The University of Cape Town
Faculty of Science
Department of Archaeology

Investigating temporal change in Fauresmith technology: Insights from Rooidam 2, Northern Cape Province, South Africa

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A Dissertation presented to the Faculty of science for the degree of Master of Philosophy

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Plagiarism Declaration

I declare that this dissertation "Investigating temporal change in Fauresmith technology: Insights from Rooidam 2, Northern Cape Province, South Africa" is my own original and unaided work. This dissertation is being submitted for the Degree of Master of Philosophy to the University of Cape Town, South Africa. It has not been submitted for examination or review at any other. I know the meaning of plagiarism and declare that all my work in the dissertation, save for that which is properly acknowledged, is my own.

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22th November 2019

Abstract

In southern Africa, stone tool assemblages with both large cutting tools (LCTs) and retouched blanks are ascribed to the Fauresmith Industry, a ‘transitional’ industry between the Earlier and Middle Stone Age. ‘Transitional’ assemblages are especially relevant for addressing questions concerning the development of increasingly complex behaviors and technological variability associated with later Middle Stone Age assemblages. Few in-situ Fauresmith assemblages have been described, despite the need for a more standardized and behaviorally meaningful understanding of these highly variable assemblages. Rooidam 2 is a pan site lying on the outskirts of Kimberley in the Northern Cape Province, with an excavated sealed and stratified Fauresmith sequence. The site is a suitable choice for investigation, as its sequence spans several strata and the excavated collection has yet to be described or analyzed in any detail. A technological intra-site analysis of ~2000 lithic specimens from Level 5, a dense concentration of artifacts comprised of 10 sub-levels was conducted in order to test for temporal change. Adjacent sub-levels were compared using both quantitative and qualitative data to test for statistically significant changes in the blank production choices and retouched tool morphology within the Fauresmith sequence. The analysis reveals that the Fauresmith assemblage from Level 5 is primarily characterized by centripetally flaked Levallois-like cores, flake and blade blanks, unifacially retouched points, scrapers, and notched pieces. There were no LCTs found in the assemblage, although a single broken fragment with bifacial flaking and a shaped convex edge has a morphology suggestive of a small biface. Although the lithic typology of the analyzed assemblage from Rooidam 2 is generally consistent with Fauresmith assemblages from nearby sites in the Northern Cape, the absence of bifaces and other LCTs is notable. The Rooidam 2 sequence also reflects instances of lithic variability between adjacent sub-levels that may be indicative of a trend towards increased behavioral flexibility in blank production (especially in the frequency of blade and unretouched points), although interestingly there were no significant changes in the retouched tool morphology. The variability within the sequence appears to be isochrestic in nature, and there is no evidence to support either a linear trajectory of lithic complexity or the reality of distinctive temporal phases within the Fauresmith industry at Rooidam 2. The technological characteristics in the assemblage, in addition to the significant instances of variability within the sequence, suggests that the lithic material from Rooidam 2 may be more appropriately described as eMSA rather than Fauresmith.

Acknowledgements

The author would like to formally the following: my supervisor, John Parkington, who I have enjoyed conversing and engaging with about terminology and your willingness to always help.

I would also like to thank my co-supervisor Jayne Wilkins for encouraging me to take part in this research and involving me in the North of Kuruman Project. The constant support and patience of them both has greatly contributed towards the final product of my research. I appreciate them both sharing their carefully developed perspectives and contributing to my growth as an archaeologist.

I also would like to mention my gratitude towards Professor David Morris, of McGregor Museum for helping to facilitate my access to the Rooidam 2 lithic collection. Thank you for your trust in handing this important piece of southern African history and for allowing me time with the material.

I am also indebted to Folke Richardt and his team of the 2006 excavation, his hard work and sharing of findings helped develop a clearer picture of the nature of the assemblage. My research would not have ever come to fruition without the efforts of his team and all those who played a part in the handing and sorting of the material.

For keeping me sane, and always providing friendship I thank my colleagues in the Department of Archaeology, Louisa Hutton, Leesha Richardson, and Patricia Groenewald. Thank you for your friendship and for our many coffee breaks. I would like to acknowledge all my other colleagues in the department for their moments of insight and helpfulness.

Lastly, I would like to thank my partner, whose unwavering support served as an anchor in keeping me uplifted and productive, who greatly contributed to my personal growth and success as a researcher and an individual.

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Chapter 1: Introduction

This purpose of this research was to investigate the intra-site variability in the typological and technological characteristics of the Fauresmith-designated assemblage from Rooidam 2, an open-air pan site in the Northern Cape province of South Africa. A dense artifact concentration identified at the site was further divided into sub-levels that allowed for a high-resolution intra-site analysis of variability in the blank production choices and retouched tools through time. A report documenting the typological and technological characteristics of the lithic assemblage has not previously been published, despite the rarity of stratified, sealed sequences. This dissertation presents the results of the first technological analysis of lithic material from Rooidam 2, and the first intra-site analysis of a Fauresmith-designated sequence to investigate temporal changes and lithic variability within an assemblage.

The site of Rooidam 2 is part of a larger paleo-pan complex that includes the nearby site of Rooidam 1, which lies on the outskirts of Kimberley. The sites are notable as they are open-air sites with deep sequences that maintain their depositional integrity. The entire sequence of Rooidam 2 has been ascribed to the Fauresmith, with the strata being further divided into distinctive temporal 'phases' (Van Riet Lowe 1945; Beaumont and Morris 1990, 2004). Small collections of the lithic material from Rooidam 2 were initially reported and taken by Peter Beaumont to create a preliminary lithostratigraphic sequence and industrial classification. The site was excavated in 2006 by Folke Richardt and aimed to investigate and document the poorly characterized temporal 'phases' in the Fauresmith succession (Beaumont and Morris 2004; Underhill 2011b). Rooidam 2 was identified by Herries (2011) and Underhill (2012) as potentially significant to addressing the viability and nature of the Fauresmith, due to it being one of few sealed, stratified sites.

The Fauresmith Inudstry, which was originally defined in the late 1920's based on a few diagnostic tool types from surface collections of material primarily in the interior cape region of South Africa (Van Riet Lowe 1927; Goodwin and Van Riet Lowe 1929). The industry is characterized by a mosaic of Early Stone Age (ESA) and Middle Stone Age (MSA) tool typologies, which resulted in the belief that it represented a transitional phase of technological development and behavioral evolution that took place during the Middle Pleistocene (Underhill 2011b; Herries 2011). Fauresmith assemblages are generally characterized by LCTs, small bifaces, prepared cores (often Levallois), blades, and a high frequency of specialized retouched tools which often include points (Underhill 2012; Chazan 2015a). The defining artifact types and technological characteristics for the industry vary from site to site making a standardized definition elusive, as the high degree of inter- and intra- site variability in the form a regionally constrained entity makes it difficult to classify within the current chrono-cultural model (Chazan 2015a). Few Fauresmith sites have been securely dated in the interior region, but assemblages that do provide age estimates constrain it to ~500 – 300 ka (Porat et al. 2010; Herries 2011; Chazan et al. 2013; Kiberd 2006; Lotter et al. 2016; Beaumont and Vogel 2006; Underhill 2011b). The techno-complex has been described as belonging to both the later Acheulean and the early MSA, and the lack of stratified, well-documented *in situ* assemblages has exacerbated the need for a better understanding of its complex nature and implications for behavioral development in archaic H. *sapiens* (Herries 2011; Underhill 2011b; Chazan 2015b, 2015a). The suggested dates for the Fauresmith overlap with those for both later Acheulean and early MSA assemblages, and have further obscured attempts to differentiate the industry from the preceding and succeeding technological entities (Herries 2011; Underhill 2011b). Research into Fauresmith-designated assemblages will further help to fill in the current gap in our knowledge regarding the nature of technological and behavioral abilities documented in the archaeological record during the Early to Middle Pleistocene.

1.1 Aims of Research

This dissertation aimed to address the following research questions:

1) What technological attributes and patterns characterize the Fauresmith-designated assemblage from square 4B, 5th Level at Rooidam 2?
2) Does the sequence show evidence for significant variability in the blank production choices or retouched tool morphology throughout relative time?
3) How do we interpret intra-site technological variability in transitional assemblages in a way that is behaviorally meaningful?
4) Does the Rooidam 2 assemblage show any evidence in defense/rebuttal of a tripartite division of the Fauresmith Industry into distinctive temporal phases based on typological or technological grounds?

1.2 Organization of Dissertation

The organization of this thesis is divided into six total chapters:

Chapter 2, the Fauresmith Industry, provides a brief history of the historical, geological, and typological background of the Fauresmith. This chapter begins with its introduction into archaeological literature in the late 1920's all the way to its continued use to describe 'transitional' ESA-MSA assemblages in the interior cape region of South Africa despite its technological variability and inconsistent descriptions. Transitional assemblages in East Africa that are well stratified with associated radiometric dates show interesting and unpredictable patterns of lithic variability suggest a pattern of emerging regionalization similar to what is seen in southern Africa. The increasing frequency of lithic assemblages with a mosaic of diagnostic artifact types demands the need for a new way of interpreting and comparing highly variable assemblages that are behaviorally meaningful.

Chapter 3, the Site History of Rooidam 1 and 2, reviews the history of investigation and excavation of the site of Rooidam 1 and 2. Published material resulting from the excavation or analyses of the sites will be included. The lithostratigraphic sequence of each site will be provided as well as the industrial ascriptions of the corresponding lithic material. A geoarchaeological study of the sediments from Rooidam 1 and 2 have allowed for an interpretation of the paleoclimate and the nature of the depositional and geological nature of the sites. Details regarding the organization and subsequent 2006 excavation led by Folke Richardt will be described to contextualize the nature of the lithic material being analyzed.

Chapter 4, the Research Aims, Materials, and Methodology, the theoretical and conceptual framework that this analysis takes to addressing the research questions is outlined. The data entry process involved the organization of the lithic material and subsequent recording of observational and quantitative artifact traits into a data entry program that was subsequently uploaded into a database. The raw lithic data was further statistically analyzed using PAST. The protocol for the intra-site analysis of the blank production choices and retouched tool morphology between adjacent sub-levels is outlined and artifact attributes used in the analysis are explicitly defined.

Chapter 5, the Results of Analysis, provides a summarized report of the technological and typological characteristics of the analyzed lithic material from Rooidam 2. The production strategies of cores, flakes and blades, and retouched products at Rooidam 2 is documented, and additional photographs of the material are provided. The results of the intra-site analysis of lithic technology between adjacent sub-levels is presented, and technological differences are further discussed. The full results of the comparison between adjacent sub-levels for both blank production and retouched tool morphology are compiled into two large data tables that show how attribute frequencies and traits change throughout the sequence.

Chapter 6, the Discussion and Conclusions, provides the interpretations to the results of the technological analysis of the Rooidam 2 and the intra-site investigation of lithic variability within the sequence. The interpretations made from the results of the analysis readdress the research questions presented in the introduction in the light of new evidence gathered from the analysis. The technological and typological attributes of the Fauresmith-designated assemblage from Rooidam 2 are compared to published descriptions of other well stratified sties in the Northern Cape region. The industrial ascription of the material from Rooidam 2 as Fauresmith is reassessed based on commonly accepted definitions of the industry. The nature of lithic variability within the sequence is discussed in the context of larger questions surrounding behavioral and cognitive complexity associated with assemblages dating to the Early-Middle Pleistocene. The limitations of this research project are touched on and future research directions are presented.

Chapter 2: The Fauresmith Industry

2.1 Lithic Terminology and Nomenclature

The standardization of nomenclature used in research and literature is necessary for valid comparisons and correlation of archaeological units. These conceptual entities often “vary both in spatial extent and temporal duration”, and work as “essential heuristic devices that enable us to think about the vast extent and duration of the archaeological record” (Chazan 2015a, 60). These archaeological entities are constructed based on the observed similarities and dissimilarities of lithic material based on typological, technological, and morphological classification. More recently, artifact typologies have taken into consideration the techniques of tool manufacture as well as morphology to provide a more comprehensive description of archaeological nomenclature (Lombard et al. 2012). These classificatory schemes are deeply entrenched in archaeological literature and can subconsciously guide research questions and expectations, which may be problematic as “what we are looking for may influence what we are looking at” (Bishop and Clark 1967, 857). With the increasing amount of lithic data available, it is becoming more difficult to establish a way of classifying archaeological assemblages in a way that can describe meaningful variability across geographical space and time. The terminology we use to organize and comprehend the archaeological record acts as a double-edged sword; it helps to make meaningful inferences about the connections and evolutionary relationships between archaeological assemblages but also tends to portray a picture of variability throughout space and time as being linear and sequential.

2.2 The Earlier, Middle, and Later Stone Age

A.J.H. Goodwin was the first to divide the South African Stone Age into conceptual time-stratigraphic units known as the Earlier, Middle, and Later periods, based of his study of the technological and typological characteristics of archaeological material from southern Africa (Volman 1984, 170). These “Ages” were established to sequentially date the stages of cultural development and tool production throughout time, although this classification system is now considered to be overly simplistic in reflecting the full spectrum of lithic variability seen in the archeological record. As a result of his combined field-work and investigations of archaeological material from the Iziko Museum of South Africa (previously the Cape Town Museum) Goodwin appreciated the absolute necessity for an entirely new cultural terminology for southern Africa that deviated from the European model (Goodwin 1958, 25). These Ages of prehistory are “by no means concurrent in different parts of the world, but cover essential stages in the local progress of developing humanity” (Goodwin 1946, 92). Goodwin’s intention was to create a “system of terminology designed to fit the field” in southern Africa and to avoid the “extraordinary anomalies that became evident with the introduction of European terms” (1946:92). It was important to create a logical framework suited to southern Africa that “should be workable…in such a way as to represent and cover the broad general sequence” (1946, 93). Although these terms have both cultural and chronological connotations, they are convenient at a higher level of abstraction, and no terms equivalent in their usefulness and comprehensiveness have been proposed (Volman 1984, 170). These ages are conceptually distinguished by a continuity of techniques and dominant tool types which replace previous modes of tool production (Goodwin 1926, 1946). Although they do offer a useful heuristic device when engaging with the archaeological record, it should be emphasized that they were based on differences in stratigraphic positioning and artifact typologies, rather than absolute dates or quantitative evidence and are intrinsically problematic in nature (Parkington 1970). The Earlier Stone Age (ESA) is associated with the first appearance of stone artifacts until the abandonment of large cutting tools (LCTs) such as bifaces or cleavers (Goodwin 1926). Middle Stone Age (MSA) assemblages are characterized by the increasing frequency of flake tools, a variety of prepared cores and retouched flakes. The Later Stone Age (LSA) is characterized by microlithic assemblages, in which specialized retouched tools, flakes, and cores are absent (Volman 1984). The terminology established by the Third Pan-African Congress of Prehistory proposed a five stage-chronology that included the ESA, MSA, and LSA but with the inclusion of two 'Intermediate' periods that represented transitional stages of cultural development that could not be unequivocally attributed as belonging to one age, although these terms were later abandoned in favor of a chronology based on in-situ excavated material from stratified sites at the Burg-Wartenstein Symposium (Clark et al. 1966; Bishop and Clark 1967; Sampson 1974; Clark and Cole 1957). The classification of lithic assemblages relating to the South African/Lesotho archaeological sequence still relies on this division between the Earlier, Middle, and Later Stone age, and has been discussed and described in detail by various researchers working in southern Africa in order to standardize terminology used in the discipline and to facilitate meaningful inter-site and regional comparisons (Clark and Kleindienst 2001; Clark et al. 1966; Lombard et al. 2012).

2.3 Industrial Complexes and Phases

An Industrial Complex or *Techno-complex* is the largest entity of formal classification, defined as "a group of industries considered to represent parts of the same whole" (Bishop and Clark 1967, 893) with more recent interpretations describing it as "a group of industries characterized by assemblages that share a polythetic range" (Lombard et al. 2012, 124) that are "considered to have cultural entity because of their having specific traditions in common" (Clark and Kleindienst 2001) and are thought to be indicative of general development or adaptive stages of advancement in human prehistory. Within an industrial complex, changes in tool design and frequencies due to raw materials, activities, and stylistic change through time and space are expected but these "changes remain within the bounds of broad similarities in the tool making tradition" (Lombard et al. 2012).

An Industrial Complex can be further divided to individual industries, with the original definition of an *Industry* being "a group of technological elements within one culture" (Goodwin 1931, 54). Further interpretations of how to define an Industry did not deviate much from the original description, where it was defined as representative of "all the known objects that a group of prehistoric people manufactured in one area over some span of time" (Clark et al. 1966, 115). The association of an Industry with a single cultural homogenous group has been excluded from further definitions, with Lombard et al. (2012) defining an Industry as a group of assemblages that share technical and typological features and a high level of similarity in design that may be "expressed as distinct industries or regional variants that are distributed less widely than techno-complexes" (Lombard et al. 2012, 125). However, archaeological assemblages, even those belonging to the same industry, should not be expected to be identical "even though they may overlap economically, chronologically and/or regionally" (Lombard et al. 2012, 124).

An industry may be further divided into *Phases* which were described by Goodwin (1931) as changes within a culture that may manifest in changes in implement size, type, frequencies, or a disappearance of certain tools. Industries "may comprise a series of successive, or in some cases distinctive, contemporaneous Phases" on the basis of deep stratified sequences (Bishop and Clark 1967, 893; Sampson 1974). Recent definitions of an archaeological Phase include "a grouping of similar artefact aggregates and/or assemblages from archaeological occurrences that can be shown to be related by typology or technology" (Clark and Kleindienst 2001, 37) and generally described as distinct technological changes within an industry by Lombard et al.

(2012). Lastly, an *Archaeological Horizon* or *Occurrence* is defined as "the minimal cultural stratigraphic unit which can be defined at any place" (Clark et al. 1966, 115; Bishop and Clark 1967).

2.4 A Brief History of the Fauresmith Industry

Stone implements later ascribed to the Fauresmith were mentioned by A.J.H Goodwin in 1926, where he noted that the specimens showed considerable variation from described assemblages described (Humphreys 1970). At around the same time, Van Riet Lowe contacted Goodwin regarding his discovery of similar artifact types, including water-worn scraper knives, scrapers, and bifaces he observed near Burghersdorp, Philippolis, and the Fauresmith district (Goodwin and Van Riet Lowe 1929, 83). Stratigraphic evidence from the Fauresmith Townlands spruit was able to conclusively prove that the materials found there represented a new industry considerably earlier than the LSA, as natural erosion at the site had exposed artifacts within water-borne gravels lying below an assemblage belonging to the LSA (Goodwin and Van Riet Lowe 1929, 85).

With these findings, an extended nomenclature in the archaeological sequence was deemed necessary (Goodwin and Van Riet Lowe 1929). The industry was named after a town of the same name in the south-western Orange Free State, where Van Riet Lowe "was the first to recognize new cultural elements" (Leakey 1947, 19 ; Humphreys 1970). The most typical artifact associated with the industry was the biface, described as a "pseudo-coup-de-poing", or a biface produced from a flake (Goodwin 1926, 1927, 30). The Fauresmith was first described as an industry between the ESA and MSA considered the culminating phase of the ESA that marks the beginning of a new lithic culture; from core to flake based treatment (Goodwin 1926, 1928; Van Riet Lowe 1927) as well as marking the development of a Levallois technique in southern Africa (Goodwin 1927; Malan 1947; Van Riet Lowe 1952a). The juxtaposition of bifaces and flake tools (often with facetted butts) marked a transition from the reliance on core tools of the ESA, to flake tools characteristic of the MSA (Goodwin 1928).

There are many theories on the origins of the Fauresmith culture, with Dreyer (1953) claiming that the Fauresmith was a 'hybrid' culture, while Clark (1959, 1970) described the Fauresmith industry as a distinct cultural tradition indicative of a more specialized toolkit in response to increasingly variable environmental conditions. Van Riet Lowe (1927; Goodwin and Van Riet Lowe 1929) speculated that the Fauresmith industry was an improvement upon earlier Acheulean industries, as a result of the increased workability of raw material called hornfels, used in the manufacture of stone implements. Humphrey's (1970) questioned the association of Fauresmith industry and hornfels, arguing that the increased workability of this raw material type was misinterpreted as the archaeological material representing new technological complexity. This was because Fauresmith assemblages were primarily found at sites geologically dominated by the metamorphized Ecca and Beaufort shales of the Karoo System (Goodwin 1927; Van Riet Lowe 1952b), with hornfels frequently being the preferred choice for tool production. However, many sites have revealed Fauresmith assemblages are not consistently dominated by the use of hornfels, assemblages can be made on a variety of available raw materials (chert, banded ironstone, quartzite, etc.) that disprove the relationship between hornfels and the Fauresmith (Beaumont and Morris 1990; McNabb and Beaumont 2011; Wilkins 2013). The industry appears to be localized to the interior of southern Africa and has been described from sites in the Northern and Eastern Provinces, the Orange Free State, and Gauteng. There have been few occurrences of material ascribed to the Fauresmith found at sites near the coastal regions of South Africa. The existence of the Fauresmith, as well as its defining typology has varied among researchers working in southern Africa since Goodwin and Van Riet Lowes (1929) original description of the industry.

The notion of the Fauresmith being 'transitional' is a remnant of its assignment to the "First Intermediate", a term used to describe material occurring after the ESA but before the MSA (Clark and Cole 1957). Based on the recommendations from the Burg-Wartenstein Symposium in 1965, the Fauresmith industry was subsumed into the greater Acheulean techno-complex and "officially speaking no longer considered to be real" and its validity as an archaeological culture is still under consideration (Bishop and Clark 1967; Sampson 1974; Underhill 2011b, 21). Fauresmith material was now described as belonging to a later phase of the Acheulean, (Humphreys 1970; Mason 1962, 1967; Volman 1984) as it was argued that many tool types said to be typical and characteristic of the Fauresmith were "known to occur in Acheulean assemblages" (Humphreys, 1970, 143). Despite the unpopularity of the term, in the 1990's the Fauresmith re-emerged again in literature to describe material coming from various sites in the Northern Cape investigated by Peter Beaumont (1990, 2004; Beaumont and Vogel 2006) which focused on a typologically based framework to define the Fauresmith. Recent investigations based on stratified assemblages from Wonderwerk Cave, Kathu Pan 1 and Canteen Kojpe, have "suggested a reality to the Fauresmith" (Underhill 2011b, 23) with Beaumont (2004; Beaumont and Vogel 2006) even defining an Earlier, Middle, and Later phase of the Fauresmith sequence at the sites of Wonderwerk Cave and Rooidam, a division originally proposed by Van Riet Lowe (1945).

