

A Quantitative Comparison of the Howiesons Poort Lithic Assemblage from Kathu Pan 6 in the Northern Cape with other Howiesons Poort assemblages in Southern Africa

A THESIS SUBMITTED IN FULFILMENT FOR THE DEGREE M.SC.
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Chapter 1: Introduction

The Howiesons Poort (HP) Stone Age Industry in southern Africa has been subject to significant interest in archaeological studies during the past few decades. HP is one of the most intensively discussed periods of the Late Pleistocene in the MSA in southern Africa because of its rich complex material culture found within the context of an even more complex blade-based industry where blanks are backed and hafted as possible arrow heads (Lombard, 2005; Lombard et al., 2012). These archaeological studies of the HP have predominantly been based on cave and rock-shelter sites along the coastline. Conversely, very few inland open-air sites have been studied to the same extent as their coastal counterparts, which limits opportunities for comparative studies between contrasting locales. This raises questions surrounding variability between various HP assemblages, what that variability may look like and what implications this variability may have on our understanding of the HP in southern Africa.

This however, presents researchers with the opportunity to fill in this gap of knowledge and this thesis aims at contributing to filling this very gap. Thus, this thesis reports the results of an analysis of the HP stone tool assemblage found at Kathu-Pan 6 (KP6) which is an open-air site found inland, near the town of Kathu in the Northern Cape, South Africa, and compares this assemblage to the published results from three well studied HP coastal rockshelter sites in southern Africa. These three sites are Pinnacle Point 5-6 (PP5-6), Klipdrift Rock Shelter (KDS) and Klasies River Mouth Cave 1A (KRM) (Henshilwood et al., 2014; Douze et al., 2018; Villa et al., 2009; Wurz, 2000; Brown, 2011; Brown et al., 2012).

This quantitative and qualitative comparison aims at investigating inter-assemblage variability between KP6 and these three well-known HP sites. A sample from each site was compared to KP6 based on Tostevin's Flintknapping Behavioural Domains for blank production and toolkit morphology (Tostevin, 2011b; Tostevin, 2012)

Following the results of these comparisons, it was observed that KP6 HP assemblage differs from each of the three selected HP sites in different ways. KP6 differs from Pinnacle Point

with respect to core orientation, mean external platform angle, profile, flake to blade ratio and backed piece frequency. KP6 differs from Klipdrift with respect to core orientation, direction of core exploitation, length-to-width ratio, width-to-thickness ratio, flake to blade ratio. Finally, KP6 differs from Klasies River Mouth Cave 1A with respect to core orientation, platform treatment, platform thickness, direction of core exploitation, length-to-width ratio, flake-to-blade ratio and backed piece frequency. This further highlights the complexities of characterizing and explaining HP variability.

Chapter 2: Background

2.1 Howiesons Poort:

2.1.1 Definition and significance

Howiesons Poort or 'HP' as a term was first used in 1927 to characterize a stone artefact assemblage excavated from a relatively small rock shelter in the Eastern Cape by Stapleton and Hewitt (1927, 1928). The characteristics they identified were the following: burins, large segments, obliquely pointed blades, and trimmed points (Stapleton et al., 1927, 1928). It was initially thought to have been a transitional industry between the MSA and the LSA and this may be due to the similarities that HP had with LSA microlithic assemblages (Lombard 2005). Excavations at a key HP site Klasies River Mouth (KRM) carried out by Singer and Wymer (1982) shed light on to the stratigraphic positioning of the HP within the Middle Stone Age (MSA) sequence, which was also confirmed by subsequent excavations at other sites (Soriano, 2007).

