

A Landscape Approach to the Surface Archaeology of the Bos River, Tankwa Karoo, Northern Cape

Matthew Shaw

October 2017

University of Cape Town

This dissertation is presented in fulfilment of the requirements for the degree of Master of Philosophy

Department of Archaeology

University of Cape Town

Supervisors: Prof. John Parkington & Dr. David Braun

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

This serves as acknowledgement that I understand the meaning of plagiarism and to declare that all the work presented in this thesis is my own, unless otherwise referenced

Matthew Shaw

12/10/2017

Contents

Contents.....	i
List of Figures.....	vi
Acknowledgements.....	ix
Abstract.....	xi

Chapter 1: Introduction	1
--------------------------------	----------

Chapter 2: The Stone Ages in South Africa	7
--	----------

2.1 The Stone Ages and relevant iconic artefacts.....	8
2.2 The Earlier Stone Age (ESA)	10
2.2.1 The Oldowan.....	10
2.2.2 The Acheulean.....	11
2.2.3 The Fauresmith.....	13
2.3 The Middle Stone Age (MSA).....	15
2.3.1 Late ESA/early MSA.....	16
2.3.2 The Still Bay (SB)	18
2.3.3 The Howiesons Poort (HP).....	20

2.3.4 The post-Howiesons Poort.....	21
2.3.5 Non-lithic Material.....	24
2.4 The Later Stone Age (LSA)	25
2.4.1 Earlier Later Stone Age and the Robberg.....	27
2.4.2 Oakhurst or Terminal Pleistocene/early Holocene non-microlithic.....	28
2.4.3 Wilton or Holocene microlithic.....	28
2.4.4 <i>Ceramic final LSA or Late Holocene assemblages</i>	29
Chapter 3: A Landscape Approach to South African Archaeology	31
<hr/>	
Chapter 4: Study Area – The Bos River, Tankwa Karoo	51
<hr/>	
4.1 Rainfall.....	52
4.2 Vegetation.....	54
4.3 Geology and raw materials.....	56
4.3.1 Cape Supergroup.....	57
4.3.2 Karoo Supergroup.....	58
Chapter 5: Methods	63
<hr/>	
5.1 Project setup – choosing a location.....	63
5.2 Fieldwork.....	66
5.2.1 Survey methods.....	66

5.2.2 Recording methods – artefacts.....	69
5.3 Post-fieldwork analysis.....	72
5.3.1 Extraction of data.....	72
5.3.2 E4 – Data entry program.....	73
5.3.3. Initial analysis of the artefacts.....	73
5.3.4 Technological organisation of artefacts.....	74
5.4 Artefact categories.....	77
5.4.1 Non-iconic artefacts.....	77
5.4.2 Iconic/temporally diagnostic artefacts.....	79
5.4.3 Raw materials.....	84
Chapter 6: Results	88
<hr/>	
6.1 Artefact distributions.....	88
6.1.1 ESA artefact distribution.....	91
6.1.2 MSA artefact distribution.....	93
6.1.3 LSA artefact distribution.....	95
6.2 Raw material use.....	99
6.2.1 Raw material preferences.....	99
6.2.2 Raw material cortex.....	100
6.3 Technological classification.....	102

7.1 ESA and ESA/MSA.....	111
7.1.1. Artefact distribution.....	111
7.1.2 Water availability.....	115
7.1.3 Raw material availability.....	117
7.1.4 Shelter.....	118
7.1.5 Technological organisation.....	118
7.1.6 Conclusion of ESA.....	122
7.2 MSA.....	123
7.2.1. Artefact distribution.....	123
7.2.2 Water availability.....	125
7.2.3 Raw material availability.....	125
7.2.4 Shelter.....	126
7.2.5 Technological organisation.....	128
7.2.6 Conclusion of MSA.....	133
7.3 LSA.....	133
7.3.1. Artefact distribution.....	133
7.3.2 Water availability.....	136
7.3.3 Raw material availability.....	137

7.3.4 Technological organisation.....	141
7.3.5 Conclusion of LSA.....	146
7.4 Non-lithic Evidence.....	147
7.5 Episodic magnet of attraction.....	151
Chapter 8: Conclusion	162
<hr/>	
References	167
<hr/>	

LIST OF FIGURES

Figure 1.1	The Tankwa Karoo in relation to other Archaeological sites in South Africa.....	2
Figure 4.1	Elevation levels of the Tankwa Karoo and areas surrounding.....	51
Figure 4.2	Rainfall levels around the Tankwa Karoo.....	51
Figure 4.3	Vegetation biomes of the Tankwa Karoo and surroundings.....	55
Figure 4.4	The geology of the area surrounding the Bos River.....	57
Figure 6.1	General artefact distribution along the Bos River.....	90
Figure 6.2	ESA artefact distribution.....	92
Figure 6.3	MSA artefact distribution.....	94
Figure 6.4	LSA artefact distribution.....	95-96
Figure 6.5	Rock art examples from the Bos River on Cape geology.....	97-98
Figure 6.6	Raw material use during the ESA, MSA, and LSA.....	100
Figure 6.7	Percentage of cortex type for different raw materials during the MSA and LSA.....	101
Figure 6.8	Edge damage on selected artefacts.....	104
Figure 6.9	Percentage of complete and incomplete flakes.....	107
Figure 7.1	Physical setting of ESA landscape-use.....	113

Figure 7.2a	Examples of ESA artefacts.....	120
Figure 7.2b	Examples of ESA/MSA artefacts.....	121
Figure 7.3	Physical setting of MSA landscape-use.....	124
Figure 7.4a	Examples of MSA blades	129
Figure 7.4b	Examples of MSA convergent flakes.....	130
Figure 7.5	Examples of MSA cores.....	132
Figure 7.6	Physical setting of LSA landscape-use.....	135
Figure 7.7	Examples of LSA artefacts.....	142
Figure 7.8a	LSA site of DRS – 12.....	143
Figure 7.8b	Examples of LSA bladelet cores from DRS – 12.....	144
Figure 7.9	Dolerite boulders along the Bos River.....	150
Figure 7.10	Marine Isotope Stages.....	154

LIST OF TABLES

Table 6.1	Technological class and raw materials of the artefacts recorded during the survey period.....	103
Table 6.2	Retouch type on the artefact from the LSA.....	104
Table 6.3	Raw material of flake products during the ESA/MSA and MSA.....	105
Table 6.4	Frequency of core types analysed for the different Stone Ages.....	106

Acknowledgements

Acknowledgement is due, first and foremost to my supervisor Professor John Parkington, for his knowledge, patience and passion for the archaeology of South Africa which encouraged many useful discussions and comments that were imperative to the coherence of this thesis.

To my co-supervisor, Doctor David Braun, who offered valuable experience and advice in conducting a landscape-scale project, as well as providing the opportunity to interact with other experts carrying out landscape projects in areas outside of South Africa.

This project would not have been possible without the generous funding supplied by the DST-NRF Centre of Excellence in Palaeosciences (CoE-Pal) and Palaeontological Scientific Trust (PAST).

A huge thank you goes to Emily Hallinan who provided assistance during and after fieldwork, which included useful discussions around landscape archaeology and the analysis of the data, as well as the editing of chapters.

A great deal of what makes these archaeological surveys that extra bit enjoyable is being given the opportunity to meet the local farmers of the area. The hospitality and kindness that was shown to us during our surveys by these farmers, particularly the Taljaard family who welcomed us into their homes and allowed us to conduct our research on their farm, cannot be underestimated. To Marie and Bill Hunt who offered their farmhouse to us as accommodation for the duration of the field seasons.

To those that helped in the field and offered invaluable advice and comments, Jess Robinson, Madelon Tuisenuis, John Almond, Alex Sumner, Alex Mackay and everybody else who played a role in aided in the completion of this thesis.

And finally, to Candice Koopowitz, who supported me all the way through from the fieldwork to the editing of chapters from across the world, I cannot thank you enough for your encouragement and positivity that pushed me through until the completion of this thesis.

Abstract

Much of our current understanding of prehistoric human behavioural patterns during the Stone Age, is derived particularly from a robust set of chronological and technological sequences from caves and rock shelters, with some focus on open-air sites. The information gained from shelters cannot be ignored or downplayed, however, they offer a spatially and temporally limited view of prehistoric lifeways.

The aim of this thesis is to provide an understanding of landscape use during the Stone Ages along the Bos River in the Tankwa Karoo, Northern Cape. Surveys were carried out around the Bos River, with the intention of mapping out and analysing all the surface stone artefacts. Analysing at the scale of the individual artefact, particularly temporally iconic artefacts, permits the landscape, although geologically and ecologically variable, to be viewed as a continuous space. The benefit of this approach allows for all artefacts across all types of settings to be analysed, providing a spatially subjective distribution of artefacts across the landscape.

The evidence described in this thesis demonstrates an episodic occupation of the Tankwa Karoo during periods of increased resources, particularly the availability of food. The Bos River is a low-energy river that receives little rain and does not facilitate the formation of large rounded cobbles and boulders, explaining the lack of an occupation during the Earlier Stone Age (ESA), whereas an expedient organisation of locally sourced raw materials for stone tools characterise the Middle Stone Age (MSA) and Later Stone Age (LSA) periods in the Tankwa Karoo.

Chapter 1: Introduction

The archaeological material derived from caves, rock shelters and open-air sites in Africa provides evidence of prehistoric stone tool-making human occupation spanning a duration of at least 3 million years (Harmand et al. 2015). Much of our current understanding of prehistoric landscape use, particularly in southern Africa, is limited by a research bias that focuses on confined points on the landscape, often caves and rock shelters, with little emphasis being placed on open-air and surface archaeological contexts. (Figure 1.1). The geographic focus of this thesis, specifically, is to provide information about the understudied and marginal area of the Tankwa Karoo in the Northern Cape, as well as to draw attention to the importance and viability of studying the surface archaeological material. The Tankwa Karoo represents a spatial gap in the archaeological record, neighboured by well-researched area of the Cederberg Mountains to the west (Parkington & Poggenpoel 1971; Mackay 2009; Hallinan 2013; Mackay et al. 2014).

Evidence of prehistoric people occupying marginal desert and desert biomes are not uncommon, with examples from Libya (Lahr et al. 2010), Egypt (Olszewski et al. 2010) and the Australian deserts (Hiscock & Veth 1991). It would not be surprising, then, to find that the Tankwa Karoo, although extremely dry at present, provides evidence of episodic occupation in the past. Looking specifically at the stone artefacts, and particularly those likely to date from the Middle Stone Age (MSA), a landscape framework is applied to the non-perennial Bos River system that flows through the Tankwa Karoo to a confluence with the Doring River in the Cederberg.

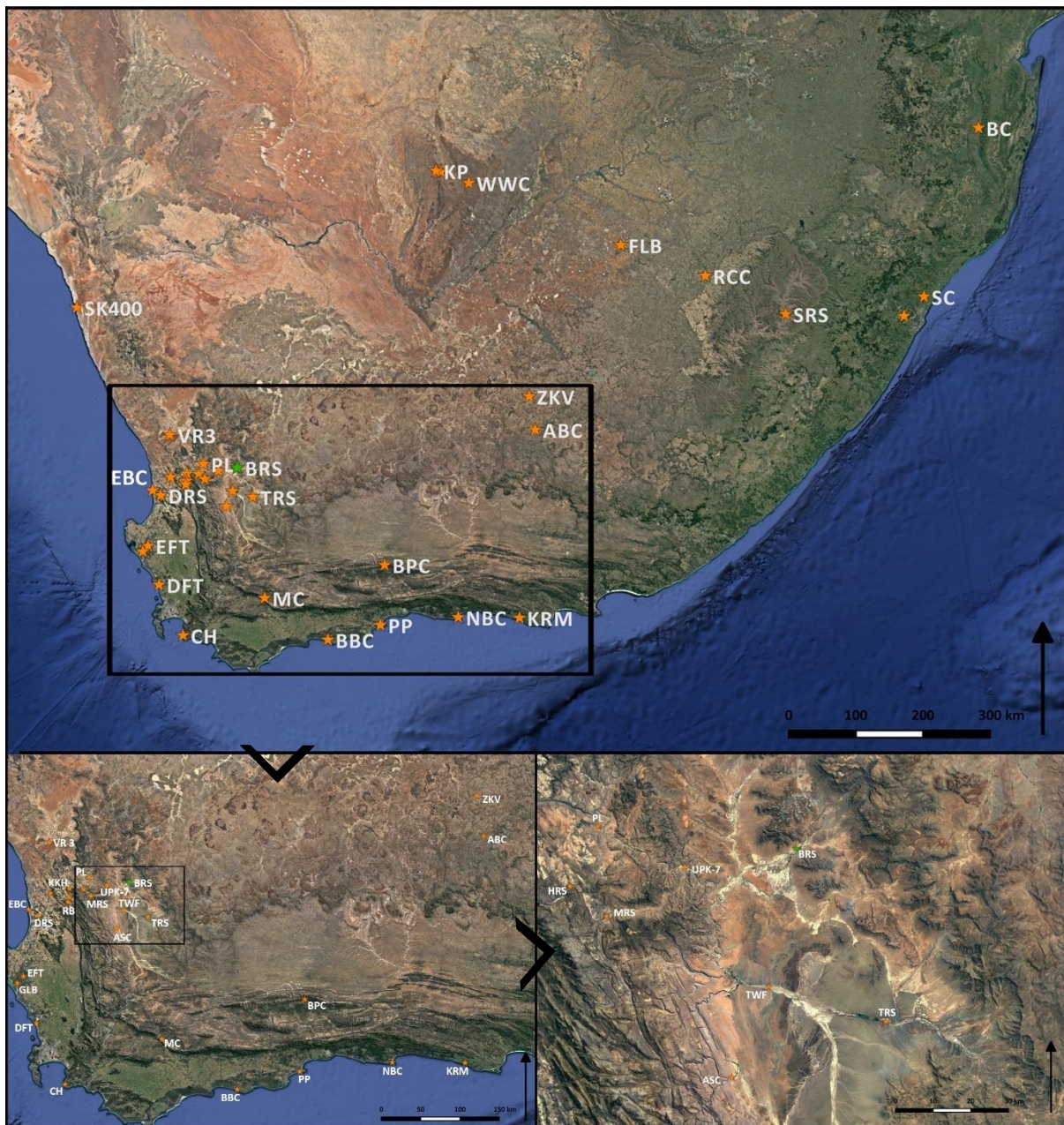


Fig 1.1 The context of the Bos River (*BRS*) in relation to South African sites described in this thesis, including Abbot's Cave (*ABC*), Aspoort Cave (*ASC*), Bestwood (*BSW*), Blombos Cave (*BBC*), Boomplaas Cave (*BPC*), Border Cave (*BC*), Cape Hangklip (*CH*), Diepkloof Rock Shelter (*DRS*), Duynfontein (*DFT*), Elandsfontein (*EFT*), Faraoskop (*FRK*), Florisbad (*FLB*), Geelbek Dunes (*GLB*), Kathu Pan (*KP*), Klasies River Main (*KRM*), Klein Kliphuis (*KKH*), Mertenhof Rock Shelter (*MRS*), Montagu Cave (*MC*), Nelson Bay Cave (*NBC*), Olifants River Survey (*ORS*), Putslaagte (*PL*), Rose Cottage Cave (*RCC*), Sehonghong Rock Shelter (*SRS*), Sibudu Cave (*SC*), SK400, Tankwa River Survey (*TRS*), Tweefontein (*TWF*), Umhlatuzana Rock Shelter (*URS*), Varsche River (*VR3*), Wonderwerk Cave (*WWC*), Zeekoe Valley (*ZKV*).

The emphasis on studying shelters in southern Africa often overlooks the logistical variability of hunter-gatherer populations (Binford 1979), which can be gained through analysing landscapes at a larger spatial scale (Kandel, Felix-Henningsen & Conard 2003). Cave and rock shelters provide a spatially and temporally limited view of prehistoric people's behaviours (Kandel & Conard 2012), with only a few examples of South African cave sites containing evidence of early Pleistocene human occupation (Chazan et al. 2012; Keller 1973).

In mobile populations, a single point on the landscape does not serve as an accurate representation of the logistical flexibility of that population. Variability within and between stone tool assemblages can be attributed to the logistical forays and functionality of an area by a single group of people (Binford 1979). Binford's logistical variability (1979) showed that a single population can be responsible for a diverse set of tools across space, further emphasising the importance of combining open-air and surface scatters with the information recovered from shelters to provide a more complete picture of prehistoric people.

This project uses a landscape approach to analyse the surface archaeology at the scale of the individual stone artefact (Parkington 1980; Holdaway, Shiner & Fanning 2004; Hallinan 2013). Implementing an approach such as this allows the environment to be viewed as a continuous landscape, rather than isolated points on the landscape. This facilitates an analysis of the lithic record from the scale of the individual artefact, rather than at the scale of the site or assemblage, allowing all artefacts to be recorded across all types of settings on the landscape, from ridges to river valleys. The shift away from analysing at the scale of a

site or assemblage and towards an analysis at the scale of the artefact allows for research to be conducted in the Tankwa Karoo, rather than it being ignored as a result of the lack of sites and assemblages.

A second benefit of this single artefact approach to the surface archaeology material is to overcome the limitations that are expressed at cave and rock shelter sites, and the resultant reflections in understanding the spatial distribution and landscape-use behaviour of prehistoric populations. Analysing at the scale of the individual artefact allows for the opportunity to record and provide evidence of prehistoric human occupation in areas that are between and amongst rock shelters. In areas where shelters, as well as other large sites, for example deflation hollows (Braun et al. 2010; Kandel & Conard 2012) and large shell middens (Parkington 2006; Jerardino 2012), are not present, there would be a significant gap in the spatial distribution of archaeological material.

The significance of this study is to use the information gained from the surface analysis of the anthropogenic lithic material in conjunction to the archaeological record derived from cave and rock shelters to generate a holistic understanding of landscape-use behaviour by prehistoric people. The methodology and thinking behind this approach, derived from “scatters between the patches” (Isaac 1978; Isaac 1981) and “off-site” (Foley 1981) frameworks, analyse landscape use at the scale of the individual artefacts across the entire Stone Age in South Africa.

In chapter 2, “Background to South African Archaeology”, the temporal classification of the Stone Ages introduced by Goodwin as an African-specific nomenclature for lithic studies (Goodwin & van Riet Lowe 1929). This approach to the archaeological record of South Africa

sought to understand the relative chronology of the archaeology using a *fossile directeur*, because of the absence of dating techniques. Lithic material in South Africa spans a large time frame encompassing the Earlier Stone Age (ESA) from 2.6 million years ago (Ma) to 250 thousand years ago (ka), followed by the Middle Stone Age (MSA) between 250 ka and 30 ka, and the Later Stone Age (LSA) with a range from 30ka to 1ka (Jacobs et al. 2008a), although there is debate about the continuities and transitions between these stages.

Chapter 3 is an overview of landscape approach to South African archaeology, forming the foundation of this thesis. This chapter is a critique of the benefits and limitations of the archaeological research at the scale of a site, assemblage, and artefact. Landscape archaeology is presented as an approach to the archaeological record, with the initial view of a landscape being only a physical entity (Blumenschine 1987; Blumenschine & Peters 1998), and later changing to include a conceptual component as well (Parkington 1980; O'Connell 1997; David & Thomas 2008). The combination of these two approaches allow for a more holistic approach to the understanding of landscape use in terms of the lithic material record that is available on the landscape (Ashmore & Knapp 1990).

The bedrock geology of the Tankwa Karoo that is important for understanding the transportation and acquisition of raw materials, is explained in chapter 4. Resources, such as water, food, shelter, and raw materials for the manufacture of stone implements, were important in the survival of prehistoric people, and would often have influenced the strategies involved in assemblage organisation and areas used for occupation.

In chapter 5, both the physical and conceptual methods that were followed in this research and the decisions for implementing them are discussed. These include the physical methods of selecting a suitable study area, conducting the fieldwork, and analysing the materials, as well as the mental frameworks involved in understanding certain technological strategies.

Chapter 6, is a presentation of the results from the fieldwork with a focus on four factors: the distribution of artefacts, raw material use, and the organisation of the technology.

These results are further discussed in chapter 7 beginning with the spatial distribution of artefacts according to their relative time period (ESA, MSA, LSA). Water availability, raw material sources, shelters, and technological organisations of the artefacts offer an important opportunity to understand the relationship between prehistoric people and the landscape (Binford 1978, 1979; Torrence 1989; Nelson 1991; Kuhn 1994).

The concluding chapter 8 brings attention to the importance of surface material to the archaeological record, with a summary of the results obtained through the analysis of the stone tools. The aim of this chapter is to demonstrate the validity of analysing surface material, and its contribution, in combination with the evidence from excavated shelters and open-air sites, to understanding prehistoric landscape use.

Chapter 2: The Stone Ages in South Africa

Stone artefacts are important clues in understanding human evolution as they are super abundant and reflect tangible evidence of solutions to problems faced by stone-tool using people. The information gained from lithic analysis relates to the cognitive capabilities of the stone-tool manufacturers, the raw material availability and procurement strategies, as well as the innovation and functionality of specific artefacts. South Africa has a rich archaeological record in caves and rock shelters, as well as the presence of artefacts scattered on the open landscape.

The earliest evidence of human 'culture' is often attributed to the discovery of stone tools (de la Torre 2011), with inferences about prehistoric human life deriving as a result from social, economic, behavioural, and environmental stresses (Isaac 1978). The appearance and variability that is expressed in stone tool technology (Foley 1987; Barton 1997; Plummer 2004) signifies a change (increase) in prehistoric human cognition (Stout et al. 2008; Jeffares 2010; Toth & Schick 2009), based on the knowledge that these tools represent an implementation of preconceived idea (Lombard 2016; Lombard & Haidle 2012; Wadley et al. 2009; Sumner 2011; McPherron 2000).

A naming system was needed to classify the different periods in Africa. The Earlier, Middle and Later Stone Age are temporal groupings implemented by Goodwin (1929) to offer an African-specific alternative to the European term-based system of Lower, Middle and Upper Palaeolithic (Goodwin 1929). Occurring in the Pleistocene and Holocene, these periods are considered generalisations spanning a time frame of at least 2.6 million years,

and encompassing different (iconic) technologies and behaviours (Goodwin 1946). To understand the significance of the stone age period and the variations of artefacts, we need to understand the implications of stone implements in the evolution of humans.

The goal of this chapter is to use the framework implemented by Goodwin & van Riet Lowe (1929) to establish the chronological specificity of a range of iconic artefact types (*fossile directeur*) across the Stone Age in South Africa (and other parts of Africa). This allows for the artefacts (specifically iconic artefacts) described in this thesis to be viewed in relation to one another and in relation to the landscape, for example certain artefact traits predate other artefacts (Hallinan 2013), providing a temporal scale for the region. The effectiveness of this approach is allowed by the large spatial scale of the project, whereby different periods of occupation in the Tankwa Karoo can be differentiated. The use of the terms 'open sites' or 'open-air sites' in this chapter and throughout the thesis, refers to sites that occur on the landscape away from caves and rock shelters that contain datable stratified deposits. Surface material is different from open-air sites in that it refers to the visible surficial artefacts on the landscape.

2.1 The Stone Ages and relevant iconic artefacts

The application of an iconic artefact approach to the surface archaeological material is beneficial in acquiring a temporal scale of the area being studied. Recording of a *fossile directeur* has the potential to offer a higher temporal resolution of the area, for example, certain artefacts (which will be discussed later in this chapter) that are attributed to tightly constrained age brackets.

It is important to consider that this approach by itself can prove dangerous in the analysis of surface archaeological material, as artefacts in an assemblage associated with a *fossile directeur* can easily be presupposed as being part of that specific cultural techno-complex (Hallinan 2013). Another concern that should be noted with an iconic artefact approach is in areas where there is a lack of this iconicity in the archaeological record, which can lead to a temporal haze of the area. Although these issues are problematic when analysing surface archaeological materials, there are possible ways to accommodate such hindrances.

This iconic artefact approach was effectively adopted by Sampson (1985) in his work in the Zeekoe valley, and later implemented by Hallinan (2013) in combination with a single artefact approach that looked to analyse the landscape at the scale of the individual artefact. The occurrence of an iconic artefact is not always restricted to specific cultural techno-complexes. Nor do they form an accurate or full representation of the entire technological strategy of these periods. However, evidence from excavated sites suggest that certain iconic artefacts only occur during certain time periods. Handaxes, for example, are common during the ESA (Keller 1973; Chazan et al. 2008; Braun et al. 2013), but they do not occur in LSA deposits. By analysing at the scale of the individual artefact in combination with temporally diagnostic artefacts, we can negate lumping artefacts into a single techno-complex and in most cases, separate artefacts into different periods based on distinct technological traits.

The culture-based naming system put forward by Goodwin & van Riet Lowe (1929) is problematic, however, it is used in this thesis as a way of providing chronological iconicity of

the Tankwa Karoo. The following paragraphs in this chapter highlights the iconic artefacts that occur in during the Stone Ages in South Africa from excavated contexts.

2.2 The Earlier Stone Age (ESA)

The earliest period is known as the ESA. The ESA ranges from about 2.6 ma to 300 ka (Beyene et al. 2013; Kuman 2014a), and is divided into two major industries – the Oldowan and the Acheulean.

2.2.1 The Oldowan

The evidence for the Oldowan is almost exclusively derived from an East African context, with only four examples in South Africa (Kuman 2014a). The Oldowan is characterised by its core types, namely chopper-cores, discoidal cores, polyhedrons, and core-scrapers/single platform cores, which was described by Leakey (Leakey 1971). These cores were initially thought to be tools, but were later understood to provide sharp-edged flakes (Toth 1987)

Typically, the duration of the Oldowan is recognised as spanning from 2.6 Ma to 1.7 Ma, with evidence from Gona, Ethiopia (Semaw 2000; Semaw et al. 2003). The discovery of tool-assisted cut-marks on bone was later discovered in Dikika, Ethiopia, which pre-dates the Oldowan at 3.39 Ma (Braun 2010; McPherron et al. 2010). The earliest example of stone artefacts has since been discovered at the Lomekwi 3 site in West Turkana, Kenya, with an age of 3.3 Ma, pre-dating the artefacts from Gona by 700 ka (Harmand et al. 2015). It is suggested by Harmand et al. (2015) that due to the age of these artefacts, a new term should be adopted, Lomekwian, as they represent a different period to the Oldowan. Three

of the four South African sites containing Oldowan artefacts are in the Cradle of Humankind (Gauteng province) in dolomitic limestone caverns, while the other site is Wonderwerk Cave (Northern Cape province). Wonderwerk Cave is the only site in South Africa at present to provide evidence of a stratified Oldowan signal in a habitual cave context, dating between 1.96 Ma to 1.78 Ma (Chazan et al. 2012). It is suggested that due to the small sample size, Wonderwerk may be indicative of an occasional use of the cave rather than an Oldowan occupational site (Kuman 2014a). Nevertheless, Oldowan technology has been described in an area away from an East African context, in other parts of Africa as well as Asia (referred to as Mode 1 industry), suggesting a widespread phenomenon (Zhu et al. 2004; Dennel & Roebrooks 2005; Mgeladze et al. 2011; Kuman 2014a; Prat 2016), and consideration for lithic studies. Evidence for Oldowan technologies in South Africa is rare, and although there may be some distinct artefacts that occur during this period, the general lack of iconic artefacts for the Oldowan in South Africa proves a limiting factor for the surface material.

2.2.2. The Acheulean

The onset of the Acheulean industry occurs between 1.75/6 Ma and 250 ka (McNabb, Binyon & Hazelwood 2004), and provides much insight into human evolution. The earliest known dates for the Acheulean derive from the site of Kokiselei 4 in Kenya and Konso Gardula in Ethiopia (Lepre et al. 2011; Beyene et al. 2013 respectively). Like its predecessor, evidence of the Acheulean industry is predominantly derived from an East African context. The difference, however, is that this industry is geographically less restricted, with more examples of Acheulean-age assemblages occurring in South Africa (Keller 1973; Klein et al. 1999; Sampson 2001; McNabb, Binyon & Hazelwood 2004; Chazan et al. 2008; Braun et al.

2013; Walker, Chazan & Morris 2013; Kuman 2014b; Presnyakova et al. 2015), Asia (Gilead 1970; Norton et al. 2006; Mishra et al. 2010), and Europe (Parfitt et al. 2010; Jime'nez-arenas et al. 2011). The Acheulean industry is characterised by bifacially shaped tools/large cutting tools (LCT) (Kleindienst 1961; Leakey 1971). This period of human evolution is often associated with an increase in human complexity.

One avenue of this complexity is based on the increase in the cognitive abilities of hominins. The handaxe, in particular, is interpreted as being a representation of spatial cognitive development, through the implementation of a preconceived template (Wynn 1995; Stout et al. 2008). This theory is contested, relating the symmetry to the raw material (McPherron 2000). A second example of this complexity deals with a change in raw material provisioning and procurement strategies employed by these hominins (Blumenschine et al. 2008; Archer & Braun 2010).

In an attempt to analyse the Acheulean, Kleindienst (1962) categorised this industry into shaped tools (handaxes, cleavers, blades, scrapers, discoids, choppers), modified tools, utilized tools, and waste products (Kleindienst 1961). Descriptions of Acheulean industries at sites are typically identified by the presence of systematically shaped tools or LCTs - handaxes and cleavers (Isaac 1978; Sharon 2008). This is problematic at sites/scatters of Acheulean age, where there is an absence of these index fossils (Iovita & McPherron 2011; Presnyakova et al. 2015). In such examples, assemblages with only large flakes were ascribed to the Acheulean, based on the premise that large flake blanks were used in the production of LCTs (Goren-inbar & Sharon 2006). The research conducted by Presnyakova and colleagues (2015) provides important insight into understanding assemblages,

particularly in open-air contexts in the ESA, where there is an absence of diagnostic artefacts.

The presence of an Acheulean industry in the South African record is derived predominantly from open-air sites, while cave contexts are rare. These closed sites allow for a temporal control for the surface archaeological record that are not found in stratified/datable sediments. Some examples of Acheulean assemblages in open-air contexts include Elandsfontein (Braun et al. 2013), Duinefontein (Klein et al. 1999; Cruz-Uribe et al. 2003) and Cape Hangklip (McNabb et al. 2004) in the Western Cape, and Zeekoe/Seacow Valley, (Sampson 2001, Sampson et al. 2015), Kathu Pan (Wilkins & Chazan 2012) and Bestwood (Morris 2014) in the Northern Cape.

The earliest date for the Acheulean in South Africa is derived from stratified mid-Pleistocene deposit found at Wonderwerk Cave, dating to approximately 1.6 Ma (Chazan et al. 2008). Data from Elandsfontein suggest an occupation between 1 Ma and 600 ka (Klein et al. 2007), although recent studies on associated fauna and palaeomagnetic data suggests a much older occupation in excess of 1 Ma (Braun et al. 2013). The occurrence of the iconic handaxe in the surface material along the Bos River would therefore be indicative of an ESA Acheulean occupation.

2.2.3 Fauresmith

The enigmatic Fauresmith is considered a transitional stage between the ESA and MSA, initially characterised as a highly refined pseudo-handaxe industry (Goodwin & van Riet Lowe 1929). The Fauresmith consists of a combination of bifacial technology (handaxes and

cleavers), a prepared core technology (Levallois technique), and a blade component (Goodwin & van Riet Lowe 1929; van Riet Lowe 1945; Underhill 2011). The technologies employed in creating these highly refined handaxes, which serve as a *fossile directeur* for the industry, were made on longitudinal flakes (as opposed to Acheulean handaxes). The primary focus in the shaping of these handaxes was the dorsal surface, with ventral surface being shaped if necessary (Goodwin & van Riet Lowe 1929; Underhill 2011).

The Fauresmith was initially considered a localised industry with occurrences noted in the Eastern Cape and along the Vaal River in South Africa (Goodwin & van Riet Lowe 1929), however, examples of sites containing Fauresmith are now much more widespread with evidence from the Seacow Valley (Karoo geology), cave and pan sites outside of Kimberley, and in the Orange and Vaal River (Sampson 1985; Beaumont 1990a, 1990b; Beaumont & Vogel 2006; Chazan et al. 2008; Wilkins & Chazan 2012). These sites are located in the eastern-central part of South Africa. The evidence for the oldest artefacts from the Fauresmith are estimated to be around 400 ka – 500 ka, from Kathu Pan (Chazan et al. 2008; Porat et al. 2010; Herries 2011; Wilkins & Chazan 2012). The Zeekoe Valley, although 500 kilometres away from the Tankwa Karoo, provides a signal for artefacts found in a Karoo environment, and in particular, it demonstrates a presence of a final Acheulean/Fauresmith industry. (Sampson 1985).

The Tankwa Karoo is situated predominantly on Karoo geology, although Cape geology does outcrop along the western extent of this area. Given that the examples of the Fauresmith industry recorded on Karoo geology, albeit much further north-east, encountering these highly refined and generally small handaxes along the Bos River was always a possibility.

2.3 The Middle Stone Age (MSA)

The archaeological record during the late Pleistocene exhibits a multitude of changes in human behaviour and technologies. It is characterised by the emergence of anatomically modern humans, dating from 195 ka to 160 ka, (White et al. 2003; McDougall et al. 2005) as well as behaviourally modern humans from at least 100 ka (McBrearty & Brooks 2000; Wadley 2003; Conard 2008; Nowell 2010; Texier et al. 2010). Anatomically modern human fossils in a South African context derived from Klasies River Main Cave, date between 115 ka and 110 ka (Grun et al. 1990; Rightmire et al. 2006), while evidence at Pinnacle Point may suggest an earlier signal between 170 ka and 91 ka (Marean et al. 2004).

The complexity in terms of spatial use, technologies and stratigraphy of cave deposits becomes more evident during the MSA, where variation in stone tool technology and raw material use is common (Mackay 2006; Thompson, Williams & Minichillo 2010; Henshilwood 2012). With the implementation of new dating techniques, primarily those using luminescence methods, a finer temporal resolution for the MSA period is produced, although the dates of certain techno-complexes within the MSA are debated (Jacobs et al. 2008a; Tribolo 2009, 2013). For the purpose of this thesis, the age range for the MSA period is taken to be between 250 ka and 30 ka (Jacobs et al. 2010).

The most notable change signifying the termination of the ESA is the disappearance of the iconic handaxes and the emergence of a prepared core technology and production of convergent flakes (Goodwin & van Riet Lowe 1929). The MSA period was initially used to temporally situate artefacts that did not conform to the ESA or LSA periods (Minichillo 2005). A simplified chronology of the MSA of southern Africa was introduced by Volman (1981), which looked to provide a standardised framework for the increasing number of

assemblages being excavated. The southern Cape MSA was divided into 4 relative groups, early MSA I being the oldest unit, followed by the early MSA II (IIa and IIb), Howiesons Poort, and the final MSA (Volman 1981). Unfortunately, this framework proved too rigid to address the variability that exists in the MSA, especially with the injection of new techniques allowing for a micro-scale analysis of deposits to ascertain refined dates for associated stone tools, such as micromorphology and geomorphology techniques.

The variability of stone tools in the archaeological record relating to the MSA of South Africa has encouraged multiple avenues of thought for quantifying these observed differences. The general descriptions of MSA artefacts by Godwin and Van Riet Lowe (1929) and later by Volman (1981), proved useful for understanding the chronology of artefacts that were associated with deposits that exceeded the maximum range of carbon dating. With the application of new techniques that became available to archaeologists, these descriptions lacked the necessary flexibility required in the identification of variability that occurs in the Stone Age.

2.3.1 Early MSA/late ESA

The early MSA/late ESA is used in this thesis to group artefacts that express similarities in technologies found during both the ESA and MSA, but not characteristic of the LSA. The early MSA was initially characterised by its prepared core technology (Levallois technique in a European context) accompanied by convergent flakes with faceted platforms. Apart from these technological changes from the ESA, quartzite was also recognised as a more prominent raw material during this time (Volman 1981). The implementation of such techniques was believed to demarcate the MSA from the ESA periods (Goodwin & van Riet

Lowe 1929). Contrary to this, some literature suggests that the origins of prepared core technology (PCT) occurred during the ESA, in transitional industries of the Fauresmith and Sangoan (McBrearty & Tyrone 2006; Wilkins, Pollarolo & Kuman 2010). Sites in South Africa with an early MSA signal have been recorded at Florisbad (Kuman, Inbar & Clarke 1999), Wonderwerk Cave (Beaumont & Vogel 2006), and Border Cave (Grun & Beaumont 2001), with dates of 280 ka, 220 ka, and 227 ka respectively.

The Levallois reduction strategy is a method of core reduction with the intent to produce particular kinds of flakes (Van Peer 1991; Inizan et al. 1999). The implications of such a technique alludes to the cognitive ability of the tool makers (Foley & Lahr 1997), as a preconceived idea needs to be implemented practically. Generally viewed as a technology that occurs during the MSA, the origins of PCT is a complex one, with variations in the period and methods involved in this reduction strategy (Kuman 2001; Wilkins et al. 2010).

The presence of blades has been identified in these transitional ESA/MSA sites. In its basic definition, a blade refers to a flake that has parallel laterals with a length twice as long as it is width (Bar-Yosef & Kuhn 1999). A relationship between behavioural modernity and blade production was thought to exist, but the presence of blade technology during the final stages of the ESA at sites across Africa and the Near East, suggests that blade technology is a result of a possible convergent evolution (Bar-Yosef & Kuhn 1999). Alternatively, this could be linked to the problematic broad definition of what constitutes as a blade. Blades recovered from the Kapthurin Formation in Kenya date to 500 ka (Johnson & McBrearty 2010). A presence of blades, suggesting hafting, was discovered at Kathu Pan, in the Northern Cape of South Africa, dating to an age of 500 ka (Wilkins & Chazan 2012).

The ages of the blade technology from the two examples described above are unique in that this technology exists significantly earlier than what was considered the onset of the MSA at 250k (Jacobs et al. 2010). An increase in the number of blade assemblages in South Africa becomes more prominent in later periods of the MSA. Evidence of blade production is present at Pinnacle Point in the lower MSA layers, dating between 161 ka and 167 ka (Marean et al. 2007). Artefacts from Klasies River Main site are described as thin, elongated laminar flakes, and occur in deposit dating between 115 ka and 110 ka (Wurz 2002). This time period (120 ka) is characterised by high sea levels, which could be responsible for removing pre-120 ka deposit from sites along the south coast, such as Klasies River Cave and Nelson Bay Cave (Hendey & Volman 1986; Mackay 2009).

The late ESA/early MSA is therefore a problematic category as it incorporates technologies that are not strictly related to ESA or MSA, such as large (often thick) blades and blade cores, radial cores, and single platform cores. These artefacts pertaining to this ambiguous period is described from the Cederberg by Hallinan (2013) as being predominantly manufactured from large quartzite cobbles and outcrops. It is with this description that artefacts from this thesis were categorised into late ESA/early MSA.

2.3.2 Still Bay (SB)

The Still Bay phase is known for its *fossile directeur* – a bifacial foliate or lanceolate, characterised by its symmetry and invasive flaking to both faces (Goodwin & van Riet Lowe 1929; Villa et al. 2009). Although this bifacial point serves as a temporally diagnostic artefact for this industry, other traits are synonymous of the Still Bay period. The use of pressure-flaking (Villa et al. 2009), heat treatment (Brown et al. 2009), and hard and soft hammer

percussion (Henshilwood 2012) are other examples of techniques used during this period. The functionality of these bifacial points is often attributed as being used as knives and spear points (Minichillo 2005; Lombard 2007).

These above-mentioned techniques implemented to create Still Bay points are suggestive of a behaviourally modern human species (Henshilwood 2012; McCall & Thomas 2012). Optically Stimulated Luminescence (OSL) dates from Jacobs et al. (2008a) suggest an age range of 71 ka to 70 ka for the Still Bay across southern Africa, while thermoluminescence (TL) dates from Diepkloof Rock Shelter suggests an older occurrence for this industry at 109 ka (Tribolo et al. 2009, 2013). The discrepancies between these two dating techniques are problematic, however, the dates still suggest that the Still Bay period occurs in the later part of the MSA.

The artefacts pertaining to the Still Bay were poorly documented and described, which resulted in this period being omitted from Volman's (1981) classification of the MSA. This could be due to poorly excavated Still Bay sites, or the general lack of a well-controlled sample size (Minichillo 2005, also see Deacon 1979). Excavations at Hollow Rock Shelter, a site in the Cederberg Mountains in the Western Cape, provided the opportunity to excavate a well-stratified Still Bay industry, which included a large sample size of bifacial points (Evans, 1994; Högberg & Larsson 2011). The occurrence of a Still Bay occupation has since been discovered in numerous cave sites in South Africa – Blombos Cave (Villa et al. 2009), Sibudu Cave (Wadley 2007), Diepkloof Rock Shelter (Porraz et al. 2013a, 2013b), Mertenhof (Will, Mackay & Phillips 2015), and possibly Umhlatuzana Rock Shelter (Lombard et al. 2010; Högberg & Lombard 2016). The Still Bay repertoire includes unifacial points, with evidence from Blombos Cave, Hollow Rock Shelter, Umhlatuzana Rock Shelter, and Sibudu Cave. The

heterogeneity of the Still Bay assemblage is further noted, with backed pieces (often associated with the overlying Howiesons Poort layers) recorded from Hollow Rock Shelter and Sibudu Cave.

The bifacial point technology associated with the Still Bay is not restricted to closed shelters, with evidence of this technology in open-air scatters (Mackay et al. 2010) and occurring as surface material (Hallinan 2013). Although considered regionally exclusive, the technology is relatively widespread in South Africa. Evidence of these bifacial foliates during surveys along the Bos River can provide temporal information with regards to the occupation of an area.

2.3.3 Howiesons Poort (HP)

The Howiesons Poort layers are traditionally noted for its *fossile directeur* – backed pieces (segments, crescents, trapezoids), typically produced from microlithic blades on non-local raw materials (Soriano, Villa & Wadley 2007; Backwell, d’Errico, Wadley 2008; Mackay 2008; Villa et al. 2009; de la Pena 2015). There is evidence of soft hammer percussive techniques in the manufacture of blades (Rigaud et al. 2006; Soriano, Villa & Wadley 2007). The HP was considered a transitional stage between the MSA and LSA, mainly due to the similarities expressed between the mid-Holocene Wilton industry and the HP (Goodwin & van Riet Lowe 1929; Volman, 1981). This view changed with the results ascertained from relevant radiometric dating techniques that became available. Ages for the HP were initially thought to be a tightly confined range between 65 ka and 59 ka (Jacobs et al. 2008a). Again, radiometric dates from Diepkloof Rock Shelter extend this range from 96 ka to 52 ka (Tribolo et al. 2009, 2013; Porraz, et al. 2013). Although the dates for the SB and HP are

debated, both results derived from the stratified context of Diepkloof Rock Shelter clearly describe the HP as chronologically overlying the SB.