2.5 Defining the Fauresmith

The term 'Fauresmith' has been used to describe a variety of transitional lithic assemblages containing both LCTs and flake tools from southern Africa, despite some of these occurrences possibly being a result of mixed archaeological material rather than a contemporary assemblage representing a new transitional industry (Underhill 2012). This industrial ascription has been in literature since the beginning of the early 20th century and the term is still used to describe modern assemblages, despite its defining typology being highly variable throughout time (Chazan 2015a). Its defining characteristics and tool typology have changed throughout the century, beginning with Goodwin and Van Riet Lowe's published work on it in 1929 and more recently defined by Beaumont's (Beaumont and Morris 1990, 2004) numerous contributions and documentation of Fauresmith assemblages from many sites in the Northern Cape. Describing what kind of lithic assemblage defines the Fauresmith industry has been difficult to establish, due to many investigations of the industry taking place before more systematic protocols were in place as well as the reliance of type specimens to define assemblages (Goodwin and Van Riet Lowe 1929). The Fauresmith was originally defined by the presence of small bifaces produced on flake blanks, as well as a variety of flake tools, often showing prepared platforms (Goodwin and Van Riet Lowe 1929; Van Riet Lowe 1945). Other artifacts associated with the Fauresmith include discs, scrapers, gravers, blades, points, and occasionally faceted hammer stones or polyhedral stones (Goodwin and Van Riet Lowe 1929; Van Riet Lowe 1945). Small cleavers made on end or side flakes are occasionally described in Fauresmith assemblages (Van Riet Lowe 1945). Throughout the Fauresmith succession it appears that LCTs occur less frequently and are eventually superseded and replaced by a variety of specialized flake tools (van Riet Lowe 1945). Tool production is associated with direct percussion using a hard hammer, with no evidence of the use of soft hammers or pressure flaking (Van Riet Lowe 1927; Wilkins and Chazan 2012). The Fauresmith may be defined as a regionally confined industry within southern Africa that represents a either a final/late stage of the Acheulean techno-complex or perhaps an early expression of the MSA (Binneman and Beaumont 1992; Beaumont and Morris 2004; Chazan et al. 2008; Chazan 2015b).

Recent investigations of Fauresmith material from well stratified sites have proved to provide a more reliable and robust definition of the industry, with most researchers defining Fauresmith assemblages as a co-occurrence of small bifaces, prepared cores technology, flakes, blades, and convergent points (Binneman and Beaumont 1992; Beaumont and Morris 2004; Watts, Chazan, and Wilkins 2016; Chazan 2015a; Lotter et al. 2016; Underhill 2011b). This more contemporary definition is based on the re-analyses of older excavated collections of in-situ lithic material ascribed to the Fauresmith from sites in the interior Cape region (Underhill 2012). At Wonderwerk Cave, Fauresmith material was reported from excavations at the front, middle, and back of the cave where it is associated with small broad bifaces, a variety of prepared core types, blades, and Levallois points (Beaumont and Morris 1990; Binneman and Beaumont 1992; Beaumont and Morris 2004; Beaumont and Vogel 2006; Vogel 2008). A re-analysis of the assemblages from Wonderwerk Cave by Chazan et al. (Chazan and Horwitz 2009) found no evidence of a Fauresmith assemblage coming from the excavations in the front of the cave due to the absence of blade products or a reduction in biface size (Excavation 1 and 2) but did find an assemblage with bifaces associated with evidence of systematic blade production in the back of the cave (Excavation 6) (Chazan and Horwitz 2010). Wilkins and Chazan (2012) describe the Fauresmith assemblage from nearby site Kathu Pan 1, Stratum 4a as being associated with bifaces, Levallois-like prepared blade cores, large blades, unifacial retouched points, various scrapers, denticulate, and notched pieces. This assemblage is associated with blade production from prepared blade cores, one of the earliest known occurrences of systematic blade technology in southern Africa (Wilkins and Chazan 2012; Wilkins 2013). Additionally, points from at least one Fauresmith site, Kathu Pan 1, show evidence of diagnostic impact fractures and basal modification which suggests that they were potentially hafted and used as thrusting spear tips (Wilkins et al. 2012, 2015). Other Fauresmith assemblages showing evidence of blade production have been described at various sites including, Rooidam 1 and 2, Biesiesput 1, Nooietegedacht 2, Roseberry Plain 1, Pniel 1 and 6 (Beaumont and Morris 1990, 2004).

A multi-site analyses of many of the original sites and material that contributed to defining the Fauresmith by Underhill (2012) provided suggestive evidence that so-called ‘Fauresmith’ assemblages may be the result of mixed material and may not actually represent cohesive occurrence of cultural material. The association of bifaces at Kathu Pan 1 from Stratum 4a has been questioned as they appear to be more weathered than other artifacts found in the same context, and are only found in the lower levels within the strata (Wilkins 2013). Although considered a key identifier of the industry, assemblages from some sites seem to either lack a biface component entirely, or their presence in an assemblage is suggested to be the result of potential mixing between ESA and MSA material (Porat et al. 2010; Underhill 2012). Chazan (2015a) however disputes the idea that the industry is a product of mixing between ESA and MSA material, arguing that the Fauresmith industry is a product of the complex “dynamics of the evolution of stone tool technology”, that is expected to show a high degree of both intra- and inter-site technological variability. The Fauresmith has also suffered from a lack of absolute dating of in-situ occurrences as well as the inconsistent descriptions of ‘diagnostic’ tool types, and Underhill (2011b, 15) notes that “there is no consensus on its content or in fact, universal agreement on its existence”. However, its continued use in literature, as well as the recent undertaking of chronometric dating on material designated to the industry, has produced more questions than it has answered and added further confusion to its complicated history and defining characteristics. While the industry was originally defined based on unexcavated samples and surface collections, "from which one cannot build a reliable type series" (Underhill 2011b, 24), there is a reasonable amount of evidence to suggest the reality of a transitional industry that exhibits inter-assemblage variability (Chazan 2015b). It is hoped, that renewed investigations of excavated assemblages and the discovery of new sites with well stratified sequences can further address questions regarding the nature and legitimacy of the Fauresmith as an industry.

2.5.1 Cores

Van Riet Lowe describes "three principal types of prepared cores throughout the Fauresmith; circular or tortoise, triangular flake-cores, and rectangular blade-cores" (1945, 52; Underhill 2011b; Van Riet Lowe 1952a). In the Later Fauresmith there appears to be specialized conical and pyramidal blade-cores (Van Riet Lowe 1952a). A variety of core types are found in the Fauresmith assemblage at Kathu Pan 1, with multiplatform cores, minimally prepared cores with a single preferential removal, and prepared blade cores dominating the assemblage (Wilkins and Chazan 2012). Both preferential and recurrent Levallois cores also occur in relatively high frequencies within the assemblage (Wilkins and Chazan 2012). Levallois-like bifacial blade cores and triangular flake cores are found at both the Dalmanutha and Sunny Slopes sites (Crook 2018).

2.5.2 Large Cutting Tools (LCTs)

Fauresmith assemblages are traditionally associated with small bifaces produced on flake blanks, with other associated LCTs such as cleavers and choppers less frequently emphasized or described in detail. Bifaces associated with the Late Acheulean were described as made on water-worn cobbles and crude, while those from the Fauresmith appeared more refined, and were produced on flakes that were trimmed and shaped (Goodwin 1927, 30; Van Riet Lowe 1927). In heavily reduced bifaces the flake origin may be difficult to see as both faces are heavily worked leading to the removal of the platform features and ventral flake characteristics. Bifaces from Fauresmith sites were often described as having a straight edge, and very often a decided S-shaped twist or screw (Goodwin 1927; Van Riet Lowe 1927; Goodwin and Van Riet Lowe 1929). Common biface shapes described by Goodwin and van Riet Lowe (1929) include almond and sometimes ovate, limande and triangular shapes appear to be rare. Porat et al. (2010) describe small and irregularly shaped bifaces in association with flakes and blades from Stratum 4a at Kathu Pan 1. The bifaces that were found in the Stratum 4a assemblage are described as being crude, less symmetrical, and made on a wider range of raw materials when compared to those from the underlying Stratum 4b, associated with the Acheulean (Porat et al. 2010; Wilkins 2013). Only one broken piece of a small biface was found in association with a Fauresmith assemblage at the Dalmautha site (Crook 2018). Although considered to be an important component of the industry, there is no standard morphology or strictly defined characteristics of bifaces associated with the Fauresmith. Bifaces are of great importance to the definition to the Fauresmith, and yet they are usually reported as occurring infrequently or often making up only a small percentage of artifacts in an assemblage (Beaumont and Morris 1990, 2004; McNabb and Beaumont 2011; Wilkins 2013).

2.5.3 Flakes and Retouched Tools

Flakes frequently show platform faceting, and appear to show convergent rather than parallel flake scars on the outer face (Goodwin 1928; Van Riet Lowe 1945; Goodwin and Van Riet Lowe 1929). In Fauresmith material “the angle between faceted striking platforms and flake surfaces of flakes and blades is seldom more than 90°” (Van Riet Lowe 1945, 52).Compared to the Acheulean toolkit, the Fauresmith showed an increased frequency of specialized flake tools, including points, scrapers, and gravers (Goodwin and Van Riet Lowe 1929). The industry was also notable for the appearance of flakes retouched into points, with Dreyer (1953) noticing that many illustrated Fauresmith flakes were triangular shaped points with convergent dorsal scars originating from the platform surface. Retouched flake tools that are commonly described in Fauresmith assemblages include various scrapers, convergent points, denticulates/notched pieces, and other uncategorized modified flakes. Flakes from Stratum 4a at Kathu Pan 1 include retouched unifacial points, nonretouched triangular points and large blades. Points from KP 1 showed diagnostic impact fractures that are consistent with the point being used as a spear, with some of the points in the assemblage also showing basal modification and shaping indicating that the points were likely hafted (Wilkins et al. 2012, 2015). Large blades and unifacial Levallois points are also reported to be frequent in the surface finds of Fauresmith material at Dalmanutha and Rosslands (Crook 2018). At Dalmuanutha the retouched tools include scrapers, a notched flake, and a possible graver. Retouched points at Dalmanutha also exhibit similar patterns basal modification to points at Kathu Pan 1, suggesting that these points may have been hafted (Crook 2018).

2.6 Fauresmith Sites

Brakfontein 231 (located in the district of Fauresmith) was designated by Van Riet Lowe as the type site for the industry, as the artifacts were well preserved and at the time the site was the “most representative collection from any single Fauresmith site” (Goodwin and Van Riet Lowe 1929, 1927, 86). However, many of the original sites attributed to the Fauresmith industry consist of surface collections of eroded materials rather than excavated assemblages. The number of sites with surface collections of Fauresmith material has made dating the industry problematic, and some of the original lithic material (including from the type site) used to define the industry may not represent *in situ* assemblages but rather the mixing of artifacts from different contexts (Underhill 2012). The Fauresmith appears to be a regional industry, as sites containing Fauresmith material seem to be localized to the interior cape region. Sites with stratified Fauresmith assemblages include material from Canteen Kopje (Underhill 2012; Lotter et al. 2016; Shadrach 2018), Wonderwerk Cave (Beaumont and Morris 1990, 2004; Beaumont and Vogel 2006), Kathu Pan 1 (Beaumont and Morris 1990; Porat et al. 2010; Wilkins and Chazan 2012; Wilkins 2013), and Bundu Farm (Kiberd 2006) and have also provided age estimates for the Fauresmith industry in the Northern Cape Province. Renewed and ongoing investigations of Fauresmith material at the sites shown in Figure 1 may be particularly meaningful in attempting to further define and date the industry.

Other sites mentioning Fauresmith assemblages in literature include: Fauresmith Townlands and Spruit, Onder Dwars River, Lockshoek (Goodwin and Van Riet Lowe 1929), Van der Elst Donga (Underhill 2012), Riverview Estates VI (Sohnge, Visser, and Van Riet Lowe 1937; Underhill 2012), Riverview Estates I and II (Malan 1947), Rooiberg and Wonderboom (Mason 1959), Rooidam 1 and 2 (Fock 1968), Muirton (Sampson 1974; Underhill 2012), Beisiesput 1 (Beaumont and Morris 1990), Pniel 6 (Beaumont and Morris 1990; Underhill 2012), Nooitgedacht 2 (Beaumont and Morris 1990; Underhill 2012), Roseberry Plain 1 (Beaumont and Morris 1990; Underhill 2012), Bestwood 1 (Chazan et al. 2012; Chazan 2015b) and Dalmanutha, Rosslands, and Sunny Slope Farms (Crook 2018).

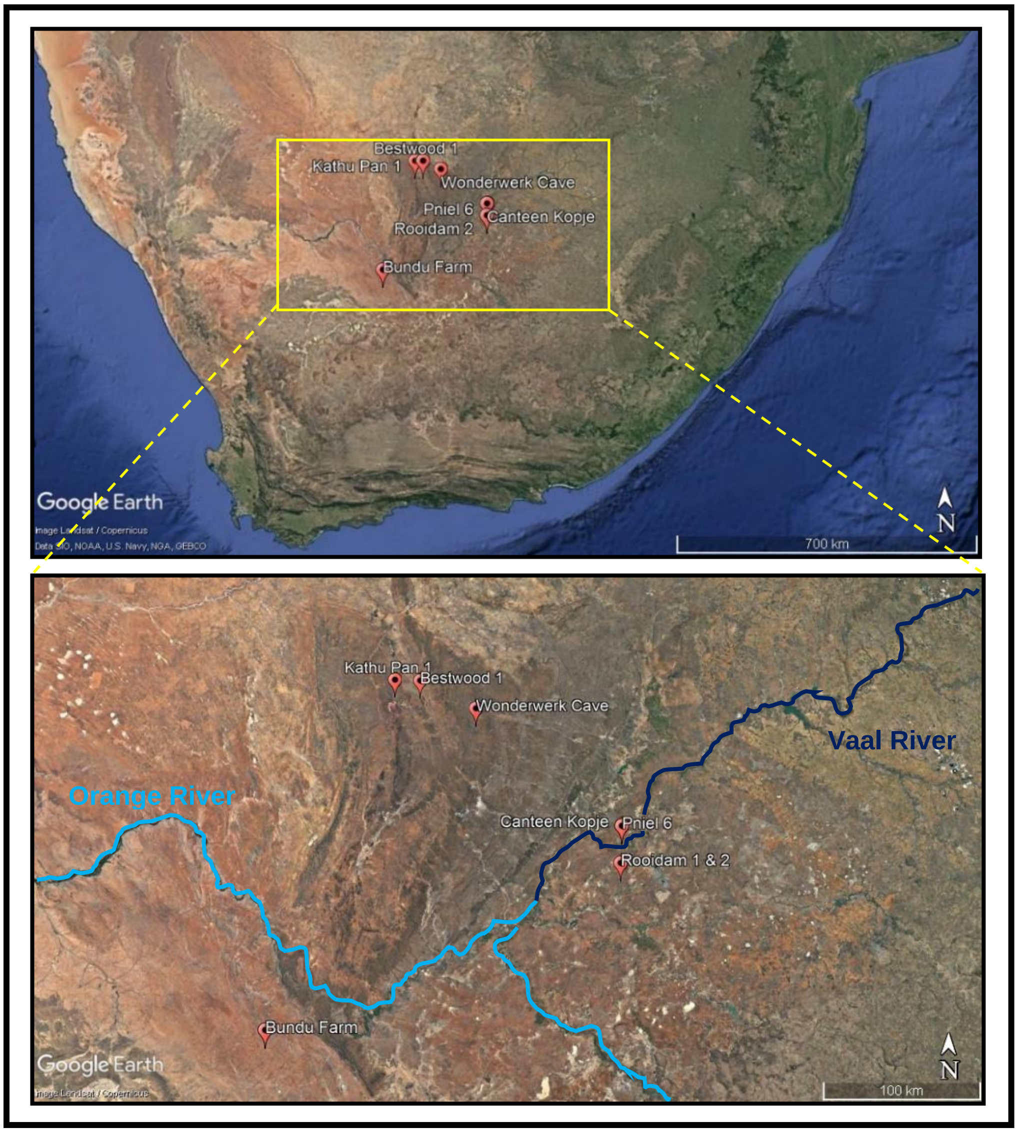


Figure 2.1 A satellite image of southern Africa showing notable sites in the interior Cape region with Fauresmith-designated assemblages, as well as a closer image of Fauresmith sites in relationship to the Orange and Vaal River (Google 2019).

2.7 Dating the Fauresmith

Dates for the Fauresmith industry come primarily from a few key sites in the Northern Cape region. At Wonderwerk, two bifaces from Excavation 1 were associated with the industry and respectively dated to >200 ka and >350 ka (Binneman and Beaumont 1992). Further investigations revealed Fauresmith material coming from Excavations 1, 2, 3, and 6 at Wonderwerk Cave that provides a combined date of ~270 – 500 ka by uranium-series, although the context of dated materials, and the association of Fauresmith material coming from Excavation 1 (Beaumont and Vogel 2006; Chazan et al. 2008) is not well established (Herries 2011). A new U-Pb date from a sample in Excavation 2 strata 5 has been dated to 548 ± 27 ka which pushes back the Fauresmith chronology even further in time (Pickering 2015). The Fauresmith assemblage from Stratum 4a at Kathu Pan 1 has provided evidence for being one of the older known occurrences of a Fauresmith assemblage at ~500 ka, as well as the earliest occurrence of lithic spear tips that were likely hafted and used as weapons (Porat et al. 2010; Wilkins and Chazan 2012; Wilkins et al. 2012). At Canteen Kopje, optically stimulated luminescence (OSL) provides a minimum age estimate of ~300 ka for Fauresmtih material which is derived from the interface of the younger Vaal graves and Hutton sands (Chazan et al. 2013). Dates for the Fauresmith/Late Acheulean are established from various faunal samples subjected to electron spin resonance (ESR) from Groups 4-6 at Bundu Farm have a mean age of ~245 ka (Kiberd 2006). Uranium-series dating of lacustrine limestone samples coming from Rooidam 1 have provided a minimum age estimate of 174 ± 20 ka for the underlying Fauresmith assemblages coming from stratums 5-8 (Szabo and Butzer 1979). Samples were taken from Rooidam 2 for OSL dating during the excavation of the site by Folke Richardt, and an average minimum age estimate of 174 ± 15 ka was established for the sequence (*pers comm*. Folke Richardt).

2.8 Division within the Industry: Earlier, Middle, and Later Phases

Material later to be classified as Fauresmith, was originally described by Van Riet Lowe as being found in and on deposits of highly calcified sands, and within these deposits are associated bifaces, cleavers, and other flake tools (Malan, 1947; Van Riet Lowe, 1952a), although this is not true of all Fauresmith sites. After a field study in the Vaal River Basin, van Riet Lowe proposed dividing the Fauresmith into two phases, an earlier Fauresmith I and later Fauresmith II (Sohnge, Visser, and Van Riet Lowe 1937). These phases were based on stratigraphic evidence from sites in the Northern Cape region, with the Riverview Estates VI material representing the type site of the Fauresmith I material, and Brakfontein 231 the type site of both the industry and the Fauresmith II (Sohnge, Visser, and Van Riet Lowe 1937; Underhill 2012). The industry was further divided on typological grounds, as Lowe believed that the industry showed a successive refinement of the Levallois technique throughout time and divided the Fauresmith into three phases (Van Riet Lowe 1945, 1952a, 1952b). However, this division appears to be based on a techno-typological sequence based on core types rather than stratigraphic evidence from excavated sites, and tools that typify the Later phase of the industry are not explicitly stated or defined (Underhill 2011a). According to Van Riet Lowe (1945) the significance of the bifaces in the Fauresmith decreases through time while increasingly specialized flake tools tend to make up larger proportions of the assemblages. Peter Beaumont applied van Riet Lowes division of the Fauresmith to other sites in the Northern Cape region, most notably the sequence at Wonderwerk Cave where Beaumont and Vogel (2006) have adopted a tripirte division for the Fauresmith assemblages. A chronology for the phases of the Fauresmith is established based on chronometric dates established form Major Unit 3 and 4 and a combination of paleomagnetism, paleoclimate, and faunal age correlations (Beaumont and Vogel 2006), although Chazan and Horwitz (2010) contest the use of the Major Units for investigating typological trends in the sequence. The phases will be further discussed and defined below. It should be noted that the Fauresmith sequence at Wonderwerk Cave is the only published sequence to apply this triparte division, since the division was originally proposed by Van Riet Lowe (1945). In order to further investigate the reality of these phases, previously excavated Fauresmith assemblages must be analyzed for significant changes in tool frequencies and variability within the unit/strata. Future excavations aimed at examining temporal variability will hopefully yield evidence to support or refute this technological division within Fauresmith industry.

2.8.1 Fauresmith I or Earlier Fauresmith

The earliest occurrence of Fauresmith material was described as lying “on the eroded calcerous tufas that overlie the Younger gravels as well and in rolled and unrolled conditions in the Youngest gravels” at Riverview Estates VI (Sohnge, Visser and Van Riet Lowe 1937, 90). This material was described as belonging to the

Fauresmith I, a sub-division of the industry based on geological inferences (Sohnge, Visser, and Van Riet Lowe 1937; Underhill 2011b). Fauresmith I artifacts were found beneath the red Kalahari sands and on the surface of the calcerous tufas at the site of Riverview Estate IV and are underlain by material that is now considered to be Earlier Acheulean (Sohnge, Visser and Van Riet Lowe 1937; Underhill 2011, 19). Formal implements in the Earlier Fauresmith include bifaces, cleavers, and crude scraper like tools on flakes as well as proto-Levallois cores that exhibit convergent and parallel longitudinal flaking (Sohnge, Visser and Van Riet Lowe 1937; Underhill 2011). Bifaces are made on either cores or large flakes, and "finished specimens show slender flaking with a lenticular cross section through the breath of the tool" (Sohnge, Visser, and Van Riet Lowe 1937, 90). Flakes were detached by direct percussion or using the anvil technique (Van Riet Lowe 1952a). Bifaces are described as on average smaller than those found in previous archaeological horizons. Other LCTs, like cleavers are also present, although smaller, on both side- and end- struck flakes (Sohnge, Visser, and Van Riet Lowe 1937; Van Riet Lowe 1945). Beaumont and Vogel (2006) have suggested that a small amount of material from MU 7, consisting of a prepared core, cleaver, and a biface resembling those from MU 4 could possibly be attributed to the Earlier Fauresmith or Later Acheulean, and date to <780 ka at Wonderwerk Cave. The material was described as possibly representing the Earlier Fauresmith phase based on the presence of bifaces and fewer retouched tools than material associated with the subsequent Middle and Later Fauresmith phases in the sequence (Beaumont and Vogel 2006; Beaumont 2011; Underhill 2011b). More recent re-analyses of the lithic material from Excavation 1 area have disputed the suggestion that there is clear evidence for Fauresmith material within this part of the sequence, although the sequence does show a developmental progression into Fauresmith-like bifaces but lacking other characteristic debitage such as blades (Chazan et al. 2008; Chazan and Horwitz 2010; Chazan 2015b). New chronometric dates on stalagmites by Pickering (2015) for MU7 potentially extends this developmental trend from Acheulean to Fauresmith-like material to ~839 ± 26 ka.

2.8.2 Fauresmith II or Middle Fauresmith

The Middle Fauresmith was originally described as material that "occurs on the deposits that overlie the Youngest Gravels and separated by calcified dirty loamy soil" overlying the Younger Gravels (Sohnge, Visser and Van Riet Lowe 1937, 91; Van Riet Lowe 1945) and is represented by material from the type site Brakfontein 231. Middle Fauresmith implements included finely finished bifaces on flakes, cleavers, blades, trimmed points, end- and side- scrapers, convex side scrapers typical Levallois type flakes and cores (tortoise), facetted polyhedral stones, and gravers (Sohnge, Visser and Van Riet Lowe 1937). Bifaces are primarily manufactured on simple flakes with plain platforms that vary in shape from pointed almond to ovate (Underhill 2011). Finished specimens show controlled and thin flaking, straight edges, and lenticular cross-sections over the breadth of the implement (Underhill 2011b; Sohnge, Visser, and Van Riet Lowe 1937). Cleavers consist of large side struck flakes, although Lowe questions their inclusion with the Fauresmith suggesting that they may have been "recovered or borrowed" from an older culture (Sohnge, Visser and Van Riet Lowe 1937, 92). Points are manufactured on long blades or on Levallois flakes and true gravers are found (Sohnge, Visser and Van Riet Lowe 1937). Middle Fauresmith material was described as occurring at a number of sites in the Northern Cape and the Free State, stratified below red aeolian Hutton sands (Beaumont and Vogel 2006). At Wonderwerk Cave the Middle Fauresmith is associated with MU4 and an inferred age of ~480 – 510 ka, based on faunal evidence and paleoclimatic data (Beaumont and Vogel 2006). Recent work done at the site Pickering (2015) has established new chronometric dates for MU4 using U-Pb that place it at 548 ± 27. This phase is associated with prepared core technology, blades, Levallois points, convex scrapers and small bifaces that compare to those from the Fauresmith assemblage at Kathu Pan 1 (Beaumont and Vogel 2006; Beaumont 2011).