The HP assemblage found at Klasies River Mouth is specifically characterized by various backed and truncated forms such as trapezes and large segments about 25 to 60 mm in length (Lombard, 2005). This assemblage additionally contains typical MSA blades, which can also be referred to as flake-blades, however these are often smaller in comparison to the other MSA phases (Lombard, 2005). Facetted platforms occur much less regularly in units below the HP. Retouch in HP pieces occur on the proximal, medial and distal blade sections as opposed to retouch being on blades with the distal end missing in the rest of the sequence (Lombard, 2005). However, the HP sample found at Rose Cottage Cave is said to be different from samples found at other sites in that it has relatively few segments or trapezes in comparison to sites like Border Cave, Klasies River and Nelson Bay Cave (This will be touched on in further detail later in the description of RCC) (Lombard, 2005).

Another example of variability among HP sites in Southern Africa is the absence or rarity of points and scrapers in HP layers at Rose Cottage Cave, Sibudu Cave and Klasies River although there are many scrapers found in the HP layers of Montagu Cave (Keller, 1978b) and in HP

layers at Umlhathuzana (Kaplan 1990). This indicates that there exists typological variability in HP assemblages across many sites which are geographically close to each other (Wadley & Harper, 1989). In light of this information however, very few true technological studies on MSA material have been completed (Lombard, 2005). Wurz (2002) commenced this kind of analysis by detailing variability within the industries of lithic production in the Klasies River sequence and established a technological and biplot –based comparative method which allows one to explain differences in MSA technology (Wurz *et al.*, 2003; 2005). The study she did initially showed that the variability in the MSA at Klasies River was due to the changes between the dominant blade and/or point technological conventions through time (Wurz, 2002). This process involved an analysis which showed that the most common form of a core is a prismatic shaped core with elongated volumes (Lombard, 2005). The blades were struck habitually from the proximal platform (Lombard, 2005). As a result, the characteristic backed artifacts of the HP and the production involved in making them is informed by the selection of whole blades and the use of light backing to shape the blanks into the different subsequent typological forms we see in the rest of the HP assemblage (Wurz, 2002).

It has been hypothesized that these blanks from HP assemblages that are selected and backed are hafted as possible arrowheads, barbs or used as cutting tools (Lombard, 2011; Parteger, 2016 & de la Peña *et al.*, 2018). It was previously believed that hafting as an activity was predominantly practiced in the Later Stone Age (Lombard, 2011). This belief was placed into question when Gibson *et al.* (2004) published micro-residue results acquired from 48 backed tools from the HP assemblage at Rose Cottage Cave. This study showed that tools of this kind often had ochre near their backed edges, suggesting that they may have been hafted where the ochre was an ingredient in the mastic (Gibson *et al.*, 2004). Plant tissue, plant fibre and white starchy deposits were also found very close to the ochre on the tools and were interpreted as a consequence of hafting (Gibson *et al.*, 2004).

A technological and typological analysis of the HP tools from Rose Cottage Cave established that some pieces were used in hunting (Soriano *et al.*, 2007). Further macro-fracture analysis of geometric backed tools from Klasies River Cave 2 echoed this finding (Wurz *et al.*, 2007). A hunting experiment conducted by (Parteger, 2007) which produced 27 weapons out of 33 replicated HP segments, showed that they can be used effectively to aid in hunting animals. In an additional hunting experiment conducted by Yaroshevich *et al.* (2010), using transversely hafted backed lithic artefacts similar in size to the Sibudu HP quartz assemblage. These backed

artefacts were used as arrowheads and exhibited significant penetrating abilities and are quite durable (Yaroshevich et al., 2010).

In summary, HP is one of the most intensively discussed periods of the Late Pleistocene in the MSA in southern Africa due to its rich complex material culture found within the context of an even more complex blade based industry where blanks are backed and hafted as possible arrow heads and barbs or used as cutting tools for butchering purposes at a kill site or residential.

