'provinces': one which is CCS-dominant with tiny blade cores in the north-eastern region of the sub-continent (generally Summer Rainfall Zone); the other in the western region (generally Winter/Year-round Rainfall Zone) which is quartz-dominated with additional flat bladelet cores and bipolar cores. Mitchell (1988) suggests that access to different materials across different regions leads to a degree of technological variation.

The Robberg Industry was in some sequences preceded by an early Later Stone Age industry (Vogel and Beaumont 1972, Beaumont 1978) which is considered transitional between the Middle Stone Age and the Later Stone Age. It is characterised typically by the early appearance of organic artefacts of early (San) hunter-gatherer material culture (D'Errico et al. 2012b, although see Mitchell 2012 and Pargeter et al. 2016), as having a mixture of Middle Stone Age and Later Stone Age tool types, including Middle Stone Age blade-points, small and large segments, bifacial points and hollow-based points, and Later Stone Age bladelets, bladelet cores and scrapers, along with a high proportion of bipolar core reduction, often associated with the use of quartz (Kaplan 1990, McCall and Thomas 2009, Mackay et al. 2014).

The Early Later Stone Age broadly coincides with the advent of MIS 2, though there are some earlier examples extending back to into MIS 3 (Beaumont 1978, Barham and Mitchell 1988, Wadley 1993, McCall and Thomas 2009, D'Errico et al. 2012b, Lombard et al. 2012). An example of this is Border Cave near the border of South Africa and Swaziland, with an Early Later Stone Age sequence which dates as far back as ~42 ka (D'Errico et al. 2012b, Villa et al. 2012). This is an intriguing date as it sets the advent of the Later Stone Age much further back in time than previously thought (Beaumont 1980, Deacon 1984, McCall and Thomas 2010), and is characterised at Border Cave by typically Later Stone Age artefacts such as worked bone, ostrich eggshell and digging sticks (Rightmire 1989, Grün et al. 2003, Villa et al. 2012). Equally intriguing is the relatively close proximity of Sibudu Cave approximately 150 km to the south, which holds a late Middle Stone Age sequence at 35 ka (Villa et al. 2005, Wadley 2005).

Following the Robberg, which persisted quite late in the east of southern Africa, are a variety of non-microlithic industries referred to as Oakhurst, Albany, or simply not named. The Oakhurst is dated to between ~12 and 8 ka across the sub-continent, and generally in the younger age range in the eastern part of southern Africa (Mitchell 1997, Wadley 2000). It is characterised by various types of large scrapers (round, end- and duckbilled scrapers) and large adzes, naturally backed knives, very few microliths or backed tools, polished bone tools and jewellery, and ostrich eggshell and marine shell ornaments (Mitchell 1997, Deacon and Deacon 1999). Raw materials of the Oakhurst Industry are slightly less fine-grained than preceding and succeeding industries (Deacon and Deacon 1999:115). There are regional variations of the Oakhurst, and the timing of this industry differs across southern Africa, beginning quite late in the eastern portion (at around 9 ka at Rose Cottage Cave for example) (Wadley 2000). The majority of sites with an Oakhurst assemblage are located in the southern/eastern portion of southern Africa, but across the region the sites with Oakhurst-like artefacts include Nelson Bay Cave (Klein 1972), Boomplaas (Klein 1978b, Deacon, H. et al. 1984), Melkhoutboom (Deacon 1976), Umhlatuzana (Kaplan 1990), and Elands Bay Cave (Orton 2006), among several others.

During the study period, there is a noticeable increase in the use of organic materials being used for decorative, symbolic and practical purposes across the sub-continent. Ostrich eggshell beads begin to increase in number at various sites (Deacon 1982, 1984, 1995, Mitchell 1995, Manhire 1993, Kandel and Conard 2005, Orton 2008b), and as suggested by ethnographic records, were likely used as pieces of jewellery when strung together by rope and worn round the ankles, wrists, neck or head (Bleek 1928: p9, Wiessner 1984). Likewise, ostrich eggshell fragments with engraved decorations on them demonstrate whole decorated water flasks that would have broken into fragments over time. Ochre has been shown to have had multiple uses, beside the commonly known application to rock art and body decoration; ethnographic records show ochre being used as sun block, and studies have also shown that ochre has antibacterial properties owing to its content of iron, allowing for the use of tanning hides (Audouin and Plisson 1982, Rifkin 2011, Hodgskiss 2012, Wadley et al. 2004). Furthermore, ochre has been widely used for hafting purposes as part of the mastic for securing lithics onto spear tips, and is preferred over plant resins alone because the compound adhesive with a mixture of plant resin and ochre is not as brittle as the plain plant resin (Wadley et al. 2004, Wadley 2005, Lombard 2007). Marine shell is present at many sites not only as a remnant of food resources, but also as decorative body adornments when perforated in the middle (Inskeep and Vogel 1985, Inskeep 1987) as well as practical tools in the form of scrapers; the species *Donax serra* has been found to have been knapped into a scraper-like tool (Parkington 2014) at several sites in the region.

### 3.4.1. WINTER RAINFALL ZONE MIS 2 ARCHAEOLOGY

The Early Later Stone Age in the Winter Rainfall Zone is characterized by a mixture of Middle Stone Age and Later Stone Age tool types, including Middle Stone Age blade-points, small and large segments, bifacial points and hollow-based points, and Later Stone Age bladelets, bladelet cores and scrapers. Elands Bay Cave has Early Later Stone Age-type lithics dating roughly 24.1 - 21.0 cal kyr BP (Pta 5304; Pta 5308) (Orton 2006). Klein Kliphuis appears to have a Middle to Later Stone Age transition dominated by microlithic quartz bipolar reduction between 33 - 22.3 cal kyr BP (Wk-20241) (Mackay 2006, 2010).

At Putslaagte 8, the Early Later Stone Age immediately precedes the Robberg, dating to between ~25 - 23 ka. In this unit both bipolar reduction and bladelet production are relatively common, and hornfels and quartz are the most abundant rocks used (Mackay et al. 2015:20).

The timing of the initial Robberg is variable across the Winter Rainfall Zone, though this may in part relate to differences in definitions used by different researchers. At Putslaagte 8 Robberg-like assemblages have a relatively early start date of 23.0 cal kyr BP (AA99784) and terminate sometime after 20.0 cal kyr BP (AA98830) (Mackay et al. 2015:20). Like the Early Later Stone Age, these assemblages are composed of more than 50% hornfels, but they also have the highest proportions of silcrete and CCS in the assemblage. The dominance of hornfels at Putslaagte 8 reflects the proximity of this site to the Doring River, in which cobbles of hornfels are common. Both marine shell and ostrich eggshell are absent from the Robberg layers at this site. This may be a taphonomic effect, though bone is abundant in the same layers. The subsequent “post-microlithic” industry of Putslaagte 8 begins some time after 17 ka and it is not clear if there is any occupational gap between the two units. This post-microlithic unit has >70% hornfels with large curve-edged hornfels scrapers that have been referred to as ‘naturally backed knives’ (Mackay et al. 2015). Unlike the Robberg component, silcrete is common. Marine shell has been found in these layers (as have ostrich eggshell beads) (Mackay et al. 2015:22), suggesting a coastal connection with the interior.

At Faraoskop Rock Shelter on the coastal sandsheet, bladelet-rich assemblages are the oldest component of the sequence, present from 20.4 - 19.5 cal kyr BP (Pta-4822) and terminating between 13.7 - 13.1 cal kyr BP (Pta-4817) and 13 - 12.6 cal kyr BP (Pta-4816) (Manhire 1993). The raw materials in the Pleistocene microlithic at Faraoskop Rock Shelter are more than 85% quartz with low proportions (<5%) of silcrete, quartzite and CCS (Manhire 1993). Hornfels varies from 4 - 6%. Ostrich eggshell beads occur throughout, with a single decorated ostrich eggshell piece in layer 4 dating to 13.7 - 13.1 cal kyr BP (Pta-4817). This layer also contains a single piece of worked white mussel (*Donax serra*); marine shell is otherwise present throughout the sequence. In the post-microlithic level 3 at Faraoskop Rock Shelter, dating 12.9 - 12.4 cal kyr BP (Pta-4816),

bladelets are uncommon, but there are no other obvious markers to characterise the lithic technology. Notably, though, while quartz continues to account for more than 85% of artefacts, the proportion of hornfels nearly doubles to >10%. After ~12 ka, Faraoskop Rock Shelter is not occupied again until the mid-Holocene ([Manhire 1993](#)).

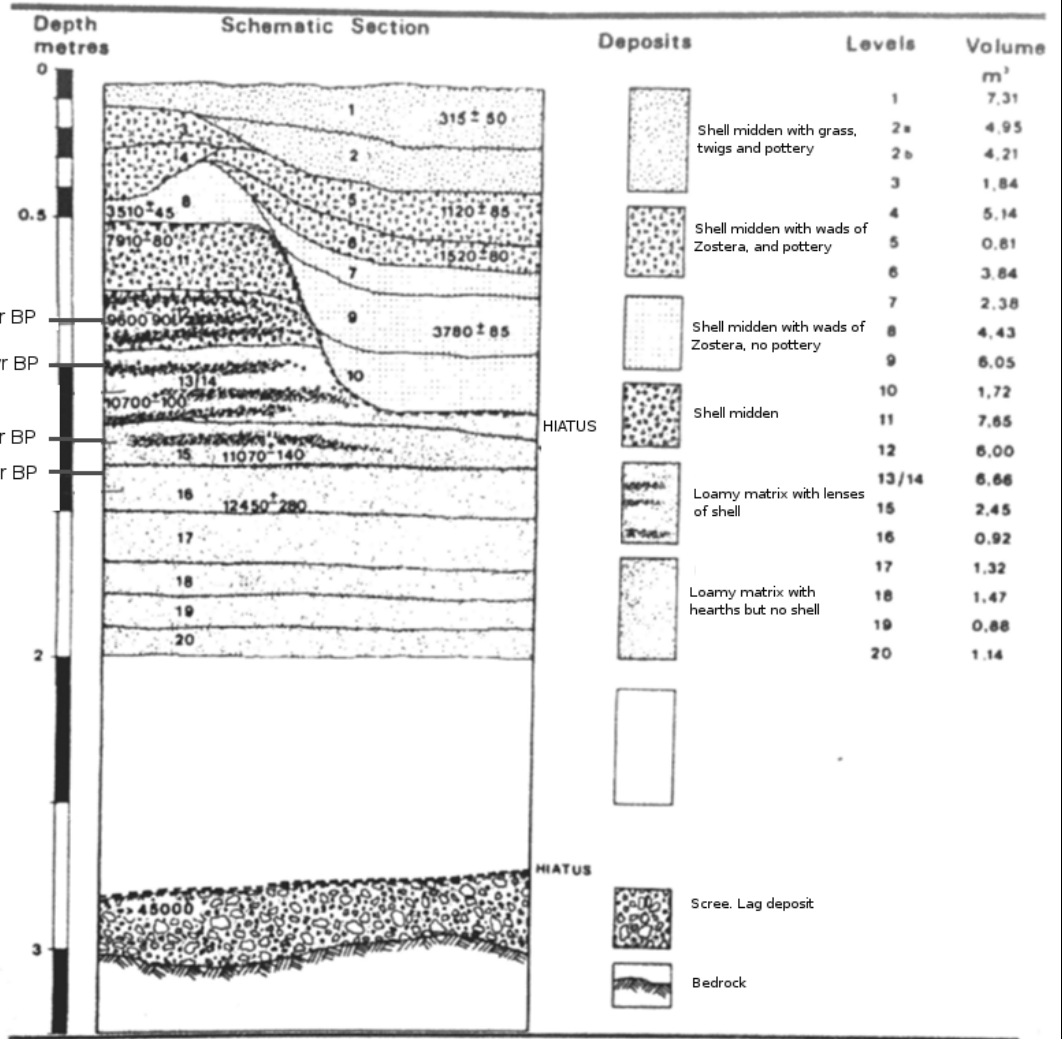
Closer to the modern coast on the sandsheet, Elands Bay Cave has an apparent occupational hiatus (or period of infrequent shelter use) after the Early Later Stone Age between ~20 cal kyr BP and ~17 cal kyr BP, followed by a Robberg-like industry referred to as 'terminal Pleistocene microlithic' between 15.6 - 13.8 cal kyr BP (GaK 4338) ([Orton 2006](#)). Similarly to Faraoskop, quartz accounts for more than 80% of all artefacts in the microlithic component of Elands Bay Cave. In the earliest microlithic layers, dating ~17 cal kyr BP (Pta 4321), bipolar reduction is very common and both bladelets and bladelet cores are uncommon. Bladelets are more common in the layers dating 16.4 - 13.2 cal kyr BP (Pta 4321; Pta 6756), and both silcrete and CCS show elevated proportions. At this point in time, hornfels sourced from the interior appears at Elands Bay Cave on the coast ([Parkington 1990](#), [Orton 2006](#)). [Orton \(2006\)](#) refers to the post-microlithic industries dating ~13 - 12 ka as 'transitional', followed by 'Albany-like' industries post-dating 11.5 cal kyr BP (Pta 2481). Quartz reaches its lowest proportion in these layers but is still easily the most common rock, and bipolar cores remain common. The post-microlithic sees increases in the proportions of quartzite, sandstone and, like Faraoskop, hornfels. Here again, the coastal link with the interior is seen. This increase is likely due to the rapid rise in sea levels: with the coast now being much closer to interior sites, movement to and from the coast would have likely been more feasible than previously. Furthermore, sea level rise brought the coastline, as well as coastal foragers, closer to the interior, and as such bringing interior and coastal groups closer to each others' habitat and interaction range since territory size was reduced. This must have had social implications such as competition and disputes, coupling and 'marriage' unions, changes in foraging strategies and/or family group size. The appearance of the above-mentioned materials in these areas also suggests an increase in trade and exchange between networks. Sites such as Elands Bay Cave or Faraoskop may have been visited more frequently. Thus we see marine shell at inland sites such as Klipfonteinrand and Putslaagte 8, and hornfels at coastal sites like Elands Bay Cave. The other most notable change in this period is the appearance of large scrapers across the region, potentially similar to those at Putslaagte 8 and again highlighting this connection.

On the south coast Winter Rainfall Zone, Byneskranskop has two new AMS dates associated with the Robberg: 17.1 - 16.5 cal kyr BP (OxA-32687) and 16.5 - 16.1 cal kyr BP (OxA-32686) ([Loftus et al. 2016](#)). The Robberg-like assemblages at this site (layers 18 & 19) have numerous bladelets, blades and blade cores. Quartz is relatively common and silcrete is rare.

Ostrich eggshell beads occur and there is a single piece of decorated ostrich eggshell (Schweitzer and Wilson 1982). The subsequent Oakhurst Industry, dating 13.9 - 11.7 cal kyr BP (OxA-32685, OxA-32684) (Loftus et al. 2016), is quartzite-dominated, with larger scrapers, adzes and micro-bladelets, and no segments. Schweitzer and Wilson (1982) refer to these layers as 'Albany'. Worked bone is present in the form of fish gorges, as well as marine shell and ostrich eggshell beads and decorated ostrich eggshell (Schweitzer and Wilson 1982, Lombard et al. 2012). Six of the eight perforated marine shell pieces in these Albany layers are *Donax serra*.

To the north, in Namaqualand, the undated site called AK2006/001G displays characteristics of a late Pleistocene microlithic industry, with a bladelet-rich, silcrete-rich assemblage, including bipolar reduction and low frequencies of retouch (Orton 2008a). As can be seen, there is much variation across the Winter Rainfall Zone in terms of the archaeology between roughly 24 ka and when the Last Glacial Maximum and Late Glacial are at their peak at 12 ka and the MIS 2 begins to terminate. Considering the dates taken at each site, and specifically those surrounding Klipfonteinrand, it is interesting to consider the timing of the Robberg termination in the area. In summary, with the dates that are available for Elands Bay Cave, Faraoskop and Putslaagte 8, it appears that the industry terminated by roughly 13.8 cal kyr BP (GaK 4338) ka at Elands Bay Cave (Parkington 1980), by 13.1 cal kyr BP (Pta-4817) at Faraoskop (Manhire 1993), but far earlier, by 20.0 cal kyr BP (AA98830), at Putslaagte 8 (Mackay et al. 2015).

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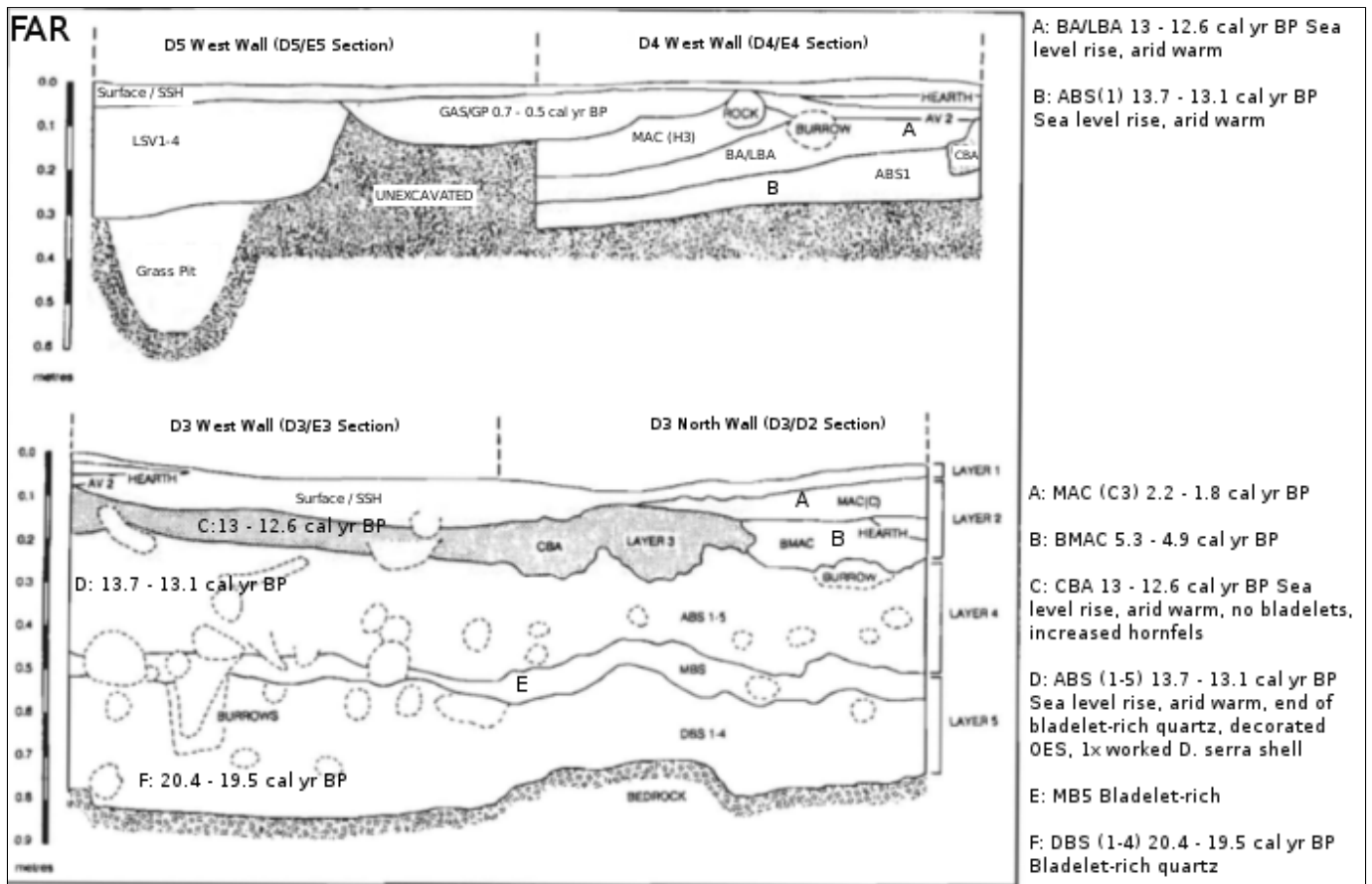


Figure 3.6. Reproduction of Figure 4 (Manhire 1993, page 7) showing the Faraoskop western and northern sections with radiocarbon dates and associated technological industries.

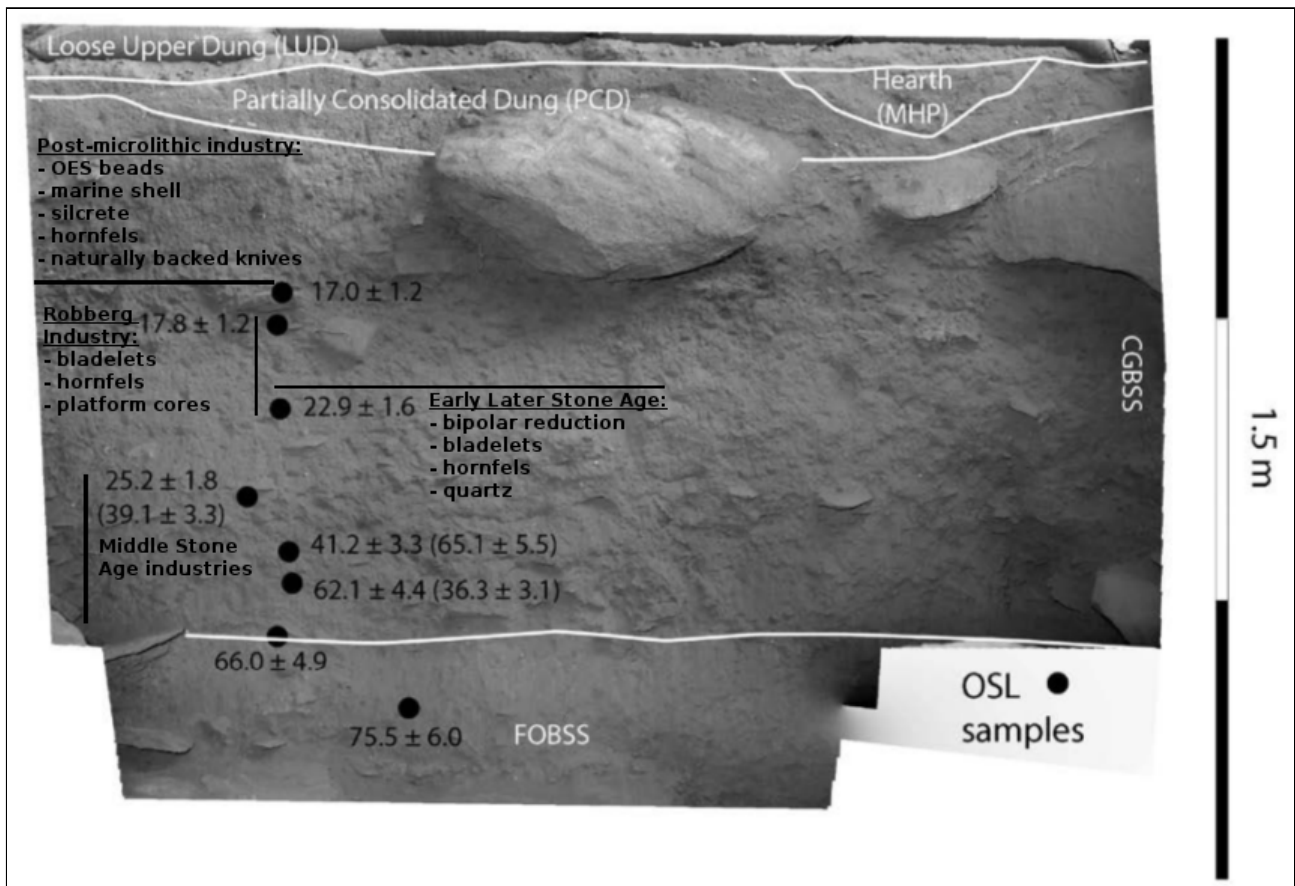


Figure 3.7. Reproduction of Figure 4 (Mackay et al. 2015, page 6) showing the Putslaagte 8 west section with OSL samples and associated technological industries (dates uncalibrated).

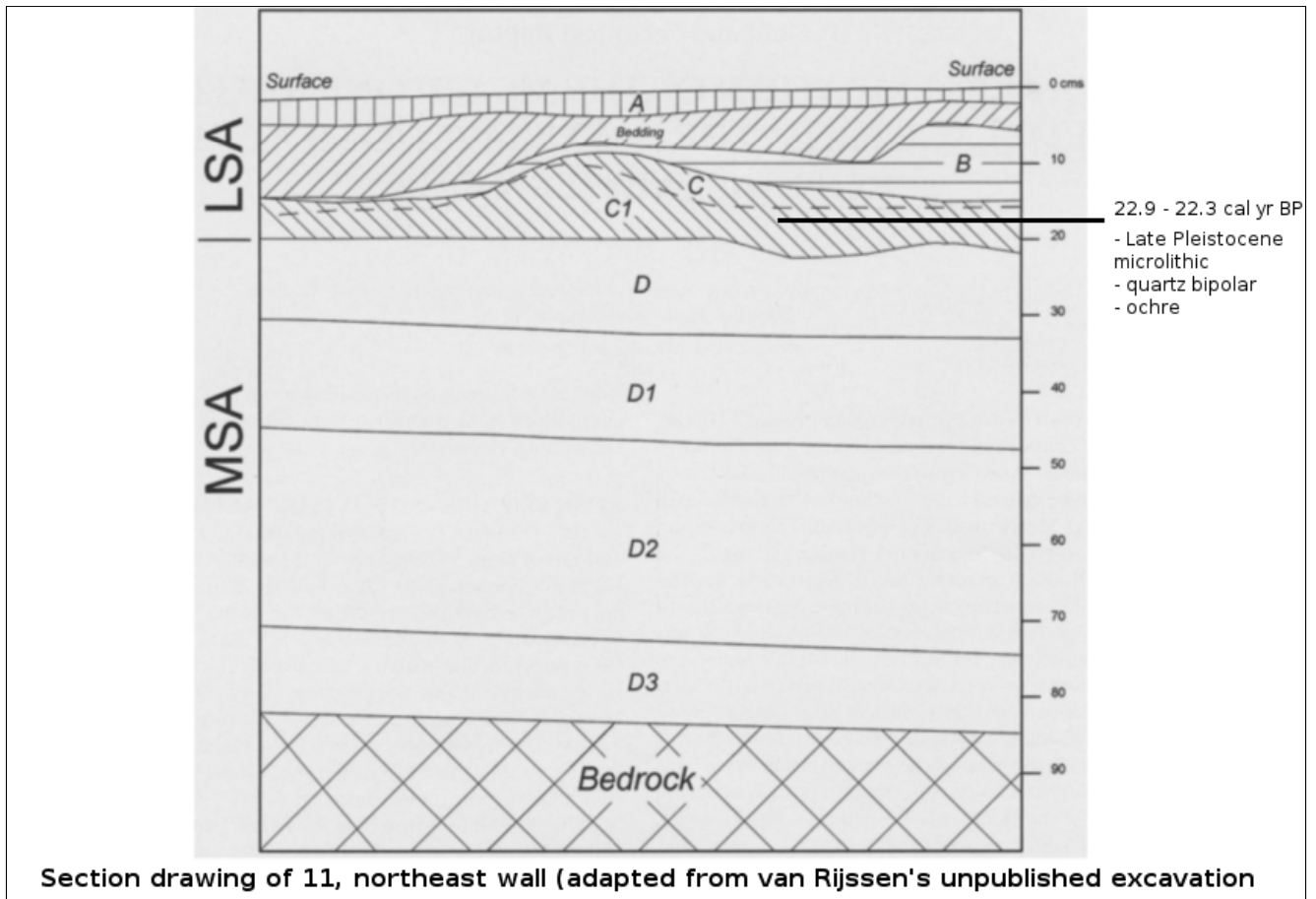


Figure 3.8. Reproduction of Figure 2 (Mackay 2006, page 182) showing the Klein Kliphuis northeast wall.

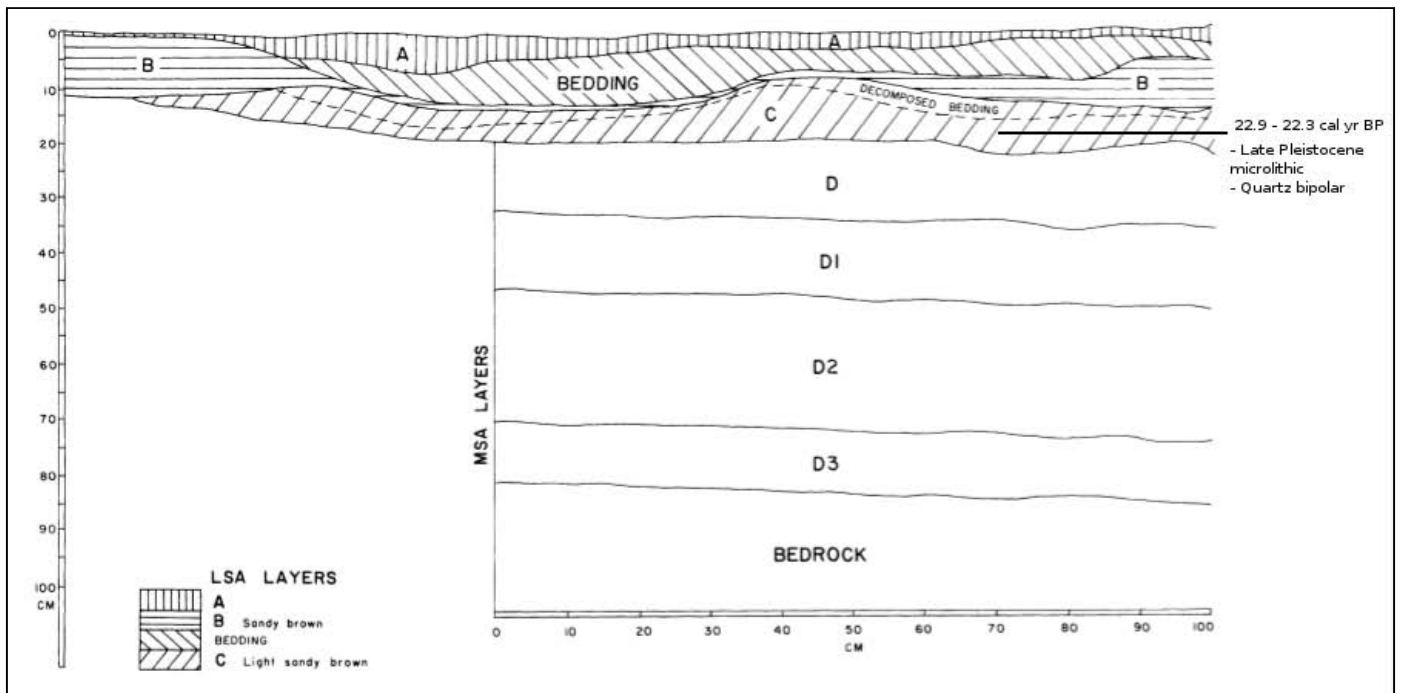


Figure 3.9. Reproduction of Figure 4 (Van Rijssen 1992, page 36) showing the Klein Kliphuis section through the east face of squares 11 & 12.