2.8.3 Fauresmith III or Later Fauresmith

The final phase of the industry is characterized by tools found in deep deposits of red, wind-blow sands which overlie surface limestones, calcified sands and Younger gravels at Riverview Estates (Van Riet Lowe 1952a). The tools from the Later Fauresmith phase appear to belong to the Middle Stone Age asides from the presence of bifaces (Van Riet Lowe 1945). The Later Fauresmith reveals "the Levallois fully developed as a technique" (Van Riet Lowe 1952a, 175). In the final stage of the Fauresmith culture Levallois-type cores include circular, cordiform, sub-triangular, rectangular, and pyramidal forms (Van Riet Lowe 1952a). Later Fauresmith material is described by Beaumont and Vogel (2006) at Wonderwerk Cave coming from MU3 excavation 2, dating to 276 – 286 ka based on U-series dating of stalagmites. The Later Fauresmith assemblage is associated with prepared cores, blades, Levallois points, convergent scrapers, and this phase is distinguished from earlier phases by the presence of coarsely flaked bifaces with remnant cortex and convergent (nosed) scrapers (Beaumont 2011; Underhill 2012). Beaumont and Vogel (2006) make note of another occurrence of Later Fauresmith material in >8 m beach deposits from the Blind River site, East London.

2.9 'Transitional' Assemblages from Eastern Africa

Archaeological evidence from Late Acheulean/Transitional/early MSA deposits seem to "demonstrate considerable diversity in hominid adaptations in the use of a variety of shaped or retouched tools and flake production strategies" (McBrearty and Tryon 2006, 264). The Kapthurin Formation in Kenya, has assemblages with features considered 'transitional' (or those referred to Late Acheulean, early MSA, or undiagnostic) between the Acheulean and the MSA are found and date to between ~465 - 395 ka (McBrearty 2001; Tryon and McBrearty 2002; Blegen, Jicha, and McBrearty 2018). These sites have lithic material sites described as Acheulean, Sangoan, Fauresmith, and MSA are interstratified within and below the K4 Bedded Tuff Member and are "considered to be contemporary in a single depositional basin over the duration of the transition" (Tryon and McBrearty 2002, 211). The inter and intra- site diversity of these dated 'transitional' assemblages problematize how we interpret the trajectory of tool development and the relationship between assemblage diversity and modern behavior, as they do not conform neatly into industrial types that fit into the current cultural historical model (McBrearty 2001; Tryon and McBrearty 2002; McBrearty and Tryon 2006; Tryon, McBrearty, and Texier 2006; Tryon and Faith 2013). These assemblages "emphasize the arbitrariness of the ESA/MSA division" (Tryon and McBrearty 2002, 228) and the "danger of the use of the *fossiles directeurs* and the failings of the African three-stage approach" (McBrearty 2001, 91). Many of these dated sites reveal that even relatively contemporary assemblages show a range of different technological products and tool reduction strategies during the Middle Pleistocene. Notable technological features of 'transitional' assemblages include the presence (or absence) of LCTs, blade technology, points, and varying methods and frequencies of Levallois reduction (Tryon and McBrearty 2002; McBrearty and Tryon 2006). It is likely a future effort to continue to narrowly focus on the transition from core to flake production as the source of technological innovation and modernity in MSA assemblages, as there is no clear liner succession of artifact typology or reduction strategies from the Acheulean to MSA lithic material (Tryon and McBrearty 2002). Rorop Lingop (GnJi-28) is a site of interest within the Kapthurin Formation, as this assemblage had small bifaces, points, and Levallois debitage that is consistent with descriptions of Fauresmith material in southern Africa and is chronometrically constrained to a comparable time range. While the boundaries between the Acheulean to MSA are ambiguous and often oversimplified, this time period does in fact seem to mark of the first occurrences "of an increasingly complex hominid adaptive pattern" as evidenced by technologically diverse lithic assemblages (McBrearty and Tryon 2006, 264).

2.10 A Greater Range of Complexity in the Later Acheulean

The Acheulean is the longest spanning techno-complex in human prehistory dating from ~1.5 ma – 300 ka and its emergence has been linked to the appearance of *Homo ergaster/erectus* (Lombard et al. 2012; de la Torre 2016). Despite some variation it is generally considered to be a relatively stable and homogenous in tool typology and technological complexity (Wynn and Tierson 1990; Lycett and Gowlett 2008). However, a growing body of evidence suggests that the Acheulean exhibits more variability than previously thought, as assemblages are not entirely uniform across geographical space and time with some occurrences lacking a biface component entirely (Lycett and Gowlett 2008; de la Torre 2016). An investigation by Wynn and Tierson (1990) followed by Lycett and Gowlett (2008) using Discriminant Function Analysis (DFA) on the most iconic tool type of the Acheulean, the biface, and revealed that there are general patterns in the conceptual form and shape that are relatively homogenous over large periods of time and geographic space. Interestingly, there is also evidence for regional trends in biface morphology over very broad geographic boundaries (i.e. Africa vs. Middle East vs. Europe) that may provide evidence for the beginnings of more regionalized tool typologies (Lycett and Gowlett 2008; Wynn and Tierson 1990). During the Later phase of the Acheulean, which is suggested to span from ~600 - 250 ka there is a general trend towards fewer cleavers, more intensively refined bifaces, and innovative flaking strategies (Tryon and McBrearty 2002; Tryon, McBrearty, and Texier 2006; Cruz-Uribe et al. 2003; Deino et al. 2018; Shadrach 2018). An exploration of the differences/similarities among Middle Pleistocene reduction strategies suggest that the origins of Levallois techniques seen in MSA assemblages may be derived from local Acheulean traditions in the Kapthurin Formation (Tryon, McBrearty, and Texier 2006). Both Victoria West type cores, and cores used to prepare large bifaces and cleavers are examples of predetermination in flake shape by a Levallois-like reduction strategy associated with Earlier Stone Age occurrences (McBrearty 2001). The use of Levallois technology, as well as blade production, generally considered to be a phenomenon belonging to the MSA predates 395 ka and is an aspect of lithic technology "that crosscuts the traditional divide between the Acheulean and the Middle Stone age" (McBrearty 2001; Tryon and McBrearty 2002; Tryon, McBrearty and Texier 2006, 2001; Blegen, Jicha and McBrearty 2018).

2.11 The Emergence of Early Middle Stone Age Assemblages

The advent of Middle Stone Age technology is generally associated with the disappearance of bifaces and other LCTs, Levallois reduction, and the production of points. The early MSA is generally defined as the period of the Middle Pleistocene that predates 130 ka (Lombard et al. 2012; McBrearty and Tryon 2006). These assemblages seem to consistently lack bifaces or other LCTs (Cruz-Uribe et al. 2003). The high degree of both inter- and intra-site variability suggests a gradual transition from the reliance on large multi-functional tools to a proliferation of smaller, specialized and predetermined tools and reduction strategies being what seems to technologically characterizes early MSA assemblages (Tryon and McBrearty 2002; Douze and Delagnes 2016). The diversification of Levallois reduction strategies and predetermined blanks, rather than its first appearance in the archeological record that signals the emergence of the behaviors and artefact variability known in Middle Stone Age industries (Tryon, McBrearty, and Texier 2006). A comparative analysis of Levallois reduction in assemblages from the Kaphturin Formation revealed four primary differences that can be used to distinguish Acheulean and early MSA occurrences; smaller flake size, the appearance of recurrent Levallois cores, a wider range of raw material types, and flake shape and retouch intensity/type (Tryon, McBrearty, and Texier 2006). Evidence from the Gademotta and Kulkuletti site complexes in Ethiopia suggests that “important diachronic changes in the production and shaping of convergent tools” can be seen in the MSA sequence (Douze and Delagnes 2016). Assemblages from the basal MSA units from Florisbad, are also consistently lacking LCTs, and also lack diagnostic retouched tool types such as points which problematizes their use as cultural indicators (Kuman, Inbar, and Clarke 1999). These sites suggest that changes in the patterns of exploitation and further utilization of both unretouched and retouched points may reveal the beginnings of a repertoire of behaviors that led to increasingly complex technological patterns associated with the MSA. Additionally, evidence from MSA assemblages in East Africa show the beginnings of regional variation and chronological change the within Middle Stone Age sequences (Tryon and McBrearty 2002).

Lithic points (a commonly indicator of MSA technology) have been found at some sites in the Kapthurin Formation and dated to before ~285 ka (McBrearty and Tryon 2006). The distinction between late Acheulean and early MSA assemblages cannot be based exclusively on artifact typology, as there is evidence to suggest that a better proxy for modern behavior would be the increasingly diverse patterns of tool production and other behaviors such as exotic raw material acquisition and transport, pigment processing, ostrich eggshell beads, and bone tools, which are more frequently associated with dated to later MSA assemblages in the African record (McBrearty 2001). Increasingly complex patterns of behaviors likely coincide with a speciation event in the human lineage that signals the emergence of anatomically modern human populations between 300 – 250 ka in the African record (McBrearty 2001; Tryon and McBrearty 2002). Elements of technology associated with the MSA have been found in archaeological occurrences that predate 285 ka, which is in agreement with fossil evidence of the earliest members of the Homo sapiens lineage dated by ESR at around ~280 ka at the site of Florisbad (Tryon, McBrearty, and Texier 2006; Kuman, Inbar, and Clarke 1999).

2.12 The Difficulty of Describing ‘Transitional’ Assemblages

Major shifts in global climate patterns occurred during a period known as the Mid-Pleistocene transition (~1.2 ma to 0.5 ma) which led to increasingly cold and arid conditions and unpredictable local environments (Head and Gibbard 2005; Head, Pillans, and Farquhar 2008). During this time period. hominins would have likely needed to exhibit adaptability to changing environments which we expect to be reflected in the intended function and design of material culture (Potts 1998). The significance of the Fauresmith industry to archaeological research lies primarily in its transitional nature, as the Mid-Pleistocene is suggested to be a time where “ new technologies…signal increased diversification and innovativeness which may be indicative of new capacities for flexible adaptive responses to changing local environments” (Wilkins and Chazan 2012, 1884). The mosaic of tool typologies and traits seen in Fauresmith assemblages across geographical time and space are often variable and inconsistent, which has made a unified and rigid defention difficult to establish for the use of inter-site comparisions (Chazan 2015b). Chazan notes that a purely systematic definition may not be representative, as transitional industries must “be explained as an outcome of the dynamics of the evolution of stone tool technology” and “archaeological systematics are not applied to biological organism but the products of human activity” (Chazan 2015a, 60). The industry highlights the inherent complexity in archaeological terminology and the need for consistent use of nomenclature and inter-site comparisons when defining and describing lithic industries which in any case acts as a barrier to extracting more interpretations (Chazan 2015a). Because there is a tendency for archaeological taxonomy to be high conservative, once established and defined the terminology is usually maintained even if the definition continues to change in definition throughout time (Chazan 2015a). Despite the caveats, the use of established terminology continues to be used to describe technological division within the paleolithic landscape of southern Africa.

There is a growing resistance to the assignment of lithic assemblages to industrial cultural types, as well as problematizing the relationship between industrial types to the larger periods of cultural-chronological time (i.e. Later, Middle, Earlier Stone Age) that are deeply intertwined with assumptions made about technological development or behavioral complexity on the southern African landscape. When observing patterns of lithic variability to make inferences about human culture or behavior, Tostevin (2000) argues that the use of industrial types constrains the interpretations we can make to understand meaningful changes in material culture and our ability to describe transitional assemblages. The use of named stone tool industries (NASTIES) was originally used for interpreting chronostratigraphic relationships in the European sequence to understand a sparse and fragmented archaeological record and "formulated in the absence of any guiding middle range theory… about the link between observed and inferred behavior" (Shea 2014, 174). These entities are further sub-divided into industrial groups that are treated as proxies for cultural behaviors of hominins (Shea 2014). NASTIES use descriptions of tool morphology and typological categories to categorize and describe inter-assemblage variability in lithic technology, and do not take into consideration the specific attributes of variation that are behaviorally relevant (Shea 2014). Empirical evidence from the archaeological record in fact "rejects a single origin and uni-linear trajectory of cultural evolution" that is so deeply entrenched in our terminology "in favor of spatiotemporally variable and intricate historical developments contingent on multiple factors" (Will, Conard, and Tryon 2019, 25). The Fauresmith industry exemplifies the problematic nature of how lithic material is classified and interpreted and additionally suffers from few well dated occurrences that temporally constrain it. Further analysis of excavated Fauresmith-designated assemblages (such as Rooidam 2) are necessary to address and engage with ongoing research concerning standardization and interpreting the social and behavioral significance of 'transitional' assemblages.

2.12 Reinterpreting Patters of Lithic Variability within ESA-MSA Assemblages

Rather than relying on the presence of diagnostic artifacts types which have previously been used to identify cultural and chronological milestones in the development and behavior of hominin populations (i.e. convergent points, Levallois technology), the archaeological record in eastern and southern Africa demonstrates a range of variability that demands for a revised understanding of the significance of lithic variability in later Acheulean or early MSA assemblages. New archaeological excavations and securely dated 'transitional' assemblages work to paint a more complex picture of the development of material culture in Africa, and in the face of new information we also must reconfigure our interpretations. A more appropriate indicator of cultural complexity is an increasing frequency in intra and inter-site diversity in blank production and assemblage composition that may reflect increasingly social and flexible adaptive behavior. This trend of diversity and localized cultural traditions, is also supported by the emergence of punctuated, innovative, and highly recognizable MSA technological traditions (i.e. Still Bay, Howiesons Poort) that have been well described and chronometrically dated to the later Pleistocene (Wurz et al. 2003; Wurz 2013). This pattern of diversity and variability is not cumulative or uni-directional in nature , as these periods of complexity or innovation in tool technologies can be punctuated and brief in duration, and do not show any technological or cultural connections to one another that would suggest one single developmental trajectory towards 'complexity' (Wurz 2013). Our understanding of 'transitional' lithic assemblages should take into consideration the degree of observed diversity or variance within an archaeological sequence as the best indicator for tangible and meaningful behavioral responses or adaptations which we consider as 'complex' or 'modern', rather than focusing on the presence or absence of certain artifact typologies within an assemblage in order to assign it an industrial classification.

2.13 Cultural Transmission and Social Learning Processes

Broad distinctions in the behavioral complexity of hominin populations are based on the chrono-cultural associations between prototypical artifact types and reduction strategies present in ESA and MSA technology. For assemblages that exhibit a mosaic of chrono-cultural features, a general description of the presence or absence of specific artifact typologies prove to be insufficient to characterize lithic variability within the assemblage or temporally constrain it. Assigning ‘transitional’ assemblages to an industrial complex will only obscure and oversimplify behaviorally meaningful patterns of variability and to lead a continued reliance on named stone tool industries (Shea 2014). An approach proposed by Tostevin (2012, 61) for measuring lithic variability within a sequence incorporates a well-established middle-range theory in order to address the “role of cultural transmission processes in shaping what is available for selection” during the production of lithics. An informative narrative of mid-Pleistocene technological development and variability must be theoretically grounded and “evolutionary explanations for technological change must avoid a strict style vs. function vs. technology distinction” in order to interpret hominin behavior, which is highly social in nature (Tostevin 2012, 62). Interpreting the social learning processes that affect the transmission of cultural knowledge and ultimately mediate blank production choices during the knapping process would allow for a more nuanced characterization of the behavioral repertoire available to hominins.

Chapter 3: Site History of Roodiam 1 & 2

3.1 Rooidam 1 & 2 (Kimberley, Northern Cape Province, South Africa)

The sites of Rooidam 1 and 2 (Figure 2) are located in the Northern Cape Province situated on the northern edge of the Karee *vloer* at an elevation of about 1150 m, about 120 m apart and 24 km west-south-west of Kimberley and in close vicinity to the Rooidam farm homestead (Beaumont and Morris 1990, 2004; Butzer 1974). In 1963 Mr. C. J. Cohen of farm Rooidam, informed G. J. Fock of bifaces he had found while digging a well. Upon visiting the site, he found bifaces and flakes when examining dumps from the well and of a pit that was dug about c. 60 m south of the farmhouse (Beaumont and Morris 1990, 2004; Fock 1968). The excavation of Rooidam 1 by Fock (1968) began as a trench nearby the old well where the previous bifaces were found, and eventually extended over a large portion of the well itself. Archaeological material found in the dumped sediments from the road metal pit in close proximity to Rooidam 1 by Peter Beaumont in the early 1970's. Small collections of sampled lithic material were taken at various times by Beaumont to produce preliminary interpretations (Beaumont and Morris 1990, 2004). A lithostratigraphy for the Rooidam 2 sequence was published by Peter Beaumont and Folke Richardt, and most of the lithics found were assigned to the Fauresmith (Beaumont and Morris 2004). Richardt lead an excavation at Rooidam 2 from 2005-2006 in order to further investigate the lithic sequence and temporal variation in the Fauresmith industry.

3.2 Geological Setting

The Karee *vloer* lies within a shallow and poorly defined valley system draining southward to the Riet River. It is mainly underlain by Dwyka shale with Karoo dolerite outcrops around the peripheral watershed (Butzer 1974). The pans and the various valley systems drain towards the Riet River and were formed by deflation as well as chemical and fluvial erosion and created widespread lacustrine conditions (Butzer 1974).The Rooidam pan sites represent part of a complex sedimentary sequence which mangles most of an elongated *vloer* that measures and terminates in the Karee Pan (Butzer 1974). The area is covered by a layer of surface lime, 1.2 m -1.83 m thick, under which is highly calcified sand silt (Butzer 1974). Dolorite bedrock is found 7.3 m to 9.1 m below surface as established by bore holes taken near the homestead during the 1964 excavation (Fock 1968). North of the site are small hills, and to the west an old *vlei* that extends south for several miles with flat elevation to the south and east (Fock 1968).

3.3 Paleoclimate

Rooidam 1 and 2 are pan sites that lie in upland plains between the Vaal and Riet rivers and are part of a complex sedimentary sequence which is associated with at "least four cycles of pan erosion and lacustrine deposition in the Kimberley region" (Butzer 1974, 16). The deposits from Rooidam belong to the penultimate lacustrine hemicycle and regional geomorphologic development reveals that the deposits belong to an earlier cycle than the nearby pan site Doornlaagte, with the youngest deposits belonging to the Upper Pleistocene from nearby paleo-lake Alexandersfontein Pan (Butzer 1974). Deposits from Rooidam 1 and 2 are found to date from the Middle Pleistocene and geomorphological events within the region "indicate repeated and appreciable environmental changes during the mid-Pleistocene" that le to alternating cycles of pan deflation and deposition (Butzer 1974, 1). Sedimentary samples collected and analyzed by Butzer (1974) from the Rooidam 1 sequence reveals a depositional sequence that begins with dry xeric conditions that become seasonal and wet, with fluctuating pan lake depth, and terminates as moister mesic conditions begin with aeolian activity.

A detailed interpretation of the sedimentary sequence from Rooidam 1 reveals that strata 2,4, and 8 derive from deep-water lake sediment deposition and lacustrine conditions (Butzer 1974; Beaumont and Morris 1990, 2004). Paleo-environmental interpretations suggest that the Rooidam 1 sequence may span over three interstadials and or/interglacial periods, in terms of the climatic evidence coming from nearby sites such as Wonderwerk Cave and Kathu Pan (Beaumont and Morris 1990, 2004).

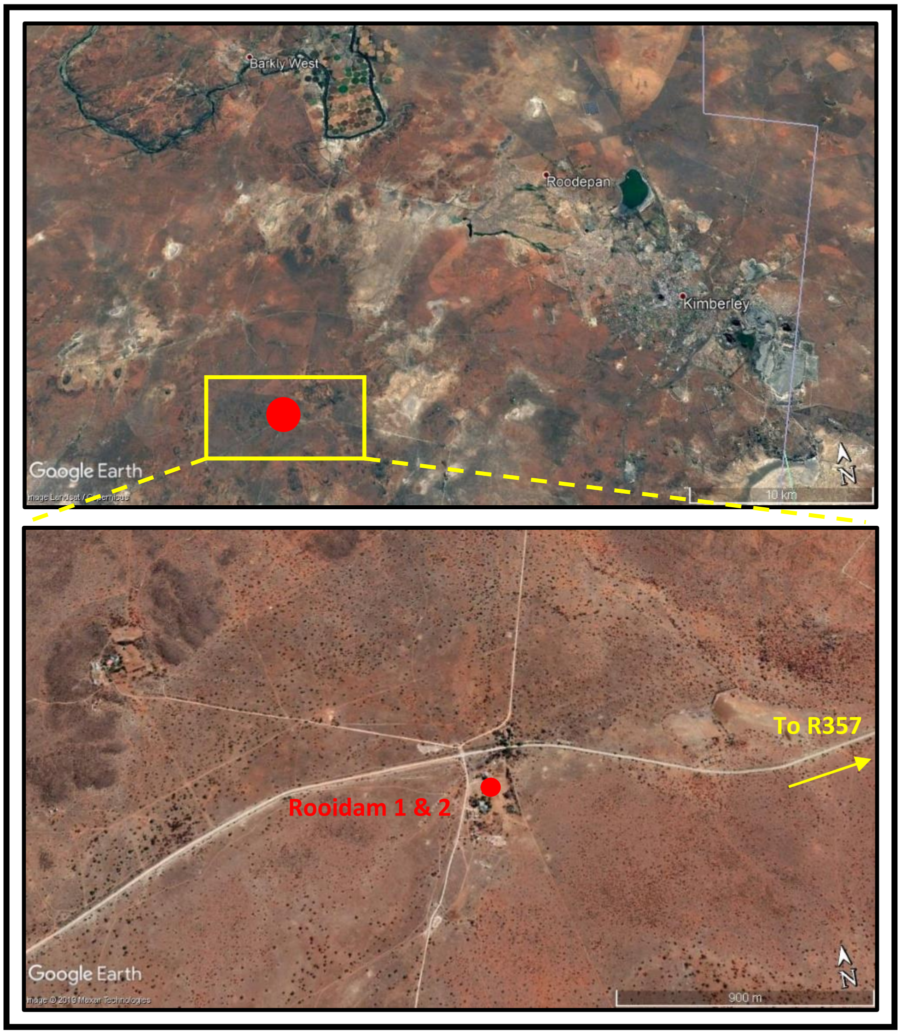


Figure 3.1 A satellite image of the relative location of Rooidam 1 and 2 and as well as surrounding towns Barkly West and Kimberley, and a closer image showing the relative location of Rooidam 1 and 2 as well as the Rooi Dam farmstead and nearby roads (Google Earth 2019).