Evidence of a HP occupation is found at numerous closed sites such as Klasies River Cave, Border Cave, Rose Cottage Cave, Diepkloof Rock Shelter, Sibudu Cave, Mertenhof Rock Shelter, and Klein Kliphuis. With the exclusion of retouched flakes, the levels ascribed to the HP show a significant and widespread increase in the frequency of blades and bladelets (Wurz 2002; Mackay 2008; Porraz et al. 2013a). Another pattern noted in specific HP-bearing sites is the increased use of the raw material silcrete (Minichillo 2006; Soriano, Villa & Wadley 2007; Mackay 2009). Sites such as Rose Cottage Cave and Sibudu Cave that fall under a summer rainfall zone (receives more than 66% of the rain in summer) do not share this pattern for material prevalence (Mackay 2009), which can be linked to the geological availability of raw materials. The assemblage during the HP time period at Rose Cottage Cave shows a selective dominance towards the use of opaline (chalcedony) material (Soriano, Villa & Wadley 2007).

The presence of (or the shift towards) backed artefacts, hafting, and raw material prevalence found in the HP are all attractive attributes towards understanding prehistoric humans and their behaviours. It is the occurrence of these factors that have enabled a great deal of focus to be placed on this period in human evolution. The backed bladelets from this period in our prehistory that serves as an iconic marker to provide temporality to the surface archaeological material.

2.3.4 Post-Howiesons Poort (pHP)

The post-Howiesons Poort is a temporal grouping of artefacts that occur after the HP, but predate the LSA and Early Later Stone Age (ELSA). Typologically, the pHP is heterogeneous,

characterised by the general absence of backed artefacts and an increase in unifacial point production (Villa et al. 2005; Soriano, Villa & Wadley 2007; Cochrane 2008; Mackay 2009; Conard, Wadley & Porraz 2012). Unifacial points refer to pointed flakes with retouch on one surface. A time period between 57 ka and 20 ka (Jacobs et al. 2008a; 2008b) is suggested for the pHP, with stratified evidence from Klasies River Cave (Cochrane 2008; Wurz 2002), Sibudu Cave (Conard, Wadley, Porraz 2012), Umhlatuzana (Lombard et al. 2010), Rose Cottage Cave (Soriano, Villa & Wadley 2007), Diepkloof Rock Shelter (Porraz et al. 2013), Klein Kliphuis (Mackay 2011), Mertenhof and Uitspankraal 7 (Will, Mackay & Philips 2015), and Tweefontein (Hallinan & Shaw 2015).

There is an overall shift in fine-grained raw material prevalence during the pHP. The dominance of silcrete use at Diepkloof Rock Shelter and Klein Kliphuis during the HP is replaced by an increase in quartz (Mackay 2006, 2011). The use of non-local raw materials, such as silcrete, decreases during the pHP at Klasies River Cave (Volman 1981; Wurz 2002; Cochrane 2008). The analysis of artefacts from Sibudu Cave portray a similar pattern in terms of a prevalence towards quartz during an early stage of the pHP, while hornfels/dolerite frequencies decrease. During a second stage of the pHP at Sibudu Cave the raw material frequencies were inverted, where dolerite/hornfels became the dominant material (Cochrane 2008). Evidence from Umhlatuzana shows a shift from a quartz-dominant assemblage during the HP, to an increase in artefacts made on hornfels in the overlying pHP levels (Lombard et al. 2010). Rose Cottage Cave compares to the other sites in the sense that there is a shift in raw material prevalence described from the HP to the pHP layers.

Technological changes associated with the pHP are described from a number of the above-mentioned sites. The pHP contains a diverse array of artefacts, which include unifacial points, convergent flakes (Levallois technology), scrapers, occasional bifacial points, backed knives and bipolar flaking (Wurz 2002; Soriano, Villa & Wadley 2007; Cochrane 2008; Mackay 2009; Conard, Wadley & Porraz 2012). Evidence from Rose Cottage Cave suggests a shift from a blade-dominated assemblage during the HP (80% blades), to one that is equally characterised by blades and flakes (Soriano, Villa & Wadley 2007). Lithic analysis from Sibudu Cave supports this change from a blade-dominated HP assemblage to a more heterogeneous pHP assemblage (Villa et al. 2005; Cochrane 2008).

The importance in dealing with the defining characteristics of this period, is reflected in open-air sites. The sites of Uitspankraal 7 (Will, Mackay & Phillips 2015) and Tweefontein (Hallinan & Shaw 2015) contain unifacial points and point cores (Levallois), which can be associated with the pHP, but are also applicable to other parts of the MSA. Fortunately, a similar core and point production strategy has been excavated from Mertenhof Rock Shelter near to Uitspankraal 7, with an age bracket of 50 ka to 60 ka (Will, Mackay & Phillips 2015).

Artefacts are not only recorded as being indicative of an MSA period based on the *fossile directeur* mentioned above, but artefacts displaying certain iconic traits that occur within this period, for example faceted platforms and laminar (larger blade) technologies, were placed into this period within the Stone Age.

2.3.5 Non-lithic materials

The importance of the MSA in human evolution is best explained through artefacts pertaining to the emergence of symbolic behaviour during the MSA period. These non-lithic materials are unfortunately more susceptible to weathering and preservation of these items is not great. There is much debate surrounding the parameters for the classification of modern behaviour, which will not be focused on in this thesis. It is, however, agreed upon that certain symbolic behaviours recorded in the archaeological record are indicative of an increasing cognitive complexity (McBrearty & Brooks 2000; Henshilwood & Marean 2003; Jeffares 2010; Lombard 2016). These non-lithic artefacts include (amongst others) engraved ochre excavated from MSA sites such as Blombos Cave (Henshilwood et al. 2009; d'Errico et al. 2012; Hodgson 2014), Klein Kliphuis (Mackay & Welz 2008), Klasies River Cave (d'Errico et al. 2012) and Diepkloof Rock Shelter (Texier et al. 2010), the use of marine beads as ornaments from Blombos Cave (d'Errico et al. 2005; Botha 2008), possible beads from Sibudu (d'Errico et al. 2008), and worked bone artefacts from Sibudu Cave (Backwell, d'Errico & Wadley 2008) and Blombos Cave (Henshilwood et al. 2001). These artefacts were excavated from stratified deposits, which enable researchers to extract reliable dates and provide a time frame for the implementation of such techniques.

The MSA is a unique period in human prehistory that incorporates evidence suggesting the emergence of an anatomically and behaviourally modern human. It is characterised by its technological innovations with both lithic and non-lithic materials and use of artefacts to create symbolism in their lives. The MSA is followed by the LSA where there is a large emphasis on material culture, particularly due to preservation over a shorter time span.

2.4 The Later Stone Age (LSA)

The Later Stone Age of South Africa is characterised by a number of different technocomplexes spanning a period of approximately forty thousand years. The LSA encapsulates a change in technological organization of artefacts, moving away from the blades and unifacial points of the pHP towards a microlithic assemblage (Deacon 1984; Goodwin & van Riet Lowe 1929). The people of the LSA incorporated the use of non-lithic material, such as bone, shell, grasses, wood, and ostrich egg shell beads, and included rock art in their lives (Parkington & Poggenpoel 1971; Parkington 1977, 1980; Deacon 1984; Orton 2006; Parkington & Manhire 2013; Parkington & Yates n.d.).

Attempts were, and continue to be made with the aim of categorising the assemblages that occur within the LSA. Initial type-site names were implemented by Goodwin and van Riet Lowe (1929) to describe LSA assemblages, which was carried through into the 1960s and 1970s (Goodwin & van Riet Lowe 1929; Sampson 1974). Goodwin and van Riet Lowe (1929) divided the LSA into a Smithfield and Wilton, which Sampson (1974) adapted, and created three categories: Oakhurst complex, Wilton complex, and Smithfield complex (Sampson 1974). These were altered and renamed as the Robberg, Oakhurst/Albany, and Wilton, which were believed to represent periods of relative stasis in the technological systems (Deacon 1984).

The issue in applying this approach is evident in assemblages that do not fit into the parameters of the initial classification (described below). This causes confusion as to what to classify the assemblage as. The problem with creating these boxes into which assemblages are placed, has been acknowledged (Orton 2006, 2014), and efforts have been made to try resolve this issue (Lombard et al. 2012). The paper written by Lombard and colleagues

attempt to classify the LSA into distinct technocomplexes, based on similarities and differences. Lombard et al. (2012) suggested that the LSA should be divided into six technocomplexes. They are as follows: An Early Later Stone Age (ELSA) between 40 ka and 18 ka, Robberg between 18 ka and 12 ka, Oakhurst ranging between 7 ka and 12 ka, Wilton between 8 ka and 4 ka, a final Later Stone Age at 4 ka to 0.1 ka, and a ceramic final Later Stone Age from 2 ka (Lombard et al. 2012). These groupings do not alleviate any problems expressed in the classification of assemblages that do not comply with the group parameters.

It was suggested that a broader description be applied to the different technocomplexes to not only account for the variability of an assemblage, but to also move away from type-site names which often have preconceived ideas attached to them (Orton 2006, 2014). Orton provides alternative technocomplexes, moving away from type-site nomenclature: the use of ELSA for pre-18 ka, Late Pleistocene microlithic between 19 ka and 9.5 ka, Terminal Pleistocene/early Holocene non-microlithic from 12 ka to 7 ka, Holocene microlithic post-8 ka, and the Late Holocene assemblages post-3 ka (Deacon 1984; Orton 2006). Dates pertaining to the Robberg have been adjusted since the writing of the above three mentioned papers, with evidence from Elands Bay Cave and Putslaagte 8 providing an earlier occurrence of the Robberg (Mackay, Jacobs & Steele 2015; Porraz et al. 2016).

The technocomplexes described below refer to both the type-site names and temporal naming system (Deacon 1984; Orton 2006; Lombard et al. 2012). The aim of this piece is to describe what characteristics define each technocomplex *sensu stricto*. This is not to detract from the concerns brought forward by Orton (2006, 2014) and Lombard et al. (2012) regarding the nomenclature of the assemblages. Descriptions are derived from

literature by Goodwin and van Riet Lowe (1929), Deacon (1984), Sampson (1974), Low and Mackay (2015), and Porraz et al. (2016).

2.4.1 Early Later Stone Age (eLSA) and the Robberg, or late Pleistocene microlithic

The Robberg and the eLSA represent two distinct technocomplexes of the LSA. Although these two periods represent a different time period and technological strategies, they were grouped under the heading 'Robberg' (Goodwin & van Riet Lowe 1929; Deacon 1984; Sampson 1974). Recent work focusing on the Late Pleistocene artefacts from Putslaagte 8 shed light on these two industries (Low & Mackay 2016), and offer a good comparative sample to a site found along the Bos River.

Dates from Putslaagte 8 show associated artefacts from eLSA layers dating between 25 ka and 22 ka (Mackay et al. 2015). Artefacts representing Robberg-like characteristics have been dated from levels at Elands Bay Cave and Putslaagte 8, providing earlier ages of the Robberg industry between 21 ka and 17 ka (Porraz et al. 2016) and 21 ka and 18 ka (Mackay et al. 2015; Low & Mackay 2016) respectively. The difference in technology has been recognised at Putslaagte 8 and Elands Bay Cave. The eLSA and Robberg share a similarity in that they are both associated with bladelets, specifically in the Cederberg at Putslaagte 8. The eLSA period described at Putslaagte 8 is characterised by bipolar flaking and a lower frequency of laminar pieces when compared to that of the Robberg (Low & Mackay 2016).

The analysis of the eLSA and Robberg assemblages show four major differences between the two technocomplexes (Low & Mackay 2016). The first difference is that the

prevalence of raw material in the eLSA assemblage is focused towards hornfels, while silcrete is the preferred raw material during the Robberg. The second and third notable difference is the implementation of a more expedient or opportunistic production strategy during the eLSA, which results in a larger mean size for blades. The Robberg is characterised by a formalised production strategy, which produces prepared cores and a smaller average blade size. The final difference between these two industries is related to the organisation of the technology. The eLSA period shows a prevalence towards the transportation of blades, while the Robberg period suggest a transport of cores (Low & Mackay 2016).

Mackay and colleagues draw comparison between the layers at Putslaagte 8 to other sites such as Boomplaas, Nelson Bay Cave, Faraoskop and Sehonghong, which show a higher frequency of blades than the layer directly underlying it (Mackay et al. 2015).

2.4.2 Oakhurst or terminal Pleistocene/early Holocene non-microlithic

This period is characterised by generally large cores and flakes (MSA-like). There are few formal tools in this assemblage, with large end scrapers and convex scrapers. This assemblage also contains bone tools. Other terms included in this period are Goodwin and van Riet Lowe's Smithfield A description (see Goodwin & van Riet Lowe 1929).

2.4.3 Wilton or Holocene microlithic

The Wilton or Holocene microlithic assemblage is, as its name suggests, a microlithic industry. This assemblage is characterised by the appearance of various specialised formal tools, which include backed microliths (bladelets and segment-shaped) and small convex

thumbnail scrapers. Other non-lithic associations that could be used to identify this period include shell, bone, and wooden artefacts, as well as rock art. This assemblage falls under Goodwin and van Riet Lowe's (1929) Wilton and Smithfield C.

2.4.4 Ceramic final LSA or late Holocene assemblages

This period is characterised by the presence of pottery with associated microlithic technology in some areas, while areas in the north and north-east of South Africa contain pottery with long end scrapers. Pottery found at sites along the coast is associated with an absence or low frequency of formal tools. An issue brought up by Orton (2014) regarding assemblages pertaining to this period is that the lack of pottery at these sites during this period may skew the interpretations of this phase.

The categorisation of artefacts into the three Stone Ages by Goodwin and van Riet Low (1929), still remain applicable today, although there are negative connotations attached to a culture name-based system. The issue with these name-based systems is that it suggests that prehistoric people that were responsible for certain iconic artefacts were only producing those assemblages, which is problematic when looking at the evidence suggested by Binford's logistical variability paper (Binford 1978), whereby one population can produce multiple different assemblages based on the purpose of forays.

Multiple technocomplexes have been added to offer a finer resolution of the Stone Age since the initial implementation of the categories (Sampson 1974; Deacon 1984). The associated problems with creating confined names (type-sites) are constantly being

addressed in an attempt to make these terms widespread and applicable to research in South Africa and neighbouring countries (Orton 2006, 2014; Lombard et al. 2012). The current research from caves, rock shelters and open-air sites are refining the temporal and geospatial parameters of these technocomplexes in attempt to better identify these periods. Landscape archaeology seeks to combine information obtained from closed and open sites to the surface archaeological material, creating a more refined idea of prehistoric human lifeways.

Chapter 3: A Landscape Approach to South African

Archaeology

A major portion of the South African archaeological record has been obtained through the excavation of large cave sites along the coast of South Africa, which have attracted many archaeologists due to the relatively deep stratigraphic deposits and the potential for understanding prehistoric behaviour in sequence. The impetus for conducting research at caves and rock shelters is the ability to obtain a high-resolution temporal sequence of the archaeological record from the datable stratified deposits. The question that arises when dealing with large single site studies is to what extent the archaeological material derived from these sites is an accurate representation of prehistoric behaviour across a broader area. The aim of this chapter is to describe how the methodologies in South African stone age archaeology have developed as well as the reasoning for the different theoretical work that underpin these practices. The archaeologists and anthropologists listed below are selected because their work best describes the development and evolution of archaeological theory, internationally and nationally, forming the foundation of this thesis.

Patterns that were derived from the excavation of large cave sites, such as stone tool technologies, were viewed as representative of prehistoric behaviour (Goodwin & van Riet Lowe 1929). This culture-historic approach assumes that prehistoric human behaviour is

homogeneous and repetitive, and that the technologies that were described from these sites were indicative of phases of past human behaviour across the region.

The movement away from a regional focus on sites and sequences towards a framework that looked to synthesise archaeological evidence at a larger spatial and temporal scale, is best presented internationally in the work by Gordon Childe, David Clarke and Lewis Binford. With a grounding in a Marxist approach, Childe viewed the past from a materialistic perspective, acknowledging the effects that societal development had on the material cultures of prehistoric people (Trigger 1994). It is with the introduction and emphasis on social and economic themes that Childe is credited with the change brought about in archaeological thought that led to a processual approach to the archaeological record (Trigger 1994).

During the late 1960s, the legitimacy of acquiring and analysing archaeological material from single sites through interpretations of material culture was criticised as being subjective and lacking scientific reasoning (Clarke 1968). It was during this period that an apparently more objective, or positivist approach was encouraged, with the aim to incorporate scientific methods into the anthropological realm. Processual archaeology, led from the United States by Lewis Binford, sought not only to describe and situate the material culture obtained from sites into a chronological system (as was achieved by culture-historic archaeology), but to explain the reasons for the manifestation of different technologies and site formations, deemed logistical variability (Binford 1978, 1980, 1981a).

The emergence of ethnoarchaeology as a method for acquiring information on site formation is rooted in the understanding that culture is a system of behavioural processes

that can be statistically analysed to identify patterns (Binford 1964). The concerns of subjectivity and applicability surrounding a culture-historic approach were further justified with the introduction of a middle range theory introduced into archaeology through Binford's research of the Nunamiut population, which provided systematic evidence for site formations in the present (Binford 1978). Middle range theory does not, however, have its origins in archaeology, originally described in 1949 by Merton, a sociologist, as a way of dealing with the dichotomy of high-level theories and low-level empirical analysis (Merton 1968). The use of middle range theory in archaeology differs slightly in that it is a methodological approach to understand site formation (Raab & Goodyear 1984), providing insights into past groups of people rather than answers.

Ethnoarchaeological studies observe recent hunter-gatherer populations to provide an analogy for understanding the organisation of archaeological material culture at sites. The goal is to form generalisations of cultural processes (laws) that can be applied to other archaeological contexts. Although the use of middle range theory applied in archaeology was adapted from its intended use in sociology, criticism about its relevance in a multi-disciplinary subject, was brought to attention in the 1970s (Schiffer 1988). Schiffer (1976) advocated a behavioural archaeology approach demonstrating that archaeological material and a site is subjected to multiple taphonomic (physical or natural) and social (people) influences, therefore requiring the implementation of multiple theories that deal with the natural and social sciences (Schiffer, Sullivan & Klinger 1978).

The middle range theory that was adopted by Binford and applied to his ethnoarchaeological accounts of the Nunamiut population demonstrated the variation of site formations that exists in the archaeological record. Ethnographic recordings of hunter-

gatherer populations demonstrate that the occupation of certain areas and the organisation of stone tool assemblages varied depending on the function or activity that was required, and could be produced by the same population (Binford 1978; Kuhn 1992, 1994). This distributional variability is explained through three organisational strategies described by Binford - personal gear, situational gear, and site furniture (Binford 1978). Personal gear refers to the type of artefacts on the individual during forays, which include multifunctional and durable tools, such as a knife or a prepared core. Situational gear entails a more expedient implementation of technology, manufactured for a specific use while on a foray. Site furniture refers to artefacts that are left at an area and re-used; characterised by its 'lateral recycling' (Binford 1978, 1979). The three types of gear demonstrated by Binford can be placed under two broader technological strategies, namely an expedient strategy which requires little energy and characterised by a low level of retouch and maintenance, whereas curated technologies describe an assemblage that requires an investment of more time and energy (Binford 1979).

The limitation of single site studies that were problematic in the previous culture-historic approach was, to a degree, alleviated. Focusing away from large cave and rock shelters and towards open-air sites became an influential part in understanding human behaviour as it demonstrated the distributional variability of assemblages left by mobile populations. The issue of extracting information from areas with a high density of artefacts, however, remained influential in the archaeological discipline.

Cultural Resource Management (CRM) or rescue archaeology in North America became common in the early 1980s (Goodyear, Raab & Klinger 1978). CRM work embodied

processual archaeology in that it incorporated GIS techniques and an implementation of scientific surface survey and recording methods of the archaeological material on the topographic landscape (Orton 2002; Verhagen & Whitley 2012). A requirement of CRM work, which is fundamental to this thesis, was to locate and record all rather than some of the remains in an area. The growing interest in acquiring spatial patterns in the archaeological record, caused a transformation in how 'sites' were understood and approached, leading to a distributional approach to the archaeological material on a topographic space (Binford 1978; Orton 2002). This shift in focus allowed for a more in-depth interrogation about prehistoric use of the environment, although these patterns were largely interpreted from an ecological understanding of the landscape (Patterson 2008).

The backing of funding and employment of people provided the necessary support to implement large surface sampling methods. The time constraints of CRM work applied pressure to the archaeologists involved in the work, which resulted in the formulation of an effective model to obtain representative information from the topographic landscape while reducing time costs. Predictive modelling (described later in chapter 5) was formulated to reduce time costs in the field by focusing on features that would have been attractive to hunter-gatherer populations (Westcott & Brandon 2000; Anderson & Smith 2003; David & Thomas 2008; Verhagen & Whitley 2012; Balla et al. 2014). A predictive sampling model, however, required the application of scientific survey methods (objective) combined with experiential (subjective) knowledge of the area, blurring the lines of the processual/post-processual theories.

Since archaeologists study what is considered a 'vulnerable database' (Byrne 1976), the aim of CRM was to record as much information as possible in a short amount of time, before it was destroyed or lost (Orton 2002). CRM work was criticised by Tilley (1989) as a

way collecting more information, instead of constructing frameworks to interpret the material. The criticism made by Tilley (1989) toward CRM work is fair but perhaps harsh. Archaeological research management provided a useful contribution to the evolution of archaeological field methods, which derived from time and monetary constraints.

The combination of theoretical laws with empirical information obtained through ethnographies formed the crux of processual archaeology (Raab & Goodyear 1984; Schiffer 1988). It was this movement towards a more scientific and less subjective approach to understanding the archaeology material culture that was being described at excavations that led to a shift in focus from single site studies to incorporating multiple sites in an area to understand prehistoric behavioural patterns.

A shift in the archaeological discipline in the 1980s evolved from a reproach of processual archaeology, particularly a criticism of over-emphasising a positivist approach to the archaeological record. Post-processualists began questioning the legitimacy of obtaining objective conclusions from such a framework, where the emphasis should incorporate the individuals (Hodder 1984; Johnson 2010). This movement is not as relevant to this thesis as others discussed above although, it did offer a new way of understanding landscapes in an archaeological context, from both the physical and cognitive point of view.

The organisational strategies demonstrated by Binford in the late 1960s and early 1970s were similarly utilised by Kuhn (1994) for the Middle and Upper Palaeolithic in Europe. Kuhn defines two strategies for lithic procurement: people provisioning and place provisioning (Kuhn 1992, 1994). The idea behind these two organisational approaches was to understand

the information reflected in the stone tools present. Toolkits ascribed to people provisioning are those that served a multi-function and that are subject to maintenance through retouch (Kuhn 1992). Prehistoric people could only carry a finite number of artefacts, which led to place provisioning. Areas for provisioning were selected in environments where the type of resource was predictable. This allowed prehistoric people to cache specific artefacts for future use (Kuhn 1992, 1994).

The emphasis on the individual (Shanks & Tilley 1987, 1992; Tilley 1994) combined with distributional variability (Binford 1968) demonstrated that prehistoric people were not bound to these caves and shelters, but could, and were, occupying other areas in the environment and leaving artefacts there. Focusing specifically on examples from an East African context, ideas about “scatters between the patches” (Isaac 1980) and “off-site” archaeology (Foley 1981) were implemented in survey studies to analyse sets of artefacts found away from major sites. The presence of volcanic deposits in the Rift Valley in East Africa provided age ranges for excavated artefacts found between volcanic layers, which facilitated an open-air approach to analysing the material. However, there are some limitations with conducting research at open-air sites and on surface archaeological material, for example time averaging and the notion of palimpsests (Bailey 2007).

The two frameworks described by Isaac (1981) and Foley (1981) were important in demonstrating the significance of open-air sites to the understanding the archaeological record. The existence of dense accumulations of artefacts away from shelters, which were viewed as centripetal features, demonstrated that hominins were not constrained to these points, but were rather occupying the broader landscape. The prerequisite for carrying out archaeological research was still based on the idea that archaeologists needed to excavate

sites. These two frameworks further guided archaeological methodology toward a shared focus between large sites and the open-air sites located between the larger sites. The research did not, however, acknowledge the smaller scatters or single artefacts that lay on the environment away from either shelters or open sites. Single artefacts or ephemeral scatters of artefacts on the physical landscape can inform researchers of how prehistoric people viewed and interacted with the landscape.

The notion of landscape is problematic but crucial for understanding site formations in the archaeological record. It was during the post-processual movement in archaeology that a critical analysis of the term 'landscape' was undertaken (Shanks & Tilley 1987; Tilley 1994; Bender 2002). Landscape is historically described as the physical topography, for example topographic features such as mountains and rivers. The research conducted by Blumenschine looked at predicting hominin landscape-use in East Africa (Blumenschine 1987; Blumenschine & Peters 1998). The method employed by Blumenschine was a slight adaptation of the predictive modelling, whereby areas (stratigraphic layers) on the physical landscape, that were known to contain artefacts and hominin remains, were targeted. However, the definition of landscape was challenged by people like Tilley (Tilley 1994, 2006) and Bender (2002) to include the conceptual or experienced landscape, referring to how prehistoric people perceived and interacted with space in the environment (Rossignol 1992; Bender 2002; David & Thomas 2008). Researchers started to adopt a multidisciplinary approach to the archaeological record, with the implementation of ecological, social, and cognitive notions that would have affected prehistoric people (Foley 1981). The problematisation of the term 'site' and the limitations of spatial information gained from shelters was addressed by Foley and CRM work, and a shift from a site-based to a landscape-based approach was adopted by many stone age archaeologists (Foley 1981).

Pre-historic humans occupied the broader landscape to make use of essential resources, which included food, water and raw materials for stone tool-making (Foley & Mahr 2015). The dependence on these resources is just one facet that encouraged people to spend a large portion of their lives away from shelters. Another avenue that emerged as part of the post-processual framework is the association of space as a cultural identity (David & Thomas 2008). The alteration in the perception of the term 'landscape' proved to be a breakthrough in archaeology, with a shift in the focus of research from single point sites on the map to open-air sites and surface material. These provide a valuable source of information pertaining the spatial organisation of prehistoric people as well as providing information of prehistoric landscape use in areas where there is an absence of shelters (Straus 1979; Forssman & Pargeter 2014).

A focus on landscape archaeology in South Africa was prompted by survey work coordinated by, among others, the Spatial Archaeological Research Unit (SARU) in the early 1980s and Garth Sampson's work in the Zeekoe valley. SARU, with the backing of sufficient funding, could employ archaeologists to carry out repeated surveys along the coast and interior, recording and mapping all archaeological 'sites' within a larger landscape-scale model. Using rock art surveys as a starting point, the aim of this strategy derived from the newly understood definition of 'landscape', was to demonstrate spatial patterns and understand mobility, resource use, and settlement distributions on the broader landscape (Parkington 1987). The evidence that hunter-gatherer populations could occupy areas away from cave sites and cover large distances demanded that large spatial scale analysis were to be conducted to provide a more holistic view of prehistoric landscape use behaviour (Hawkes et al. 1985; O'Connell 1997).

Multiple sites were excavated around the Verlorenvlei in the Western Cape, to gather information of landscape use in a small regional setting which would allow for a comparative analysis of the material culture. To place these excavated and recorded sites in a temporal context, sampling for radiocarbon dates at these sites were carried out, providing a more robust understanding of prehistoric landscape-use behaviour, as well as assign the artefacts to a time period.

An idea of mobile populations, or seasonal mobility, was suggested by Parkington, which encouraged a focus on landscape-scale research and alluded to the idea that prehistoric people attached meaning to specific spaces (places) on the landscape and led mobile existences (Parkington 1987). An excavated late-Holocene layer from the 1968 excavations at De Hangen Cave yielded numerous marine shell items. The location of De Hangen cave made these marine shells surprising as the cave is 70 kilometres from the nearest coastline. Implications of this discovery, suggested a relationship between coastal and interior places, later termed 'seasonal mobility' (Parkington & Poggenpoel 1971; Parkington 1972; 2001)..

The seasonal mobility model proposed by Parkington (1972), hypothesised that seasonally exploited resources occurring in the deposit from inland and coastal cave sites would express complementary signals. The coastal site of Elands Bay Cave and the Sandveld rock shelter of Diepkloof, were selected to test this hypothesis (Parkington 1972, 1980, 2001; Parkington & Poggenpoel 1987). The relative dearth of LSA deposit at Diepkloof Rock Shelter, located along the Verlorenvlei, allowed for the focus to be placed on Elands Bay Cave. The Elands Bay Cave sequence incorporates the Late Pleistocene and Holocene periods, which allowed for some comparison to the shallow sequence at De Hangen Cave (Parkington & Poggenpoel 1971; Parkington 1976, 1977, 1980, 1990; Mackay 2009). The

material excavated from the Holocene layers was taken to be a seasonal occupation of the site, strengthening Parkington's hypothesis that people were lived a mobile existence. The size and maturity of the animal remains (seal, fish and black mussels) were used to provide information regarding the exploitation periods of the cave occupants. (Parkington 1977).

Patterns of spatial distribution of sites that were recorded in the Western Cape, were integrated on a finer scale analysis through the work of Tony Manhire who analysed the smaller assemblages on the landscape (Manhire 1984). This method demonstrated that different landscape features produced a different stone tool signal, providing further evidence of distributional variability, possibly linked to how prehistoric people viewed certain spaces (Manhire 1983, 1984; Parkington 1987). The research conducted by Parkington and Manhire further emphasised the importance of analysing multiple sites in an area to acquire a well-documented spatial and temporal scale of the region, as well as a better understanding of prehistoric landscape use.

Contemporaneous to the research being carried out by SARU in the Western Cape, Sampson conducted a large-scale landscape survey in the Zeekoe (Seacow) Valley in the Karoo (Sampson 1985). Sampson's ambitious Zeekoe Valley Archaeological Project (ZVAP) was established with the aim of developing field techniques that could detect territorial boundaries based on the archaeological material left on the landscape (Sampson 1985, 1986; Sampson et al. 2015). These surveys included the recording of all open archaeological sites, revealing spatial patterns surrounding mobility and resource use by prehistoric hunter-gatherers.

Sampson's (1985) research in the Zeekoe Valley is important for adopting a landscape approach to the archaeological record, particularly to this thesis as the

methodologies implemented in Sampson's project forms a large component for the methods described in this thesis. The reasons for conducting a large landscape project in this region was, as Sampson (1985) describes it, due to knowledge of an abundance and long Stone Age sequence in the area. The repetitiveness of stratified iconic artefacts from shelters and open-air 'sites' facilitated a seriation approach, allowing the surface materials to be placed in a relative chronological framework. Iconic artefacts, such as handaxes, were not manufactured during the LSA, while bifacial points pre-date backed artefacts from the Howiesons Poort periods (Henshilwood 2012; Porraz 2013b). This redundancy in the archaeological record permitted Sampson to correlate his findings to the Orange River Valley archaeological sequence (Sampson 1972, 1985).

The Karoo geology (geologic location of the ZVAP) is not conducive in the formation of caves and rock shelters, ultimately limiting the potential for a deep stratigraphic sequence of the region to be compiled. Sites, that contained even shallow deposits, were excavated and dated, providing a relative framework of assemblage change of the region, based on radiocarbon dates. The low probability of locating sites with a deep stratigraphic context further promoted the study of surface artefacts (Sampson 1985).

The lack of stratigraphic preservation in the Karoo presented the challenge of assigning artefacts to a relative chronological framework. Although Sampson's (1985) aim was to map and analysis material at the scale of a site, he could assign assemblages from a site to a certain time period (ie. Wilton or Albany) based on the presence of distinct formal tools consistently found within those assemblages at other sites (Sampson 1972, 1985). From this, Sampson demonstrated landscape use during different periods in time. The approach implemented by Sampson does, however, describe the site from the scale of an

entire assemblage, a compound unit, rather than the scale of the individual artefact, singular unit, in which temporally distinct artefacts could be conflated into a different assemblage. Another issue with using this approach, which was noted by Sampson (1985), was in instances where there was a lack of diagnostic formal tools and the assemblage could not be assigned to a specific stratigraphic sequence. Assemblages that do not possess formal tools could be assigned to a relative (broader) time period based on the general flaking properties and the degree of patination on artefacts (Sampson 1985).

Surface material is often disregarded in archaeology as they are subjected to natural post-depositional processes, removing any provenience. Sampson (1985) dealt with this issue by noting that mixing of archaeological material by taphonomic processes in the Karoo is rare, and when it does occur it is easily recognisable based on the weathering (patination) of the artefacts (Sampson 1985). Archaeological material on the surface has the added benefit of supplementing information acquired from the excavation of caves, providing information of how prehistoric people occupied the broader landscape (Manhire 1984; Parkington 1987).

Research implemented by SARU in an area where stratigraphic preservation in shelters were available demonstrated the mobility of hunter-gatherer populations (Parkington 1972, 1980, 1987; Manhire 1984). The research of the Zeekoe Valley by Sampson (1985) was carried out on a landscape that does not support the formation of long lasting shelters, relying on the analysis of open-air sites and surface material to provide a relative age for the occupation of the area. The most influential aspect derived from these two research projects is scale. It is imperative to conduct a large-scale analysis if knowledge pertaining to landscape-use behaviour by prehistoric people is to be gained. This can only be

acquired through the analyses and comparison of material culture from shelters, open-air sites, and surface material.

Recent landscape studies in South Africa include a focus on open-air sites along the West Coast of South Africa (Kandel & Conard 2012; Braun et al. 2013; Will et al. 2013), but the work of Alex Mackay and Emily Hallinan in the Western Cape is more closely related to this thesis.

The work by Mackay in the Doring River catchment area in the Cederberg region concentrated on excavating multiple rock shelters in this area to obtain a well-documented regional scale. The excavations from the rock shelter sites of Klein Kliphuis (Mackay 2006, 2011), Klipfonteinrand (Mackay 2012), Putslaagte 8 (Mackay et al. 2015), and Mertenhof Rock Shelter (Will, Mackay & Phillips 2015) provide a relatively well resolved stratigraphic sequence for this area. As discussed in the above paragraphs, the information obtained from caves and rock shelters is limited in terms of spatial information, but they do provide the chronological framework to connect an iconic sequence.

The archaeological record of the region was further supplemented by surveys along the Doring River, resulting in excavations of sites along this watercourse (Mackay et al. 2014; Will, Mackay & Phillips 2015). As demonstrated by Sampson (1985), assemblages can be assigned to a relative chronological sequence derived from excavated sites in the area, based on the presence of iconic formal tools (Will, Mackay & Phillips 2015).

This method of analysing and providing dates for the material culture present in a catchment area is adopted from the previous work of SARU and Parkington in the Verlorenvlei catchment area. The added benefit of excavating open-air sites to tie in with

the excavated sequence, allows for larger scale analysis to be conducted and patterns about prehistoric landscape use to be theorised, modelled and tested (Mackay & Marwick 2011).

The surface archaeological material along the Olifants River in the Western Cape was recorded and analysed by Hallinan (2013). The methodologies adopted in her research was drawn from the methods applied to American CRM work (Westcott & Brandon 2000; Anderson & Smith 2003) as well as those implemented by Sampson in the Zeekoe valley (Sampson 1985), although it was explicitly driven with a focus on iconic artefacts. Hallinan's research along the Olifants River aimed to test a hypothesis formulated by Deacon (1988), with the focus on the surface archaeological material.

Deacon (1988) proposed a model for general landscape use during the periods within the South African Stone Ages. The basis for this model was, however, derived from information gathered at numerous excavated cave sites in South Africa and applied to a physical landscape context. Deacon described the landscape use of prehistoric hominins in terms of stenotopic and eurytopic adaptations (Deacon 2001), whereby landscape referred to the physical location of the archaeological material. These terms were initially used in evolutionary ecology to characterise organisms that are adapted to surviving in a limited range of environments (stenotopic), and a wide range of environments (eurytopic). He hypothesised that ESA occupation would be stenotopic, while the LSA would express a more eurytopic characteristic (Deacon 2001).

A predictive modelling framework is based on experiential knowledge of the area, whereby areas that are considered attractive (for example rivers, high points on the landscape) are targeted for search attention. This model requires a certain degree of familiarity of the area, which entailed 'featureless' areas on the landscape to be included in

the survey paths (Hallinan 2013), allowing for empirical decisions of targeting specific areas to be formulated. Distinct spatial patterns of landscape occupation were demonstrated by Hallinan in the Olifants River region, which could be replicated and applied to future work in the area. Hallinan's (2013) research determined that ESA occupation was restricted to major water courses, while the MSA sites were more widely distributed, with specific focus along rocky outcrops, whereas the people living during the LSA were less restricted and occupied a widespread area with a focus on shelters (Hallinan 2013).

An influential method administered by Hallinan along the Olifants River was one that was previously applied to the Zeekoe valley (Sampson 1985), which sought to place assemblages in a relative chronological sequence based on iconic artefacts (Sampson 1985; Hallinan 2013). Hallinan (2013) combined this with an analysis of the landscape at the scale of the individual artefact (Manhire 1984; Hallinan 2013) The efficacy of individual artefact analysis is demonstrated in Sampson's (1985), Hallinan's (2013), Hallinan and Shaw's (2015), and Mackay's (Will, Mackay & Phillips 2015) research, which exposes the temporality of the artefacts. This allows for the artefacts to be viewed in relation to one another on the landscape, an example being that one artefact is temporally older than another based on diagnostic features (Hallinan 2013). The ability to assign artefacts to a relative temporal sequence, from repetitively excavating stratified deposits, is extremely beneficial when dealing with landscape studies and areas that do not contain shelters. Assigning artefacts to a time period allows for a better understanding of prehistoric human landscape behaviour to be inferred (Isaac 1980; Foley 1981; Hallinan 2013).

The limitations pertaining to a landscape approach to the archaeological record are predominantly issues relating to scale and palimpsests/time-averaging (Bailey 2007). These concerns are present throughout the evolution of landscape archaeology, and are

effectively addressed through the application of a temporally diagnostic approach as well as analysing assemblages at the scale of the formal artefacts (Manhire 1984; Sampson 1985; Hallinan 2013). The issue of scale that is present in landscape surveys is deals with the temporality and spatial aspects of scale. The landscape contains artefacts ranging an extended period time of over a million years, from the ESA to historical times. The issue of scale has, however, become less problematic in recent years with the advancements of technologies involved in dating deposits.

Prior to this, scale was a limiting factor in South African archaeology, as sediments from an open-air context were not conducive to dating, consequently there was little temporal control for a region lacking stratified deposits from shelters. Improved dating techniques allow for open-air sites, such as sand dunes, river terraces and pans to be dated (Wilkin & Chazan 2012; Braun et al. 2013; Mackay et al. 2014; Lotter et al. 2016). Surface surveys and analysis by Manhire (1984), Sampson (1985), and Hallinan (2013) demonstrate that surface artefacts can be placed in a chronological sequence, and at a finer-scale, analysis of single artefacts can separate different phases of human occupation at an area (Hallinan & Shaw 2015).

Dealing with a large spatial scale does entail a degree of compromise in the temporal resolution of the area (Kandel 2005). Depending on the research question, a finer-scale resolution, although optimal, is not always necessary, particularly when trying to understand landscape use behaviour at the scale of the Olifants River or Tankwa Karoo (Hallinan 2013).

Analysing at the scale of the individual artefact has the potential to deal with the notion of palimpsests. A palimpsest refers to the accumulation of material culture over time

in a specific area (Bailey 2007). This will inherently influence the temporal scale of a 'site', with multiple possible occupations or uses being deflated on a single surface. The formation of assemblages in shelters and open-air contexts are both subjected to time-averaging (Stern 1994; McNabb 1998), whereby individual areas of artefact accumulation could either be a result of repeated use over a long period, or a once-off use of the area before it was rapidly buried (Stern 1994). It will therefore be difficult to infer prehistoric human behaviour at these areas, as the accumulation of artefacts may not be contemporaneous with one another.

The concern around palimpsests and time-averaging is warranted, as the effects of these processes can skew the data and provide an inaccurate view of prehistoric human behaviour. The single artefact approach aims to negate the effects of a palimpsest. By analysing at the scale of the individual artefact, we can separate the different phases of technology and place them into relative time periods (see Hallinan & Shaw 2015 for an example). This can be done through technological characteristics of the artefact (certain technologies are associated to different time periods), combined with the degree of patination of the artefact to determine relative antiquity of undiagnostic pieces (Sampson 1985; Dietl, Kandel & Conard 2005). Although Sampson (1985) was hesitant to use patina as an indication of relative age, it proved useful in assigning artefacts into a cultural-stratigraphic group (Sampson 1985).

The evolution of landscape archaeology has provided a framework of constructive criticisms on which we can build and improve the methodologies and understanding of landscape use behaviours. This thesis aims to apply the methods and techniques obtained from previous

archaeologists to surface archaeology of the Tankwa Karoo. The strategies employed in this research aim to mitigate the temporal haze that occurs in landscape archaeology, through the application of a temporally diagnostic artefact approach to the surface material being analysed. Dealing with a large spatial scale, coupled with the temporally diagnostic marker approach, artefacts can be coarsely assigned to a relative chronological framework based on repeated patterns of iconic artefacts temporal positions from excavated sequences in the region. The concept that the landscape is viewed in relation to itself, allows for inferences to be formulated concerning the chronological order of the surface material, for example, one artefact is older than another.

Landscape archaeology is a multidisciplinary approach to understanding the interaction of prehistoric people and the landscape - on a physical, social, cultural and economic level (Torrence 1989; Ashmore & Knapp 1990; Anschuetz, Wilshusen & Scheick 2001; David & Thomas 2008). It is imperative to the approach of landscape archaeology that sites of all contexts are considered, which include shelters, open-air sites, and surface material. The popularity in the use of the term 'landscape archaeology' in the archaeological literature increased from the 1980s, attributed to the change in the perception of a 'landscape' (David & Thomas 2008). Their argument states that firstly, the interpretation of the word landscape was not restricted to only describing the physical environment. Secondly, prehistoric humans were not only adapted to environmental conditions, but were affected by social processes as well (social landscape). Lastly, the movement to a post-processual approach to archaeology, viewing space on the landscape as a cultural identity (Parkington 1980; Fleming 2006; David & Thomas 2008).

The importance of understanding the history of landscape archaeology or a landscape approach to the archaeological record, encourages growth within the discipline,

with the application of new techniques based on the fundamental foundational work laid out by former archaeologists. Post-processual archaeology, need not be viewed as an anti-processual model that replaces this framework (Flemming 2006), but rather the emphasis should be on selecting features from both processual and post-processual frameworks, which can be adopted and coherently applied to the archaeological record, to further strengthen the discipline.