### 3.4.2. YEAR-ROUND RAINFALL ZONE MIS 2 ARCHAEOLOGY

The Robberg industry was first identified and named in this region, at Nelson Bay Cave on the Robberg peninsula (J. Deacon 1978, 1982, Lewis 2007). The Robberg-assigned layers at Nelson Bay Cave have new AMS ages of 23.4 - 12.0 cal kyr BP (OxA-32608, OxA-32607, OxA-32458, OxA-32457, OxA-32606), however it appears that some mixing occurs between Robberg and Oakhurst assemblages (Loftus et al. 2016). Similarly to Elands Bay Cave there seems to be a MIS 2 hiatus at Nelson Bay Cave, in this case between 18.5 - 17.65 cal kyr BP (OxA-32458) and 14.14 - 13.78 cal kyr BP (OxA-32457). After 14.8 cal kyr BP (OxA-32456) (Loftus et al. 2016) there is a fairly consistent set of ages through to the start of the Holocene (Deacon 1978, Mitchell 1988, Wadley 1993, Loftus et al. 2016). The Robberg assemblages at Nelson Bay Cave are characterised by a large number of bladelets, a few segments and scrapers (Deacon 1982, 1984, Lombard et al. 2012). Both YGL and YSL have mostly quartz artefacts, but only YSL has lots of silcrete (~24%). BSL has lower rates of quartz and much higher numbers of quartzite artefacts. Bone tools are rare but include fish gorges. Marine shell is very uncommon but ostrich eggshell beads do occur (Deacon 1982, 1984, Lombard et al. 2012).

The Oakhurst at Nelson Bay Cave is dated to between 14.8 - 9.5 cal kyr BP (OxA-32456, OxA-32455, OxA-32454, OxA-32453, OxA-32452, OxA-32451) (Loftus et al. 2016). Stone artefacts are more than 95% quartzite in most layers. Tools are characterised by many large scrapers mostly made of quartzite, no backed tools, and polished bone tools (including fish gorges) (Deacon 1978, 1982, 1984, Lombard et al. 2012). Ostrich eggshell beads are common and there is a diversity of marine shell, including *Donax serra*.

Nelson Bay Cave has various rubble (spall) layers that have been interpreted as having several possible origins (Butzer 1973a); frost-weathering is likely to have played a role in the flat and angular spalls, while thermoclastic weathering does not seem to have been significantly effectual. In order to determine this, several experiments were conducted by Butzer (1970) based on heating and cooling but which had little effect, while the major hearth units at the site were not associated with significant spall layers. Chemical-weathering may also have played a large role in the spalling events at Nelson Bay Cave (Butzer 1973a).

Boomplaas has an early Later Stone Age referred to as an 'undifferentiated blade industry' dating from >40 ka to ~25 ka (UW-300) (Deacon et al. 1976), but details are limited and the assemblages appear to be quite small (Deacon 1982). The Robberg at this site dates to between 18.0 - 16.6 cal kyr BP (UW-301) and 14.2 - 13.6 cal kyr BP (Pta-1828). Raw material choice is quite variable, although quartz is the most common rock throughout. In the oldest Robberg layers (GWA and CL4) silcrete is very common (>25%); in CL3 quartz is largely dominant (>80%) while in CL1, CL2 and BRL7, CCS artefacts are >15% and there is almost no silcrete. Blades and

bladelets are common in all of these layers, with tools being small scrapers, adzes, backed bladelets, segments, and a grindstone. Ostrich eggshell beads and some decorated fragments also occur in the Robberg at Boomplaas.

The Albany at Boomplaas dates to between 10.5 - 10.1 cal kyr BP (lab code unknown) and 12.5 - 12.1 cal kyr BP (UW-411). Quartz is still the most common rock for making artefacts, but quartzite remains quite common and there is much more hornfels than in earlier or later levels (Lombard et al. 2012). Tools are mostly large scrapers, and bladelets are very rare. Ostrich eggshell beads are quite abundant in the Albany, and there are many different engraved motifs on fragments of ostrich eggshell, including cross-hatching, parallel lines and ladders (Mitchell 1988, Binneman and Deacon 1986, Wadley 1993, Deacon 1979, Vogel 2001).

At Melkhoutboom, the Robberg deposit is dated to 18.9 - 18.4 cal kyr BP (UW-233), and includes small bladelet cores, ostrich eggshell beads, and two decorated ostrich eggshell fragments (with incised parallel lines) also occur in this period (Deacon 1969, Deacon 1974, Deacon 1976, Lombard et al. 2012).

Interesting to note is that raw materials used during the Terminal Pleistocene in both the Winter and the Year-round Rainfall Zones consist mostly of quartz, quartzite and silcrete, with low numbers of alternative materials. The case is slightly different in the Summer Rainfall Zone, discussed below.

### 3.4.3. SUMMER RAINFALL ZONE MIS 2 ARCHAEOLOGY

The Summer Rainfall Zone has a large number of archaeological sites dating to MIS 2, including Early Later Stone Age, Robberg and Oakhurst. Border Cave is one of the best examples of an Early Later Stone Age site, with dates between 44 ka and 42 ka for the emergence of the Later Stone Age (D'Errico et al. 2012b, Villa et al. 2012), which is far older than the majority of other Early Later Stone Age sites, which fall within the range of 30 - 20 ka, as seen at other sites discussed in this chapter. The Early Later Stone Age raw materials at Border Cave are dominated by rhyolites, with a transition to chalcedony and quartz in later Robberg levels (Villa et al. 2012).

This Early Later Stone Age technology is succeeded by the Robberg Industry as early as 25.0 cal kyr BP (Sehonghong, Pta-6077) in the Summer Rainfall Zone, persisting until 12.6 cal kyr BP (Pta-6065) (Mitchell 1995). Umhlatuzana has a later Robberg industry which initiates at around 16.5 cal kyr BP (Pta-4226) and terminates by 10.2 cal kyr BP (Pta-4307) (Kaplan 1990). At Rose Cottage Cave the Robberg occurs between 19.1 - 18.8 cal kyr BP (Pta-6195) and 11.2 - 10.7 cal kyr BP (Pta-7275). The industry is characterised by cone-shaped bladelet cores, substantial numbers of scrapers, backed tools, grindstones, bone points and ostrich eggshell beads (Wadley 1996b; Pienaar et al. 2008, Lombard et al. 2012).

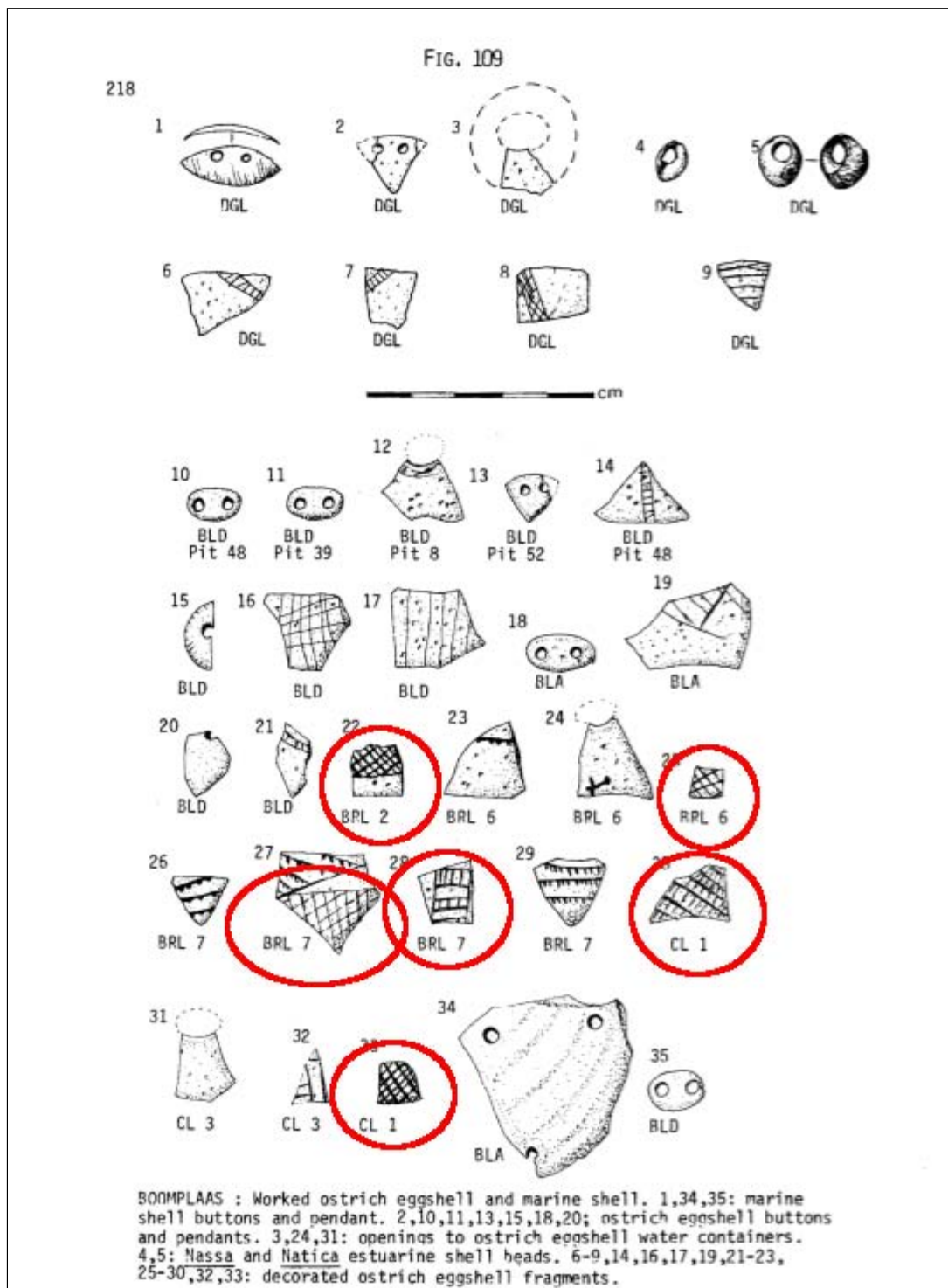


Figure 3.10. Reproduction of Figure 109 (Deacon 1982; page 218), indicating engraved ostrich eggshell from Boomplaas, in the layers BRL (dating to 13 - 11.2 cal kyr BP [UW-411]) and CL (dating to 18 - 13.6 cal kyr BP [Pta-1828, UW-301]).

The raw materials in the Summer Rainfall Zone are high-quality fine-grained volcanic materials from the Drakensberg lavas, such as milky quartz, chalcedony and opalines (cryptocrystalline raw material types) (Wadley 1993, Mitchell 1995, Villa et al. 2012, Pargeter and Redondo 2016). Rose Cottage Cave and Sehonghong have high numbers of fine-grained brightly coloured opalines (chalcedonies, cherts, agates), and Robberg assemblages (especially bladelets and scrapers) are made up of more than 80% of these. Additional use of hornfels and quartz is also evident, with some sandstone, quartzite and tuffaceous rock at Umhlatuzana and Rose Cottage Cave.

Following the Robberg industry, lithics took on a less microlithic character. The Oakhurst Industry (also known as the Albany Industry in the interior) occurs in the period between 12 – 7.5 ka and is characterised by end-scrapers and very few microliths. Bone tools are also common during this period (Deacon and Deacon 1999). These Holocene industries have been found at several sites in the Summer Rainfall Zone: Bushman Shelter (Sampson 1974, Plug 1981 and 1982), Jubilee Rock Shelter (Wadley 1987), Rose Cottage Cave (Wadley 1997), Sehonghong (Mitchell 1996) and Ntloana Tsoana (Mitchell 1993).

The age of ostrich eggshell beads at Sehonghong is 14.2 cal kyr BP (Pta-6062) to 15.1 cal kyr BP (Pta-6058), with no engraved fragments of ostrich eggshell having been recovered there. Ostrich eggshell must have been introduced to the site from elsewhere, as ostriches were unlikely to have inhabited this region with its environmental conditions (Mitchell 1995). This is also the case at Umhlatuzana, where ostrich eggshell beads date to 16.5 - 15.8 cal kyr BP (Pta - 4226) (Kaplan 1990). At Sehonghong, a marine shell pendant exists, predating 13.5 - 12.6 cal kyr BP (Pta-6065), which was necessarily transported up to 200 km to reach the site (Mitchell 1995). At Rose Cottage Cave, ostrich eggshell beads are no older than 12 ka, and neither engraved ostrich eggshell nor marine shell have been recovered in the Robberg or Oakhurst (Wadley 2001). Border Cave has an early date of 40.8 - 44.3 cal kyr BP (KIA 44423) for ostrich eggshell beads (Villa et al. 2012). A final remark on the spall layers at Border Cave is that Butzer (1978) believes the origin of this to have been mechanical, caused by frost-weathering, suggested by the numerous flat, angular spalls. However, interesting to note is that although minimum temperatures (to produce frost) were unlikely to have been reached at Border Cave during these spalling events, the continuation of decreasing winter temperatures could have had an effect (1978: 330).

The most significant conclusions to draw from this region are that the Robberg persisted quite late until roughly 12 ka and dominant raw materials are of a high-quality due to the topography of the region (opalines wash down river tributaries from the Drakensberg lavas (Wadley 1991) and are more easily accessible than in other parts of southern Africa).

### 3.5 CONCLUDING REMARKS

This chapter has synthesised research into environmental and climatic changes in southern Africa, including changes in sea levels over the last 25 kyr, as well as current day conditions within the three key rainfall zones of the region. Following this, the palaeoenvironments of these three rainfall zones were discussed, specifically that of the last 21 - 11 kyr, when the Last Glacial Maximum, and later, the Late Glacial periods determined the climatic conditions of the sub-continent. The Cederberg, specifically, was discussed and situated within the context of MIS 2, with a

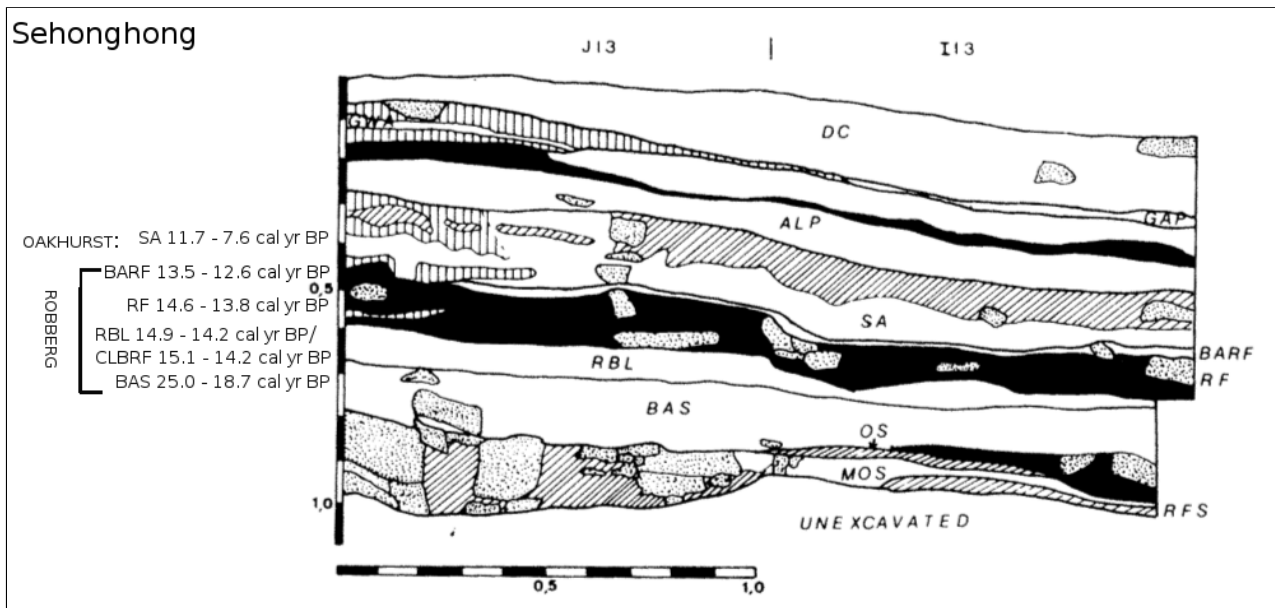


Figure 3.11. Reproduction of Figure 2 (Mitchell 1995, page 29) showing the Sehonghong north section with radiocarbon dates and associated technological industries.

synthesis of archaeological trends during the Late and Terminal Pleistocene of this area and the three key rainfall zones. The Terminal Pleistocene in the Cederberg was a period of change from arid and warm to moister and colder conditions during the Last Glacial Maximum, and then warmer and dryer again at the glacial-interglacial transition before the start of the Holocene around 12,700 <sup>14</sup>C yr BP (Quick 2009, Chase et al. 2011, Valsecchi et al. 2013). The key lithic industry that appears across southern Africa during this time is the microlithic, bladelet-rich Robberg Industry, the oldest start date appearing to be at Sehonghong in the Summer Rainfall Zone at 25.0 - 23.8 cal kyr BP (Pta-6077) (Mitchell 1995), and the youngest termination date seemingly at Umhlatuzana in the Summer Rainfall Zone at 10.6 -10.2 cal kyr BP (Pta- 4307) (Kaplan 1990). Across the board, an increase in the use of organic materials as decorative and symbolic becomes noticeable during this period, with ostrich eggshell jewellery and decorated water flasks, decorated bone implements, the more regular use of ochre and the transport of marine shell across large distances, are all indicative of behaviourally modern practices.

This chapter has been important for understanding the context within which human behavioural adaptation has occurred over the last 29,000 years of MIS 2. When looking at southern Africa as a whole, and the various palaeoenvironmental changes that took place in the Terminal Pleistocene and the pressures that these changes presented to mobile hunter-gatherer groups (unreliable water and food sources, rapidly changing environments and climate), it becomes clear that several patterns emerge in the archaeological record that unite human behavioural trends. This can be seen in the movement of material between the coast and the interior during specific time periods, or in shared ideas and production of lithic industries between groups of people, and symbolic and decorative assemblages (such as jewellery, ochre usage or

decorated receptacles). The remainder of this thesis will situate Klipfonteinrand Rock Shelter within this context and compare the patterns that emerge here with those on a local, regional and inter-regional scale during the Terminal Pleistocene.

### 3.5.1 QUESTIONS AND EXPECTATIONS

In light of the aforementioned discussion and the succession of industries through MIS 2 potentially responding to climatic fluctuations, Klipfonteinrand offers several key features that support a pattern of movement and cohesion among sites on a local, regional and inter-regional level. At a local scale, how does the archaeology at Klipfonteinrand respond to palaeoenvironmental changes as we understand them in the Cederberg? Is the Robberg Industry a response to environmental change or did it develop independently? What are the characteristics of the archaeology of this period at Klipfonteinrand?

At a regional scale, Elands Bay Cave on the coast has a series of layers dominated by quartz bipolar lithics during the terminal Pleistocene, as does Putslaagte 8 in the interior to the northeast of Klipfonteinrand. How does the lithic archaeology of Klipfonteinrand fit in with these sites further away? Does the archaeology look the same, regionally, at the same time? Are the dates of Robberg termination similar on a regional level?

Finally, at an inter-regional scale, revised dates from recent studies by [Loftus et al. \(2016\)](#) suggest asynchronous Robberg termination dates between the east and west of southern Africa. How does Klipfonteinrand compare with sites further away? How does industrial change relate to environmental change and sea level change?

The subsequent results are analysed with the following expectations in mind:

- Analysis of changes in stone artefact core and tool types should reflect a combination of adaptive and cultural factors in response to environmental variation ([Tostevin 2011](#), [Tostevin 2012](#), [Mackay, Stewart et al. 2014](#)). Although this is not necessarily a one-to-one correlation, and there are certainly other causal mechanisms of behavioural change such as demography, social structure or cultural transmission, the key environmental transformations that are discussed are the focus of this thesis. It is expected that patterns could emerge when studying the timing of technological industrial changes between sites across southern Africa.

- Taphonomic effects notwithstanding, the occurrence of marine shell at the site at the time of global sea level rise is very interesting considering the minimum distance of the site to the coastline. The presence of marine shell is expected to reflect interactions with coastal populations and potentially with movement between the two regions. Such interactions would likely have been more difficult during MIS 2, where the distance to shore was approximately 110-130 km away ([Lambeck et al. 2002](#), [Barrable et al. 2002](#), [Mackay 2013](#)). Thus the appearance of marine shell at Klipfonteinrand is associated with the rise in sea levels is discussed (see Figure 3.1). The very presence of marine shell at the site is particularly interesting, as the normal transport radius of shellfish is 8-10 km ([Bailey and Craighead 2003](#), [Jerardino 2003](#), [Jerardino and Marean 2010](#)). This points most likely to the transport of these shellfish to Klipfonteinrand being for use other than food, as shellfish would become inedible after only a few hours of being removed from water ([Steele and Klein 2013](#)), and were thus likely brought inland for use as tools, receptacles or ornaments.

- Measurements of the thickness of ostrich eggshell fragments may provide insights into decay and preservation, as well as environmental variation ([Johnson et al. 1997](#), [Koch 1998](#), [Johnson et al. 1998](#), [Ecker et al. 2015](#)). If older fragments of ostrich eggshell are thinner than younger fragments, it may be pointing either to declining preservation conditions, or to external factors such as water availability and vegetation consumed by ostriches during the study period, affecting the composition of the shell.

- Changes in the size of ostrich eggshell beads suggest changes in cultural preference which may, in some cases, be linked to population replacement ([Kandel and Conard 2005](#), [Orton 2008b](#)).

- Variation in the size and abundance of roof spall may reflect the interaction between ambient temperature, moisture and rock shelter occupation, particularly where occupation is associated with the use of fire within the shelter ([Butzer 1973, 1979](#), [Butzer et al. 1978](#), [Butzer 2004](#), [Chase and Meadows 2009](#)). Spall size may be a reflection of occupation intensity insofar as it is possible that more intensive trampling of the ground by people and/or their livestock could break spalls down into smaller sizes, therefore layers with larger spalls may have encountered less intensive trampling, suggesting less intensive occupation.

This study includes a lithic analysis based on a quantification of lithic change within specific parameters, as set out below. This chapter begins by looking at the lithic sample selected for analysis, and then moves on to each of the other materials studied. Basic analyses have been done for all excavated materials, which will be described here; the level of analysis is coarse, and was necessary due to time constraints based on the scale of data included in this research. For example, it is not refined enough to reach reliable conclusions of important parameters of lithic variability, such as metrics, knapping technique or reduction sequences. Although the majority of the data presented is quantitative (looking at abundance and presence/absence), some detailed discussion is provided for the lithics, ostrich eggshell and marine shell. Within the southern trench, materials from squares 8, 9 and 10 have been analysed, as these had the most intact sequence, with an extensive west section. Square 9 has a smaller assemblage, owing to the fact that it was excavated right against the rear wall of the shelter where a large boulder protruded into the square, limiting the volume of deposit. The data set that this research is based on includes both finds plotted *in situ* and the remaining material from the aggregate brought back to the laboratory at the University of Cape Town. However, the data that are presented are only from uncompromised stratigraphic units, omitting any data that were not found *in situ* or that have been significantly impacted by post-depositional disturbance. Furthermore, the quantities of materials presented in Chapter 5 are relative to the volume of sediment removed (ie. bucket height data was used to make calculations to standardise the results across varying meta-strata).

#### 4.1 RADIOCARBON DATES

Following the end of the excavations at Klipfonteinrand, a series of 12 radiocarbon assays on piece plotted charcoal was made for the rear trench (See Table 5a in Chapter 5 for radiocarbon dates). Sampled charcoal nodules were larger than 1 cm or agglomerations in bags. These samples were dated in Seattle by DirectAMS. These dates are plotted in OxCal and are compared with the sections and strata for signs of occupational pulsing and discontinuity. A further five ages on bone submitted were unsuccessful.

#### 4.2 LITHICS

Different rock types have different distributions through space, and the frequency of these at any given place will be influenced by changing occupational loci, by distance to source and by the transport decisions made while people were moving around landscapes (Gramly 1980, Parry and

Kelly 1987, Jeske 1989, Andrefsky 1994a, Kuhn 1995a, Brantingham 2003, Wilson 2007, Pop 2015). These changes will be responsive to environmental variation but cannot be entirely explained by them: stochastic cultural factors are also at play (Deacon, J. 1978, Mitchell, 1988, Fitzhugh 2001, Orton 2006, Lombard et al. 2012).

A total of 1357 lithics was included in this particular analysis from the southern trench squares. During analysis, only plotted data were used for the raw material recording. Time constraints did not allow for additional analysis of aggregate data. It should be noted that when different analysts classify rocks, variable results are produced. In this case, the classification of plotted artefacts was all done under the supervision of Dr. Mackay, and thus provides at least an internally consistent classification of raw materials among the plotted fraction.

A general frequency analysis was conducted for artefact types, including bladelets, bladelet cores, bipolar cores (counted separately from other cores), other cores (including core reduced pieces, radial, platform, discoid and rotated cores), scrapers, backed artefacts, naturally backed knives, *outils esquillées*, notches and an 'other' category (which includes miscellaneous retouched pieces and large bladelets >30 mm). Also separated were distinctive flakes twice as wide as they are long, likely relating to the post-Robberg reduction of cobble cores (Mackay pers. comm.); they were prosaically referred to as 'wingnuts' due to their form. No analysis was conducted for debitage products, although they made up a sizeable proportion of the lithic assemblage and are important for a complete and comprehensive view of lithic assemblages. This scale of analysis was beyond the scope of this project, but would be useful in future studies.

After this basic classification, any artefact types that are common in the Robberg Industry at other sites in southern Africa were selected from this assemblage (see types below), and a more comprehensive study of these artefacts was undertaken in order to determine whether any particular raw materials were preferentially chosen to produce formal tools during this time-period. As discussed in Chapter 3, silcrete and hornfels cannot be sourced locally to Klipfonteinrand. The hornfels at this site can thus be used to link the occupants of this site to the Doring River 20 km to the north-east. Silcrete has been located on the Agtesfontein ridges 25 km to the southeast and at Swartvlei 25 km to the northeast. The Doring River also holds secondary silcrete cobbles (Schmidt and Mackay 2016).

Regarding the aggregate, only lithics recovered from the 3 mm sieve were analysed, the reason being that the 1 mm bags contained very small and fragmented pieces of stone that mostly consisted of roof spall and almost no formal tools, whereas the 3 mm bags contained mostly whole artefacts, and not as much roof spall and debris. Only artefacts that fit the "bladelet" description were taken from the 1 mm bags and included in the count for the 3 mm bags, in order for a control to be established for the bladelet-rich Robberg-like component of the lithic assemblage. According

to [Deacon \(1984a\)](#) and [Wadley \(1996\)](#), Robberg bladelets are characterised as being mostly un-retouched, smaller than 25 mm, and originating from unfaceted platform cores.

The total number of artefacts found in each context was recorded. The number of specifically Robberg-like artefacts was recorded within that, and categorised as follows: scrapers, bladelets (flakes <25mm in size, twice as long as they are wide), bladelet cores, backed artefacts, bipolar cores, other cores (including core reduced pieces, radial, platform, discoid and rotational cores) and 'other' (*outils esquillées*, miscellaneous retouched pieces and large bladelets >30 mm). Finally, the number of each of these Robberg-like artefacts made from each of the different materials is recorded: silcrete, quartzite, quartz, CCS, hornfels. The more distinctive Robberg-like artefact types that can be specifically categorised are bladelets and bladelet cores ([Deacon 1984a](#), [Wadley 1996](#)). However, even these, as well as the rest of the artefact types mentioned above, can be found in many other technological industries through time, including later industries (e.g. the Wilton) as well as much earlier industries (e.g. the Howiesons Poort) ([Deacon 1984a](#), [Cochrane 2006](#), [2008](#)). They have been included in this recording because they have been found most abundantly in the Robberg industry between 22 and 10 ka (see Chapter 3). This current assessment does not assume that the lithics within this time-period are definitively a Robberg assemblage; this is merely a comparison of artefact-types to other sites which have been identified as having a specifically Robberg sequence. When assessing the raw material selection between 22 and 10 ka, particular attention has been given to the bladelets and bladelet cores.

It is plausible that patterns in the timing of the Robberg Industry could emerge across the southern Africa, considering the relatively short time-span in which it occurs. Data relating to the dating of the Robberg Industry in southern Africa are assessed in order to determine whether this technological industry was introduced in one area of the region, and disseminated to new regions in an organised way, in order to attempt to explain the variation in start and end dates of the industry at different sites. The sites mentioned in Chapter 1 are assessed and divided according to rainfall zones. Specifically, the start and end dates, as stipulated by the relevant researchers for each site, for the emergence and disappearance of lithics adhering to the character of the Robberg Industry will be recorded. In conjunction, the relevant palaeoclimatic data for each time period and site will be recorded, as discussed in Chapter 3.

### 4.3 OSTRICH EGGSHELL

The state of preservation of organic materials such as ostrich eggshell will be influenced by local (potentially site-specific) variation in preservational conditions. These can be approximated by quantifying variation in abundance through the sequence, while additional measures such as changes in the thickness of ostrich eggshell fragments may provide insights into decay and

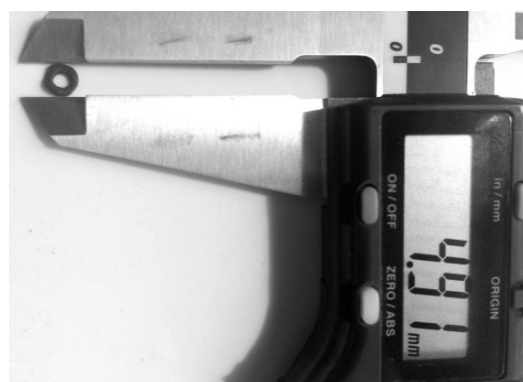
potential aridity (Johnson et al. 1997, Koch 1998, Johnson et al. 1998, Ecker et al. 2015) or the confounding effects of taphonomy. It is expected that ostriches were always present in the area, as ostrich eggshell fragments occur throughout the sequence, albeit in far lower numbers in older levels. In order to explore the potential extent of taphonomic control on this decrease in ostrich eggshell, thickness of fragments was measured as a possible proxy for decay, though the potential influence of environmental factors is also noted (Koch 1998, Johnson et al. 1997, Johnson et al. 1998, Lee-Thorp and Sponheimer 2007, Ecker et al. 2015). Time constraints did not allow for analysis of plotted ostrich eggshell fragments or beads, but the number of beads was relatively low (n=19).


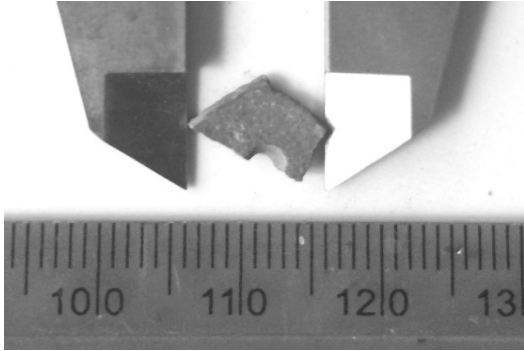

The size of ostrich eggshell beads was measured (with a pair of Absolute Digimatic callipers in millimetres (mm)), in order to determine any changes of cultural preference through time (Mitchell 1996, Orton 2008b), where the maximum dimension (widest side) of the bead in its diameter was measured, as well as its thickness (Figure 4.1 and 4.2). Some beads in the collection are unfinished, and in these cases the maximum length of the bead was measured at the opposite side of the initiated perforation (Figure 4.3). As studies have shown (Kandel & Conard 2005, Orton 2008b), different production strategies were used when creating ostrich eggshell beads in the Later Stone Age; once an ostrich egg had broken and been fragmented, beads were manufactured in one of two ways: either fragments would first be drilled and then rounded into the final bead shape, or they would be rounded first and then drilled.

In calculating bead diameter metrics, only beads from reliable and uncompromised contexts were included, and unfinished beads, which generally have a larger size as they have not been shaped completely or ground down to a finished product, were excluded.

The thickness of ostrich eggshell fragments was measured (Figure 4.4). Neither the length nor breadth of the ostrich eggshell fragments was measured, as it is difficult to tell much from these types of measurements, as ostrich eggshell could have been broken up and fragmented in any number of ways.