3.4 Rooidam 1

The excavation of Rooidam 1 by G.J. Fock extended over a period of five weeks beginning in July of 1964 and ending in August and reached a depth of 7.3 m (Fock 1968). The excavation began as a trench near the an old well where previous bifaces were found, eventually proceeding down the well itself to a depth of 7.3 m (1968). The presence of artifacts encouraged Fock to continue excavation in November 1965 during a drought, a depth of 8.8 m was reached however the water table and prevented further digging (1968). A motorized pump installed by Mr. Cohn extended the well to a total depth of 9.8 m at which point he had found no further artifacts and reached dolerite bedrock (Beaumont and Morris 2004, 1990; Fock 1968).

As there was no observed visible separation or accumulation of artifacts and the excavation was carried out in arbitrary spits of 0.15 m (1968). The excavation began as a trench 1.83 m wide and 9.1 m long near the old well, and was dug in terraces (1968). At a depth of 5.2 m below surface, a connecting tunnel was dug to the well and the excavation proceeded down the well shaft, which was 5.2 m deep and 1.83 m x 1.83 m square. Subsequent study and geoarchaeological analysis by Butzer (1974), revealed a mainly sub-horizonal sequence divisible into 12 units (named and described by Beaumont 1990, 2004) summarized in Table 1.

Table 3.1 Summarized lithostratigraphic sequence for Rooidam 1 established by Beaumont (1990, 2004)

Strata	Depth (m) and sediment description
Stratum 1	~0.3 m of unconsolidated non-calcareous brown sand
Stratum 2	~1.0 m of cemented laminated white marl and calcite
Stratum 3	~0.2 m of compact stratified pale brown calcified silt
Stratum 4	~0.9 m of cemented massively bedded white marl and calcite
Stratum 5	~0.4 m of partly cemented laminated white marl and marly clay
Stratum 6	~0.5 m of prismatic calcified white silts and laminated marls
Stratum 7a	~0.3 m of compact laminated white marl with veins of sand
Stratum 7b	~0.3 m of compact prismatic white marl with veins of sand
Stratum 8	~0.3 m of compact bedded white marl with calcareous crusts
Stratum 9	~1.5 m of compact prismatic white silt with brown
Stratum 10	~3.8 m of unconsolidated non-calcareous reddish sand
Stratum 11	~0.6 m of decomposing dolerite rubble overlying bedrock

Beaumont ascribed artifacts laying on the surface of Stratum 1 to the LSA and patinated ‘Middle Fauresmith’ (previously described as MSA 1) artifacts in nearby sections of that level. Stratum 2 is archaeologically sterile (Beaumont and Morris 1990, 2004; Butzer 1974). Stratums 3-8 yielded material that was originally ascribed by Fock (1968) and Beaumont (1990) to the Fauresmith industry, although the material was later described as being Later Acheulean (Beaumont and Morris 2004).

Fock (1968) found what he describes as “heavy artifacts” made on hornfels and diabase in Stratum 10, although the very small sample size makes associating the artifacts with an industry impossible (Beaumont and Morris 2004). The artifacts include picks, various flakes with no secondary trimming or shaping, a shaped knife and backed convex flake, a chopper, and a core (Fock 1968). Although the sample is too small for precise industrial ascription, the material could possibly reveal information about typological variation and development within the greater assemblage. Beaumont (1990, 2004) also mentions artifacts made on hornfels and a few diabase specimens found in Stratum 10, the small sample size prevents typological ascription. Butzer (1974) makes no mentions of artifacts being found in Stratum 10 and describes the unit as archaeologically sterile, however this conclusion is not based on excavated material but derived materials examined from a stratigraphic profile. He does note the presence of rolled or badly corroded artifacts in Stratum 11 (Butzer 1974).

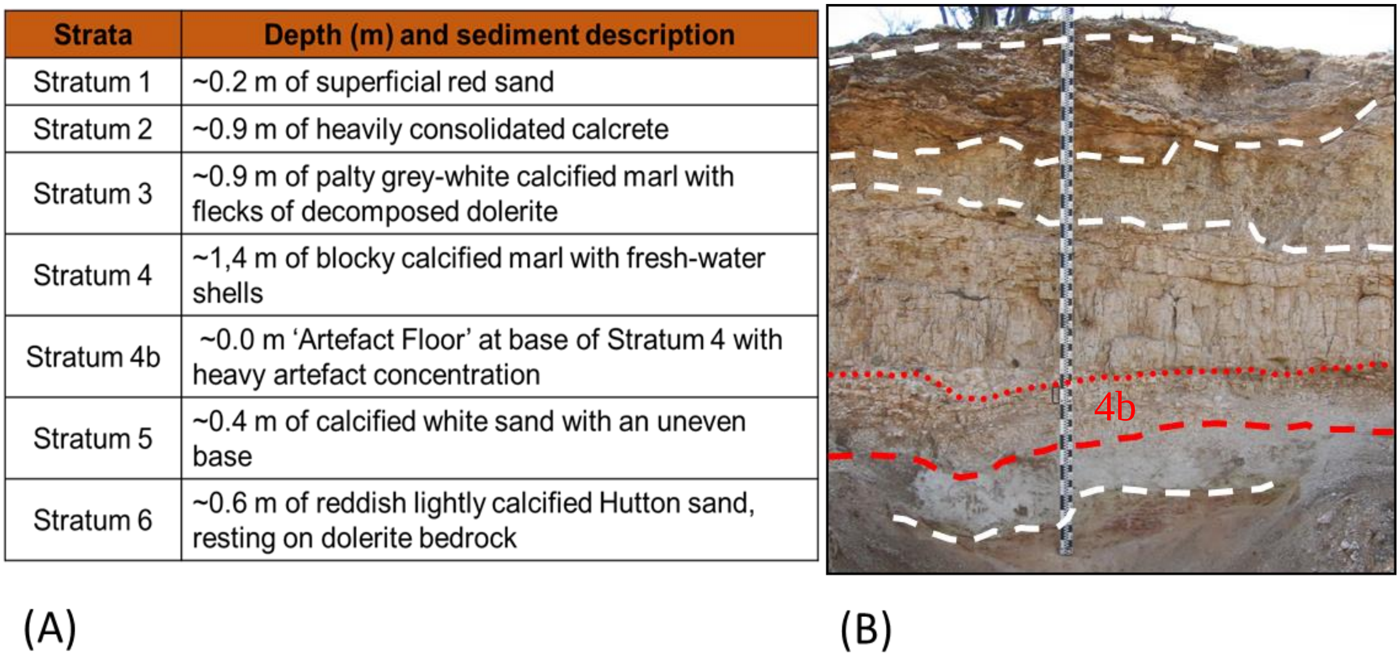
A total of 18,791 artifacts were found, only 33% of these are finished implements with the rest comprising the waste products or unfinished tools (Fock 1968). There were few artifacts found within the top layers of the sequence, with most of the archaeological material being found in the lower layers (1968). Over 90% of the total artifacts come from Stratum 9 which is thought to represent a key occupational period at the site (Beaumont and Morris 1990, 2004; Fock 1968). The primary raw material used for toolmaking at the site is hornfels, and an outcrop of this material can be found about 1 km to the west (Butzer 1974).

The assemblage consists of predominately flakes with a low incidence of larger tools and contains small bifaces, few choppers, a low incidence of blades and cores that include both single and prepared platform types (Fock 1968; Beaumont and Morris 1990, 2004). Bifaces represent only 2% of the finished implements and 0.7% of all artefacts in the assemblage (1968). Although not mentioned by either Fock (1968) or Beaumont (1990, 2004), Volman (1984) notes that the assemblage contained flake sections which appear to be broken on purpose, producing artifacts with parallel edges and uniform thickness along their length. The only organic remains found during the excavation were freshwater shells identified as *Bulinus tropicus* and *Planorbis natalensis* from Stratum 9, and a single ostrich eggshell fragment too miniscule for dating (Fock 1968). There were no teeth or bones found at the site, which is likely due to the nature of lime found in the area and conditions unfavorable of preservation (1968). Many artifacts from Rooidam 1 show weathered surfaces and irregular natural surfaces suggesting that they were exposed for prolonged periods of time (Beaumont and Morris 1990, 2004; Fock 1968). Fock (1968) concluded that the site does not represent a single occupational sequence. This is supported by Butzers (1974) interpretation of a major occupation along the margins of seasonal shallow lakes, as well as sporadic lake side visitations identified in the higher levels of the sequence. Artifacts in levels higher of the sequence are generally associated with subaerial *vloer*-margin deposits in a semi-primary context (Butzer 1974).

Szabo and Butzer (1979) attempted uranium series dating on two lacustrine limestone samples taken from the sequence. The two samples, Bu-1 from Stratum 2, and Bu-2 from Stratum 8, both overlie concentrations of artifacts, including the remarkably rich Stratum 9 (Beaumont and Morris 2004; Szabo and Butzer 1979). The uranium-series dating of two samples, Bu-1 and Bu-2, were calculated to date to 174,000 ± 20 ka and 108,000 ± 9 ka old, respectively. However, the stratigraphic position of Bu-2 implies that it should be older than Bu-1 and produce a radiometric age older than the sample taken from higher in the sequence, making this date problematic. Szabo and Butzer (1979) determined that the age estimate for Bu-2 is likely the result of uranium in the ground water exchanging freely with uranium in the sample causing the sample Bu-2 to recrystallize from aragonite to calcite (Szabo and Butzer 1979). The major hominin occupation contemporary with the large number of artifacts found in Stratum 9 can only be associated with the minimum age estimate of ~174 ka (Szabo and Butzer 1979) . Sporadic occupation by hominin populations around the fluctuating margins of temporary pan lakes can be dated sometime prior to about 174 ka, and interpreted from sediments found in Stratums 7-5 at the site (Szabo and Butzer 1979). However, while further attempts at dating material from Rooidam 1 are needed Szabo and Butzer’s dated sample Bu-1 provides a minimum age estimate for the Fauresmith at the site.

3.5 Rooidam 2

The site (28° 46’10” S, 24° 31’10” E) lies at an altitude of 1182-1179 m and is a road metal pit about 60 m south of the farmhouse that was opened sometime during the 1970’s by prospectors. Beaumont took small collections from deposits from 1979 onwards and described the sequence (Beaumont and Morris 1990, 2004). An excavation of the site led by Folke Richardt (University of Lund) was meant to provide “a clearer documentation of typological trends within the Fauresmith succession there” (Beaumont and Morris 2004, 23). An investigation of the sequence at Rooidam 2 could provide evidence for typological trends or raw material usage within the industry supporting or refuting Lowes typo-technological division of the industry into phases (van Riet Lowe 1945). Lithics coming from Rooidam 2 are reportedly less weathered and damaged than those from Rooidam 1 (Beaumont and Morris 2004, 1990). The preliminary lithostratigraphic succession is described by Beaumont and Richardt (2004) summarized in Figure 3.



Strata	Depth (m) and sediment description
Stratum 1	~0.2 m of superficial red sand
Stratum 2	~0.9 m of heavily consolidated calcrete
Stratum 3	~0.9 m of palty grey-white calcified marl with flecks of decomposed dolerite
Stratum 4	~1,4 m of blocky calcified marl with fresh-water shells
Stratum 4b	~0.0 m ‘Artefact Floor’ at base of Stratum 4 with heavy artefact concentration
Stratum 5	~0.4 m of calcified white sand with an uneven base
Stratum 6	~0.6 m of reddish lightly calcified Hutton sand, resting on dolerite bedrock

Figure 3.2 (A) Lithostratigraphic sequence for Rooidam 2 by Beaumont (1990, 2004) note that in Richardts 2005-06 excavation where Stratum 4b is referred to as Level 5 (B) A photograph taken during Richardts excavation of the natural exposed profile of pan wall with the dense concentration of artifacts (Level 5) bounded by red segmented lines. Profile photography courtesy of Folke Richardt

Lithic material from Strata 1-5 were ascribed to the Fauresmith industry (Beaumont and Morris 1990, 2004). Artifacts from Stratum 1 are attributed to the Middle Fauresmith and underlain by lacustrine accumulations in with what is described as coarser Early Fauresmith material (Beaumont and Morris 2004). Of note is the presence of what is described as “a single artifact thickness of unabraded lithics” at the base of Stratum 4, representing an in-situ artifact ‘Floor’ exposed on the northern face of the quarry (Beaumont and Morris 2004).

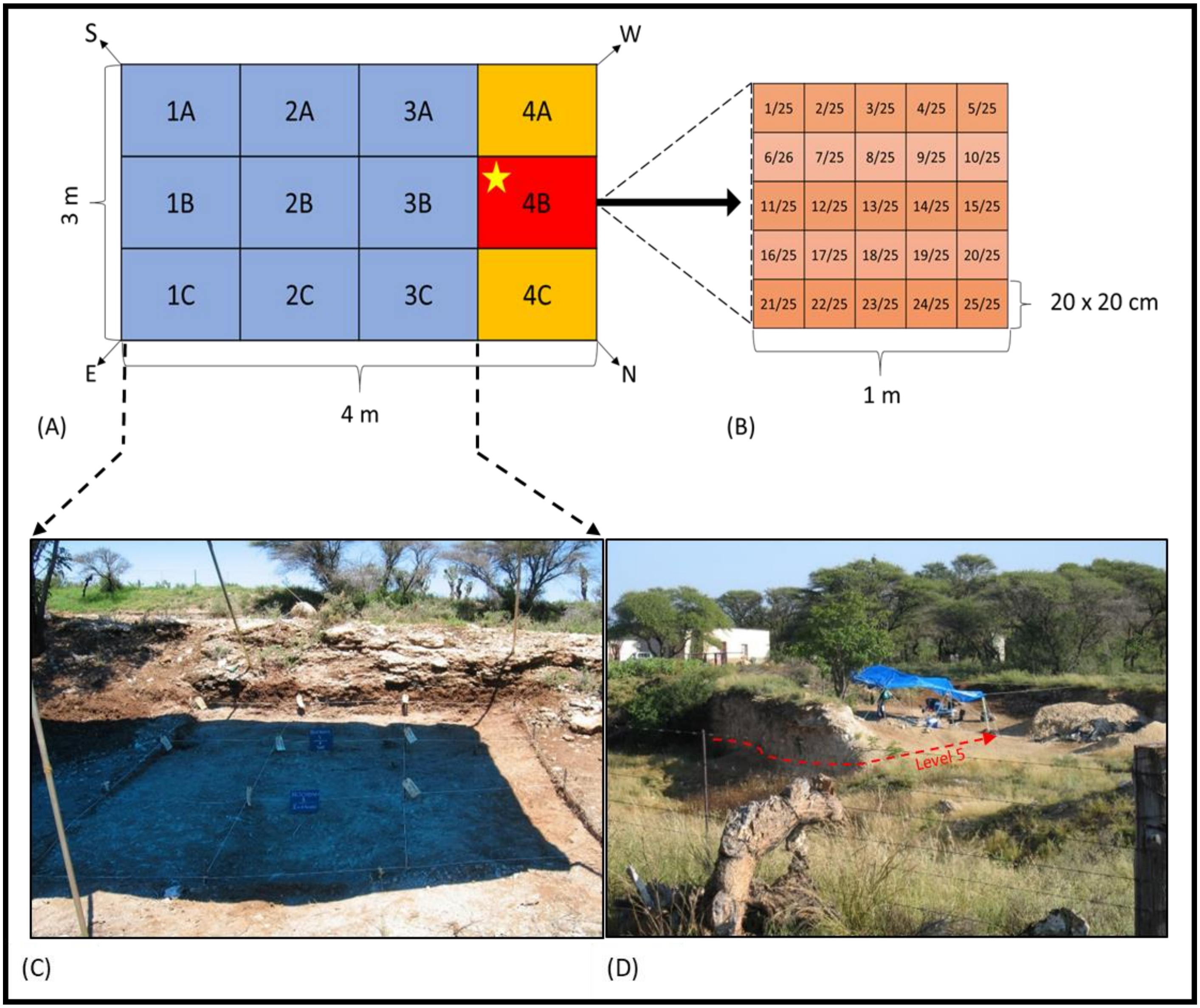


Figure 3.3 (A) Rooidam 2 excavation plot area (blue), squares opened during second field season (yellow) and square 4B (red) material from which is the focus of this analysis (B) Further sub-division of excavation square , artifact finds were bagged for each sub-level according a 25/25 grid (C) A photograph of the excavation area squares during the first field season, excluding squares 4a, 4b, and 4c which were only opened during the second field season (D) The excavation area took place on a slope facing opposite the exposed pan wall. Photographs courtesy of Folke Richardt

Excavations at the site took place over three field seasons from 2005-2006 by a small team led by Folke Richardt. The focus of the investigation was to investigate intra-site changes in tool frequencies from Level 5 and develop a clear stratigraphy of the site. The excavation area began as nine 1m x 1m squares, but during the second field season three additional squares were opened, for a total of twelve 1m x 1m squares as shown in Figure 2. The excavation reached a depth of 3 m, that extended to the base of Level 5. The sequence is divided into Levels 1-5, which are directly comparable to Beaumont's lithostratigraphy (Beaumont and Morris 2004) with Level 5 being described as an 'artifact floor', which is further divided into 10 sub-levels due to the massive concentration of artifacts. Levels 1-4 were dug according to changes in natural stratigraphy/soil composition. Each of the 10 sub-levels making up Level 5 represents one layer of artifacts. Levels leading up to Level 5 were variable in depth as they were dug according to natural changes in soil stratigraphy, while sub-levels in the artifact floor proceeded according to arbitrary spits of 10 cm. Each excavation square was further divided into 25 sub-sections measuring 20 x 20 cm, so the for the spatial distribution of artifacts in each square could be documented. In addition to finding lithics, the remains of ostrich eggshell fragments, freshwater snails, seeds, and one unidentified *in-situ* tooth (*pers comm*. Folke Richardt) were recovered. In addition, the results from four OSL samples taken from the sequence produced an average suggested age estimate of 174 ± 15 ka (*pers comm.* Folke Richardt), although this age is a minimum age estimate for the Fauresmith occupation at Rooidam 2 and does not provide a constrained temporal range.

3.6 The Significance of Investigating the Fauresmith Industry at Rooidam 2

Open air pan sites in the interior Cape region such as Rooidam 1 and 2 made it clear that hominid occupation during the Pleistocene was not only represented along the banks of the Vaal River, but had extended towards the upland depressions or pans between the Vaal and Riet rivers (Butzer 1974). The sample assemblage from Rooidam 2 was identified as a sealed, open-air site of importance for interpreting the Fauresmith sequence (Beaumont and Morris 1990, 2004; Underhill 2012). The assemblage offers an opportunity to investigate the typological trends that make up the vaguely defined ‘phases’ of (Beaumont and Morris 2004; Beaumont and Vogel 2006) of the Fauresmtih industry, and the meaning of temporal variability within ‘transitional’ assemblages which are often associated with the expression of increasingly modern behaviors and technology. The results of this analyses will contribute towards a working and comparable definition of Fauresmith assemblages and identify instances of temporal changes in the sub-levels of Level 5 that may indicate distinctive phases of the industry loosely identified in the Wonderwerk Cave sequence (Beaumont and Morris 2004; Beaumont and Vogel 2006). The results of the analysis are novel in that there are few quantitative analyses of Fauresmith-designated assemblages, and none have thoroughly investigated intra-Fauresmith temporal variability.

Chapter 4: Research Aims, Materials, and Methodology

4.1 Aims of Research

The aims of this analysis are to (1) technologically describe the artifact types and attribute frequencies that characterize the lithic assemblage from Level 5 at Rooidam 2, and to (2) quantitively test for intra-site variability in the choices made during the production of blanks and the morphology of retouched tools within the sequence. Additional aims are to (3) interpret the patterns of lithic variability at Rooidam 2 in order to more clearly define the unretouched and retouched blank types and core reduction strategies of transitional assemblages, and (4) use the results of the intra-site analysis to investigate the legitimacy of the distinctive temporal 'phases' identified in Faursmith-designated assemblages from Wonderwerk Cave (Beaumont and Vogel 2006).

4.2 The Rooidam 2 Assemblage (5th Level, Square 4B)

The lithic artifacts used for this analysis comes from the 2005-06 excavation at Rooidam 2 led by Folke Richardt, and the collection is curated at the McGregor Memorial Museum in Kimberley, South Africa. The lithic artifacts for this analysis come from the excavation square 4B, Level 5 (which is equivalent to Beaumont's Stratum 4b) of Richardts excavation which was originally described as a "single artefact thickness of unabraded lithics" (Beaumont and Morris 2004). Level 5 is broken down into sub-levels, with a total of 10 sub-levels excavated in arbitrary 5cm spits. The 10 sub-levels making up Level 5 are estimated to have made up a small sequence of 45 cm in depth. Each individual lithic artifact is labelled with the site accession number and unique specimen number (excluding sieved material). Artifacts were grouped into larger bags according to the sub-levels within Level 5, and further bagged in accordance with their spatial location in the excavation square established by the 25/25 grid system. A total sample size of *n* =2116 lithic artifacts were coded into the database. Due to time constraints, the 6th level was not coded and is excluded from the analysis. The total number of artifacts from each sub-level is provided in Table 2.

Accompanying reference material regarding the excavation process from Folke Richardt included field notes, detailed plan drawings of the excavation squares and artifact finds, as well as illustrations of a select number of artifact specimens.

Table 4.1 A table showing the recorded number of lithic artifacts for each individual sub-level (excluding the 6th sub-level) of Level 5. The sub-levels are ordered according to their relative age within the sequence.

Sub levels of Level 5	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	1st
Recorded *n*	97	108	317	287	0	566	252	245	155	89
Total sample size *n*	= 2116									

A majority of lithics from Rooidam 2 exhibited what was interpreted as weathering (i.e. edge damage, rounding of edges and arises) as well as a distinctive calcareous build-up on the surface of the artifacts, making the distinction between patinated/weathered and cortical surfaces on individual artifacts difficult. Often, this calcrete-like buildup also obscured dorsal/platform scars, as well as the extent of retouch on the lateral edges. Therefore, it should be noted that some attributes (number of dorsal scars, number of platforms facets, and retouch) may be underestimated to some extent in the analysis. Artifacts coded as retouched pieces needed to exhibit clear evidence of intentional shaping in the form of three or more continuous/patterned removals or multiple flake scars within a larger scar.

4.3 Data Entry

The analysis of the Rooidam 2 assemblage has been done using an open source data entry program E4 (oldstoneage.com). The program is meant to function as a data entry interface and is adaptable and can be modified to record the attributes and traits of a variety of different lithic artifacts representing different time periods or regional provenience. For the collection of data from the Rooidam 2 assemblage, I followed the protocol of Wilkins et al. (2014), using E4 software to record technological (e.g. platform type, dorsal scar pattern), metric (e.g. maximum dimensions, technological dimensions), typological (e.g. end-scraper, side-scraper, core type), and functional (e.g. diagnostic impact fractures) traits on each lithic artifact. This entry process begins with recording the artifact provenance and identification number for each individual artifact, classifying the artifact by type, and proceeding with the input of data that is relevant and applicable to that specific artifact type. Because the coded traits established by Wilkins et al. (2014) were used to record and analyze lithic technology from Pinnacle Point 5-6, a coastal site in the Western Cape Province, some traits and conditions have been adapted to account for the typological differences that we would expect to see at a transitional ESA-MSA interior site (such as raw material types and retouched tool typology). The raw data from E4 was then exported to a Microsoft Excel database for further analyses.