2.2 Raw Material

HP assemblages are characterized in part by their raw material. At most HP sites the dominant raw materials are crystal quartz and cryptocrystalline silicas such as silcrete and chert in addition to hornfels and chalcedony, which were once all regarded as “non-local” fine-grained raw materials (Ambrose & Lorenz 1990; Lombard 2005). The increased use of quartz and other fine-grained raw materials which were often referred to as ‘non-local’ has been identified in well-described sequences at sites like Klasies River Mouth (Wurz, 2000, 2002). At Klasies Main River site, local quartzite was mostly used for lithic artefact production during the MSA occupation (Lombard, 2005). While smaller quantities of quartz, silcrete, chalcedony and hornfels were identified to have been used in the MSA tool assemblages prior to the HP at Klasies, researchers also identified increase in use of the afore mentioned raw materials in the HP assemblage (Singer & Wymer, 1987; Thackeray, 1989; Wurz, 2002; Wurz et al., 2003; Wurz 2005; Lombard, 2005). The nearest silcrete outcrop to the site is more than 20 km away but several of the backed pieces termed non-local raw material (Singer & Wymer, 1982) have cortex which come from pebbles that are collected from nearby valleys (Lombard, 2005). A study was then conducted on the variability in the MSA stone artefact sequence at Klasies River which yielded no evidence that suggests a difference in the reduction strategies of quartzite and non-quartzite HP cores although, the non-quartzite cores show a greater degree of reduction as they are shorter and thinner (Wurz 2000, 2002). The study also revealed an interesting observation where the frequencies of non-local lithics at Klasies River begin to rise before the technological transition to the HP, in late MSA II levels, and decline gradually through the end of the HP and into the beginning of the MSA III (Ambrose 2002; Singer & Wymer 1982; Wurz,

2002). This identified pattern in the change in raw material suggests that the invention of small blade technology and backed microliths could have been a response to the potential of fine-grained raw materials (Lombard, 2002). The restriction of access to these fine-grained resources may explain the decline in use and the adaptation therefore to accommodate the mechanical properties of coarse-grained local materials (Ambrose 2002; Ambrose & Lorenz 1990).

The terms ‘non-local’ and ‘exotic’ were used by Singer & Wymer (1982) to describe the fine-grained lithic raw materials that increased in frequency during the HP period. These terms were used interchangeably by Singer & Wymer (1982) and subsequently by Ambrose & Lorenz (1990) later and in both cases the terms were not explicitly defined. Depending on the context, ‘non-local’ could mean the raw material appears naturally at a distance usually less than 25 or 50 km away from the site (Minichillo 2006). The presence of this raw material was thought to have been indicative of a foraging range, special procurement journeys or long distance trading (Minichillo 2006). The term ‘exotic’ is often used informally to describe a locally rare raw material and may also occur at a great distance from the site itself with the source of this raw material being unknown (Minichillo 2006).

Minichillo (2006) further highlights the fact that very little raw material surveys have been carried out at key HP sites in Southern Africa. Not knowing the sources of raw materials and applying the “non-local” term which inferred such knowledge had unintended consequences when these observations were later for mobility patterns. Van Andel (1989) suggested that the offshore bedrock geology near Klasies could contain numerous of the fine-grained materials used for stone-tool making during the MSA. Additionally, this bedrock would have been exposed during low sea levels most likely during the HP period and may have weathered into beach cobbles (Minichillo 2006).

At Pinnacle Point near Mossel Bay in the Western Cape, a geological survey was carried out, it was found that silcrete can be found in secondary geological context, as cobbles in streams and on the beach, all within a 15 km radius of the site itself (Minichillo, 2006). Similar findings were revealed at Klasies where silcrete cores from the HP component of the site were regularly made on stream or beach cobbles (Minichillo, 2006). It is clear that the various ‘non local’ fine grained raw materials mostly originated from water-worn cobbles and are being transported to the sites in cobble form. These and many other surveys in and around other HP sites challenged

our perception of silcrete and many other fine grained raw materials as a ‘non-local’ raw material and thus our perception on mobility patterns of the occupants of these HP sites.

However, for the purposes of this particular study we will refrain from the use of the terms ‘local’, ‘non-local’ and exotic as we are more interested in whether the raw material is coarse or fine-grained and its relative abundance on the landscape.