Figure 4.1  
Bead diameter (mm)



<p>Figure 4.2 Bead thickness (mm)</p>	
<p>Figure 4.3 Unfinished bead, largest side (mm)</p>	
<p>Figure 4.4 Fragment thickness (mm)</p>	

#### 4.4 MARINE SHELL

Marine shell is examined for the purpose of ascertaining linkages between occupation of Klipfonteinrand and potential social connections with the coastline 110 - 130 km away. Shell was classified by species with the intention of obtaining information about which species late Pleistocene people had available to them and which they were exploiting, and whether this changed over time, as well as the frequency of marine shell in the assemblage. It is not possible to reliably determine which species were consumed at the coast, as these would presumably not have made it back to Klipfonteinrand. However, the species that did come into contact with the inhabitants of Klipfonteinrand in the interior may offer insight into the cultural and practical use of marine shell (for example as tools or receptacles) as opposed to just food. Each fragment was also weighed, and assessed closely for intentional anthropogenic modification.

## 4.5 ADDITIONAL

### 4.5.1 ROOF SPALL

An abundance of naturogenic rock from the shelter itself was recovered during excavation. These were plotted *in situ* if they measured 5 cm or more. The 10 largest rocks and roof spall that were greater in size than 30 mm per context in the aggregate have also been measured. The average size of these ten largest rocks was determined in order to ascertain any changes likely related to changes in temperature over the last ~23,000 years ([Butzer 1973b](#), [Butzer et al. 1978](#), [Boelhouwers 1993](#), [Butzer 2004](#)).

### 4.5.2 CHARCOAL

The aim of analyzing the charcoal is to determine the frequency of charcoal at the site over time, and to shed some light on the patterns of fire building within the shelter over the last ~23,000 years. Potentially, if a stratigraphic unit consists of denser charcoal then it is fair to assume that more fires were built during that period of time, or that there was an increase in the occupation and use of the rock shelter.

Charcoal was not plotted *in situ* as a find, but rather as a sample for radiocarbon dating, and only if each charcoal nodule was larger than 1 cm in size, or if it was found in a mound or group of nodules. If charcoal appeared in uniform patterns or structures, then the outline was fully plotted with the Total Station to determine whether it was a significant hearth, post-hole, or other burned feature. That which was not sampled and which remained in the aggregate deposit was later weighed and tabulated by means of 'mass in grams', presenting a simple version of the abundance of charcoal plotted against stratigraphic unit of time.

### 4.5.3 BONE

Bone has been weighed for the purposes of understanding preservation and site taphonomy. Bone (over the size of 30 mm) was plotted *in situ* with the total station. Similar to charcoal, the frequency of bone has been tabulated by means of 'mass in grams', showing frequency through time. A full analysis of the bone from this site has been undertaken by Teresa Steele (2016).

### 4.5.4 OCHRE

According to archaeologists, if a piece of ferruginised rock can make a streak on a surface it is called ochre, or at the very least pigment ([Hahndiek 2014](#), [Sumner 2014 personal communication](#)). The objective of analysing the ochre is to gain an understanding of the behaviour of the occupants of Klipfonteinrand rock shelter, and their concept of symbolism in everyday life.

The main objective with the ochre is to categorise it into types. This is inherently quite difficult to do, because the scope of this project does not allow for a geochemical analysis of the material, and so a close examination of how the ochre has been formed or exactly what type it is has not been possible. Therefore the categories and terms I have chosen are merely descriptive and are based on colour: red, yellow, purple, orange, black and reddish-brown.

The ochre has been weighed and classified, and any fragments that were intentionally ground, polished, flaked or worked in any way have been recorded. In order to provide the pretext for a more in-depth study on whether scheduling affects ochre sourcing and reduction, ochre data have been tabled and classified into types, with total quantities recorded and the frequency of reduction recorded as well.

A large material assemblage is analysed in this research project, and the analytical methods that have been presented here and applied to these materials result in interesting patterns and trends. These will be demonstrated in the following chapters.

This chapter presents results from an analysis of the materials excavated at Klipfonteinrand from three squares (8, 9 and 10) and only from uncompromised stratigraphic units. Most data from stratigraphic units that are not reliable have been omitted, except for the very small marine shell assemblage (the whole of which has been included merely for the purposes of species presence/absence). Each material is discussed in its own section for ease of reference, according to the main research questions set out in Chapter 3.

### 5.1 RADIOCARBON DATES

The samples taken from charcoal in the southern trench resulted in a series of almost continuous age brackets between ~13 ka and ~22 ka; these radiocarbon ages are presented in Table 2a and 5a. However, some discontinuity can be seen in the occupation of the site; the radiocarbon dates were plotted in OxCal, and assessed relative to the sequence, and it was observed that there are occupational pulses at Klipfonteinrand. This occurs most clearly between 14,230 ±130 and 16,170 ±100 cal kyr BP, and again between 19,130 ±100 cal kyr BP and 22,100 ±120 cal kyr BP. Therefore, a mostly steady and continuous occupation of Klipfonteinrand can be seen between roughly 16 and 19 ka, with less intensive occupation occurring at the start of the BWBS, and at the end of the OB, meta-strata.

The oldest radiocarbon date does not represent the termination of occupation at the site, as the northern trench is far older in sequence based on the lithic industries recovered. Furthermore, accumulation of deposit appears to have begun in the southern trench at roughly 60,000 ka (based on technology recovered), with a hiatus in occupation of approximately 38,000 years until deposit begins to accumulate again at 22,100 ±120 cal kyr BP. This has implications for the understanding of industrial and cultural changes prior to BWBS: since occupation of Klipfonteinrand was either very ephemeral or non-existent before 22.3 cal kyr BP, we cannot know for sure when exactly the Robberg Industry began in this microregion or what cultural preferences persisted. Therefore the earliest dates of this assemblage do not necessarily indicate the start dates of the Robberg Industry at Klipfonteinrand.

META STRAT	RADIOCARBON DATE ( <sup>14</sup> C yr BP)	CALIBRATED AGE (cal kyr BP)	LAB CODE
LWBS	11723±52	13384-13703	D-AMS 001836
LWBS	12303±41	14003-14425	D-AMS 002439
OB	13439±56	15897-16314	D-AMS 003797
OB	13584±58	16087-16555	D-AMS 003798
WS	13722±49	16275-16766	D-AMS 001837
WS	14131±61	16885-17407	D-AMS 002440
BB	14656±55	17606-17979	D-AMS 003799
BB	14706±65	17637-18039	D-AMS 001838
BWBS	15309±65	18355-18710	D-AMS 002440
BWBS	15342±65	18389-18739	D-AMS 002441
BWBS	15871±59	18902-19276	D-AMS 003800
BWBS	18232±71	21829-22294	D-AMS 001839

Table 5a. Calibrated radiocarbon ages taken from charcoal samples from the southern trench, with associated meta-strata indicated.

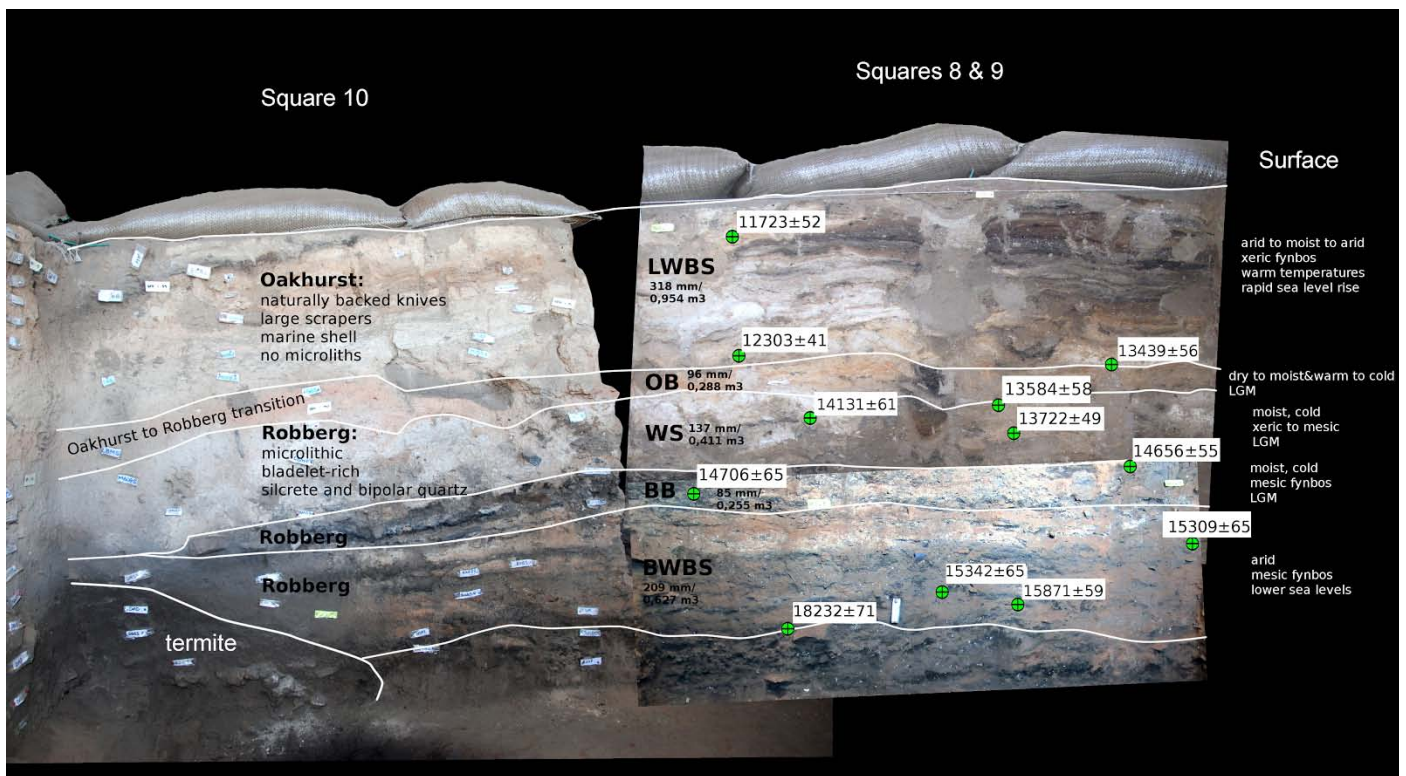


Figure 5.1 Photograph of southern section of southern trench, with (raw) dated meta-strata indicated alongside the volume of sediment of each meta-stratum, with lithic industry details to the left and palaeo-environmental details to the right.

## 5.2 LITHICS

In light of the questions related to industrial change at Klipfonteinrand - including what the characteristics of the archaeology at the site actually are; how this site compares with sites further afield in terms of lithic technological changes and whether it looks similar at a regional scale at a similar time; whether the dates of Robberg termination are similar at a regional level; and at an inter-regional scale how industrial change at Klipfonteinrand compares with environmental and sea level changes - the following results were observed during data collection.

### 5.2.1 ARTEFACT TYPES AND TECHNOLOGICAL CHARACTERISATION

Bladelets occur in far higher numbers (62.61 % of the assemblage) than any other artefact type between 22.3 and 16.3 cal kyr BP (Figure 5.2). Cores (bladelet cores, bipolar cores, core reduced pieces, radial, platform, discoid and rotated cores) are also high in number during this period (25.57 % of the assemblage). Bipolar cores are in fact highest in number between 18.0 and 16.3 cal kyr BP. Bladelets drop in number between 16.6 and 15.9 cal kyr BP while cores dominate the assemblage, but bladelets do increase again between 14.4 and 13.4 cal kyr BP. Bladelet cores are highest in number from 22.3 - 18.4 cal kyr BP, however only comprise 3.48 % of the assemblage. Naturally backed knives begin to appear in the period between 16.6 and 13.4 cal kyr BP.

Artefacts that were selected by type for closer analysis totalled 539. These more specific artefact types include bladelets, bladelet cores, bipolar cores, other cores (including core reduced pieces, radial, platform, discoid and rotational cores), scrapers, backed artefacts and 'other' (which includes miscellaneous retouched pieces and large bladelets >30 mm). The frequency of these artefact types increases in older levels; specifically bladelets and bladelet cores are at their highest in number between 22.3 and 16.3 cal kyr BP. The 'other cores' category peaks in the same time period, and bipolar cores between 18.0 and 16.3 cal kyr BP (Figure 5.3).

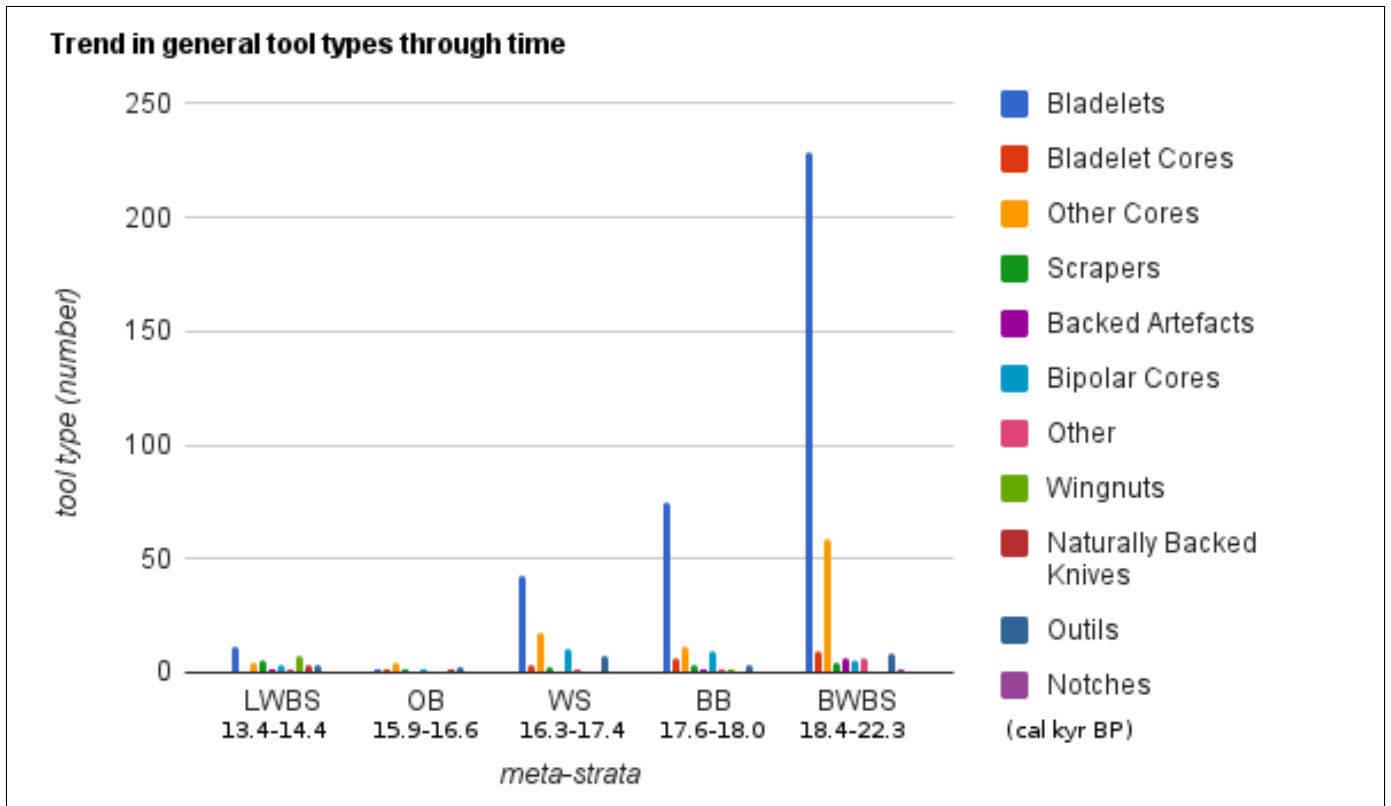


Figure 5.2. Bar chart showing the patterns of general artefact type numbers through time, indicating bladelets outnumbering other tool types from BWBS to WS (between 22.3 and 16.3 cal kyr BP), with an appearance of naturally backed knives in OB and LWBS (between 16.6 and 13.4 cal kyr BP).

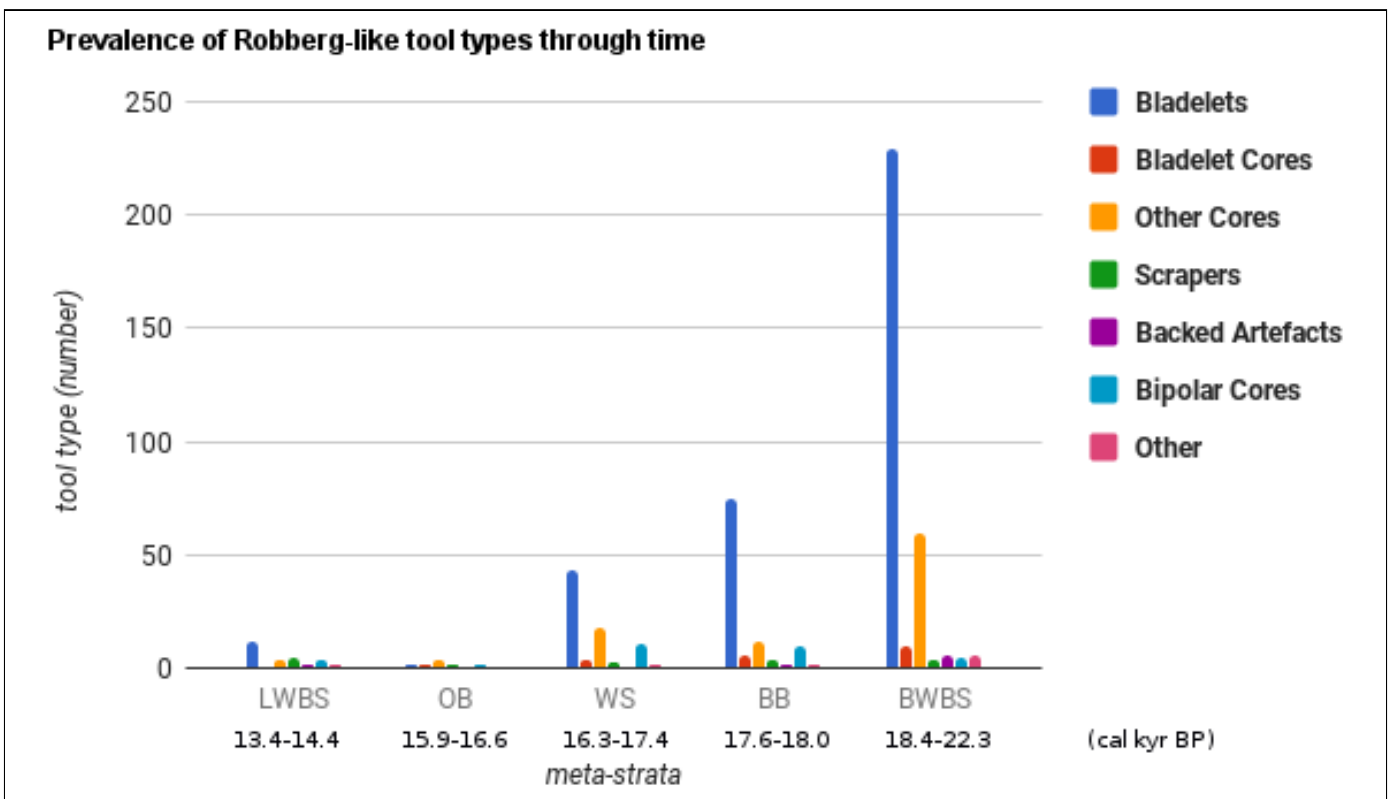


Figure 5.3. Bar chart of patterns in artefact type attributed to the Robberg only, indicating a gradual decrease in bladelets in WS and OB (from 17.4 - 15.9 cal kyr BP) from their peak in BWBS (between 22.3 and 18.4 cal kyr BP), with bladelet cores and other cores peaking in number between 22.3 and 16.3 cal kyr BP, and bipolar cores peaking between 18.0 and 16.3 cal kyr BP.

### 5.2.2. RAW MATERIAL SELECTION

The raw materials that were recorded from the plotted finds assemblage include hornfels (41,71 %), quartz (21.89 %), silcrete (16.51 %), quartzite (14.96 %) and CCS (4.94 %) and came to a total of 1357 artefacts (see Table 5b for frequency of these materials). The dominant material is hornfels, peaking between 16.6 and 15.9 cal kyr BP in OB (Figure 5.4). There is also a notable decrease in silcrete from 22.3 - 16.3 cal kyr BP (WS to BWBS) (Figure 5.4 and Figure 5.5).

Within the microlithic assemblage, a different pattern emerged regarding raw material usage through time; whereas hornfels is the dominant material in the overall lithic assemblage, silcrete (50.1 %) in fact dominates the lithics that were most Robberg-like in nature (Table 5c), with quartz following at 28.1 %.

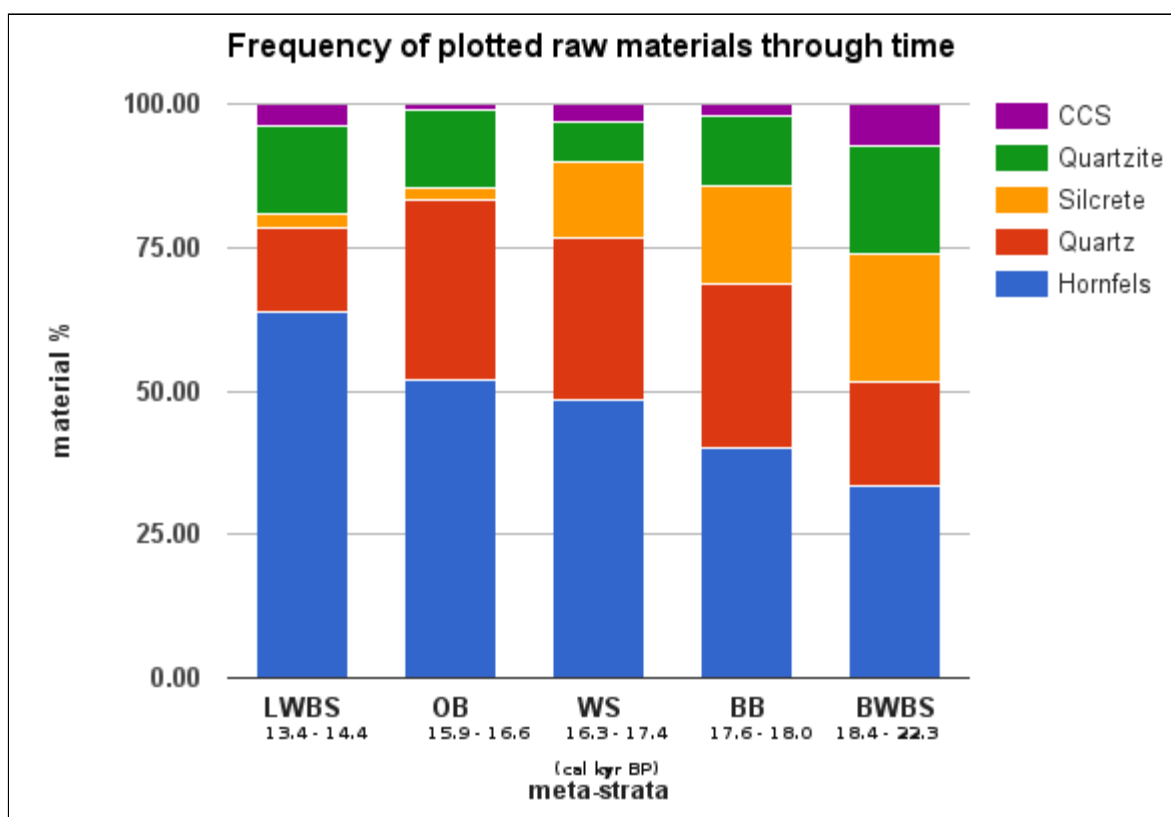


Figure 5.4. Bar chart showing changes in the abundance of raw material through time, indicating the dominance of hornfels throughout, with a peak in LWBS (between 14.4 - 13.4 cal kyr BP), as well as a gradual decrease in silcrete, most notable in WS (from 17.4 - 16.3 cal kyr BP) onwards.

<u>Raw Material</u>	<u>%</u>	<u>Raw Material</u>	<u>%</u>
<i>hornfels</i>	41.71	<i>hornfels</i>	6.93
<i>quartz</i>	21.89	<i>quartz</i>	28.27
<i>silcrete</i>	16.51	<i>silcrete</i>	50.67
<i>quartzite</i>	14.96	<i>quartzite</i>	5.07
CCS	4.94	CCS	6.40

Table 5b. Frequency of raw materials of the whole assemblage between 22.3 and 13.4 cal kyr BP.	Table 5c. Frequency of raw materials within Robberg-like artefact assemblage between 22.3 and 13.4 cal kyr BP.
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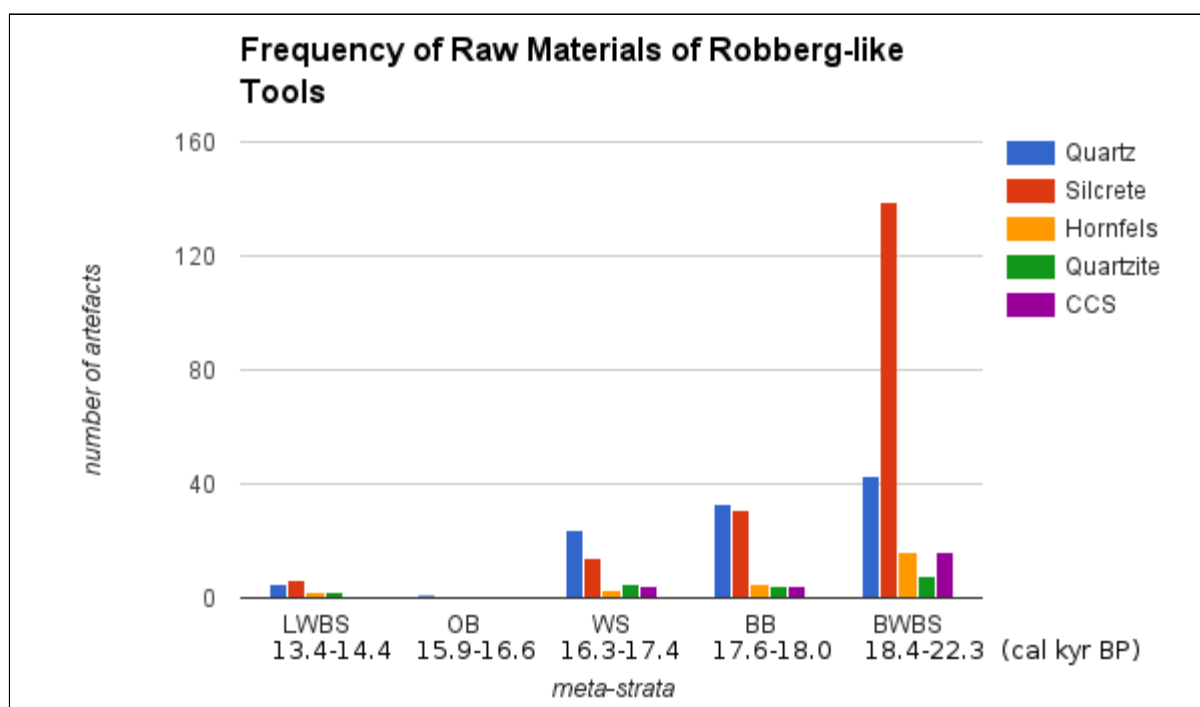


Figure 5.5. Bar chart showing the increase of silcrete in BWBS, BB and WS (between 22.3 - 16.3 cal kyr BP) in the assemblage of artefact types specifically selected to represent a Robberg-like industry.

### 5.2.3 PATTERNS OF TIMING ACROSS THE REGION

The start and end dates for assemblage patterning at sites within the Winter, Year-round and Summer rainfall zones are recorded, and their corresponding palaeoenvironmental data are related to this in Table 6d.

RAINFALL ZONE	SITE ACRONYM	ROBBERG START DATE (cal kyr BP)	CORRESPONDING PALAEO-DATA	ROBBERG END DATE (cal kyr BP)	CORRESPONDING PALAEO-DATA	ASSOCIATED REFERENCES
WRZ	KKH	22.9	Moist, cold	22.3	Moist, cold	Chase & Meadows 2007, Chase 2010, Mackay et al. 2010
	KFR	22.3 - 18.4	Arid (changing to moist and cold)	17.4 - 16.3	Drier, warmer	Scott and Woodborne 2007, Scott et al. 2012, Valsecchi et al. 2013, Mackay 2013
	PL8	23.0	Arid	20.0	Moist, cold	Meadows & Sugden 1993, Scott and Woodborne 2007, Mackay et al. 2015
	FAR	20.4 - 19.5	Moist, cold	13.7 - 13.1	Arid, warm	Manhire 1993, Carr et al. 2006
	BNK	17.1 - 16.6	Moist, cold	16.5 - 16.1	Moist, cold	Schweitzer and Wilson 1983, Loftus 2016
	EBC	15.6	Moist, warm	13.8	Moist, warm	Cowling et al. 1999, Parkington et al. 2000
YRZ	NBC	23.4 - 22.6	Arid (changing to moist and cold)	12.5 - 12.0	Moist, warm	Deacon 1978, Loftus 2016
	BMP	18.0 - 16.6	Arid, cold	14.2 - 13.6	Arid, slightly warmer	Klein 1983, Deacon 1979, Deacon et al. 1984, Deacon 1995
	MKB	18.9	Moist, cold	18.4	Moist, cold	Deacon 1969 and 1976
SRZ	SEH	25.0 - 23.8	Arid, cold	13.5 - 12.6	Moist, warm	Mitchell 1995, Loftus et al. 2015
	UMH	16.5 - 15.8	Arid, cold	10.6 - 10.2	Moist, warm	Kaplan 1989 & 1990, McCall & Thomas 2009
	RCC	19.1 - 18.8	Moist, cold	11.2 - 10.7	Drier, warmer	Wadley 1996 & 2001, McCall & Thomas 2009

Table 5d. Patterns in timing and palaeoenvironmental character of the Robberg across southern Africa (see Abbreviations list for full site names, and see Appendix 1 for original laboratory codes for dates).

### 5.3 OSTRICH EGGSHELL

The following results of ostrich eggshell analysis refer to questions regarding how Klipfonteinrand archaeology compares with sites locally, regionally and inter-regionally, and relates to the questions of the effects of preservation and/or environmental conditions, as well as cultural preferences in terms of bead sizes.

#### 5.3.1 PLOTTED AND UNPLOTTED FRAGMENT THICKNESS

A total of 449 ostrich eggshell fragments was excavated at Klipfonteinrand in squares 8, 9 and 10 through all the meta-strata. The majority was recovered from the uppermost levels, and towards the middle and end, the volume of ostrich eggshell decreases. Although much lower in number, the ostrich eggshell fragments are preserved right down to the oldest levels in the meta-stratum BWBS, at least dating to between 22.3 and 18.4 cal kyr BP (Figure 5.6). Measurements taken of the ostrich eggshell fragments from the southern trench show that they are all between 1.23 mm and 2.26 mm thick on average (mean: 1.66 mm with a 95% CI of 0.07) (Figure 5.7). Ostrich eggshell peaks in thickness between 16.6 and 15.9 cal kyr BP and 18.0 - 17.6 cal kyr BP. As the tables below indicate, there is no statistical difference between the mean thickness of ostrich eggshell fragments, despite the variability between samples and small sample size.