Chapter 4: Study area – The Bos River, Tankwa Karoo

The Tankwa Karoo region is situated in the Northern Cape Province of South Africa. It is characterised as a flat landscape, bordered by the Cederberg Mountains to the west and the Roggeveld Mountains to the east (Figure 4.1). The Bos River itself is very ephemeral with little-to-no water observed in it during this fieldwork, even following winter rains. The same can be said for the slightly more prominent Tankwa River located to the south of the Bos River, which flows episodically.

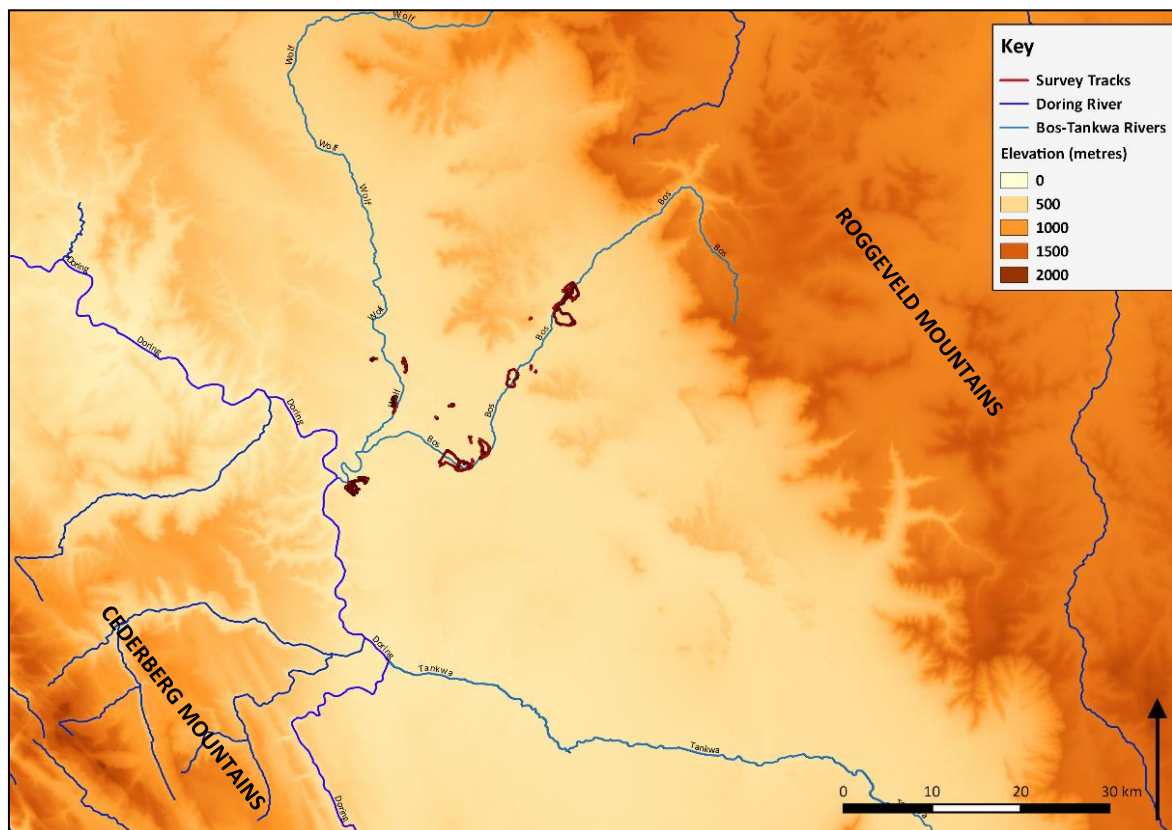


Fig 4.1 Elevation of the Bos River and survey tracks in relation to the Roggeveld Mountains to the east and the Cederberg Mountains to the west.

As for a more significant water source, the Bos River and Tankwa River are both tributaries of the Doring River to the west. This river is classified as a perennial river, although its water levels are highly seasonal. The Doring River forms part of the Olifants/Doring River system of the Western Cape, which has attracted landscape-scale research because of the abundance of archaeological material that has been discarded in these more resource rich areas (Hallinan 2013; Mackay et al. 2014). There is an absence of archaeological research/evidence in the rain shadow of the Cederberg, making the geographical location of the Tankwa Karoo interesting as a comparative case. Although the Tankwa Karoo is not located in the central regions of South Africa, it does, however, offer useful information regarding a dry marginal archaeological signal.

The Bos River is predominantly characterised by a wide floodplain, suggesting a low energy episodic system. In the section of the river nearer to its confluence with the Doring River, it is forced into a narrow channel by prominent quartzite outcrops. The landscape away from the alluvium can be regarded as relatively stable since artefacts frequently lie either directly on bedrock or on a single deflated 'desert pavement' surface. The effect of rainfall patterns, vegetation and raw material availability are all factors that influence the attractiveness of these arid areas to prehistoric people.

4.1 Rainfall

The Tankwa Karoo is classified as a semi-desert environment, with present-day annual rainfall ranging between 100 mm and 150 mm. It is situated on the boundary of the winter and year-round rainfall zones (WRZ and YRZ respectively), although strictly the Bos River falls marginally within the WRZ region based on the description by Chase & Meadows

(2007). The rainfall records kept by the local farmers along the Bos River, demonstrate that sixty percent of the annual precipitation falls in winter, predominantly supplied by the runoff from the Roggeveld Mountain. The area is also characterised by short intense periods of rain, which collects on the flat landscape for a limited period of time (Figure 4.2).

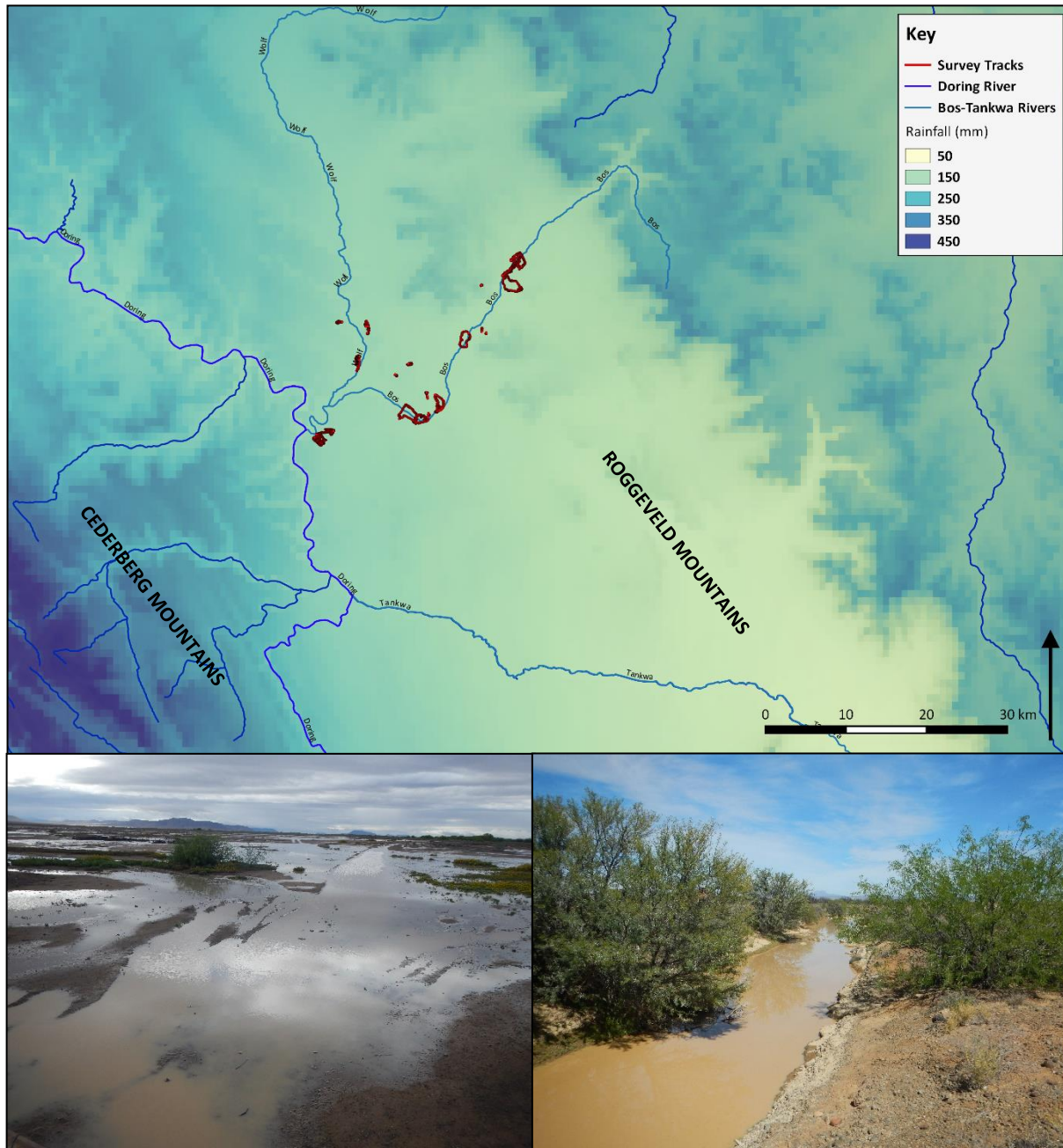


Fig 4.2 Annual Rainfall (mm) in the Tankwa Karoo and surrounding areas (top), the two pictures below demonstrate the Bos River landscape after an hour of rain (left) and a section of the Bos River that contains water (right).

Rainfall in this area is affected by orographic effects of the Roggeveld Mountains that border the Tankwa Karoo to the east, with little influence from the Cederberg Mountains. From this we can infer that the Tankwa Karoo would always have been more arid than the neighbouring Cederberg and Roggeveld areas in prehistoric times.

A study conducted by Peterson (2015) looking at the vegetation changes in the Tankwa Karoo, suggests that there has been no significant change in the total annual rainfall over the past fifty-five to ninety-nine years. Rainfall data for the nearby towns of Calvinia, Ceres and Sutherland over the period 1911 – 2010 were used. However, the climate and environment are likely to have fluctuated on a greater temporal scale throughout the Pleistocene, which makes this area interesting in terms of it being a marginal option to the better watered Cederberg and Roggeveld regions.

4.2 Vegetation

The study area incorporates both the Succulent Karoo and Fynbos biomes (Figure 4.3) (van der Merwe et al. 2008), characterised by succulents and a general sparsity in plant cover (Rubin 1998; Mucina et al. 2006). The Succulent Karoo contains a variety of geophytes that provide substantial nutrients to animals and potentially humans that consume them. Evidence based on historical photographs suggests an overall increase in grasses, shrubs, and (alien) trees over the past hundred years, particularly in the drainage basins, and presumably the result of human interference (Peterson 2015). Unfortunately, no palaeoenvironmental studies have been conducted in this area as of yet.

There has, however, been extensive pollen analysis conducted on rock hyrax middens from the Cederberg, research that provides useful information concerning the past environment of the neighbouring Tankwa basin (Scott, Marais & Brook 2004; Chase 2010).

These middens have been reported to extend as far back as 50 000 years ago, possibly further (Chase & Meadows 2007; Scott & Woodborne 2007a, 2007b), as far as and beyond the transition between the MSA and LSA.

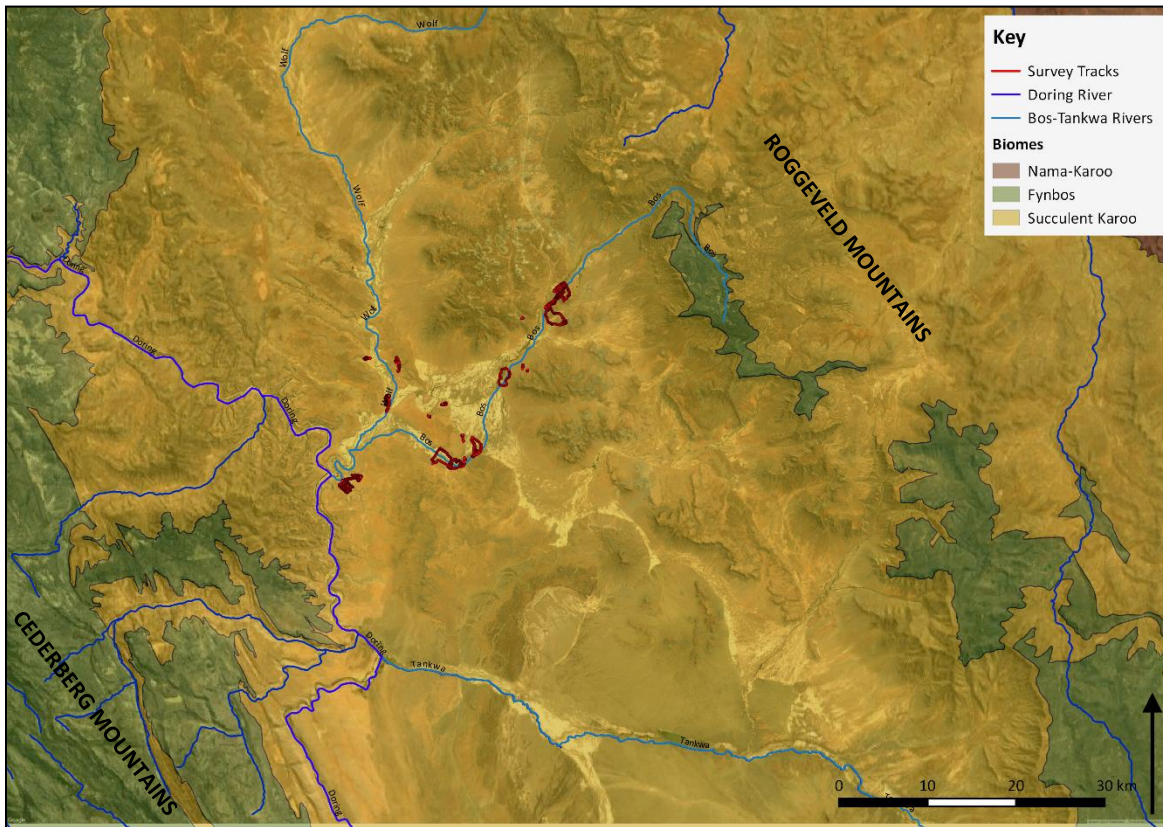


Fig 4.3 The two main vegetation biomes in the Tankwa Karoo, the Fynbos and Succulent Karoo. The Nama-Karoo biome begins to the east of the Bos River on the plateau.

Information regarding the palaeoenvironment from rock hyrax middens in the Cederberg does not provide explicit evidence for the past environment of the Tankwa Karoo, but through the comparison between the modern environmental conditions of the Cederberg and the Tankwa Karoo, we can infer that the Tankwa region would have been drier than the Cederberg throughout the Stone Age.

Field observations from this Tankwa Karoo study revealed that during and following the winter rains there is a visible increase in flora, attracting animals and people. Current

farmer's and prehistoric pastoralists' migration strategies sought to exploit this low lying flat area during winter, and occupy the adjacent mountains during the summer months due to an increase in the availability of water (Smith & Ripp 1978).

4.3 Geology and raw materials

The geology of the region is significant for archaeological work as it dictates the topography and soil conditions – which affect drainage and vegetation – and the availability of stone raw materials to past human group for tool-making. The area under study encompasses Cape Supergroup geology in the west, which is characterised by quartzitic sandstones, and the shale-based Karoo Supergroup geology in the east, with glacial tillites and intrusive dolerite dykes and sills (Figure 4.4). Unlike the vegetation and rainfall which can fluctuate over short time periods, the geology of an area remains stable, which in turn implies that raw material sources would be relatively constant through the time period covered by this study.

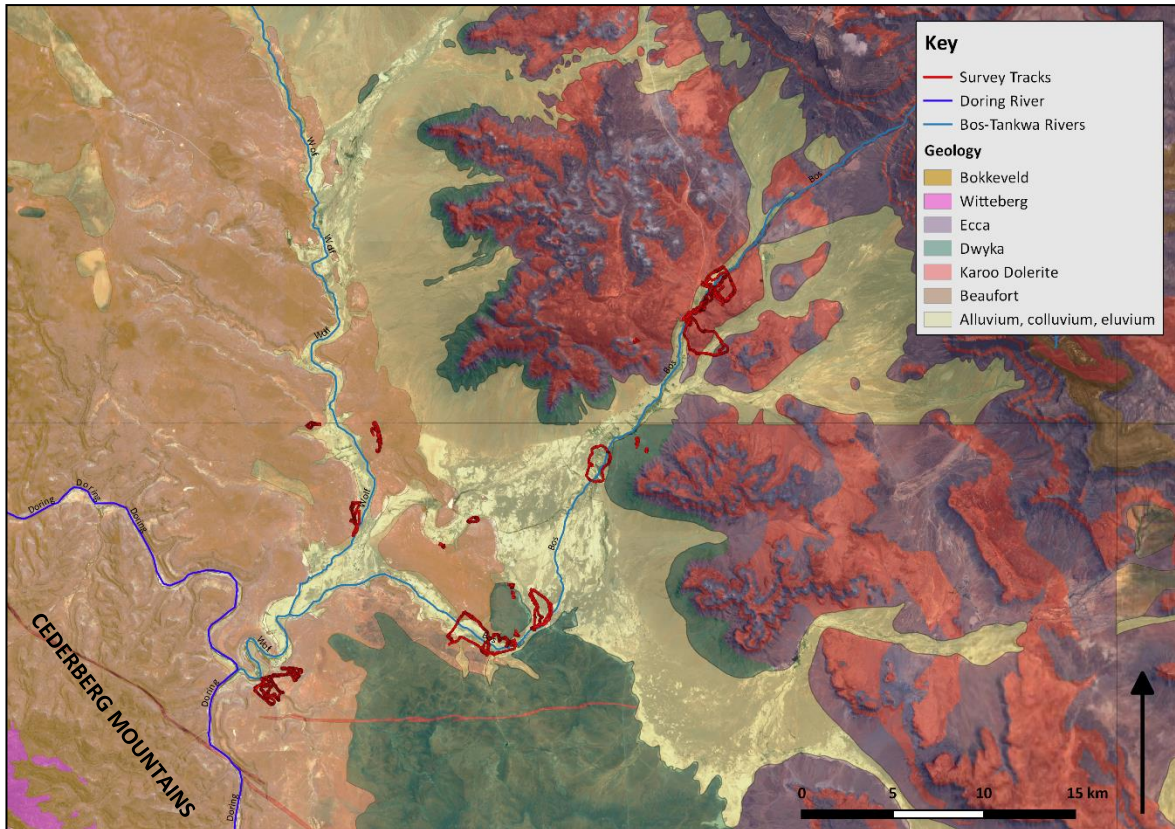


Fig 4.4 The Bos River in relation to the different geologic areas, which incorporates both Cape and Karoo geologies.

4.3.1 Cape Supergroup

The Cape Supergroup is comprised of three main groups, namely the Table Mountain Sandstone group deposited first, followed by the Bokkeveld Group, and finally the Witteberg Group. The two groups of relevance are the Bokkeveld and Witteberg groups. The Bokkeveld Group consists of interbedded layers of quartz-rich sandstone, mudstone and shales, while the Witteberg Group has a more sandy nature than the Bokkeveld Group (McCarthy & Rubidge 2005; Hodgson 2009).

The Witteberg Group forms the uppermost layer of the Cape Supergroup, truncated by the Dwyka Formation of the Karoo Supergroup. The quartzite and shale geologies form a topographically complex landscape of steeply incised river valleys that erode to form

shallow caves and rock shelters. The presence of these shallow overhangs makes attractive locations for prehistoric people, as it provides a place of suitable habitation. These shelters also offer the opportunity rock surfaces that could be used as canvasses for rock painting. The study area overlaps with both of these groups, allowing the tool-makers access to the raw materials present on the geology. The fracture properties of quartz and quartzitic rocks of the Cape Supergroup were exploited in the manufacture of artefacts by past humans, as they provided a sharp and durable edge.

4.3.2 Karoo Supergroup

The Karoo landscape is composed of rock-strewn plains with raised flat-topped ridges and conical inselbergs (koppies). Five groups make up the Karoo Supergroup, although only the three oldest groups are relevant to this project – the Dwyka, Ecca and Beaufort groups. The study area does not overlap with the Beaufort group, but because of its close proximity to the study area it has it included. The other two groups, Stormberg and Drakensberg, occur to the east well outside the study area.

The sediments that form the glaciogenic Dwyka (Tillite) group were deposited into a depression (Karoo Sea) as a result of glaciers melting and retreating (McCarthy & Rubidge 2005, Hodgson 2009). The Dwyka diamictite (mud containing dropstones/glacial erratics) is characterised as being poorly sorted, due to the large rock fragments and mud that were deposited into the inland sea by melting glaciers. Dwyka outcrops along the margins of the Karoo basin, and in certain examples, the transported and rolled dropstones in the diamictite appear to have been flaked. These dropstones seem to be crypto-crystalline in structure, which is a property favourable in the manufacture of stone tools.

The overlying Ecca Group shales indirectly played a more significant role in tool-making than the Dwyka group. The heat from the intrusive dolerite dykes found in the area indurated and metamorphosed the surrounding rock, causing the formation of hornfels. Hornfels was a more preferred raw material in the manufacture of stone artefacts, due to its flaking properties. The three properties of stones required to create stone tools are: brittle and elastic, which allow for rocks to be knapped to produce sharp edges; isotropic/uniform in nature to allow for the force to travel through the raw material producing predictable conchoidal fractures; and cryptocrystalline or fine-grained in structure.

Another raw material conducive to knapping, is chert. The Matjiesfontein chert band forms part of the Collingham Formation of the Ecca Group. This half a metre-thick band outcrops in the southwestern Karoo outside of the current study area. The exploitation and manufacture of artefacts from this chert band has been recorded, and may potentially be a significant source of the chert found in archaeological contexts in the Cederberg (Almond 2009, Tusenuis 2013, 2015).

The Beaufort Group can be seen in the Roggeveld Mountains. This group consists predominantly of sandstones and shales and rises steeply in the eastern boundary of the Tankwa Karoo. The relationship between the Roggeveld and Cederberg Mountains was historically significant during periods when precolonial and later colonial pastoralists moved their sheep from the mountains to the Tankwa Karoo plains to exploit the grasses during the winter months (Smith & Ripp 1978).

The geology and distribution of raw materials would have changed very little over Pleistocene time, which makes understanding the geological composition of the survey and surrounding areas important. The presence of artefacts made from local and non-local raw

materials, allow for inferences to be made with regards to raw material transport and procurement strategies employed.

The terms 'local' and 'non-local', as well as 'primary' and 'secondary' raw materials have certain implications pertaining to foraging strategies, for example indicating foraging range, trade or procurement forays (Minichillo 2006). Two key definitions pertinent to this debate is the primary and secondary contexts of rocks. The primary context of raw materials refers to the specific place of formation, whereas raw materials that have been transported through natural processes (fluvial activity) will be in a secondary context. Local raw materials are relative to a particular site or area, occurring in either a primary or secondary context. The formation of hornfels occurs on the Karoo geology through the induration of shale by the heat from intrusive dolerite dykes. The location of hornfels outcrops on the Ecca Formation in the Karoo would be described as being a primary context, and considered a local raw material for the occupants of that area. However, as is the case in the archaeological record, hornfels outcrops erode, are then transported through fluvial activity, and deposited in other areas as cobbles. Although the raw material is in a secondary context, it becomes local to the area in which it was deposited.

The definition of the term 'non-local' raw materials is more problematic and is variable among archaeologists (Porráz et al. 2013b). According to Kelly's 'The Foraging Spectrum' (1995), non-local raw materials refer to the materials that occur outside of the average foraging range of hunter-gatherers. The issue of defining the distance of a foraging range, however, has encouraged much debate (Minichillo 2006, Ambrose 2001, 2006). The boundaries of a foraging range are dependent on the people and the environment. Minichillo (2006) uses a range of greater than twenty-five or fifty kilometres to delimit local from non-local, while Ambrose (2001, 2006) suggests a range in excess of forty kilometres to

demarcate a foraging range. The boundary limits described by Ambrose (2001, 2006) were derived from ethnographic evidence from hunter-gatherers in Australia (from Gould and Saggers 1985 in Ambrose 2006).

The study area overlaps both the Karoo and Cape Supergroups, providing a variety of raw materials that exhibit positive flaking properties. The favoured raw materials from the Cape geology used in the manufacture of stone tools are quartzite, quartz and silcrete, whereas the dominate raw materials used from the Karoo geology consist mainly of indurated shales (hornfels) and CCS (crypto-crystalline silica), although glacial tillites can introduce different raw materials.

Although this area is considered a semi-desert, rainfall collects on the lands, and following the winter months, the bare alluvial floodplains of the Tankwa Karoo are covered by grasses, geophytes and forbs. The occupation of the Tankwa Karoo plains by indigenous prehistoric pastoralists (Khoe) during the winter months (the period when this area receives most of its rain), followed by the migration to the mountains during summer due to the availability of water, suggests that the lack of water in this region is not a deterring factor for those willing to adopt opportunistic strategies (Smith & Ripp 1978).

Prehistoric people occupying the Cederberg would have had access to more predictable and secure resources in the form of water, raw materials, and shelters. The challenge that exists in surveying along and around the Bos River is to formulate and apply an approach that would allow for a comparison to be made between the Cederberg and the Tankwa Karoo.

Although the Tankwa Karoo is known to have been used episodically during the winter months by indigenous herders for their livestock to pasture in the grasses produced by the winter rains (Smith & Ripp 1978), the extent of seasonal occupation during the Stone Ages is not yet known. The location of the Bos River on the boundary of two different geological formations, the Cape and Karoo Supergroups, provides an opportunity to compare the archaeology along the Bos River to the archaeology described from the better studied neighbouring Cederberg (Cape geology). Historically, the Tankwa Karoo has been seasonally exploited by pastoralists migrating between the flat plains and the adjacent mountain ranges. The flow patterns and low energy system of the Bos River coupled with the rainfall and pastoralist migration patterns, suggest that the Tankwa Karoo would be episodically attractive during more intense periods of rainfall. In order to investigate this idea, a set of appropriate methods are needed, which will be describe in the following chapter.

Chapter 5: Methods

This chapter describes the development of methods to be applied to both the fieldwork and the post-fieldwork components of the project. The aim is to understand human behaviour at a landscape scale through the study and analysis of the lithic material along the Bos River in the Tankwa Karoo (as described in Chapter 1). A two-step approach was adopted. The first consisted of an initial survey along the Bos River, followed by the analysis of the artefacts that were photographically recorded along with their respective co-ordinates. Combining the information gathered from fieldwork observations (geology, topography, hydrology, vegetation) with the lithic analysis, allows for a more in-depth view of the understudied and marginal desert area of the Tankwa Karoo. An 'off-site' (Foley 1981) and 'scatter between the patches' (Isaac 1981) approach serves as the foundational framework, furthered by analysing the topographic landscape at the scale of the individual artefact.

5.1 Project setup – choosing a location

The initial phase was to identify a potential area as a focal point for this project (Plog, Plog & Wait 1978). The following three criteria collectively formed the basis in deciding on the Bos River in the Tankwa Karoo as a suitable area:

(a) The first requirement was to locate an area that has a well-studied neighbouring region that could be used for comparative purposes. The high density of archaeological material found in South Africa has attracted numerous researchers, and prompted copious

amounts of research along the coastal (Parkington 1976; Volman 1981; Henshilwood et al. 2001; Marean et al. 2004) and interior regions (Parkington & Poggenpoel 1971; Hogberg & Larsson 2011; Mackay et al. 2014, 2015; Will, Mackay & Phillips 2015) of the south-western parts of southern Africa. This has provided a robust understanding of human prehistory in this region of South Africa. In particular, the well-stratified archaeology of the Cederberg has been reasonably documented and published in both landscape and site specific studies (Parkington & Poggenpoel 1971; Hallinan 2013; Mackay et al. 2014, 2015). The Cederberg, therefore, provides a useful starting point and proxy for comparison to areas in close proximity.

(b) The second criterion was to locate an area that has been subjected to little or no archaeological work, which could contribute new evidence to understanding prehistoric landscape use. A preference towards research focusing on rock shelters sites is understandable as it provides temporal stratified information for the region, although on the downside, it offers a narrow perspective on the broader questions around the relationship between humans and the environment (Kandel & Conard 2012). With the focus being on these closed sites, there are more opportunities for large scale research projects looking at surface scatters and open-air sites. The South African Heritage Resources Information System (SAHRIS) implemented by South African Heritage Resources Agency (SAHRA), is an easily accessible online inventory, which provides a spatial representation and identification of recorded sites in South Africa, as well as the associated archaeology. Possible areas of interest that have not been subjected to in-depth research could be found using this system.

(c) The final criterion was to locate an area around a relatively significant water drainage system as water is a constraining feature, and serves as a centripetal force for humans and animals (both modern and prehistoric). The Bos river is considered a significant river because it runs through a marginal desert region, although it substantially less prominent than the Doring and Olifants Rivers to the west (Hallinan 2013; Mackay 2009; Will, Mackay & Phillips 2015) and the springs in the Zeekoe valley approximately 500 km to the east (Sampson 1974). The archaeological material from the Zeekoe valley is beneficial to the material recorded along the Bos River as the it is located on an arid erosional landscape in Karoo geology, comparable to the Tankwa Karoo.

The intention of these criteria was to define an innovative project that might contribute to the general understanding of landscape archaeology in southern Africa. Using the above conditions, coupled with techniques allowed by Geographic Information Systems (the use of Google Earth to generate satellite imagery), narrowed down the area to the Bos River in the Tankwa Karoo. The location of this area was geologically interesting as it incorporated two different geologies and serves as a relatively significant water source in a semi-desert environment. The marginality of the Tankwa Karoo is expressed in its opportunistic attractiveness to people, characterised by episodic migratory (people and animals) and rainfall patterns. Other landscape-based studies are conducted in areas with higher precipitation than that of the Bos River (Kandel & Conard 2011; Hallinan 2013), making it an interesting comparative for other studies in the south-western part of southern Africa.

5.2 Fieldwork

Following the methodologies implemented by Hallinan (2013) in her study of the Olifants River Valley in the Western Cape, the optimal strategy for effectively and efficiently obtaining information would be to conduct surveys on foot. The feasibility of a walk down survey was further encouraged by a preliminary visit to the study area.

5.2.1. Survey methods

The fieldwork component entailed a total of twenty-one survey days over three non-consecutive weeks, carried out by groups of two to three qualified archaeologists. The strategy for the surveys was to hike in two teams across the landscape along roughly predetermined routes. Potential survey paths were identified using GIS and aerial photography, with the focus being on visibly distinct (topographic) features - the primary feature being the Bos River itself. These routes would include sampling from areas on the Cape geology, Karoo geology, and areas where the Karoo geology grades into the Cape geology. The different geological areas provided people in the past with access to different raw materials and different topographic landscapes.

The history and geology of the Tankwa Karoo dictates its gentle undulating topographic landscape, which makes the presence of certain favourable features on the landscape nearly non-existent. These landscape features not only include physical points on the landscape such as shelters and high-lying areas which may have been used as vantage points (Hallinan 2013), but landscape also incorporates the conceptual construct of a landscape, meaning that the idea of landscape is fluid and that the notion of space on the

landscape is constantly being shaped and reshaped over time (Parkington 1980; Bender 2002). The perceived significance of space could perhaps lead to preferred and repetitive use of a specific area.

The intention to start on the western extent of the study area was motivated by the familiarity offered by the geology, archaeology and climate of the nearby Cederberg region. (Chase & Meadows 2007; Hallinan 2013; Mackay et al. 2014). Access to the land adjacent to the Dooring River was not possible for the first survey trip, which redirected the starting higher up the Bos River.

The natural terrain of the landscape around the Bos River is complex, particularly due to the large erosional floodplains and farmed areas, which does not facilitate a probabilistic sampling technique using a grid-like survey method (Kandel & Conard 2012). The constraints of the topographic features encompassed in the survey area, combined with the specific research question, allowed for a more flexible survey method to be implemented (Hallinan 2013), which was originally applied in a South African context to the research in the Zeekoe valley by Sampson (1985).

Based on prior knowledge and experiential learning in the adjacent Cederberg area, a judgement-based strategy (David & Thomas 2008) could be adopted to test if similar patterns of occupation existed along the Bos River. Commonly referred to as predictive modelling, this strategy is formulated on the premise that certain topographical features, more than others, would have attracted prehistoric people (Sampson 1985). The application of this model is used to project known patterns from relatively well-studied areas, onto unknown areas (Westcott & Brandon 2000; Anderson & Smith 2003; David & Thomas 2008;

Balla et al. 2014). This flexible judgement-based model that targets specific areas on the landscape is applied to professional archaeological contract work, particularly in America (Kvamme 1992; David & Thomas 2008).

Predictive modelling (David & Thomas 2008) can be adopted for the Tankwa Karoo because of the information derived and published from the Zeekoe valley and neighbouring Cederberg Mountains (Sampson 1985; Hallinan 2013). Hallinan's research (2013) in the Cederberg demonstrated, for example, topographical features such as rocky outcrops and high-lying areas overlooking rivers and floodplains had a greater potential for artefact scatters. Because targeting specific areas on the landscape will create biases, the implementation of a predictive model should rather be used to supplement and guide surveys methods. Incorporating areas that fall outside of this model, 'featureless' or 'negative' areas, will allow for a stronger correlation between prehistoric people and landscape-use to be inferred (Hallinan 2013).

Using the river as the focal point, surveyors were able walk in transects relative to this topographical feature. Surveys were conducted in two teams several meters apart from one another, with one team focused near the floodplain, while the other team covered areas away from the river or on higher-lying ridges. As a result, this technique allows surveyors to radiate from the river, and create perpendicular survey paths across featureless sections of the landscape.

Each team of surveyors was required to carry a hand-held GPS device (Garmin EtrexH) with an optimal accuracy of three meters and recording points every thirty seconds. This provided information about artefact distribution with regards to areas that were surveyed but contained no artefacts.

5.2.2 Recording methods – artefacts

Artefacts, which include flaked stone and other anthropogenically-altered materials (ostrich eggshells, pottery, glass, iron), were recorded in the field on laminated graph paper with the aid of GPS-enabled cameras (Nikon CoolPix AW100 GPS cameras). This provided further integrity to the location of the artefacts, when combined with the spatial information obtained from the handheld GPS units. All artefacts were photographed, which included background scatter (fragments and chunks of stone artefacts), undiagnostic pieces, and iconic artefacts (referred to as temporally diagnostic artefacts discussed later in this chapter).

The ventral and dorsal surfaces of each artefact was photographed, with additional profiles being photographed where needed. These included any diagnostic features such as faceted platforms, retouch, and side profiles of the artefacts. Once photographed the artefacts were placed back and left *in situ*. This recording method allowed for the focus to be on the individual artefact, viewing the landscape in its entirety (Dunnell & Dancey 1983), moving away from the notion of ‘sites’ (Foley 1981) and the preconceptions that are attached to the word site (Hallinan 2013).

Iconic artefacts

Iconic artefacts, sample squares for dense scatters (more than twenty artefacts), and non-local raw materials were given preference in terms of GPS waypoints, to provide a marginally more accurate position of the artefacts than provided by the cameras.

A large portion of the surface archaeological materials are difficult to situate in a chronological framework, resulting in a reliance on time sensitive or temporally diagnostic artefacts to provide a relative time period of the area and assemblage (Parkington 1980; Sampson 1985; Hallinan 2013). These artefacts occur throughout the Stone Age, and include artefacts such as handaxes from the ESA, bifacial points and backed artefacts from the MSA, bladelet cores and distinctive scrapers from the LSA, and pottery for periods post-dating 2 ka, which have been continuously and stratigraphically associated with datable deposits elsewhere in the region (Hogberg & Larsson 2011; Mackay et al. 2014; Will, Mackay & Phillips 2015). Adopting this methodological approach to the surface record has proved successful in revealing spatial patterns of prehistoric people (Sampson 1985; Hallinan 2013), but does not explain if and why variation exists within and between these patterns (Parkington 1993).

Raw materials

The availability and quality of raw materials play an important role in understanding the durability of prehistoric people and how they were adapting to the environment. The attractiveness of an area is not limited to the availability of rocks used in the manufacture of stone artefacts, however, these raw materials are present on the landscape as they preserve better than organic material.

The occurrence of non-local raw material (see chapter 4) has implications for understanding mobility and procurement strategies (Mackay 2009). Silcrete, in particular, falls into this category as it is a non-local raw material, with the greatest distance from a known raw material source to discarded artefacts along the Bos River being approximately

20 km. To map the distribution and extent of silcrete, all the silcrete artefacts (including chunks and shatter) were recorded using GPS waypoints.

High density areas

In areas where artefact density was high (more than twenty artefacts in one square meter), particularly in LSA assemblages along the face of mountains, a sample square was utilised, specifically targeting areas of peak density. In one instance, two dense artefact scatters were identified and sampled. Temporally diagnostic artefacts were still recorded to provide a relative temporal scale, but were further supplemented with the information gathered from this one meter by one meter sampling method. The benefit of adopting this technique was that it provided a good representative sample of the technology found in the relevant location. An added advantage of using this technique was to reduce the time spent recording artefacts in relation to the information that would be gained (Hallinan 2013). The effects of carrying out a sample square method does not negatively impact the spatial distribution of occupational use around the Bos River. If smaller scatters of artefacts were found, the normal protocol of recording all artefacts was followed.

The focus on recording of iconic artefacts and non-local raw materials was motivated by the important information that they contain in terms of answering questions about mobility and landscape use. Although all artefacts were photographed, the prioritised recording on these

two specific categories were described in more depth during the analysis of all the recorded artefacts.

5.3 Post-fieldwork analysis

The post-fieldwork stage focused around the transformation of the raw data, that was gained from the initial surveys, into a visual representation of spatial information in the study area.

5.3.1. Extraction of data

The co-ordinates recorded on the GPS were extracted using EasyGPS software, while the embedded location data obtained via the photographs were extracted using BR's EXIFextracter and saved as a comma-separated value (CSV) file. These sets of information were imported into Quantum GIS (QGIS v.2.12.3) software to allow for spatial analysis. The longitude and latitude values retrieved from the survey logs on the GPS units were recorded as single points. Through a QGIS plugin (MMQGIS), the point data plotted from the GPS units was transformed into line data, which presents a more visually informative depiction of the survey area.

Plotting the information as line data provides an added benefit of locating errors in GPS points. In instances where there were errors in the GPS points (points obscured and 'thrown' to incorrect locations), the log files were consulted and the incorrect points were deleted. The removal of these erroneous points provide a more accurate depiction of the paths, without compromising the integrity of the information. GPS coordinates were not always recorded by the cameras, and in such cases, the handheld GPS unit was consulted

and a set of coordinates (from the handheld) could be assigned to the photograph based on the time and date of photograph and log files.

5.3.2. E4 – data entry program

Prior to plotting the location information acquired from the GPS cameras, the photographs of the artefacts were first analysed and recorded using E4, a data entry program. Through the utilisation of configuration files that are written by the user, this program allows data to be entered more efficiently, and decreases the chance of errors. As stated above, the configuration files are written by the user which allows for the focus to be on specific variables relevant to the research questions.

The efficiency of recording artefacts through this program results from being able to create conditions. These conditions enable certain variables/fields to be bypassed depending on the values entered in the preceding variables/fields. For example, if a 'core' is selected, then variables specifically applicable to that artefact will be displayed sequentially, while other variables are skipped. This program automatically creates a Microsoft Access Database (.mdp file) from the configuration file. The file can then be exported to Microsoft Excel (or other programs) and saved as a CSV file for use in GIS programs.

5.3.3. Initial analysis of artefacts

All photographed artefacts were analysed according to multiple qualitative morphological traits. Each artefact was allocated a number, starting arbitrarily at one and increasing sequentially. The photograph numbers, date and time pertaining to an individual artefact was included in the list of variables under the unique artefact number. Each individual

artefact analysed was then assigned a single set of co-ordinates (from the photograph or GPS unit). These points, once plotted in QGIS, not only provided the necessary provenience of each artefact, but also included all the analysed data attached to the co-ordinates.

Through the manipulation of the data in QGIS, favourable variables (eg: flake morphology, raw material etc.) could be selected to display spatial distribution. The combination of GPS data from both the cameras and GPS units provided a visual analysis of the data, looking at the artefact distribution and frequency of artefacts relative to the distance surveyed.

5.3.4. Technological organisation of artefacts

The employment of different technological strategies is a response to different stresses imposed on the prehistoric toolmaker, whether it is raw material availability or the intended purpose of a foray. The importance of raw materials in the manufacture of artefacts by stone age people is not only reflected in the spatial patterns of artefact distributions, but also in the technological organisation of assemblages and artefacts (Mackay & Marwick 2011; Torrence 1989; Shott 1989). A combination of the technological analysis of all photographed artefacts with artefact distributions provided a spatial representation of where specific technological strategies were employed on the physical landscape, which then has the possibility of being translated into understanding the conceptual landscape.

Besides following the previously mentioned survey methods (photographing artefacts and laying a down a grid), a conceptual framework or method, such as technological organisation of artefacts, was also needed for understanding certain behaviours. The implementation of a specific technological strategy is influenced by several factors including resources on the landscape, purpose or function of an activity, as well as

the cost-to-benefit returns of the different technological strategies (Mackay & Marwick 2011; Torrence 1989, Ugan et al. 2003). Optimal foraging models have been implemented to understand and quantify the multiple factors that would have affected and encouraged different technological strategies. Research conducted by Binford (1977, 1978, 1979) suggested that the technological organisation of tools and assemblages was embedded in a mobility framework (Binford 1979; Kuhn 1994). Through his anthropological research on an Inuit hunter-gatherer group, Binford described two distinct technological strategies that could explain the variation between assemblages; namely an expedient (situational) and curated (planned) technology (Binford 1979, 1980). Curated technologies are understood to require a large investment of time and energy to produce and maintain the stone tools when they blunt or break, whereas expedient technologies require a minimal input of energy and are discarded and replaced readily (Binford 1979; Torrence 1989; Ugan et al. 2003).

In areas where resources were predictable, artefacts were created in 'down times' (Torrence 1989) and cached at a specific area for future use, commonly referred to as place provisioning (Kuhn 1992). In contrast to this, individual provisioning was adopted in areas where the predictability and availability of resources were uncertain, as a way to minimise the risk of not being prepared (Kuhn 1992; Torrence 1989; Bousman 2005). A contrast is made between technological expediency and opportunistic behaviour (Nelson 1991). It is argued that although an expedient strategy is employed as a result of an unexpected situation (for example, a random encounter with a carcass or animals while searching for other resources), provisions were implemented prior to the foray to deal with such encounters, specifically through place provisioning (Binford 1978; Kuhn 1992, 1994).