4.4 Interpreting Lithic Variability at Rooidam 2

To interpret lithic variability within the Rooidam 2 assemblage, "we must address both the historical events and processes of the culture change" to understand the significance of patterns of technological change visible in the archaeological record over the course of the sequence (Tostevin 2000, 92). A methodology developed by Tostevin (2011) that assigns a standardized and quantitative value to variance was adapted and used to test for statistically significant intra-site variation in blank production choices and retouched tool morphology at Rooidam 2. It was originally developed to identify patterns in lithic technological organization and production that could represent instances of behavioral adaptability or cultural transmission in hominin groups during the Middle Pleistocene to Late Pleistocene transition at Kebara Cave, Israel (Tostevin 2011). It aims to interpret lithic technology by using the observable choices made during production hierarchy to construct an emic decision hierarchy, an example of how both *chaîne opératoire* and technological sequence studies can both contribute to making interpretations in a way that does not obscure significant behavioral data (Tostevin 2011).

Artifact attribute states act as the smallest units of analysis as they are physical observations that reflect learned behaviors related to blank production and retouched tool shape and retouch type (Tostevin 2000, 2007). Related artifact attributes are then grouped together into four "Domains" of blank production; core modification, platform maintenance, debitage exploitation, and dorsal convexity. The results of flake fracture experiments have revealed that the "flintknapper has control over a number of independent operational steps during the process of tool making…the identification of the specific choices characteristic of an assemblage can be used to construct a unique behavioral signature for that assemblage" (Tostevin 2000, 95). The domains are representative of independent flintknapping behaviors and responses to the physical constraints of the tool making process (Tostevin 2000) and contribute to a technological signature of lithic production for each sub-level that can be compared. The choice of artifact attributes for analysis are based on Carr's middle-range theory of artifact visibility, which relies on the assumption that artifact attributes related to blank production are physically less visible than the retouched tool kit on the paleolithic landscape, and similarities in blank production between different hominin populations may reflect a higher degree of social learning and intimacy than similarities in retouched tool types or morphology between assemblages (Tostevin 2007).

Retouched pieces are also analyzed according to attributes that may affect the general morphology and functionality of formal tools. The artifact attributes, or flintknapping steps, used for this analysis are generally consistent to those used by Tostevin (2011). A few attributes (i.e. lateral edges, cross-section, and distal terminus) were changed due to certain attribute states used by Tostevin (2011) not being recorded during the data collection process, while others were added specifically to address relevant questions concerning the nature of the Fauresmith industry (i.e. blade production, and unretouched and retouched points). Although the frequency of blades and points are not artifact attributes, they were included in this analysis to investigate potential changes in their production through the sequence. The analysis of the retouched tool morphology included the addition of artifact attribute variables such as retouched edge angle, retouched piece typology, and the frequency of retouched points.

By understanding both the blank production behaviors and retouched tool types and morphology of an assemblage, a "technological signature" can be established for each sub-level or assemblage and compared for both intra-site variability and inter-site differences (Tostevin 2011, 2012). Comparing the similarities and differences in assemblages from one sequence can be used for inter-site comparison and identifying temporal phases or pulses within an industry. In this way, significant changes in blank production and artifact attribute frequencies within an assemblage can be used as a proxy for identifying innovative adaptations or changes in cultural transmission.

4.5 PAST (PAleonotological STatistics)

PAST is a free statistical software program for scientific data analysis and utilized here to analyze the individual sub-levels in the Level 5 sample assemblage (Hammer, Harper and Ryan 2001). Lithic attributes for each sub-level were compared from the bottom of the sequence (sub-Level 10) to the top (sub-Level 1) and tested for statically significant differences in the blank production strategies and the retouched tool morphology between the sub-levels. Artifact attributes were subjected to standardized t-tests for quantitative variables (i.e., platform thickness, external platform angle) and *chi*-square tests for categorial variables (i.e., platform treatment, profile shape). For categorical attributes the probability, chi-square value, and degrees of freedom are reported. For technical measurements the t value, probability, and degrees of freedom are reported. The probability (p) value is the probability that the data from two sub-levels were produced by the same behaviors, a value of $p < 0.05$ is used to indicate significance (Tostevin 2000). Only the artifact attribute data coming in Domains 2 and 4 were subjected to statistical analysis due to the interpretive and observational data used to characterize Domains 1 and 3 of the blank production behaviors.

4.6 Comparing intra-site Blank Production Choices

One of the goals of analyzing both the blank production strategies and retouched tool morphology of the 10 levels making up the 'Artifact floor' from Rooidam 2 is to asses if separate phases of lithic variability exist in Fauresmith assemblages (Beaumont and Vogel 2006) are visible within the analyzed assemblage. By comparing the "technological signature" (Tostevin 2012) of each level in the sequence we can further characterize lithic variability within Level 5 (Stratum 4b), and address questions concerning differences in artifact types or methods of tool production/reduction. The analyzed data includes lithic artifacts coded as complete flakes, flake fragments, blades/fragments, and cores. Artifact attributes states are grouped into four separate domains of production for each sub-level. Descriptive statistics are calculated for quantitative data and attribute frequencies are calculated for categorical or observational data. Pair-wise comparisons between adjacent levels are made between the sub-levels, beginning with the oldest level in the sequence and continuing to the youngest level in order to test for significant changes in lithic tool production within the sequence. Each domain is composed of two or more attribute states, and for each individual Domain the similarity/dissimilarity between adjacent levels is calculated, where a value of 0 would indicate no significant differences in production choices and 1 would indicate significant differences in all attribute states. The total difference between adjacent sub-levels is then calculated, with this value being representative of the total cumulative difference of all the Domains of production. Because the total difference value between each adjacent sub-level is calculated using all four Domains of production, a maximum value of 4 would represent significant changes in blank production choices and a value of 0 would indicate no significant changes. Higher values of calculated difference between adjacent sub-levels should be interpreted as an estimated higher degree of variance or dissimilarity between the levels, with lower value indicating similarity and a lack of significant change in production choices. Artifact attribute states that show a significant difference when compared to an adjacent sub-level ($p= <0.05$) are indicated by bold text and a highlighted section.

4.6.1 Domain 1: Core Modification

The attributes in this domain are based on qualitative observations about core reduction strategies that can be identified in the assemblage. Because of their interpretive nature, these descriptions of core modification are not subjected to statistical analysis and are rather used to understand general identifiable changes that can be seen in the sub-levels of the assemblage.

4.6.1.1 Core Orientation:

This is meant to interpret the types of surfaces being chosen for flaking (possibly) to obtain flakes of certain size or morphological parameters decided as necessary by the toolmaker). Flake exploitation surfaces can be roughly categorized as broad, longitudinal, or discoidal (Tostevin, 2012). To determine which category best describes the cores in the assemblage, each core was examined, and the ‘exploitation’ face was determined by looking at which face had the most flake scars with negative bulbs of percussion. The exploitation face is then referred to as ‘Face 1’ with ‘Face 2’ being the next most exploited face if the core had more than 2 faces. Both Face 1 and 2 are subsequently divided into four sectors (A, B, C, D) with Sector ‘A’ being the section of Face 1 that has the most flake scars with visible negative bulbs, with the other sectors being labelled in a clockwise fashion. Sector ‘A’ on Face 2 should be in the same position as on Face 1. The number of flake scars with negative bulbs. originating from in that sector are then recorded. Note that only flake scars >1mm are recorded. Evidence of core management flaking strategies as seen on the remnant core are also recorded (i.e. debordant flake, side blade, centripetal flaking) and used in conjunction with evidence of these characteristic removals recorded from the debitage to suggest possible core management strategies known and used by the toolmakers.

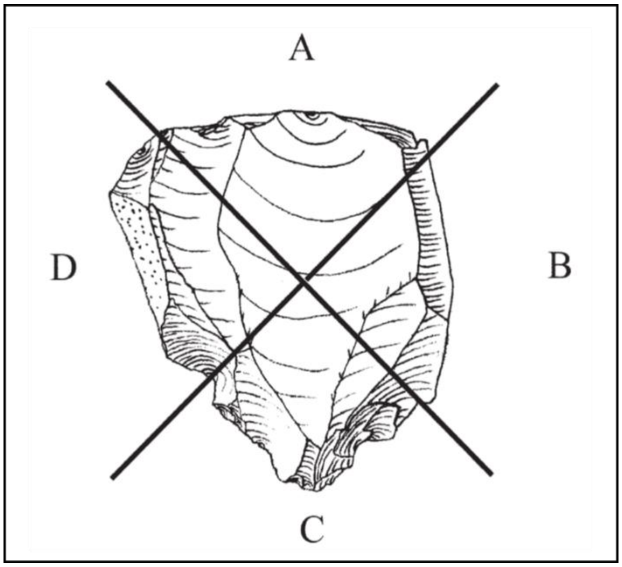


Figure 4.1 A diagram from Tostevin (2012) that visualizes the methodology used to determine core orientation.

4.6.1.2 Core Management:

This describes the maintenance of core convexity and associated flintknapping strategies. Debordant flakes and side blade removals can be identified by in the debitage as well as remnant flake removals on the extant core faces. Other strategies such as centripetal flaking, can only reliably be identified by examining the core faces. The management strategies will be noted for each level in the sequence. The goal of this analysis is simply to identify if certain management strategies are present or absent in each of the sub-levels.

4.6.2 Domain 2: Platform Maintenance

Attributes included in this domain are platform treatment, external platform angle, and platform thickness. Quantitative attributes were tested for significance using a standardized t-test, where the t value, p value, and degrees of freedom (df) is reported. The mean, standard deviation, minimum value, and maximum value are reported for each sub-level. For qualitative attribute values, a chi-square test was used to test for significance and the Fisher's Exact value, the chi-square value, and the degrees of freedom (df) are reported. The frequency of each attribute state is reported for each sub-level.

4.6.2.1 Platform Treatment:

All complete flakes, blades and retouched pieces were included. Proximal flake, blade, and retouched piece fragments are also. Entries where this attribute was categorized as indeterminate are excluded.

4.6.2.2 External Platform Angle:

All complete and proximal flake/blade fragments are included in this analysis. I chose to include proximal fragments in which the platform surface may be incomplete, as in some cases the point of percussion was still present on the remnant platform surface. If the point of percussion was not visible on the remaining platform surface, I choose to take the EPA from the center of that remaining surface.

4.6.2.3 Platform Thickness:

All complete flakes, blades and retouched pieces. This measurement is the distance between the point of percussion and the opposing point on the dorsal edge of the striking platform and dorsal surface of the flake. Proximal flake, blade, and retouched piece fragments are included in this analysis.

4.6.3 Domain 3: Direction of Core Exploitation

The direction of core exploitation at the early and late stages of debitage are based on qualitative observations from the dorsal scar directionality. It is meant to provide a general understanding of trends in the exploitation of flaking surfaces. As with the qualitative descriptions of Core Orientation and Core Management, the primary objective in this analysis is to identify the presence or absence of exploitation strategies within each sub-level. The descriptions for Early and Late Debitage exploitation are not subjected to any statistical testing due to small sample size and provides only a tentative picture of core exploitation trends within the assemblage.

4.6.3.1 Debitage Exploitation:

To determine debitage exploitation I only include complete flakes, blades, and retouched pieces. Complete flakes, blades, and retouched pieces are then sorted according to maximum length, with larger flakes/blades being associated with earlier phases of the reduction sequence and smaller flakes/blades associated with later phases of reduction. The total number of complete flakes/blades is divided by 4 to separate them into separate ‘phases’ of exploitation. Because we are only looking at early and late debitage exploitation we will only be looking at the first and last of these phases. We then look at the dorsal scar directionality in order to determine which scar patter is most dominant within that phase.

4.6.4 Domain 4: Dorsal Convexity System

Attributes in this domain have to do with maintaining the dorsal convexity of a core during the reduction sequence. This domain includes both qualitative and quantitative variables. Quantitative attributes were tested for significance using a standardized t-test, where the t value, p value, and degrees of freedom (df) is reported. For qualitative attribute values, a chi-square test was used to test for significance and the Fisher’s Exact p value, the chi-square value, and the degrees of freedom (df) are reported. The frequency of each attribute state is reported for each sub-level.

4.6.4.1 Length/Width Ratio:

This is recorded for only complete flakes and blades and retouched pieces. This ratio is calculated by dividing the Technical Length and Technical Width.

4.6.4.2 Width/Thickness Ratio:

This is recorded for only complete flakes and blades and retouched pieces. This ratio is calculated by dividing the Technical Width and Mid Thickness.

4.6.4.3 Aris Orientation:

This is recorded for all complete flakes/blades and flake/blade fragments and retouched pieces. Artifacts coded as shatter are not included. Aris Orientation has two qualitative observable descriptions; Parallel or Convergent.

4.6.4.4 Profile Shape:

This is recorded for all complete flakes/blades and flake/blade fragments and retouched pieces. Artifacts coded as shatter are not included. Profile Shape has three qualitative observable descriptions; Flat, Curved, or Twisted.

4.6.4.5 Blade Frequency:

This includes all complete flakes/blades as well as flake/blade fragments. All complete blades and blade fragments are totaled and divided by the number of complete flakes and flake fragments to calculate the ratio, or frequency of blade products to flake products in that level.

4.6.4.6 Unretouched Point Frequency:

This includes all complete flakes/blades and flake/blade fragments that were also classified as unretouched. All complete and flake/blade fragments that are also coded as unretouched points are included. Unretouched points can be both a blade and an unretouched point simultaneously and therefore included in both counts. All complete blades and blade fragments are divided by the number of unretouched points to calculate the ratio, or frequency of unretouched points to blades in that level.

4.6.5 Comparing intra-site Retouched Tool Morphology

The analysis of retouched tool is not separated into domains of production, because these retouched tools are essentially an extension of the production process, with the retouched tools being products of that process that are chosen for further reduction or utilization. The artifact attributes in this section contribute to establishing the morphology, type of retouch, and retouched tool typology. An important part of defining retouched pieces is the morphology of the artifact and the type of retouch. It should be noted that due to the nature of many artifacts in the assemblage exhibiting abrasion or damage, flake scars that appeared to be relatively fresh or inconsistent with the observed pattern of retouch were not included for analysis.

4.6.5.1 Length/Width Ratio:

This is recorded for only complete retouched pieces. The ratio is calculated using Technical Length and Technical Width.

4.6.5.2 Width/Thickness Ratio:

This is recorded for only complete retouched pieces. The ratio is calculated using Technical Width and Mid Thickness.

4.6.5.3 Profile Shape:

This includes all complete retouched pieces as well as all retouched piece fragments that include information about the profile shape of the flake. As in the Pair Wise comparison table, profile shape has three qualitative observable descriptions; Flat, Curved, or Twisted.

4.6.5.4 Retouched Edge Angle:

This includes all complete retouched pieces and retouched piece fragments.

4.6.5.5 Retouch Type:

This includes all complete retouched pieces and retouched piece fragments that have been classified according to a distinctive type of retouch.

4.6.5.6 Retouched Piece Typology:

This qualitative observational category includes all complete retouched pieces and retouched piece fragments that have been attributed to a specific type of retouched tool typology.

4.6.5.7 Retouched Point Frequency:

This includes all complete retouched pieces as well as retouched piece fragments that have been attributed to a specific retouched piece typology, excluding indeterminate entries. For the sake of analysis, all retouched tool types excluding retouched points are grouped as “Other” for comparison. All “Other” tool types are then divided by the number of retouched points to calculate the frequency of retouched points to other tool types within the level.

Chapter 5: Results

5.1 The Rooidam 2 Assemblage (Square 4B, Level 5)

The assemblage is dominated by flake production, with flake fragments being the most common artifact type (47%), with a frequency of 14% for complete flakes. Blade production is also represented in the assemblage with 19% of artifacts being complete blades and blade fragments. Cores make up 3% of the artifact assemblage. Retouched tools represent are 9% of the artifacts in the assemblage, with 69% of those retouched tools being produced from flake blanks and 27% and on blade blanks and 4% indeterminate. Undiagnostic artifacts coded as shatter make up 8% of the assemblage. No hammerstones or manuports were found. Table 5.1 shows the number and percentage of recorded artifacts by lithic artifact type. Dolerite chunks were also found in the assemblage coming from multiple sub-levels. However, these chunks are extremely rough and do not appear to have intentional flake scars or evidence of modification/use. The aggregate mass value of dolerite chunks was taken for each sub-level but is excluded from further analysis. Most artifact class types show high frequencies of artifacts with <50% remaining cortex on flaked surfaces (Table 5.2). Cores show the most even distribution of remaining surface cortex, although most cores in the assemblage still exhibit <50% of the original cortical surface. The low frequency of artifacts with remnant cortical surfaces could suggest that the initial stages of tool production may have occurred elsewhere. The assemblage was produced solely on hornfels, with the exception of dolerite cobbles. Hornfels is an ideal knapping material as it is fine-grained and offers a greater deal of control and predictability over flaked products than coarser-grained materials. Low frequencies of remnant cortex on analyzed lithics may indicate that even though the material was local, the initial stages of tool reduction may have taken place away from the site and closer to the raw material sources. Reduced nodules of material or preforms were then brought back to the site for further reduction and shaping. There is no evidence in the Rooidam 2 assemblage for non-local raw material being brought to the site as a manuport or for further reduction, although this cannot be said with certainty without further geochemical analyses.

The raw data for the analyzed assemblage is available through the online data repository Figshare (https://figshare.com/s/e3c4dc0258c320346525)

Table 5.1 Total number of recorded specimens by lithic artifact type classification, as well as the relative frequency of that type within the Level 5 assemblage

Lithic Artifact Type	*n*	Percentage
Blade/BladeFrag	405	19%
Complete Flakes	298	14%
Flake Fragments	986	47%
Cores	72	3%
Retouched Tools	190	9%
Shatter	165	8%
Total *n*	2116	100%

Table 5.2 Total number and estimated total percentage (%) of the area of remnant cortex on the surface of an artifact, divided by lithic artifact type

Lithic Artifact Type	*n*	0%	1-20%	21-40%	41-60%	61-80%	81-99%	100%
Flakes	1268	938	82	100	56	36	45	11
Blades	401	327	12	35	18	6	3	0
Retouched Tools	187	157	9	9	5	3	4	0
Shatter	164	107	16	17	17	3	3	1
Cores	96	20	21	30	16	6	3	0
Total *n*	2116	1549	140	191	112	54	58	12

5.1.1 Cores

Prepared core types dominate the assemblage, with frequent Levallois-like cores with a clear distinction and hierarchy between the preparation surface(s) and an exploitation surface(s). Both recurrent and preferential exploitation strategies are represented consistently in all the sub-levels across a variety of core types (Figure 5.1 and 5.2). Surfaces that were broad and flat were being most frequently exploited for blank production (Table 5.3). Remnant scars on extant cores reveal that the core surface convexity was often managed by centripetal flake removals, and occasionally *debordant* removals to maintain or rejuvenate the exploitation face of the core. Other core types that in the assemblage are multiplatform cores, blade cores, as well as cores that do not easily fit within existing typologies or morphological categories (Figure 5.3). Cores from the assemblage were variable in their maximum dimensions and mass (Table 5.4), although there were a number of smaller cores that were distinctive (Figure 10). Examining extant scars on cores reveal that they were predominately used for flake production, although the production of blades and unretouched points are represented as well.

Figure 5.1 (above) A Levallois-like core (with two hierarchical surfaces and an exploitation and preparation face) showing a large preferential removal of an elongated and pointed blank. Specimen no. 13140, from the 7th sub-level.

Core blanks that were spherical or cubic in form, likely deriving from river cobbles or nodules, were either preferred by toolmakers or more locally available than flat tabular blanks for blank production (Table 5.5)

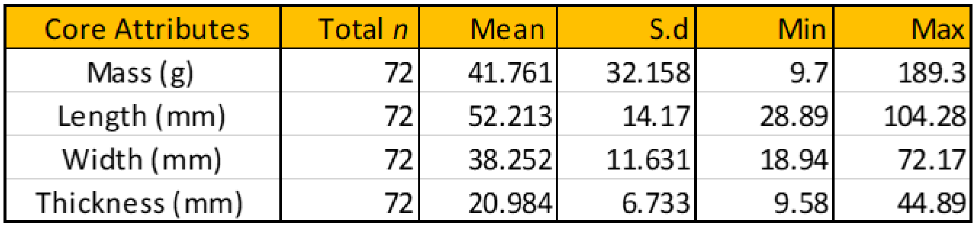
Figure 5.2 A Levallois-like core (with two hierarchical surfaces and an exploitation and preparation face) showing recurrent flake blank removals. Specimen no. 12710, from the 3rd sub-level.

Table 5.3 Frequency of different general approaches to core exploitation including all complete cores from Level 5 (sub-levels 10-1)

Core Orientation	*n*	Frequency
Use of a broad surface	60	83%
Use of a longitudinal surface	4	6%
Use of a broad and a longitudinal surface	8	11%
Total *n*	72	100%

Figure 5.3 A core with an unusual cubic like morphology, with multiple exploitation surfaces showing flake removals.

Table 5.4 Summary statistics of recorded core attributes that includes all complete cores from Level 5 (sub-levels 10-1)



Core Attributes	Total *n*	Mean	S.d	Min	Max
Mass (g)	72	41.761	32.158	9.7	189.3
Length (mm)	72	52.213	14.17	28.89	104.28
Width (mm)	72	38.252	11.631	18.94	72.17
Thickness (mm)	72	20.984	6.733	9.58	44.89

Figure 5.4 Cores (<5 cm) from Rooidam 2 showing a variety of reduction strategies and morphologies. Specimen numbers are read from top to bottom and left to right: 12003, 11987, 11985, 14069, 1202, 12429.

Table 5.5 Recorded number and frequency of cores according to core blank sphericity, an observational category determined by examining intersecting faces of a core with remnant cortex

Core Blank Sphericity	*n*	Frequency
Spherical or Cubic	49	68%
Non-spherical/Flat	13	18%
Flake	6	8%
Indeterminate	4	6%
Total *n*	72	100%

5.1.2 Flake and Blade Production

Both flake and blade products (*n*=896) frequently exhibit evidence of platform preparation, with 29% having negative bulbs of percussion, 49% showing multiple remnant facets without negative bulbs, and 21% having platforms that were not prepared. Remnant flake scars indicate that 65% of blanks show convergent flaking, and 35% have a parallel flaking pattern, which is more commonly identified in blade products (Figure 5.5). In conjunction with evidence from extant scars on cores, dorsal scars on flake and blade products most frequently show radial patterns of blank exploitation. The most common profile shape of blanks is flat (44%), with twisted 's' shaped profiles (37%), and curved profiles being somewhat less frequent (19%). Considering the number of cores that showed preferential exploitation of broad flat surfaces for blank production, it makes sense that a considerable number of flakes, blade, and unretouched point blanks would exhibit a flat or twisted profile. Blanks had an average exterior platform angle of ~74°, as well as platforms that are wide and thin in morphology, and tended to have a low length to width ratio but a higher width to thickness ratio (Table 5.6). Flake blanks were often side-struck, wide, and with rhomboid-like morphology (Figure 5.6). Blade products were categorized according to a technical category which assigns the product to a stage in the production sequence. In the assemblage, 3% of all blade products were classified as belonging to the initial stages of core reduction, with 91% of blade products coming from the main production phase of exploitation, and the remaining 6% of blade products were either indeterminate or undiagnostic (Table 5.7). A significant number of unretouched points (*n*=186) were found in the assemblage, which tended to express similar technical features and flaking patterns as both blade and flake blanks. No unretouched points exhibited evidence of diagnostic impact fractures (DIF's) to suggest their possible use of hafted spear tips or projectile weapons.