**Statistics - (OB and BB have an unreliable mean because of the small sample size)**

	LWBS	OB	WS	BB	BWBS
<b>std dev</b>	0.18	0.45	0.20	0.38	0.19
<b>mean</b>	1.64	1.94	1.60	1.83	1.64
<b>95% CI</b>	0.09	4.09	0.21	3.43	0.30

## ANOVA (single factor)

### Summary

<u>Groups</u>	<u>Count</u>	<u>Sum</u>	<u>Average</u>	<u>Variance</u>
LWBS	18	29.47929167	1.637738426	0.031495588
OB	2	3.876557377	1.938278689	0.207009205
WS	6	9.571136364	1.595189394	0.040660215
BB	2	3.66	1.83	0.1458
BWBS	4	6.57	1.6425	0.036158333

ANOVA - P-value > 5% therefore no significant difference between data sets

<u>Source of Variation</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>P-value</u>	<u>F crit</u>
Between Groups	0.247983196	4	0.061995799	1.394893537	26.23%	2.727765306

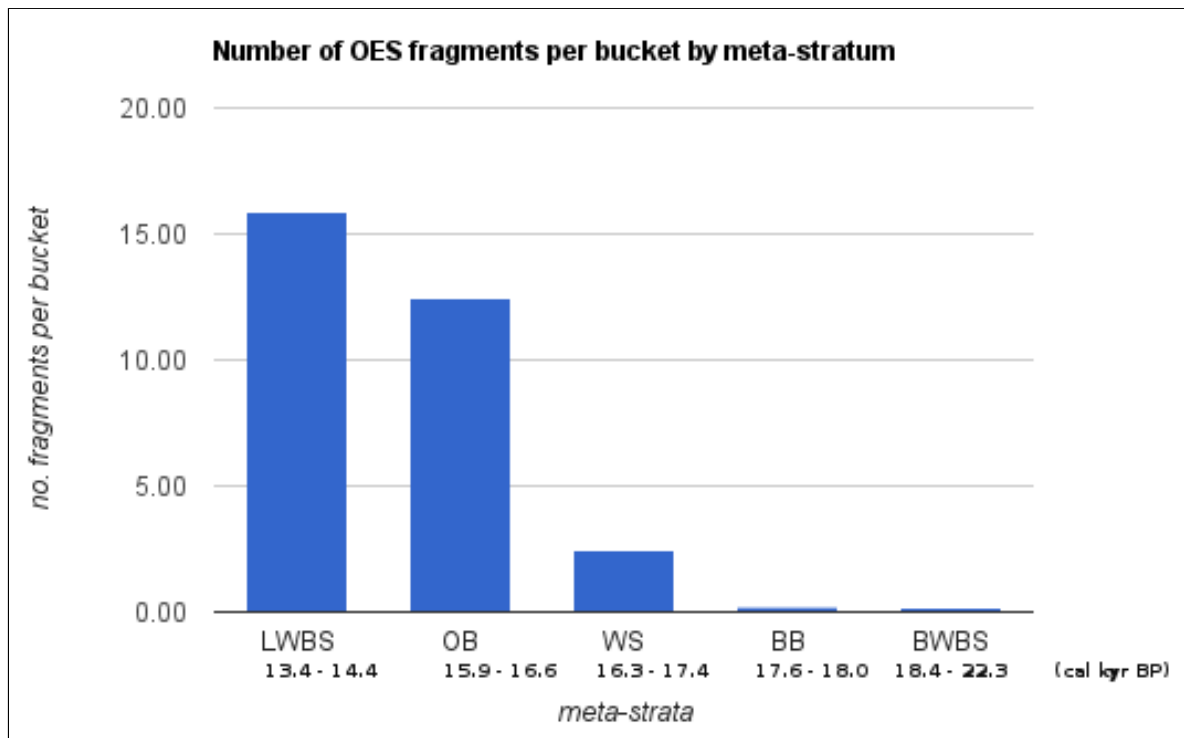


Figure 5.6. Bar chart of number of ostrich eggshell fragments per bucket, indicating a gradual decrease in ostrich eggshell prevalence through the sequence, but slight preservation in the oldest levels of the southern trench.

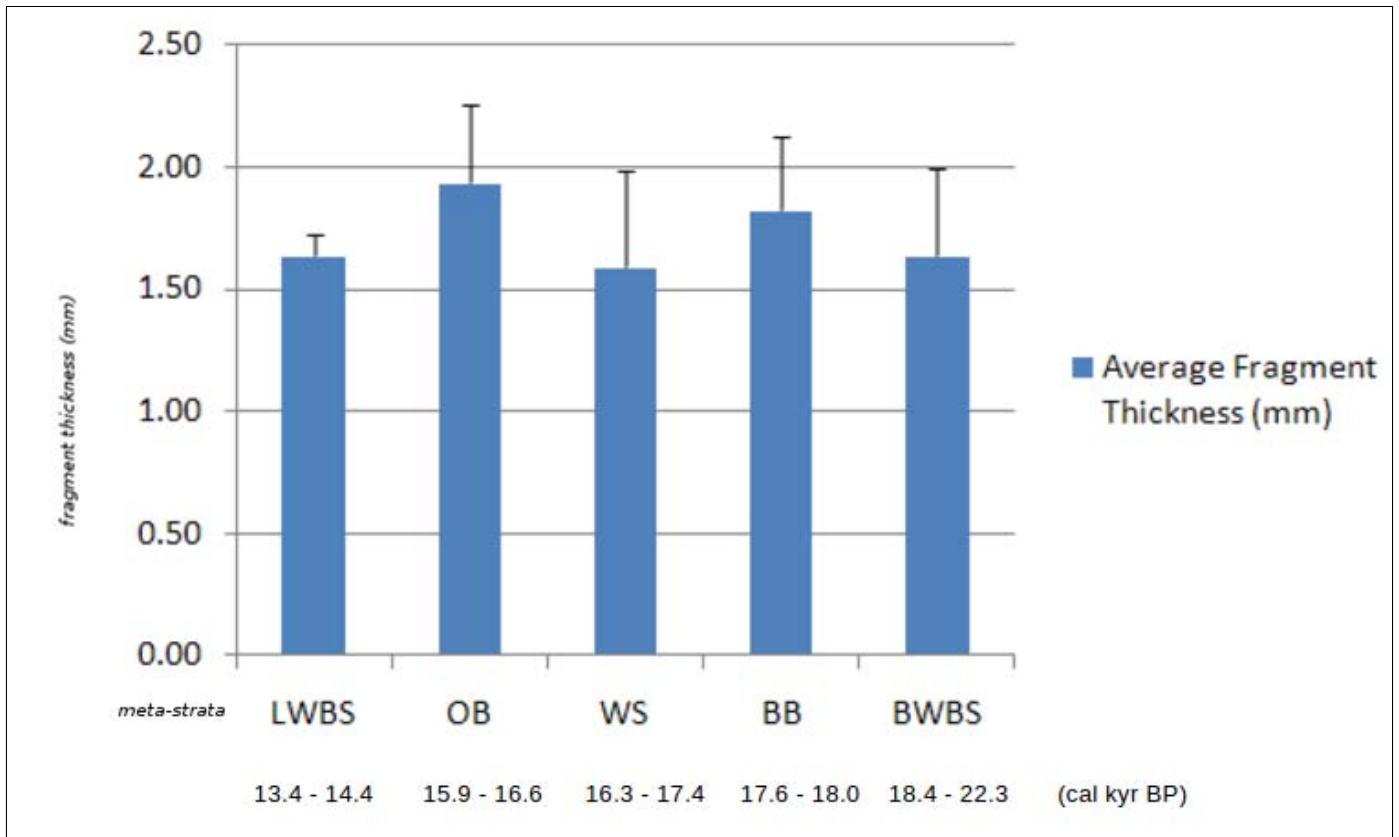


Figure 5.7 Column chart with Y-error bars indicating ostrich eggshell fragment thickness through time.

### 5.3.2 OSTRICH EGGHELL BEADS & ENGRAVED FRAGMENTS

A total of 19 ostrich eggshell beads at various stages of manufacture (unfinished beads = 3) was recovered from the excavation, 15 from the LWBS meta-stratum, 1 from OB, 2 from WS, and 1 from BB. The finished and uncompromised bead assemblage (n=16) has a range in diameter of 6.01 mm, the minimum diameter being 3.92 mm and the largest being 9.93 mm. The mean bead diameter is 5.85 mm, with a standard deviation of 1.76 mm. No further analysis is done on this assemblage, as the sample size beyond LWBS is too small.

During manufacture, it appears that the first method of manufacture suggested by [Kandel and Conard \(2005\)](#), and [Orton \(2008\)](#) was the preferred method of bead production at Klipfonteinrand: the majority of the unfinished beads that were excavated had been partially drilled but not rounded. All rounded beads had drill-holes. There is a slight decrease in the diameter of beads toward the younger levels of deposit.

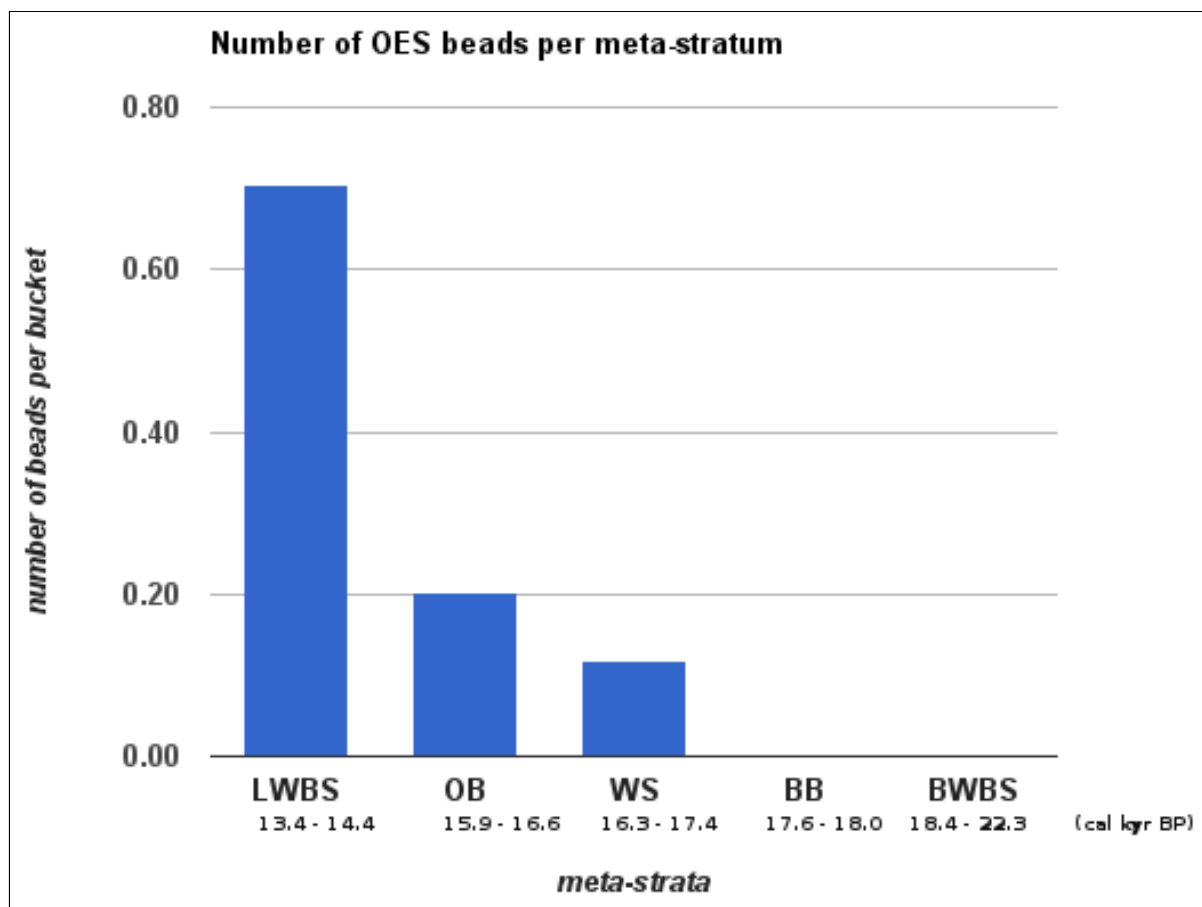


Figure 5.8 Bar chart showing the number of ostrich eggshell beads per bucket through time, indicating the majority of beads found in layers dating to between 14.4 and 13.4 cal kyr BP (LWBS).

A total of 5 pieces of engraved ostrich eggshell were recovered. All of these pieces have a cross-hatched design on them, with one piece displaying parallel lines at the top and base of the cross-hatching (see Figure 5.9). Two of the fragments come from uncompromised contexts: C248 and C418. The age of these fragments is roughly 13.7 - 13.4 cal kyr BP and they lie within the LWBS meta-stratum. They both have a crosshatched design with diagonal parallel lines, and are similar to the other designs in this assemblage.

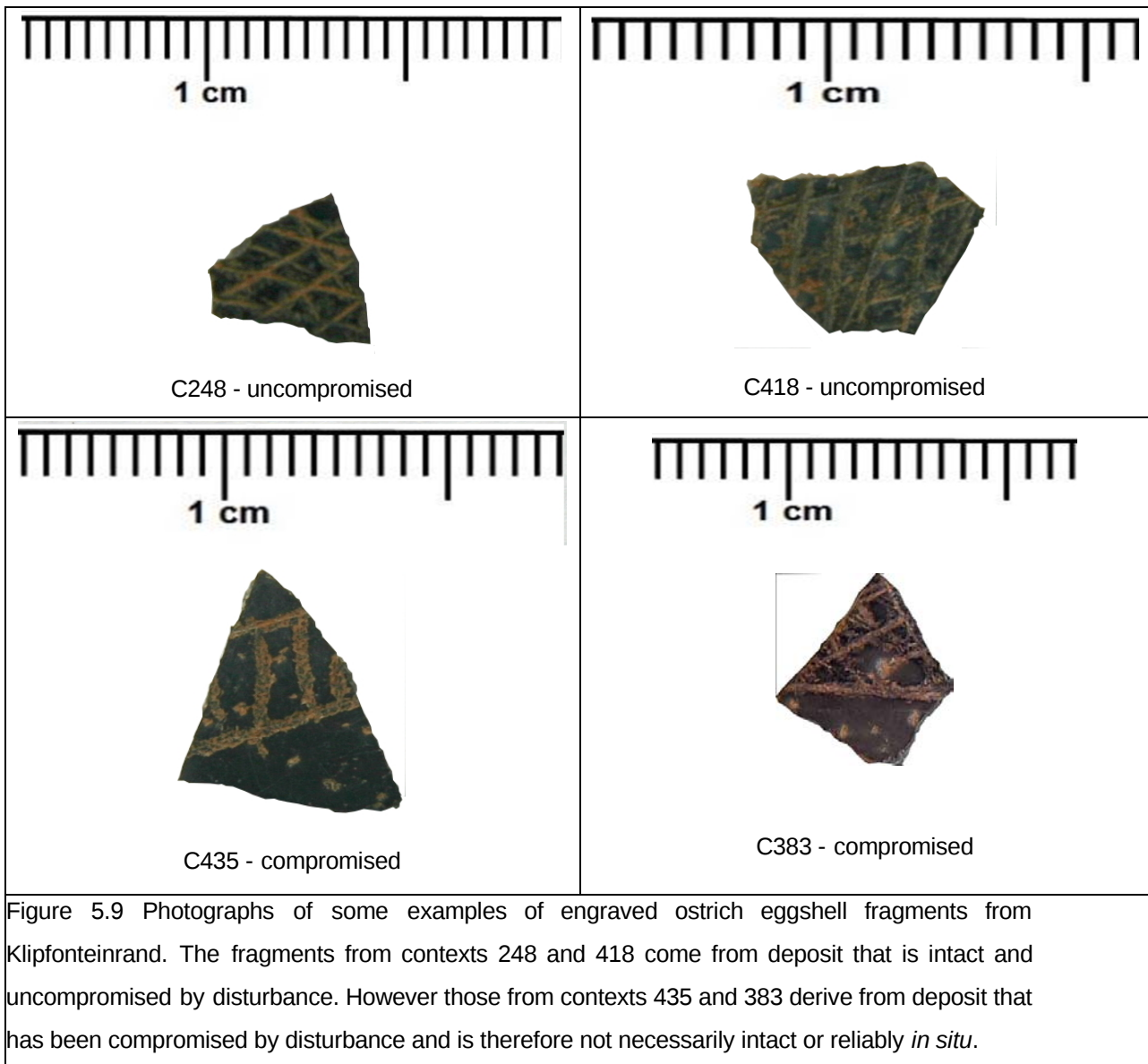


Figure 5.9 Photographs of some examples of engraved ostrich eggshell fragments from Klipfonteinrand. The fragments from contexts 248 and 418 come from deposit that is intact and uncompromised by disturbance. However those from contexts 435 and 383 derive from deposit that has been compromised by disturbance and is therefore not necessarily intact or reliably *in situ*.

#### 5.4 MARINE SHELL

Marine shell in the southern trench assemblage (MNI count is 10 with a total weight of 22.82 g) appears at Klipfonteinrand in the WS meta-stratum, however the overall majority of shell is found in the OB meta-stratum dating to between 16.6 and 15.9 cal kyr BP, with an increase in *Donax serra* between 14.4 and 13.4 cal kyr BP. There is a fragment of *Choromytilus meridionalis* found in square 9 in the WS meta-stratum which is very interesting, as it is the oldest fragment that is reliably *in situ*, in deposit dated to 17.4 - 16.9 cal kyr BP. Unfortunately, no data was recorded for the diachronic trends in fragmentation of marine shell, however during post-excavation analysis it was observed that shell fragments were generally smaller in older levels. All marine shell that was recovered was very fragmented and fragile, regardless of the age, and this suggests the poor preservation state in deposit older than 13.4 cal kyr BP.




Image	Species	Common Name	Meta-stratum	Amount of Shell (g)	% of Assemblage
	<i>Donax serra</i>	White Mussel	LWBS	7.4	32.43
			OB	5.2	22.79
			WS	0	0
			BB	0	0
			BWBS	0	0
	<i>Choromytilus meridionalis</i>	Black Mussel	LWBS	0.41	1.80
			OB	5.1	22.35
			WS	0.01	0.04
			BB	0	0
			BWBS	0	0
	<i>Aulacomya ater</i>	Ribbed Mussel	LWBS	0	0
			OB	1	4.38
			WS	0	0
			BB	0	0
			BWBS	0	0
	Unidentifiable		LWBS	3.2	14.02
			OB	0.5	2.19
			WS	0	0
			BB	0	0
			BWBS	0	0
<b>Total</b>				<b>22.82</b>	<b>100%</b>

Table 5e. Species data of marine shell from Klipfonteinrand related to meta-strata (photographs examples only, not of actual specimens from Klipfonteinrand).

## 5.5 ADDITIONAL MATERIALS

The following results will be used to gain insight into the characteristics of the archaeology at Klipfonteinrand between 22.3 and 13.4 cal kyr BP, as well as the relationship between the archaeological and the palaeoenvironmental changes occurring during this time. The materials presented below enhance the understanding of the occupation of the site in this period.

### 5.5.1 CHARCOAL

In the un-plotted charcoal assemblage of 765.70 g, it can be seen that the majority accumulated during OB between 16.6 and 15.9 cal kyr BP. Interestingly, as indicated in Figure 5.10 below, there is a higher mass of charcoal at 7.07 g per bucket in the older layers of BWBS (22.3 - 18.4 cal kyr BP) to subsequent layers (BB has 0.57 g per bucket and WS has 2.49 g per bucket). However, in

OB between 16.6 and 15.9 cal kyr BP, a sharp increase can be seen in 29.74 g per bucket, after which charcoal mass drops slightly to 15.64 g per bucket in LWBS (14.4 to 13.4 cal kyr BP).

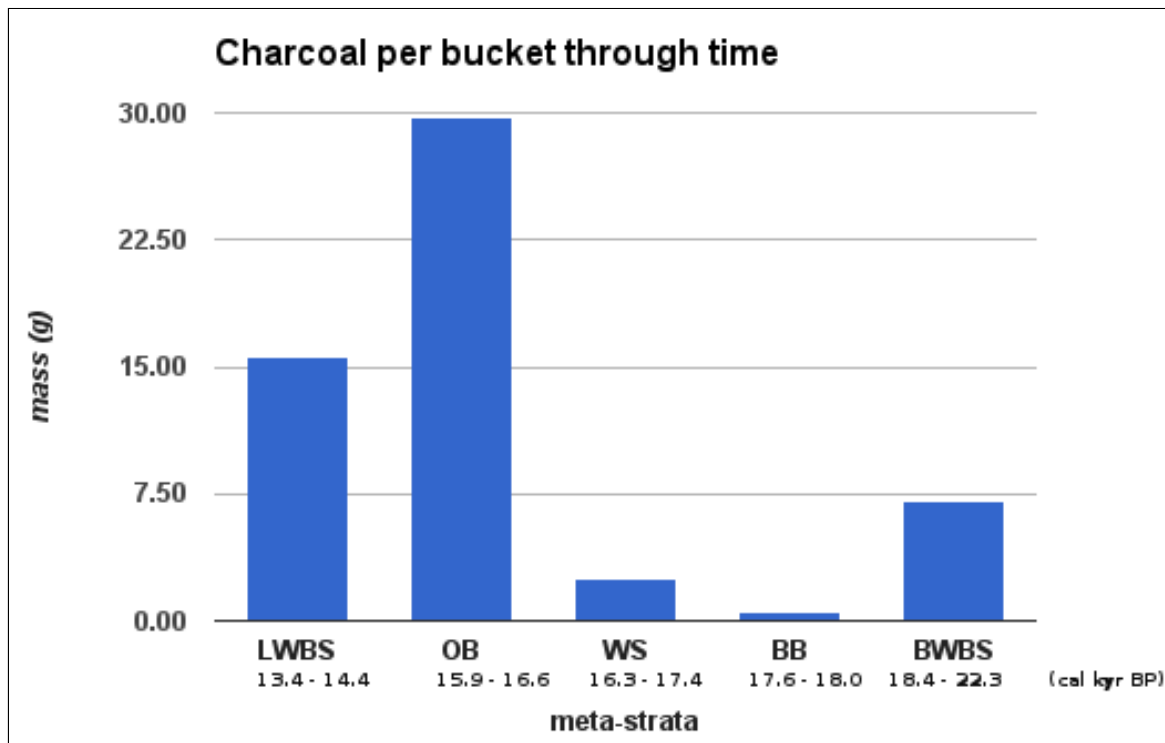


Figure 5.10 Bar chart indicating accumulation of charcoal through time, showing a peak in OB (between 16.6 and 15.9 cal kyr BP).

### 5.5.2 BONE

In the bone assemblage of 25,359.91 g of fragments, the majority of bone per bucket was found in the OB meta-stratum, accounting for 28.86% of the bone assemblage (Figure 5.11). Throughout the layers between 22.3 and 16.3 cal kyr BP, bone mass remains relatively stable, averaging 278.72 g per bucket. There is a sharp increase between 16.6 and 15.9 cal kyr BP to 729 g per bucket, and thereafter another decrease to 262.25 g per bucket in LWBS. During post-excavation analysis, it was observed that the density and fragility of bone changed in older layers: bone became more porous, less dense and far more fragile, with fragments becoming smaller and more fragmented towards older levels.

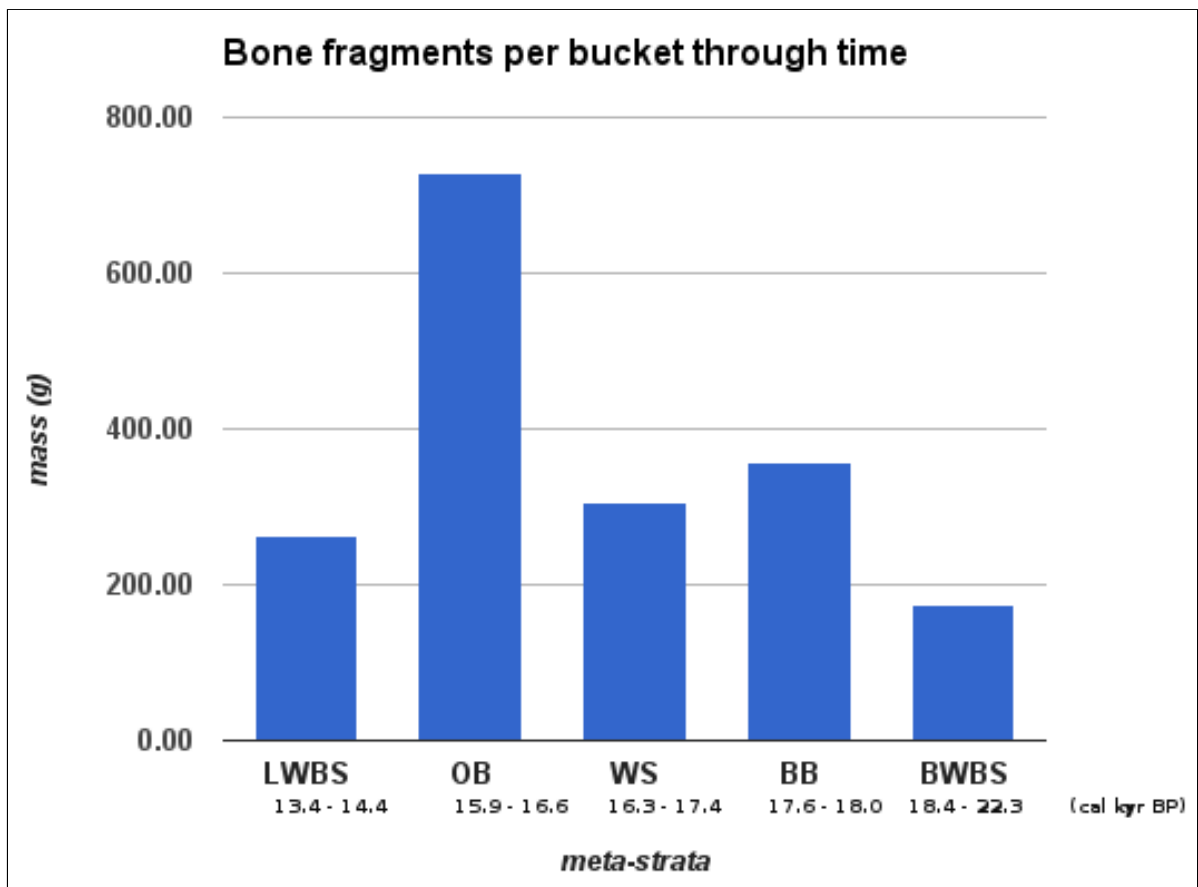


Figure 5.11 Bar chart showing abundance of bone through time, with the majority recovered from levels dating to between 16.6 and 15.9 cal kyr BP (OB meta-stratum).

### 5.5.3 OCHRE

#### 5.5.3.1 PLOTTED AND UNPLOTTED OCHRE

In the assemblage of 1046.24 g of ochre, much of this (16.59 g per bucket) was recovered in the BB meta-stratum between 18.0 and 17.6 cal kyr BP ( Figure 5.12), and in LWBS between 14.4 and 13.4 cal kyr BP (14.7 g per bucket). Prior to this, ochre mass per bucket in BWBS between 22.3 and 18.4 cal kyr BP is 9.95 g, and the subsequent layers of WS and OB average 7.89 g per bucket.

In terms of the usage of colour in the ochre assemblage, some interesting patterns emerge: red ochre is by far the most abundantly collected colour (Figure 14), with much of this (248.85 g) occurring in BWBS (22.3 to 18.4 cal kyr BP), and a gradual decrease through time in the usage of this colour until LWBS (14.4 to 13.4 cal kyr BP) when only 42.2 g is present. The introduction of black ochre and reddish-brown ochre can be seen in LWBS, but only in very small amounts (10 g and 16.4 g respectively). Ochre with a slightly purple hue is present in OB (16.6 to 15.9 cal kyr BP) and BB (18.0 to 17.6 cal kyr BP) in small amounts (11.01 g and 5 g respectively). When two different colours were used in one context simultaneously, this was recorded as a 'combination' and this does not occur between 17.4 and 15.9 cal kyr BP (in WS and OB). When more than two

colours were used in one context simultaneously, this was recorded as a 'variety' and this does not appear to happen in BB (18.0 to 17.6 cal kyr BP) or OB (16.6 to 15.9 cal kyr BP).

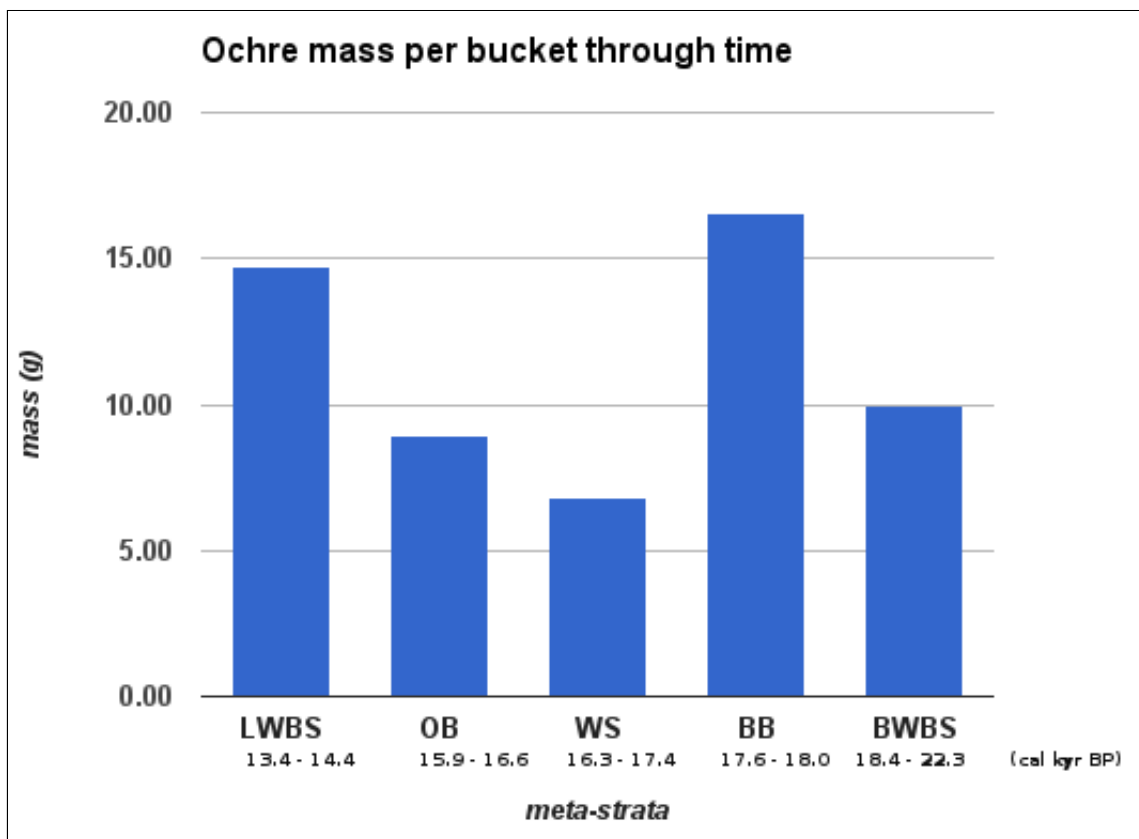


Figure 5.12 Bar chart showing the abundance of ochre nodules through time, and an increase in ochre in BB (18.0 - 17.6 cal kyr BP).