The maintainability and reliability strategies implemented in artefact manufacture are not synonymous with one another and will often result in different types of tools being produced (Bleed 1986; Nelson 1991). Artefacts that form part of a reliable system will be manufactured by specialists and occur in predictable environments where the use and maintenance occur at different times (Bleed 1986; Nelson 1991). A maintainable system is imperative in unpredictable environments as the artefacts are generally portable and the repair and maintenance of the artefact need to be efficient (Bleed 1986; Nelson 1991).

Bifacial tool technology, which include examples of handaxes and bifacial points, is characterised as a maintainable system. Bifacial technology incorporates a high-investment system, suggesting that these tools were not readily discarded, but rather maintained and curated. Bifacial artefacts have the potential to be long-use items due to their durable edge and large volume, which allows for the artefact to be used as a core in unpredictable environments (Kelly 1988; Shott 1989).

Examples of artefacts that fall under a reliable system include blades and backed artefacts. The manufacturing of multiple well-designed and redundant components is put in place to reduce the risk of tool failure, for example the hafting of numerous backed artefacts in case one fails (Kelly 1988; Igreja & Porraz 2013). The technological organisation of artefacts are largely influenced by environmental conditions and the activities undertaken by the manufacturers of the stone tools.

This step in the methodological process involved the amalgamation of the coordinate data with the information gathered from analysing the artefacts. The aim is to present visually the spatial distribution of specific artefacts types (cores, blades, points) and time periods in

the study area. In doing so, certain analysed traits can be viewed independently which allows for a finer-scale approach of landscape use, as well as offer possible reasons for the distribution of artefacts based on their technology and the landscape.

5.4 Artefact categories

The variables that were selected for this analysis look to answer questions pertaining to the occupation and adaptation of people to the Tankwa Karoo. These questions tend to rely more heavily on the analysis of qualitative information rather than the quantitative information, for example raw material type and dorsal scar patterns. Artefact dimensions did not form part of this analysis, but these measurements can be determined from the photographs. There is a broad range of variables used in this analysis, although, some variables are not imperative to the aim of this thesis, but were recorded with the intention of future analytical work.

All artefacts spanning across the Earlier to the Later Stone Age were recorded and analysed. Artefacts or structures belonging to historical times were also recorded, but no further analysis was conducted on them. The classification and definitions of the ESA, MSA and LSA artefacts were derived from key papers by Volman (1981), Deacon (1984), and Inizan et al. (1999).

5.4.1 Non-iconic artefacts

Common artefacts that are produced during the manufacture and discard stage of knapping include basic cores, flakes and chunks. Artefacts that were easily categorised as one of the

aforementioned non-iconic classes (core, flake, chunk/shatter), could be placed into their relative time periods of the ESA, MSA and LSA, based on their association with the broader assemblage, general characteristics, and natural patina of the stone (Sampson 1985; Hallinan 2013).

Chunks/shatter

Artefacts classified as chunks/shatter are undiagnostic artefacts consisting of evidence of flake scars with no initiation points or clear ventral surface. Other examples include pieces broken off from cores.

Flake

Flakes are a result of striking a core through percussive force. They display positive features associated with this force – a striking platform, a ventral surface, and a bulb of percussion. Included in this category are flake fragments, proximal-, medial-, and distal flakes.

Core

Artefacts with at least two negative flake scars (with initiation points) are categorised as cores, which lack a ventral surface, unless produced on a flake (Volman 1981; Inizan et al. 1999)

Adiagnostic artefacts

Adiagnostic artefacts are stone implements that were recorded as individual artefacts, but did not exhibit attributes ('iconic' traits) common in certain time periods, and were therefore placed into an 'unidentified' time period.

A category of ESA/MSA was created following Hallinan's (2013) approach, which placed undiagnostic artefacts that were clearly not LSA into this category. The ESA is not identified solely by the presence or absence of bifaces such as handaxes and cleavers, but includes the debitage incurred through the shaping of a biface (Presnyakova et al. 2015) and large expedient flakes. The early MSA is poorly characterised and is often associated with large cores and flakes (Tyron 2006). This transitional period between the ESA and MSA is enigmatic because of the rarity of chronostratigraphic records at this time depth around 250 kya (Wilkins, Pollarolo & Kuman 2010; Van Peer et al. 2003). Quantifying stone tools for this transitional period is problematic, therefore, artefacts that showed characteristics that were not specifically diagnostic of ESA or MSA, and were not found in association with any other diagnostic pieces were placed in the category ESA/MSA.

5.4.2 Iconic/temporally diagnostic artefacts

Certain technological strategies employed during the production of artefacts can provide a relative temporal scale for the area, by linking these diagnostic artefacts to similar artefacts excavated from dated stratified contexts (Parkington 1980; Mazel & Parkington 1981; Volman 1981; Manhire 1984; Hallinan 2013). The repetitive sequencing of temporally diagnostic artefacts from excavations prove the legitimacy of using these artefacts in non-stratified areas containing artefacts.

By analysing open-air scatters at the scale of the individual artefact we can understand the entire techno-complex and identify overlapping phases of human activity at an assemblage scale (Hallinan & Shaw 2015). These patterns formulated from the individual artefacts translates into a pattern between assemblages, which ultimately allows for

comparison between assemblages across geologically and ecologically variable landscapes. At a broad scale handaxes can be associated to the ESA, and for more specific periods within the MSA, backed artefacts and bifacial points can be attributed to the HP and SB respectively (Henshilwood 2012). This allows us to survey and analyse all artefacts across all types of settings on the landscape, from the higher-lying ridges to the flatter river beds (Hallinan 2013).

Handaxe

A core or flake (or core-tool) that is bifacially flaked on both surfaces along its perimeters, usually converging toward a tip at one end (Wynn 1995; Iovita & McPherron 2011). This *fossil directeur* of the Acheulean (ESA) is associated with the species of early *Homo* and is described in various areas around the world.

Blade

Morphologically, a blade is commonly defined as a flake with a length that is at least twice as long as its width, although some researchers suggest larger ratios of up to 4:1, which increases the edge to volume ration (Bar-Yosef & Kuhn 1999; Shott & Weedman 2007). From a technical perspective, a blade is a flake with parallel or slightly converging laterals, often possessing ridges that run parallel to the technological axis of the flake. A combination of these two morphological traits are used to identify flakes as blades. An **elongated flake** is used to describe a flake that has laminar morphology, but has non-parallel lateral edges and non-parallel dorsal scars.

Bifacial point

A core or flake that is produced through invasive bifacial flaking often resulting in one or both ends converging to a point (Goodwin & van Riet Lowe 1929; Henshilwood et al. 2001).

A major morphological characteristic of a bifacial point is its bilateral symmetry, often described from the Still Bay period during the MSA.

Backed artefacts

Artefacts, particularly bladelets, with regular and abrupt retouch along at least one lateral margin that does not produce a sharp cutting edge (Mackay 2008). Backed artefacts are characteristic during the Howiesons Poort period of the MSA as well as during the LSA, although these are typically smaller than the MSA backed artefacts, with the implication of backing being suggestive of hafting capabilities (Lombard 2007; Charrié-Duhaut et al. 2013).

Unifacial points

As the name suggests, unifacial points are flakes that are subjected to invasive flaking or retouch on the lateral sides, resulting in the distal end of the flake being worked to a point.

Unifacial points are also characterised by basal thinning. These flakes are a common component of the post-Howiesons Poort (Cochrane 2008; Conard, Porraz & Wadley 2012).

Prepared core technology (Levallois)

The Levallois technique originated in a European context and was used to describe a prepared core technology during the Middle Palaeolithic. Levallois is a core reduction strategy that incorporates the shaping and preparation of a core to produce a predetermined end product, such as a flake, point or blade (van Peer 1991; Inizan et al. 1999). Morphologically, the method and concept employed in a Levallois strategy results in a hemispherical core that is hierarchically organised. Technologically, Levallois cores need to adhere to six criteria that form part of the Levallois Volumetric Concept (van Peer 1991). This term inherently filtered into an African context whereby it was used to describe prepared core technologies, such as radial cores and preferential point cores, during the MSA.

Faceted platforms

The striking platform of a flake containing at least two facets (dihedral), which is indicative of core preparation and a common strategy during the MSA.

Bipolar core

Bipolar flaking techniques incorporate the use of an anvil rather than free-hand percussion, which results in splintering or crushing on opposing ends of the core (Barham 1987; Conard et al. 2004). Quartz and CCS are favoured raw materials in the manufacture of bipolar flakes in South Africa, commonly occurring during the Late Pleistocene.

Bladelet

Bladelets are elongated flakes that do not exceed a maximum length of 25 millimetres and are characterised by parallel laterals (Deacon 1984; Lombard & Parsons 2008). These flakes are often unretouched and associated with the Early Later Stone Age and Robberg industry during the Late Pleistocene.

Adze

A flake that has steep retouch or step-flaking on one or both laterals, resulting from use (Deacon 1984). These tools were used in hafts, with evidence of mastic in adzes and examples of them still in hafts (Deacon 1984). It has been suggested that adzes that display step-flaking on both laterals were reversed in the mount. Artefacts described as adzes are common in the mid to late Holocene from sites such as Andriesgrond and Diepkloof (Mazel & Parkington 1981).

Scrapers

Two morphological features common of scrapers are a flat ventral surface and dorsal that exhibits steep (30 to 90 degrees) unifacial retouched. Scrapers are sub-divided into categories according to the position of the working surface in relation to the platform – side scraper and end scrapers. The iconicity of these stone implements that provide relative chronological ages are dependent on the varying styles of scrapers, for example thumbnail and convex scrapers. Convex scrapers that have a maximum dimension that is less than 20

mm are referred to as thumbnail scrapers. They are common throughout the Stone Ages, however, they become more prominent (thumbnail scrapers) in the Holocene.

Rock art

Rock art refers to both rock paintings that occur frequently in the Cederberg Mountains and rock engravings that are more common on the dolerite boulders found in the Upper Karoo of the Northern Cape. Rock art is specific to the LSA with an estimated age range from around 26 000 ka (Thackeray 1983) to as recent as 300 years ago (Parkington & Manhire 2003). The subject matter of rock art, particularly rock paintings, provides a relative age for the occupation of the area. Examples of domestic animals that have been dated from sites in South Africa are able to provide a minimum age of the paintings. Rock art is, in most instances, depicted on fixed surfaces, meaning that their positioning on the landscape is exactly where the artists wanted them to be.

5.4.3 Raw Materials

CCS (Chert and chalcedony)

CCS is an umbrella term used for grouping fine-grained cryptocrystalline sedimentary rocks (Luedtke 1978), which include chert (opaque) and chalcedony (semi-translucent). CCS occurs in small cobbles transported in the river systems and in glacial tillites. It is a favoured raw material in small tool-making technologies as it fine-grained and fractures conchoidal to produce sharp edges.

Dolerite

An igneous rock that forms in dykes or sills (Farndon & Parker 2009; Wadley & Kempson 2011). The visible crystals found within the dolerite obstructs the flow of energy introduced when flaking, resulting in unpredictable fracturing. Examples of artefacts on dolerite have been recorded, however, the frequency is low.

Hornfels (in the past referred to as Lydianite)

Shales that are near sills or dykes are subjected to intense heat, which effectively bakes these rocks, forming a non-foliated metamorphic rock that is fine-grained, known as hornfels (Farndon & Parker 2009; Wadley & Kempson 2011). The abundance of this raw material on the Karoo landscape combined with its fine-grained structure, makes this a favourable material for manufacturing stone tools.

Silcrete

Silcrete is a resistant rock (technically a weathering process) that forms as an indurated crust at or near the surface in soils through the cementation of soil by silica. Its appearance resembles that of quartzite, although they have two different origins and internal structure. The flaking qualities of silcrete are enhanced through the heat treatment of the rock, which reorganises the internal structure of the silcrete (Schmidt et al. 2013).

Quartz

There are multiple variations of quartz that occur in nature, however, only two are significant for the archaeological record of this area – crystal quartz and vein/milky quartz, which occur within the TMS group. The selection of quartz in the manufacture of artefacts was favoured as this mineral is brittle (ability to fracture), breaks in a conchoidal manner, and is abundant (Farndon & Parker 2009).

Quartzite

Quartzite is a non-foliated metamorphic rock like hornfels, however, the composition and origins are different. Quartzite is quartz sandstone that has been subjected to heat and pressure produced by tectonic activity, such as the compression of plates that formed the Cape Fold Belt. Quartzite, when knapped, produces a sharp and durable edge and occurs in large outcrops and cobbles on Cape Geology (Farndon & Parker 2009).

Mudstone

Artefacts produced from mudstone are rare, although evidence of mudstone artefacts were recorded in the study area. This raw material is a fine-grained sedimentary rock formed as a result of clay and silt.

The above chapter aims to describe the parameters for selecting the Bos River as a favourable area to conduct research. The techniques, strategies and logistical decisions

described above proved to be the more ideal approach to carry out fieldwork surveys, which would enable the analysis and interpretation of artefacts across the semi-arid landscape of the Tankwa Karoo. It is with this toolkit of methods that an understanding of prehistoric landscape use could potentially be determined.

Chapter 6: Results

A total of 5241 surface artefacts, potential outcrop sources, and historical buildings were recorded and analysed during this thesis. Discrepancies between the above-mentioned total number of recorded items (5241) and the artefact frequencies presented in the tables (4960) are due to the recording and classification of features, such as possible raw material sources, historical structures, and historical artefacts (glass), which were not included in the tabulated lithic analysis in this chapter. The analysed artefacts included the recording of 18 historical areas (stone walls, 'kraals', buildings), 1156 LSA artefacts (144 cores, 699 flakes), 2078 MSA artefacts (209 cores, 1566 flakes), 509 ESA/MSA artefacts (103 cores, 344 flakes), 6 ESA handaxes and 1474 indeterminate-age pieces (164 cores, 726 flakes). The frequency of handaxes is low, and these occur only on the Cape geology section of the survey, although handaxes have been recorded in impact assessment reports for the Tankwa Karoo National Park approximately 50 km away from the Bos River (Tusenuis 2014). The aim of the analysis is to create a detailed record of the artefacts that would enable the investigation of key questions on the spatial distribution patterns, technological organisation and raw material procurement strategies.

6.1 Artefact distributions

The distribution of the recorded artefacts on the landscape (Figure 6.1) reveals different spatial patterns over successive time periods relating to landscape-use, discard behaviour (Holdaway, Shiner & Fanning 2004), and logistical variability of prehistoric groups (Binford

1979). Not only do we need to consider these anthropogenic factors in creating spatial patterns, we also need to acknowledge the effects of certain taphonomic influences, such as time-averaging (Binford 1981b; Stern 1994; Bailey 2007) and slope wash.

It is important to understand that the scale of time involved in creating assemblages is much greater than the scale of time regarding daily behaviours of prehistoric people (Holdaway & Wandsnider 2006). We are able to account for this time-averaging by focusing on the individual artefact as well as recording all artefacts. Research conducted by Hallinan (2013) applied the same method as described in this thesis, allowing for comparisons between the Tankwa Karoo and the Olifants River Valley possible. The artefact distribution section below is to provide a brief introduction to the spatial patterns of artefacts, but will be discussed in greater detail in Chapter 7.

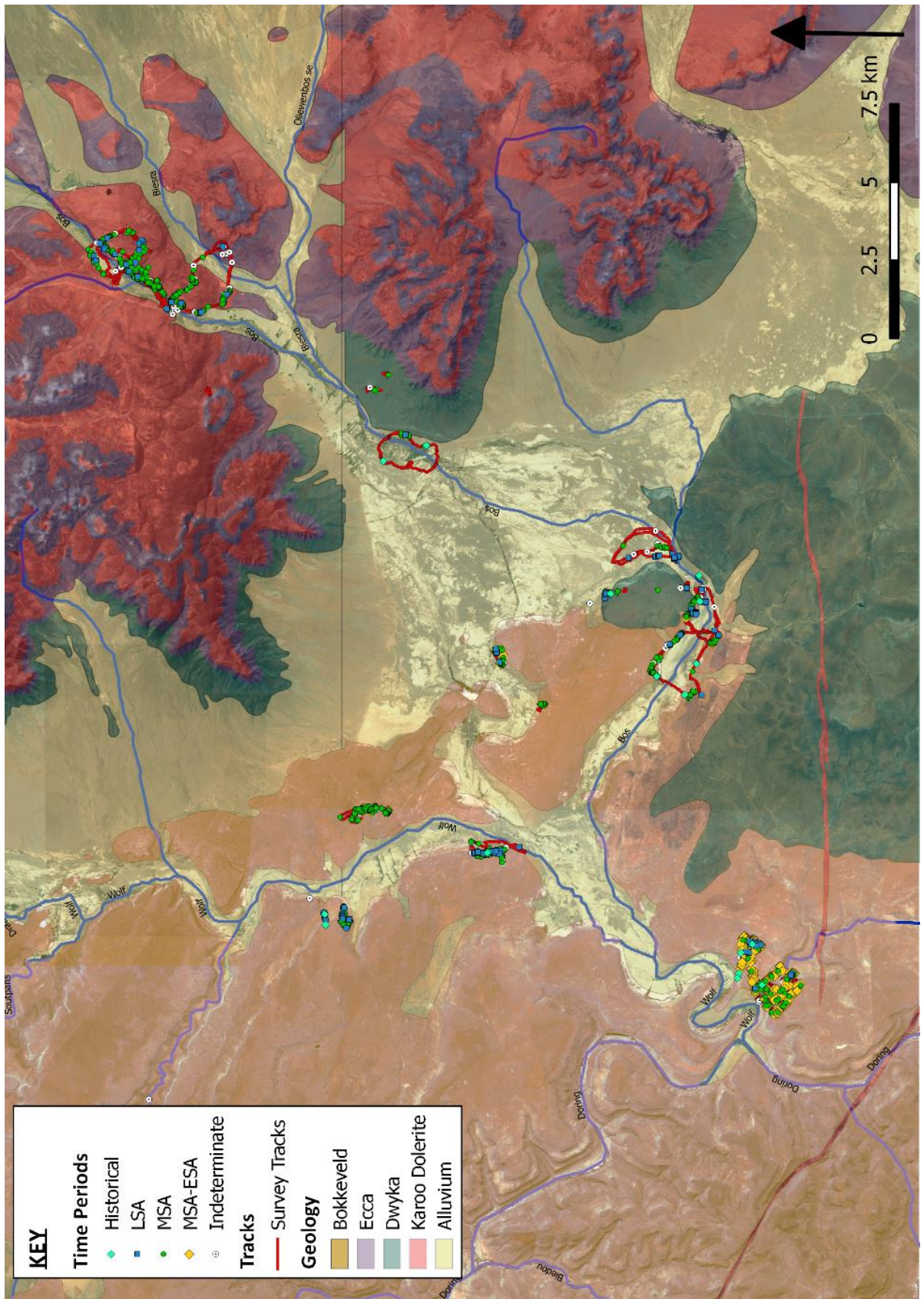


Fig. 6.1 Distribution of all recorded artefacts in their geological context along the Bos River. Red lines indicate survey tracks.

6.1.1 ESA artefact distribution

Artefacts attributed to the ESA time period, handaxes, were plotted against a geological map, which demonstrated a spatial constraint arising from the Cape geology (Figure 6.2).

This area is characterised by mountains with steeply incised valleys, and occurs near the confluence of the Bos and Doring River. Personal observation revealed that these artefacts were predominantly recorded on high elevations along the flat ridges overlooking the Doring and Bos Rivers. ESA/MSA artefacts (see chapter 5) exhibited a similar spatial patterning to ESA artefacts, being located on Cape geology above the rivers.

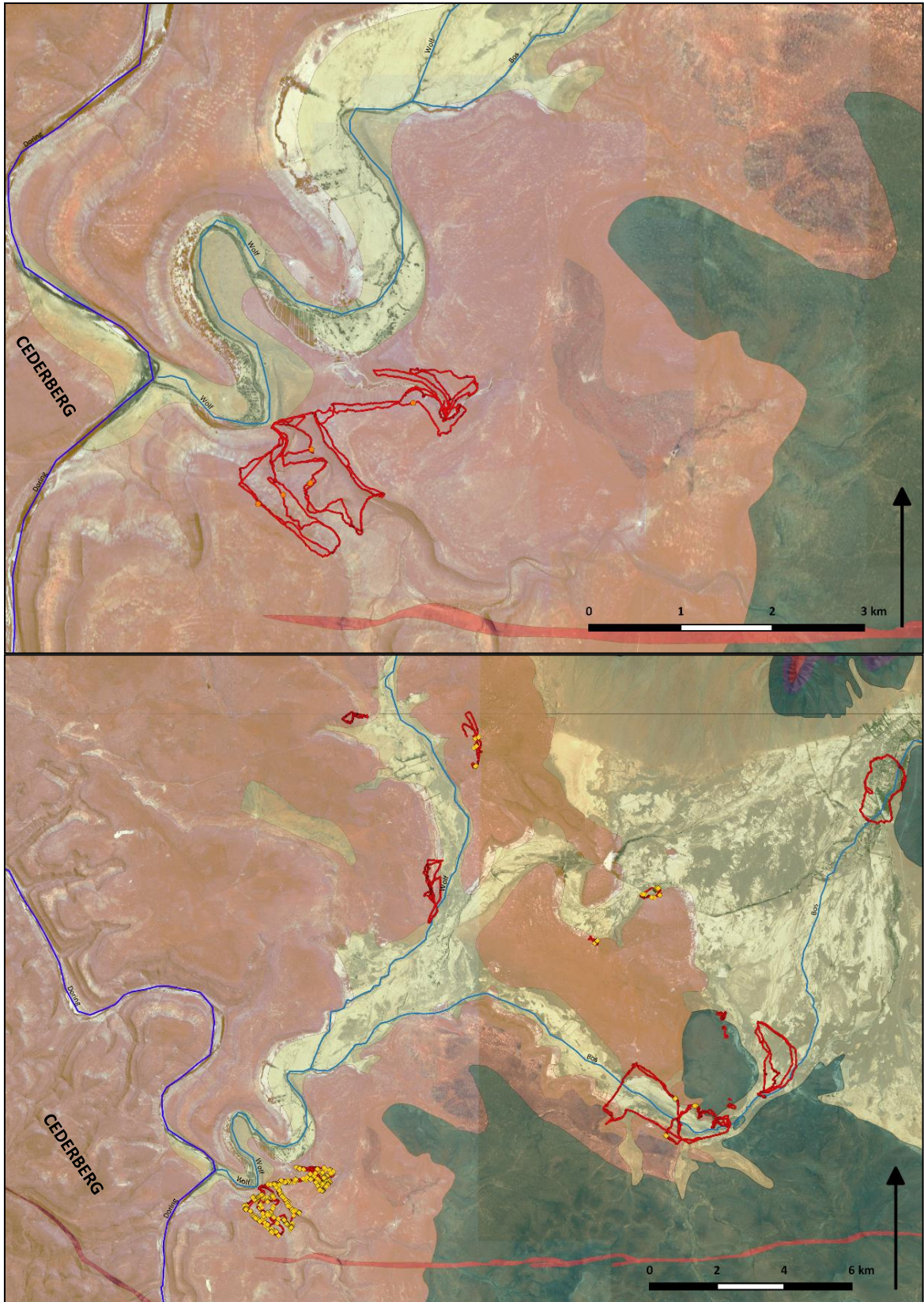


Fig. 6.2 Distribution of ESA artefacts (orange dots in the top image) and ESA/MSA artefacts (yellow dots in the bottom image) along the Bos River on a geological map.

6.1.2 MSA artefact distribution

Unlike the ESA however, MSA artefacts, for example blades, faceted platform flakes, and discoidal cores, depict a more a widespread distribution, occurring on both Cape and Karoo geologies. The artefacts that were not recorded on the Cape geology were located above the floodplains of the Bos River, and occasionally occurred on slightly raised hill tops overlooking the river (Figure 6.3).

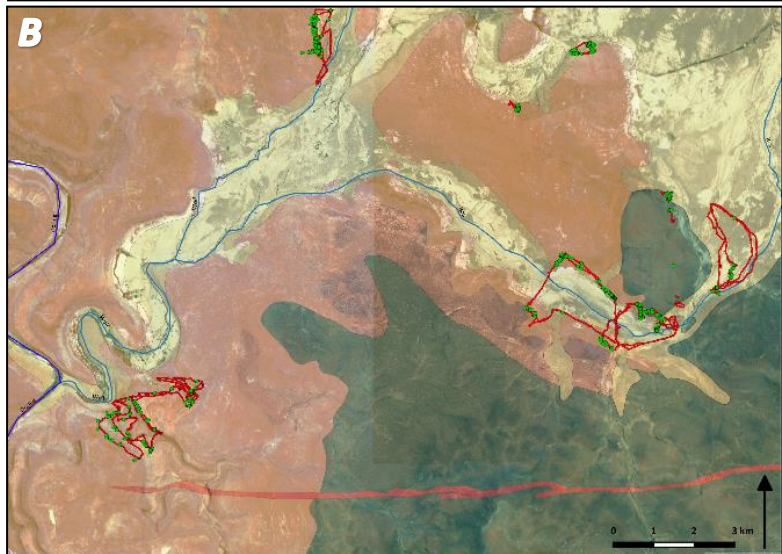
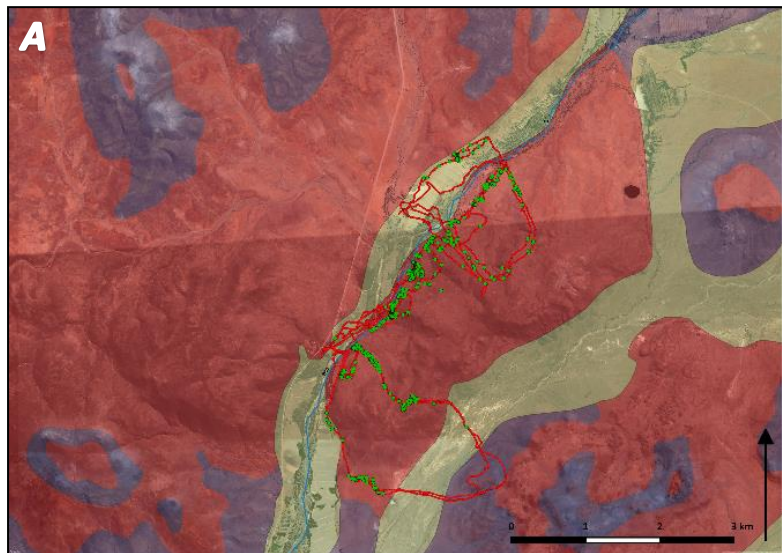
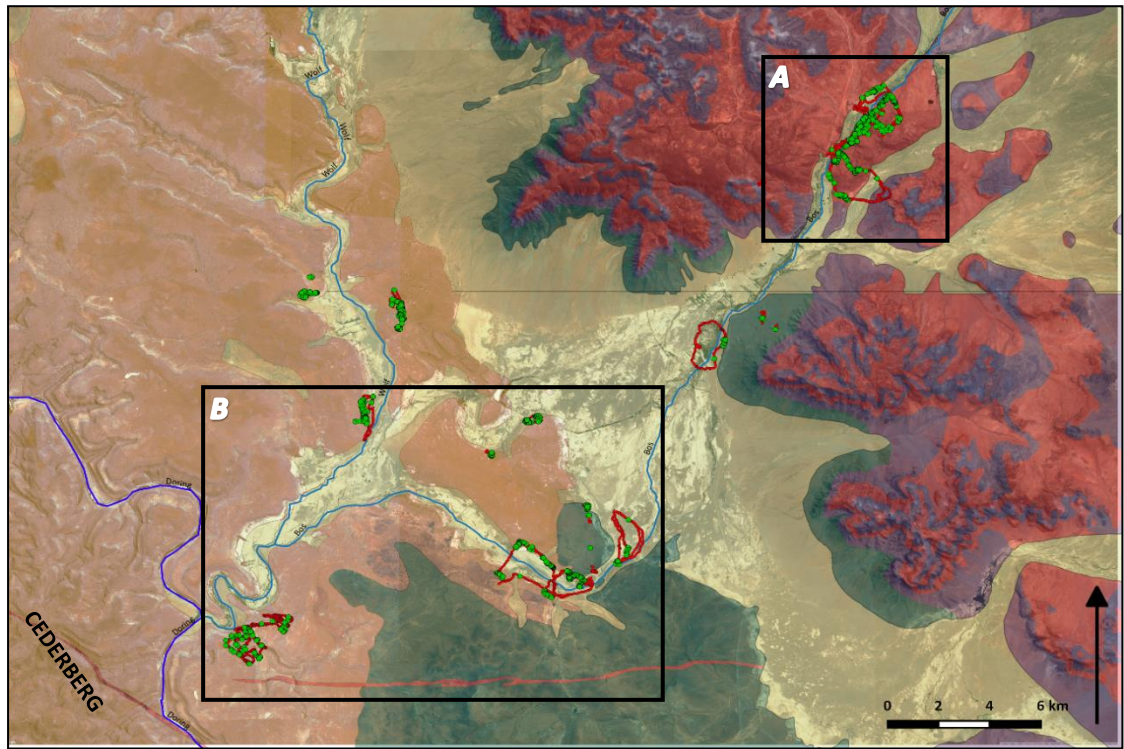


Fig 6.3 Distribution of MSA artefacts on the Ecca geology (A) and Cape geology (B)

6.1.3 LSA artefact distribution

LSA artefacts were recorded on Cape and Karoo geology, although they demonstrate a different spatial pattern to the patterns described from the ESA/MSA and MSA artefacts. (Figure 6.4). On Cape geology, LSA artefacts tended to be associated with rock shelters and overhangs in the quartzite ridges above the Bos and Wolf Rivers. Although there is a lack of shelters on the Karoo geology, LSA artefacts appear to be concentrated around some of the large dolerite boulders as well as in flat exposed areas on the ground. In addition to this pattern LSA artefacts were also recorded on small ridges interspersed with MSA artefacts.



Fig 6.4 Spatial distribution of LSA artefacts on Cape geology (A), Dwyka Formation (B), and Eccra formation (C).

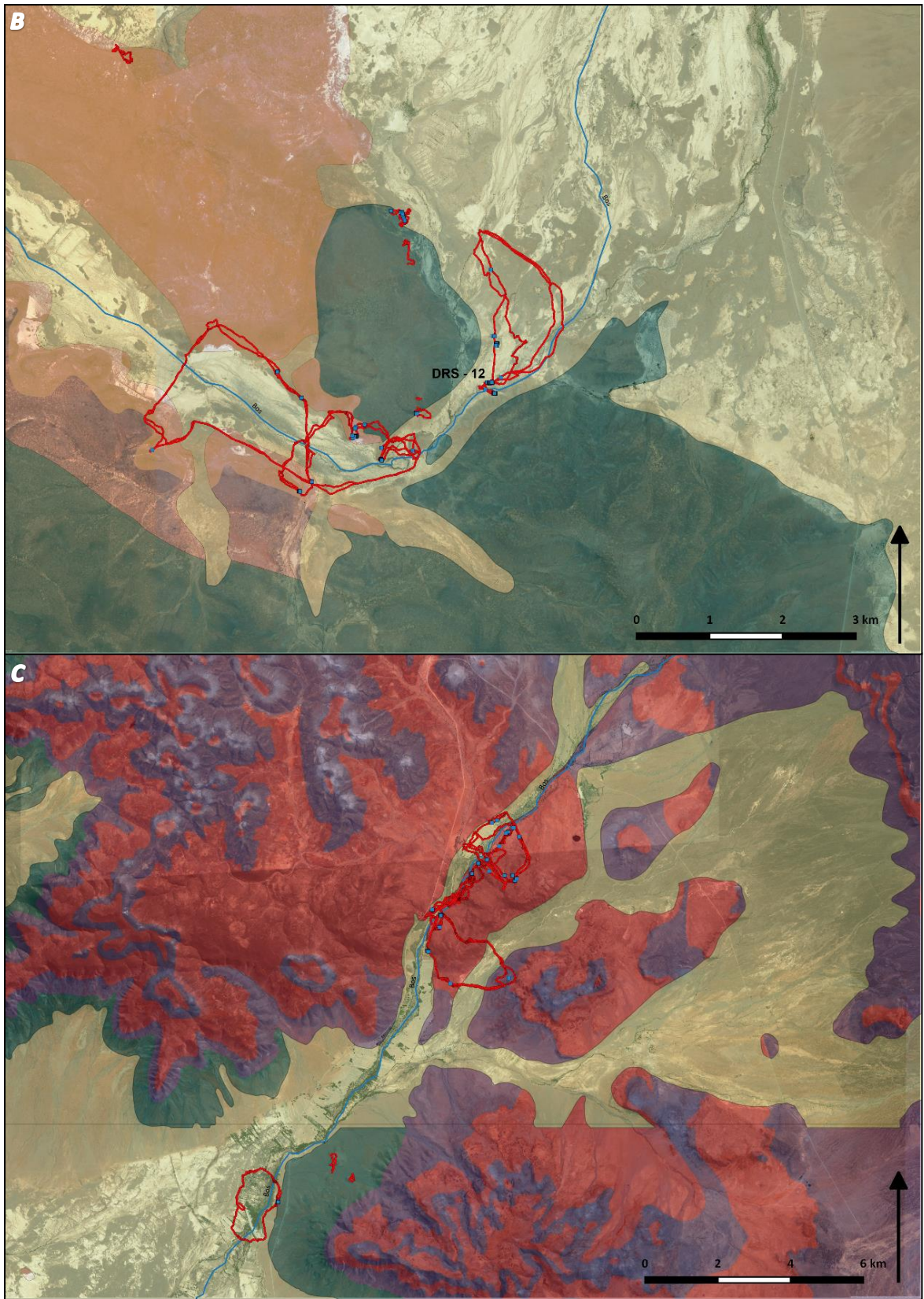


Fig 6.4 continued. Spatial distribution of LSA artefacts on Cape geology (A), Dwyka Formation (B), and Ecca formation (C).

Rock art sites recorded during the surveys were found on Cape geology and were associated with LSA artefacts. Interestingly, a panel of rock art depicting an eland torso and other smudges was discovered on Karoo geology (Figure 6.5), with a small amount of hornfels artefacts nearby. This site occurs right below the main road running through the Tankwa Karoo, which may have resulted in possible associated material being disturbed. The general pattern of LSA and MSA artefact distribution suggests a preference for areas near the Bos River or ridges overlooking it.

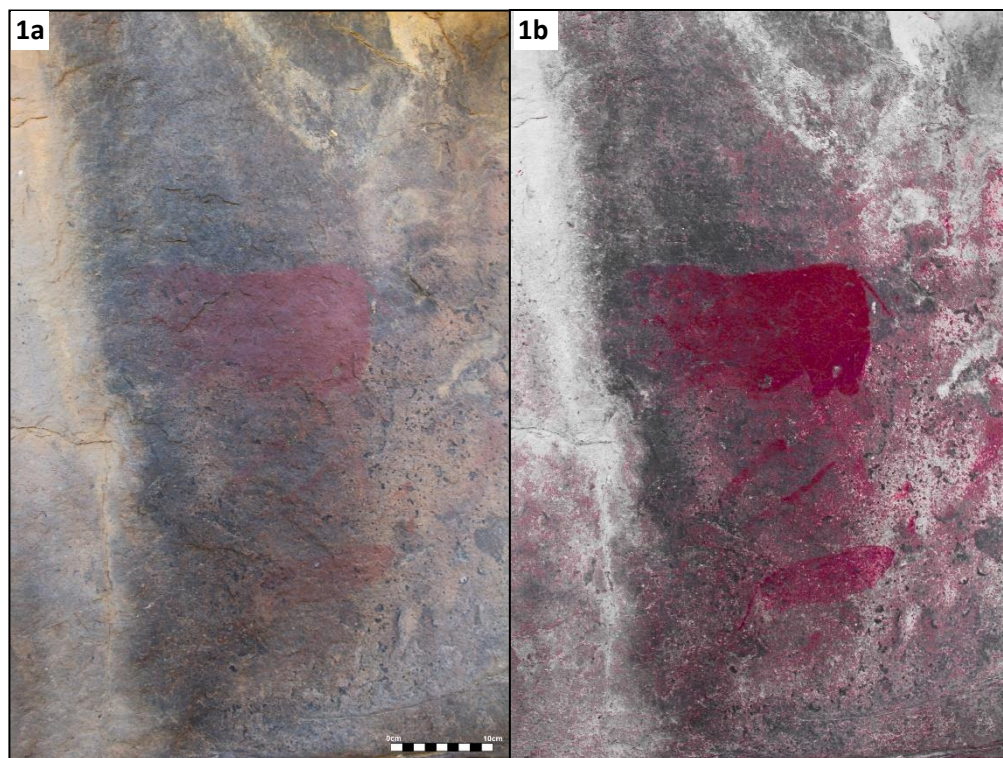


Fig. 6.5 Rock painting along the Bos River: (1a and 1b) painting of an eland and a smaller antelope underneath on the Ecca geology at the site of SNP-2 (left), while the image on the right is an enhanced version of the left photograph.

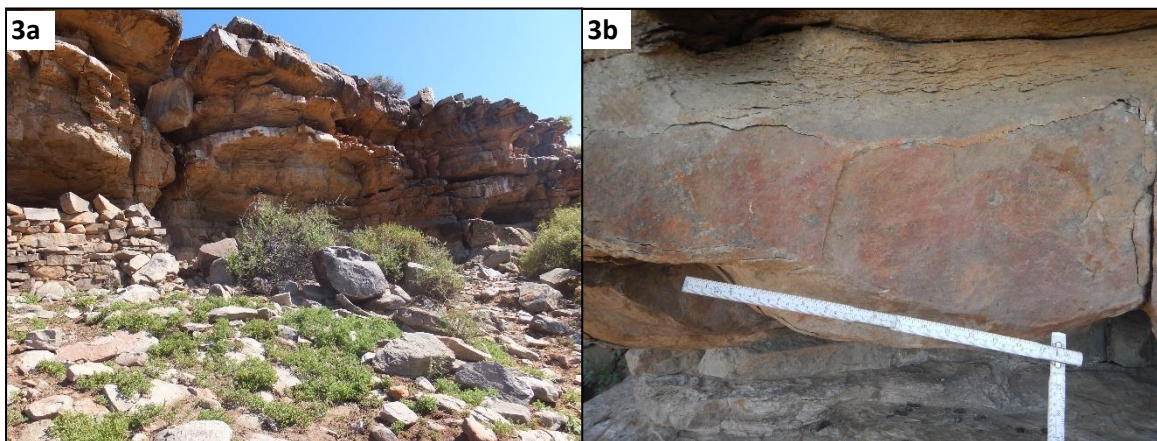
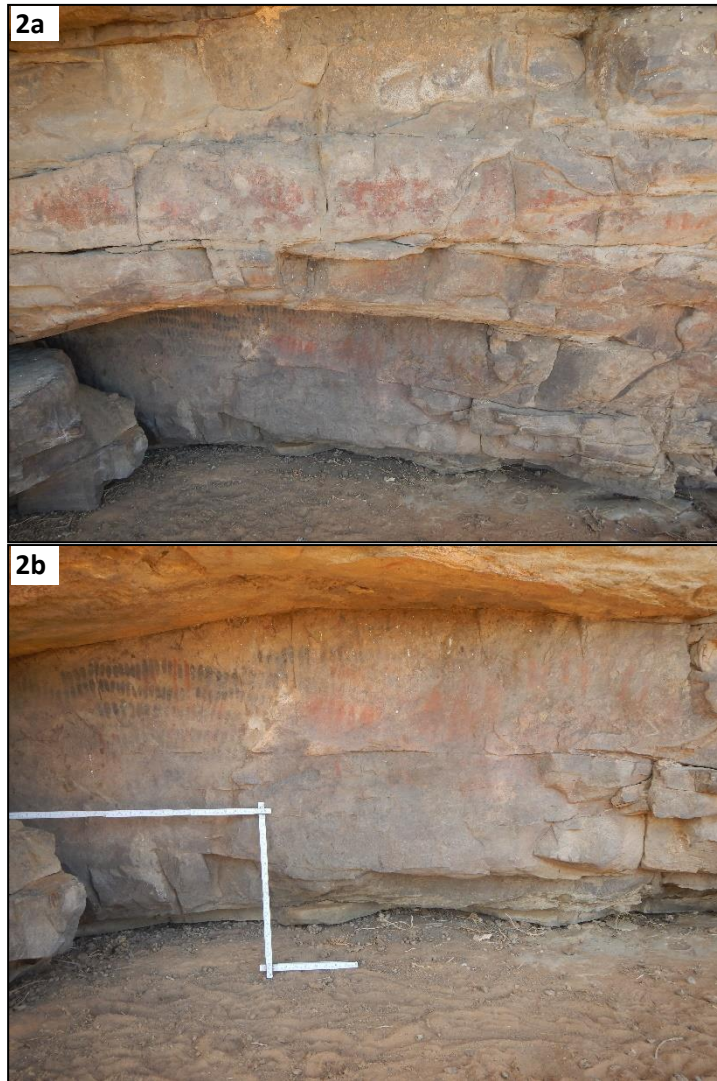


Fig. 6.5 continued. Rock painting along the Bos River: (2a and 2b) displays rock paintings of multiple black daubes with some red daubes and other unidentifiable paintings from the site STK-1 on Cape geology; (3a and 3b) rock paintings in a small overhang on Cape geology (STK-3).

6.2 Raw material use

6.2.1 Raw material preference

Raw material use is of importance in this study as it reveals the mobility and relates to the cognitive abilities of prehistoric people. As discussed in chapter 4, hornfels occurs locally on the Karoo geology, while quartzite, quartz and silcrete are found on the Cape geology. There is a clear shift in raw material preference during the ESA to LSA period. The ESA (in the form of handaxes) and ESA/MSA (large flakes) recordings show a preference towards the use of quartzite in the manufacture of artefacts (Figure 6.6). Quartzite makes up 92% of the total artefacts described under this period, with hornfels at 3.5%, and silcrete at 2%. The shift away from a quartzite-dominant assemblage is evident at some point within the MSA of this area.

The artefacts assigned to the MSA indicate hornfels as a preferred raw material, contributing over half the assemblage. Although it is still present, quartzite only makes up 27% of the MSA material, with CCS at 7% and silcrete at 2%. Hornfels continues to be a more significant source of raw material during the LSA making up roughly one-third of the assemblage, but a shift in preference towards the use of CCS is captured in the analysis, contributing a quarter of the total LSA artefacts recorded. Increases in quartz to 10.5% and silcrete to 8.5% of the total recorded LSA artefacts are noted for this period, with a dramatic decrease in quartzite from the to 7%. Distinguishing between dolerite and hornfels in the case of some artefacts, proved difficult during the analysis (Wadley & Kempson 2011). In these instances, hornfels was selected as the term to use and a comment was made regarding the uncertainty. The proportion of these cases did not have a significant impact on the overall result.