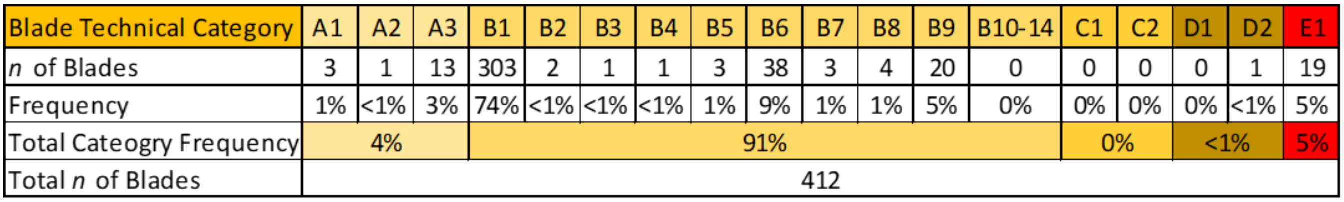
Figure 5.5 A selection of blades and blade fragments from Rooidam 2 showing both convergent and parallel flake scar patterns on the dorsal face. Specimen numbers are from left to right: 13140, 7957, 6268, 6893.

Table 5.6 A summary of descriptive statistics for all flake, blade, and unretouched points (including retouched tools). To calculate L/W and W/T ratio only complete artifacts were included. *Exterior Platform Angle

Descriptive Statistic	*EPA(°)	Platform Thickness (mm)	Length/Width Ratio	Width/Thickness Ratio
Mean	74.4	6.057	1.415	3.686
S.d.	11.105	3.225	1.095	1.24
Min	32	0.47		
Max	133	36.12		
Total *n*	1034	1035	420	420

Figure 5.6 A selection of complete flakes from Rooidam 2 showing the morphology of flake blanks and flaking patterns on the dorsal face. Specimen numbers are read from top to bottom and left to right: 14136, 12387, 13086, 7958

Table 5.7 A table showing the number and frequency of recorded blades classified by technical category. Blade products are classified according to their flaking position on the core surface and stage of removal within the production phases (A, B, C, D, E) and then further sub-divided according to specific attributes (A1, A2, A3).

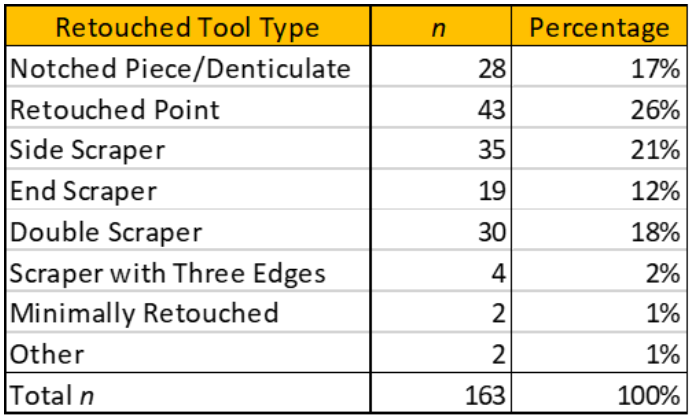


Blade Technical Category	A1	A2	A3	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10-14	C1	C2	D1	D2	E1
n of Blades	3	1	13	303	2	1	1	3	38	3	4	20	0	0	0	0	1	19
Frequency	1%	<1%	3%	74%	<1%	<1%	<1%	1%	9%	1%	1%	5%	0%	0%	0%	0%	<1%	5%
Total Cateogry Frequency	4%			91%										0%		<1%		5%
Total *n* of Blades	412																	

5.1.3 Retouched Tools

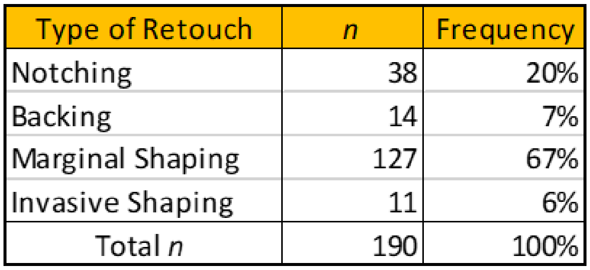
The retouched tools (*n*=163) in the assemblage that could be classified by typology are dominated by various types of scrapers (53%), retouched points (26%), followed by denticulates or notched pieces (17%) with minimally retouched pieces making up only a small portion of the assemblage (Table 5.8). Most retouched tools exhibit either marginally retouched edges or some degree of notching, with rare occurrences of invasive edge shaping or steep backing like scars (Table 5.9). Out of the retouched tools that could be assigned, 69% were produced from flake blanks, with 27% produced on blade blanks, and 4% on indeterminate blanks (Table 5.10). Retouched tools in the assemblage show consistent faceting and preparation of the platform surface. Tools classified as retouched points were of specific interest due to their relative importance and potential use as spear tips, but do not show any macroscopic evidence of DIF’s or dorsal preparation indicative of hafting or use as projectile spear tips. Retouched points from the assemblage are variable in morphology with two distinctive variations that are likely the result of blank choice which both tend to show a convergent dorsal scar pattern. (Figures 5.7, 5.8, 5.9) and ranging in size (Figure 5.10). Retouched points are similar in shape and size to unretouched points. Extant scars on prepared cores show preferential point removals with a comparable morphology to the both unretouched and retouched points in the assemblage. Average values for the dimensions and platform characteristics of retouched points is provided in Table 14.

Table 5.8 Retouch tool type frequencies including all retouched tools that could be classified according to typological categories



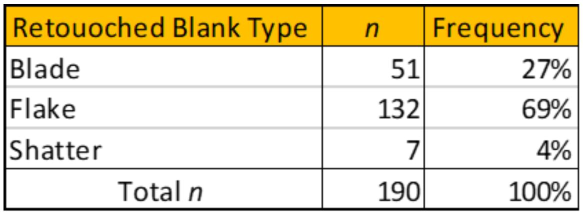
Retouched Tool Type	*n*	Percentage
Notched Piece/Denticulate	28	17%
Retouched Point	43	26%
Side Scraper	35	21%
End Scraper	19	12%
Double Scraper	30	18%
Scraper with Three Edges	4	2%
Minimally Retouched	2	1%
Other	2	1%
Total *n*	163	100%

Table 5.10 Retouch type frequencies including all retouched tools from Level 5 (sub-levels 10-1)



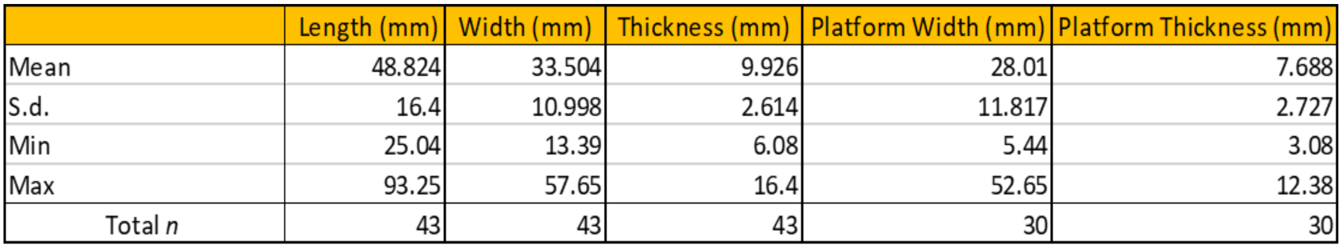
Type of Retouch	*n*	Frequency
Notching	38	20%
Backing	14	7%
Marginal Shaping	127	67%
Invasive Shaping	11	6%
Total *n*	190	100%

Table 5.9 Retouched blank types frequencies represented by all retouched tools from Level 5 (sub-Levels 10-1)



Retouoched Blank Type	*n*	Frequency
Blade	51	27%
Flake	132	69%
Shatter	7	4%
Total *n*	190	100%

Table 5.11 Summary statistics of all retouched points from Level 5(sub-levels 10-1). Retouched points generally have a wide base with a convergent flaking pattern. Platforms show evidence of preparation and are also relatively wide and thin in morphology.



	Length (mm)	Width (mm)	Thickness (mm)	Platform Width (mm)	Platform Thickness (mm)
Mean	48.824	33.504	9.926	28.01	7.688
S.d.	16.4	10.998	2.614	11.817	2.727
Min	25.04	13.39	6.08	5.44	3.08
Max	93.25	57.65	16.4	52.65	12.38
Total *n*	43	43	43	30	30

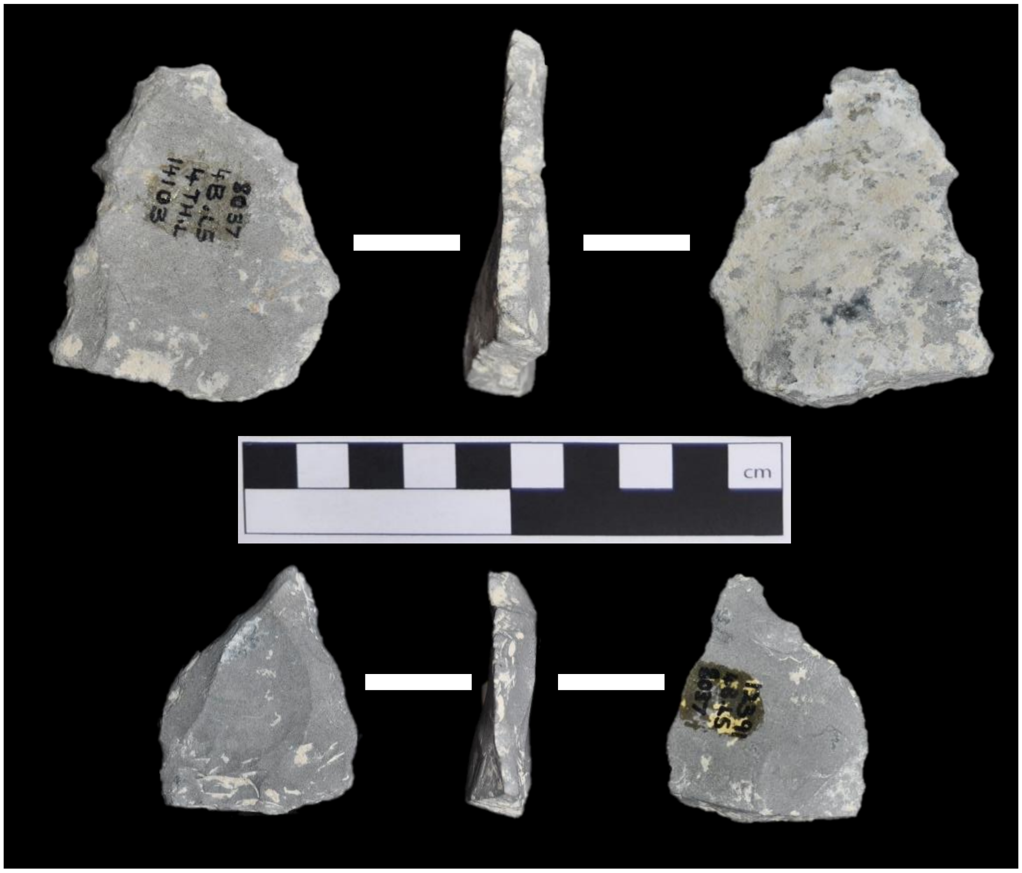


Figure 5.7 Retouched points from Rooidam 2 that have a wide proximal base, convergent flaking on the dorsal surface, and a twisted profile shape. The general morphology suggests that they were produced from a flake or unretouched point blank. Specimen numbers from top to bottom: 14103 (4th sub-level) and 12391 (2nd sub-level).

Figure 5.8 Retouched points from Rooidam 2 that were likely produced from blade blanks due to their elongaged form. The dorsal surface shows convergant flake scars, and there are continious retouch along the lateral edges. Specimen numbers of top and bottom: 13267 (7th sub-level) and 12032

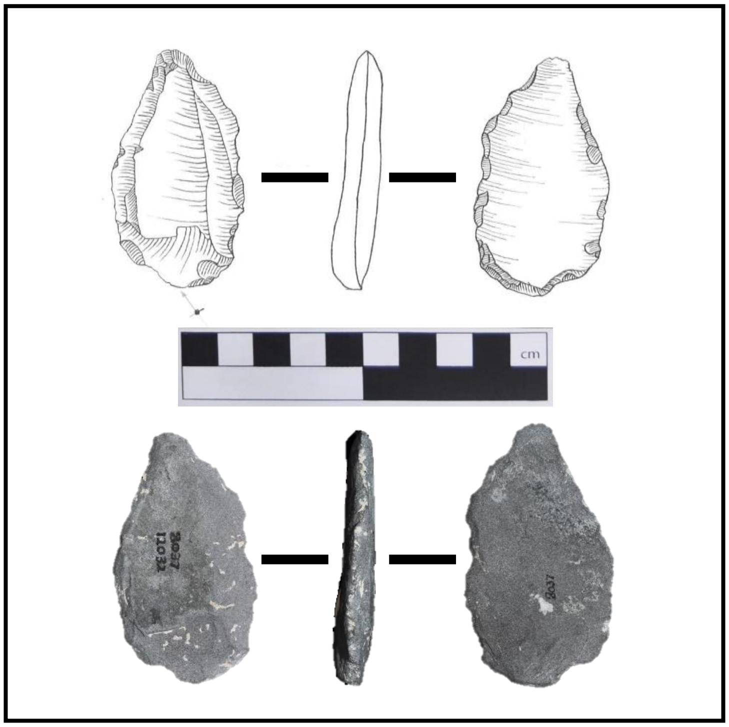


Figure 5.9 An illustration showing the flaking pattern and retouched edges retouched point (bottom) a photograph of the same retouched point. Specimen number: 12032, 1st sub-level Original lithic illustration done by Elia Andrews.

Figure 5.10 A selection of retouched points showing the diversity in overall size. Specimen number from left to right: 14070 (4th sub-level), 5705 (5th sub-level), 12040 (1st sub-level), 12697 (3rd sub-level)

5.2 Results of Intra-site Level Comparison of Blank Production Choices

Figure 5.11 summarizes the results of comparing the four domains of blank production choices between adjacent sub-levels by using the total calculated variance. A more extensive and detailed table with all calculations and a breakdown of differences in each domain of production can be found in **Table 5.12**. The total calculated variance value is used to identify potential patterns of variance or significant changes in blank production choices within the sequence. The sub-levels with high values of calculated variance based on blank production choices are the 7th sub-level, followed by the 4th, 2nd, and 1st sub-levels. The 1st sub-level shows the highest value within the sequence for total calculated variance. Therefore, the highest degree of variance in the blank production sequence is between the 2nd and 1st sub-level and occurs between the younger sub-levels of the sequence. The first instance of significant variance occurs between the 8th and 7th sub-levels, from which subsequent instances of significant variance continue to be detected throughout the sequence. These instances of variance between adjacent sub-levels do not appear to be particularly patterned in consistent manner that could be used to support or refute the existence of technological phases within the sequence. There does seem to be a visible pattern within the sequence of higher variation in blank production choices in the younger sub-levels when compared to the basal layers. The 10th, 9th, and 8th sub-levels which show similar patterns of blank production choices over time and little technological variation based on total calculated variance. The 7th sub-level appears to serve as a division between the less variable basal sub-levels, and the younger sub-levels that show more variability in the tool making process. The total calculated variance between adjacent sub-levels in the sequence is significant in that it shows that the blank production choices were heterogenous and may be correlated to a more MSA-like pattern of variability represented in the lithic reduction sequence.

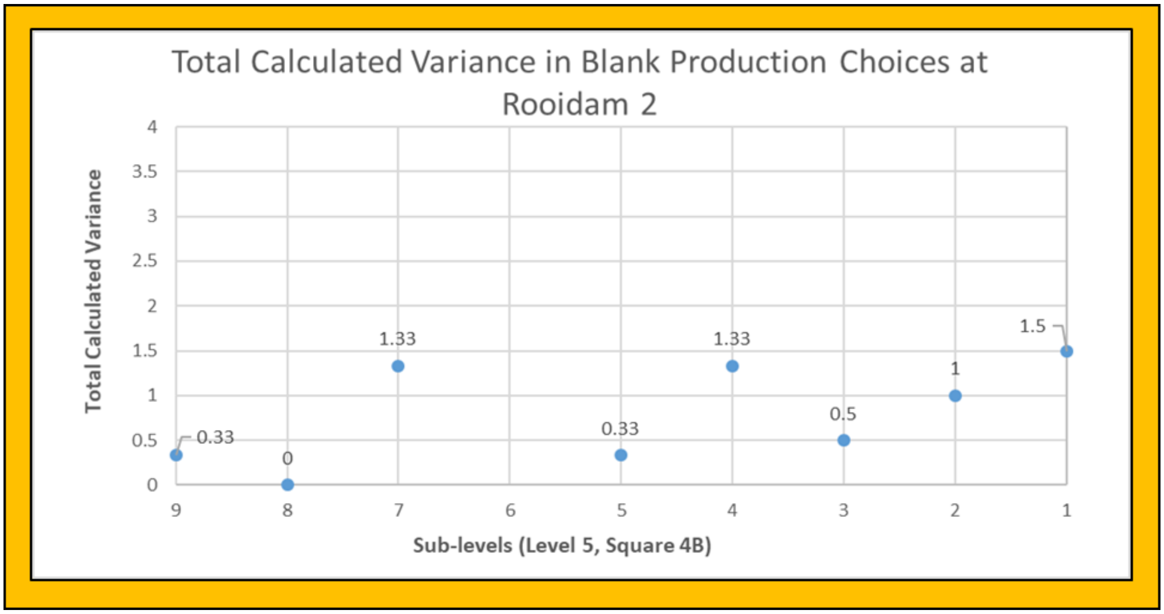


Figure 5.11 A scatterplot graph showing the relationship between the total calculated variance values for the adjacent sub-levels within the sequence (Level 5) for the Blank Production Choices. Note that a value is absent for the comparison of the 7th and 6th sub-level due to the lack of recorded data for the 6th sub-level.

Although the 1st sub-level has the highest calculated value of difference, it should be noted that the maximum possible calculated variance between each sub-level would be a value of 5 (due to the five Domains of production). A total calculated variance value of 5 would then represent a sub-level that show a significant difference in every step of in black production as well as the retouched tool kit compared to the older, underlying sub-level. The highest calculated values of total variance recorded in the sequence are 1.5 (1st) and 1.33 (7th and 4th) which imply that there are some significant differences between these adjacent levels. However, while these differences are statistically significant do indicate variation, they also imply that the blank production choices between made between adjacent sub-levels are somewhat similar as well. Because of the relatively low total calculated values of variance, these changes within the sequence should be interpreted with caution. It is also important to note that the relative weight that certain Domains have in terms of contributing to the total calculated difference does vary according to the number of attribute states being compared within that Domain. For example, Domains 1 and 3, dealing with core modification and the direction of core exploitation for tool making are based on qualitative observations using evidence from extant flake scars, and yet heavily contribute to the total calculated difference. Despite this, further examination of the differences in blank production choices reveals clusters of significant change associated with attribute states that make up Domain 2 (Platform Preparation) and Domain 4 (Dorsal Convexity System).

5.2.1 Core Modification and Exploitation

Preferred core reduction strategies did not change much throughout the sub-levels, with broad flat surfaces being chosen for exploitation. Longitudinal surfaces were occasionally chosen for reduction, and sometimes both broad and longitudinal surfaces were exploited on a single core. Centripetal flake removals were primarily used for the management of core surfaces in most sub-levels although this pattern deviates in the 7th and 5th sub-levels, where extant scars primarily show evidence of *debordant* or elongated blade-like removals to manage surface convexity. By the 4th level, centripetal flake removals once again become the most represented removal types for rejuvenating the flaking surfaces. The directionality of core exploitation did not show much variation throughout the sub-levels, with the 2nd and 1st sub-levels varying the most within the sequence. There a few observable differences in the directionality of core exploitation with almost all exploitation characterized as either radial or bi- or unidirectional and no clear preference detected.

5.2.2 Platform Maintenance

The 7th sub-level shows an increase in the percentage of flake products that exhibit some degree of platform preparation (80%) and fewer products that show unprepared platforms. Compared to the previous sub-levels (10th – 8th) which show a lower frequency of prepared platform types and a higher percentage of unprepared platforms compared to later sub-levels. Despite some change in frequency, throughout all sub-levels the percentage of flaked products that exhibit evidence of platform preparation is relatively high, never falling below 70%. An increase in average platform thickness can be seen in the 7th and 3rd sub-levels when compared to other adjacent levels, from the 3rd sub-level average platform thickness seems to show an increase that peaks in the 1st sub-level. There are no significant changes associated with exterior platform angle in the sequence.

5.2.3 Dorsal Convexity System

The most visible clustering of significant differences between sub-levels are seen when making pair-wise comparisons of attribute states belonging to the fourth domain, the dorsal convexity system. Some attributes do show one or two instances of significant differences between the sub-levels (such as length/width,

width/thickness, profile shape, and aris orientation) however these attributes do not show clustered patterning that correlates with changes in other variables and making them difficult to interpret as meaningful changes in technological organization. Significant changes in both the frequencies of blades and unretouched points can be interpreted as occurring around the 7th sub-level and continuing throughout the 3rd. The frequency of blade to flake products shows a steady increase beginning with the 7th sub-level (which is also notable for having the highest frequency of blade to flake products in the entire assemblage) and ending in the 3rd layer where the number of blade products reverts to a similar frequency seen in the 10th-8th sub-levels. Additionally, significant differences between the frequency of unretouched points to blade products across the sub-levels showed a similar pattern of clustering. The frequency of unretouched points fluctuates throughout the sub-levels making it more difficult to interpret. Interestingly the highest frequencies of unretouched points occur in the older sub-levels of the artifact floor, with the 7th sub-level once again being the first sub-level in the sequence to show significantly fewer unretouched points. This trend continues until the 3rd sub-level, in which unretouched points are more frequently produced compared to both the previous sub-level 4th and the following 2nd.

5.3 Results of Intra-site Level Comparison of Retouched Tool Morphology

The retouched tool kit is essentially an extension of the blank production choices, as retouched tools are products of the initial production process, but with an additional dimension of variability as they have been chosen for further retouch or utilization by tool makers. The blank production choices for unretouched lithics artifacts are similar for the retouched products in the assemblage, asides from the morphology of lateral and distal edges where retouch is present and has affected the shape of the tool. The full results of the comparisons of the retouched tool kit between adjacent sub-levels within the sequence are provided in **Table 5.13**. There was no significant temporal variation detected in any attributes related to retouched tool morphology in any of the sub-levels within the sequence. The retouched tools in appear to be mostly represented by unifacially flaked scrapers, points, and denticulate/notched pieces, usually with one or two edges of marginal retouch or notching present that very rarely extends into the body of the tool. Blanks of varying shape, length, and size were utilized for retouch, with no definitive preference detected.

Significantly, there were no definitive bifaces or other LCTs found in any of the sub-levels in the sequence. One identified artifact did appear to be a possible biface fragment; relatively small (<30 mm) in length and thin (<15 mm) with a worked and rounded convex shape that may represent a convergent tip. The frequency of the retouched tool type categories is also generally consistent throughout the sequence, with no individual sub-level appearing to have a substantial increase or decrease in any one category of retouched tool. One obstacle to testing for significant variance in the retouched tool kit is that tests of significance on the sub-levels (10th-8th) could not be done because of inadequate sample sizes ($n < 2$) of retouched tools or complete retouched tools, in the case of length/width and width/thickness calculations.