### 5.5.3.2 GROUND / WORKED OCHRE

Of the assemblage analysed in the southern trench, 15 pieces of ground ochre were recovered. The LWBS meta-stratum has many of the ochre pieces (0.38 pieces per bucket) that have been ground or worked in some way (Figure 5.13): the various ways that ochre has been modified in this assemblage include grinding of the surface of fragments and often creating a striated effect, rubbing fragments to make them smooth and/or polished, flaking fragments in a similar way as to knapping stone artefacts, and shaping ochre fragments (one piece appeared to have been shaped into a crayon - square 8, context 286, compromised. Figure 5.15) Older layers contain a lower number of ground ochre nodules per bucket (averaging 0.15 pieces per bucket), and interestingly, no recorded ground ochre nodules came from the WS meta-stratum between 17.4 and 16.3 cal kyr BP.

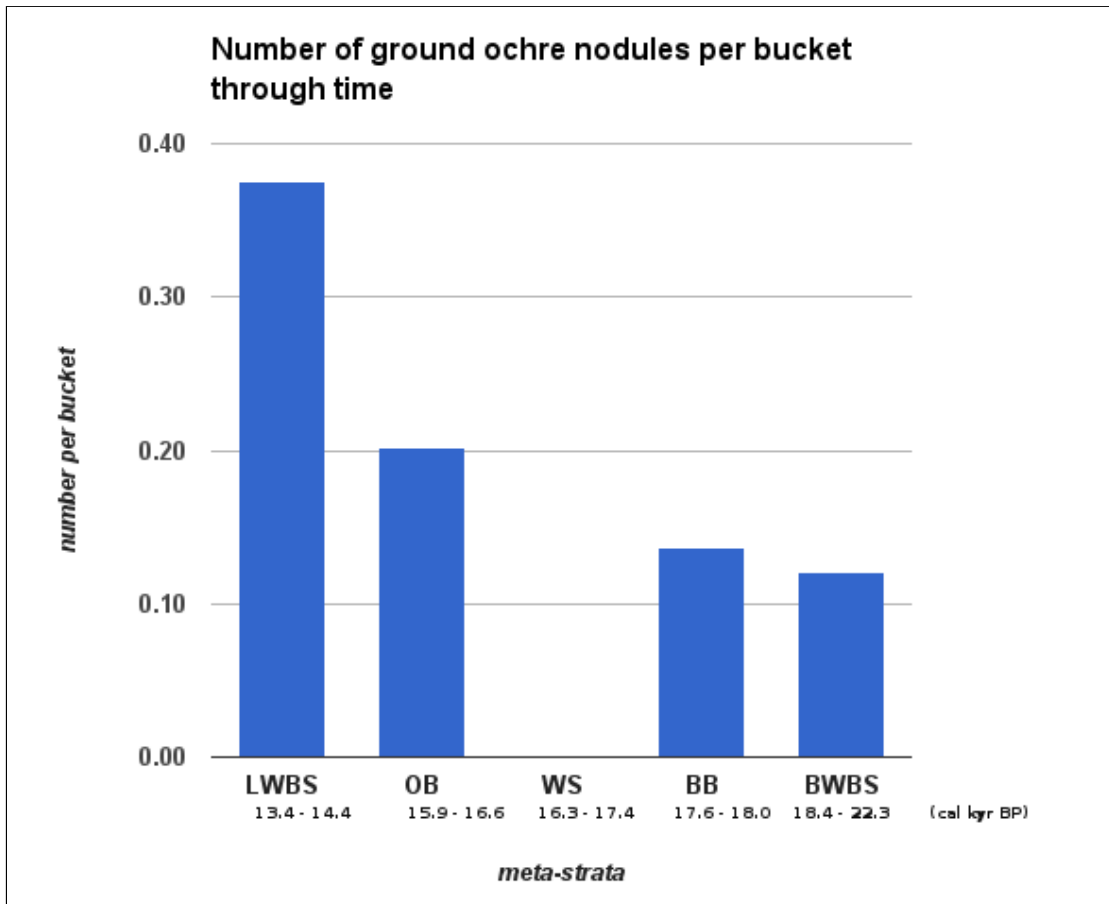


Figure 5.13 Bar chart showing changes in the number of ground or worked ochre nodules per bucket through time, indicating the majority lying in levels dating to 14.4 - 13.4 cal kyr BP (LWBS meta-stratum).

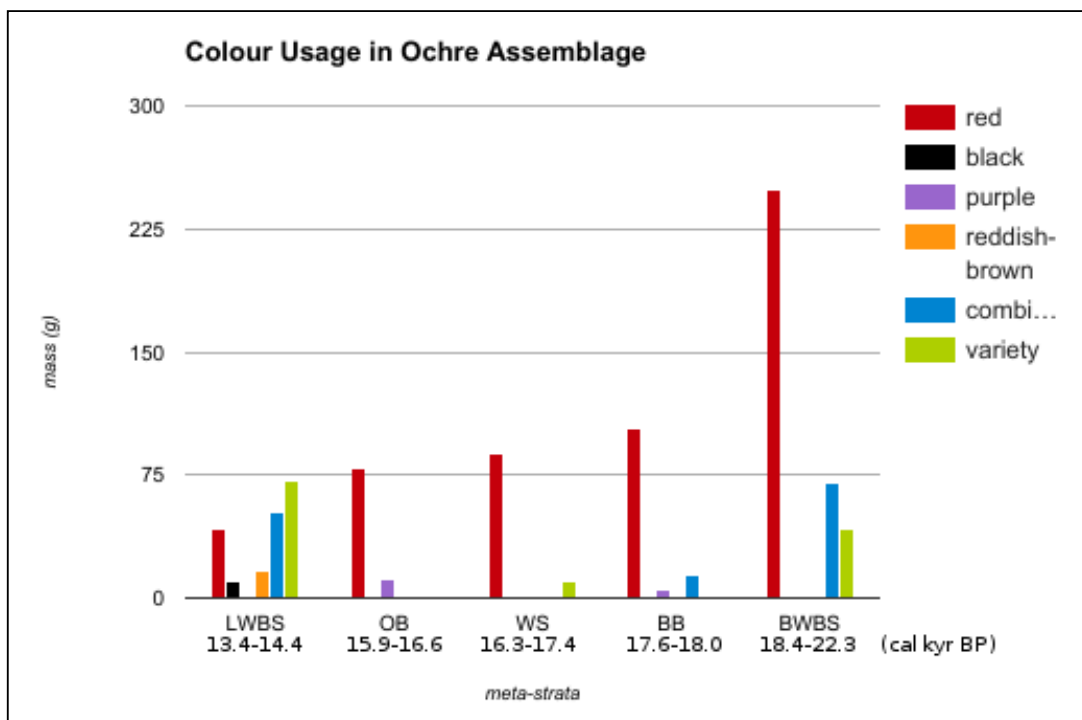


Figure 5.14 Bar chart showing changes in colour usage in the ochre assemblage through time, indicating an increase in red ochre between 22.3 and 18.4 cal kyr BP (BWBS).



Figure 5.15 Photograph of ochre 'crayon' from Square 8.

#### 5.5.4 LARGEST ROCKS AND ROOF SPALL

During excavation as well as post-excavation sorting of the aggregate, the largest 10 rocks (spalls) greater than 30mm were selected and then measured from each context and its corresponding quadrants. From the southern trench, 699 of the largest rocks were measured. There is a gradual increase in the numbers of spalls through time; this was measured by the frequency of times that all 10 of the largest spalls could be measured as opposed to fewer than 10. This increase occurs in the meta-stratum OB (equating to the period between 16.6 and 15.9 cal kyr BP) (Figure 5.16). In younger deposits, the spalls that could be measured were relatively few.

On average, roof spall size was around 51.15 mm in this assemblage (with a 95% CI of 2.23). The average size of spalls increases toward older levels, particularly between WS and BWBS (equating to the time period 22.3 - 16.3 cal kyr BP) (Figure 5.17). There is no significant difference in mean size between meta-strata.

**Statistics** - OB has an unreliable mean because of the smaller sample size:

	LWBS	OB	WS	BB	BWBS
<b>std dev</b>	15.53	10.44	12.20	11.78	14.67
<b>mean</b>	48.25	44.41	50.94	53.89	52.34
<b>95% CI</b>	6.34	6.82	4.60	5.16	3.54

#### ANOVA (single factor)

##### Summary

<u>Groups</u>	<u>Count</u>	<u>Sum</u>	<u>Average</u>	<u>Variance</u>
LWBS	23	1109.68	48.2469565217	241.0289403162
OB	9	399.71	44.4122222222	108.9617444444

WS	27	1375.51	50.9448148148	148.8243336182
BB	20	1077.8	53.89	138.8330631579
BWBS	66	3454.41	52.3395454545	215.0640105594

ANOVA - P-value > 5% therefore no significant difference between data sets

<u>Source of Variation</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>P-value</u>	<u>F crit</u>
Between Groups	847.0941032571	4	211.7735258143	1.1120576564	35.33%	2.4363174639

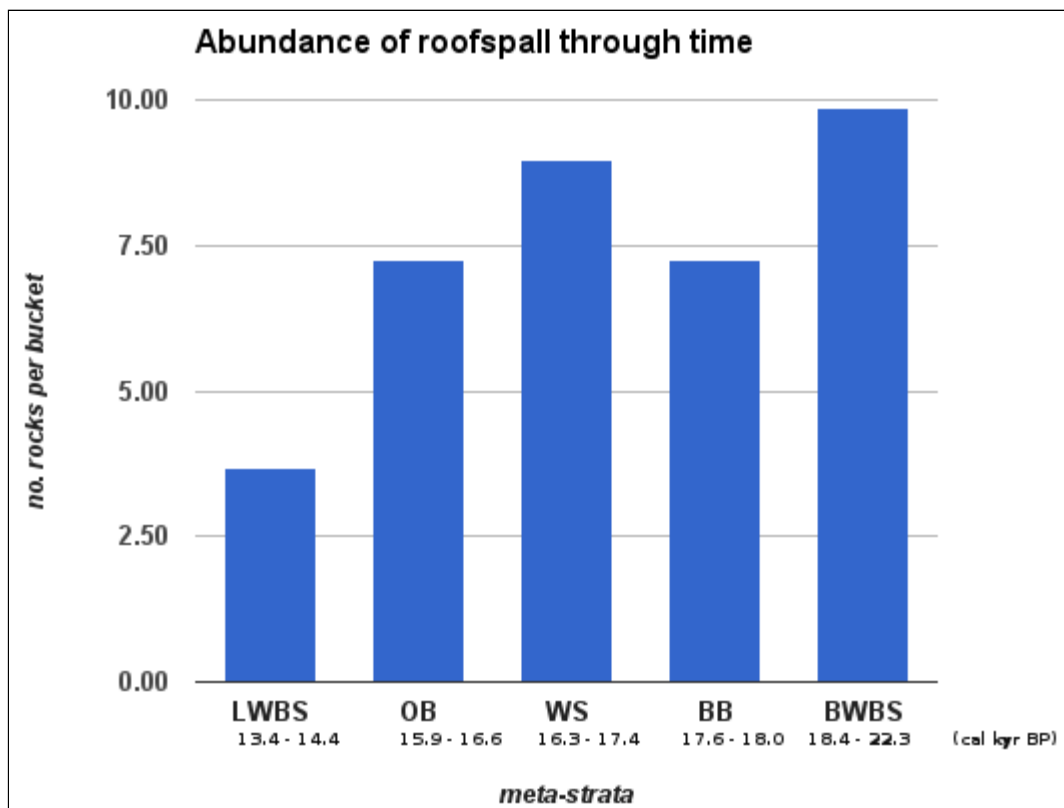


Figure 5.16 Bar chart showing the changes in numbers of rocks present in the deposit through time, indicating a gradual trend to more rock fall in older levels.

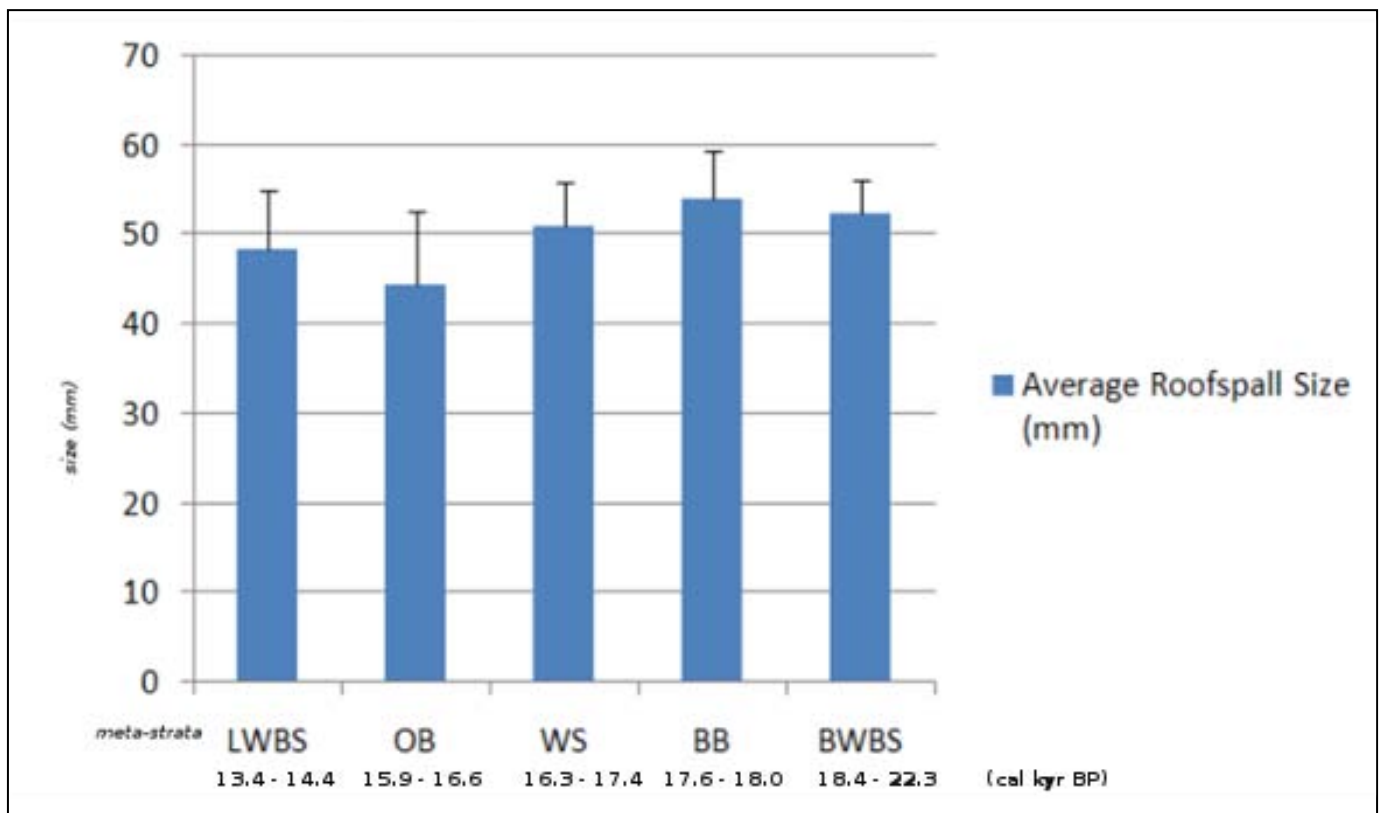


Figure 5.17 Column chart with Y-error bars indicating the trends in average roof spall size through time.

## 5.6 SUMMARY OF RESULTS

In summary, the major results that are presented in this chapter include the following:

- **Lithics:**
  - hornfels dominates the general lithic artefact assemblage throughout time. However, in the Robberg-like components of the lithic assemblage, the dominant material is silcrete (between 22.3 and 18.4 cal kyr BP) followed by quartz (between 18.0 and 16.3 cal kyr BP)
  - micro-bladelets <25 mm and 'other cores' dominate the artefact category between 22.3 and 16.3 cal kyr BP with an increase in bipolar cores between 18.0 and 16.3 cal kyr BP. Bladelet cores are most abundant between 22.3 and 16.3 cal kyr BP, albeit in low numbers. An increase in numbers of naturally backed knives occurs from 16.6 - 13.4 cal kyr BP.



Figure 5.18 Photograph of small selection of bladelets.

- **Ostrich eggshell:**

- fragments are at their thickest between 16.6 and 15.9 cal kyr BP and 18.0 and 17.6 cal kyr BP, and at their thinnest between 22.3 and 18.4 cal kyr BP, 17.4 and 16.3 cal kyr BP and 14.4 and 13.4 cal kyr BP. There is no statistical difference in the mean thickness of ostrich eggshell fragments between meta-strata.
- a total of 19 beads was recovered, the oldest dating to 17.4 - 16.9 cal kyr BP, with 3 unfinished beads found in LWBS. Overall bead diameter varies with a major peak between 16.6 and 15.9 cal kyr BP.
- a small sample of engraved ostrich eggshell fragments dating to 14.4 - 13.4 cal kyr BP were recovered, which have cross-hatched designs and parallel-lined motifs, with a ladder-like design.



Figure 5.19 Photograph of selected ostrich shell fragments and beads.

- **Marine shell** peaks between 16.6 and 15.9 cal kyr BP and the dominant species is *Donax serra*.
- **Roof spall** is most abundant between 22.3 and 18.4 cal kyr BP and 17.4 and 16.3 cal kyr BP, and the size decreases from 18.0 - 15.9 cal kyr BP. There is no statistical difference in mean size between meta-strata.
- **Charcoal** abundance per bucket peaks between 16.6 and 15.9 cal kyr BP.
- **Bone** abundance per bucket also peaks between 16.6 and 15.9 cal kyr BP.
- **Ochre** weight per bucket peaks in BB between 18.0 and 17.6 cal kyr BP and in LWBS between 14.4 and 13.4 cal kyr BP. Red ochre is the most abundantly used colour in the ochre assemblage, but decreases gradually through time. Ochre was ground most frequently between 14.4 and 13.4 cal kyr BP (LWBS).

The following chapter will synthesise and discuss these results in more detail, situating Klipfonteinrand within the context of the Terminal Pleistocene of southern Africa.

This chapter discusses the results presented in Chapter 5, and contextualises Klipfonteinrand in the larger framework of MIS 2 archaeology and palaeoenvironments, on a local, regional and inter-regional scale. It must be kept in mind that the conclusions drawn from these results can only be based on general trends, as the samples and assemblages analysed are only of a small portion of the excavation as a whole. The various materials recovered from the excavations at the site show specific diachronic patterns and suggestions can be made about lithic technologies, craft and design, and complex landscape use of Late Pleistocene hunter-gatherers. The overarching purpose of this is to attempt to gain a better understanding of human behaviour during this environmentally unstable time period.

Archaeologically, it appears that the MIS 2 period exhibits similar patterns of behavioural characteristics expressed in technological industries, use of the landscape, and reactions to palaeoenvironmental changes. All of the sites discussed in this study undergo a sequence of technological changes between roughly 30 and 10 ka: the beginnings of the Later Stone Age are seen by the introduction into archaeological deposits of higher numbers of organic cultural materials of early (San) hunter-gatherer origin ([D'Errico et al. 2012b](#), although see [Mitchell 2012](#) and [Pargeter et al. 2016](#)), such as ostrich eggshell and bone tools, as well as a mixture of Middle and Later Stone Age lithic tools like segments and bifacial points coupled with bladelets, scrapers and bipolar core reduction of quartz ([Kaplan 1990](#), [McCall and Thomas 2009](#), [Mackay et al. 2014](#)). This period is referred to as the Early Later Stone Age ([Vogel and Beaumont 1972](#), [Beaumont 1978](#)) and generally lasts until around 22 ka (although this varies somewhat across the subcontinent, as has been discussed). Following this industry is usually a microlithic, bladelet-rich industry with a higher proportion of bipolar reduction and bladelet cores but low frequencies of retouch or backing ([Deacon, J. 1984a](#), [Wadley 1996](#)). This is often referred to as the Robberg Industry and can be seen at several southern African sites between 22 and 10 ka ([Deacon, J. 1982](#), [Mitchell 2000](#), [Barham and Mitchell 2008](#)). Following this, it seems that an informal non-microlithic industry with large scrapers and flakes, and naturally backed knives called the Oakhurst developed (again at different times across the subcontinent, as shown in Chapter 3) ([Barham and Mitchell 2008](#)). Alongside this technological transformation, the climate and environment manifested several variations within this time frame. It appears from data collected that the Winter Rainfall Zone was more humid and up to 8 - 10°C cooler in winter months than present during MIS 2 ([Boelhouwers 1999](#), [Boelhouwers and Meiklejohn 2002](#), [Chase et al. 2011](#), [Scott et al. 2012](#)). The conditions during the Last Glacial Maximum at 21 ka, have been described

as having been more intense for people living at this time, with very dry and cold environments, lower sea levels and an associated degree of risk and social stress (Deacon 1984b, Talma and Vogel 1992, McCall and Thomas 2009). In the Cederberg specifically, the beginning of the Robberg at around 22 ka was relatively arid (Scott et al. 2012), followed by a more moist and cold period around 19 ka (Scott and Woodborne 2007). Thereafter, sea levels rose and a moisture and temperature increase is seen until roughly 12 ka at which point another arid episode occurred (Quick 2009, Chase et al. 2011, Valsecchi et al. 2013). Within this relatively short span of time, the climate and environment of southern Africa experienced quick bursts of variability at seemingly severe levels, presumably having a great affect on the groups of people living here and experiencing these conditions through time. Considering the usually gradual rate of adaptation and evolution, the rapidly changing conditions between 22 and 12 ka must surely have had an impact on the flexibility and productivity of groups of people within their environment, the changes in faunal and floral behaviour and adaptation, and the possible unpredictability of acquiring resources. Microlithic tool production is better suited for these contexts, like periods of climatic and resource instability due to the nature of this technology; smaller tools are more easily transportable and maintainable during times of high residential mobility (Kuhn 1994, Bousman 2005).

## 6.1 THE SITE

This study was designed to provide a description of changes in archaeological composition at Klipfonteinrand Rock Shelter and to see the potential effects of environmental changes on archaeological materials, as well as on the adaptations of, and changes in, human behaviour toward environmental variation during MIS 2.

The dates obtained at Klipfonteinrand for the terminal Pleistocene indicate a period of mostly repetitive use of the shelter, with one or two possible hiatus periods. This occurs when there is an absence of dates and sediment build-up between 22,100 ±120 cal kyr BP and 19,130 ±100 cal kyr BP, as well as between 16,170 ±100 cal kyr BP and 14,230 ±130 cal kyr BP (Figure 2.6 and 5.1). This means that the sediment between BWBS and OB likely reflects a repetitively frequent occupation of the site, with a brief period of less intensive occupation around the transition from OB to LWBS, and thereafter more repetitive occupation until the end of LWBS at the top. Insofar as the possible Robberg Industry at Klipfonteinrand is concerned, it began *at least* by 22.3 cal kyr BP. Since no Terminal Pleistocene deposit nor dates are available prior to this, it is unknown when exactly the industry was introduced and could very well be much older than 22.3 cal kyr BP in this microregion. The diagrams in Chapter 5 (Figures 5.1 to 5.3) show that the Robberg-like assemblage appears to end dramatically at 16.3 cal kyr BP when bladelets sharply decrease in number, followed possibly by an Oakhurst Industry at 16.6 cal kyr BP. Since we

cannot know what occurred during the OB-LWBS transition, it is difficult to know what changes took place technologically over the course of that 2000 year period and has implications for the re-peak in bladelets in LWBS and subsequently the argument surrounding the termination of the possible Robberg Industry at Klipfonteinrand. However, it does appear that 'Robberg' termination sits at 16.3 cal kyr BP.

Similarly, at Putslaagte 8 there is a hiatus between 22 and 21 ka ([Mackay et al. 2015: 19](#)). One possibility for these contemporary hiatuses is that they reflect unfavourable environmental conditions during this time on the eastern side of the Cape Fold Belt mountain range. The aridity of the Last Glacial Maximum ([Carr et al. 2006](#), [Scott et al. 2012](#)), particularly during the time of possible hiatus of Klipfonteinrand, may have forced inhabitants to abandon the site in favour of areas with more reliable water availability. Alternatively, it could be suggesting changing settlement systems and landscape use, for instance avoiding rock shelters and making use of alternative habitation sites. A more in-depth look at open sites in the region may help to clarify the occupational behaviour of people when not inhabiting rock shelters. However, archaeologists have tended to focus on studying rock shelters because of the better preservation and being closed, more reliably *in situ*, environments that can be dated, while under-representing open sites. This is most likely because of the erosional nature of open sites and the deflated contexts in which artefacts are usually found ([Bailey 2007](#), [Mackay et al. 2014](#)), resulting in sites being out of context, or being difficult to locate if the area is disturbed. Although open-site studies are increasing in the greater Cederberg ([Hallinan 2013](#)) with ongoing research at several open sites along the Doring River and surrounding areas, much of this is as yet unpublished and there is still not enough information to draw many reliable conclusions (although see [Mackay et al. 2010](#), [Mackay et al. 2014](#)).

The high proportion of bladelets and cores during the period 22.3 - 16.3 cal kyr BP demonstrates a possible Robberg Industry occurring at this site. There is a generally low proportion of bladelet cores at the site in comparison with other cores, and this could be indicating that bladelets were manufactured more commonly off-site. Moreover, bipolar cores decrease in number when bladelets are at their highest in number, suggesting that they were not manufactured using the bipolar technique. It follows, therefore, that bladelets were either manufactured off-site, or using a technique other than bipolar reduction or classic bladelet core reduction. Considering the time period and the high numbers of bladelets present, it is probable that Klipfonteinrand does contain a Robberg Industry, however it is acknowledged that this particular study presents a relatively small sample size and limited assemblage, and more concrete answers would certainly be exposed should a more detailed study be done.

Although hornfels is dominant throughout the lithic assemblage, silcrete peaks in the early stages of the microlithic assemblage, after which both hornfels and silcrete dominate. This is replaced by a non-microlithic, hornfels- and quartz-dominant industry with naturally backed knives and large scrapers potentially indicating an Oakhurst assemblage.

The mean size and abundance of roof spall at Klipfonteinrand reflect potential variation and interaction between ambient temperature, moisture and shelter occupation (Butzer 1973, 1979, Butzer et al. 1978, Butzer 2004, Chase and Meadows 2009). Results show a gradual decrease in the number of spalls toward younger levels, and there is also a (greater) decrease in the size of the spalls between 18.0 and 15.9 cal kyr BP. This correlates with the change in temperature discussed in Chapter 3, as spalls decrease in size as temperatures increase, while in colder conditions with more moisture, spalls are more abundant and larger in size. Although the timing does not necessarily correspond, evidence from Elands Bay Cave, Sea Harvest (Butzer 2004), Nelson Bay Cave (Butzer 1973a) and Border Cave (Butzer et al. 1978) suggests that climate and temperatures do have an effect on the weathering of spalls in southern Africa. During the coldest parts of the Last Glacial Maximum, frost and continual cold temperatures may very well have had an affect on the spalling events at Klipfonteinrand. It is with regret that time constraints did not allow for a closer study of the angularity of spalls in order to determine mechanical weathering as an origin of these layers, but certainly the abundance and size of spalls correlates with changes in temperature and moisture. As with the laboratory studies by Butzer (1973a) on materials excavated at Nelson Bay Cave, it also appears that the use of fire within the shelter at Klipfonteinrand does not necessarily have an impact on the falling of spalls, as the density of charcoal is lowest when spalls are high in number. Furthermore, when charcoal peaks in OB, roof spall is at its smallest size. Despite the small sample size of OB, this leads either to the conclusion that people were not building more fires than usual during colder periods when spalls are abundant, or that there was less intensive occupation of the shelter during these periods. Furthermore, it seems unlikely that fire-building has much of an effect on the weathering of shelter walls, as suggested by the low number of spalls even when charcoal density is high. In addition to this, studies at Elands Bay Cave by Duncan Miller (unpublished) have shown that it is possible that higher spall abundance could reflect less intensive occupation of the shelter, in the sense that spalls that are present appear to be more abundant compared with less abundant sediment build-up and anthropogenic material. However, this does not appear to be the case at Klipfonteinrand, where spalls are abundant in higher-intensity occupation layers like BWBS and WS. Finally, it is possible that more intensive trampling of the ground could break spalls down into smaller sizes, therefore layers with larger spalls may have encountered less intensive trampling, suggesting less intensive occupation. However, this does not appear to be the case at

Klipfonteinrand, where spall size is in fact smallest between 16.6 and 15.9 cal kyr BP (during OB), but larger between 18.0 and 16.3 cal kyr BP (BB-WS), with a decrease again in BWBS between 18.4 and 22.3 cal kyr BP.

It appears that preservation at Klipfonteinrand is modest: while most of the organic materials persist throughout the sequence (although no information from MIS 4 has been presented, it was observed during excavation that organic materials were present in the deposit even at this depth and age, including bone fragments and charcoal), the frequency of such materials is low. Although delicate materials like ostrich eggshell fragments are found right down in some of the oldest levels (older than 23 ka), they occur in low numbers. Similarly, Putslaagte 8 has bone and ostrich eggshell preserved, poorly, up to approximately 41.2 ka, with a marine shell (*Nassarius kraussianus*) found in this level, which may in fact have moved down from younger levels given the poor preservation of other, more robust organic materials (Mackay et al. 2015). Klein Kliphuis has very few organic materials in levels older than the Holocene, with low numbers of bone pieces and very fragmentary charcoal remains that have been broken down by bioturbative processes, although small numbers of organics do survive in the older Middle Stone Age levels (Mackay 2010). At Hollow Rock Shelter, only charcoal seems to persist into these levels (Hogberg and Larsson 2011, Evans 1994). However, a Middle Stone Age site like Diepkloof Rock Shelter, which has high numbers of ostrich eggshell fragments dating to 60,000 years BP and older (Texier et al. 2010, 2014), the engravings on which can still clearly be seen, likely has differing conditions affecting the preservation ability here.

A very interesting pattern that emerges with the fluctuations in fragment thickness is the possibility that they are indicative of drier and wetter periods (Koch 1998, Johnson et al. 1997, Johnson et al. 1998, Ecker et al. 2015). Using stable isotope analysis, Ecker et al. (2015) have shown that ostrich eggshell can be used as a proxy to determine the aridity of palaeoenvironments. This degree of analysis was not possible in the present study but the statistically reliable fragment measurements of ostrich eggshell from Klipfonteinrand do appear to tell a general, if not specifically quantifiable, story: fragments are thickest during BB and again in OB, during periods of warming and increased moisture (Quick 2009, Chase et al. 2011, Valsecchi et al. 2013), but fragments are thinner between 22.3 and 17.6 cal kyr BP, during the coldest and driest phase of the Last Glacial Maximum in this region (Scott 1994, Stokes et al. 1998, Meadows and Baxter 1999, Cowling et al. 1999, Mix et al. 2001, Tyson et al. 2001, Barham and Mitchell 2008, Quick 2009, Rector and Verrelli 2010, Chase et al. 2011, Valsecchi et al. 2013). Ostriches lay eggs just after the rainy season (Sinclair 1978), and with this reliance on water and nutrients for eggshell durability, enough rainfall would be required for ostriches to prosper in a region. During moisture-rich periods, C<sub>3</sub> grasses, the preferred diet of ostriches (Johnson et al. 1998)

which are opportunistic feeders (Kok 1980, Brown et al. 1982, Bertram 1992), were more likely to have dominated the region (Chase et al. 2011). It appears clearly that fragment thickness during the Last Glacial Maximum and Late Glacial varies depending on the water and nutrient-rich vegetation available to ostriches in this region at these points in time.