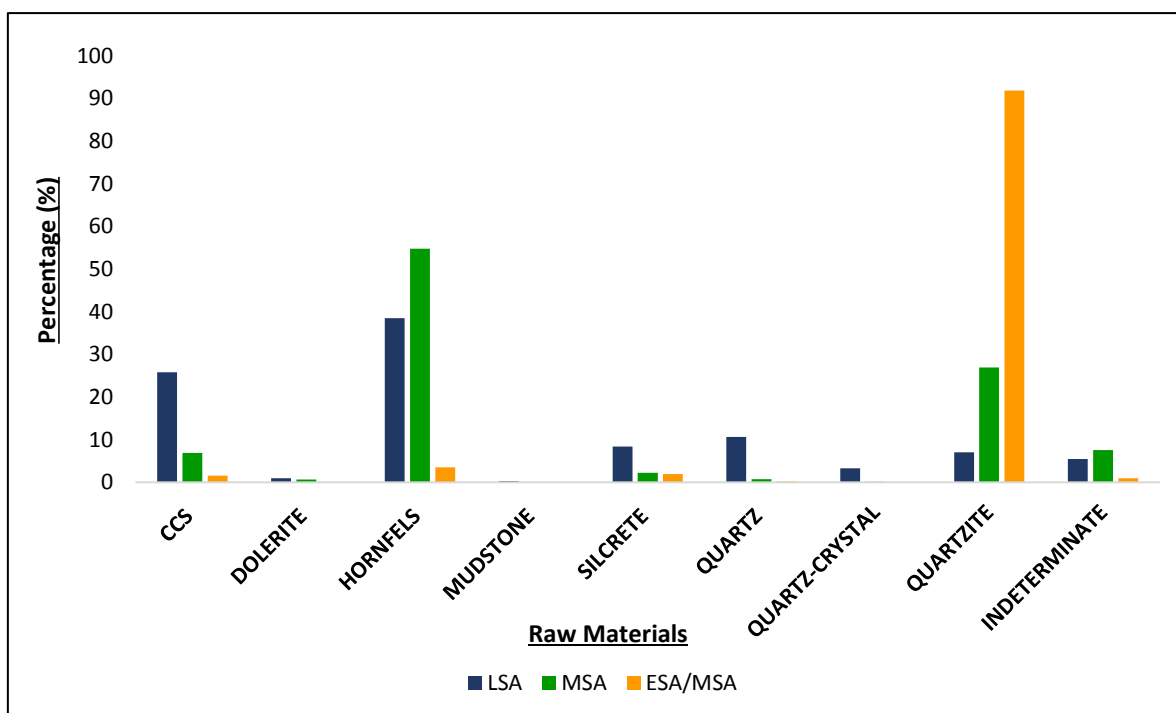


Fig. 6.6 Percentage of artefact raw material contribution during the relative time periods.

6.2.2 Raw material cortex

The raw materials can occur locally as outcrops, or non-locally in the form of cobbles transported in a river channel (see chapter 4 for definitions on local and non-local raw materials). The overall cortex-type present on the artefacts (particularly those on hornfels, CCS, and silcrete during the MSA and LSA) indicate that people manufacturing these artefacts were acquiring the necessary materials from the river channel as opposed to the outcrops (Figure 6.7).

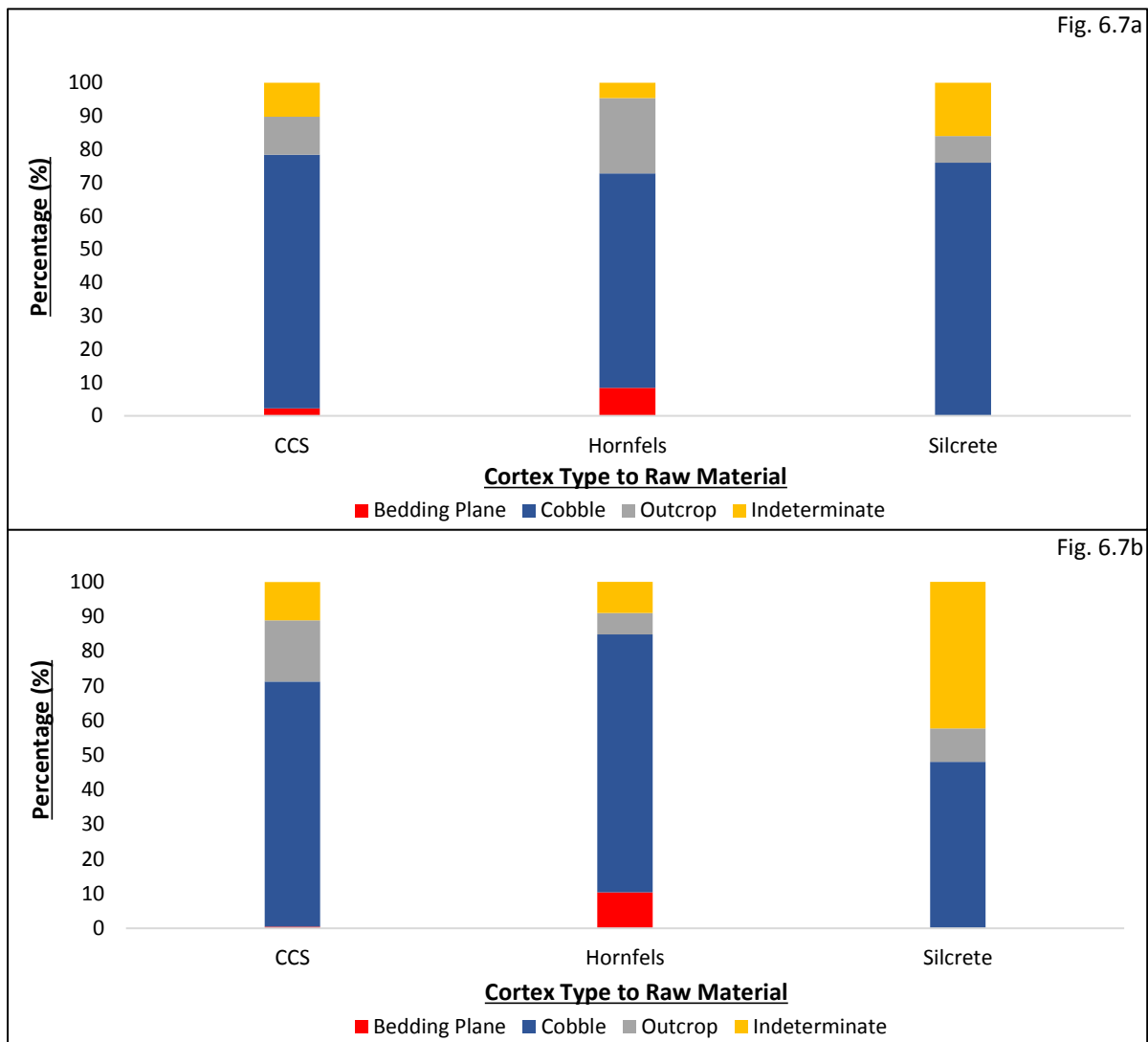


Fig. 6.7 Represents the percentage of cortex type per raw material type during the LSA (**Fig. 6.7a**) and MSA (**Fig. 6.7b**).

This pattern of utilising cobbles is consistent in both the MSA and LSA periods along the Bos River, with 70% of the artefacts containing cortex being classified as cobble rather than outcrop cortex. The only exception to this, is the quartzite material from the ESA/MSA, which comprises an even distribution of outcrop and cobble origin on artefacts with cortex.

6.3 Technological classification

Table 6.1 shows the count of all artefacts analysed and classified according to the relative raw materials and time periods. Flakes contribute two-thirds of the assemblages for the ESA/MSA and LSA, while there is a noticeable increase in flakes during the MSA to three-quarters of the assemblage. A retouch component was noted only on the LSA artefacts (Table 6.2). Although no definitive retouch was observed on the MSA artefacts, there was a noticeable number of these flakes that had edge damage along the lateral margins.

The presence of flakes associated with a convergent and laminar/blade technology is expressed during the MSA (Bar-Yosef & Kuhn 1999), with some examples of elongated flakes being placed in an ESA/MSA period. These laminar and convergent flakes account for roughly a quarter of all recorded flakes during the MSA and ESA/MSA categories (Table 6.3). Laminar flakes were divided into two categories, blades and elongated flakes. Elongated flakes account for 11% of the total number of flakes attributed to the MSA and ESA/MSA category, while blades contribute 8%, and convergent flakes/points are less than 4% of the total flakes.

There appears to be a preference towards hornfels use along the Bos River, particularly during the MSA, which may be a result of the natural laminar banding of the raw material as it breaks along thin bands. Formal tools (backed artefacts, notched pieces and scraper retouch) do not form a large component of artefacts (only evident in the LSA), with less than a 2% contribution to the total number of LSA artefacts analysed.

Table 6.1 Technological class and raw materials of the artefacts recorded during the survey period.

Class	Material	LSA	MSA	ESA/MSA	INDETERMINATE	TOTAL
Flake	CCS	186	96	5	158	445
	DOLERITE	8	12	0	18	38
	HORNFELS	270	854	13	236	1373
	MUDSTONE	2	1	0	1	4
	SILCRETE	57	29	6	61	153
	QUARTZ	64	9	1	30	104
	QUARTZ-CRYSTAL	16	-	-	5	21
	QUARTZITE	58	443	314	159	974
	INDETERMINATE	23	122	5	57	207
	TOTAL	684	1566	344	725	3319
Core	CCS	61	22	2	45	130
	DOLERITE	-	1	-	1	2
	HORNFELS	26	85	1	45	157
	SILCRETE	14	5	2	8	29
	QUARTZ	14	1	-	15	30
	QUARTZ-CRYSTAL	15	2	-	12	29
	QUARTZITE	8	65	104	24	201
	INDETERMINATE	6	11	-	14	31
	TOTAL	144	192	109	164	609
	Chunks & Shatter	CCS	29	21	1	92
DOLERITE		-	1	-	1	2
HORNFELS		144	198	4	112	458
MUDSTONE		-	-	-	1	1
SILCRETE		22	4	2	28	56
QUARTZ		44	5	-	31	80
QUARTZ-CRYSTAL		7	1	-	6	14
QUARTZITE		9	50	54	62	175
INDETERMINATE		10	20	2	52	84
TOTAL		265	300	63	385	1013
Retouch	CCS	16	-	-	-	-
	HORNFELS	2	-	-	-	-
	SILCRETE	1	-	-	-	-
	TOTAL	19	-	-	-	19
				TOTAL	4960	

Table 6.2 Retouch type on artefacts from the LSA

Retouch Type and Bladelets	Frequency
Adze	1
Backed	4
Retouch	2
Scraper (other)	2
Thumbnail scraper	10
TOTAL	19

Approximately 1.5% of the total artefacts show clear signs of edge damage, particularly noticeable on the MSA flakes (Figure 6.8). The MSA period is associated with the highest flake to core ratio at 8:1, while a 3:1 and 4:1 flake to core ratio characterises the ESA/MSA and LSA respectively. These figures reveal a shift in the technological organisation during the MSA, with the focus on the production of flakes, potentially laminar flakes. Interestingly, this is not reflected in the cores during this time period, with blade cores only making up 6.5% of the total.

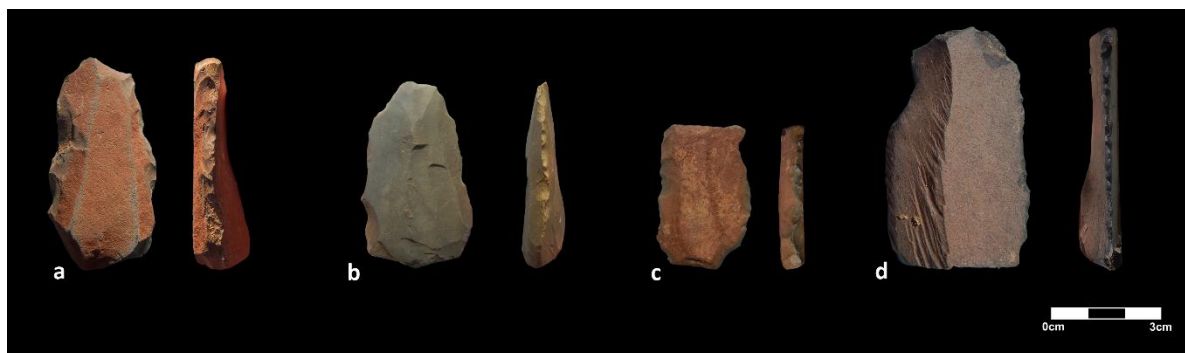


Fig. 6.8 Artefacts displaying evidence of edge damage: **(a and b)** examples of hornfels flakes with edge damage on laterals; **(c)** some larger removals on dorsal surface of hornfels flake fragment; **(d)** dolerite flake.

There is no specific preference in the technology employed with regards to the cores, with single platform cores, radial cores, and irregular cores making up most MSA core types (Table 6.4). A total of three Levallois cores (prepared cores) were identified. Two of these cores were preferential unidirectional Levallois cores (point cores), one was produced on CCS with multiple elongated removals, while the other was produced on a small (5 cm long) quartzite piece. A single example of a Nubian-like point core on silcrete was discovered in the survey area. Other examples of this technology have recently been identified along the Tankwa River in the Tankwa Karoo and the Doring River in the Cederberg (Hallinan & Shaw 2015; Will, Mackay & Phillips 2015).

Table 6.3 Raw material of flake products during the ESA/MSA and MSA

	POINTS/CONVERGENT		ELONGATED	TOTAL
	FLAKES	BLADE	FLAKES	
CCS	3	8	5	16
DOLERITE	0	2	2	4
HORNFELS	50	110	94	254
MUDSTONE	0	0	1	1
SILCRETE	2	5	8	15
QUARTZITE	18	19	95	132
INDETERMINATE	1	9	9	19
TOTAL	74	153	214	441

Cores that were placed in the ESA/MSA category included radially-worked cores as the dominant core type, followed by irregular cores and single platform cores. (Table 6.4). Most of these cores are produced on quartzite, outcropping naturally on the Cape geology as well as being sourced from the rivers. The cores produced during the LSA are manufactured from a wider range of raw materials, with a technological focus on single platform and bladelet core production, predominantly on CCS and some hornfels. These cores make up roughly a quarter each of the total LSA cores, with the 20% of the total LSA

artefacts comprising of irregular cores (Table 6.4). There is a clear change from quartzite dominant radial cores during the ESA/MSA, towards a focus on hornfels radial and single platform cores in the MSA, and a shift to CCS bladelet and single platform cores thereafter.

Table 6.4 Frequency of core types per their associated time period

	LSA	MSA	ESA/MSA	INDETERMINATE	TOTAL
ADJACENT PLATFORM	1	3	0	2	6
BIPOLAR	17	1	0	14	32
BLADELET	33	0	0	3	36
CORE-ON-FLAKE	4	6	0	5	15
CORE FRAGMENT	16	25	9	22	72
IRREGULAR	28	48	21	36	133
LEVALLOIS	0	3	0	0	3
NUBIAN	0	1	0	0	1
OPPOSED PLATFORM	5	7	9	4	25
OTHER	7	3	3	16	29
RADIAL	1	43	36	8	88
SINGLE PLATFORM	32	46	18	54	150
TOTAL	144	186	96	164	590

The life histories of an artefact should always be acknowledged when analysing lithics, with an understanding of the formation of the raw material, as an outcrop source and/or as a cobble source transported in rivers, the procurement of the raw material, the use of the artefact (Binford 1979; 1981b) and the discard of the artefact (Binford 1981b; Holdaway & Wandsnider 2006). Different taphonomic factors will have various effects on the location and preservation of artefacts, from geophysical processes, for example erosion and weathering (Bailey & King 2010) to temporal time-averaging (Stern 1994; Holdaway & Wandsnider 2006; Bailey 2007). Roughly three-quarters of the flakes that were analysed were complete, suggesting that there was little disturbance from post-depositional taphonomic processes, which include weathering and trampling (Figure 6.9).

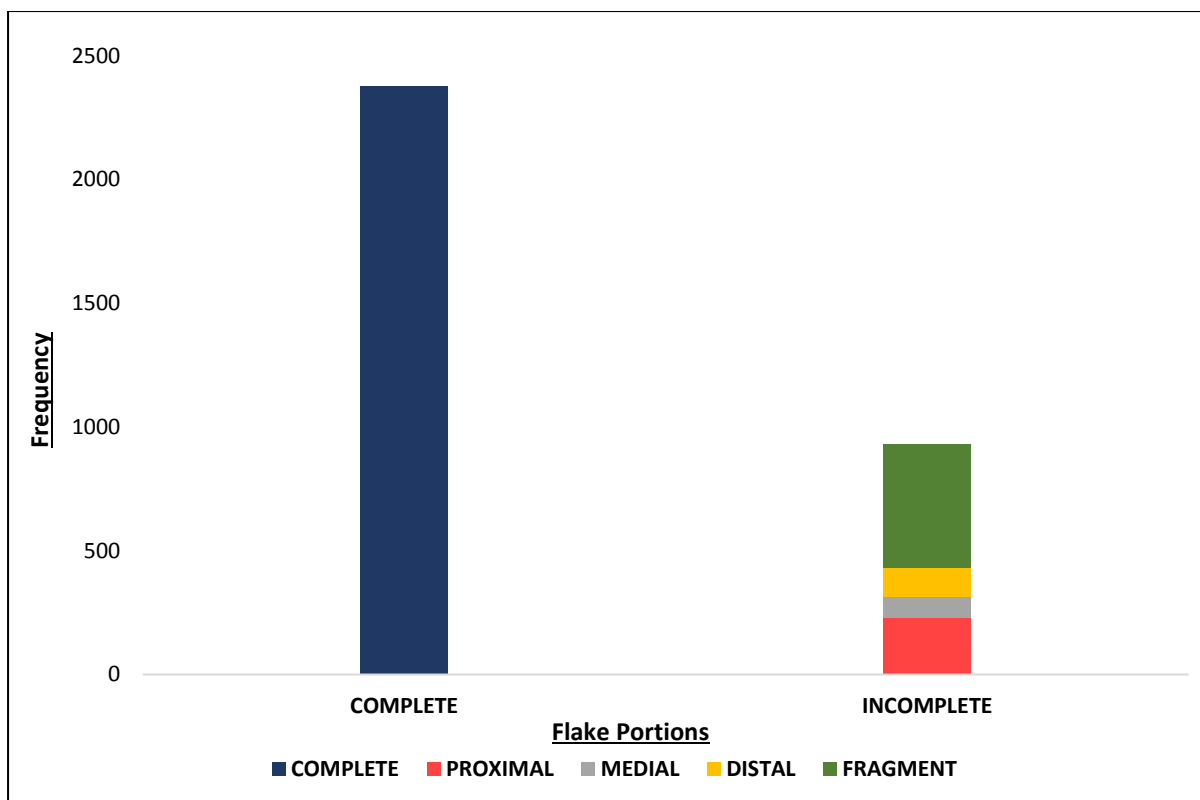


Fig. 6.9 A comparison between complete flakes and incomplete flakes

The tables and graphs provided in this section highlight important variables and patterns that will be expanded on in the following chapter. The artefact distribution in terms of raw material and technological organisation of the artefacts are valuable clues to the understanding of landscape use. The technological strategies reflected in the analysis of individual artefacts allow for comparisons to be made to similar research in the neighbouring area (Hallinan 2013).

Finally, the results will be discussed in the following chapter in terms of the influence that water availability, raw material sources, and shelter would have had on the technological organisation of artefacts (Binford 1978; Kuhn 1992, 1994) in the Tankwa Karoo, as well as the location of recorded artefacts in this region (Holdaway & Wandsnider 2006; Bailey 2007). Using this information, together with optimal foraging theories (Bleed

1986; Torrence 1989; Nelson 1991; Ugan, Bright & Rogers 2003), allows one to understand the life history of the artefact from the initial stages of procurement of the raw materials to the final discard of the artefact, as well as the possible reasoning's for the patterns observed along the Bos River in the Tankwa Karoo.

Chapter 7: Discussion

The emphasis on open-air studies in recent years has provided an additional component in understanding prehistoric human patterning, particularly during the Middle and Later Stone Ages (Kandel & Conard 2012). The density of lithic material across the open and varied landscape demonstrates the increasing adaptability of prehistoric people in the Stone Ages, and helps to foreground their concept of landscape 'value'. The focus on the artefacts on the landscape is a useful proxy for understanding prehistoric people's decisions. The archaeological record along the Bos River spans a period of possibly a million years, with evidence of artefacts from the ESA, ESA/MSA, MSA, and LSA occurring on the landscape.

Although the sample size of the artefacts recorded from the surveys along the Bos River is relatively small, this does not compromise the interpretation of the archaeological record present. Locations on the landscape would not be continuously used by mobile prehistoric people (Holdaway & Wandsnider 2006), resulting in a low density of artefact accumulation (Binford 1981b). The reasons for the occupation or lack of occupation during each period in the Stone Age is described in terms of five main factors relating to stone tools – artefact distribution, water availability, raw material availability, shelter, and technological organisation. These five features are embedded in the over-arching effects of the palaeoclimate on the fauna and flora of the region. A lithic analysis of the artefacts along the Bos River served as the primary source of information about prehistoric human behaviour, due to the lack of rock art and poor preservation of non-lithic materials such as bone and wood in the open environment of the Tankwa Karoo.

The location of the Bos River on the boundary of Cape and Karoo geology (Figure 4.4) is important to the discussion of the results, as prehistoric people occupying this area would be able to access resources from both geological contexts. Two studies, one in the neighbouring Cederberg (Cape geology) and the other in the more distant Zeekoe valley (Karoo geology), are used for comparative purposes to attempt to understand spatial links between these geologically distinct landscapes. Any similarities that are drawn specifically between the Zeekoe valley and the Bos River need to be approached with caution, as the area that forms part of Sampson's (1985) study region is approximately 500 km to the east of the Tankwa Karoo.

Similarities observed in the spatial and temporal distribution of artefacts on the landscape through time, provides a broad scale of changes in prehistoric occupation along the Bos River. The availability of water in the Bos River and the raw materials that are available and present in this area, suggest possible reasons the occupation and lack of occupation of specific places. Technological analysis of the artefacts recorded demonstrates a finer-scale understanding of how prehistoric people adapted to this environment, in terms of their technological strategies, raw material procurement and curation of stone artefacts. These features determine the where and the how of prehistoric occupation, but do not explain the why, although it does offer some clues with respect to general lack of water and stone raw materials when compared to the nearby Cederberg and further afield Zeekoe Valley (Sampson 1985; Hallinan 2013).

The analysis of the lithic material provides information on the strategies implemented by the prehistoric tool-makers to adapt to the Tankwa Karoo, although, it does not speak to the reasons why this area was occupied. Answers to this question can perhaps

be sought through an understanding of the global palaeoclimate and the effects that it may have on the rainfall patterns in the Tankwa Karoo, and the further effects it has on the fauna and flora of the region. The Stone Age in South Africa, more specifically the Western Cape, spans a period of over a million years, which incorporates multiple fluctuations in the climate that can cause short-term changes in areas like the Tankwa Karoo. An increase in vegetation, for example, can attract herds of wild animals, as is the case with the large springbok migrations that occurred in the Karoo in the late nineteenth century (Roche 2004).

The question of the changing attractiveness of the Tankwa Karoo along the Bos River can be approached through the analysis of the discarded lithic material present on the environment today, in combination with an understanding of the geology, rock art studies, historical accounts of large fauna migrations, and the palaeoclimate of the area and its surroundings. I attempt this by describing the effects of each one of the five previously mentioned factors on the three different Stone Ages.

7.1 ESA and ESA/MSA

7.1.1 Artefact distribution

A review of artefact distribution around the Bos River offers certain insights into the decision-making process of prehistoric people by indicating landscape settings that were favoured, as opposed to areas that might not have been (Parkington 1980; Sampson 1985; Hallinan 2013). The ESA has been characterised as showing a narrow landscape focus

restricted to water sources (Deacon 1988), a pattern that is well represented along the Olifants River Valley and surrounds (Hallinan 2013).

An ESA signal was identified along a ridge above the portion of the Bos River that meanders across the Cape geology (Figure 7.1). It is not uncommon to find areas in South Africa containing dense accumulations of ESA material, with examples from the Cederberg (Hallinan 2013), Upper Karoo (Sampson 2001), Cape Hangklip (McNabb, Binyon & Hazelwood 2004), and Montagu Cave (Keller 1973; Archer pers. comm. 2016). All artefact classified as ESA and ESA/MSA artefacts were strictly located on the Cape geology, with no examples occurring further up the Bos River on the Karoo geology. Only one example of a handaxe in the Tankwa Karoo is known, and it was recorded during an impact assessment in the Tankwa Karoo (Tusenuis 2014). There are currently no diagnostic ESA artefacts observed along the Tankwa River to the south of the Bos River (Hallinan pers. comm. 2015).

The artefacts recorded for the Acheulean (Fauresmith-like) in the Zeekoe valley (Upper Karoo) revealed that these stone artefacts were more clustered around raw material sources than the water sources. In the Zeekoe Valley there was a higher frequency of Acheulean artefacts clustered closer to flaked and non-flaked hornfels outcrops than those focused near springs. This is not to imply that water was a less desirable resource, but it may not have been a prioritised resource in that area during those times (Sampson 1985). It is important to note that the pattern described above may be because of visibility in terms of knapping/quarry sites, by nature, expressing a strong archaeological signal, whereas activities around water sources may have been less visible. There were no recordings of flaked hornfels outcrops recorded along the Bos River, with one possible source along a tributary of the Bos River, although a recording of a debitage and flakes around a flaked

hornfels outcrop further south near the Tankwa River was identified (Hallinan pers. comm. 2015).



Fig. 7.1 Physical setting of ESA landscape-use

Two possible explanations come to mind which could explain the low frequency of ESA artefacts observed in the Tankwa Karoo. The first is the possibility that the ESA material is buried because of sedimentation over an extensive time frame. The general nature of the Karoo landscape is, however, characterised by its thin sandy soil layer, scarcity of plants, and large erosional areas. Artefacts recorded around the Bos and Tankwa Rivers are highly visible and in some cases, appear to be resting on a stable palaeo-landscape, referred to as a desert pavement (Olszewski et al. 2010; Usik et al. 2013; Hallinan & Shaw 2015). An area of deep sediment build-up is exposed in the lower reaches of the Bos River in the expansive floodplain, although this area yielded no surface archaeological material. It could, however, be a target for future research with the aim of dating the sediment and conducting test excavations. Based on the characteristics and observations of the Karoo environment it seems unlikely that the lack of ESA artefacts is attributed to them being buried.

The second, more plausible idea, deals with the degree of attractiveness of the Tankwa Karoo for prehistoric people. Water, food, and raw materials for tool-making act as focal resources that are imperative to the survival of people. The high density and wide distribution of ESA artefacts that occur in South Africa demonstrate that prehistoric people were producing a large amount of lithic material and able to occupy large areas of the varying landscapes (Lahr & Foley 1994; Kandel & Conard 2012; Braun et al. 2013; Kuman 2014a, 2014b). The capability of adapting to an array of environments is evident in the above studies, which include semi-desert biomes that share similar and more extreme conditions to the Tankwa Karoo (Foley & Lahr 2015), which is interesting given the overall lack of ESA material along the Bos River.

7.1.2. Water availability

In some instances, particularly during the ESA and earlier parts of the MSA, it is difficult to tease apart the magnet of attraction to large water channels for prehistoric people – whether it is the actual water or the availability of raw materials being transported in the rivers. Although the aim is to try separate these two influences, they are often discussed in the same paragraphs.

Water is scarce in the Tankwa Karoo, with only two (larger) ephemeral rivers, the Bos and the Tankwa, present. These two non-perennial rivers are contrasted to the Doring River to the immediate west that provides the Cederberg fringe with water, while the pans and permanent springs found in Sampson's (1985) study provided water to the Zeekoe valley. The Doring River to the east of the Cederberg is classified as a perennial river and drains an approximate area of 24 000 km², attracting animals, providing water as well as transporting raw materials in the form of large cobbles to the prehistoric people that lived in that region (Mackay et al. 2014).

The research conducted by Hallinan (2013) in the Cederberg could substantiate the model proposed by Deacon (1988), with evidence of ESA artefacts scattered along the Olifants River, but rarely located more than 1 km from the river channels. The issue with large perennial rivers is that the attraction to them is not explicit in the archaeological record, as they provide both water and raw materials in the form of large transported cobbles. Evidence from the open-air dune site of Elandsfontein along the West Coast of South Africa, is particularly interesting in that the analysis of the research demonstrates the movement of raw materials into the dune area where a presence of springs is observed

(Braun et al. 2013). This suggests that the availability of water sources has the potential to influence the areas of occupation, specifically on Cape geology.

The episodicity of available water in the Tankwa Karoo would have been a concern for hominins, possibly being attracted to the more stable source of water and raw materials from the nearby Doring River. Although water is a primary focal point for ESA hominins on the Cape geology, the patterns observed on Karoo geology by Sampson (2001) suggest a different focus. The Karoo is considered a semi-desert with an annual rainfall of well under 200mm, resulting in water being a rare resource. Evidence for the relationship between the distribution of ESA artefacts (Fauresmith or late-Acheulean) and water sources (permanent springs) was noted occasionally on Karoo geology from the Zeekoe valley (Sampson 1985, 2001; Sampson et al. 2015). Springs, however, do not always serve as focal points for prehistoric human occupation, as is shown in the dune sites along the West Coast of South Africa by (Kandel & Conard 2012), which suggests that hominins may have been drawn to water sources for both water and raw materials.

Interestingly, there was a much greater correlation between raw material sources (flaked and non-flaked hornfels outcrops) and Acheulean artefact distribution in the Upper Karoo (Sampson 1985, 2001). Sampson (2001) proposes that the pattern described above is largely motivated by the presence of predators around the springs, a consideration towards the impact that raw material accessibility has on these patterns need to be incorporated. These springs not only provide a source of water, they also provide an opportunity for the hominins to scavenge kills associated near these water sources (Blumenshine 1987). The fact that these hominins were choosing raw material outcrops over the springs that provide

water and food, emphasises how different environments can influence different resource focus.

7.1.3 Raw material availability

The organisation of the lithic technology in the archaeological record can be directly linked to the availability of raw materials (Kuhn 1992). The transportation of hornfels and large quartzite cobbles by the Doring River provides a predictable source of raw materials throughout the Cederberg. The ESA and ESA/MSA artefacts found along the section of the Bos River that runs through Cape geology were produced on large locally sourced quartzite cobbles, and include examples of large bifaces (handaxes), radial and irregular cores, as well as large elongated flakes.

Quartzite forms as large outcrops on Cape geology and is transported in the Doring River across the Cederberg area. The volume and velocity of the Doring River flow facilitates the transport of large quartzite cobbles that are favoured during the ESA. The raw material is a durable stone that fractures in a relatively predictable manner, producing a sharp cutting edge on the flakes being produced. The abundance of quartzite on the Cape geology and the size of the outcrops provided early hominins with an almost endless supply of flakable raw material. The availability and transport of large raw material cobbles may be another factor influencing the associated pattern of ESA occupation along prominent river bodies, specifically in relation to quartzite availability on the Cape geology. Again, it is difficult to tease apart whether the attraction to these waterways are based on the raw material availability or the water itself (Hallinan 2013).

The ESA material associated with the late-Acheulean (Fauresmith-like) artefacts analysed in the Zeekoe valley favour locally available hornfels and – in rare instances – siltstone. Artefacts on Cape quartzite does not permeate into the Tankwa Karoo, although quartzite can occur as glacial erratics in the Dwyka. The lack of an ESA signal on the Karoo portion of the study area may be attributed to the inability of the Tankwa Karoo system to produce large quartzite cobbles and boulders. The overall lack of large raw material outcrops in the Tankwa Karoo coupled with the low energy system of the Bos River, does not facilitate the formation of large cobbles that are favoured during the ESA on the Cape geology (Hallinan 2013). The ESA material recorded by Sampson (1985) is attributed to the late-Acheulean, which is characterised by a more refined bifacial flaking (Beaumont 2006; Porat et al. 2010).

7.1.4 Shelter

Shelter use during the ESA in South Africa is uncommon, although, this is interesting in terms of landscape use. The distribution of artefacts during the ESA, particularly from the Olifants River Valley (Hallinan 2013), suggests that hominins during the ESA were occupying areas near the Olifants River. Again, the attraction to this river channel could be related to it being a source of water and/or a source of raw materials. It seems that in the case of the Olifants River patterns, the hominins were favouring the open landscape rather than available shelters that are abundantly spaced throughout the Cape Fold Mountains (Hallinan 2013).

In instances where ESA occupation does exist in caves, two of the more prominent examples containing ESA deposits are Montagu Cave (Keller 1973; Archer pers. comm. 2016)

and Wonderwerk Cave (Chazan et al. 2012), it appears that the caves are particularly large and close to a water source. The implications of the research carried out by Hallinan (2013) and the research being conducted on the ESA in these caves, suggest that the attractiveness of the water channels (water and/or raw material source) during the ESA outweigh the attractiveness of a shelter. Although this is the case from Hallinan's research, the distribution of ESA artefacts found close to river sources could be attributed to hominins discarding and procuring raw materials from the water channel. This, however, is unlikely given that ESA artefacts occur in these open exposed areas in direct line of site of nearby rock shelters (Hallinan 2013, own observations).

7.1.5 Technological organisation

The only diagnostic artefacts pertaining to the ESA were the six recorded handaxes occurring on the Cape geology (Figure 7.2). The ESA lithic material does not of course comprise solely of handaxes, although, they are easy to distinguish unlike the other large cores and flakes that were characterised as ESA/MSA. Handaxes are considered a multifunctional artefact with the capability of being a large cutting tool (LCT) and, if necessary, a core from which sharp flakes can be detached (Kelly 1988; McPherron 2000). The large size of the quartzite cobbles and outcrops made them a preferred source of raw materials during the ESA, favouring the maintainable flaking system of the hominins - the production of large bifaces that could be constantly reduced to produce usable detached pieces (Bleed 1986; Nelson 1991). The overall lack of diagnostic ESA artefacts is problematic for trying to approach landscape use from a technological perspective, although the reason

for this signal is explained in the above paragraphs pertaining to water availability, raw material availability, and shelters.

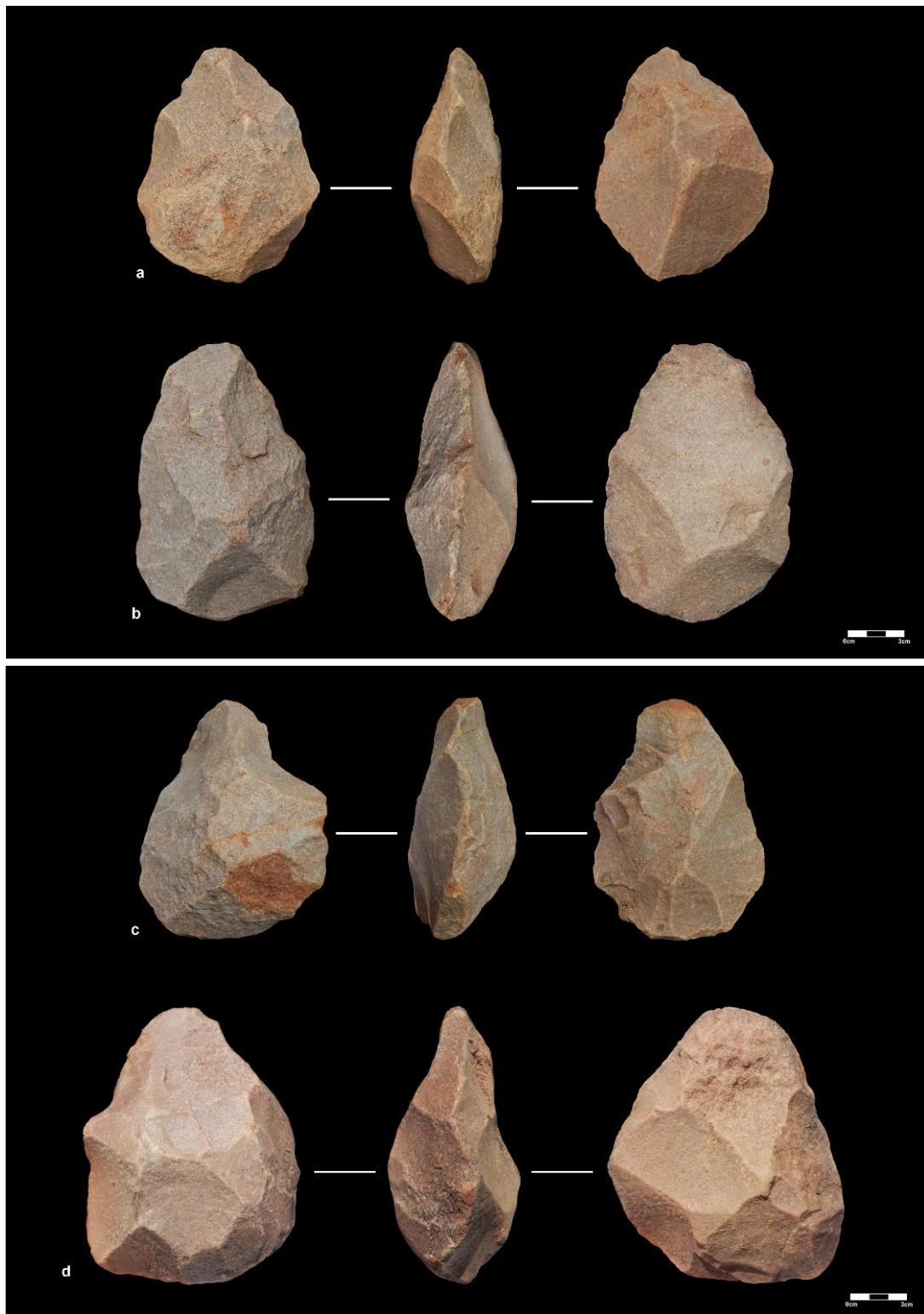


Fig 7.2a Examples of ESA artefacts along the Bos River on the Cape geology portion: (a-d) quartzite handaxes.



Fig 7.2b Examples of ESA/MSA quartzite artefacts along the Bos River on the Cape geology portion: (a) irregular core; (b) radially flaked core; (c, d, g) examples of elongated quartzite flakes

7.1.6 Conclusion of ESA

The pattern described by Hallinan (2013) suggests that ESA hominins were tethered to large waterways, the Olifants River, which provides water as well as raw materials for stone tools. Because these two resources coincide with one another, the ability to conclude whether a preference towards raw material or water was favoured, is made difficult (Hallinan 2013). This contrasts with Sampson's (1985) research in the Zeekoe valley, which demonstrates a tendency of sites to be located around raw material sources, with far less sites associated around springs (Sampson 1985, Sampson et al. 2015). The ESA pattern described from the Zeekoe valley suggests that ESA hominins favoured raw material outcrops as opposed to the permanent springs (Sampson 1985, 2015). Research from Hallinan's (2013) and Sampson's (1985) work do not suggest that shelters would have been as strong a magnet for ESA hominins as water and/ or raw materials.

The spatial distribution of ESA artefacts in the Cederberg is tethered to the rivers as they provide both water and raw materials in the form of large cobbles (Hallinan 2013). The geologic composition of the Tankwa Karoo and the ephemerality of the Bos River does not allow for the transport and formation of large cobbles that can be used by ESA hominins. The presence of ESA and ESA/MSA artefacts on the Cape geology section of the Bos River, and the lack of ESA artefacts along the Bos River that flows through the Karoo geology, demonstrates a reliance on sizeable raw material cobbles and boulders during the ESA, which are produced during transport in a large and active fluvial system, like the Olifants and Doring Rivers. The spatial distribution of ESA and ESA/MSA artefacts produces a pattern suggestive of an inability or non-desire to access the semi-desert area of the Tankwa Karoo, due to the episodicity of the water channel.

7.2 MSA

7.2.1 Artefact distribution

The higher frequency of MSA artefacts as compared to artefacts from the ESA and LSA, may suggest that the area around the Bos River was exploited more intensively during this period in comparison to the ESA and LSA periods. This is true for the ESA at least, although, the larger time scale of the MSA needs to be considered when comparisons are made with the LSA.

The spatial distribution of artefacts relating to the MSA along the section of the Bos River that flows over Cape geology shows a similar pattern to surface artefacts described from the Olifants valley and along the Varsche River (Soutfontein) in Namaqualand (Mackay et al. 2010). In both instances, MSA people favoured the areas along ridges and next to the floodplain of the prominent river (Mackay et al. 2010; Hallinan 2013). Hallinan's (2013) research demonstrates the occupation of rocky outcrops during the MSA, occurring away from the water course (Figure 7.3).

The MSA artefacts that were recorded on the portion of the Bos River that topographically runs across Karoo geology, demonstrated the same pattern as above, favouring small ridges over-looking the river as well as areas just above the floodplain of the Bos River. Sampson's (1985) work in the Zeekoe valley does not reveal this pattern, as concentrations of MSA artefacts (referred to as Orangian, Florisbad, and Zeekoegat by Sampson) are predominantly recorded as quarry sites (at raw material outcrops), with some examples located near springs (Sampson 1985; Sampson et al. 2015).

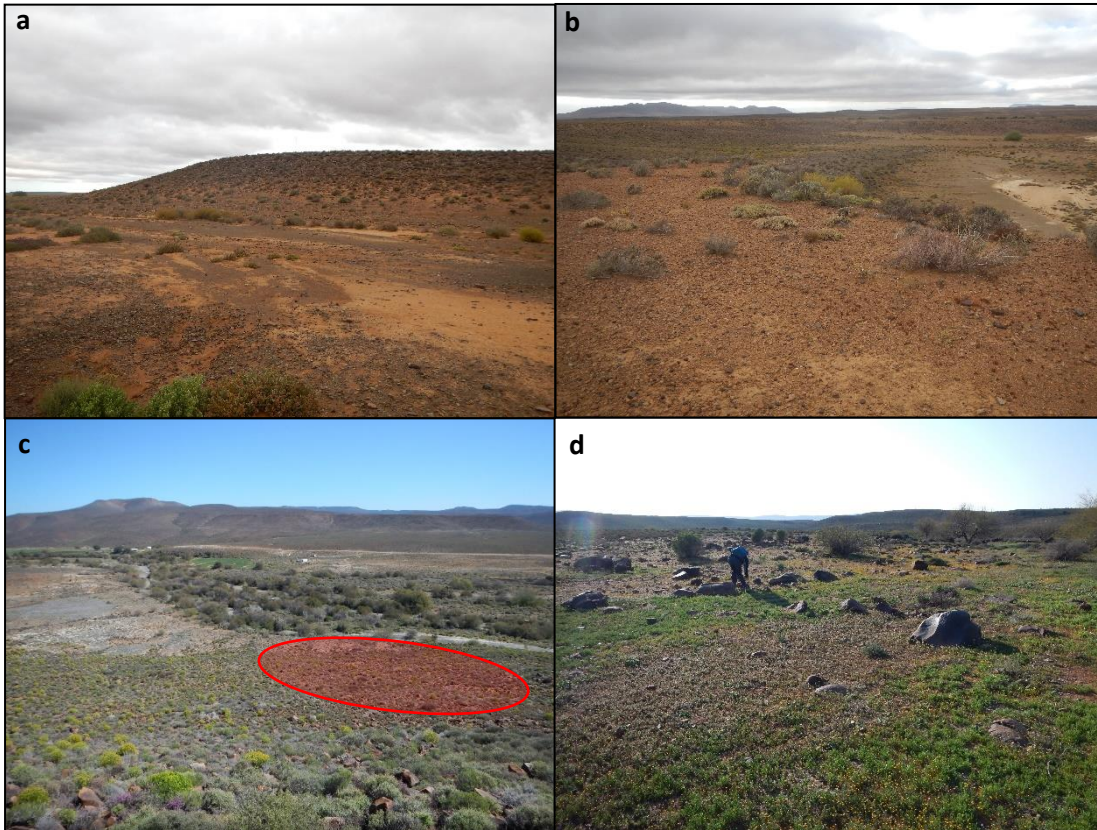


Fig. 7.3 Physical setting of MSA landscape-use: **(a and b)** depict MSA occupational areas on top of ridges on the Dwyka geology, and are often associated with LSA artefacts; **(c and d)** shows the MSA landscape-use on the Ecca geology as being near to the Bos river, either on small hills or directly alongside the river.