Table 5.12 A table comprising of the full results of the intra-site anlysis of adjacent sub-levels. The mean, s.d., minimum, and maximum values and frequencies are provided for each attribute or measurement. Highlighted boxes mark an attributed in which statistically signifigant change was detected. Differences in attributes contribute to a total calculated variance value that is used to compared the relative difference between adjacent sub-levels.

Tool Reduction Steps by Domain	Level 10	Level 9	Level 8	Level 7	Level 5	Level 4	Level 3	Level 2	Level 1
Domain 1: Core Modification									
Core Reduction Strategy	n=4 Use of a broad surface	n=4 Use of a broad surface	n=9 Use of a broad surface	n=10 Use of a broad surface	n=15 Use of a broad surface	n=8 Use of a broad surface	n=7 Use of a broad surface	n=6 Use of a broad surface	n=10 Use of a broad surface
Core Management	Centripital flaking	Centripital flaking	Centripital flaking	**Debordant removals**	Debordant removals	**Centripital flaking**	Centripital flaking	Centripital flaking	Centripital flaking
Number of Differences/ 2 Steps	0/2=0	0/2=0	0/2=0	1/2=0.5	0/2=0	1/2=0.5	0/2=0	0/2=0	0/2=0
Domain 2: Platform Maintenance									
Platform Preparation	n= 41 Not Prepared= 29% Facetted with Bulb =29% Residual facet= 41%	n=47 Not Prepared= 23% Facetted with Bulb= 40% Residual facet =36% p=0.588, Fishers Exact chi^2=1.221 df=2	n=152 Not Prepared=29% Facetted with Bulb=26% Residual facet =45% p=0.171, Fishers Exact chi^2=3.792 df=2	**n=124** **Not Prepared=19%** **Facetted with Bulb=20%** **Residual facet=60%** **p=0.040, Fishers Exact** **chi^2=6.420** **df=2**	n=218 Not Prepared=17% Facetted with Bulb=29% Residual facet =54% p=0.209, Fishers Exact chi^2=3.160 df=2	n=101 Not Prepared=21% Facetted with Bulb=23% Residual facet =56% p=0.466, Fishers Exact chi^2=1.479 df=2	n=106 Not Prepared=19% Facetted with Bulb=29% Residual facet=52% p=0.580, Fishers Exact chi^2=1.125 df=2	**n=69** **Not Prepared=23%** **Facetted with Bulb=45%** **Residual facet =32%** **p=0.028, Fishers Exact** **chi^2=7.081** **df=2**	n=38 Not Prepared=13% Facetted with Bulb=55% Residual facet =32% p=0.433, Fishers Exact chi^2=1.796 df=2
External Platform Angle	n=47 Mean=74.638 S.d.=9.106 Min=54 Max=107	n=53 Mean=75.472 S.d.=8.920 Min=50 Max=92 t=0.457, p=0.649 df=98	n=170 Mean=73.953 S.d.=12.046 Min=32 Max=104 t=0.844, p=0.399 df=221	n=146 Mean=74.349 S.d.=12.363 Min=44 Max=116 t=0.287, p=0.774 df=314	n=250 Mean=74.496 S.d.=10.894 Min=40 Max=110 t=0.123, p=0.902 df=394	n=113 Mean=75.133 S.d.=12.230 Min=35 Max=133 t=0.495, p=0.621 df=361	n=121 Mean=74.810 S.d.=9.813 Min=39 Max=100 t=0.222, p=0.824 df=232	n=80 Mean=73.813 S.d.=9.472 Min=49 Max=105 t=0.712, p=0.478 df=199	n=40 Mean=74.075 S.d.=10.391 Min=51 Max=114 t=0.137 p=0.891 df=118
Platform Thickness	n=47 Mean=5.917 S.d.=2.582 Min=2.35 Max=14.02	n=53 Mean=6.146 S.d.=2.754 Min=1.25 Max=12.48 t=0.422, p=0.674 df=98	n=171 Mean=5.595 S.d.=2.497 Min=0.47 Max=12.86 t=1.362, p=0.174 df=222	**n=146** **Mean=6.375** **S.d.=4.093** **Min=0.91** **Max=36.12** **t=2.074,** **p=0.039** **df=315**	n=251 Mean=5.954 S.d.=3.281 Min=0.74 Max=18.63 t=1.120, p=0.263 df=395	n=113 Mean=5.51 S.d.=2.668 Min=0.81 Max=13.73 t=1.259, p=0.209 df=362	**n=121** **Mean=6.386** **S.d.=3.698** **Min=0.76** **Max=30.58** **t=2.056,** **p=0.041** **df=232**	n=80 Mean=6.287 S.d.=2.966 Min=1.23 Max=13.13 t=0.200, p=0.842 df=199	n=40 Mean=7.122 S.d.=2.837 Min=1.35 Max=12.92 t=1.463, p=0.146 df=118

Number of Differences/ 3 Steps		0/3=0	0/3=0	2/3=0.66	0/3=0	0/3=0	1/3=0.33	1/3=0.33	0/3=0
Domain 3: Direction of Core Exploitation									
Early Debitage Exploitation	Radial	Radial	Radial	Radial	Radial	Radial	Radial	**BiorUni**	**Radial**
Late Debitage Exploitation	Radial	Radial	Radial	Radial	**BiorUni**	Radial	Radial	Radial	Radial
Number of Differences/ 2 Steps		0/2=0	0/2=0	0/2=0	1/2=0.5	0/2=0	0/2=0	2/2=0.5	1/2=0.5
Domain 4: Dorsal Convexity System									
Length/Width Ratio	n=16 Mean= 1.015 S.d.= 0.317	**n=23 Mean=1.373 S.d.=0.567 t=2.229, p=0.032 df=37**	n=74 Mean=1.272 S.d.=0.590 t=0.714, p=0.477 df=95	n=54 Mean=1.157 S.d.=0.590 t=1.075, p=0.284 df=126	n=113 Mean=1.264 S.d.=0.570 t=1.103, p=0.271 df=165	n=42 Mean=1.220 S.d.=0.580 t=0.422, p=0.674 df=153	n=52 Mean=1.424 S.d.=0.416 t=0.741, p=0.460 df=92	n=30 Mean=1.256 S.d.=0.497 t=1.089, p=0.279 df=80	n=17 Mean=1.387 S.d.=0.496 t=0.856, p=0.396 df=45
Width/Thickness Ratio	n=16 Mean=3.944 S.d.=1.486	n=23 Mean=3.390 S.d.=1.040 t=1.334, p=0.191 df=37	n=74 Mean=3.596 S.d.=1.164 t=0.754, p=0.456 df=95	n=54 Mean=3.974 S.d.=1.455 t=1,616, p=0.109 df=126	n=112 Mean=3.594 S.d.=1.196 t=1.772, p=0.078 df=164	n=42 Mean=3.880 S.d.=1.060 t=1.353, p=0.178 df=152	n=52 Mean=3.625 S.d.=1.225 t=1.054, p=0.295 df=92	n=30 Mean=3.302 S.d.=0.918 t=1.241, p=0.218 df=80	**n=17 Mean=4.223 S.d.=1.520 t=2.533, p=0.015 df=45**
Aris Orientation	n=16 Convergent=44% Parallel= 56%	n=12 Convergent=75% Parallel=25% p=0.136, Fishers Exact chi^2=1.607 df=1	n=49 Convergent=65% Parallel=35% p=0.734, Fishers Exact chi^2=0.088 df=1	n=43 Convergent=58% Parallel=42% p=0.524, Fishers Exact chi^2=0.241 df=1	n=91 Convergent=65% Parallel=35% p=0.566, Fishers Exact chi^2=0.310 df=1	n=29 Convergent=72% Parallel=28% p=0.505, Fishers Exact chi^2=0.279 df=1	n=42 Convergent=67% Parallel=33% p=0.795, Fishers Exact chi^2=0.064 df=1	n=26 Convergent=85% Parallel=15% p=0.157, Fishers Exact chi^2=1.816 df=1	**n=10 Convergent=40% Parallel=60% p=0.014, Fishers Exact chi^2=5.115 df=1**
Profile Shape	n=41 Flat= 34% Curved= 20% Twisted= 46%	n=48 Flat=40% Curved=33% Twisted=27% p=0.132, Fishers Exact chi^2=4.024 df=2	n=153 Flat=37% Curved=22% Twisted=42% p=0.115, Fishers Exact chi^2=4.236 df=2	**n=145 Flat=54% Curved=15% Twisted=31% p=0.012, Fishers Exact chi^2=8.916 df=2**	n=246 Flat=51% Curved=12% Twisted=37% p=0.367, Fishers Exact chi^2=2.011 df=2	n=111 Flat=50% Curved=13% Twisted=37% p=0.973, Fishers Exact chi^2=0.049 df=2	**n=105 Flat=37% Curved=25% Twisted=38% p=0.039, Fishers Exact chi^2=6.493 df=2**	n=74 Flat=27% Curved=34% Twisted=39% p=0.277, Fishers Exact chi^2=2.601 df=2	n=42 Flat=45% Curved=17% Twisted=38% p=0.064 Fishers Exact chi^2=5.497 df=2
Blade Frequency	n=85 Blade= 16% Flakes= 84% Frequency= 0.197	n=89 Blade=17% Flake=83% Frequency= 0.203	n=283 Blade=13% Flake=87% Frequency= 0.150	**n=265 Blade=41% Flake=59% Frequency= 0.688**	**n=492 Blade=23% Flake=77% Frequency= 0.298**	**n=227 Blade=36% Flake=64% Frequency= 0.554**	**n=220 Blade=18% Flake=82% Frequency= 0.222**	n=136 Blade=18% Flake=82% Frequency= 0.225	**n=75 Blade=31% Flake=69% Frequency= 0.442**

		p=0.892, Fishers Exact chi^2=0.018 df=1	p=0.383, Fishers Exact chi^2=0.521 df=1	**p=0.001, Fishers Exact chi^=52.474 df=1**	**p=0.001, Fishers Exact chi^2=25.508 df=1**	**p=0.006, Fishers Exact chi^2=12.110 df=1**	**p=0.001, Fishers Exact chi^2=16.5 df=1**	p=1, Fishers Exact chi^2=0.009 df=1	**p=0.06, Fishers Exact chi^2=3.481 df=1**
Unretouched Point Frequency	n=24 Unretouched Point= 42% Blade= 58% Frequency= 0.714	n=21 Unretouched Point=38% Blade=62% Frequency= 0.615 p= 1, Fishers Exact chi^2=0.004 df=1	n=58 Unretouched Point=52% Blade=48% Frequency= 1.071 p=0.318, Fishers Exact chi^2=0.666 df=1	**n=127 Unretouched Point=20% Blade=80% Frequency= 0.393 p=0.001, Fishers Exact chi^2=18.060 df=1**	**n=149 Unretouched Point=28% Blade=72% Frequency= 0.393 p=0.012, Fishers Exact chi^2=2.254 df=1**	n=108 Unretouched Point=30% Blade=70% Frequency=0.421 p=0.889, Fishers Exact chi^2=0.126 df=1	**n=57 Unretouched Point=47% Blade=53% Frequency= 0.871 p=0.027 Fishers Exact chi^2=4.368 df=1**	n=22 Unretouched Point=23% Blade=77% Frequency= 0.294 p=0.072 Fishers Exact chi^2=3.042 df=1	n=25 Unretouched Point=28% Blade=72% Frequency= 0.389 p=0.747, Fishers Exact chi^2=0.006 df=1
Number of Differences/ 6 Steps		2/6=0.33	0/6=0	3/6=0.5	2/6=0.33	1/6=0.17	3/6=0.5	0/6=0	3/6=0.5
Total Difference Lvl 10 vs 9		0.33							
Total Difference Lvl 9 vs 8			0						
Total Difference Lvl 8 vs 7				1.67					
Total Difference Lvl 7 vs 5					0.83				
Total Difference Lvl 5 vs 4						0.67			
Total Difference Lvl 4 vs 3							0.83		
Total Difference Lvl 3 vs 2								0.83	
Total Difference Lvl 2 vs 1									1

Table 5.13 A table comprising of all the full results of the intra-site anlaysis of retouched tool morphologies between adjacent sub-levels. The mean, s.d., minimum, and maximum vales are provided for each attribute or measurement. The 10th and 9th sub-level had a very small sample of retouched pieces, making comparisions impossible.

Tool Kit Morphology	Level 10	Level 9	Level 8	Level 7	Level 5	Level 4	Level 3	Level 2	Level 1
Domain 5: Retouched Tool Kit									
Length/Width Ratio	n=2 Mean=N/A S.d.=N/A	n=7 Mean=1.283 S.d.=0.456 Sample size is inadequate for level comparison	n=15 Mean=1.515 S.d.=0.41 t=1.192, p=0.247 df=20	n=1 Mean=N/A S.d.=N/A Sample size is inadequate for level comparison	n=16 Mean=1.296 S.d.=0.387 Sample size is inadequate for level comparison	n=6 Mean=1.411 S.d.=0.962 t=0.564 p=0.579 df=20	n=6 Mean=1.071 S.d.=0.355 t=1.311, p=0.219 df=10	n=4 Mean=1.157 S.d.=0.467 t=0.335, p=0.746 df=8	n=9 Mean=1.383 S.d.=0.56 t=0.662, p=0.522 df=11
Width/Thickness Ratio	n=2 Mean=N/A S.d.=N/A	n=7 Mean=3.591 S.d.=1.141 Sample size too small for level comparison	n=15 Mean=3.155 S.d.=0.799 t=1.041, p=0.310 df=20	n=1 Mean=N/A S.d.=N/A Sample size is inadequate for level comparison	n=16 Mean=3.687 S.d.=0.957 Sample size is inadequate for level comparison	n=6 Mean=3.911 S.d.=1.249 t=0.447, p=0.660 df=20	n=6 Mean=4.089 S.d.=1.263 t=0.240, p=0.815 df=10	n=4 Mean=3.522 S.d.=0.761 t=0.796, p=0.449 df=8	n=9 Mean=4.092 S.d.=1.458 t=0.727, p=0.483 df=11
Profile Shape	n=0	n=11 Flat=64% Curved=18% Twisted=18% Sample size too small for level comparison	n=24 Flat=33% Curved=21% Twisted=46% p=0.201, Fishers Exact chi^2=3.195 df=2	n=5 Flat=20% Curved=40% Twisted=40% p=0.638, Fishers Exact chi^2=0.898 df=2	n=29 Flat=48% Curved=14% Twisted=38% p=0.231, Fishers Exact chi^2=2.437 df=2	n=9 Flat=44% Curved=11% Twisted=44% p=1, Fishers Exact chi^2=0.133 df=2	n=12 Flat=42% Curved=17% Twisted=42% p=1, Fishers Exact chi^2=0.130 df=2	n=10 Flat=30% Curved=30% Twisted=40% p=0.864, Fishers Exact chi^2=0.635 df=2	n=13 Flat=46% Curved=15% Twisted=38% p=0.861, Fishers Exact chi^2=0.936 df=2
Retouched Edge Angle	n=2 Mean=N/A S.d.=N/A	n=17 Mean=69.059 S.d.=9.795 Min=54° Max=89° Sample size too small for level comparison	n=14 Mean=86.429 S.d.=13.001 Min=50° Max=80° t=0.688, p=0.495 df=54	n=16 Mean=71.625 S.d.=8.18 Min=57° Max=83° t=1.627, p= 0.10 df=53	n=16 Mean=75.625 S.d.=7.881 Min=61° Max=89° t=0.092, p=0.927 df=56	n=10 Mean=72.9 S.d.=6.674 Min=58° Max=81° t=0.483, p=0.631 df=50	n=25 Mean=74.8 S.d.=9.17 Min=57° Max=93° t=0.593, p=0.557 df=33	n=19 Mean=70.421 S.d.=16.936 Min=49° Max=115° t=1.100, p=0.277 df=42	n=20 Mean=75.45 S.d.=8.965 Min=56° Max=86° t=1.167, p=0.251 df=37

Retouch Type	n=2 Marginal Edge Shaping= 100% Invasive Edge Shaping= 0% Notch Denticulate= 0% Backing= 0%	n=17 Marginal Edge Shaping=76% Invasive Edge Shaping=0% Notch/Denticulate=24% Backing=0% Sample size too small for level comparison	n=39 Marginal Edge Shaping=72% Invasive Edge Shaping=8% Notch/Denticulate=15% Backing=5% p=0.602, Fishers Exact chi^2=2.655 df=3	n=16 Marginal Edge Shaping =75% Invasive Edge Shaping=6% Notch/Denticulate=6% Backing=13% p=0.702, Fishers Exact chi^2=1.640 df=3	n=42 Marginal Edge Shaping=57% Invasive Edge Shaping=10% Notch/Denticulate=21% Backing=12% p=0.588, Fishers Exact chi^2=2.291 df=3	n=10 Marginal Edge Shaping=30% Invasive Edge Shaping=10% Notch/Denticulate=50% Backing=10% p=0.273, Fishers Exact chi^2=3.622 df=3	n=25 Marginal Edge Shaping=68% Invasive Edge Shaping=4% Notch/Denticulate=24% Backing=4% p=0.142, Fishers Exact chi^2=4.24 df=3	n=19 Marginal Edge Shaping=79% Invasive Edge Shaping=0% Notch/Denticulate=11% Backing=11% p=0.528, Fishers Exact chi^2=2.690 df=3	n=20 Marginal Edge Shaping=65% Invasive Edge Shaping=5% Notch/Denticulate=25% Backing=5% p=0.505, Fishers Exact chi^2=2.738 df=3
Retouched Piece Typology	n=2 Side Scraper= 50% End Scraper= 0% Double Scraper= 0% Scraper w/Three Edges= 0% Retouched Point= 50% Notch Denticulate= 0% Minimally Retouched= 0%	n=16 Side Scraper= 25% End Scraper= 6% Double Scraper= 31% Scraper w/Three Edges= 0% Retouched Point= 19% Notch/Denticulate= 19% Minimally Retouched= 0% Sample size too small for level comparison	n=33 Side Scraper= 27% End Scraper= 12% Double Scraper= 21% Scraper w/Three Edges= 0% Retouched Point= 27% Notch/Denticulate= 12% Minimally Retouched= 0% p= 0.846, Fishers Exact chi^2=1.479 df=4	n=9 Side Scraper= 22% End Scraper= 11% Double Scraper= 22% Scraper w/Three Edges= 11% Retouched Point= 22% Notch/Denticulate= 11% Minimally Retouched= 0% p=0.680, Fishers Exact chi^2=3.820 df=5	n=36 Side Scraper= 25% End Scraper= 8% Double Scraper= 14% Scraper w/Three Edges= 6% Retouched Point= 22% Notch/Denticulate= 22% Minimally Retouched= 3% p=0.961, Fishers Exact chi^2=1.434 df=6	n=8 Side Scraper= 0% End Scraper= 13% Double Scraper= 0% Scraper w/Three Edges= 0% Retouched Point= 25% Notch/Denticulate= 63% Minimally Retouched= 0% p=0.290, Fishers Exact chi^2=7.519 df=6	n=24 Side Scraper= 25% End Scraper= 13% Double Scraper= 17% Scraper w/Three Edges= 0% Retouched Point= 29% Notch/Denticulate= 17% Minimally Retouched= 0% p=0.120, Fishers Exact chi^2=7.852 df=4	n=15 Side Scraper= 27% End Scraper= 7% Double Scraper= 27% Scraper w/Three Edges= 0% Retouched Point= 27% Notch/Denticulate= 13% Minimally Retouched= 0% p=0.961, Fishers Exact chi^2=0.853 df=4	n=18 Side Scraper= 0% End Scraper= 28% Double Scraper= 17% Scraper w/Three Edges= 6% Retouched Point= 39% Notch/Denticulate= 6% Minimally Retouched= 6% p=0.112, Fishers Exact chi^2=9.769 df=6
Retouched Point Frequency	n=2 Retouched Point= 50% Other = 50% Ratio: 1	n=17 Retouched Point= 18% Other= 82% Ratio: 0.214	n=33 Retouched Point= 27% Other = 73% Ratio: 0.375	n=9 Retouched Point= 22% Other= 78% Ratio: 0.286	n=36 Retouched Point= 22% Other= 78% Ratio: 0.286	n=8 Retouched Point= 25% Other= 75% Ratio: 0.333	n=24 Retouched Point= 29% Other= 71% Ratio: 0.412	n=15 Retouched Point= 27% Other= 73% Ratio: 0.364	n=18 Retouched Point= 39% Other= 61% Ratio: 0.636

		Sample size too small for level comparison	p=0.510, Fishers Exact chi^2=0.569 df=1	p=1, Fishers Exact chi^2=0.093 df=1	p=1, Fishers Exact chi^2=0 df=1	p=1, Fishers Exact chi^2=0.029 df=1	p=1, Fishers Exact chi^2=0.052 df=1	p=1, Fishers Exact chi^2=0.028 df=1	p=0.712, Fishers Exact chi^2=0.55 df=11
Number of Differences/ 7 Steps		Sample size too small	0/7=0	0/5=0	0/5=0	0/7=0	0/7=0	0/7=0	0/7=0
Total Difference Lvl 10 vs 9		Sample size too small							
Total Difference Lvl 9 vs 8			0						
Total Difference Lvl 8 vs 7				0					
Total Difference Lvl 7 vs 5					0				
Total Difference Lvl 5 vs 4						0			
Total Difference Lvl 4 vs 3							0		
Total Difference Lvl 3 vs 2								0	
Total Difference Lvl 2 vs 1									0

Chapter 6: Discussion and Conclusions

6.1 Characterizing Blank Production at Roodiam 2

The results of this analysis problematize the original ascription of the lithic material from Rooidam 2 to the Fauresmith Industry, based on the currently accepted definition and typological charactertistics of described Fauresmith assemblages in southern Africa. The lithic material from Rooidam 2 was originally designated as a Fauresmith assemblage although the analyzed lithic material is not consistent with other described Fauresmith assemblages due to the complete absence of bifaces or LCTs. In the analyzed sample there were no recorded bifaces, except for a bifacial fragment that shows a convex morphology and size that is reminiscent of a small broken biface. Despite the near lack of bifaces, other artifact types commonly associated with Fauresmith assemblages such as blades, retouched points, and convergent scrapers are represented in the sample assemblage from Rooidam 2. Prepared core technology, and the application of both preferential and recurrent Levallois strategies is also consistent with descriptions of the Fauresmith that are well represented by the assemblage from Rooidam 2. It is possible that the artefact types in the sample assemblage are not completely representative of the full spectrum of lithic technology at the site, as bifaces and other LCTs do not usually occur in high frequencies and are reported to make up only a small percentage of overall artifact types in the Fauresmith assemblages from Kathu Pan 1 and Canteen Kopje (McNabb and Beaumont 2011; Wilkins 2013).