Marine shell, in contrast, which does not persist earlier than ~16.6 - 16.1 cal kyr BP, is either not well-preserved in older levels, or (and the more likely reason for its absence) low sea levels discouraged commonly occurring connections between the coast and the interior. In addition, marine shell does not seem to be well preserved before approximately 11 ka at Elands Bay Cave (Parkington 1980). This is interesting considering the preservation of *Nassarius kraussianus* shell at Putslaagte 8 in levels dating to between 33.2 and 44.5 ka (Mackay et al. 2015). Thus it would appear that preservation of fragile materials such as marine shell in the Winter Rainfall Zone is site-dependent and it cannot reliably be said that preservation is generally either good or bad in this region. This raises the question of whether or not to use fragile materials like marine shell or ostrich eggshell at all when determining the quality of preservation. When finding small pieces of these materials in much older deposit, it is difficult to know how seriously to take their provenance in light of preservation quality and taphonomic processes. Therefore the impacts of taphonomy on changing densities of fragile materials must always be taken into consideration.

Klipfonteinrand offers a well-dated, reliable and material-rich sequence that contains data that are similar to other Later Stone Age sites in southern Africa with microlithic industries, and can be linked to several of these sites on a local, regional and inter-regional scale.

## 6.2 LOCAL PATTERNS

The analysis of the lithic assemblage presented some interesting patterns in the dominant raw materials of Klipfonteinrand. In the overall assemblage of artefacts, hornfels is the dominant material, and peaks between 16.6 and 15.9 cal kyr BP. Putslaagte 8 was previously considered to be an unusual example of a hornfels-dominant assemblage for this time period (Mackay et al. 2015), and it appears that Klipfonteinrand can now be included in this. The timing of this hornfels peak correlates with a rise in sea levels between 19 and 14 ka (Lambeck et al. 2002 a&b, Stanford et al. 2006, Compton 2011). It is during this period (specifically from ~16 - 13 ka) that hornfels appears at coastal sites like Elands Bay Cave (Parkington 1990, Orton 2006). As has been mentioned in Chapter 3, hornfels is unavailable locally at Elands Bay Cave, but likely came from the interior Doring River 10 km north-northeast of Klipfonteinrand, and quite close (2.2 km eastward) to Putslaagte 8. This is also the case with Faraoskop Rock Shelter in between Elands Bay Cave and Klipfonteinrand. A regional link can thus be drawn between these sites at this time

period with the movement of hornfels from the interior to the coast at the time of sea level rise (Parkington 1977). It is of course possible that at the time of this collection, hornfels was available in other areas; Parkington suggests the possibility that “hornfels sources lay west of Elands Bay Cave in the pre-Cape rocks now under water” (Parkington 1986:210). However, this has been neither tested nor confirmed, and therefore the Doring River stands as the closest hornfels source to the Winter Rainfall Zone sites surrounding Klipfonteinrand.

The specific artefact types (as set out in Chapter 4) that represent a Robberg-like component of the lithic assemblage also present interesting patterns. The peak in numbers of bladelets between 22.3 and 16.3 cal kyr BP suggests that Klipfonteinrand has a possible Robberg sequence, which is dominated by silcrete (50.1 %). This draws a link with the sites in Namaqualand which are also dominated by silcrete even though quartz is the more readily-available raw material in the area and dominates so many other similar microlithic assemblages in the region (Orton 2008a). This appears to conflict somewhat with the model of ‘technological provinces’ proposed by Mitchell (1988) that states that microlithic assemblages in the western region of southern Africa are quartz dominated. Klipfonteinrand is largely silcrete-dominated (50.1 %), however quartz does make up a substantial proportion of the remainder of the microlithic assemblage (28.1 %). At AK2006/001G in Namaqualand, there is a silcrete outcrop very near to the site which was the supply for that assemblage (Orton 2008a), whereas the closest silcrete source for Klipfonteinrand is thus far unknown. Of course, there are factors other than the local geology that influence material selection, including the mobility and range of a population, technological and manufacturing preferences and needs, as well as the final product and the requirements for specific prey species. At the start of MIS 2, when the use of silcrete peaks at Klipfonteinrand, conditions were very arid (Scott et al. 2012), and thus it was likely that grazing mammals would have been the targeted prey (Quick 2009, Chase et al. 2011). During the Last Glacial Maximum conditions transitioned from moist and cold to arid and warm, and silcrete numbers coincided more closely with quartz. These high-quality raw materials were preferred for microlithic, more reliable and transportable hunting tools of small browsing mammals during wet periods (Rector and Verrelli 2010), and larger grazing mammals during drier and warmer periods (Quick 2009, Chase et al. 2011). Furthermore, in periods of uncertainty, mobility and range would likely be greater in order to maximise resource exploitation. It is probably for this reason that microlithic technologies were developed.

The timing of this bladelet-rich assemblage at Klipfonteinrand (at least 22.3 to 16.3 cal kyr BP), and at Putslaagte 8 (23.0 - 20.0 cal kyr BP) (Mackay et al. 2015:20) is interesting insofar as sites nearby tend to have later termination dates for their Robberg assemblages: Faraoskop Rock Shelter ends at 13.7 - 13.1 cal kyr BP (Pta-4817) (Manhire 1993, Orton 2006) and Elands Bay

Cave at 13.5 cal kyr BP (AA-5834) ([Parkington 1990](#), [Orton 2006](#)). One reason may be due to small-scale differences in resource availability at each of the sites or because of environmental productivity between sites that are located within a relatively short distance from each other, yet in different ecological zones on opposite sides of the Cape Fold Belt Mountain Range and near to the coast. The adoption of a highly specialised microlithic industry would have likely increased the reliability of resource exploitation in these various regions, and its persistence nearer to the coast for a longer period of time highlights this necessity. The Robberg Industry typically consists of high quality raw materials not easily fractured, very small tool types that can be quickly recreated and easily transported, as well as simply and easily fitted and hafted.

However, it must be taken into account that neither the commencement nor the termination dates for the possible Klipfonteinrand Robberg Industry are necessarily absolute: we may not be seeing a sudden cultural break when looking at the stratigraphy (Figure 2.6) but rather a stratigraphic break, during which time there was cultural change. The possible Robberg Industry appears to terminate in the OB meta-stratum ending at 16.2 cal kyr BP. Thereafter, an apparent 2000-year hiatus occurs at 15.9 cal kyr BP. Despite the drop in bladelet numbers after WS, they reappear in LWBS after the hiatus. Therefore we cannot be certain that it did not terminate later than that and more closely coincident with sites nearby. It is likely that with more research into open sites in this region, understanding human behaviour (movement patterns, landscape use and technological changes) will become far easier.

Backed and retouched artefact numbers are low at Klipfonteinrand, which is consistent, generally, with other Robberg sites ([Lombard, Wadley, Deacon 2012](#)), while the marginal increase in backed artefacts between 22.3 and 17.6 cal kyr BP potentially reflects the suggestion put forward by [Bousman \(2005:219\)](#) that the discard of backed microlithic artefacts increases during times when on-the-go hunting is necessary due to riskier conditions and tools needing to be kept in perfect condition; this appears to be the case at Klipfonteinrand when this occurs at the height of the Last Glacial Maximum.

An intriguing pattern that emerges toward the end of the MIS 2 sequence at Klipfonteinrand is the increase in marine shell fragments in the deposit between 16.6 and 13.4 cal kyr BP, another factor strengthening the claim that Klipfonteinrand was linked at a local scale to sites near the coast. Marine shell peaks at Klipfonteinrand at the start of OB (roughly 16.3 - 15.9 cal kyr BP), as well as appearing at Putslaagte 8 post-17 ka ([Mackay et al. 2015](#)). Marine shell is also present at Faraoskop, although quite a bit earlier at 20.4 - 19.5 cal kyr BP (Pta 4822): here the second-most dominant species is *Donax serra*, with *Choromytilus meridionalis* being dominant ([Manhire 1993](#)), which, at Klipfonteinrand, is the second-most dominant species. The coastline before sea levels began to rise gradually between 19 and 14 ka would have been much further away from

Klipfonteinrand; the distance of the site from the coastline was between 110 km and 130 km (Barrable et al. 2002; Clark et al. 2009; Compton 2010), with sea levels up to -120m lower than present (Ramsay and Cooper 2002). Furthermore, the dominance of *Donax serra* in the marine shell assemblage implies contact with sandy shores between 16.6 - 15.9 cal kyr BP. This is a species that populates sandy beaches rather than rocky shores, and has the habit of burrowing down into the sand (Kilburn and Rippey 1982, Jerardino and Marean 2010). A concept mentioned by Parkington (2014) is that of the *Donax serra* 'scraper', a flaked white mussel that is common at coastal sites and shell middens. No scrapers such as these were found in the Klipfonteinrand assemblage, although the fragments are too broken and badly preserved to show evidence of knapping or use-wear, and it is certainly probable that *Donax serra* were being exploited for their capabilities as tools as well as decorative items (Mitchell 1996) rather than food resources this far inland (Jerardino 2003, Bailey and Craighead 2003, Jerardino and Marean 2010). The robusticity of *Donax serra* is the likely reason for their abundance this far into the interior, as they would have made excellent tools or decorative items in the Late Pleistocene: studies at Nelson Bay Cave show the use of white mussel as scrapers (when knapped on the less angular side of the shell) and body ornaments (when perforated in the middle) (Ray Inskeep, unpublished) Furthermore, studies done by researchers at coastal sites in southern Africa suggest that *Donax serra* have extremely high nutritional content, especially when they reach sexual maturity during winter months and gonad contents become very high, yielding a large amount of protein, carbohydrates and energy for the consumer (Galimberti 2010, Jerardino et al. 2014, Kyriacou et al. 2014, 2016). It thus follows that *Donax serra* may have been a preferred species for food during the late Pleistocene, and more likely that they were brought to interior sites like Klipfonteinrand as tools and decorative items obtained whilst trading. This is supported by the presence of *Donax serra* scrapers at Elands Bay Cave at the same time as the increase at Klipfonteinrand; at Elands Bay Cave these tools appear amongst dozens of other food shellfish species but were clearly used as scrapers rather than food remains (Parkington, unpublished). The connection that has been drawn between Klipfonteinrand and Elands Bay Cave with the appearance of hornfels at the coast, and marine shell in the interior, strengthens the hypothesis that the shells at Klipfonteinrand were likely scrapers, despite no longer being visible as such.

The likely reasons for these intriguing coastal-interior connections at the time of sea level rise between 19 and 13 ka include networking with other mobile groups and trade-exchange systems, population growth and increased mobility and expanding territories at a time of more stable environmental conditions at the end of the Last Glacial Maximum (Mitchell 1996). The fact that the assemblage size of marine shell is small could also suggest that pieces were being brought back as keepsakes or "beauty shells" (Jerardino and Marean 2010) from trade events or

seasonal migration trips to the coast. [Parkington's \(1972, 1976\)](#) seasonal mobility hypothesis suggests that hunter-gatherer groups which were highly mobile followed a pattern of migration according to seasonal change, driven both by fluctuations in gatherable resources and following favored climates and temperatures. However, it is more plausible that this occurred after the rapid rise of sea levels post-13 ka and during the Holocene ([Compton 2011, Lambeck et al. 2012](#)) when sea levels were far closer to the present coastline of today. Prior to this, although sea levels were rising gradually ([Porraz, Parkington et al. 2013](#)) between 19 and 14 ka, it is more likely that groups of people had a system of trade and exchange with coastal populations ([Mitchell 1996, Barham and Mitchell 2008](#)) as opposed to migrating seasonally between the interior and coast as [Parkington \(1972, 1976\)](#) suggests, since marine shell is only sparsely and not consistently present at the site.

Ostrich eggshell beads also reflect similarities between Klipfonteinrand and locally nearby sites. Although marginal, the size of finished ostrich eggshell beads at Klipfonteinrand changes at around 16.6 - 16.1 cal kyr BP, which could be suggesting possible changes in style, cultural preference, or manufacturing strategy and therefore potentially either a replacement of the previous group by another ([Kandel and Conard 2005, Orton 2008b](#)), or a “cultural provincial boundary” between multiple groups using the site through time. Bead size increases slightly until the OB meta-stratum dated to between 16.6 and 15.9 cal kyr BP, but starts to decrease during this time until the end of LWBS (13.7 - 13.4 cal kyr BP). Nearby, Faraoskop Rock Shelter has ostrich eggshell beads that remain small from the start of occupation of the site at 20.4 - 19.5 cal kyr BP (Pta-4822) until 1.8 - 2.2 cal kyr BP (Pta-4955), although exact measurements are not given ([Manhire 1993](#)). The Klipfonteinrand assemblage thus mirrors that of Faraoskop from the start of OB until the end of LWBS in the relative smallness of beads. The various stages of preparation reflected in the ostrich eggshell bead assemblage suggest that it is possible that ostrich eggshell beads were manufactured on site ([Orton 2008b](#)) between 14.4 and 13.4 cal kyr BP, however the sample size is too small to make any definitive comments.

The key location of Klipfonteinrand and the time period being studied gives an interesting perspective on the relationship between coastal and interior populations in the Winter Rainfall Zone, and the response of these populations to changing environments during the Last Glacial Maximum and Late Glacial and the decision-making taking place. It appears that inhabitants of this region during the Last Glacial Maximum/Late Glacial period chose to make predominant use of a raw material that was not locally available during a time of unstable climatic conditions of the Last Glacial Maximum: silcrete (although locally available quartz and hornfels do make up the second and third largest frequency of materials). This is likely due to the high-quality of silcrete and quartz

and the ability to produce microlithic technologies with the small nodules that are available (Mackay 2008).

Cultural factors like migration habits and movement (Parkington's 1972, 1976) with networking between groups and changes in population size (Mitchell 1996, Bousman 2005) would also have had a large role to play in the adoption of microlithic technologies. Considering the variable, and likely unreliable, availability of water at Klipfonteinrand during the Last Glacial Maximum/Late Glacial period, as well as the response of fauna to environmental changes, it is probable that during periods of extreme aridity movement across the landscape would have been much more frequent in order to locate water and follow faunal resources (Deacon, H. 1976, Sampson 1995, Mitchell 2002, Bousman 2005). This environmentally responsive concept is not new, and can be seen in different time periods in southern Africa, like the Howiesons Poort industry for instance, which has been described as “an adaptive response” to extremely cold environmental conditions (Cochrane 2008:164).

### 6.3 REGIONAL PATTERNS

On a regional scale, Klipfonteinrand has similarities to other sites with regards to the timing and design of engraved ostrich eggshell fragments. Assemblages from Nelson Bay Cave, Boomplaas and Byneskransop much further south than Klipfonteinrand (Figure 1.4) have similar motifs engraved on them at a similar time period (see Figure 3.5 for examples of ostrich eggshell engravings from Boomplaas) (Deacon, H. 1976, Deacon, J. 1982, Wadley 1993, Lewis 2008). Ostrich eggshell fragments are understood to have originated from broken ostrich eggshell containers and water-flasks that had been engraved, and are found at many late Pleistocene sites across southern Africa, the number of engraved fragments increasing substantially into the late Pleistocene and Holocene (Deacon H. 1976, Deacon, J. 1982, 1984, Schweitzer and Wilson 1982, Parkington 1990, Texier et al. 2013). The Klipfonteinrand fragments have a similar parallel-lined motif and the “ladder-like” pattern that Deacon describes at Boomplaas (from layers CL, BRL, and DGL, with crosshatched designs similar to those from layers CL and BLD (Deacon 1982: 215). Layer CL at Boomplaas is dated to 18.0 - 14.2 cal kyr BP (Pta-1828, UW-301), correlating to layers BB through LWBS (18.0 - 13.4 cal kyr BP) where these ostrich eggshell fragments were found in at Klipfonteinrand.

The majority of ostrich eggshell beads and engraved fragments come from layers dating to between 14.4 and 13.4 cal kyr BP, which falls within the range of ostrich eggshell-bearing layers at Boomplaas (Deacon 1982, 1984, 1995) and is slightly younger than those at Nelson Bay Cave (Deacon 1974, Deacon et al. 1976, Wadley 1993, Loftus et al. 2016). They persist in lower numbers until the WS meta-stratum, between 17.4 and 16.3 cal kyr BP, which is generally

consistent with these sites in the southern region. Changes in ostrich eggshell bead size and engraved ostrich eggshell patterns likely reflect cultural preference and could potentially be associated with changing economic strategies or cultural and familial groups (Kandel and Conard 2005, Orton 2008b). With such a small sample size, however, and with marginal fluctuations therein, it is not entirely possible to know what these changes might mean.

The period being discussed is of course a lengthy timespan with several groups of people passing through Klipfonteinrand Rock Shelter. Considering the environmental data that has been presented in previous chapters, it is likely that, in general, human behaviour adapted to environmental change and resource availability, thereby influencing cultural and technological transformations between groups through time. The changes in material attributes like size, style, decoration, number and use most likely reflect these greater cultural transformations, just as they do today.

#### 6.4 INTER-REGIONAL PATTERNS

On an inter-regional level, Klipfonteinrand stands out as one of the sites with an earlier termination date for the Robberg Industry (see Table 5d). The peak of Robberg-like artefacts at Klipfonteinrand between 22.3 and 16.3 kcal kyr BP is earlier than many of the other sites in southern Africa: in the Summer Rainfall Zone, the Rose Cottage Cave Robberg terminates at 11.2 - 10.7 cal kyr BP (Pta-7275) (Wadley 1996b, Pienaar et al. 2008, Lombard et al. 2012), Umhlatuzana by 10.6 - 10.2 cal kyr BP (Pta-4307) (Kaplan 1990, Lombard et al. 2012) and the Sehonghong Robberg terminates by 13.5 - 12.6 (Pta-6065) (Lombard et al. 2012, Kaplan 1990, Mitchell 1995). In the Year-round Rainfall Zone, the Nelson Bay Cave Robberg terminates by 12.0 cal kyr BP (Deacon 1982, 1984, Loftus et al. 2016). Even sites closer to Klipfonteinrand in the Winter Rainfall Zone, like Elands Bay Cave and Faraoskop Rock Shelter, have later Robberg termination dates (Manhire 1993, Orton 2006). These differences in technology on different sides of the Cape Fold Belt mountain range at the same time raise the question of why this could have been the case: it may have to do with the use of different areas and territoriality, and the transfer of information between groups (Whallon 2006), as well as differing patterns of land-use and resource procurement in the region (Kuhn 1992). Again however, when looking at the Klipfonteinrand stratigraphic build-up, it is possible that this early termination may have been later and cannot be seen due to the occupational hiatus at the site.

Ostrich eggshell beads and decorated fragments at Melkhoutboom have been dated to 18.9 - 12.1 (UW-233; GaK-1538) (Deacon, H. 1976), consistent with but also later than the dates from Klipfonteinrand which range between 17.4 and 13.4 cal kyr BP. The design of these fragments correlates with the patterns from Klipfonteinrand, being described as “ladder-like” by J. Deacon

(1982: 215). This is also older than ostrich eggshell beads and fragments from Umhlatuzana, Sehonghong and Rose Cottage Cave, which are closer to the final Klipfonteinrand date for this material (Kaplan 1990, Mitchell 1995, Wadley 2001).

The sites with similar Robberg commencement dates to Klipfonteinrand are Putslaagte 8 (Mackay et al. 2015) nearby, and Nelson Bay Cave (J. Deacon 1978, 1982, Lewis 2007) (on the coast of the Year-round Rainfall Zone) and Melkhoutboom (Deacon 1969, Deacon 1974, Deacon 1976, Lombard et al. 2012) (near the coast of the Summer Rainfall Zone). Also interesting is the similarity in timing of the appearance of microlithic technologies at Klipfonteinrand with Sehonghong (Wadley 1993, Mitchell 1995) in the Summer Rainfall Zone: the dates for the early Robberg at this site are between 25.0 and 23.8 cal kyr BP (Pta-6077), which is earlier than many of the rest of southern African Robberg sites, as seen in Chapter 3. This reflects patterns of idea exchange and networking over a large area. The termination of the Klipfonteinrand microlithic industry matches that of Byneskranskop, but is not comparable to other Winter Rainfall Zone sites.

The premise behind this study has been to make a useful statement on the Late Pleistocene archaeological assemblages of southern Africa, particularly in the Winter Rainfall Zone in the west, and the patterns that can be drawn between the sites comprising these assemblages based on the effects of palaeoenvironmental transformations. This has been done by using Klipfonteinrand Rock Shelter in the Cederberg as the primary case-study and contextualising this site amongst other archaeological sites with similar assemblages and occupation periods.

### 7.1 SITE CONTEXTUALISATION

With regards to the contextualisation of Klipfonteinrand, it appears that the site contains a silcrete- and hornfels-rich microlithic assemblage between at least 22.3 - 16.3 cal kyr BP. This assemblage could be attributed to the Robberg Industry, insofar as microlithic bladelets are higher in number than any other artefact type during this time; the, albeit ephemeral, assemblage of bladelet cores is at its peak during the same time; and the use of bipolar reduction on mostly quartz is present, but slightly more ephemeral here than at other similar sites ([Mitchell 1988](#), [Orton 2006](#), [Schweitzer and Wilson 1982, 1983](#), [Wadley 1993](#)). Before 22.3 cal kyr BP, it is unclear which technological industry persisted near Klipfonteinrand as no Terminal Pleistocene dates nor deposit are available until the Middle Stone Age (roughly 60 ka), with a hiatus of around 38,000 years. After 16.6 cal kyr BP, the bladelet-rich industry is replaced, when both bladelets and silcrete decrease substantially and hornfels and quartz remain dominant. It is possible that this replacement industry is an early version of the Oakhurst, on account of the near-complete lack of microlithic artefacts, the appearance of naturally backed knives and an increase in large scrapers directly after bladelets disappear. Further analysis is needed to determine the precise technological change that occurs at Klipfonteinrand after this point.

### 7.2 COASTAL CONNECTIONS

Despite the distance of the interior from the coast, it has been shown to have been linked at the time of sea level rise between 19 - 11 ka. By roughly 16 ka, the coastline was already within 25 - 30 km of the present coastline, bringing the people inhabiting Klipfonteinrand much closer to marine resources and shelters. Marine shell fragments appear in higher numbers within this timeframe at Klipfonteinrand, Putslaagte 8 and Faraoskop, three sites that were previously very much further from the coast than by 16 - 11 ka. Comparatively, the appearance of interiorly-sourced hornfels at sites such as Elands Bay Cave (much closer to the shoreline than

before at this point) demonstrates a clear connection with inland populations. It is unknown whether people travelled directly to and from the coast more often at this point, or whether they made contact with groups coming from the coast. However, these suggestions are not necessarily mutually exclusive, and it is likely that the mobility of people at the end of MIS 2 increased greatly with warmer and more stable environmental conditions.

This coastal connection brings up the likely notion of behavioural changes of hunter-gatherers and their mobility strategies at a time when resources were probably more nutrient-rich and abundant along the shorelines than inland, which between 16 - 11 ka was warm but quite arid, as well as resources being more predictably available in the intertidal zone. With the rise in sea level, the decreased size of coastal plains, and the likely growth of populations (Fisher 2016), movement between these regions probably became more regular. The more easily accessible marine resources available after sea level rise to people occupying the Sandveld between the coast and the interior would have provided invaluable nutrition (Kyriacou et al. 2014, De Vynck et al. 2016), important for cognitive development, balanced protein and iron levels (Kyriacou et al. 2014), and behavioural and social development (Marean 2015). Of course, Klipfonteinrand is, and always has been, a site based in the interior, even with sea level rise. It has also been suggested that hunter-gatherers would not usually travel further than 8 - 10 km per day in the pursuit of resources (Fisher 2016), and inhabitants of Klipfonteinrand would certainly not be making daily trips to the coastline. However, mobility and range size would have likely increased along with favourable conditions and the probable growth of group sizes, allowing for more regular networking and trade with coastal groups. The patterns of movement between these sites are intriguing in light of the palaeoenvironmental changes that took place in the Winter Rainfall Zone between 16 - 12 ka, and remind us that these sites and the stories they hold are not isolated events, but are rather connected through time and across space.

### 7.3 REGIONAL COMPARISON

The technological industries at Klipfonteinrand fit quite well within the framework that has been identified by researchers of Stone Age archaeology in southern Africa (Deacon, J. 1984 a&b, Mitchell 1988, Wadley 1996, Mitchell 1997, Deacon and Deacon 1999, Wadley 2000). The technological industries present interesting patterns, and can be compared with other rock shelter sites in the surrounding regions. Within the Winter Rainfall Zone, Klipfonteinrand is most similar to Putslaagte 8, which is also the terminal Pleistocene site of closest proximity. The typical technological markers of the Robberg Industry appear at both sites earlier than the majority of other sites in the Winter Rainfall Zone prior to 21 ka, although this technology persists slightly longer at Klipfonteinrand (until 16.3 cal kyr BP) than at Putslaagte 8 (20.0 cal kyr BP) (Mackay et

al. 2015). Klein Kliphuis appears to have an equally early Late Pleistocene microlithic industry between 22.9 and 22.3 cal kyr BP (Wk-20241), however this is dominated by quartz bipolar technology and large amounts of ochre (Van Rijssen 1992, Mackay 2006). Klipfonteinrand is slightly different from Elands Bay Cave and Faraoskop in timing and in raw material use: these two sites have a dominance of quartz in the typical Robberg layers (Manhire 1993, Orton 2006), whereas Klipfonteinrand is silcrete-dominant. Faraoskop Robberg technology begins to show at roughly 20 ka, but terminates quite a bit later than Klipfonteinrand at roughly 13 ka, and also contains a marine shell assemblage with *Donax serra* (Manhire 1993). At Elands Bay Cave, Robberg-type lithics appear between 15.6 - 13.8 cal kyr BP (Parkington 1980, Orton 2006), and therefore subsequent to Klipfonteinrand. Byneskranskop seems to have a Robberg dated to between 17.1 - 16.1 cal BP (Loftus et al. 2016) that is timed toward the end of the Klipfonteinrand sequence, and is characterised by numerous bladelets, blades and blade cores. However quartz is more common and silcrete quite rare (Schweitzer and Wilson 1982).

In the Year-round Rainfall Zone, Boomplaas appears to be comparable to Klipfonteinrand, with a silcrete-rich Robberg between 18.0 - 13.6 cal kyr BP (Wadley 1993, Meadows and Baxter 1999), as well as engraved ostrich eggshell with a very similar “ladder-like” design to both Klipfonteinrand and Melkhoutboom (Deacon 1982). Melkhoutboom fits into this framework with Robberg-like small bladelet cores, dated to 18.9 - 18.4 cal kyr BP (Deacon 1969, Deacon 1974, Deacon 1976, Lombard et al. 2012). Furthermore, Nelson Bay Cave is comparative with bladelets, blade cores and a higher frequency of silcrete between 18.1 - 17.6 cal BP (OxA-32458) (Deacon 1982, 1984, Loftus et al. 2016).

In the Summer Rainfall Zone, the start dates for the Robberg appear to be mostly similar to Klipfonteinrand, with Sehonghong and Umhlatuzana both containing high numbers of bladelets, bladelet cores, scrapers and backed tools from 20 ka, but terminating quite a bit later than Klipfonteinrand at roughly 12 ka (Kaplan 1990, Mitchell 1995). Rose Cottage Cave, however, begins later than this at 19.1 cal kyr BP (Pta-6195), terminating at 10.7 cal kyr BP (Pta-7275) (Wadley 1996b; Pienaar et al. 2008, Lombard et al. 2012). Raw materials in this region differ, with high numbers of brightly-coloured opaline tools, although hornfels and quartz are also present (Wadley 1993, Mitchell 1995).

However there is no apparent pattern to these start and end dates; it cannot be stated, for example, that the Robberg Industry began in one region and swept across the subcontinent over time, because start dates appear at similar times all over, with outliers appearing randomly across southern Africa. The termination of the Robberg also appears to be rather random, with termination dates ranging between 18 - 12 ka (see Table 5d). It should be recognised that the dating framework that is so heavily relied on is not as precise as we would like.

## 7.4 PALAEOCLIMATIC ELEMENT

All of this happened within the palaeoenvironmental framework presented, which must have played a key role in the decision-making, responses and ultimately survival of people affected by it. What provides an interesting pattern is the way in which the palaeoenvironment correlates with the Robberg dates presented: the majority of sites have a Robberg Industry that begins during arid and cold conditions, and which terminates during more moist and warm conditions. The variation of the rainfall zones and climatic regions across the subcontinent do not seem to affect this pattern: regardless of the location of the site (bar the outliers mentioned previously), the Robberg tends to begin during arid phases, persists through climatic variations, and terminates during a warming and drying phase typical of the Late Glacial (see Figures 7.1 and 7.2).



Figure 7.1. Satellite map of Winter Rainfall Zone sites, indicating start and end dates for Robberg assemblages (cal kyr BP), alongside associated palaeoenvironmental data (please see Abbreviations Glossary for full site names).

## 7.5 ARCHAEOLOGICAL IMPLICATIONS

What were the driving factors influencing the production of a highly specialised technology? The Robberg has been described as innovative in its formation (Deacon 1984b), most likely because of the technological predecessor during the Early Later Stone Age having been less specialised and

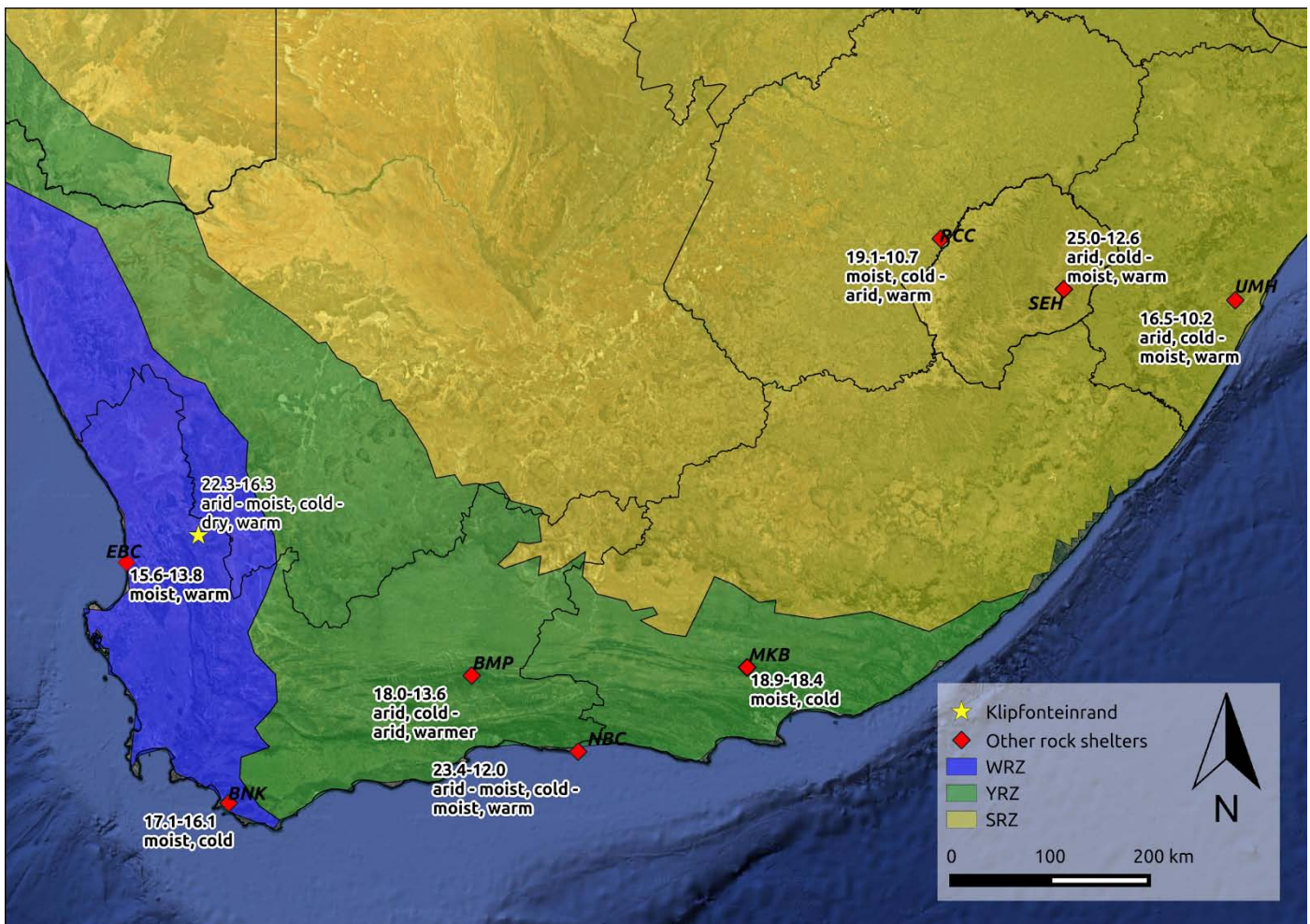


Figure 7.2. Satellite map of sites within all rainfall zones of southern Africa, indicating start and end dates for Robberg assemblages (cal kyr BP), alongside associated palaeoenvironmental data (please see Abbreviations Glossary for full site names). Not all WRZ sites in text appear on this map.

more of a mixture of Middle and Later Stone Age technological components (Kaplan 1990, McCall and Thomas 2009, Mackay et al. 2014). Robberg assemblages are specifically comprised of high numbers of bladelets under 25 mm in size, an increase in bladelet cores and bipolar reduction of quartz and a decrease in backed artefacts (Deacon, J. 1984a, Wadley 1996). It has been shown that microlithic technologies probably developed in times of stress and increased mobility (Deacon 1984b, McCall and Thomas 2009), but the exact uses of Robberg tool types are as yet unknown. However, in a time of dry conditions, low productivity, unstable climates and riskier resource acquisition, an industry that is highly specialised, reliable and systematically maintainable would be of key importance (Barham and Mitchell 2008). At the time of Robberg termination across southern Africa, conditions appear to become more amenable and less unstable. It is at this time that the subsequent less specialised technology appears in the Oakhurst Industry.