The overall distribution of MSA artefacts along the Bos River compares more closely to the spatial patterns that were described by Hallinan (2013) in the Olifants valley, with an occupation of ridges over-looking a major water source. The spatial distribution of MSA artefacts is further described in terms of other possible factors influencing occupational areas, such as water, raw material availability and the possibility of food.

7.2.2 Water availability

The distribution of MSA artefacts along the Bos River shows that access to water was an important factor in determining site preferences. This distribution of artefacts shares a similar pattern to what has been described on Cape geology (Mackay et al. 2010; Hallinan 2013; Mackay et al. 2015; Will, Mackay & Phillips 2016). The attraction to the water channel may in fact be a result of prehistoric people tracking migratory game. The relatively long time span of the MSA encompasses a number alternating periods of glacial and interglacial stages (Chase & Meadows 2007), which would suggest multiple drier and wetter periods in the Tankwa Karoo. The Tankwa Karoo could have been exploited episodically during periods of intense wet periods, which may have resulted in a higher frequency of MSA artefacts.

7.2.3 Raw material availability

MSA artefacts were made from a range of raw materials from quartzite and silcrete from the Cape geology, to CCS and hornfels from the Karoo geology. Artefacts that were recorded as MSA artefacts on the Cape geology section of the Bos River utilised locally available and workable-sized quartzite and hornfels cobbles.

The raw material use during the MSA on the Karoo geology shows a strong preference towards the use of hornfels, with occasional CCS (found in the Bos River as cobbles) and silcrete use. The nature and structure of hornfels facilitates the manufacture of thin laminar products, which is a common trait of MSA hornfels artefacts (flaking along bedding planes). Exploitation of the natural bands/layers in rocks is not uncommon, with evidence of this strategy being employed on banded ironstone from Kathu Pan (Wilkins

2017). The locally available hornfels occurs in its primary context (outcrop), as well as in a secondary context as cobbles in the river bed. The proximity of the Bos River allows prehistoric people to access the various raw materials located on Cape and Karoo environments. The relationship between the spatial distribution of artefacts and the raw material used could suggest an interaction and movement of the prehistoric people between the Cederberg and Tankwa Karoo.

As described previously in this chapter, the low energy system of the Bos River does not facilitate the production and transport of large rounded cobbles for producing sizeable artefacts. The production of elongated blades and convergent flakes during the MSA does not require large cobbles, and is therefore not a limiting factor as it was during the ESA. The lack of ESA assemblages which require large cobbles, and the presence of MSA and LSA assemblages which utilised much smaller raw material packages, alludes to the idea that the availability of morphologically desirable raw material was an influential decision-making factor.

7.2.4 Shelter

The occupation of shelters and caves during the MSA is well recorded in southern Africa, with examples of sites along the coastal regions (Marean et al. 2004; Villa et al. 2009; Volman 1981) and interior regions (Mackay 2006, 2009; Högberg & Larsson 2011; Porraz et al. 2013a), although open-air MSA sites are commonly noted in the Cederberg region where shelters are available (Hallinan 2013; Will, Mackay & Phillips 2015).

The spatial patterning described by Hallinan (2013) shows that an occupation of rocky outcrops on ridges are favoured during the MSA. It is not surprising that the spatial distribution of MSA artefacts along the Bos River would reflect a similar pattern to the MSA artefacts occurring in open-air contexts, recorded by Hallinan (2013). Evidence of an earlier MSA signal was recorded along the floodplains of the Bos River on Karoo geology, whereas later MSA artefacts, for example the Nubian-like core (Hallinan & Shaw 2015; Will, Mackay & Phillips 2015) were found on higher lying ridges immediately adjacent to the Bos River (Figure 7.3). The reason for this could be related to certain inventions, for example, water flasks being made by prehistoric people during the MSA, which would allow them to travel greater distances away from water sources (Texier et al. 2010). The implication of this would mean that MSA people were able to provision for water and opportunistically occupy the Tankwa Karoo, even if water was scarce.

The occupation and use of shelters do not appear to be a significant constraint to people during the MSA in the Cederberg and Tankwa Karoo region, with examples of MSA artefacts being recorded from open-air sites (Hallinan 2013; Hallinan & Shaw 2015; Will, Mackay & Phillips 2015) and shelters (Mackay 2009). Although the episodic attractiveness of the Tankwa Karoo would allow people during the MSA to exploit resources in the region, the lack of shelters around the Bos River would not be a deterrent.

7.2.5 Technological organisation

A third (n=466) of the total flakes analysed consisted of elongated flakes, which included points, blades and general elongated flakes (Figure 7.4a and 7.4b). The application of a laminar flaking strategy may have been favoured because of the natural laminar bedding planes of the hornfels. The implementation of a blade-based reduction system allows for the production of multiple standardised artefacts, situating this reduction strategy in a reliable system (Kelly 1988; Bleed 1989; Nelson 1991). This pattern is reflected in the MSA artefacts along the Bos River with a total of thirteen blade cores recorded, three of which were produced on hornfels, while blades (elongated flakes with parallel sides) make up a third of the artefacts that were classified under a laminar technology, with half showing evidence of faceted platforms.

One advantage of a blade reduction strategy is the ability to maximise the economy of the raw material by producing many blanks from a single blade core, through multiple techniques (Bar-Yosef & Kuhn 1999). Initial preparation of a blade core is time-intensive, although, each blade is produced in the same manner as the previous one, which increases the ability to create numerous blades following the initial setup of the core (Bar-Yosef & Kuhn 1999). Only 10% of the total blades recorded retained any form of cortex, suggesting that the cores would have been intensely flaked.



Fig 7.4a Examples of MSA blades: **(a)** patinated hornfels blade from Cape geology; **(b)** semi-translucent quartzite blade from Cape geology; **(c)** dolerite blade on Dwyka geology; **(d, h)** broken hornfels blades on Eccca geology; **(e, f, i-l)** hornfels blades on Eccca geology with varying degrees of patination and weathering; **(g)** proximal CCS blade on Eccca geology. Faceted (including dihedral) platforms on **a, b, e, f, g, and k.**



Fig 7.4b Examples of MSA convergent flakes/points: **(a)** quartzite convergent flake from Cape geology; **(b-m)** convergent hornfels flakes from the Eccra geology with moderate to heavy patina; **(b)** point with potential edge damage on the ventral surface.

The other reason for the lack of cortex, focusing particularly on the hornfels blades, could be due to the exploitation of outcrop hornfels. Hornfels cobbles procured from the rivers will, in most cases, have 100% cortex in the initial phase of procurement, which will decrease as the reduction process is implemented. Outcrop hornfels on the other hand, will have a weathered surface on the exterior face (furthest side away from the dolerite dyke), while the rest of the outcrop will have no cortex. Although outcrop cortex can be identified on artefacts, only one of the three hornfels blade cores retained outcrop cortex, while the other two had cobble cortex. It is more likely that the reason for the lack of cortical hornfels pieces is because of the repetitive manufacture of blades from a single core.

The MSA material reflects an expedient-based technology, with evidence of curation and preparation of the artefacts forming a small component. A total of three Levallois or prepared core technology examples were recorded, with two preferential unidirectional point cores and one Nubian-like core (Figure 7.5). The Nubian-like core is interesting as it is manufactured on a non-local piece of silcrete, with examples of this technology recently described along the Tankwa River (Hallinan & Shaw 2015) and Doring River (Will, Mackay & Phillips 2015) in the eastern Cederberg. This non-local silcrete artefact appears to have been transported from the Cederberg to the Tankwa Karoo over a distance of approximately 20 km, embedded in a maintainable, individual provisioning system (Kuhn 1992; Bleed 1986). Although only one example of a Nubian-like core was recorded in this study area, the implications of discovering a technology that is characteristically described in North Africa (Olszewski et al. 2010; Usik et al. 2013), suggests a convergent evolution rather than an interconnection between these populations, whereby similar technologies are produced by people occupying a similar regional setting (Hallinan & Shaw 2015; Will, Mackay & Phillips 2015).

The lack of formal retouched tools or diagnostic artefacts, such as bifacial points and backed artefacts during the MSA in this area suggest that this area may or may not have been occupied during certain periods in time, for example the Still Bay and Howiesons Poort, or that a technological system that is not particularly focused on curation nor expediency, but rather on the batch-processing of standardised flakes that could be used and discarded with minimal energy and time costs being applied (Torrence 1989).

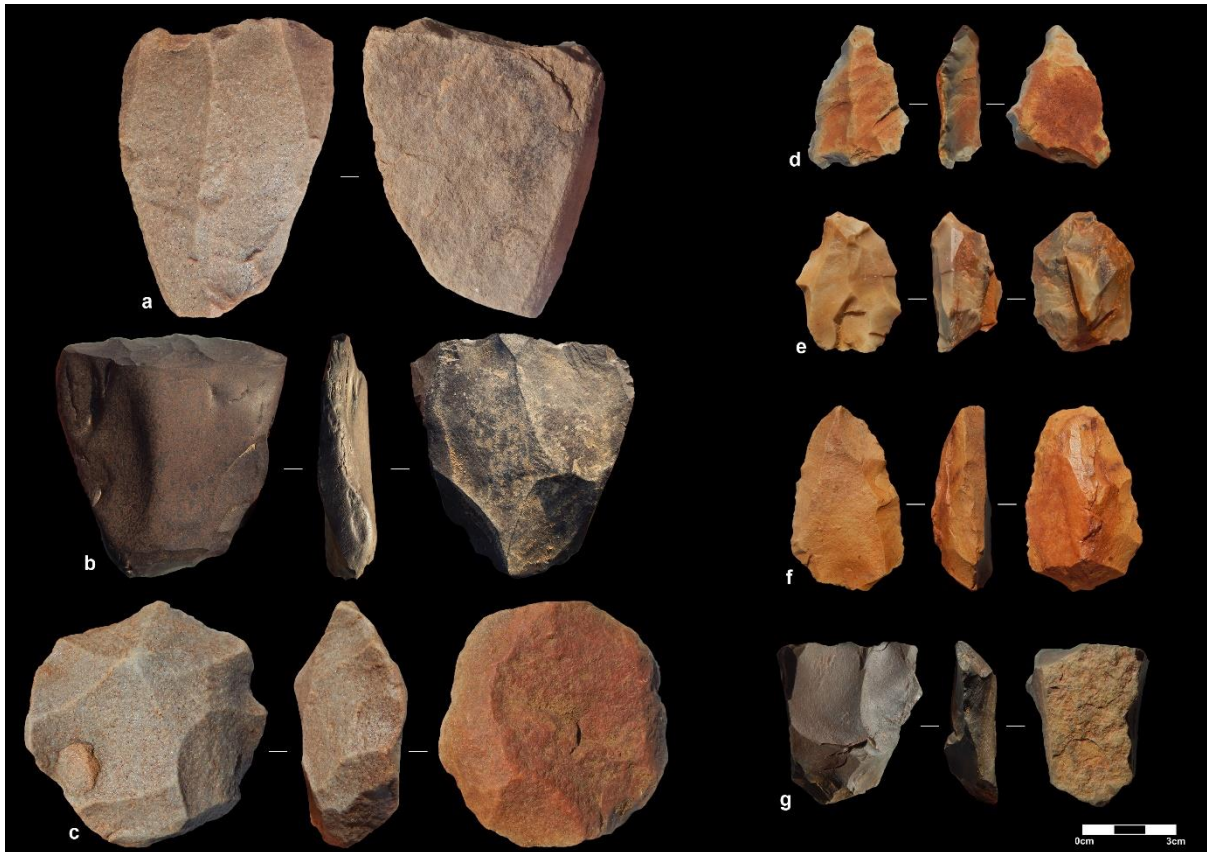


Fig. 7.5 Examples of MSA cores: **(a)** quartzite single platform core recorded on Cape geology; **(b)** single platform hornfels core from Cape geology portion to produce thin elongated flakes, retaining 40% cobble cortex and evidence of platform preparation; **(c)** radial quartzite core recorded on the Cape/Dwyka boundary with both surfaces being flaked, although one surface is favoured; **(d)** possible point core on heavily patinated CCS from Cape/Dwyka transitional area; **(e)** CCS preferential point core (two hemispheres) from Cape geology; **(f)** Nubian-like silcrete point core from Eccca geology; **(g)** single platform hornfels core to produce thin elongated flakes from Eccca geology, retaining outcrop cortex/bedding plane.

The overall low density of artefacts in this area, in comparison to the Cederberg and Zeekoe Valley, suggests that the Bos River was used only episodically during times of increase resource availability, rather than regularly and seasonally. The technological organisation of the MSA artefacts recorded shows a focus towards a reliable, blade-based system, which further suggests that the MSA people would have viewed the Tankwa Karoo as containing predictable resources, but presumably only during periods when the time and energy spent

on forays would be rewarded with a higher return in resources (Torrence 1989; Nelson 1991; Kuhn 1992; Bousman 1993).

7.2.6 Conclusion of MSA

An increasing ability to adapt to a semi-desert region and the procurement and use of smaller packages of raw materials, allowed prehistoric people of the MSA to access and exploit areas like the Tankwa Karoo. The abundance of locally available hornfels cobbles in the Tankwa Karoo facilitated an expedient blade production. The initial preparation of a blade core is time intensive, however, multiple blades following this preparation can be produced (Bar-Yosef & Kuhn 1999).

The spatial distribution and expedient technology described during the MSA (like the LSA), suggests that occupation of the Bos River was episodic and relatively brief, which further supports the argument that the Bos River was exploited during periods when there were periods of rains that were more intense than the general seasonal variation in rainfall.

7.3 LSA

7.3.1 Artefact distribution

The widespread use of the topographic landscape during this period is evident from ongoing research in South Africa, with particular relevance to the Cederberg (Low & Mackay 2016; Orton & Mackay 2008; Hallinan 2013; Parkington 1980). The distribution of diagnostic LSA artefacts analysed along the Bos River are sporadic and relatively infrequent, making up only 20% of the total analysed artefacts. The low density of LSA material could be explained by

the frequency of artefacts that were placed into an indeterminate age bracket as they proved difficult to distinguish between the LSA and MSA pieces. Different land use patterns were identified for the LSA across the different geologies.

The principal landscape-use patterns during the LSA that occur on the Karoo geology were either associated with small boulder outcrops, flat exposed areas near the river (on the alluvial floodplain), or at localised points on small ridges (Figure 7.6). As discussed in chapter 4, the Tankwa Karoo is characterised by its relatively flat shale-based topography, which is not conducive for the formation of shelters. Areas at right angles to the Bos river were surveyed to acquire a spatial distribution of artefacts away from the river. Only two LSA artefacts were recorded during this trip, which were found on a ridge between the Bos River and a relatively large tributary known as the Biesra River, suggesting that this area did not attract regular occupation.

The LSA locations recorded along the Bos River on the Cape geology tend to be on areas along rock faces/talus slopes and rock shelters (Figure 7.6). Assemblages that were in rock shelters were often associated with rock art, while the assemblages relating to rock walls were scattered along the surface and down the talus slope. Clusters of LSA artefacts along these rock faces are often associated with the presence of a grassy or sandy non-vegetated area, referred to as a 'sward' (Milton 1978). The patterns observed along the Cape geology section of the Bos River displays a similar pattern to LSA occupational areas observed by Hallinan (2013) in the Orange River Valley, specifically the occupation of shelters and overhangs.



Fig. 7.6 Physical setting of LSA landscape-use: (**a and b**) are examples of LSA sites on Cape geology, with an overhang (**a**) and talus slope/sward in front of the rock face (**b**); (**c and d**) show the use of open flat areas (**c**) and outcrops (**d**) on Dwyka geology; (**e and f**) show the different areas of occupation during the LSA on Ecca geology, with evidence of artefacts along ridges (**c**) and outcrops (**d**) overlooking the river.

7.3.2 *Water availability*

The ability to access a broader landscape is demonstrated during the LSA as prehistoric people started to occupy shelters away from major water sources (Hallinan 2013). These hunter-gatherers could provision for water scarce areas. Fragments of ostrich eggshell flasks from the rock shelter sites of De Hangen and Diepkloof Rock Shelter (Parkington & Poggenpoel 1971; Texier et al. 2010) on Cape geology, and the evidence of cached ostrich eggshell flasks from the open-air contexts of Connie's Limpet Bar along the West Coast near Elands Bay Cave (Parkington 2006; Jerardino et al. 2009) and Thomas' Farm in the Northern Cape (Henderson 2002), demonstrate that LSA hunter-gatherers had the ability to plan ahead and store water, which not only increased their foraging range, but also untethered themselves from water points. The advantage of provisioning a place with these flasks in an area where water is unpredictable (Kuhn 1992), would enable access and occupation to water-scarce regions, such as the Tankwa Karoo.

The distribution of LSA artefacts along the Bos River express a variety of settings, influenced by the lack of suitable shelters or caves. LSA artefacts recorded on the Cape geology section of the Bos River focused in rock shelters and along rock faces that were located directly next to the Bos River and its tributaries. This is similar to the pattern expressed by Hallinan (2013).

LSA sites described from the Zeekoe valley were focused on the edge of the hills and/or ridges, as there was a lack of shelters in the area (Sampson 1985). The advantage of occupying a higher ground as opposed to the lower ground provides a greater visibility of the surrounding area. Concentrations of LSA artefacts that occurred on the Karoo geology express three different patterns, one of which was the occupation of specific points on the

ridges overlooking the river (Figure 7.6). A focus on the edge of ridges is a common characteristic of LSA landscape use in the Tankwa Karoo, with evidence of this preference along the Tankwa River (Hallinan pers. comm 2016; Hallinan & Shaw 2015). The two remaining patterns observed for the LSA on Karoo geology are the occupation of a flat open area near to the Bos River, and the focus around small dolerite outcrops overlooking the river.

The increase adaptive competence of LSA hunter-gatherers allowed for them to provision for areas where water was known to be unpredictable, therefore decreasing their dependency on major water courses.

7.3.3 Raw material availability

The use of quartzite that was prevalent during the ESA diminishes dramatically during the LSA along the Bos River, with a shift in focus towards the use of finer-grained raw materials like CCS, hornfels and quartz, which all contribute 75% of the recorded LSA artefacts, with less than 10 percent of artefacts being produced from silcrete. The LSA assemblages that were recorded on the Cape geology section of the Bos River show a wider range of raw material use and a higher frequency of artefacts in comparison to the study area that incorporates Karoo geology. Artefact analysis from sites, such as Renbaan, Klein Kliphuis, and Aspoort on Cape geology, describe quartz as generally being the preferred raw material choice during the LSA, with CCS and hornfels contributing only a small percentage of the total LSA assemblage (Smith & Ripp 1978; Orton & Mackay 2008; Mackay 2009).

The low density of artefacts on the Karoo geology suggests that LSA hunter-gatherers were not frequently occupying this area. Rather, the occupation of the Tankwa Karoo appears to be episodic, procuring small cobbles from the low-energy Bos River. Hornfels occurs in a primary context on the Karoo geology, allowing for an easy procurement of hornfels for artefacts. A definite source of the CCS is unknown, although the Matjiesfontein chert band may be a likely source of the CCS, along with the example of a quarry site of grey pitted CCS recorded on the Cederberg/Tankwa boundary (Smith & Ripp 1978). The Bos River contains an abundance of small irregular chert cobbles, that could be introduced into the Doring River and easily transported into the Cederberg region. These unworked CCS cobbles that were recorded in the cobble bed of the Bos River during surveys, which contained bands of fine-grained blue/grey cherts. The preference towards geologically local hornfels (40%) and CCS (25%) during the LSA suggest that people were procuring the raw materials on or near to the Karoo geology, the presence of cobbles cortex promotes the utilisation of the Bos River as a source, with an occasional exploitation of quartz from Cape geology.

The use of hornfels and CCS during this period is not uncommon as it has been observed on Cape geology by Hallinan (2013). Chert and chalcedony artefacts are characterised by their crypto-crystalline structure, which allows better control and a more predictable fracture in the manufacturing process. The size of the high-quality CCS nodules is usually small, seldom exceeding a dimension of 5 cm, with artefacts retaining cobble cortex. The crypto-crystalline structure and small packages of CCS allow for the manufacture of smaller artefacts (bladelets) and refined retouch seen in scrapers. The manufacturing of smaller tools is more attractive for highly mobile people as these artefacts are more

portable and easily transported (Parkington 1980), with further evidence of this derived from Robberg and ELSA bladelet industries (Low & Mackay 2016).

Prehistoric people during the LSA would benefit more from the Tankwa Karoo than hominins living during the ESA because of the availability of favoured small CCS nodules for producing bladelets and fine retouched tools. CCS nodules do, however, occur in the Cederberg through the transportation in the Doring River. Raw material options and availability along the Bos River would have been more attractive for people during the LSA than for people during the ESA, because of the size constraints of the CCS and raw materials introduced in the tillites. Although the Tankwa Karoo provides workable stone for people living during the LSA, it does not seem likely that these people were going into this region to gather raw materials, given that the Doring River as well as the Cape Geology contains an abundance of workable stone, such as quartz, hornfels and silcrete.

7.3.4 Shelter

The number of recorded rock shelters and cave sites from surveys (Hallinan 2013) and excavations in the neighbouring Cederberg region (Parkington & Poggenpoel 1971; Smith & Ripp 1978) show that the occupation of these shelters are more favoured and more frequent during the LSA than during the ESA or MSA. The distributional pattern presented by Hallinan (2013) shows a preference towards an occupation of shelters in the region, with only some examples of LSA artefacts being recorded in open-air site deflation hollows (Hallinan 2013). Unlike the hominins during the ESA or the earlier part of the MSA, mobile groups of prehistoric people during the LSA and the later parts of the MSA would not be tethered to specific points on the landscape, such as water sources, as they were able to

provision for this by creating water flasks from ostrich eggs (Henderson 2002; Texier et al. 2010).

The distribution of artefacts on the section of the survey that occurred on Cape geology seemed to depict a similar pattern, with LSA artefacts being recorded in small shelters and rock overhangs (Figure 7.3), often associated with rock art. Distributional patterns described from the adjacent Cederberg region suggest that LSA people showed a preference towards shelters rather than raw material sources and water, which is more common during the ESA and MSA (Hallinan 2013). Prehistoric people were not constrained to areas on the physical landscape, but selected specific places to occupy on the landscape. Although this may be the case in areas where shelters are known, it did not stop episodic occupation of the Tankwa Karoo during periods of attractiveness during the LSA. Scatters of LSA artefacts were recorded from small boulder outcrops, flat exposed areas near the river (on the alluvial floodplain), or at localised points on small ridges (Figure 7.6).

The occupation and use of shelters are more noticeable during the LSA, particularly in the Cederberg (Hallinan 2013). In the Karoo where there is an overall lack of shelters, LSA artefacts were still observed and recorded, suggesting that shelters, although favourable for prehistoric people, were not a constraining factor in determining the occupation of different areas. Alternatively, the attractiveness of the Tankwa Karoo during certain episodes was too great and LSA hunter-gatherers were forced but able to exploit an area lacking shelters for brief periods.

7.3.5 Technological organisation

The technological organisation of an assemblage can reflect the challenges and responses that the tool-maker encountered on the landscape, based on the strategy and 'time' spent in manufacturing and maintaining a tool. The LSA artefacts recorded on the Karoo geology are indicative of an expedient technological method, with many of the artefacts classified as flakes with plain platforms, being produced on CCS and hornfels. Formally retouched tools were not recorded on the Karoo portion of the study area, although, nineteen retouched tools (Figure 7.7) including one adze, four backed artefacts, two miscellaneous retouched pieces and twelve scrapers, were associated on the talus slope at multiple sites along the base of a ridge on Cape geology. Backing retouch technology is generally regarded as a maintainable technological system, suggesting that resources were not always predictable and often a preference towards people provisioning were favoured (Binford 1979; Bleed 1986; Kuhn 1994).

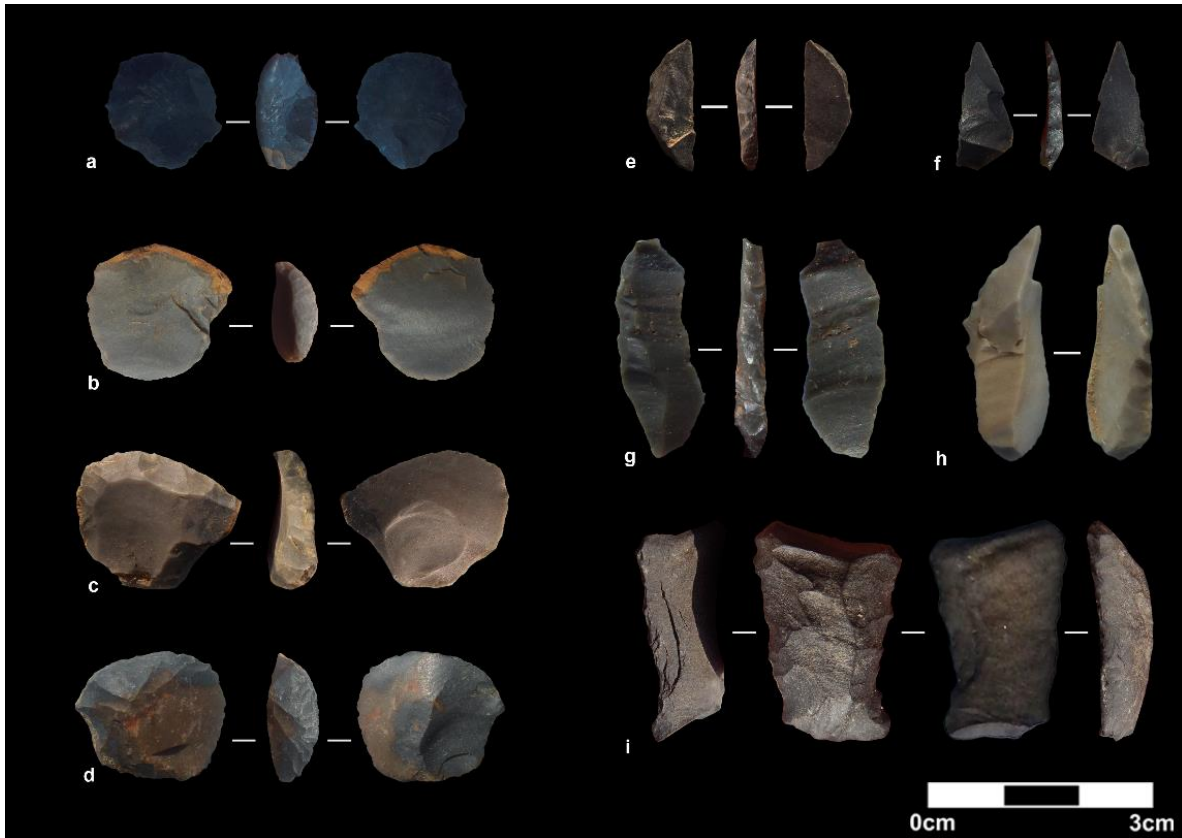


Fig 7.7 Examples of LSA formal artefacts: **(a-d)** CCS thumbnail scrapers depicting retouched lateral; **(e)** backed hornfels segment; **(f-h)** backed CCS bladelets; **(i)** hornfels adze with step-fractures/utilisation on both laterals.

LSA bladelet cores were recorded on the boundary of Cape and Karoo geologies. The bladelet flaking system during the LSA is implemented to mass produce laminar products as part of a reliable strategy (Bleed 1986; Kuhn 1992). A quarter ($n=36$) of the total cores recorded for the LSA were identified as bladelet cores, with a large majority of them exhibiting five or more bladelet removals. The low frequency of bladelets in the study area make up only three percent ($n=21$) of the total LSA flakes.

A notable assemblage containing a concentration of local (CCS) and non-local (silcrete) raw materials was recorded on a flat stretch of alluvium alongside the Bos River and between two Dwyka outcrops, approximately 10 km away from the Doring River. This assemblage

offers the opportunity to create a comparison between this area and a site in the Cederberg, which will be discussed in detail below.

A cluster of dolerite cobbles and non-anthropogenic dolerite chunks characterised this area, covering an area of approximately fifty metres by fifteen metres (Figure 7.8a). The geographic position of this assemblage, Dorsdam 12 (DRS-12), along the Bos River on the Karoo geology and near the Cape geology, would have provided a sense of safety for prehistoric people, regarding the predictability and availability of raw material resources to the eastern Cederberg (Binford 1978; Bleed 1986; Kuhn 1992).



Fig. 7.8a LSA site of DRS - 12

Analysis of the artefacts suggests a Late Pleistocene LSA character, with the presence of fine-grained materials and the preference towards a bladelet production (Figure 7.8b). This bladelet-based flaking system (Mitchell 1995; Wadley 1996; Low & Mackay 2016) in South Africa is often referred to as the Robberg industry and the ELSA (Wadley & Binneman 1985; Mackay, Jacobs & Steele 2015).

Recent research at Putslaagte 8 in the adjacent Cederberg area shows distinct differences between bladelet production during the Robberg (post-22 ka) and ELSA (pre-22 ka) periods (Mackay et al. 2015; Low & Mackay 2016). The analysis of the artefacts from

Putslaagte 8 provides insight into the technological organisations during these two periods in the context of the Cederberg, which can be related to DRS-12. Low and Mackay (2016) suggest that the ELSA bladelet production system expresses a more expedient or opportunistic strategy, with minimal core preparation while bladelet cores pertaining to the Robberg industry suggest a more formalised approach (Low & Mackay 2016). The ELSA bladelets have a larger mean size than the bladelets from the Robberg industry, and a preference towards hornfels over silcrete is described in the ELSA (Low & Mackay 2016).

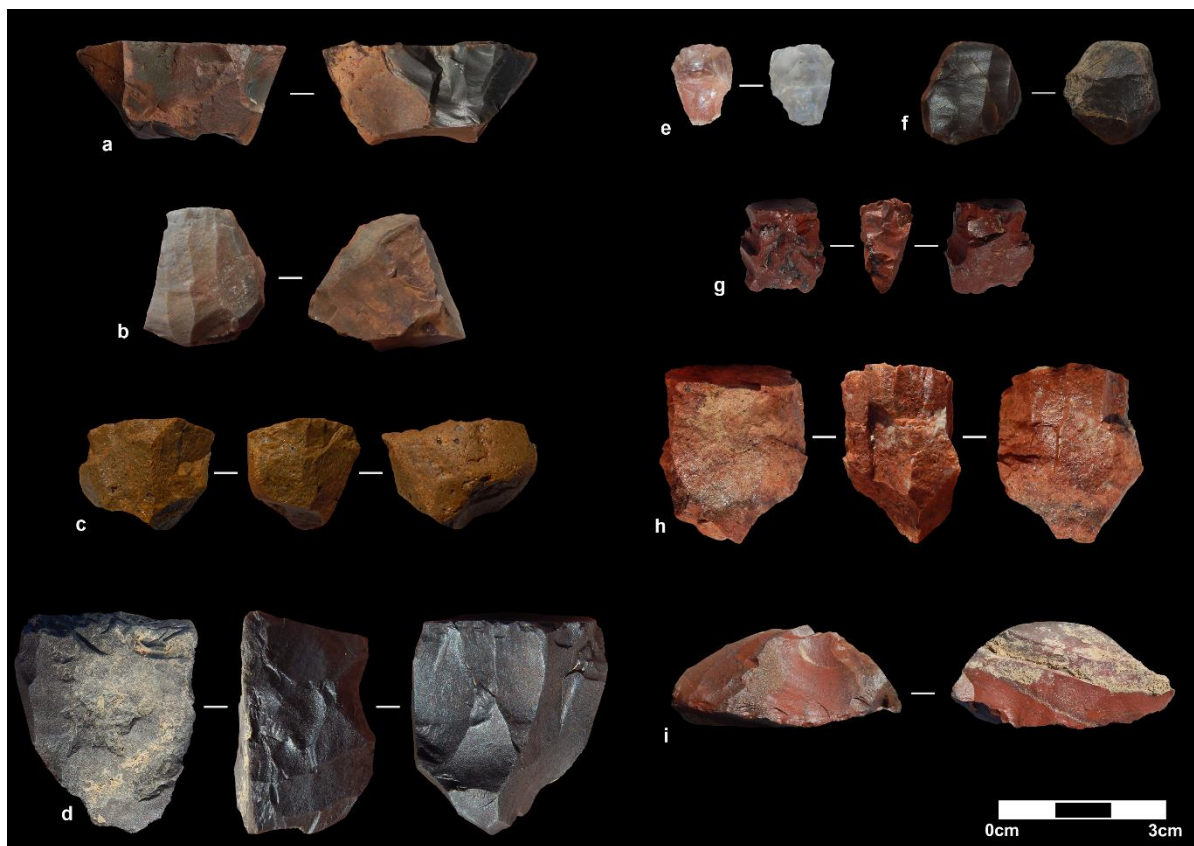


Fig 7.8b Examples of bladelet cores from DRS – 12: **(a, i)** single platform CCS bladelet cores; **(b, f)** bidirectional CCS bladelet cores; **(d)** rotated CCS bladelet core with multiple removals on thick lateral; **(c, g, h)** single platform silcrete bladelet cores; **(e)** bidirectional crystal quartz bladelet core.

CCS (n=9) is the preferred raw material at DRS-12, followed by silcrete (n=3), quartz (n=1), and an indeterminate raw material (n=1). A total of only three bladelets were recorded in this area, two of which were on CCS and one on quartz. Raw material preference from Putslaagte 8 is for quartz, with some examples of silcrete. Differences described between raw material procurement during these two time periods at Putslaagte 8 and DRS-12 is not unexpected as they occupy two different geological zones. Hornfels is locally available on the Ecca Formation of the Karoo geology, and is also transported along the Bos River. However, the absence of bladelet cores on hornfels may be indicative of the need for raw materials that are finer-grained, like CCS or quartz. The cluster of bladelet cores at DRS-12 suggest that this may have been a provisioned place, where bladelets were manufactured during 'down time' and carried away, while the bladelet cores were left for future use (Kuhn 1992; Torrence 1989).

Another issue described by Low and Mackay (2016) is the transportation of bladelets and cores during the ELSA and Robberg at Putslaagte 8. The analysis from the rock shelter revealed that the ELSA was characterised by the transport of bladelets, while the pattern of bladelet production during the Robberg industry reflected the transport of bladelet cores (Low & Mackay 2016). Although this area contains a relatively small sample size, the ratio of bladelet cores to bladelets recorded in this particular area along the Bos River, is taken to reflect a focus on the transport of bladelets rather than the cores. The combination of the concentration of bladelet production along a section of the Bos River with the research conducted at Putslaagte 8, suggests that this particular section was probably occupied pre-22 ka (ELSA) (Low & Mackay 2016). It is important to consider that these two areas occur on different geologies, which ultimately impacts raw material availability.

7.3.6 Conclusion of LSA

The environment of the Tankwa Karoo sees a drastic seasonal change between the summer and winter months. One of the fieldwork trips that was conducted during spring following the winter rains, revealed an extensive grass cover over the usually sandy alluvial plains along the Bos River. A similar description of the area was noted by Smith and Ripp (1978) during their research at Aspoort Cave which occurs on the fringe of the Tankwa and Cederberg region. It is common practice for farmers (modern and historic) to relocate their sheep during winter from the mountainous areas of the Roggeveld to pasture in the Tankwa Karoo (Smith & Ripp 1978).

These same factors that governed indigenous herders and historical farmers, and to a degree continue to govern modern farmers' seasonal migration into the Tankwa Karoo, may well have been those factors that motivated prehistoric people to occupy the Tankwa Karoo. During and directly following these winter months, the Tankwa Karoo would have contained more water and fauna (grasses and geophytes), which would in turn attract wild game to the area. The possibility of acquiring food in the form of large migratory animals and succulents, as well as occasional pools of water, are strong reasons to occupy the arid Tankwa Karoo closer to the end of winter.

Shelters are not a constraining factor for people occupying the Tankwa Karoo during the LSA, with artefact clusters situated near floodplains and on top of ridges. Prehistoric people during the LSA were making use of shelters in the Cederberg (Parkington & Poggenpoel 1971; Smith & Ripp 1978), but were capable of occupying open areas, as observed in the surveys for this thesis. The pattern emerging from the spatial distribution of LSA artefacts in the Tankwa Karoo when compared to the neighbouring Cederberg, suggests

that prehistoric people were episodically making use of the Tankwa Karoo for short periods of time.

7.4 Non-lithic evidence

Lithic analysis is useful in understanding where prehistoric people occupied the landscape, where they discarded artefacts, and how they adapted to that environment. The Tankwa Karoo environment does not promote the preservation of non-lithic material, which includes bone and wood implements, with only a few examples of ostrich eggshell fragments associated with LSA lithic material. Although stone artefacts are more resilient to taphonomic processes in comparison to other archaeological material during this time frame, there is another source of material culture that is usually preserved and demonstrates evidence of landscape-use by prehistoric hunter-gatherers, namely rock art.

Rock art is widespread across South Africa and is dominated by two different types, rock painting and rock engraving (Morris 1988; Deacon & Deacon 1999; Ouzman 2001; Lewis-Williams 2006), generally created by either San hunter-gatherers, Khoe pastoralists, or Bantu-speaking pastoralists and farmers (Lewis-Williams 2006). Rock paintings in South Africa are more prominent in, although not restricted to, the mountains of the Cederberg and Drakensberg (Deacon & Deacon 1999; Lewis-Williams 2006), whereby the different sandstones in the Cederberg and Drakensberg eroded to form shelters and flat surfaces for painting. Rock engravings are more commonly recorded on large patinated boulders (Rudner & Rudner 1968; Beaumont & Vogel 1989; Parkington, Morris & Rusch 2008) from the central plateau in the semi-arid region of the interior of South Africa (Lewis-Williams 2006), generally characterised as a flat and rocky landscape with isolated hills (Morris 1988;

Ouzman 2001). The distribution of the two rock art types is not restricted to these geographic boundaries and do occasionally overlap (Morris 1988), with examples of rock engravings occurring on suitable rocks where paintings predominate, as is true for the opposite patterning (Deacon & Deacon 1999).

Rock art and the ethnographic accounts of rock art from South Africa further reiterates the notion that a landscape is a multilevel entity that incorporates the physical environment as well as a cultural component dealing with other worlds (Vinnicombe 1996; Ouzman 2001). Shelters containing rock paintings do not imply that the shelter was used as an occupational site, nor does every shelter contain depictions of art (Deacon & Deacon 1999). The marking of areas on the landscape with rock art ultimately attaches meaning to these places (Parkington 1980; Deacon 1988; Ouzman 2001). Lewis-Williams & Dowson (1990) describe this as a two-level process where the first level describes the rock surface as a veil that separates the physical world from the spiritual world, often reflected in paintings of animals interacting with the surface of the rock, animals sometimes appearing to be coming out of cracks (Lewis-Williams & Dowson 1990). The second level demonstrates the specificity of the rocks or shelters chosen to be marked, where certain areas are regarded as more appropriate for certain activities, for example rain-making or initiation (Lewis-Williams & Dowson 1990; Deacon & Deacon 1999).

There are considered to be three main forms depicted in rock art, namely animals, human figures and a schematic or inanimate category (Morris 1988; Deacon & Deacon 1999), with possibly therianthropic subjects as a fourth form. The meanings and interpretations allude to a range of possible subjects that include trance, healing, rain-making, hunting, and initiation (Lewis-Williams 1994, 2006; Deacon & Deacon 1999). Other

animals are also depicted in both rock paintings and engravings, often associated with that specific environment (Deacon & Deacon 1999), although this is not always true, as is the case with a lack of petroglyphs depicting springbok in the Upper Karoo that were ubiquitous on the large plains (Morris 1988). The lack of springbok petroglyphs is strange given the large migratory herds of these animals in the Karoo (a more in-depth explanation of this will be described in a later paragraph).

The section of the Bos River that is located on Cape geology near its confluence with the Doring River does include shelters and overhangs, but with only two of them containing rock paintings. Soutkloof (STK - 1) has a wave-like procession of multiple black daubes (lines), with red daubes and crosses present (Figure 6.5), whilst the other site Soutkloof – 3 (STK-3) contains poorly preserved red rock paintings and is associated with a stone wall that enclosed most of the overhang. One example of a rock painting was recorded on the Karoo geology along the Bos River. Sonop - 2 (SNP-2), has a depiction of a large red eland torso (approximately 20 cm in length), with a visible tail and upper parts of the hind limbs. Underneath the eland torso are two diagonal lines, and below them is a smaller torso of an antelope with a tail, but no visible limbs. Depictions of eland are not uncommon (Morris 1988), although rock paintings are far less common in the Karoo than engravings. SNP-2 was located on an outcrop near the Bos River but alongside the main road that stretches across the Tankwa Karoo.

There were no examples of rock engravings in the survey area, which is not attributable to a lack of usable surfaces, as the area contained numerous patinated dolerite boulders (Figure 7.9). Although no rock engravings were recorded, one farm worker

explained that he had seen engraved rocks on top of the mountain to the east of the Bos River (presumably the Roggeveld Mountains).



Fig. 7.9 Dolerite boulders along the Bos River, with the potential for engraving as seen in bottom picture with recent scratches and drawing.