It is relevant to note that many of the artifact types and reduction strategies characteristic or 'diagnostic' of the Fauresmith are shared with late Acheulean and early Middle Stone Age assemblages. Assemblages with prepared cores (including classic Levallois and non-Levallois cores) a higher frequency of retouched tools, and that lack of bifaces or LCTs are generally described as belonging to a phase of the Middle Stone Age. The results of this analysis do not aim to conclusively prove or disprove an industrial ascription, but the absence of bifaces and LCTs juxtaposed with a high frequency of retouched flake tools and evidence of prepared core strategies suggest that this assemblage would be also be appropriately be described as eMSA. Folke Richardt noted that the Rooidam 2 assemblage appeared to be more representative of the MSA than the Fauresmith, despite published reports, a conclusion possibly based on the lack of bifaces observed during the excavation *(pers. comm.* Folke Richardt*).*

6.2 Comparing the Rooidam 2 assemblage to other sites in the Northern Cape

One of the reoccurring problems with defining the industry has been the reliance on unreliable data and the inability to make inter-assemblage comparisons. There is a lack of available data from which analysts can make quantitative observations of artifact form and typology collected form excavated Fauresmith assemblages. The Fauresmith industry has been subjected to a reliance on the presence of specific *fossille directeurs* to identify assemblages even though these defining artifact types have varied throughout the history and use of the industry. This has led to a proliferation of archaeological assemblages across southern Africa being ascribed to the Fauresmith industry by various analysts, even though there is little consensus on what features or combined tool types define it. One way to address both the legitimacy of the industry as an archaeological occurrence and come to a more standardized definition is to make inter-site comparisons of lithic technology. By comparing the artifact attribute frequencies as well as general production patterns and tool typologies of the artifacts from the artifact floor at Rooidam 2 to other described Fauresmith assemblages in the Northern Cape region, a more consistent definition of what production strategies or tool types characterize the industry can be established. Fauresmith assemblages have been described in detail from Kathu Pan 1 (Wilkins and Chazan 2012, Wilkins 2013), Wonderwerk Cave (Beaumont and Vogel 2006, Chazan et al. 2008), and Canteen Kopje (McNabb and Beaumont 2011, Chazan et al. 2013). The combined efforts and investigations into the lithic technology of the Fauresmith assemblages at these sites have yielded quantitative and qualitative data that facilitates inter-site comparisons of raw material type frequencies, core exploitation strategies, and retouched tool morphology.

6.2.1 Canteen Kopje

Canteen Kopje is alluvial diamond diggers site that has been extensively disturbed due to intensive mining activity that occurred within the area, upon the discovery of Acheulean artifacts the site was declared as a National Monument site (Beaumont and Morris 1990, 2004). Fauresmith material has been reportedly found at multiple excavation areas within a geological interface between the overlying fine 'Huttton Sands' and underlying alluvial Younger Gravels (Beaumont and Morris 2004; Chazan et al. 2013; Lotter et al. 2016; Shadrach 2018). An exploratory excavation in 2007 aimed to date archaeological sediments by OSL to provide temporal constraint within the sequence yielded a tentative minimum age estimate of ~300 ka for the accumulation of the fine sands associated with Fauresmith artifacts (Chazan et al. 2013). The first controlled excavation of the site by Peter Beaumont focused on undisturbed deposits and revealed a Fauresmith assemblage in Area 1, in the upper 30 cm of Until 2a (McNabb and Beaumont 2011). The raw material types present in this assemblage are andesite, hornfels, quartzite, and chert artifacts were also found. The assemblage from Area 1 had only two recorded bifaces and no other LCTs. The assemblage is rich in prepared cores "with an emphasis on convergent points and laminar technology" although there are also unprepared cores and small cores with a cubic-like morphology (McNabb and Beaumont 2011,53). The retouched tool types include denticulates, a single scraper, and retouched points with most retouch being described as non-invasive, steep, and occasionally bifacial (McNabb and Beaumont, 2011). The Area 1 assemblage shares many characteristics in both core reduction strategies and retouched tool types with the assembalge from Rooidam 2. Both sites show evidence of core reduction strategies aimed to produce flake products, which included blades and convergent unretouched points. Both assemblages share a similar suite of retouched tool types. The most prominent differences between the assemblage from Area 1 and Rooidam 2 are the raw material type, and the presence of bifaces. More recent geoarchaeological investigations of the site focuses on the formation processes surrounding the deposition and integrity of the Fauresmith horizon in excavation Pit 6 and Pit 4 West (Lotter et al. 2016; Shadrach 2018). An investigation regarding the artifact types and attributes was not conducted for the Pit 6 Fauresmith material, however it was found to be in relatively good context despite some displacement and dominated by fine-grained raw materials (Lotter et al. 2016). The Fauresmith assemblage from Pit 4 West may have experienced some vertical displacement due to bioturbation is be considered in-situ (Shadrach 2018). Artifacts were produced predominately on Ventersdorp lava and other fine-grained materials such as cryptocrystaline silicate, with less than <1 of the lithics made on hornfels. A small sample of variably sized cores revealed that they were most commonly identified as single platform, with multi-facial and polyhedron cores also present. The presence of *debordant* flakes can be attributed to the production of Levallois or radial core exploitation, which is also seen to have been a common method of core exploitation at Rooidam 2. There were four LCTs in the assemblage that included 3 cleavers (one noted as 'small') and a 'small' biface Retouched tools were reported to be made a variety of blank types, although this is based on a very small sample size (n=7). The assemblage from Rooidam 2 is made of a larger sample but does share similarities in the core reduction strategies and blank diversity seen in the Fauresmith material from Canteen Kopje.

6.2.2 Kathu Pan 1

Kathu Pan 1 is part of a complex of archaeological sites in close vicinity to the town of Kathu. The Fauresmith assemblage from Stratum 4a is primarily based on banded ironstone formation (Wilkins 2017). The assemblage shows prepared core types, systematic blade production, and Levallois cores that exhibit both preferential and recurrent exploitation. Flaked products include large blades, Levallois flakes, and a variety of retouched tools that were preferentially produced on blade blanks (points, denticulates, and scrapers). The retouched points are of great significance, as multiple lines of evidence (experimental replication, DIF's, and edge-damage distribution) suggest that they were likely hafted and used as thrusting spear tips (Wilkins et al. 2012, 2015). At KP1 bifaces were only found in the lower levels in Stratum 4a and none could be identified as being produced from flake blanks, as well as appearing to be more weathered than other artifacts (Wilkins 2013). A comparison between the bifaces from the Fauresmith bearing Stratum 4a and the underlying Acheulean assemblage from Stratum 4b reveals there is no significant variation in size (Wilkins 2013). The KP1 assemblage has many similarities with the assemblage from Rooidam 2, with a variety of prepared type cores, including Levallois cores and products. The retouched tool typology at both sites are dominated by retouched points, denticulates, and scrapers. Retouched points make up 24% of retouched tools at KP1 with a mean length of 70 mm (Wilkins 2018) at Rooidam 2 they make up 26% of all retouched tools and are much smaller, with a mean length of ~42 mm. This difference in relative length is likely due to the retouched point at KP1 being selectively produced on blade blanks whereas retouched points from Rooidam 2 are produced on both flake and blades blanks, with no clear preference. Although bifaces were identified in Stratum 4a, Wilkins (2013) does question their inclusion with the Fauresmtih material and if found to be intrusive would correlate with the lack of bifaces at Rooidam 2

6.2.3 Wonderwerk Cave

Wonderwerk Cave is a large pheratic cave within the Kuruman Hills site with evidence of hominin occupations extending as far back as ~2 Ma (Chazan and Horwitz 2010). Fauresmith assemblages occur in the sequences of three separate excavation areas, represented by horizontal layers MU3 and MU4. They are generally described as having flaked prepared cores, bifaces, blades, scrapers, and convergent points (Beaumont and Morris 2004). The dominant raw material type represented by the Fauresmith material is banded ironstone, followed by chert and quartzite, compared to Rooidam 2 which is almost entirely manufactured on hornfels. The retouched tool typologies represented at both sites are similar, although denticulates appear to be absent from the Wonderwerk assemblages. At both sites there is for the management of prepared cores, used to produce convergent Levallois points and blade products (Beaumont and Morris 2004; Beaumont and Vogel, 2006).A diverse range of bifaces are found in the Fauresmith layers at Wonderwerk, while the assemblage from Rooidam 2 appears to lack a biface component.

Excluding the lack of bifaces from the assemblage, the lithics from Rooidam 2 are most consistent with the artifact typology that characterizes the Later phase of the Fauresmith from Wonderwerk Cave, described as having "prepared cores, blades, Levallois points and…convergent or nosed scrapers" (Beaumont and Vogel 2006, 221; Vogel 2008). However, the artifact types identified in the Rooidam 2 assemblage could also be interpreted as belonging to both the Middle and Later phases of the Fauresmith, with these phases appearing to be differentiated primarily by the refinement of the bifaces. Beaumont described the lithostratigraphy from Rooidam 2 as having Middle Fauresmith in Stratum 1 that overlies Early Fauresmith material from Stratum 2-6 (Beaumont and Morris 2004). The analyzed sequence from Level 5, which occurs at the base of Stratum 4

(4b) was therefore suggested by Beaumont to likely be representative of Early Fauresmith material. This is especially problematic, considering that in Early Fauresmith assemblages we would expect to find LCTs such as bifaces, cleavers and a lower frequency of retouched tools (Beaumont and Vogel 2006). The assemblage from Rooidam 2 shows a relatively high frequency of retouched pieces (9% of all coded artifacts), as well as both unretouched and retouched points which have not been previously associated with the Early Fauresmith.

However, the phases identified in the Wonderwerk sequence are based on evidence spanning multiple excavations and represent a large volume of excavated material that is representative of a longer period of deposition compared to an individual level, or stratum, of an assemblage which represents less excavated material and a shorter sequence. Due to the stratigraphic concerns and lack of corresponding radiometric dates the analyzed Fauresmith sequence from Rooidam 2 cannot be compared with any sort of temporal resolution leading to the identification of phases. Additionally, while there is a weak pattern of increasingly variability in the Rooidam 2 sequence, these are not well enough defined or patterned to warrant separation into phases. The lithic assemblage from Rooidam 2 is not currently able to support nor refute the tripartite sub-division of the Fauresmith industry.

6.3 Interpreting Intra-site Technological Variability and Behavioral Complexity

One aim of the analysis was to test for intra-site technological variability within the sequence, and to test for signs of distinctive temporal phases proposed to exist within the industry (Van Riet Lowe 1945; Beaumont and Vogel 2006). It is also an opportunity to reflect on how technological variability in blank production choices within an archaeological assemblage can contribute to our understanding of the development of behavioral complexity and increasingly plasticity in the repertoire of hominins through time. The analyzed sequence from Rooidam 2 shows an increasing tempo of intra-site technological variability within the dense artifact layer. The lithic succession within the sequence at Rooidam 2 does show a pattern of change between adjacent sub-levels which is more prominent in the younger sub-levels when compared to the basal sub-levels in the blank production choices. This pattern of technological diversity is a phenomenon commonly associated with MSA technology, where heterogenous lithic production strategies and products are interpreted as hominins exhibiting increased behavioral flexibility, adaptability, and innovation in response to climactic fluctuations and instability (Wilkins, Pollarolo and Kuman 2010; Wilkins 2018). It is also important to note that although there were instances of variability in the blank production choices, these differences showed no cumulative, or uni-directional trajectory of development within the sequence (such as an exponentially increasing frequency of blade vs. flake products or retouched tools). Interestingly, current research involving technological changes in ‘transitional’ assemblages in East Africa emphasize that there is no single trajectory of cumulative tool development from the Early Stone Age to the Middle Stone Age (McBrearty 2001; McBrearty and Tryon 2006.

6.4 Social Learning Processes and Variability during the ESA-MSA Transition

Social learning processes that allow for the transmission of cultural knowledge, such as imitation and emulation, play an integral part of the lithic production sequence and actively contributed to the accumulated cultural knowledge that influenced blank production choices and strategies made by tool makers. Imitative behavior is process orientated, while an emulative approach is orientated towards an end-goal or product (Wilkins 2018). Investigations into lithic variability tend to mainly consider imitation in the tool making process, because imitation is seen as a uniquely human capability (Wilkins 2018). Lithic accumulations are often reduced to a dominant or most representative *chaine operatoire* of the assemblage, which is then used to assign an industrial ascription (Wilkins 2018). If stone tool production was primarily communicated through the social process of imitative learning, an analysis of the lithic reduction sequences within an assemblage would be expected to exhibit a general pattern of inter or intra-site homogeneity (Wilkins 2013), a pattern typically thought to characterize Acheulean or Early Stone Age assemblages. Emulative learning strategies, which likely prioritized the functionality or purpose of the end-product may be more representative of the diverse reduction strategies often associated with Middle Stone Age assemblages. The transition from a formulaic step-by-step replication strategy for producing stone tools, to a method that allows an individual tool maker to be more flexible to potential knapping accidents, constraints in raw material, and behavioral responses to unpredictable local changes in climate, may have provided an adaptive advantage to early humans (Wilkins 2018).

The change in emphasis from one social learning process to another, or perhaps the use of both interchangeably, may be especially archaeological visible within assemblages that are described as ‘transitional’ in nature and show a mosaic of tool typologies and technological features. Changes in the social learning processes and cultural transmission of knapping strategies and techniques may have been brought about by evolutionary change, cognitive development, or as an adaptive response to environmental factors. Wilkins (2018) proposes three parameters that can be identified in archaeological assemblages that are indicative of instances of emulative learning within the tool production process; 1) diverse core reduction strategies, 2) diverse selection of blank types for retouched tools, and 3) convergent tool function. The lithic assemblage from Rooidam 2 is consistent with two of these paraments, the assemblage exhibits both non-prepared cores and a variety of prepared Levallois cores and a variety of retouched tools types produced on both flake and blade blanks. Asides from attempting to identify potential DIF’s, there was no further investigation into the macro/micro fracture patterns or wear use analysis on the lithics. The data collected from this analysis is insufficient to suggest any convergence or diversity in tool function based on form or typology. However, by identifying the potential evidence for emulative learning strategies within the archaeological record we can start to identify trends of innovation and diversity in blank production and the reshaping and use of retouched pieces.

6.5 Implications for Behavioral Modernity and Cognitive Development

The transition between the ESA and MSA marks the emergence of technological traits (blades, points, Levallois technology) or behaviors (extended trade networks, long distance raw material transport, symbolism) that are used as proxies for identifying so-called ‘modern’ human behaviors, and increasingly complex cognitive capabilities of early humans. The idea of ‘complexity’ in our interpretations of the archaeological record are based on preconceived notions of a chronologically organized linear process of development that follows a sequential trajectory. Some archaeological finds and the inferred behaviors considered to be indicative of modernity lack a robust theoretical grounding and can often be more adeptly attributed to changes in the paleoenvironment or resource exploitation management (Henshilwood and Marean 2003). Approaches to understanding the cognitive abilities and complexity of hominin populations in the archaeological record are based on “techno-cultural taxonomies” and trait lists that provide inconsistent results and interpretations. These units of analysis were not established based on cognitive theories and “it is inappropriate to use any of them as proxies for modern cognition” (Wynn and Coolidge 2009, 117). Because of this, Wynn and Coolidge (2009) advocate for a stricter definition of ‘modernity’ that includes cognitive requirements which are not based on the absence/presence of traits but rather the emergence of an enhanced working memory and development of executive functions. ‘Modernity’ in the form of logical reasoning, language, and culture is associated with the emergence of anatomically modern humans and seems to be a relatively recent phenomena in prehistory (<50 ka), and a suggested anatomical mechanism for this development is related to a genetic mutation (Coolidge and Wynn 2005).

There was a marked development in the evolution of spatial abilities relating to artifact symmetry that occurred ~ 400 ka and are linked to enhanced cognitive abilities, although this is not necessarily indicative of modern behavior in a cognitive sense (Wynn 2002). The development in enhanced cognitive abilities is dated to a time period in which the Fauresmith was likely to overlap with and may be visible in the technological trends that differentiates it from Late Acheulean material. The Fauresmith is notorious for its reliance on the identification of the absence/presence of certain tool typologies and traits, which makes it inherently difficult to assess in terms of recognizing complex behaviors or cognitive abilities. While some Fauresmith assemblages have been associated with archaeological material that could be argued to be indicative of more complex or modern behaviors (exotic pigments or hafted projectile spears) (Watts, Chazan, and Wilkins 2016; Wilkins et al. 2012), the assemblage from Rooidam 2 did not have those kinds of had no associated finds or proxies for modern human behavior though this could be a preservation issue.

6.6 Limitations and Future Directions

A limitation of this study is that the measured variability between the adjacent sub-levels of Rooidam 2 may simply reflect natural stochastic variation between arbitrarily established units of analysis, rather than meaningful and culturally mediated patterns of technological change. Thus, the interpretations that can be extrapolated from the results of this analysis are unfortunately limited by the scope of this research alone. Measuring variability within a technological sequence using the sub-levels of the sequence is problematic, as they are essentially arbitrary units of analysis that have no established time depth or apparent typological differentiation within the dense concentration of lithics that makes up the layer. The use of sub-levels to divide the concentration was established in order to explore variability within Fauresmith-bearing strata, which had been a primary research objective during excavation. We can be relatively confident that the lithics recovered from higher sub-levels are younger than the lower sub-levels, but where exactly the lines were drawn between these levels was arbitrary and could have an influence on the observed patterns. Due to constraints on time, the 6th sub-level of the sequence could not be recorded and included in the analysis. An inclusion of the material from Rooidam 2 with data from the 6th sub-level would be ideal and help to provide a more robust and complete record of the technological changes within the intra-site sequence.

The excavated assemblage represents a dense concentration of lithic material and is a suitable choice of site for a more thorough investigation of highly variable and poorly defined ‘transitional’ assemblages in the interior cape. A minimum age estimate of ~174 ka for Rooidam 1 (Szabo and Butzer 1979) and 2 (unpublished) were provided for both of the sites, using two different methods of chronometric dating (U-series and OSL), although the date from Rooidam 2 is unpublished and should be interpreted with caution and the exact . A larger scale analysis of the assemblages from both Rooidam 1 and 2 would be especially valuable, as these two sites are in close proximity (120 m) with similar stratigraphy and could be interpreted as one inter-connected living/activity space in which early humans occupied. An analysis aimed at interpreting potential activity zones would help to understand the use and management and division of space and further define behavioral mechanisms affecting lithic variability within the sequence. The data recorded for this analysis includes a multitude of individual attributes for each artifact and can be used to facilitate meaningful comparisons between Rooidam 2 and other sites in the interior cape. A multi-site investigation and analysis of Fauresmith assemblages (see Underhill 2012) using a similar methodology that attempts to quantitatively measure variability between and within a sequence would be able to further investigate the integrity and patterns of Fauresmith-designated assemblages.

6.7 Conclusion

An implied relationship in lithic studies between chrono-cultural entities (such as industrial complexes) and specific artifact types cause an indisputable tension when attempting to characterize assemblages that are ‘transitional’. In southern Africa, the artifact type frequencies and reduction strategies of assemblages categorized as either late Acheulean, Fauresmith, or early Middle Stone Age greatly overlap in their general composition despite the evolutionary implications for cultural and behavioral complexity differing greatly based on how the assemblage is classified. A technological investigation of a sample assemblage of lithic material from Rooidam 2, a Fauersmith-designated site, was designed to further investigate the nature of Middle Pleistocene transitional assemblages, with a focus on four research questions (Chapter 4). This thesis has contributed to each of these questions, as follows;

1. *What technological attributes and patterns characterize the sample assemblage from square 4B Level 5 at Rooidam 2?*

The sample assemblage from Rooidam 2 is technologically characterized by core reduction strategies that made use of flat and broad surfaces for exploitation. Levallois reduction dominated the core types in the assemblage, using preferential and recurrent approaches. Other core types included multiplatform and irregular blocky cores. The production of flakes, blades, and unretouched convergent points is well represented in the assemblage. There is a relatively high frequency of retouched points that includes points, scrapers, and notched pieces and other minimally worked types that do not fit neatly into a typology. Retouch is marginal and extends along the perimeter of the edges. The analyzed sample from Rooidam 2 is consistent then with many of the artifact types and attributes that are used to describe Fauresmith occurrences (retouched tools, convergent points, Levallois reduction) and yet is lacking a major defining component, the biface. The identification of a single potential ‘small’ biface fragment in the 7th sub-level of the sequence is of interest but is not compelling enough to decisively say that the production of bifaces or other LCTs took place at the site. Despite the Rooidam 2 assemblage originally being designated as Fauresmith, it exhibits high frequency of unretouched and retouched blanks, and a diverse range of core types and reduction strategies that are represented throughout the entire sequence, which are traits more frequently associated with MSA assemblages. Based on artifact typology and technological patterns, the Rooidam 2 sequence may be more appropriately interpreted as an eMSA assemblage based on the absence of bifaces/LCTs and the relative abundance of retouched tools made on a diverse range of blank types. Although the analyzed lithic assemblage from Rooidam 2 is most consistent with an early MSA classification based on artifact typology, the author believes to assign it decisively to an industrial entity will not address the larger theoretical questions surrounding the nature of variability and its behavioral implications for hominin development.

2. *Does the sequence show evidence for significant variability in the blank production choices or retouched tool morphology?*

The results of the intra-site analysis of Rooidam 2 revealed instances of significant lithic variability between adjacent sub-levels with respect to the choices made during the initial production of blanks. There was no significant changes or variance in the morphology of retouched tools. The most common attributes that varied between adjacent sub-levels were related to the management of the dorsal convexity that resulted in the shape and morphology of the blank product (i.e. flake, blade, unretouched point). This variability in blank production between the adjacent sub-levels was non-linear and did not indicate any cumulative changes in artifact types or frequencies that would suggest a developmental trajectory from less to more ‘complex’ expression of behavior throughout the sequence. An increased tempo and degree of technological variation in lithic technology is a pattern generally associated with MSA assemblages that are dated to the Late Pleistocene.

3. *How do we interpret intra-site technological variability in a way that is behaviorally meaningful for a transitional assemblage?*

A comparison of variance between adjacent sub-levels allowed for an examination of the meaningful behavioral choices that contributed to the decisions and steps made by toolmakers during the lithic production sequence. Shifts in the technological choices that are represented in each sub-level can be detected in the individual domains of production, and significant changes in specific artifact attribute types and frequencies can be examined. Technological changes in the intra-site sequence can be interpreted by giving them a quantitative value, following Tostevin (2011, 2012), which can then be used to track changes in toolmaking behaviors over time and postulate the social/cultural factors that have driven change within blank production or retouched tool morphology. It is especially important to address and quantify intra-site technological changes in transitional assemblages due to their inherent variability as a whole.

4. *Does the sample assemblage from Rooidam 2 show any evidence in defense/rebuttal of a triparte division of the Fauresmith based on typological or technological grounds?*

An idea that could be addressed through an intra-site analysis of the Rooidam 2 sequence was to be able to investigate the legitimacy of temporal 'phases' within the Fauresmith industry, a division originally suggested by Van Riet Lowe (1945) and more recently applied to the Fauresmith material from Wonderwerk Cave (Beaumont and Vogel 2006). Rooidam 2 was identified by Beaumont (2004) as an important site for clarifying the typological trends within the Fauresmith, where Stratum 4b (Level 5) was thought to contain material that would contribute to defining the Early phase of the Fauresmith. Direct comparisons with the sequence at Wonderwerk Cave (which is stratigraphically-constructed from six separate excavations within the cave grouped into 'Major Units') would be inappropriate due to the relative time depth and larger volume of excavated material there. However, the intra-site analysis of the Rooidam 2 sequence does not show a pattern of variability that could be interpreted as distinctive 'phases' that differ in terms of general artifact typology or attribute frequencies. These 'phases' seem to be based mostly on the identification of key artifact types and the refinement of bifaces, and at Rooidam 2 the retouched tool morphology did not significantly vary and there were no recorded bifaces. There is no evidence from the Rooidam 2 sequence that lends any support to a division of the assemblage into technological 'phases' at this time.

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