The precise reasons for the Robberg Industry persisting so impressively across vast space (at sites all across the southern Africa in different biomes and environmental regions) as well as through time (through a period of differing environmental events and changing populations) are as yet unknown. However, these varying components and the response of people to them (despite

population and, possibly, cultural replacements) speaks to the resilience of the industry, and the necessity for reliability and high-quality hunting techniques and equipment during unstable and varying times.

## 7.6 PROBLEMATISING CONTINUITY / DISCONTINUITY

An important feature of these types of studies is the difficulty of dealing with continuity and discontinuity in the archaeological record. Site-use and deposit build-up are largely non-mechanical and hardly continuous. Hiatuses do appear to occur at the majority of the sites studied here, for instance between 20 - 17 ka at Elands Bay Cave (Orton 2006), and between 22 - 21 ka at Putslaagte 8 (Mackay et al. 2015). Generally, a hiatus at a site could be reflecting unfavourable conditions in the region, or a lack of water availability during a specific time period. Whatever the reasons, this discontinuity in the archaeological records of sites is paramount to affecting the incomplete database of information that is available for research. It is very difficult to draw reliable conclusions regarding human behaviour, patterns of social cohesion and development, or landscape use when the timing between sites is discontinuous. Assessing sites in an isolated manner is not conducive to forming accurate or reliable conclusions, and therefore relationships must be found on a spatial level as well as through time in order to reach an overall understanding of the past. One of the ways this comes across at Klipfonteinrand is the discontinuous nature of occupation, seen through the dates obtained from the deposit. The stratigraphy (Figure 2.6) shows periods of relatively infrequent occupation prior to 22.3 cal kyr BP, between 22.1 to 19.1 cal kyr BP, and finally between 16.2 to 14.2 cal kyr BP. These are key dates surrounding the appearance and disappearance of Robberg-like artefacts. Therefore the problem becomes evident when trying to ascertain the exact boundaries of the start and termination of the possible Robberg Industry at Klipfonteinrand, and thereby comparing these accurately to other nearby sites. Without clear boundaries, it cannot reliably be said that these artefact types (microlithic bladelet technology developed using the bipolar or bladelet core reduction techniques) fit within a particular industrial package, as it cannot be known whether they drifted in and out within the lengthy hiatuses on either end of the time spectrum, or whether they were definitively and more suddenly introduced and terminated at a more specific time - in response to a change in environment, cultural variation/replacement, or faunal availability for instance.

More observations are needed in this field: additional excavations of pre-excavated and unexcavated rock shelters, much more research into open sites to get a clearer and less-biased perspective on landscape use, and a more detailed palaeoenvironmental picture. A more complete framework, in other words, would be useful, onto which to base our assumptions of the Late Pleistocene. More radiocarbon dates would also help to clarify things: the type of work being done

by [Loftus et al. \(2016\)](#) in updating existing dates for example is the key to gaining more accurate and numerous dates for the many sites that have been previously excavated in southern Africa. It is important to duplicate observations and replicate data in different contexts in order to build more robust patterns.

At Klipfonteinrand, further research into various components is needed, as this study has provided only a baseline assessment of the site. Studying the lithic assemblage in more detail would allow for a comprehensive understanding of the technological variations at the site. An assessment of the angularity of roof spalls could determine whether mechanical weathering is the cause of these layers, or whether human occupation of the site or changes in temperature affected the build-up of spalls. Certainly a closer look at the marine shell assemblage would help to determine more precisely whether any of the shells were used as scrapers. Faunal studies are necessary to enhance the palaeoenvironmental record, as are studies of the charcoal assemblage to determine floral variation through time. An assessment of the connection between the ochre and rock art at Klipfonteinrand may prove interesting. And stable isotope analysis similar to that of [Ecker et al. \(2015\)](#) focusing on the ostrich eggshell assemblage may be very useful in identifying more precise periods of aridity and moisture in this region.

## 7.7 FINAL REMARKS

This thesis has set out to answer a series of questions presented in Chapter 1. The analysis of the lithic industry has confirmed the presence of a Robberg-like component at Klipfonteinrand, occurring from at least 22.3 to 16.3 cal kyr BP. The industry at this particular site has been compared with other sites further afield and similarities drawn in terms of artefact types, raw material selection and timing of the appearance and disappearance of the microlithic Robberg Industry. Lithics and marine shell have been analysed and confirm the likelihood of coastal-interior connections made at the time of rapid sea level rise, between coastal sites such as Elands Bay Cave and interior sites such as Klipfonteinrand. Ostrich eggshell has been studied with results suggesting the possibility of using this material to determine environmental variations, including water availability and vegetation changes. The study of roof spall reflects a possible link between rock exfoliation and temperature changes as well as shelter occupation, but a weaker link between exfoliation and fire building in the shelter. Charcoal, bone and ochre studies enhance our understanding of site usage and occupational episodes, as well as site taphonomy.

Several subjects have arisen in this thesis, with unanswered questions that can hopefully be addressed in future studies of the assemblages. These include knowing whether observed changes reflect population or cultural replacement, or merely a difference in stylistic preference;

the reasons for people having adopted specific technologies and their usefulness in the broader picture, and whether or not this reflects a response to environmental changes.

The project has added to an understanding of the palaeoenvironmental framework of the MIS 2 period, and the role it played locally, regionally and inter-regionally, and, beyond this, the behaviour of hunting-and-gathering groups of people occupying the region. The major patterns observed include the presence of a microlithic industry comparable to that seen elsewhere in southern Africa known as the Robberg Industry, as well as movement between the coast and the interior of the west coast of South Africa at the time of rapid sea level rise. The study of these patterns has determined that connections can be drawn between groups inter-regionally based on lithic and non-lithic material, and has situated Klipfonteinrand within the broader context of archaeological sites of this time period.

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**Images of marine shell species in Chapter 5:**

*Donax serra* - Creative Commons

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**APPENDIX 1**  
**RESULTS DATABASE**

# All Lithics - raw material

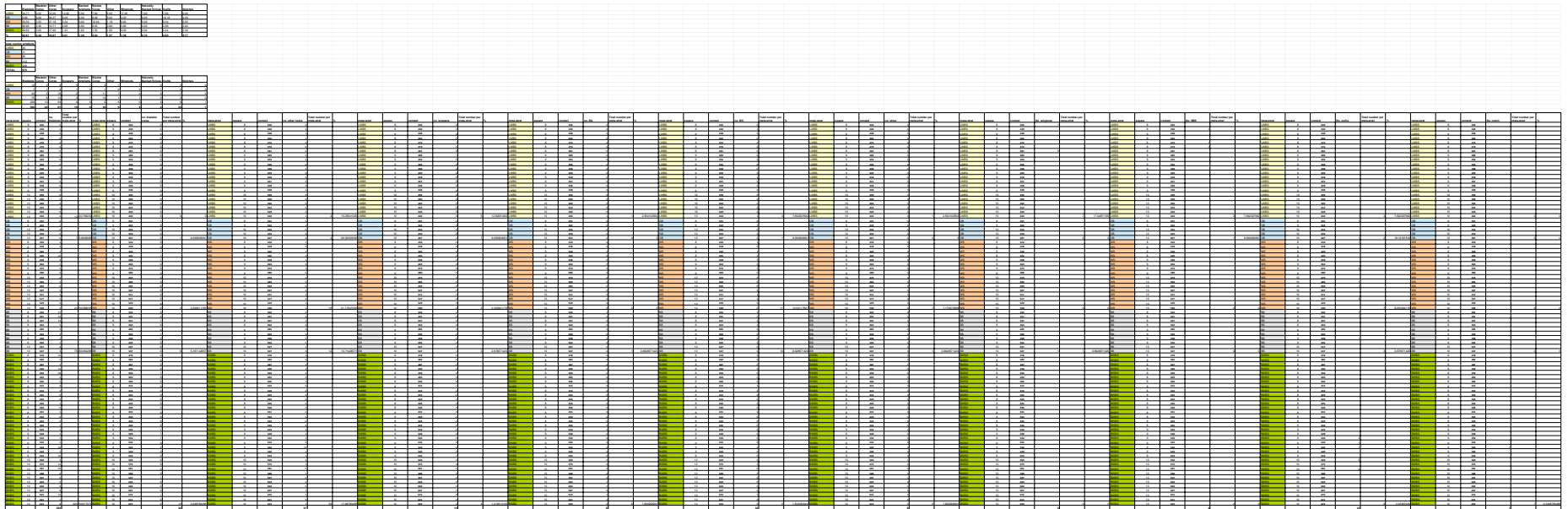
	Hornfels	Quartz	Silcrete	Quartzite	CCS
LWBS	83.82	14.47	2.63	15.13	3.95
OB	52.08	31.25	2.08	13.54	1.04
WS	48.28	23.26	13.48	8.26	3.04
BB	40.00	28.78	17.07	12.20	1.95
BWBS	33.53	17.95	22.55	18.69	7.27
%	41.71	21.89	16.91	14.96	4.94

1357	total number artifacts
LWBS	152
OB	96
WS	230
BB	205
BWBS	674
1357	

meta-strat	square	content	no. quartz	total number per meta-strat	%	meta-strat	square	content	no. silcrete	total number per meta-strat	%	meta-strat	square	content	no. hornfs	total number per meta-strat	%	meta-strat	square	content	no. CCS	total number per meta-strat	%
LWBS	8	226	0			LWBS	8	226	0			LWBS	8	226	1			LWBS	8	226	0		
LWBS	8	230	5			LWBS	8	230	0			LWBS	8	230	4			LWBS	8	230	1		
LWBS	8	248	0			LWBS	8	248	0			LWBS	8	248	2			LWBS	8	248	0		
LWBS	8	266	1			LWBS	8	266	0			LWBS	8	266	2			LWBS	8	266	1		
LWBS	8	272	2			LWBS	8	272	0			LWBS	8	272	11			LWBS	8	272	2		
LWBS	8	274	1			LWBS	8	274	0			LWBS	8	274	5			LWBS	8	274	0		
LWBS	8	281	2			LWBS	8	281	0			LWBS	8	281	2			LWBS	8	281	0		
LWBS	9	389	1			LWBS	9	389	2			LWBS	9	389	15			LWBS	9	389	0		
LWBS	9	396	0			LWBS	9	396	0			LWBS	9	396	3			LWBS	9	396	0		
LWBS	9	398	1			LWBS	9	398	0			LWBS	9	398	0			LWBS	9	398	0		
LWBS	9	409	2			LWBS	9	409	0			LWBS	9	409	0			LWBS	9	409	1		
LWBS	9	418	1			LWBS	9	418	0			LWBS	9	418	7			LWBS	9	418	0		
LWBS	9	421	0			LWBS	9	421	0			LWBS	9	421	0			LWBS	9	421	0		
LWBS	9	428	0			LWBS	9	428	0			LWBS	9	428	0			LWBS	9	428	0		
LWBS	9	438	4			LWBS	9	438	0			LWBS	9	438	5			LWBS	9	438	0		
LWBS	10	399	0			LWBS	10	399	0			LWBS	10	399	1			LWBS	10	399	0		
LWBS	10	400	1			LWBS	10	400	2			LWBS	10	400	0			LWBS	10	400	0		
LWBS	10	404	0			LWBS	10	404	0			LWBS	10	404	0			LWBS	10	404	0		
LWBS	10	412	1			LWBS	10	412	0			LWBS	10	412	0			LWBS	10	412	0		
LWBS	10	420	0			LWBS	10	420	0			LWBS	10	420	7			LWBS	10	420	1		
LWBS	10	444	0	22	7.41	LWBS	10	444	0	4	1.79	LWBS	10	444	4	97	17.14	LWBS	10	444	0	23	11.53
OB	8	291	10			OB	8	291	24			OB	8	291	24			OB	8	291	3	6	8.96
OB	9	442	18			OB	9	442	1			OB	9	442	15			OB	9	442	1		
OB	10	456	0			OB	10	456	0			OB	10	456	4			OB	10	456	0		
OB	10	459	1			OB	10	459	0			OB	10	459	0			OB	10	459	0		
OB	10	467	1	30	10.10	OB	10	467	1	2	0.89	OB	10	467	6	50	8.83	OB	10	467	0	13	6.40
WS	8	310	4			WS	8	310	1			WS	8	310	13			WS	8	310	0		
WS	8	318	0			WS	8	318	0			WS	8	318	4			WS	8	318	0		
WS	8	320	7			WS	8	320	3			WS	8	320	12			WS	8	320	1		
WS	8	326	15			WS	8	326	7			WS	8	326	20			WS	8	326	1		
WS	9	458	8			WS	9	458	4			WS	9	458	13			WS	9	458	2		
WS	9	463	3			WS	9	463	1			WS	9	463	4			WS	9	463	0		
WS	9	474	4			WS	9	474	5			WS	9	474	11			WS	9	474	0		
WS	9	480	2			WS	9	480	1			WS	9	480	4			WS	9	480	1		
WS	10	474	0			WS	10	474	0			WS	10	474	0			WS	10	474	0		
WS	10	483	0			WS	10	483	0			WS	10	483	5			WS	10	483	0		
WS	10	492	0			WS	10	492	0			WS	10	492	0			WS	10	492	0		
WS	10	507	2			WS	10	507	3			WS	10	507	0			WS	10	507	0		
WS	10	511	1			WS	10	511	0			WS	10	511	3			WS	10	511	2		
WS	10	517	0			WS	10	517	0			WS	10	517	8			WS	10	517	0		
WS	10	529	0			WS	10	529	0			WS	10	529	0			WS	10	529	0		
WS	10	530	19	65	21.89	WS	10	530	3	31	13.84	WS	10	530	6	111	19.61	WS	10	530	1	16	7.88
BB	8	335	25			BB	8	335	9			BB	8	335	19			BB	8	335	2		
BB	8	341	8			BB	8	341	5			BB	8	341	8			BB	8	341	0		
BB	8	347	7			BB	8	347	5			BB	8	347	15			BB	8	347	0		
BB	8	363	0			BB	8	363	0			BB	8	363	0			BB	8	363	0		
BB	9	485	4			BB	9	485	1			BB	9	485	0			BB	9	485	0		
BB	9	494	1			BB	9	494	1			BB	9	494	0			BB	9	494	0		
BB	9	498	2			BB	9	498	1			BB	9	498	4			BB	9	498	0		
BB	9	502	3			BB	9	502	3			BB	9	502	3			BB	9	502	0		
BB	10	527	8			BB	10	527	9			BB	10	527	12			BB	10	527	2		
BB	10	547	1	59	19.87	BB	10	547	1	35	15.63	BB	10	547	3	82	14.49	BB	10	547	0	25	12.32
BWBS	8	378	8			BWBS	8	378	3			BWBS	8	378	11			BWBS	8	378	1		
BWBS	8	382	0			BWBS	8	382	1			BWBS	8	382	9			BWBS	8	382	0		
BWBS	8	387	5			BWBS	8	387	7			BWBS	8	387	16			BWBS	8	387	0		
BWBS	8	390	7			BWBS	8	390	5			BWBS	8	390	13			BWBS	8	390	1		
BWBS	8	394	8			BWBS	8	394	16			BWBS	8	394	6			BWBS	8	394	4		
BWBS	8	403	0			BWBS	8	403	1			BWBS	8	403	0			BWBS	8	403	0		
BWBS	8	406	6			BWBS	8	406	21			BWBS	8	406	20			BWBS	8	406	6		
BWBS	8	415	5			BWBS	8	415	1			BWBS	8	415	4			BWBS	8	415	1		
BWBS	8	419	0			BWBS	8	419	0			BWBS	8	419	0			BWBS	8	419	0		
BWBS	8	422	0			BWBS	8	422	0			BWBS	8	422	0			BWBS	8	422	0		
BWBS	8	424	0			BWBS	8	424	0			BWBS	8	424	1			BWBS	8	424	0		
BWBS	8	426	7			BWBS	8	426	4			BWBS	8	426	3			BWBS	8	426	2		
BWBS	8	430	2			BWBS	8	430	2			BWBS	8	430	0			BWBS	8	430	0		
BWBS	8	431	1			BWBS	8	431	0			BWBS	8	431	0			BWBS	8	431	0		
BWBS	8	434	3			BWBS	8	434	2			BWBS	8	434	1			BWBS	8	434	0		
BWBS	8	443	2			BWBS	8	443	1			BWBS	8	443	0			BWBS	8	443	0		
BWBS	8	446	1			BWBS	8	446	0			BWBS	8	446	0			BWBS	8	446	0		
BWBS	9	524	7			BWBS	9	524	1			BWBS	9	524	8			BWBS	9	524	1		
BWBS	9	528	11			BWBS	9	528	3			BWBS	9	528	13			BWBS	9	528	0		
BWBS	9	534	3			BWBS	9	534	9			BWBS	9	534	15			BWBS	9	534	4		
BWBS	9	535	2			BWBS	9	535	0			BWBS	9	535	4			BWBS	9	535	0		
BWBS	9	544	11			BWBS	9	544	12			BWBS	9	544	6			BWBS	9	544	5		
BWBS	9	549	1			BWBS	9	549	2			BWBS	9	549	2			BWBS	9	549	1		
BWBS	9	553	2			BWBS	9	553	2			BWBS	9	553	2			BWBS	9	553	1		
BWBS	10	569	6			BWBS	10	569	2			BWBS	10	569	16			BWBS	10	569	1		
BWBS	10	575	7			BWBS	10	575															



# All Lithics - tool types





# Robberg Lithics - materials

	Quartz	Silcrete	Hornfels	Quartzite	CCS
LWBS	13.33	40.00	13.33	13.33	0.00
CB	100.00	0.00	0.00	0.00	0.00
WB	46.15	26.52	5.77	9.82	7.69
BB	40.24	37.80	5.10	4.88	4.88
BWBS	13.11	51.75	7.11	1.56	7.11
%	29.84	82.85	7.12	5.21	6.68
Total number	Quartz	Silcrete	Hornfels	Quartzite	CCS
LWBS	5	6	2	2	0
CB	1	0	0	0	0
WB	24	14	3	5	4
BB	33	31	5	4	4
BWBS	43	130	16	8	16
TOTAL	108	190	26	19	24

Total number artefacts	
LWBS	15
CB	1
WB	50
BB	77
BWBS	222
TOTAL	185

meta-strat	square	contrast	no. quartz	Total number per meta-strat	%	meta-strat	square	contrast	no. hornfs	Total number per meta-strat	%	meta-strat	square	contrast	no. QZst	Total number per meta-strat	%	meta-strat	square	contrast	Total number per meta-strat	%	CCS	Total number per meta-strat	%
LWBS	8	236	0	0	0	LWBS	8	236	0	0	0	LWBS	8	236	0	0	0	LWBS	8	236	0	0	0	0	
LWBS	8	230	0	0	0	LWBS	8	230	0	0	0	LWBS	8	230	0	0	0	LWBS	8	230	0	0	0	0	
LWBS	8	248	0	0	0	LWBS	8	248	0	0	0	LWBS	8	248	0	0	0	LWBS	8	248	0	0	0	0	
LWBS	8	266	0	0	0	LWBS	8	266	0	0	0	LWBS	8	266	0	0	0	LWBS	8	266	0	0	0	0	
LWBS	8	272	0	0	0	LWBS	8	272	0	0	0	LWBS	8	272	0	0	0	LWBS	8	272	0	0	0	0	
LWBS	8	274	0	0	0	LWBS	8	274	0	0	0	LWBS	8	274	0	0	0	LWBS	8	274	0	0	0	0	
LWBS	8	281	0	0	0	LWBS	8	281	0	0	0	LWBS	8	281	0	0	0	LWBS	8	281	0	0	0	0	
LWBS	9	389	0	0	0	LWBS	9	389	0	0	0	LWBS	9	389	0	0	0	LWBS	9	389	0	0	0	0	
LWBS	9	393	0	0	0	LWBS	9	393	0	0	0	LWBS	9	393	0	0	0	LWBS	9	393	0	0	0	0	
LWBS	9	396	0	0	0	LWBS	9	396	0	0	0	LWBS	9	396	0	0	0	LWBS	9	396	0	0	0	0	
LWBS	9	398	0	0	0	LWBS	9	398	0	0	0	LWBS	9	398	0	0	0	LWBS	9	398	0	0	0	0	
LWBS	9	409	0	0	0	LWBS	9	409	0	0	0	LWBS	9	409	0	0	0	LWBS	9	409	0	0	0	0	
LWBS	9	418	0	0	0	LWBS	9	418	0	0	0	LWBS	9	418	0	0	0	LWBS	9	418	0	0	0	0	
LWBS	9	421	0	0	0	LWBS	9	421	0	0	0	LWBS	9	421	0	0	0	LWBS	9	421	0	0	0	0	
LWBS	9	428	0	0	0	LWBS	9	428	0	0	0	LWBS	9	428	0	0	0	LWBS	9	428	0	0	0	0	
LWBS	9	438	0	0	0	LWBS	9	438	0	0	0	LWBS	9	438	0	0	0	LWBS	9	438	0	0	0	0	
LWBS	10	289	0	0	0	LWBS	10	289	0	0	0	LWBS	10	289	0	0	0	LWBS	10	289	0	0	0	0	
LWBS	10	400	0	0	0	LWBS	10	400	0	0	0	LWBS	10	400	0	0	0	LWBS	10	400	0	0	0	0	
LWBS	10	404	0	0	0	LWBS	10	404	0	0	0	LWBS	10	404	0	0	0	LWBS	10	404	0	0	0	0	
LWBS	10	412	0	0	0	LWBS	10	412	0	0	0	LWBS	10	412	0	0	0	LWBS	10	412	0	0	0	0	
LWBS	10	420	0	0	0	LWBS	10	420	0	0	0	LWBS	10	420	0	0	0	LWBS	10	420	0	0	0	0	
LWBS	10	444	1	5	33.33	LWBS	10	444	1	5	33.33	LWBS	10	444	1	2	13.33	LWBS	10	444	1	0	0	0.00	
CB	8	291	0	0	0	CB	8	291	0	0	0	CB	8	291	0	0	0	CB	8	291	0	0	0	0	
CB	9	462	0	0	0	CB	9	462	0	0	0	CB	9	462	0	0	0	CB	9	462	0	0	0	0	
CB	10	456	0	0	0	CB	10	456	0	0	0	CB	10	456	0	0	0	CB	10	456	0	0	0	0	
CB	10	459	0	0	0	CB	10	459	0	0	0	CB	10	459	0	0	0	CB	10	459	0	0	0	0	
CB	10	467	1	1	100.00	CB	10	467	0	0	0.00	CB	10	467	0	0	0.00	CB	10	467	0	0	0	0.00	
WB	8	310	0	0	0	WB	8	310	0	0	0	WB	8	310	0	0	0	WB	8	310	0	0	0	0	
WB	8	318	0	0	0	WB	8	318	0	0	0	WB	8	318	0	0	0	WB	8	318	0	0	0	0	
WB	8	320	0	0	0	WB	8	320	0	0	0	WB	8	320	0	0	0	WB	8	320	0	0	0	0	
WB	8	326	4	4	4	WB	8	326	2	2	1	WB	8	326	1	1	WB	8	326	0	0	0	0		
WB	9	458	0	0	0	WB	9	458	0	0	0	WB	9	458	0	0	0	WB	9	458	0	0	0	0	
WB	9	463	0	0	0	WB	9	463	0	0	0	WB	9	463	0	0	0	WB	9	463	0	0	0	0	
WB	9	473	0	0	0	WB	9	473	0	0	0	WB	9	473	0	0	0	WB	9	473	0	0	0	0	
WB	9	480	0	0	0	WB	9	480	0	0	0	WB	9	480	0	0	0	WB	9	480	0	0	0	0	
WB	10	474	0	0	0	WB	10	474	0	0	0	WB	10	474	0	0	0	WB	10	474	0	0	0	0	
WB	10	483	0	0	0	WB	10	483	0	0	0	WB	10	483	0	0	0	WB	10	483	0	0	0	0	
WB	10	492	0	0	0	WB	10	492	0	0	0	WB	10	492	0	0	0	WB	10	492	0	0	0	0	
WB	10	507	0	0	0	WB	10	507	0	0	0	WB	10	507	0	0	0	WB	10	507	0	0	0	0	
WB	10	513	0	0	0	WB	10	513	0	0	0	WB	10	513	0	0	0	WB	10	513	0	0	0	0	
WB	10	517	0	0	0	WB	10	517	0	0	0	WB	10	517	0	0	0	WB	10	517	0	0	0	0	
WB	10	529	0	0	0	WB	10	529	0	0	0	WB	10	529	0	0	0	WB	10	529	0	0	0	0	
WB	10	535	0	24	46.15	WB	10	535	0	14	26.92	WB	10	535	0	3	5.77	WB	10	535	0	6	0.62	4	7.69
BB	8	335	8	8	8	BB	8	335	1	1	1	BB	8	335	0	0	0	BB	8	335	0	0	0	0	
BB	8	341	9	11	11	BB	8	341	1	1	1	BB	8	341	2	2	2	BB	8	341	0	0	0	0	
BB	8	347	8	8	8	BB	8	347	1	1	1	BB	8	347	2	2	2	BB	8	347	0	0	0	0	
BB	8	353	5	5	5	BB	8	353	1	1	1	BB	8	353	0	0	0	BB	8	353	0	0	0	0	
BB	9	485	1	2	2	BB	9	485	0	0	0	BB	9	485	0	0	0	BB	9	485	0	0	0	0	
BB	9	494	0	0	0	BB	9	494	0	0	0	BB	9	494	0	0	0	BB	9	494	0	0	0	0	
BB	9	498	0	0	0	BB	9	498	0	0	0	BB	9	498	0	0	0	BB	9	498	0	0	0	0	
BB	9	502	0	0	0	BB	9	502	0	0	0	BB	9	502	0	0	0	BB	9	502	0	0	0	0	
BB	10	527	0	0	0	BB	10	527	0	0	0	BB	10	527	0	0	0	BB	10	527	0	0	0	0	
BB	10	547	0	31	40.24	BB	10	547	0	31	37.80	BB	10	547	0	5	6.10	BB	10	547	0	4	4.88	4	4.88
BWBS	8	378	4	4	4	BWBS	8	378	1	1	1	BWBS	8	378	0	0	0	BWBS	8	378	0	0	0	0	0
BWBS	8	382	0	0	0	BWBS	8	382	0	0	0	BWBS	8	382	0	0	0	BWBS	8	382	0	0	0	0	0
BWBS	8	387	0	0	0	BWBS	8	387	0	0	0	BWBS	8	387	0	0	0	BWBS	8	387	0	0	0	0	0
BWBS	8	390	0	0	0	BWBS	8	390	0	0	0	BWBS	8	390	0	0	0	BWBS	8	390	0	0	0	0	0
BWBS	8	394	0	0	0	BWBS	8	394	0	0	0	BWBS	8	394	0	0	0	BWBS	8	394	0	0	0	0	0
BWBS	8	403	0	0	0	BWBS	8	403	0	0	0	BWBS	8	403	0	0	0	BWBS	8	403	0	0	0	0	0
BWBS	8	406	0	0	0	BWBS	8	406	0	0	0	BWBS	8	406	0	0	0	BWBS	8	406	0	0	0	0	0
BWBS	8	415	0	0	0	BWBS	8	415	0	0	0	BWBS	8	415	0	0	0	BWBS	8	415	0	0	0	0	0
BWBS	8	418	0	0	0	BWBS	8	418	0	0	0	BWBS	8	418	0	0	0	BWBS	8	418	0	0	0	0	0
BWBS	8	422	0	0	0	BWBS	8	422	0	0	0	BWBS	8	422	0	0	0	BWBS	8	422	0	0	0	0	0
BWBS	8	424	0	0	0	BWBS	8	424	0	0	0	BWBS	8	424	0	0	0	BWBS	8	424	0	0	0	0	0
BWBS	8	426	0	0	0	BWBS	8	426	0	0	0	BWBS	8	426	0	0	0	BWBS	8	426	0	0	0	0	0
BWBS	8	428	0																						

Lithics - all core materials

	Silcrete	Hornfels	Quartzite	Quartz	CCS	Other
LWBS	0	2	0	2	1	0
OB	0	1	0	8	0	0
WS	3	7	0	16	0	0
BB	4	2	2	8	0	1
BWBS	21	14	1	15	11	2

Marine Shell

meta-strat	square	context	m.shell weight (g)	TOTAL no. full buckets of sed.	FINAL	weight m. shell per bucket, by strat	MNI				
LWBS	8	226		1.27	LWBS	0.52	4			LWBS	7.4
LWBS	8	230		3	OB	2.38	5			OB	5.2
LWBS	8	248	5.2	1.32	WS	0.00	1			WS	0
LWBS	8	266		1.09	BB	0.00				BB	0
LWBS	8	272		1.14	BWBS	0.00			<b>Donax serra</b>	BWBS	0
LWBS	8	274	0.01	0.55						LWBS	0.41
LWBS	8	281	0.4	1.14						OB	5.1
LWBS	9	389	5.4	2.02						WS	0.01
LWBS	9	393		0.91						BB	0
LWBS	9	396		1					<b>Choromytilus m</b>	BWBS	0
LWBS	9	398		2.05						LWBS	0
LWBS	9	409		0.36						OB	1
LWBS	9	418		0.55						WS	0
LWBS	9	421		0.14						BB	0
LWBS	9	428		0.41					<b>Aulacomya ater</b>	BWBS	0
LWBS	9	438		0.95						LWBS	3.2
LWBS	10	399		0.36						OB	0.5
LWBS	10	400		0.18						WS	0
LWBS	10	404		1.18						BB	0
LWBS	10	412		0.27					<b>Unidentifiable</b>	BWBS	0
LWBS	10	420		1							
LWBS	10	444		0.41							
OB	8	291	10.3	0.91							
OB	9	442	1.5	1.14							
OB	10	456		0.59							
OB	10	459		1.41							
OB	10	467		0.91							
WS	8	310		1.07							
WS	8	318		0.36							
WS	8	320		1.27							