The general lack of any form of rock art along the Bos River is interesting, given the density of rock art in the Cederberg Mountains (Manhire, Parkington & van Rijssen 1983; Lewis-Williams 1985, 1994; Vinnicombe 1996; Deacon 1988; Deacon & Deacon 1999) and the number of recorded rock engravings in the central part of South Africa (Rudner & Rudner 1968; Morris 1988; Beaumont & Vogel 1989; Ouzman 2001; Parkington, Morris & Rusch 2008). The implication of the absence of rock art around the Bos River could be attributed to the area being occupied episodically and opportunistically rather than regularly or intensely. Rituals and trances are often associated with water and rain, with ethnographic accounts that describe shamans as going to water pits, or to where people drink water, or viewing the water as being alive (Lewis-Williams & Dowson 1990).

Although this thesis is focused specifically on the lithic material, it is important to consider the other facets of the archaeological record that contribute to the material culture of prehistoric hunter-gatherers. A more detailed review and survey of rock art in this area is required to test if this spatial distribution occurs throughout the Tankwa Karoo and what the causality for this pattern (or lack thereof) along the Bos River is.

7.5 Episodic magnets of attraction

The information gained through the above interpretation of the stone artefacts that were recorded during the surveys along the Bos River, combined with the availability of water and stone raw materials in this area, suggests that the Tankwa Karoo was not being occupied or utilised to gain access to water or stone raw materials. The occurrence of silcrete along the Bos River demonstrates a potential movement of prehistoric people between the Cederberg (Cape geology) and the Tankwa Karoo. Evidence provided in Hallinan's (2013) project along

the Olifants River describes landscape-use, particularly in the ESA, as being tethered to the river as a source of water and raw material.

If the impact of the magnets of attraction discussed above, raw material sources, water availability and shelters, are not the main impetus for occupying the Tankwa Karoo, then the question is, what would be the 'pull' factor that would draw prehistoric people from a relatively predictable environment in the Cederberg to the Tankwa Karoo? This can perhaps be answered through an understanding of the global palaeoclimate and the effects that this could have had on the episodic migrations of animals.

Palaeoclimate

The palaeoclimate at a global scale can be divided into two distinct periods; the glacial periods characterised by a decrease in sea levels, temperature and rainfall, and the interglacial periods which are characterised by an increase in sea levels as the glaciers melt, an increase in temperature and moisture, as well as an increase in precipitation (Shackleton & Opdyke 1973). Precipitation is probably the key factor that could explain the attraction to the Tankwa Karoo, particularly considering that a low-latitude region like South Africa would have been more affected by precipitation than temperature during the alternating glacial and interglacial periods (Chase & Meadows 2007). It is also suggested that the WRZ would have extended north-eastwards during the interglacial periods (Chase & Meadows 2007), increasing the rainfall in the Roggeveld Mountains which feeds the Tankwa Karoo with water. The increase in precipitation in the area, perhaps stronger episodes of rain during the interglacial periods, would see an increase in vegetation, as observed during surveys

following the winter rainfall months, and attract wild animals to the area, which would encourage prehistoric people to occupy the Tankwa Karoo.

Alternating periods in the Earth's palaeoclimate record of warm and cold temperatures (Marine Isotope Stages (MIS)) affect the environment at a large scale (Figure 7.10), which inherently has an impact on the behaviour of prehistoric people. The dearth of well-stratified deposits containing Acheulean assemblages in the WRZ is problematic for extracting information regarding the palaeoclimate of the area, while there is an absence of ESA material before 1 Ma along the coastal regions of South Africa, which can be attributed to the high sea levels described by Compton (2011). The non-existence of a local palaeoclimate record for the Tankwa Karoo during the Stone Ages is problematic in determining what affects were imposed on the prehistoric people. The implementation of a global palaeoclimate recorded, coupled with the palaeoclimate records from the Cederberg (Chase & Meadows 2007; Mackay, Stewart & Chase 2014) and the Zeekoe valley (Sampson 1985; Sampson et al. 2015) offers some integrity of a relative palaeoclimate model for the Tankwa Karoo.

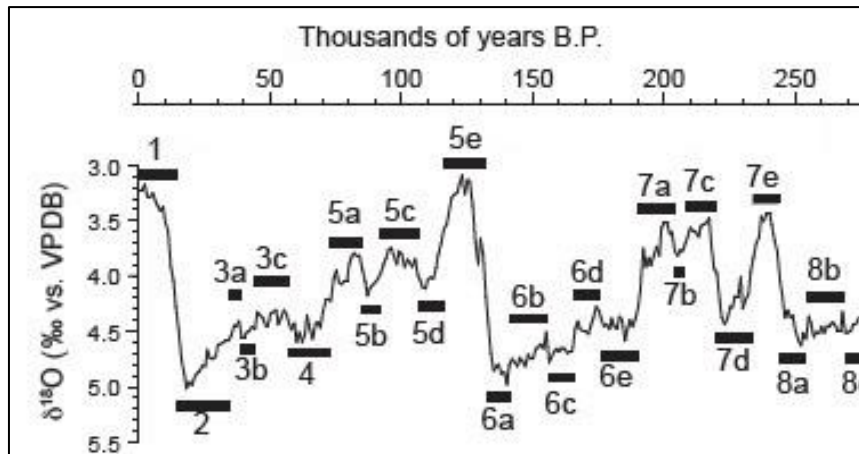


Fig. 7.10 Marine Isotope Stages over the last 300 ka years (from Railsback et al. 2015).

The known abandonment of the Zeekoe valley across the Stone Ages can be determined based on the lack of excavated iconic artefacts (Sampson 1985). This correlates with cycles of cold and dry periods, possibly relating to glacial periods of MIS 8 (278 ka – 245 ka), MIS 6 (190 ka – 131 ka), and MIS 4 (74 ka – 58 ka) (Sampson 1985), while Mackay, Stewart & Chase (2014) attribute the technological systems during MIS 4 and MIS 2 (31 ka – 15 ka) of South Africa as a period coalescent state, whereby interactions between populations are at their highest (Mackay, Stewart & Chase 2014). Perhaps this relationship between coalescence described in the southernmost Africa during glacial periods and the abandonment of arid regions (Upper Karoo) during glacial periods, provides insight into the occupational variability expressed along the Bos River. The archaeological record along the Bos River could therefore be a reflection of episodic occupation during interglacial periods, whereas the abandonment of the area occurs during glacial periods.

Occupation of the Zeekoe valley during the MSA is related specifically to MIS 5 (131 ka – 72 ka) with the emergence of the Orangian assemblage (Sampson 1985). Another period of abandonment of the Zeekoe valley follows the Orangian, during MIS 4, with the re-occupation of the area during MIS 2. These periods of occupation and abandonment can

be determined based on the presence and lack of certain iconic artefacts in the region. Archaeological evidence pertaining to the Acheulean along the Bos River is lacking, which, following the pattern expressed in the Zeekoe valley, may be attributed to the colder periods of the glacial period of MIS 28 at 1 Ma (Railsback et al. 2015).

The MSA occurs during MIS 6 through to MIS 3 (190 ka – 31 ka), which is characterised by two glacial and two interglacial periods. MIS 5 (131 ka – 72 ka) is problematic in that this period entails multiple short alternating periods of cold and warm weather (MIS 5a through the MIS 5e). Research conducted by Chase & Meadows (2007), propose the possibility of an extension of the rainfall zone in a north-east direction, during glacial periods (Chase & Meadows 2007). The implications of this could not only result in an increase in precipitation levels in the Tankwa Karoo, but also in the Roggeveld Mountains which provides water to the Tankwa Karoo, making the Bos River opportunistically attractive during these periods. Perhaps the episodic occupation of the Tankwa Karoo is not bound to glacial or interglacial periods, but rather it is opportunistically exploited when conditions are favourable.

During these periods of climatic variation, probably episodes of more intense rains, may have prompted the utilisation of the Bos River. The attractiveness to the Tankwa Karoo is encouraged during wetter seasons with the (possibly denser) growth of numerous plant species of the Succulent Karoo biome, which would attract wildlife, and possibly prehistoric people. Water and nutrients needed by animals and prehistoric people could be supplied by certain succulents on the landscape, as some species are edible and have a high-water content (Ripley et al. 2013), while geophytes found in the Succulent Karoo biome (*hyacinthaceae*) contain edible underground storage organs (Steyn, Bester & Bezuidenhout

2013). The variety of plant species that exists in the Succulent Karoo biome, particularly in the Tankwa Karoo, act as a source of nutrients for wildlife. The accumulation of animal herds feeding on the fauna would have been opportunistically attractive for prehistoric people.

It is important to keep in mind that the palaeoclimate record for the Tankwa Karoo is not well defined, particularly in comparison to the neighbouring Cederberg. The changes in the climate described above are based on general trends at a global scale. However, palaeoenvironmental at a global scale, combined with records from the surrounding areas, provide clues for what the climate in the Tankwa Karoo may have been like.

The fluctuations in the earth's climate, specifically precipitation, has a resounding effect on the behaviour of prehistoric people, in terms of their adaptive capabilities and areas of occupation. The technological organisation of the stone artefacts is suggestive of brief expedient forays into the Tankwa Karoo, possibly during periods when there were more intense episodes of rains and a greater amount of resources available (falling above the average rainfall). The question of why prehistoric people were occupying the Tankwa Karoo is broadly related to the climatic 'push-pull' conditions, but could be more specifically linked to an increase in food resources during more intense climatic episodes.

The migration of large springbok herds was a phenomenon that occurred infrequently and episodically, and persisted until the end of the nineteenth century (see Roche 2004). The recollections of these migrations are based on traveller accounts and newspaper articles from the Upper Karoo, which have been synthesised by Roche (2004). Although the Upper Karoo is far removed from the Tankwa Karoo, there were recorded sightings of springbok

migrations as far south as the town of Calvinia, 60km north of the Bos River. Research on modern springbok populations in the Kalahari demonstrates that these antelopes can survive and maintain their body weight in areas that lack water through advanced adaptive abilities rather than a reduced water requirement (Nagy & Knight 1944). Although springboks can survive in arid regions, they are limited to amount of stress that they can endure before migrating to more resource-laden areas. The cause of these mass migrations is linked to climate, particularly during severe droughts in the northern extent of South Africa.

The weather in the Upper Karoo, which is considered to be situated in the SRZ (Chase & Meadows 2007) is controlled by the anticyclonic Kalahari High Pressure cell (KHP), that during winter causes a temperature inversion layer that prevents the moist maritime air along the east coast of South Africa from infiltrating the interior. During the summer months, the KHP moves south, lifts and disappears, allowing the moist air to penetrate the interior and results in rain. During periods of severe droughts, the springboks were forced or 'pushed' to migrate south during the winter months to the WRZ areas, where they were 'pulled' towards more fertile lands to pasture. The disappearance of the KHP is often characterised by northerly tropical winds that bring with it moisture and rain, resulting in the springbok retreating to the interior (Roche 2004). The emergence of this wind and the arrival of the springbok back into the interior (Bushmanland) was often associated with rain by hunter-gatherers (Bleek & Lloyd 1911).

The most dramatic recorded episodicity in the Karoo is that of the springbok migrations, which had the possibility of attracting prehistoric people into the Karoo and Tankwa Karoo region. The evidence of springbok migration (occurring further south from

their usual habitat) is evident in the ethnographic and archaeological record from the Abbot's Cave in the Seacow Valley (Plug 1993) as well as the site of SK400 in Namaqualand (Dewar et al. 2006). Ethnographic accounts suggest that springboks not only provided food and raw materials, but also served a purpose in rituals pertaining to rain (Lewis-Williams & Dowson 1999). Referred to as *Whai* by the San, the patterns and association of springbok movements with rain were known to the hunter-gatherers (Bleek & Lloyd 1911).

A high possibility of rain would be characterised by the return of the springbok back to the interior during the summer months (and possibly the tropical winds), which would be known to the hunter-gatherers (Bleek & Lloyd 1911). The link between the rains and springbok offered some predictability for hunter-gatherers in that severe droughts would see an episodic migration of springbok further south, however, the time frame of these migrations was unpredictable (Roche 2004). It is likely that this pattern of migration would have been known by prehistoric hunter-gatherers that occupied the Tankwa Karoo, exploiting the region during episodes of increased rainfall in the Tankwa Karoo or perhaps the aridity of areas further north, which forced animal populations to migrate south and occupy the Tankwa region.

Depictions of springbok rock art exist in the Karoo, although they are rare and far less common than the eland (Morris 1988). Not much can be said on the rock art as the area around the Bos River only contains one rock painting of an eland, and a smaller antelope that has faded. The possibility that springbok migrations could have extended further south into the Tankwa Karoo during severe droughts in the Upper Karoo should not be disregarded.

Although geographically distant from the Tankwa Karoo, the high number of springbok remains from SK400 in Namaqualand and Abbot's Cave in the Seacow Valley (known migratory routes of springboks; Roche 2004) suggest that hunter-gatherer populations during the LSA in these areas were using springboks as a source of protein and raw material resource. Interestingly, both sites show a high percentage of juvenile/neonatal springbok remains (Plug 1993; Dewar et al. 2006). Springbok lamb in the spring or early summer (September to December), which provides evidence of when prehistoric hunter-gatherers were occupying these areas. Furthermore, the example from Namaqualand demonstrates the collective occurrence of male, female and juvenile remains, suggesting that the hunting of these animals took place during a severe drought, as springbok of all ages and both sexes only tend to amalgamate under such conditions (Dewar et al. 2006). Plug (1993) suggests that pregnant ewes or ewes that had recently given birth were targeted due to their high fat reserves during pregnancy. Both sites, although far apart, demonstrate hunting of springbok during spring/summer months, which coincides with the rainfall period in the interior, further demonstrating that these occurred during episodes of drought that pushed springboks further south.

The underlying theme with the paragraphs concerning springbok migrations is the unpredictability and episodicity of this marginal Karoo environment, that under specific instances, the Tankwa Karoo and Karoo proper could be opportunistically occupied for short intense periods.

The alternating patterns of warm and cool periods, and the possibility of increased episodes of aridity and rainfall, coupled with the migratory pattern of springbok suggests that during

certain periods in time, areas like the Tankwa Karoo, could become more richly populated with fauna and flora than it usually is. These changes would have been known to the prehistoric people, who would occupy and take advantage of such areas for a short period of time. A theme presented by Binford is that occupation of places is not constant or redundant (Binford 1981b), and therefore these areas can be used in various ways over different times, representing traces of prehistoric occupation (Holdaway, Shiner & Fanning 2004). However, the noticeably low frequency and the expedient technologies from the analysed artefacts along the Bos River suggest that this area was rarely occupied, and when conditions favoured movement into the Tankwa Karoo, it was only brief and episodic.

The surface lithic material provides a unique understanding of the occupation of the Tankwa Karoo during the Stone Ages. The Bos River is characterised as a low energy fluvial system that receives water from the rains in the Roggeveld Mountains to the east. The formation of large rounded cobbles, such as those observed in the Olifants (Hallinan 2013) and Doring Rivers (Mackay et al. 2014; Hallinan pers. comm. 2015) is hindered by the ephemerality of the Bos River. The raw material procurement strategies combined with the distribution and expedient technological organisation of the artefacts analysed on the Karoo portion of the Bos River suggest a brief use of this area throughout the MSA and LSA with a general absence of ESA material.

The evidence described in this chapter suggests an over-arching theme of episodicity, where the Tankwa Karoo would have been an episodic magnet of attraction for prehistoric people during the MSA and LSA periods, particularly the inhabitants of the Cederberg region. The availability of water and raw materials in the Tankwa Karoo was likely

not the primary impetus for prehistoric occupation in the region, but rather, the episodically increase in available resources of fauna and flora would have served as the necessary attractive magnets of attraction

Chapter 8: Conclusion

This thesis aims not to dismiss or devalue research focusing solely on shelters, but rather to emphasise the importance and legitimacy that surface stone tools can offer through a technological analysis of the artefacts (Straus 1979; Kandel et al. 2005; Forssman & Pargeter 2014). Analysing all the artefacts along the Bos River seemed the best way to deal with a topographic surface with few overhangs and sparse, but recognisable scatters of stone artefacts. These artefacts were chronologically placed into the archaeological record by relating the iconic artefacts recorded to the fairly well-stratified sequence of the southern Cape (Hallinan 2013). It is through the combination of information gained from shelters, open-air sites, and surface archaeological material, that a better understanding of prehistoric landscape use can be inferred.

To appreciate the relevance of surface material and conduct this project, it was necessary to first understand the history of landscape archaeology through a processual approach to the archaeological record expressed in the work of Binford. This approach sought to understand the formation of different sites on the landscape and succeeded in explaining logistical variability in a group of people (Binford 1978, 1980). The introduction of ethnoarchaeology and middle range theory provided a method for comparing modern hunter-gatherer groups to those hunter-gatherers responsible for the archaeological record (Raab & Goodyear 1984). Schiffer (1988) suggested that sites would be exposed to multiple taphonomic

factors, which include erosion, trampling, people, and time-averaging (Holdaway & Wandsnider 2006; Bailey 2007).

Following this, an understanding of the term 'landscape' as a physical and conceptual construct was required, where 'places' on the topographic landscape were of symbolic importance to prehistoric people and not necessarily to procure raw materials (Parkington 1980). The excavation of shelters and caves provided the necessary chronology of southern African archaeology, even before suitable dating techniques were implemented (Goodwin & van Riet Lowe 1929). The repetitive and redundant appearance of iconic or temporally diagnostic artefacts recovered from such excavations, provided some temporal validity for open-air sites (Mackay et al. 2013; Hallinan & Shaw 2015; Will, Mackay & Phillips 2015), and allowed for large-scale research projects, such as this project and others (Hallinan 2013) to be conducted.

The legitimacy of surface archaeological material and the ability to analyse this material is possible because of the evolving approaches towards the surface material that evolved from the 1900s to the present, incorporating a combination of logistical variability of mobile groups (Binford 1978) and discard behaviour (Holdaway, Shiner & Fanning 2004), the effects of taphonomy on sites and artefacts (Schiffer 1988; Bailey & King 2010), the technological organisation of artefacts (Binford 1978; Kuhn 1994), the notion of palimpsests (Bailey 2007) and time-averaging (Holdaway & Wandsnider 2006), and using a temporally diagnostic artefact approach (Holdaway, Shiner & Fanning 2005; Hallinan 2013).

A technological analysis demonstrated the expedient technologies of prehistoric people used in the manufacture of the recorded stone artefacts along the Bos River. The implications of an expedient technology suggest that minimal effort was required to produce several sharp-edged artefacts (Binford 1979; Kuhn 1994; Ugan et al. 2003), therefore little time was spent in this region manufacturing these tools (Torrence 1989). The idea that a brief occupation of the Bos River seemed likely, was further emphasised by viewing the technology in relation to other factors that could potential attract prehistoric people to the region. These included water availability, raw material availability, shelter, and other more seasonally affected resources such as plant and animals. Furthermore, the episodicity of occupation in this region still exists today, with farmers moving their livestock from the Roggeveld Mountains to the Tankwa Karoo plains during the winter months.

An application and understanding of the above approaches provides a unique opportunity to characterise occupation and landscape use of the marginal Tankwa Karoo. The results from this thesis show an opportunistic and episodic occupation of the Tankwa Karoo, particularly during periods of more intense resource availability. The lack or minimal presence of ESA artefacts in the Tankwa Karoo suggests that there was little attractiveness towards this area, while evidence of MSA and LSA artefacts, albeit low frequencies and expedient technologies, perhaps suggest that the Tankwa Karoo would be occasionally favourable for brief periods.

Historically, there has been a relationship between the Tankwa Karoo and surrounding mountain ranges, with farmers seasonally migrating their animals between the mountains during the dry summer months and the Tankwa Karoo plains during the wetter

winter months (Smith & Ripp 1978). Furthermore, historical accounts of large southward migrating springbok herds from the north in the Upper Karoo during periods of drought, could offer a possible reason for brief exploitation of areas like the Tankwa Karoo (Roche 2004).

Archaeological research in the Tankwa Karoo is still in its infancy, but the potential to expand and conduct research in this semi-desert area can offer valuable information on landscape-use during the Stone Ages (Sampson 1985; Holdaway & Wandsnider 2006). The archaeological record from the Cederberg is relatively well understood and enables archaeologists to chronologically relate iconic artefacts, recorded on surfaces of indeterminate age, to the archaeological record. To fully understand the occupation of the Tankwa Karoo, surveys will need to be conducted near and on the Roggeveld Mountains to the east of the Bos River. Implementing the same survey strategy followed in this thesis to the plateau and gullies of the Roggeveld Mountains will allow for a comparable analysis of the lithic material analysed along the Bos River. The effect of the Roggeveld Mountains in terms of the rainfall entering the Tankwa Karoo, also has the potential of introducing raw materials from the plateau through river transport.

There is a large portion of the Bos River drainage that is predominantly sediment, with large incised gullies of approximately two metres deep, while other areas of the Bos River are characterised by a layer of sediment covering small cobbles. OSL sampling on open-air river terrace sediment has been conducted along the Doring River in the Cederberg, which has provided minimum ages for artefacts that are lying on those sediment bodies (Mackay et al. 2014; Will, Mackay & Phillips 2015). A similar approach could be

carried out on the sediment-rich areas of the Bos River that contain artefacts. Sampling of the Bos River can also be conducted to understand the geomorphology of the river, which can provide more detailed information on cobble transport and potentially the type of rainfall and climate required to create the Bos River drainage system.

Further potential for expanding this project would be to locate sites containing stratified deposit to provide a regional temporal scale of the Tankwa Karoo, rather than relying solely on the archaeological record from the Cederberg. Although the formation of rock shelters in the Tankwa Karoo is low, there is more potential for shelters to have formed in the Roggeveld Mountains.

Prehistoric people were not restricted to caves and rock shelters, but were actively engaging with the broader topographical and conceptual landscape. The Bos River surveys have not only presented information on landscape-use behaviours in this part of the Tankwa Karoo during the Stone Ages, but have also shown the value of incorporating surface material into the archaeological record for a more comprehensive understanding of human evolution. The information presented in this thesis provides evidence towards the Tankwa Karoo serving as an opportunistic magnet of brief episodic attraction for prehistoric people during favourable periods.

References

- Almond, J. 2014. Proposed SANParks upgrade at Elandsberg rest camp and staff village at Roodewerf park office, Tankwa Karoo National Park, Hantam local municipality, Northern Cape. Palaeontological specialist study: combined desktop and field-based assessments. Natura Viva cc. (Unpublished)
- Ambrose, S.H. 2001. Palaeolithic technology and human evolution. *Science* 291: 1748-1753.
- Ambrose, S.H. 2006. Howiesons Poort lithic raw material procurement patterns and the evolution of modern human behaviour: A response to Minichillo (2006). *Journal of Human Evolution* 50(3): 365-369.
- Anderson, D.G. & Smith, S.D. Eds. 2003. *Archaeology, history and predictive modelling: research at Fort Polk 1972 – 2002*. Tuscaloosa: Alabama Press.
- Anschuetz, R., Wilshusen, H. & Scheick, C.L. 2001. An archaeology of landscapes: perspectives and directions. *Journal of Archaeological Research*. 9(2): 157-211.
- Archer, W. & Braun, D.R. 2010. Variability in bifacial technology at Elandsfontein, Western Cape, South Africa: a geometric morphometric approach. *Journal of Archaeological Science*. 37: 201-209.
- Ashmore, W. & Knapp, A.B. Eds. 1999. *Archaeologies of Landscape: Contemporary Perspectives*. Malden: Blackwell.
- Backwell, L., d'Errico, F. & Wadley, L. 2008. Middle Stone Age bone tools from the Howiesons Poort layers, Sibudu Cave, South Africa. *Journal of Archaeological Science* 35: 1566-1580.
- Bailey, G.N. & King, G.C.P. 2010. Dynamic landscapes and human dispersal patterns: Tectonics, coastlines, and the reconstruction of human habitats. *Quaternary Science Reviews*: 1-21.
- Bailey, G.N. 2007. Time perspectives, palimpsests and the archaeology of time. *Journal of Anthropological Archaeology* 26: 198-223.
- Balla, A., Pavlogeorgatos, G., Tsiafakis, D. & Pavilidis, G. 2014. Efficient predictive modelling for archaeological research. *Mediterranean Archaeology and Archaeometry*. 14(1): 119-129.

- Bar-Yosef, O. & Kuhn, S. 1999. The big deal about blades: laminar technologies and human evolution. *American Anthropologist* 101(2): 322-338.
- Barham, L.S. 1987. The bipolar technique in southern Africa: a replication experiment. *South African Archaeological Bulletin* 45(145): 45-50.
- Barton, C.M. 1997. Stone tools, style, and social identity: an evolutionary perspective on the Archaeological record. *Archaeological Papers of the American Anthropological Association*.7(1): 141-156.
- Beaumont, P.B. 1990a. Kathu. In *Guide to Archaeological Sites in the Northern Cape*. P.B. Beaumont. & D. Morris, Eds. Kimberley: McGregor Museum. 75-101.
- Beaumont, P.B. 1990b. Wonderwerk Cave. In *Guide to Archaeological Sites in the Northern Cape*. P.B. Beaumont. & D. Morris, Eds. Kimberley: McGregor Museum. 101-134
- Beaumont P.B. & Vogel J.C. 1989. Patterns in the age and context of rock art in the Northern Cape. *The South African Archaeological Bulletin*. 44: 73-81.
- Beaumont, P.B. & Vogel, J.C. 2006. On a timescale for the past million years of human history in central South Africa. *South African Journal of Science*. 102: 217-228.
- Bender, B. 1989. The history of liberal arts curriculum. In *Tracing Archaeology's Past: The Historiography of Archaeology*. Christenson, A.L. Ed. Carbondale: Southern Illinois University Press. 54-61
- Bender, B. 2002. Time and landscape. *Current Anthropology* [Special issue]. 43(4): 103-112.
- Beyene, Y., Katoh, S., WoldeGabriel, G., Hart, W.K., Uto, K., Sudo, M., Kondo, M., Hyodo, M. et al. 2013. *PNAS*. 110(5): 1584-1591. DOI: 10.1073/pnas.1221285110
- Binford, L. 1964. A consideration of archaeological research design. *American Antiquity* 29: 425-441.
- Binford, L.R. 1978. Dimensional analysis of behaviour and site structure: learning from an Eskimo hunting stand. *American Antiquity* 43(3): 330-361.
- Binford, L.R. 1979. Organizational and formation processes: looking at curated technologies. *Journal of Anthropological Research* 35: 255-273.

Binford, L.R. 1980. Willow smoke and dogs' tails: hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45(1): 4-20.

Binford, L.R. 1981a. *Bones: Ancient Men and Modern Myths*. New York: Academic Press.

Binford, L.R. 1981b. Behavioral archaeology and the "Pompeii Premise". *Journal of Anthropological Research* 37(3): 195-208.

Bleed, P. 1986. The optimal design of hunting weapons: maintainability or reliability. *American Antiquity* 51(4): 737-747.

Bleek, W.H.I. & Lloyd, L.C. 1911. *Bushman Folklore*. London: George Allen & Company. Digitised in 2007. Available: <https://archive.org/details/specimensofbushm00bleeuoft>

Blumenschine, R.J. 1987. Characteristics of an early hominid scavenging niche. *Current Anthropology* 28(4): 383-407.

Blumenschine, R.J. & Peters, C.R. 1998. Archaeological predictions for hominid land use in the paleo-Olduvai Basin, Tanzania, during lowermost Bed II times. *Journal of Human Evolution* 34: 565-607.

Blumenschine, R.J., Masao, F.T., Tactikos, J.C. & Ebert, J.I. 2008. Effects of distance from stone source on landscape-scale variation in Oldowan artefact assemblages in the Palea-Olduvai Basin, Tanzania. *Journal of Archaeological Science*. 35: 76-86.

Botha, R. 2008. Prehistoric shell beads as a window on language evolution. *Language & Communication*. 28: 197-212.

Boone, J.L. & Smith, E.A. 1998. Is it evolution yet? A critique of evolutionary Archaeology. *Current Anthropology* [Special Issue: The Neanderthal Problem and the Evolution of Human Behaviour]. 39(S1); S141-S174.

Bousman, C.B. 1993. Hunter-gatherer adaptations, economic risk and tool design. *Lithic Technology* 18(1/2): 59-86.

Bousman, B.C. 2005. Coping with risk: Later Stone Age technological strategies at Blydefontein Rock Shelter, South Africa. *Journal of Anthropological Archaeology* 24: 193-226.

Braun, D.R. 2010. Australopithecine butchers. *Nature*. 466:828.

Braun, D.R., Plummer, T., Ditchfield, P., Ferraro, J.V., Maina, D., Bishop, L.C. & Potts, R. 2008. Oldowan behaviour and raw material transport: perspectives from the Kanjera Formation. *Journal of Archaeological Science*. 35: 2329-2345.

Braun, D.R., Levin, N.E., Stynder, D., Herries, A.I.R., Archer, W., Forrest, F., Roberts, D.L., Bishop, L.C. et al. 2013. Mid-Pleistocene hominin occupation at Elandsfontein, Western Cape, South Africa. *Quaternary Science Reviews*. 82: 145-166.

Brown, K.S., Marean, C.W., Herries, A.I.R., Jacobs, Z., Tribolo, C., Braun, D., Roberts, D.L., Meyer, M.C. & Bernatchez, J. 2009. Fire as an engineering tool of early modern humans. *Science* 325: 859-862.

Byrne, W.J. 1976. The resource question and rescue archaeology. *Bulletin*. 8: 109-121.

Charrié-Duhaut, A., Porraz, G., Cartwright, C.R., Igreja, M., Connan, J., Poggenpoel, C. & Texier, P.-J. 2013. First molecular identification of a hafting adhesive in the Late Howiesons Poort at Diepkloof Rock Shelter (Western Cape, South Africa). *Journal of Archaeological Science* 40(9): 3506-3518.

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

Chase, B.M. & Meadows, M.E. 2007. Late Quaternary dynamics of southern Africa's winter rainfall zone. *Earth Science Reviews* 84: 103-138.

Chazan, M., Ron, H., Matmon, A., Porat, N., Goldberg, P., Yates, R., Avery, M., Sumner, A. et al. 2008. Radiometric dating of the Earlier Stone Age sequence in Excavation I at Wonderwerk Cave, South Africa: preliminary results. *Journal of Human Evolution*. 55: 1-11.

Chazan, M., Avery, M.D., Bamford, M.K., Berna, F., Brink, J., Fernandez-Jalvo, Y., Goldberg, P., Holt, S. et al. 2012. The Oldowan horizon in Wonderwerk Cave (South Africa): Archaeological, geological, paleontological and paleoclimatic evidence. *Journal of Human Evolution*. 63(6): 859-866.

Clarke, D.L. 1968. *Analytical Archaeology*. London: Methuen.

Clark, J.L. 2011. The evolution of human culture during the later Pleistocene: using fauna to test models on the emergence and nature of "modern" human behaviour. *Journal of Anthropological Archaeology*. 30:273-291.

Compton, J.S. 2001. Holocene sea-level fluctuations inferred from the evolution of depositional environments of the southern Langebaan Lagoon salt marsh, South Africa. *The Holocene*. 11(4): 395-405.

Cochrane, G.W.G. 2008. The transition from Howiesons Poort to post-Howiesons Poort industries in southern Africa. *South African Archaeological Society*. 10: 157-167.

Conard, N.J. 2008. A critical view of the evidence for a southern Africa origin of behavioural modernity. *South African Archaeological Society Goodwin Series*. 10: 175-179.

Conard, N.J., Porraz, G. & Wadley, L. 2012. What is in a name? Characterising the 'post-Howieson's Poort' at Sibudu. *South African Archaeological Bulletin* 67(196): 180-199.

Conard, N.J., Soressi, M., Parkington, J.E., Wurz, S. & Yates, R. 2004. A unified lithic taxonomy based on patterns of core reduction. *South African Archaeological Bulletin* 59(179): 13–17.

Corvinus, G., 2004. Homo erectus in East and Southeast Asia, and the questions of the age of the species and its association with stone artifacts, with special reference to handaxe-like tools. *Quaternary International*. 117: 141-151.

Cruz-Uribe, K., Klein, R.G., Avery, G., Avery, M., Halkett, D., Hart, T., Milo, R.G., Sampson, C.G. et al. 2003. Excavation of buried Late Acheulean (Mid-Quaternary) land surfaces at Duinefontein 2, Western Cape Province, South Africa. *Journal of Archaeological Science*. 30: 559-575.

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

d'Errico, F., Backwell, L. & Wadley, L. 2012. Identifying regional variability in the Middle Stone Age bone technology: the case of Sibudu Cave. *Journal of Archaeological Science*. 39: 2479-2495.

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

d'Errico, F., Henshilwood, C. & Nilssen, P.J. 2001. An engraved bone fragment from c. 70,000-year-old Middle Stone Age levels at Blombos Cave, South Africa: implications for the origin of symbolism and language. *Antiquity* 75(288): 309-318.

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

de la Peña, P. 2015. Refining our understanding of Howiesons Poort lithic technology: the evidence from Grey Rocky Layer in Sibudu Cave (KwaZulu-Natal, South Africa). *PLoS ONE* 10(12): e0143451. doi:10.1371/journal.pone.0143451.

de la Torre, I. 2011. The origins of stone tool technology in Africa: a historical perspective. *Philosophical Transactions of the Royal Society B*. 366: 1028-1037.

David, B. & Thomas, J. 2008. Landscape archaeology: introduction. In *Handbook of Landscape Archaeology*. B. David & J. Thomas, Eds. New York: Left Coast Press. 27-43.

Dayet, L., Texier, P.-J., Daniel, F. & Porraz, G. 2013. Ochre resources from the Middle Stone Age sequence of Diepkloof Rock Shelter, Western Cape, South Africa. *Journal of Archaeological Science*. 40: 3492-3505.

Deacon, H.J. 2001. Modern human emergence: an African archaeological perspective. In *Humanity from African Naissance to Coming Millennia: Colloquia in Human Biology and Palaeoanthropology*. P.V. Tobias, M.A. Raath, J. Moggi-Cecchi & G.A. Doyle, Eds. Firenze: Firenze University Press. 213-222.

Deacon, J. 1984. Later Stone Age people and their descendants in southern Africa. In: Klein, R.G. (ed) *Southern African Prehistory and Palaeoenvironments*: 221-328. Rotterdam: Balkema.

Deacon, J. 1988. The power of a place in understanding southern San rock engravings. *World Archaeology* 20(1): 129-140.

Deacon, J. 1997. 'My heart stands in the hill': rock engravings in the Northern Cape. *Kronos*. 24: 18-29

Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: Uncovering the Secrets of the Stone Age*. Walnut Creek: Altamira Press.

Dennel, R. & Roebroeks, W. 2005. An Asian perspective on early human dispersal from Africa. *Nature Reviews*. 438: 1099-1104.

Dietl, H., Kandel, A.W. & Conard, N.J. 2005. Middle Stone Age settlement and land use at the open-air sites of Geelbek and Anyskop, South Africa. *Journal of African Archaeology* 3(2): 233-244.

Dewar, G. 2007. *The archaeology of the coastal desert of Namaqualand, South Africa: a regional synthesis*. Unpublished PhD thesis. Cape Town: University of Cape Town.

Dewar, G., Halkett, D., Hart, T., Orton, J. & Sealy, J. Implications of a mass kill site of springbok (*Antidorcas marsupialis*) in South Africa: hunting practices, gender relations, and sharing in the Later Stone Age. *Journal of Archaeological Science*. 33: 1266-1275.

Dunnell, R.C. 1980. Evolutionary theory and Archaeology. *Advances in Archaeological Method and Theory*. 3: 35-99.

Dunnell, R.C. & Dancey, W.S. 1983. The siteless survey: a regional scale data collection strategy. *Advances in Archaeological Method and Theory*. 6: 267-287.

Evans, U. 1994. Hollow rock shelter, a middle stone age site in the Cederberg. *Southern African Field Archaeology*. 3(2): 63-73.

Farndon, J. & Parker, S. 2009. *The illustrated encyclopedia of minerals, rocks and fossils of the world*. London: Hermes House.

Fleming, A. 2006. Post-processual landscape archaeology: a critique. *Cambridge Archaeological Journal* 16(3): 267-280.

Foley, R. 1981. Off-site archaeology: an alternative approach for the short-sited. In *Pattern of the Past: Studies in Honour of David Clarke*. I. Hodder, G. Isaac & N. Hammond, Eds. Cambridge: Cambridge University Press. 157-183.

Foley, R. 1987. Hominid species and stone-tool assemblages: how are they related? *Antiquity*. 61: 380-392.

Foley, R. & Lahr, M.M. 1997. Mode 3 technologies and the evolution of modern humans. *Cambridge Archaeological Journal* 7(1): 3-36.

Foley, R. & Lahr, M.M. 2015. Lithic landscapes: early human impact from stone tool production on the Central Saharan environment. *PLoS ONE*. 0(3): e0116482. doi:10.1371/journal.pone.0116482.

- Foley, R., Martin, L., Lahr, M.M. & Stringer, C. 2016. Major transitions in human evolution. *Philosophical Transactions of the Royal Society B*. 371: 2015229.
- Forssman, T. 2013. Missing pieces: Later Stone Age surface assemblages on the greater Mapungubwe landscape, South Africa. *Southern African Humanities*. 25: 65-85.
- Forssman, T. & Pargeter, J. 2014. Assessing surface movement at Stone Age open-air sites: first impressions from a pilot experiment in northeastern Botswana. *Southern African Humanities*. 26: 157-176.
- Gibson, N.E., Wadley, L. & Williamson, B.S. 2004. Microscopic residues as evidence of hafting on backed tools from the 60 000 to 68 000 year-old Howiesons Poort layers of Rose Cottage Cave, South Africa. *South African Humanities*. 16: 1-11.
- Gilead, D. 1970. Handaxes industries in Israel and the Near East. *World Archaeology*. 2(1): 1-11.
- Goldberg, P. & Berna, F. 2010. Micromorphology and context. *Quaternary International*. 214: 56-62.
- Goldberg, P. & Aldeias, V. 2016. Why does (archaeological) micromorphology have such little traction in (geo)archaeology. *Archaeological and Anthropological Sciences*.
- Goodwin, A.J.H. 1929. The Stone Ages in South Africa. *Journal of the International African Institute*. 2(2): 174-182.
- Goodwin, A.J.H. 1946. The Terminology of Prehistory. *The South African Archaeological Bulletin*. 1(4): 91-100.
- Goodwin, A.J.H. & van Riet Lowe, C. 1929. The Stone Age cultures of South Africa. *Annals of the South African Museum* 27: 1-289.
- Goodyear, A.C., Raab, L.M. & Klinger, C. 1978. The status of archaeological research design in cultural resource management. *American Antiquity*. 43(2): 159-173.
- Goren-Inbar, N. & Sharon, G. Eds. 2006, Invisible handaxes and visible Acheulian biface technology at Gesher Benot Ya'akov, Israel. In *Axe age: Acheulian tool-making from quarry to discard*. N. Goren-Inbar & G. Sharon, Eds. London: Routledge.

Gould, S.J. & Lewontin, R.C. 1979. The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. *Proceedings of the Royal Society of London. Series B, Biological Sciences*. 205(1161): 581-598.

Grün, R., Shackleton, N.J. & Deacon, H.J. 1990. Electron-spin-resonance dating of tooth enamel from Klasies River Mouth Cave. *Current Anthropology* 31(4): 427-432.

Grün, R. & Beaumont, P. Border Cave revisited: a revised ESR chronology. *Journal of Human Evolution*. 40: 467-482.

Hallinan, E. 2013. Stone Age Landscape Use in the Olifants River Valley, Western Cape. MPhil dissertation, University of Cape Town.

Hallinan, E., and Shaw, M. 2015. A new Middle Stone Age industry in the Tankwa Karoo, Northern Cape Province, South Africa. *Antiquity Project Gallery*. 89(344).

Harmand, S., Lewis, J.E., Feibel, C.S., Lepre, C.J., Prat, S., Lenoble, A., Boës, X., Quinn, R.L. et al. 2015. 3.3-Million-year-old stone tools from Lomekwi 3, West Turkana, Kenya. *Nature*. 521(7552): 310-315.

Hawkes, K., O'Connell, J.F., Hill, K. & Charnov, E.L. 1985. How much is enough? Hunters and limited needs. *Ethology and Sociobiology*. 6: 3-15.

Henderson, Z. 2002. A dated cache of ostrich-eggshell flasks from Thomas' Farm, Northern Cape Province, South Africa. *South African Archaeological Bulletin* 175(57): 38-40.

Hendey, Q.B. & Volman, T.P. 1986. Last interglacial sea levels and coastal caves in the Cape Province, South Africa. *Quaternary Research* 25(2): 189-198.

Henshilwood, C.S., Sealy, J.C., Yates, R., Cruz-Uribe, K., Goldberg, P., Grine, F.E., Klein, R.G.,

Poggenpoel, C., van Niekerk, K. & Watts, I. 2001. Blombos Cave, southern cape, South Africa: Preliminary Report on the 1992-1999 excavations of the Middle Stone Age Levels. *Journal of Archaeological Science* 28: 421-448.

Henshilwood, C.S. 2008. Winds of change: palaeoenvironments, material culture and human behaviour in the late Pleistocene (~77 ka-48 ka ago) in the Western Cape Province, South Africa. *South African Archaeological Society Goodwin Series*. 10: 35-51.

Henshilwood, C.S. 2012. Late Pleistocene techno-traditions in southern Africa: a review of the Still Bay and Howiesons Poort, c. 75-59 ka. *Journal of World Prehistory* 25: 205-237.

Henshilwood, C. & Marean, C.W. 2003. The origin of modern human behaviour: a review and critique of models and test implications. *Current Anthropology* 44(5): 627-652.

Henshilwood, C.S., d'Errico, F.E., Marean, C.W., Milo, R.G. & Yates, R. 2001. An early bone tool industry from the Middle Stone Age at Blombos Cave, South Africa: implications for the origins of modern human behaviour, symbolism and language. *Journal of Human Evolution* 41: 631-678.

Henshilwood, C.S., d'Errico, F., Yates, R., Jacobs, Z., Tribolo, C., Duller, G.A.T., Mercier, N., Sealy, J., Valladas, H., Watts, I. & Wintle, A.G. 2002. Emergence of modern human behaviour: Middle Stone Age engravings from South Africa. *Science* 295: 1278-1280.

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

Herries, A.I.R. 2011. A chronological perspective on the Acheulian and its transition to the Middle Stone Age in southern Africa: the question of the Fauresmith. *International Journal of Evolutionary Biology* 2011: 1-25.

Hiscock, P. & Veth, P. 1991. Change in the Australian desert culture: a reanalysis of tulas from Puntutjarpa rockshelter. *World Archaeology*. 22(3): 332-345.

Hodder, I. 1984. Archaeology in 1984. *Antiquity*. 58. Available: <https://doi.org/10.1017/S0003598X00055940>.

Hodgson, D.M. 2009. Distribution and origin of hybrid beds in sand-rich submarine fans of the Tanqua depocentre, Karoo Basin, South Africa. *Marine and Petroleum Geology* 26: 1940-1956.