Marine Shell

WS	8	326		2.59			
WS	9	458		0.91			
WS	9	463	0.01	0.5			
WS	9	473		1.09			
WS	9	480		0.52			
WS	10	474		0.09			
WS	10	483		1.09			
WS	10	492		0.27			
WS	10	507		4			
WS	10	511		0.55			
WS	10	517		1.86			
WS	10	529		0.05			
WS	10	530		0.73			
BB	8	335		2.45			
BB	8	341		2.61			
BB	8	347		2.64			
BB	8	363		2.5			
BB	9	485		0.43			
BB	9	494		1			
BB	9	498		0.66			
BB	9	502		0.86			
BB	10	527		1.18			
BB	10	547		0.3			
BWBS	8	378		2.5			
BWBS	8	382		0.79			
BWBS	8	387		0.77			
BWBS	8	390		1.89			
BWBS	8	394		2.27			
BWBS	8	403		0.32			
BWBS	8	406		2.23			
BWBS	8	415		1.27			
BWBS	8	419		0.25			
BWBS	8	422		0.11			

Marine Shell

BWBS	8	424		2.05						
BWBS	8	426		0.77						
BWBS	8	430		0.2						
BWBS	8	431		0.23						
BWBS	8	434		0.32						
BWBS	8	443		0.2						
BWBS	8	446		0.32						
BWBS	9	524		0.93						
BWBS	9	528		0.98						
BWBS	9	534		1.52						
BWBS	9	535		0.18						
BWBS	9	544		1.11						
BWBS	9	549		0.23						
BWBS	9	553		0.5						
BWBS	10	569		1.18						
BWBS	10	575		2.36						
BWBS	10	581		2.5						
BWBS	10	588		0.3						
BWBS	10	597		0.14						
BWBS	10	603		0.23						
BWBS	10	604		1.34						
BWBS	10	607		0.36						
BWBS	10	615		1.68						
BWBS	10	621		0.34						
BWBS	10	623		0.82						
			<b>22.82</b>							

Roofspall

meta-strat	square	context	no. rocks	TOTAL no. full buckets of sed.	FINAL	no. rocks per bucket, by strat						
LWBS	8	226	0	1.27	LWBS	3.66	<b>rock size results:</b>					
LWBS	8	230	5	3	OB	7.26	<b>LWBS</b>	<b>OB</b>	<b>WS</b>	<b>BB</b>	<b>BWBS</b>	<b>average:</b>
LWBS	8	248	2	1.32	WS	8.97	48.25	44.41	50.94	53.89	52.34	<b>49.966</b>
LWBS	8	266	0	1.09	BB	7.25						
LWBS	8	272	0	1.14	BWBS	9.85						
LWBS	8	274	2	0.55								
LWBS	8	281	1	1.14								
LWBS	9	389	8	2.02								
LWBS	9	393	3	0.91								
LWBS	9	396	4	1								
LWBS	9	398	6	2.05								
LWBS	9	409	0	0.36								
LWBS	9	418	12	0.55								
LWBS	9	421	1	0.14								
LWBS	9	428	0	0.41								
LWBS	9	438	5	0.95								
LWBS	10	399	9	0.36								
LWBS	10	400	2	0.18								
LWBS	10	404	10	1.18								
LWBS	10	412	1	0.27								
LWBS	10	420	5	1								
LWBS	10	444	2	0.41								
OB	8	291	9	0.91								
OB	9	442	8	1.14								
OB	10	456	7	0.59								
OB	10	459	2	1.41								
OB	10	467	10	0.91								
WS	8	310	5	1.07								
WS	8	318	5	0.36								
WS	8	320	15	1.27								
WS	8	326	20	2.59								
WS	9	458	12	0.91								
WS	9	463	3	0.5								
WS	9	473	14	1.09								
WS	9	480	10	0.52								
WS	10	474	5	0.09								
WS	10	483	12	1.09								

Roofspall

meta-strat	square	context	no. rocks	TOTAL no. full buckets of sed.	FINAL	no. rocks per bucket, by strat							
WS	10	492	3	0.27									
WS	10	507	10	4									
WS	10	511	10	0.55									
WS	10	517	18	1.86									
WS	10	529	3	0.05									
WS	10	530	7	0.73									
BB	8	335	18	2.45									
BB	8	341	13	2.61									
BB	8	347	19	2.64									
BB	8	363	8	2.5									
BB	9	485	3	0.43									
BB	9	494	7	1									
BB	9	498	10	0.66									
BB	9	502	10	0.86									
BB	10	527	14	1.18									
BB	10	547	4	0.3									
BWBS	8	378	19	2.5									
BWBS	8	382	12	0.79									
BWBS	8	387	10	0.77									
BWBS	8	390	7	1.89									
BWBS	8	394	17	2.27									
BWBS	8	403	0	0.32									
BWBS	8	406	30	2.23									
BWBS	8	415	3	1.27									
BWBS	8	419	3	0.25									
BWBS	8	422	2	0.11									
BWBS	8	424	0	2.05									
BWBS	8	426	4	0.77									
BWBS	8	430	0	0.2									
BWBS	8	431	3	0.23									
BWBS	8	434	0	0.32									
BWBS	8	443	5	0.2									
BWBS	8	446	2	0.32									
BWBS	9	524	14	0.93									
BWBS	9	528	20	0.98									
BWBS	9	534	20	1.52									
BWBS	9	535	5	0.18									

Roofspall

meta-strat	square	context	no. rocks	TOTAL no. full buckets of sed.	FINAL	no. rocks per bucket, by strat							
BWBS	9	544	20	1.11									
BWBS	9	549	4	0.23									
BWBS	9	553	2	0.5									
BWBS	10	569	15	1.18									
BWBS	10	575	19	2.36									
BWBS	10	581	35	2.5									
BWBS	10	588	3	0.3									
BWBS	10	597	3	0.14									
BWBS	10	603	5	0.23									
BWBS	10	604	13	1.34									
BWBS	10	607	6	0.36									
BWBS	10	615	14	1.68									
BWBS	10	621	4	0.34									
BWBS	10	623	8	0.82									
			<b>699</b>										

OES - engraved

<b>meta-strat</b>	<b>square</b>	<b>context</b>	<b>no. engraved frags.</b>	<b>TOTAL no. full buckets of sed.</b>	<b>FINAL</b>	<b>eng. OES frags. per bucket, by strat</b>
LWBS	8	226	0	1.27	LWBS	0.09
LWBS	8	230	0	3	OB	0.00
LWBS	8	248	1	1.32	WS	0.00
LWBS	8	266	0	1.09	BB	0.00
LWBS	8	272	0	1.14	BWBS	0.00
LWBS	8	274	0	0.55		
LWBS	8	281	0	1.14		
LWBS	9	389	0	2.02		
LWBS	9	393	0	0.91		
LWBS	9	396	0	1		
LWBS	9	398	0	2.05		
LWBS	9	409	0	0.36		
LWBS	9	418	1	0.55		
LWBS	9	421	0	0.14		
LWBS	9	428	0	0.41		
LWBS	9	438	0	0.95		
LWBS	10	399	0	0.36		
LWBS	10	400	0	0.18		
LWBS	10	404	0	1.18		
LWBS	10	412	0	0.27		
LWBS	10	420	0	1		
LWBS	10	444	0	0.41		
OB	8	291	0	0.91		
OB	9	442	0	1.14		
OB	10	456	0	0.59		
OB	10	459	0	1.41		
OB	10	467	0	0.91		
WS	8	310	0	1.07		
WS	8	318	0	0.36		

OES - engraved

WS	8	320	0	1.27		
WS	8	326	0	2.59		
WS	9	458	0	0.91		
WS	9	463	0	0.5		
WS	9	473	0	1.09		
WS	9	480	0	0.52		
WS	10	474	0	0.09		
WS	10	483	0	1.09		
WS	10	492	0	0.27		
WS	10	507	0	4		
WS	10	511	0	0.55		
WS	10	517	0	1.86		
WS	10	529	0	0.05		
WS	10	530	0	0.73		
BB	8	335	0	2.45		
BB	8	341	0	2.61		
BB	8	347	0	2.64		
BB	8	363	0	2.5		
BB	9	485	0	0.43		
BB	9	494	0	1		
BB	9	498	0	0.66		
BB	9	502	0	0.86		
BB	10	527	0	1.18		
BB	10	547	0	0.3		
BWBS	8	378	0	2.5		
BWBS	8	382	0	0.79		
BWBS	8	387	0	0.77		
BWBS	8	390	0	1.89		
BWBS	8	394	0	2.27		
BWBS	8	403	0	0.32		
BWBS	8	406	0	2.23		

OES - engraved

BWBS	8	415	0	1.27		
BWBS	8	419	0	0.25		
BWBS	8	422	0	0.11		
BWBS	8	424	0	2.05		
BWBS	8	426	0	0.77		
BWBS	8	430	0	0.2		
BWBS	8	431	0	0.23		
BWBS	8	434	0	0.32		
BWBS	8	443	0	0.2		
BWBS	8	446	0	0.32		
BWBS	9	524	0	0.93		
BWBS	9	528	0	0.98		
BWBS	9	534	0	1.52		
BWBS	9	535	0	0.18		
BWBS	9	544	0	1.11		
BWBS	9	549	0	0.23		
BWBS	9	553	0	0.5		
BWBS	10	569	0	1.18		
BWBS	10	575	0	2.36		
BWBS	10	581	0	2.5		
BWBS	10	588	0	0.3		
BWBS	10	597	0	0.14		
BWBS	10	603	0	0.23		
BWBS	10	604	0	1.34		
BWBS	10	607	0	0.36		
BWBS	10	615	0	1.68		
BWBS	10	621	0	0.34		
BWBS	10	623	0	0.82		
			2			

# OES fragments

meta-strat	square	context	no. OES frags.	TOTAL no. full buckets of sed.	FINAL	OES frags. per bucket, by strat		LWBS	OB	WS	BB	BWBS		LWBS	OB	WS	BB	BWBS	
LWBS	8	226	10	1.27	LWBS	15.87	avg. frag. thickness (mm) results:	1.29	1.62	1.29	1.56	1.42	Median	1.62	1.94	1.59	1.83	1.67	
LWBS	8	230	7	3	OB	12.50		1.42	2.26	1.50	2.10	1.55	quartile 1	1.53	1.62	1.50	1.56	1.49	
LWBS	8	248	17	1.32	WS	2.42		1.47		1.58		1.78	quartile 2	1.77	2.26	1.71	2.10	1.80	
LWBS	8	266	18	1.09	BB	0.21		1.53		1.59		1.82	max	2.08	2.26	1.90	2.10	1.82	
LWBS	8	272	31	1.14	BWBS	0.15		1.53		1.71			min	1.29	1.62	1.29	1.56	1.42	
LWBS	8	274	36	0.55				1.54		1.90									
LWBS	8	281	32	1.14				1.56											
LWBS	9	389	22	2.02				1.60											
LWBS	9	393	8	0.91				1.61											
LWBS	9	396	24	1				1.62											
LWBS	9	398	42	2.05			1.66												
LWBS	9	409	5	0.36			1.69												
LWBS	9	418	42	0.55			1.75												
LWBS	9	421	3	0.14			1.76												
LWBS	9	428	11	0.41			1.78												
LWBS	9	438	28	0.95			1.80												
LWBS	10	399	1	0.36			1.80												
LWBS	10	400	0	0.18			2.08												
LWBS	10	404	0	1.18															
LWBS	10	412	0	0.27															
LWBS	10	420	1	1															
LWBS	10	444	0	0.41	338														
OB	8	291	61	0.91															
OB	9	442	1	1.14															
OB	10	456	0	0.59															
OB	10	459	0	1.41															
OB	10	467	0	0.91	62														
WS	8	310	24	1.07															
WS	8	318	2	0.36															
WS	8	320	11	1.27															
WS	8	326	1	2.59															
WS	9	458	1	0.91															
WS	9	463	1	0.5															
WS	9	473	0	1.09															
WS	9	480	0	0.52															
WS	10	474	0	0.09															
WS	10	483	0	1.09															
WS	10	492	0	0.27															
WS	10	507	0	4															
WS	10	511	0	0.55															
WS	10	517	0	1.86															
WS	10	529	1	0.05															
WS	10	530	0	0.73	41														
BB	8	335	0	2.45															
BB	8	341	0	2.61															
BB	8	347	0	2.64															
BB	8	363	0	2.5															
BB	9	485	0	0.43															
BB	9	494	1	1															
BB	9	498	0	0.66															
BB	9	502	0	0.86															
BB	10	527	1	1.18															
BB	10	547	1	0.3	3														
BWBS	8	378	0	2.5															
BWBS	8	382	2	0.79															
BWBS	8	387	0	0.77															
BWBS	8	390	0	1.89															
BWBS	8	394	1	2.27															

# OES fragments

BWBS	8	403	0	0.32	
BWBS	8	406	0	2.23	
BWBS	8	415	0	1.27	
BWBS	8	419	0	0.25	
BWBS	8	422	0	0.11	
BWBS	8	424	0	2.05	
BWBS	8	426	0	0.77	
BWBS	8	430	0	0.2	
BWBS	8	431	0	0.23	
BWBS	8	434	0	0.32	
BWBS	8	443	0	0.2	
BWBS	8	446	0	0.32	
BWBS	9	524	0	0.93	
BWBS	9	528	1	0.98	
BWBS	9	534	0	1.52	
BWBS	9	535	0	0.18	
BWBS	9	544	0	1.11	
BWBS	9	549	0	0.23	
BWBS	9	553	1	0.5	
BWBS	10	569	0	1.18	
BWBS	10	575	0	2.36	
BWBS	10	581	0	2.5	
BWBS	10	588	0	0.3	
BWBS	10	597	0	0.14	
BWBS	10	603	0	0.23	
BWBS	10	604	0	1.34	
BWBS	10	607	0	0.36	
BWBS	10	615	0	1.68	
BWBS	10	621	0	0.34	
BWBS	10	623	0	0.82	5
			449		

OES - beads

meta-strat	square	context	no. OES beads.	TOTAL no. full buckets of sed.	FINAL	OES beads per bucket, by strat			meta-strat	Context	Avg. bead size (mm) per context	Average per meta-strat		Avg. bead size (mm) per meta-strat
LWBS	8	226	1	1.27	LWBS	0.70		avg. bead diameter (mm) results:	LWBS	226	4.51		LWBS	6.40
LWBS	8	230	1	3	OB	0.20			LWBS	230	5.09		OB	9.19
LWBS	8	248	3	1.32	WS	0.12			LWBS	248	5.31		WS	5.69
LWBS	8	266	1	1.09	BB	0.00			LWBS	266	6.89		BB	5.37
LWBS	8	272	1	1.14	BWBS	0.00			LWBS	272	5.96		BWBS	
LWBS	8	274	1	0.55					LWBS	274	10.2			
LWBS	8	281	0	1.14					LWBS	281				
LWBS	9	389	2	2.02					LWBS	389	7.965			
LWBS	9	393	0	0.91					LWBS	393				
LWBS	9	396	0	1					LWBS	396				
LWBS	9	398	2	2.05					LWBS	398	4.23			
LWBS	9	409	0	0.36					LWBS	409				
LWBS	9	418	2	0.55					LWBS	418	5.815			
LWBS	9	421	0	0.14					LWBS	421				
LWBS	9	428	1	0.41					LWBS	428	8.06			
LWBS	9	438	0	0.95				LWBS	438					
LWBS	10	399	0	0.36				LWBS	399					
LWBS	10	400	0	0.18				LWBS	400					
LWBS	10	404	0	1.18				LWBS	404					
LWBS	10	412	0	0.27				LWBS	412					
LWBS	10	420	0	1				LWBS	420					
LWBS	10	444	0	0.41				LWBS	444			6.40		
OB	8	291	1	0.91				OB	291	9.19				
OB	9	442	0	1.14				OB	442					
OB	10	456	0	0.59				OB	456					
OB	10	459	0	1.41				OB	459					
OB	10	467	0	0.91				OB	467			9.19		
WS	8	310	0	1.07				WS	310					
WS	8	318	0	0.36				WS	318					
WS	8	320	1	1.27				WS	320	7.19				
WS	8	326	0	2.59				WS	326					
WS	9	458	0	0.91				WS	458					
WS	9	463	1	0.5				WS	463	4.18				
WS	9	473	0	1.09				WS	473					
WS	9	480	0	0.52				WS	480					
WS	10	474	0	0.09				WS	474					
WS	10	483	0	1.09				WS	483					
WS	10	492	0	0.27				WS	492					
WS	10	507	0	4				WS	507					
WS	10	511	0	0.55				WS	511					
WS	10	517	0	1.86				WS	517					



OES - beads

BWBS	10	615	0	1.68					BWBS	615				
BWBS	10	621	0	0.34					BWBS	621				
BWBS	10	623	0	0.82					BWBS	623				

## Charcoal

<b>meta-strat</b>	<b>square</b>	<b>context</b>	<b>charcoal weight (g)</b>	<b>TOTAL no. full buckets of sed.</b>	<b>FINAL</b>	<b>weight of charcoal per bucket, by strat</b>
LWBS	8	226	68.01	1.27	LWBS	15.64
LWBS	8	230	147.52	3	OB	29.74
LWBS	8	248	0	1.32	WS	2.49
LWBS	8	266	0.02	1.09	BB	0.57
LWBS	8	272	4	1.14	BWBS	7.07
LWBS	8	274	1.5	0.55		
LWBS	8	281	0	1.14		
LWBS	9	389	16.41	2.02		
LWBS	9	393	1.51	0.91		
LWBS	9	396	11.01	1		
LWBS	9	398	4.01	2.05		
LWBS	9	409	8.01	0.36		
LWBS	9	418	0.01	0.55		
LWBS	9	421	0	0.14		
LWBS	9	428	1	0.41		
LWBS	9	438	7.2	0.95		
LWBS	10	399	18.01	0.36		
LWBS	10	400	4	0.18		
LWBS	10	404	14.31	1.18		
LWBS	10	412	3	0.27		
LWBS	10	420	14.6	1		
LWBS	10	444	9.01	0.41		
OB	8	291	0	0.91		
OB	9	442	4.01	1.14		
OB	10	456	3	0.59		
OB	10	459	0	1.41		
OB	10	467	140.52	0.91		
WS	8	310	0.2	1.07		
WS	8	318	0	0.36		

Charcoal

WS	8	320	2.1	1.27		
WS	8	326	5.6	2.59		
WS	9	458	9.8	0.91		
WS	9	463	3.91	0.5		
WS	9	473	8.3	1.09		
WS	9	480	7.01	0.52		
WS	10	474	0.6	0.09		
WS	10	483	4	1.09		
WS	10	492	0	0.27		
WS	10	507	0.6	4		
WS	10	511	0	0.55		
WS	10	517	0.02	1.86		
WS	10	529	0.01	0.05		
WS	10	530	0	0.73		
BB	8	335	0.01	2.45		
BB	8	341	0.02	2.61		
BB	8	347	0	2.64		
BB	8	363	0	2.5		
BB	9	485	0.02	0.43		
BB	9	494	0	1		
BB	9	498	4.81	0.66		
BB	9	502	1	0.86		
BB	10	527	0.5	1.18		
BB	10	547	2.03	0.3		
BWBS	8	378	6.01	2.5		
BWBS	8	382	3	0.79		
BWBS	8	387	3.5	0.77		
BWBS	8	390	29.7	1.89		
BWBS	8	394	2	2.27		
BWBS	8	403	2	0.32		
BWBS	8	406	12.01	2.23		

Charcoal

BWBS	8	415	2	1.27		
BWBS	8	419	2	0.25		
BWBS	8	422	0.5	0.11		
BWBS	8	424	2	2.05		
BWBS	8	426	3	0.77		
BWBS	8	430	0	0.2		
BWBS	8	431	10.01	0.23		
BWBS	8	434	0	0.32		
BWBS	8	443	0.01	0.2		
BWBS	8	446	2.5	0.32		
BWBS	9	524	0	0.93		
BWBS	9	528	16.02	0.98		
BWBS	9	534	0	1.52		
BWBS	9	535	35.5	0.18		
BWBS	9	544	0.01	1.11		
BWBS	9	549	0	0.23		
BWBS	9	553	5	0.5		
BWBS	10	569	8.01	1.18		
BWBS	10	575	44	2.36		
BWBS	10	581	0	2.5		
BWBS	10	588	7	0.3		
BWBS	10	597	0	0.14		
BWBS	10	603	9.5	0.23		
BWBS	10	604	0	1.34		
BWBS	10	607	0	0.36		
BWBS	10	615	20	1.68		
BWBS	10	621	9.2	0.34		
BWBS	10	623	0.01	0.82		
			<b>765.7</b>			

Bone

meta-strat	square	context	bone weight (g)	TOTAL no. full buckets of sed.	FINAL	weight of bone per bucket, by strat
LWBS	8	226	148.61	1.27	LWBS	262.25
LWBS	8	230	392.7	3	OB	729.00
LWBS	8	248	320.01	1.32	WS	305.28
LWBS	8	266	535.03	1.09	BB	357.57
LWBS	8	272	526.11	1.14	BWBS	173.31
LWBS	8	274	501.01	0.55		<b>1827.42</b>
LWBS	8	281	482.1	1.14		
LWBS	9	389	366.92	2.02		
LWBS	9	393	101.31	0.91		
LWBS	9	396	110.5	1		
LWBS	9	398	325.01	2.05		
LWBS	9	409	43.02	0.36		
LWBS	9	418	225.91	0.55		
LWBS	9	421	18.5	0.14		
LWBS	9	428	114.61	0.41		
LWBS	9	438	228.52	0.95		
LWBS	10	399	220.7	0.36		
LWBS	10	400	139.61	0.18		
LWBS	10	404	52.8	1.18		
LWBS	10	412	118.3	0.27		
LWBS	10	420	309.41	1		
LWBS	10	444	305.32	0.41		
OB	8	291	964.71	0.91		
OB	9	442	857.2	1.14		
OB	10	456	482.2	0.59		
OB	10	459	256.31	1.41		
OB	10	467	1055.4	0.91		
WS	8	310	502.11	1.07		
WS	8	318	156	0.36		

Bone

WS	8	320	524.81	1.27		
WS	8	326	1195.91	2.59		
WS	9	458	116.01	0.91		
WS	9	463	187.9	0.5		
WS	9	473	502.61	1.09		
WS	9	480	232.62	0.52		
WS	10	474	74.02	0.09		
WS	10	483	516.41	1.09		
WS	10	492	214.01	0.27		
WS	10	507	274.1	4		
WS	10	511	233.42	0.55		
WS	10	517	268.7	1.86		
WS	10	529	102.01	0.05		
WS	10	530	73.91	0.73		
BB	8	335	1375.8	2.45		
BB	8	341	1033.7	2.61		
BB	8	347	724.8	2.64		
BB	8	363	458.12	2.5		
BB	9	485	225.51	0.43		
BB	9	494	222.02	1		
BB	9	498	300.52	0.66		
BB	9	502	481.31	0.86		
BB	10	527	306.71	1.18		
BB	10	547	102.8	0.3		
BWBS	8	378	1197.7	2.5		
BWBS	8	382	184.71	0.79		
BWBS	8	387	330.31	0.77		
BWBS	8	390	221.33	1.89		
BWBS	8	394	278.5	2.27		
BWBS	8	403	2.5	0.32		
BWBS	8	406	469.2	2.23		

Bone

BWBS	8	415	216.41	1.27		
BWBS	8	419	53.01	0.25		
BWBS	8	422	14.01	0.11		
BWBS	8	424	18.3	2.05		
BWBS	8	426	3.5	0.77		
BWBS	8	430	0.7	0.2		
BWBS	8	431	2.01	0.23		
BWBS	8	434	2.02	0.32		
BWBS	8	443	4.01	0.2		
BWBS	8	446	4.4	0.32		
BWBS	9	524	778.81	0.93		
BWBS	9	528	279.61	0.98		
BWBS	9	534	266.31	1.52		
BWBS	9	535	35.51	0.18		
BWBS	9	544	252.31	1.11		
BWBS	9	549	21	0.23		
BWBS	9	553	138.01	0.5		
BWBS	10	569	181	1.18		
BWBS	10	575	289.41	2.36		
BWBS	10	581	207.32	2.5		
BWBS	10	588	32	0.3		
BWBS	10	597	27.2	0.14		
BWBS	10	603	10.5	0.23		
BWBS	10	604	68.2	1.34		
BWBS	10	607	59.31	0.36		
BWBS	10	615	59.01	1.68		
BWBS	10	621	24.01	0.34		
BWBS	10	623	20.1	0.82		
			<b>25359.91</b>			

# Ochre

meta-strata	square	context	ochre weight (g)	TOTAL no. full buckets of sed.	FINAL	weight of ochre per bucket, by strat	meta-strata	no. pieces ground	FINAL	no. ground pieces per bucket, by strat	Colour Usage					
											LWBS	OB	WS	BB	BWBS	
LWBS	8	226	4.8	1.27	LWBS	14.70	LWBS		LWBS	0.38						
LWBS	8	230	50.1	3	OB	8.95	LWBS	2	OB	0.20	red	42.20	78.81	87.55	103.22	248.85
LWBS	8	248	0.8	1.32	WS	6.83	LWBS		WS	0.00	black	10.00	0.00	0.00	0.00	0.00
LWBS	8	266	13.8	1.09	BB	16.59	LWBS		BB	0.14	purple	0.00	11.01	0.00	5.00	0.00
LWBS	8	272	13.2	1.14	BWBS	9.95	LWBS		BWBS	0.12	reddish-brown	16.40	0.00	0.00	0.00	0.00
LWBS	8	274	13	0.55			LWBS				combination	51.9	0	0	14	70.42
LWBS	8	281	10	1.14			LWBS				variety	70.91	0	10.81	0	42.3
LWBS	9	389	11.01	2.02			LWBS	1								
LWBS	9	393	2.7	0.91			LWBS	1								
LWBS	9	396	9.1	1			LWBS									
LWBS	9	398	8.11	2.05			LWBS									
LWBS	9	409	12.81	0.36			LWBS									
LWBS	9	418	14	0.55			LWBS	3								
LWBS	9	421	24.5	0.14			LWBS	1								
LWBS	9	428	10.2	0.41			LWBS									
LWBS	9	438	18	0.95			LWBS									
LWBS	10	399	8.5	0.36			LWBS									
LWBS	10	400	15	0.18			LWBS									
LWBS	10	404	38.3	1.18			LWBS									
LWBS	10	412	13.1	0.27			LWBS									
LWBS	10	420	22.1	1			LWBS									
LWBS	10	444	0	0.41			LWBS									
OB	8	291	30	0.91			OB	1								
OB	9	442	6.7	1.14			OB									
OB	10	456	7.7	0.59			OB									
OB	10	459	0	1.41			OB									
OB	10	467	0	0.91			OB									
WS	8	310	0	1.07			WS									
WS	8	318	0	0.36			WS									
WS	8	320	0	1.27			WS									
WS	8	326	4.9	2.59			WS									
WS	9	458	1.9	0.91			WS									
WS	9	463	2.7	0.5			WS									
WS	9	473	27.1	1.09			WS									
WS	9	480	3.3	0.52			WS									
WS	10	474	5.4	0.09			WS									
WS	10	483	23.81	1.09			WS									
WS	10	492	2.3	0.27			WS									
WS	10	507	0	4			WS									
WS	10	511	0	0.55			WS									
WS	10	517	3	1.86			WS									
WS	10	529	0	0.05			WS									
WS	10	530	41.3	0.73			WS									
BB	8	335	10.5	2.45			BB									
BB	8	341	0	2.61			BB									
BB	8	347	30.31	2.64			BB									
BB	8	363	0	2.5			BB									
BB	9	485	7.1	0.43			BB									
BB	9	494	11.6	1			BB	2								
BB	9	498	1.9	0.66			BB									
BB	9	502	40.4	0.86			BB									
BB	10	527	110.2	1.18			BB									
BB	10	547	30.7	0.3			BB									



Patterns of Robberg Timing

Robberg Industry Timing in the Rainfall Zones							
	site	start date (cal kyr BP)	end date (cal kyr BP)			start date (cal kyr BP)	end date (cal kyr BP)
WRZ	KKH	22.9	22.3			SEH	23.9 - 22.9
	KFR	22.3 - 18.4	17.4 - 16.3			NBC	23.4 - 22.6
	PL8	21	18			KFR	22.3 - 18.4
	FAR	20.4 - 19.5	13.7 - 13.1			BMP	22.1 - 21.0
	BNK	17.1 - 16.6	16.5 - 16.1			PL8	21
	EBC	15.6	13.8			FAR	20.4 - 19.5
						MKB	18.9
YRZ	NBC	23.4 - 22.6	14.1 - 13.8			BNK	17.1 - 16.6
	BMP	22.1 - 21.0	18.0 - 16.6			RCC	16.6 - 15.6
	MKB	18.9	18.4			UMH	16.5 - 15.8
					EBC	15.6	
SRZ	SEH	23.9 - 22.9	14.6 - 13.8				
	UMH	16.5 - 15.8	10.6 - 10.2				
	RCC	16.6 - 15.6	11.2 - 10.7				

**APPENDIX 2**  
SOUTHERN AFRICAN SITE DETAILS

**Details for sites as they appear on the South African National Inventory (SAHRIS)**

<b>SAHRIS Site ID</b>	<b>Site Reference</b>	<b>Full Site Name</b>	<b>Site Type</b>	<b>Grading</b>	<b>Latitude (S)</b>	<b>Longitude (E)</b>
80422	KFR	Klipfonteinrand	Rock Art, Artefacts, Deposit, Burial Grounds & Graves	Grade IIIa	-32.071528	19.13
163397	RCC	Rose Cottage Cave	Archaeological	Grade IIIa	-29.207136	27.454662
195989	NBC	Nelson Bay Cave	Archaeological	Grade IIIa	-34.103127	23.38764
195990	BNK	Byneskranskop	Archaeological	Grade IIIa	-34.58	19.47
78604	BMP	Boomplaas Cave	Rock Art	Grade IIIa	-33.393611	22.193889
108599	BC	Border Cave	Archaeological	Grade IIIa	-27.021944	31.99
17185	DRS	Diepkloof Rock Shelter	Archaeological	Grade II	-32.48373	18.535928
330891	EBC	Elands Bay Cave	Rock Art, Artefacts, Deposit	Grade II	-32.317819	18.317917
330896	KKH	Klein Kliphuis	Rock Art, Artefacts	Grade IIIa	-32.11995	18.900306
80929	MRS	Mertenhof Rock Shelter	Rock Art, Artefacts, Deposit	Grade IIIa	-32.15685	19.18309
81471	PL8	Putslaagte 8	Rock Art	Grade IIIa	-31.937892	19.155293
330773	HRS	Hollow Rock Shelter	Artefacts, Deposit	Grade IIIa	-32.083758	19.079314
87096	SEH	Sehonghong Shelter	Rock Art, Deposit, Artefacts	Grade IIIa	-29.7	28.833333
354523	MKB	Melkhoutboom Cave	Rock Art, Deposit, Artefacts, Burial Grounds & Graves	Grade IIIa	-33.288339	25.765778
19598	UMH	Umhlatuzana Rock Shelter	Deposit, Artefacts	Grade II	-29.807778	30.756111
369847	RS	Reception Shelter	Deposit, Artefacts	Grade IIIa	-31.526	18.601111
32410	FAR	Faraoskop Rock Shelter	Deposit, Artefacts, Burial Grounds & Graves	Grade IIIa	-32.020187	18.521805