Hodgson, D.M. 2014. Decoding the Blombos engravings, shell beads and Diepkloof ostrich eggshell patterns. *Cambridge Archaeological Journal* 24(1): 57-69.

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

Högberg, A. & Lombard, M. 2016. Still Bay point-production strategies at Hollow Rock Shelter and Umhlatuzana Rock Shelter and knowledge-transfer systems in southern Africa at about 80-70 thousand years ago. *PLoS ONE* 11(12). doi:10.1371/journal.pone.0168012

Holdaway, S.J., Shiner, J. & Fanning, P. 2004. Hunter-gatherers and the archaeology of discard behavior: an analysis of surface stone artifacts from Sturt National Park, western New South Wales, Australia. *Asian Perspectives* 43(1): 34-72.

Holdaway, S.J. & Wandsnider, L. 2006. Temporal scales and archaeological landscapes from the eastern desert of Australia and intermontane North America. *Anthropology Faculty Publications* 80.

Igreja, M. & Porraz, G. 2013. First functional insights into the innovative Early Howiesons Poort technology at Diepkloof Rock Shelter (Western Cape, South Africa). *Journal of Archaeological Science* 40(9): 3475-3491.

Iovita, R. & McPherron, S. 2011. The handaxe reloaded: A morphometric reassessment of Acheulian and Middle Paleolithic handaxes. *Journal of Human Evolution*. 61: 61-74.

Isaac, G. 1978. Food sharing and human evolution: archaeological evidence from the Plio-Pleistocene of East Africa. *Journal of Anthropological Research* 34: 311-325.

Isaac, G. 1981. Stone Age visiting cards: approaches to the study of early land use patterns. In *Pattern of the Past: Studies in Honour of David Clarke*. I. Hodder, G. Isaac & N. Hammond, Eds. Cambridge: Cambridge University Press. 131-155.

Inizan, M.L., Reduron-Ballinger, M., Roche, H. & Tixier, J. 1999. *Technology and Terminology of Knapped Stone*. Nanterre: Cercle de Recherches et d'Etudes Préhistoriques.

Jacobs, Z. 2010. An OSL chronology for the sedimentary deposits from Pinnacle Point Cave 13B - a punctuated presence. *Journal of Human Evolution* 59: 289-305.

Jacobs, Z., Roberts, R.G., Galbraith, R.F., Deacon, H.J., Grün, R., Mackay, A., Mitchell, P. & Vogelsang, R. et al. 2008a. Ages for the Middle Stone Age of southern Africa: implications for human behaviour and dispersal. *Science* 322: 733-735.

Jacobs, Z., Wintle, A.G., Duller, G.A.T., Roberts, R.G. & Wadley, L. 2008b. New ages for the post-Howiesons Poort, late and final Middle Stone Age at Sibudu, South Africa. *Journal of Archaeological Science* 35: 1790-1807.

Jeffares, B. 2010. The co-evolution of tools and minds: Cognition and material culture in the hominin lineage. *Phenomenology and the Cognitive Science*. 9: 503-520.

Jerardino, A. 2012. Megamiddens. *The Digging Stick*. 29(3): 12-16.

Jerardino, A., Horwitz, L.K., Mazel, A. & Navarro, R. 2009. Just before Van Riebeeck: glimpses into terminal LSA lifestyle at Connies Limpet Bar, West Coast of South Africa. *South African Archaeological Bulletin* 64(189): 75-86.

Jiménez-Arenas, J.M., Santonja, M., Botella, M. & Palmqvist, P. 2011. The oldest handaxes in Europe: fact or artefact? *Journal of Archaeological Science*. 38(12): 3340-3349.

Johnson, M. 2010. *Archaeological theory: an introduction*. 2nd ed. USA: Wiley & Blackwell.

Johnson, C.R. & McBrearty, S. 2010. 500,000 year old blades from the Kapthurin Formation, Kenya. *Journal of Human Evolution* 58(2): 193-200.

Kaifu, Y., Kono, R.T., Sutikna, T., Saptomo, E.W., Jatmiko & Due Awe, R. 2015. Unique Dental Morphology of *Homo floresiensis* and Its Evolutionary Implications. *PLoS ONE*. 10(11): e0141614. doi:10.1371/journal.pone.0141614.

Kandel, A.W. 2005. *Comparative studies in landscape archaeology*. Unpublished PhD thesis. Tübingen: Eberhard Karls University Tübingen

Kandel, A.W., and Conard, N.J. 2012. "Settlement patterns during the Earlier and Middle Stone Age around Langebaan Lagoon, Western Cape (South Africa)." *Quaternary International* 270: 15–29. doi:10.1016/j.quaint

Kandel, A.W., Felix-Henningsen, P. & Conard, N.J. 2003. An overview of the spatial archaeology of the Geelbek Dunes, Western Cape, South Africa. In: Füleký, G. (ed) *Papers of the 1st International Conference on Archaeology and Soils*: 37-44. Oxford: British Archaeological Reports International Series 1163.

Keller, C.M. 1973. Montagu Cave in prehistory: a descriptive analysis. *University of California Anthropological Records* 28: 1-150.

Kelly, R.L. 1988. The three sides of a biface. *American Antiquity* 53: 231-244.

Kelly, R.L. 1995. *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. New York: Percheron Press.

Kleindienst, M.R. 1961. Variability within the Late Acheulean Assemblage in Eastern Africa. *The South African Archaeological Bulletin*. 16(62): 35-52.

- Klein, R.G., Avery, G., Cruz-Uribe, K., Halkett, D., Hart, T., Milo, R.G., & Volman, T.P. 1999. Duinefontein 2: an Acheulean site in the Western Cape Province of South Africa. *Journal of Human Evolution*. 37: 153-190.
- Klein, R.C., Avery, G., Cruz-Uribe, K. & Steele, T. 2007. The mammalian fauna associated with an archaic hominin skullcap and later Acheulean artifacts at Elandsfontein, Western Cape Province, South Africa. *Journal of Human Evolution*. 52: 164-186.
- Kuhn, S.L. 1992. On planning and curated technologies in the Middle Palaeolithic. *Journal of Anthropological Research* 48(3): 185-214.
- Kuhn, S.L. 1994. A formal approach to the design and assembly of mobile toolkits. *American Antiquity* 59(3): 426-442.
- Kuman, K. 1998. The earliest South African industries. In *Early Human Behaviour in Global Context: The Rise of Diversity of the Lower Palaeolithic*. M. Petraglia & R. Korisettar, Eds. *Record*. London: Routledge Press. 151-186.
- Kuman, K. 2001. An Acheulean factory site with prepared core technology near Taung, South Africa. *South African Archaeological Bulletin* 173-174: 8-22.
- Kuman, K. 2014a. Oldowan Industrial Complex. In *Encyclopedia of Global Archaeology*. C. Smith, Ed. London: Springer. 5560-5570.
- Kuman, K. 2014b. Acheulean Industrial Complex. In *Encyclopedia of Global Archaeology*. C. Smith, Ed. London: Springer. 7-18.
- Kuman, K., Inbar, M. & Clarke, R.J. 1999. Palaeoenvironments and cultural sequence of the Florisbad Middle Stone Age hominid site, South Africa. *Journal of Archaeological Science* 26: 1409-1425.
- Kvamme, K.L. 1992. A Predictive site location model on the high plains: An example with an independent test. *Plains Anthropologist*. 37(138): 19-40.
- Lahr, M.M. & Foley, R. 1994. Multiple dispersals and modern human origins. *Evolutionary Anthropology*. 3(2): 48-60.
- Lahr, M.M., Foley, R., Crivellaro, F., Fernandez, J.M., Wilshaw, A., Purdon, A., Halladay-Garrett, C. et al. 2010. *Libyan Studies*. 41: 133-154.

Langley, M.C., Clarkson, C. & Ulm, S. 2008. Behavioural complexity in Eurasian Neanderthal populations: a chronological examination of the archaeological evidence. *Cambridge Archaeological Journal*. 18(3): 289-307.

Leakey, M.D. 1971. *Olduvai Gorge, volume 3: excavations in Beds I and II, 1960-1963*. Cambridge: Cambridge University Press.

Lepre, C.L., Roche, H., Kent, D.V., Harmand, S., Quinn, R.L., Brugal, J-P., Texier, P-J., Lenoble, A. 2011. An earlier origin for the Acheulean. *Nature*. 477: 82-85.

Lewis-Williams, J.D. 1985. The San artistic achievement. *African Arts*. 18(3): 54-59.

Lewis-Williams, J.D. 1994. Rock art and ritual: southern Africa and beyond. *Complutum*. 5: 277-289.

Lewis-Williams, J.D. 2006. The evolution of theory, method and technique in southern African rock art research. *Journal of Archaeological Method and Theory*. 13(4): 343-377.

Lewis-Williams, J.D. & Dowson, T.A. 1990. Through the Veil: San Rock Paintings and the Rock Face. *The South African Archaeological Bulletin*. 45(151): 5-16.

Lewis-Williams, D. & Dowson, T. 1999. *Images of Power: Understanding San Rock Art*. 2nd ed. Cape Town: Struik.

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

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

Lombard, M. 2016. Mountaineering or ratcheting? Stone Age hunting weapons as proxy for the evolution of human technological, behavioral and cognitive flexibility. In *The nature of culture*. M.N. Haidle, N.J. Conard & M. Bolus, Eds. Springer. 135-136.

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

Lombard, M. & Haidle, M.N. 2012. Thinking a bow-and-arrow set: Cognitive implications of Middle Stone Age bow and stone-tipped arrow technology. *Cambridge Archaeological Journal* 22(2): 237-264.

Lombard, M., Wadley, L., Jacobs, Z., Mohapi, M. & Roberts, R.G. 2010. Still Bay and serrated points from Umhlatuzana Rock Shelter, KwaZulu-Natal, South Africa. *Journal of Archaeological Science* 37: 1773-1784.

Lotter, M.G., Gibbon, R.J., Kuman, K., Leader, G.M., Forssman, T. & Granger, D.E. 2016. A Geoarchaeological Study of the Middle and Upper Pleistocene Levels at Canteen Kopje, Northern Cape Province, South Africa. *Geoarchaeology: An International Journal* 31: 304-323.

Low, M. & Mackay, A. 2016. The Late Pleistocene microlithic at Putslaagte 8 rockshelter in the Western Cape, South Africa. *South African Archaeological Bulletin* 71(204): 146–159.

Luedtke, B.E. 1978. Chert sources and trace-element analysis. *American Antiquity* 43(3): 413-423.

McBrearty, S. & Tyrone, C. 2006. From Acheulean to Middle Stone Age in the Kapthurin Formation, Kenya. In *Transitions before the transition: Evolution and stability in the Middle Paleolithic and Middle Stone Age*. E. Hovers & S.L. Kuhn, Eds. 257-277.

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

McCall, G.S. & Thomas, J.T. 2012. Still Bay and Howiesons Poort foraging strategies: recent research and models of culture change. *African Archaeological Review* 29: 7-50.

McCarthy, T. & Rubidge, B. Eds. 2005. *The story of Earth and life. A southern African perspective on a 4.6-billion-year journey*. Cape Town: Struik Publishers.

McNabb, J. 1998. On the move. Time, averaging and resource transport in the Oldowan. In *Stone Age Archaeology. Essays in Honour of John Wymer*. N. Aston, F. Healy, & P. Pettitt, Eds. 15-22.

McNabb, J., Binyon, F. & Hazelwood, L. 2004. The large cutting tools from the South African Acheulean and the question of social traditions. *Current Anthropology*. 45(5): 653-677.

McDougall, I., Brown, F.H. & Fleagle, J.G. 2005. Stratigraphic placement and age of modern humans from Kibish, Ethiopia. *Nature* 433: 733-736.

McPherron, S.P. 2000. Handaxes as a measure of the mental capabilities of early hominids. *Journal of Archaeological Science* 27: 655-663.

McPherron, S.P., Alemseged, Z., Marean, C.W., Wynn, J.G., Reed, D., Geraads, D., Bobe, R. & Bérart, H.A. 2010. Evidence for stone-tool-assisted consumption of animal tissues before 3.39 million years ago at Dikika, Ethiopia. *Nature*. 466: 857-860.

Mackay, A. 2006. A characterization of the MSA stone artefact assemblage from the 1984 excavations at Klein Kliphuis, Western Cape. *South African Archaeological Bulletin* 61(184): 181-188.

Mackay, A. 2008. On the production of blades and its relationship to backed artefacts in the Howiesons Poort at Diepkloof, South Africa. *Lithic Technology* 33(1): 87-99.

Mackay, A. 2009. *History and selection in the Late Pleistocene archaeology of the Western Cape, South Africa*. Unpublished PhD thesis. Canberra: Australian National University.

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

Mackay, A. 2012. *Report on excavations at Klipfonteinrand, 2011/12*. Unpublished report.

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

Mackay, A. & Marwick, B. 2011. Costs and benefits in technological decision making under variable conditions: examples from the Late Pleistocene in southern Africa. In *Keeping Your Edge: recent approaches to the organisation of stone artefact technology*. B. Marwick & A. Mackay, Eds. Oxford: British Archaeological Reports International Series 2273. 119-134.

Mackay, A., Stewart, B.A. & Chase, B.M. 2014. Coalescence and fragmentation in the late Pleistocene archaeology of southernmost Africa. *Journal of Human Evolution*. 72: 26-51.

Mackay, A., Jacobs, Z. & Steele, T. 2015. Pleistocene archaeology and chronology of Putslaagte 8 (PL8) rockshelter, Western Cape, South Africa. *Journal of African Archaeology*. 13(1): 71-98. doi:10.3213/2191-5784-10267

Mackay, A., Orton, J., Schwartz, S. & Steele, T.E. 2010. Soutfontein (SFT)-001: preliminary report on an open-air site rich in bifacial points, southern Namaqualand, South Africa. *South African Archaeological Bulletin* 65 (191): 84-95.

Mackay, A., Sumner, A., Jacobs, Z., Marwick, B., Bluff, K. & Shaw, M. 2014 Putslaagte 1 (PL 1), the Doring River, and the later Middle Stone Age in southern Africa's Winter Rainfall Zone. *Quaternary International*. 350: 43–58.

Manhire, A. 1984. *Stone tools and Sandveld settlement*. Unpublished MPhil. thesis. Cape Town: University of Cape Town

Manhire, A., Parkington, J.E. & van Rijssen, B. 1983. A distributional approach to the interpretation of rock art in the South-Western Cape. *Goodwin Series*. 4: 29-33.

Marean, C.W., Nilssen, P.J., Brown, K., Jerardino, A. & Stynder, D. 2004. Palaeoanthropological investigations of Middle Stone Age sites at Pinnacle Point, Mossel Bay (South Africa): archaeology and hominid remains from the 2000 field season. *Palaeoanthropology* 2: 14-83.

Marean, C.W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A.I.R., Jacobs, J., Jerardino, A. et al. 2007. *Nature*. 449: 905-909.

Mazel, A. & Parkington, J. 1981. Stone tools and resources: a case study from southern Africa. *World Archaeology* 13(1): 16-30.

Merton, R.K. 1968. On sociological theories of the middle range. In *Social Theory and Social Structure*. New York: Free Press. 39-72.

Mgeladze, A., Lordkipanidze, D., Moncel, M.L., Desprée, J., Chagelishvili, R., Nioradze, N. & Nioradze, G. 2011. Hominin occupations at the Dmanisi site, Georgia, Southern Caucasus: Raw materials and technical behaviours of Europe's first hominins. *Journal of Human Evolution*. 60: 571–596.

Milton, S.J. 1978. *Plant communities of Andriesgrond, Clanwilliam District*. Unpublished report. Cape Town: University of Cape Town, Bolus Herbarium.

Minichillo, T.J. 2005. *Middle Stone Age lithic study, South Africa: an examination of modern human origins*. Unpublished PhD thesis. Washington: University of Washington.

Minichillo, T. 2006. "Raw material use and behavioral modernity: Howiesons Poort lithic foraging strategies." *Journal of Human Evolution* 50(3): 359–364.

Mishra, S., Gaillard, C., Hertler, C., Moigne, A-M. & Simanjuntak, H.T. 2010. India and Java: contrasting records, intimate connections. *Quaternary International*. 223-224: 265-270.

Mitchell, P.J. 1995. Revisiting the Robberg: new results and a revision of old ideas at Sehonghong Rock Shelter, Lesotho. *South African Archaeological Bulletin* 50(161): 28-38.

Morris, D. 1988. Engraved in place and time: a review of variability in the rock art of the Northern Cape and Karoo. *South African Archaeological Bulletin*. 43: 109-121.

Morris, D. 2014. Rectification and/or regularisation of activities relating to the Bestwood township development near Kathu, Northern Cape: phase 1 archaeological impact assessment. Kimberley. (Unpublished).

Mucina, L., Jürgens, N., le Roux, A., Rutherford, M.C., Schmiedel, U., Esler, K.J., Powrie, L.W. & Desmet, P.G. 2006. Succulent Karoo Biome. In *The vegetation of South Africa, Lesotho and Swaziland*. L. Mucina, & M.C. Rutherford, Eds. Pretoria: South African National Biodiversity Institute.

Nagy, K.H. & Knight, M.H. 2004. Energy, water, and food use by springbok antelope (*Antidorcas marsupialis*) in the Kalahari Desert. *Journal of Mammalogy* 75 (4). 860-872.

Nelson, M.C. 1991. The study of technological organization. *Archaeological Method and Theory* 3: 57-100.

Norton, C.J., Bae, K., Harris, J.W.K., Lee, H. 2006. Middle Pleistocene handaxes from the Korean Peninsula. *Journal of Human Evolution* 51: 527-536.

Nowell, A. 2010. Defining behavioural modernity in the context of Neanderthal and anatomically modern human populations. *Annual Review of Anthropology*. 39: 437-452. Available: <http://www.anthro.annualreviews.org> [2013, July 2].

O'Connell, J.F. 1997. On Plio/Pleistocene Archaeological Sites and Central Places. *Current Anthropology* 38(1): 86-88.

Olszewski, D.I., Dibble, H.L., McPherron, S.P., Schurmans, U.A., Chiotti, L. & Smith, J.R. 2010. *Journal of Human Evolution* 59: 188-201.

Orton, C. 2002. *Sampling in archaeology*. UK: Cambridge University Press.

Orton, J. 2002. Patterns in stone: The lithic assemblage from Dunefield Midden, Western Cape, South Africa. *The South African Archaeological Bulletin* 57(175): 13-37.

Orton, J. 2006. The Later Stone Age lithic sequence at Elands Bay, Western Cape, South Africa: raw materials, artefacts and sporadic change. *Southern African Humanities* 18(2): 1-28.

Orton, J. 2014. The Holocene technocomplexes, a reply to Lombard and colleagues. *The South African Archaeological Society* 69 (199): 110-112.

Orton, J. & Mackay, A. 2008. New excavations at Klein Kliphuis Rock Shelter, Cederberg Mountains, Western Cape, South Africa: The Late Holocene deposits. *The South African Archaeological Bulletin* 63(187): 69-79.

Ouzman, S. 2001. Seeing is deceiving: rock art and the non-visual. *World Archaeology*. 33(2): 237-256.

Parfitt, S.A., Ashton, N.M., Lewis, S.G., Abel, R.L., Coope, R., Field, M.H., Gale, R., Hoare, P.G. et al. 2010. Early Pleistocene human occupation at the edge of the boreal zone in northwest Europe. *Nature*. 466: 229-233.

Parkington, J. 1972. Stone implements as information. *Goodwin Series* 1: 10-20.

Parkington, J. 1976. Coastal settlement between the mouths of the Berg and Olifants rivers, Cape province. *The South African Archaeological Bulletin* 31(123/124): 127-140.

Parkington, J. 1977. Soaqua: hunter-fisher-gatherers of the Olifants River Valley Western Cape. *The South African Archaeological Bulletin* 32(126): 150-157.

Parkington, J. 1980. Time and place: some observations on spatial and temporal patterning in the Later Stone Age sequence in southern Africa. *The South African Archaeological Bulletin* 35(132): 73-112.

Parkington, J. 1987. Changing views of prehistoric settlement in the Western Cape. In *Papers in the Prehistory of the Western Cape*. J.E. Parkington & M. Hall, Eds. 4-23. Oxford: British Archaeological Reports International Series 332(i).

Parkington, J. 1993. The neglected alternative: historical narrative rather than cultural labelling. *The South African Archaeological Bulletin* 48: 94-97.

Parkington, J. 2001. Mobility, seasonality and southern African hunter-gatherers. *The South African Archaeological Bulletin* 56(173/174): 1-7.

Parkington, J. 2006. *Shorelines, Strandlopers and Shell Middens*. Cape Town: Creda Communications.

Parkington, J. 2013. Rounded but not reworked? Spatial patterning in the stone tool assemblage from Dunefield Midden. *The South African Archaeological Bulletin* 68(198): 211-216.

Parkington, J. & Poggenpoel, C. 1971. Excavations at De Hangen, 1968. *The South African Archaeological Bulletin* 26(101/102): 3-36.

Parkington, J. & Poggenpoel, C. 1987. Diepkloof Rock Shelter. In *Papers in the prehistory of the Western Cape, South Africa*. J.E. Parkington & M. Hall, Eds. Oxford: British Archaeological Reports International Series 332(ii). 269-293.

Parkington, J. & Manhire, A. 2003. The domestic context of fine line rock paintings in the Western Cape, South Africa. *Kronos* 29: 30-46.

Parkington, J. & Yates, R. n.d. The stone tool assemblages. *Elands Bay Cave: A View on the Past* Unpublished manuscript.

Parkington, J. Morris, D. & Rusch, N. 2008. *Karoo Rock Engravings*. Cape Town: Krakadouw Trust

Parkington, J., Fisher, J.W. & Tonner, T.W.W. 2009. "The fires are constant, the shelters are whims": a feature map of Later Stone Age campsites at the Dunefield Midden site, Western Cape Province, South Africa. *The South African Archaeological Bulletin* 64(190): 104-121.

Patterson, T.C. 2008. The history of landscape archaeology in the Americas. In *Handbook of Landscape Archaeology*. B. David & J. Thomas, Eds. New York: Left Coast Press. 77-84.

Peters, C.R. & Blumenschine, R.J. 1995. Landscape perspectives on possible land use patterns for Early Pleistocene hominids in the Olduvai Basin, Tanzania. *Journal of Human Evolution* 29: 321-362.

Peterson, H. 2015. *In retrospect: how the vegetation of the Tanqua Karoo has changed over the last century*. Unpublished Honours thesis. Cape Town: University of Cape Town.

- Plog, S., Plog., Wait, W. 1978. Decision making in modern surveys. *Advances in Archaeological Method and Theory* 1: 383-421.
- Plug, I. 1993. The macrofaunal remains of wild animals from Abbot's Cave and Lame Sheep Shelter, Seacow Valley, Cape. *Koedoe*. 36(1): 15-26.
- Plummer, T. 2004. Flaked stones and old bones: biological and cultural evolution at the dawn of technology. *Yearbook of Physical Anthropology*. 47: 118-164.
- Porat, N., Chazan, M., Grün, R., Aubert, M., Eisenmann, V. & Horwitz, L. 2010. New radiometric ages for the Fauresmith industry from Kathu Pan, southern Africa: implications for the Earlier to Middle Stone Age transition. *Journal of Archaeological Science* 37: 269-283.
- Porraz, G., Parkington, J.E., Rigaud, J.-P., Miller, C.E., Poggenpoel, C., Tribolo, C., Archer, W., Cartwright, C. et al. 2013a. The MSA sequence of Diepkloof and the history of southern African Late Pleistocene populations. *Journal of Archaeological Science* 40(9): 3542-3552.
- Porraz, G., Texier, P.-J., Archer, W., Piboule, M., Rigaud, J.-P. & Tribolo, C. 2013b. Technological successions in the Middle Stone Age sequence of Diepkloof Rock Shelter, Western Cape, South Africa. *Journal of Archaeological Science* 40(9): 3376-3400.
- Porraz, G., Schmid, V.C., Miller, C.E., Tribolo, C., Cartwright, C.R., Charrié-Duhaut, A., Igreja, M. et al. 2016. Update on the 2011 excavation at Elands Bay Cave (South Africa) and the Verlorenvlei Stone Age. *Southern African Humanities*. 29: 33-68.
- Prat, S. 2016. First hominin settlements out of Africa. Tempo and dispersal mode: Review and perspectives. *Human Palaeontology and Prehistory*. (in press).
- Potts, R., Behrensmeyer, A.K. & Ditchfield, P. 1999. Paleolandscape variation and Early Pleistocene hominid activities: Members 1 and 7, Olorgesailie Formation, Kenya. *Journal of Human Evolution*. 37(5): 747-788.
- Presnyakova, D., Archer, W., Braun, D.R., Flear, W. 2015. Documenting Differences between Early Stone Age Flake Production Systems: An Experimental Model and Archaeological Verification. *PLoS ONE* 10(6): 2-26.
- Raab, L.M & Goodyear, A.C. 1984. Middle-Range Theory in Archaeology: A Critical Review of Origins and Applications. *American Antiquity*. 49(2): 255-268.
- Railsback, L.B., Gibbard, P.L., Head, M.J., Voarintsoa, N.R.G. & Toucanne, S. 2015. An optimized scheme of lettered marine isotope substages for the last 1.0 million years, and

- the climatostratigraphic nature of isotope stages and substages. *Quaternary Science Reviews*. 111: 94-06.
- Rigaud, J.-P., Texier, J.-P., Parkington, J. & Poggenpoel, C. 2006. Le mobilier Stillbay et Howiesons Poort de l'abri Diepkloof. La chronologie du *Middle Stone Age* sud-africain et ses implications. *Comptes Rendus Palevol* 5: 839-849.
- Ripley, B.S., Abraham, T., Klak, C. & Cramer, M.D. 2013. How succulent leaves of Aizoaceae avoid mesophyll conductance limitations of photosynthesis and survive drought. *Journal of Experimental Botany*. 64(18): 5485-5496.
- Rightmire, G.C., Deacon, H.J., Schwartz, J.H. & Tattersall, I. 2006. Human foot bones from Klasies River main site, South Africa. *Journal of Human Evolution*. 50: 96-103.
- Roche, C.J. 2004. "Ornaments of the desert." Springbok treks in the Cape colony, 1774-1908. MA dissertation, University of Cape Town.
- Rossignol, J. 1992. Concepts, methods, and theory building: a landscape approach. In *Space, time, and archaeological landscapes*. J. Rossignol & L. Wandsnider, Eds. New York: Plenum Press. 3-20.
- Rubin, F. 1998. The physical environment and major plant communities of the Tankwa-Karoo National Park. *Koedoe*. 41(2): 61-94.
- Rudner, J. & Rudner, I. 1968. Rock-art in the thirstland areas. *South African Archaeological Society*. 23(91): 75-89.
- Sampson, C.G. 1972. The Stone Age industries of the Orange River Scheme and South Africa. *Memoirs of the National Museum (Bloemfontein)* 6: 1-288.
- Sampson, C.G. 1974. *The Stone Age Archaeology of Southern Africa*. New York: Academic Press.
- Sampson, C.G. 1985. Atlas of Stone Age settlement in the Seacow Valley. *Memoirs of the National Museum (Bloemfontein)* 20: 1-116.
- Sampson, C.G. 1986. Model of prehistoric herder-hunter contact zone: a first approximation. *Goodwin Series*. 5: 50-56.
- Sampson, C.G. 2001. An Acheulian settlement pattern in the Upper Karoo region of South Africa. In *A very remote period indeed: papers on the Palaeolithic presented to Derek Roe*. S. Milliken & J. Cook, Eds. Oxford: Oxbow Books. 28-36.

Sampson, C.G., Moore, V., Bousman, C.B., Stafford, B., Giordano, A. & Willis, M. 2015. A GIS analysis of the Zeekoe Valley Stone Age Archaeological record in South Africa. *Journal of African Archaeology*. 13(2): 167-185.

Schiegl, S. & Conard, N.J. 2006. The Middle Stone Age sediments at Sibudu: results from FTIR spectroscopy and microscopic analyses. *Southern African Humanities*. 18 (1): 149-172.

Schiffer, M.B. 1976. *Behavioural Archaeology*. New York: Academic Press.

Schiffer, M.B. 1983. Toward the identification of formation processes. *American Antiquity* 48(4): 675-706.

Schiffer, M.B. 1988. The structure of archaeological theory. *American Antiquity*. 53(3): 461-485.

Schiffer, M.B., Sullivan, A.P. & Klinger, T.C. 1978. The design of archaeological surveys. *World Archaeology* 10(1): 1-28.

Schmidt, P., Porraz, G., Slodczyk, A., Bellot-gurlet, L., Archer, W. & Miller, M.E. 2013. Heat treatment in the South African Middle Stone Age: temperature induced transformations of silcrete and their technological implications. *Journal of Archaeological Science*. 40(9): 3519-3531.

Semaw, S. The world's oldest stone artefacts from Gona, Ethiopia: their implication for understanding stone technology and patterns of human evolution between 2.6-1.5 million years ago. *Journal of Archaeological Sciences*. 27: 1197-1214.

Semaw, S., Rogers, M.J., Quade, J., Renne, P.R., Butler, R.F., Dominguez-Rodrigo, M., Stout, D., Hart, W.S. et al. 2003. 2.6-Million-year-old stone tools and associated bones from OGS-6 and OGS-7, Gona, Afar, Ethiopia. *Journal of Human Evolution*. 45: 169-177.

Scott, L. & Woodborne, S. 2007a. Pollen analysis and dating of Late Quaternary faecal deposits (hyraceum) in the Cederberg, Western Cape, South Africa. *Review of Palaeobotany and Palynology* 144: 123-134.

Scott, L. & Woodborne, S. 2007b. Vegetation history inferred from pollen in Late Quaternary faecal deposits (hyraceum) in the Cape winter-rain region and its bearing on past climates in South Africa. *Quaternary Science Reviews* 26: 941-953.

Scott, L., Marais, E. & Brook, G.A. 2004. Fossil hyrax dung and evidence of Late Pleistocene and Holocene vegetation types in the Namib Desert. *Journal of Quaternary Science*. 19: 829-832.

Shackleton, N.J. & Opdyke, N.D. 1973. Oxygen isotope and palaeomagnetic stratigraphy of Equatorial Pacific core V28-238. *Quaternary Research*. 3: 39-55.

Shanks, M. & Tilley, C. 1987. *Social theory and archaeology*. Albuquerque: University of New Mexico Press.

Shanks, M. & Tilley, C. 1992. *Re-constructing archaeology: theory and practice*. 2nd ed. New York: Routledge.

Sharon, G. 2009. Acheulian giant-core technology: A worldwide perspective. *Current Anthropology*. 50(30): 335-367.

Shott, M.J. 1989. On tool-class use lives and the formation of archaeological assemblages. *American antiquity*. 54(1): 9-30.

Shott, M.J. & Weedman, K.J. 2007. Measuring reduction in stone tools: an ethnoarchaeological study of Gamo hidescrapers from Ethiopia. *Journal of Archaeological Science*. 34: 1016-1035.

Smith, A.B. & Ripp, M.R. 1978. An archaeological reconnaissance of the Doorn/Tanqua Karoo. *The South African Archaeological Bulletin* 33(128): 118-133.

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

Steele, T., Mackay, A., Fitzsimmons, K.E., Igreja, M., Marwick, B., Orton, J., Schwartz, S.,

Stalschmidt, M. 2016. Varsche River 003: A Middle and Later Stone Age site with Still Bay and Howiesons Poort assemblages in southern Namaqualand, South Africa. *Paleo Anthropology*. 2016: 100-163.

Stern, N. 1994. The implications of time-averaging for reconstructing the land-use patterns of early tool-using hominids. *Journal of Human Evolution* 27(1-3): 89-105.

Steyn, H.M., Bester, B.P. & Bezuidenhout, H. 2013. An updated plant checklist for Tankwa Karoo National Park, South Africa. *South African Journal of Botany*. 88: 247-251.

- Stout, D., Toth, N., Schick, K. & Chaminade, T. 2008. Neural correlates of Early Stone Age toolmaking: technology, language and cognition in human evolution. *Philosophical Transactions of the Royal Society*. 363: 1936-1949. doi: 10.1098/rstb.2008.0001
- Straus, L.G. 1979. Caves: a palaeoanthropological resource. *World Archaeology* 10(3): 331-339.
- Sumner, T.A. 2011. Psychological components of Middle Paleolithic technology: The proceduralization of lithic core reduction. *Journal of Anthropological Archaeology*. 30: 416-431.
- Texier, P., Porraz, G., Parkington, J., Rigaud, J., Poggenpoel, C., Miller, C., Tribolo, C., Cartwright, C. 2010. A Howiesons Poort tradition of engraving ostrich eggshell containers dated to 60,000 years ago at Diepkloof Rock Shelter, South Africa. *Proceedings of the National Academy of Sciences* 107(14): 6180-6185.
- Texier, P.-J., Porraz, G., Parkington, J., Rigaud, J.-P., Poggenpoel, C. & Tribolo, C. 2013. The context, form and significance of the MSA engraved ostrich eggshell collection from Diepkloof Rock Shelter, Western Cape, South Africa. *Journal of Archaeological Science* 40(9): 3412-3431.
- Thackeray, A.I. 1983. Dating the rock art of southern Africa. *Goodwin Series* 4: 21-26.
- Thompson, E., Williams, H.M. & Minichillo, T. 2010. Middle and late Pleistocene Middle Stone Age lithic technology from Pinnacle Point 13B (Mossel Bay, Western Cape Province, South Africa). *Journal of Human Evolution*. 59: 358-377.
- Tilley, C. 1989. Excavation as theatre. *Antiquity*. 63(239): 275-280.
- Tilley, C. 1994. *A Phenomenology of Landscape: Places, Paths and Monuments*. Oxford: Berg.
- Tilley, C. 2006. Introduction: identity, place, landscape and heritage. *Journal of Material Culture*. 11(1/2): 7-32.
- Toth, N. 1987. Behavioral inferences from Early Stone artefact assemblages: an experimental model. *Journal of Human Evolution*. 16: 763-787.
- Toth, N. & Schick, K. 2009. The Oldowan: The tool making of early hominins and chimpanzees compared. *Annual Review of Anthropology*. 38: 289-605.

- Torrence, R. 1989. Re-tooling: towards a behavioral theory of stone tools. In: Torrence, R. (ed) *Time, Energy and Stone Tools*: 57-66. Cambridge: Cambridge University Press.
- Tribolo, C., Mercier, N., Valladas, H., Joron, J.L., Guibert, P., Lefrais, Y., Selo, M., Texier, P.-J. et al. 2009. Thermoluminescence dating of a Stillbay-Howiesons Poort sequence at Diepkloof Rock Shelter (Western Cape, South Africa). *Journal of Archaeological Science*. 36: 730-739.
- Tribolo, C., Mercier, N., Douville, E., Joron, J.L., Reyess, J.-L., Rufer, D., Cantin, N., Lefrais, Y. et al. 2013. OSL and TL dating of the Middle Stone Age sequence at Diepkloof Rock Shelter (South Africa): a clarification. *Journal of Archaeological Science* 40(9): 3401-3411.
- Trigger, B.G. 2006. *A history of archaeological thought*. U.K: Cambridge University Press.
- Tüffers, A.V., Martin, C.E. & von Willert, D.J. 1995. Possible Water Movement from Older to Younger Leaves and Photosynthesis During Drought Stress in Two Succulent Species from South Africa, *Delosperma tradescantioides* Bgr. and *Prenia sladeniana* L. Bol. (Mesembryanthemaceae). *Journal of Plant Physiology* 146(1-2): 177-182.
- Tusenius, M.L. 2013. Archaeological Impact Assessment of the proposed extension of a borrow pit on Prince Albert Townlands, Central Karoo District, Western Cape. Natura Viva cc. (Unpublished).
- Tusenius, M.L. 2015. Archaeological Impact Assessment of the proposed Prince Albert housing project on remainder of ERF 743, Prince Albert, Central Karoo District, Western Cape Town. Natura Viva cc. (Unpublished).
- Tyron, C.A. 2006. "Early" Middle Stone Age lithic technology of the Kapthurin Formation (Kenya). *Current Anthropology* 47(2): 367-375.
- Ugan, A., Bright, J. & Rogers, A.R. 2003. When is technology worth the trouble? *Journal of Archaeological Science* 30(10): 1315-1329.
- Underhill, D. 2011. A history of Stone Age archaeological study in South Africa. *The South African Archaeological Bulletin* 66(193): 3-14.
- Usik, V.I., Rose, J.I., Hilbert, Y.H., Van Peer, P. & Marks, A.E. 2013. Nubian Complex reduction strategies in Dhofar, southern Oman. *Quaternary International* 300: 244-266.

- van der Merwe, H., van Rooyen, M.W. & van Rooyen, N. 2008. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. *Koedoe* 50(1): 61-71. Available: <http://www.koedoe.co.za>
- Van Peer, P. 1991. Interassemblage variability and Levallois styles: the case of the Northern African Middle Palaeolithic. *Journal of Anthropological Archaeology* 10: 107-151
- Van Peer, P., Fullagher, R., Stokes, S., Bailey, R.M., Moeyersons, J., Steenhoudt, F., Geerts, A., Vanderbeken, T., De Dapper, M. & Geus, F. 2003. The Early to Middle Stone Age transition and the emergence of modern human behaviour at site 8-b-11, Sai Island, Sudan. *Journal of Human Evolution* 45:187–193.
- van Riet Lowe, C. 1945. The evolution of the Levallois technique in South Africa. *Man* 45: 49-59.
- Verhagen, P. & Whitley, T.G. 2012. Integrating archaeological theory and predictive modeling: a live report from the scene. *Journal of Archaeological Method and Theory* 19: 49-100.
- Villa, P., Delagnes, A. & Wadley, L. 2005. A late Middle Stone Age artifact assemblage from Sibudu (KwaZulu-Natal): comparisons with the European Middle Palaeolithic. *Journal of Archaeological Science* 32: 399-422.
- Villa, P., Soressi, M., Henshilwood, C.S. & Mourre, V. 2009. The Still Bay points of Blombos Cave (South Africa). *Journal of Archaeological Science* 36(2): 441-460.
- Villa, P., Soriano, S., Tsanova, T., Degano, I., Higham, T.F.G., d'Errico, F., Backwell, L., Lucejko, J.J. et al. 2012. Border Cave and the beginning of the Later Stone Age in South Africa. *Proceedings of the National Academy of Sciences* 109(33): 13208-13213.
- Vinnicombe, P. 1996. On cultural exchange and interpretation of rock art in southern Africa. *Current Anthropologist* 37(3): 513-514.
- Volman, T.P. 1981. *The Middle Stone Age in the Southern Cape*. Unpublished PhD thesis. Chicago: University of Chicago.
- Wadley, L. 1996. The Robberg Industry of Rose Cottage Cave, Eastern Free State: The Technology, Spatial Patterns and Environment. *The South African Archaeological Bulletin* 51: 64-74.
- Wadley, L. 2003. How some archaeologists recognize culturally modern behaviour. *South African Journal of Science* 99: 247-250.

Wadley, L. 2007. Announcing a Still Bay industry at Sibudu Cave, South Africa. *Journal of Human Evolution* 52(6): 681-689.

Wadley, L. & Binneman, J.N.F. 1995. Arrowheads or pen knives? A microwear analysis of mid-Holocene stone segments from Jubilee Shelter, Transvaal. *South African Journal of Science* 91: 153-155.

Wadley, L. & Kempson, H. 2011. A review of rock studies for archaeologists, and an analysis of dolerite and hornfels from the Sibudu area, KwaZulu-Natal. *Southern African Humanities* 23: 87-107.

Wadley, L., Williamson, B.S. & Lombard, M. 2004. Ochre in hafting in middle stone age southern Africa: a practical role. *Antiquity* 78: 661-75.

Wadley, L., Hodgskiss, T. & Grant, M. 2009. Implications for complex cognition from the hafting of tools with compound adhesives in the Middle Stone Age, South Africa. *Proceedings of the National Academy of Sciences of the United States of America* 106(24): 9590-9594.

Walker, S.J.H., Chazan, M. & Morris, M. 2013. Kathu Pan: location and significance. *A report requested by SAHRA for the purpose of nomination*. Cape Town. (Unpublished).

Westcott, K.L. & Brandon, R.J. Eds. 2000. *Practical applications of GIS for archaeologists: a predictive modelling kit*. London: Taylor and Francis.

White, T.D., Asfaw, B., DeGusta, D., Gilbert, H., Richards, G.D., Suwa, G. & Clark Howell, F. 2003. Pleistocene *Homo sapiens* from Middle Awash, Ethiopia. *Nature* 423: 742-747.

Wilkins, J. 2017. Middle Pleistocene lithic raw material foraging strategies at Kathu Pan 1, Northern Cape, South Africa. *Journal of Archaeological Science* 11: 169-188.

Wilkins, J., Pollarolo, L. & Kuman, K. 2010. Prepared core reduction at the site of Kudu Koppie in northern South Africa: temporal patterns across the Earlier to Middle Stone Age boundary. *Journal of Archaeological Science* 37(6): 1279-1292.

Wilkins, J. & Chazan, M. 2012. Blade production ~500 thousand years ago at Kathu Pan 1, South Africa: support for a multiple origins hypothesis for early Middle Pleistocene blade technologies. *Journal of Archaeological Science* 39: 1883-1900.

Will, M., Mackay, A., and Phillips, N. 2015. Implications of Nubian-like core reduction systems in southern Africa for the identification of early modern human dispersals. *PLoS ONE* 10(6): e0131824. doi:10.1371/journal.pone.0131824.

Will, M., Parkington, J.E., Kandel, A. & Conard, N. 2013. Coastal adaptations and the Middle Stone Age lithic assemblages from Hoedjiespunt 1 in the Western Cape, South Africa. *Journal of Human Evolution* 64: 518-537.

Wurz, S. 2002. Variability in the Middle Stone Age lithic sequence, 115,000–60,000 years ago at Klasies River, South Africa. *Journal of Archaeological Science* 29(9): 1001-1015.

Wurz, S. & Lombard, M. 2007. 70 000-year-old geometric backed tools from the Howiesons Poort at Klasies River, South Africa: were they used for hunting? *South African Humanities* 19: 1-16.

Wynn, T. 1995. Handaxe enigmas. *World Archaeology* 27(1): 10-24.

Wynn, T. & Tierson, F. 1990. Regional comparison of the shape of the later Acheulean handaxes. *American Anthropologists* 92: 74-84.

Wynn, T. & Coolidge, FL. 2010. Beyond symbolism and language. *Current Anthropology* [Special issue] 51: S1-S16.

Zhu, R.X., Potts, R., Xie, F., Hoffman, K.A., Deng, C.L., Shi, C.D., Pan, Y.X., Wang, H.Q. et al. New evidence on the earliest human presence at high northern latitudes in northeast Asia. *Nature* 431: 559–562.