2.3 History of Research and Chronology

The discovery of HP in the Eastern Cape has inspired research in and around this industry and has gradually grown in popularity though is not exempted from controversy. As I have mentioned above, HP assemblages were initially thought to have been transitional between the MSA and the LSA likely due to the similarities that HP had with LSA microlithic assemblages (Lombard 2005). Size alone of the HP tools relative to the LSA tools could lead one into thinking that the HP is indeed a transitional assemblage as the tools are smaller than MSA tools but slightly larger than LSA tools. This notion was put into question following the excavation carried out by Singer and Wymer (1982) at Klasies River Main site and other archaeologists at sites such as Border Cave, Die Kelders, Blombos Cave, Montague Cave, Boomplaspas and Umhlatuzana (Butzer et al., 1978; Grine et al. 1991; Henshilwood et al., 2001b; Keller, 1973a; Deacon 1979; 1989; Deacon et al., 1984; Kaplan, 1990) which uncovered MSA sequences. The notion then shifted to the prevailing idea that the MSA can be split into six chronological subdivisions namely MSA I, MSA II, Stillbay, HP, MSA III and MSA IV of which the HP assemblage is then a sub-stage in the MSA sequence (Lombard 2005). This placement of the HP within the MSA sequence was further cemented by the discovery of many sites in Lesotho, Namibia and Zimbabwe (Carter 1969, 1976, 1977; Carter et al., 1988; Volman 1984; Vogelsang, 1998; Helgren et al., 1983; Larsson, 1996; Larsson, 2001)

Although in the mid 1970’s the HP was placed chronologically between the MSA and the LSA of southern Africa (Lombard 2005), subsequently, in the 1980’s the HP was given a suggested age dating to Oxygen Isotope stage (OIS) 5b in addition to some sequences which may have lasted until the start of OIS 4 (Volman 1984). At the time the most likely scenario was that the HP linked to the same time period as the ending of the Last Interglacial and/or the beginning

of the Last Glacial suggesting a date of about 70 000 years ago or more (Deacon 1989; Deacon & Geleijnse 1988; Klein 1989). However, the development of electron spin resonance, amino acid racemization, luminescence dating and particularly single-grain optically stimulated luminescence dating have placed the age of HP between 80 000 to 60 000 years ago (Lombard, Wadley et al 2012). Jacobs et al. (2008) using optically stimulated luminescence placed the age of HP between 65 000 to 59 000 years ago. At Klasies, based on electron spin resonance and thermoluminescence, the HP dates to between 50 000 and 60 000 years ago (Eggins et al. 2005; Feathers 2002; Tribolo et al., 2005). The date for the HP assemblage at Border Cave is around 75 000 years ago (Grün and Beaumont 2001; Grün et al., 1990) and are quite similar to the dates obtained at Pinnacle Point which is dated to 71 000 years ago (Wurz 2013; Wilkins et al., 2017). At Diepkloof the OSL analysis of the HP assemblage dates it to between 109 000 and 52 000 years ago (Porraz et al. 2013b; Tribolo et al. 2013) which may suggest that HP lasted longer than was previously thought. This is still however up for debate because of the difficulties associated with estimating model input values and contradictory results from different methods (Jacobs & Roberts, 2015)

2.4 History of Comparative Studies on HP Assemblages

Comparative studies between HP assemblages in southern Africa have traditionally been typological. Here I highlight three major comparisons that had an impact on why there may be differences between HP assemblages across southern Africa.

Rose Cottage Cave (RCC), an inland cave site in the Free State, houses a unique HP assemblage that challenges common notions of what an HP assemblage should look like particularly, when compared to sites like Klasies River Main site. Researchers found that HP blade production is indeed a true technological innovation although, it was not based on indirect percussion as many have suggested before at Klasies (Soriano et al, 2007). Additionally, they found that although the assemblage is dominated by backed pieces similar to the Klasies assemblage, not all these pieces were used for hunting or hafted weapons and that the patterns of raw material procurement do not conform to models based on the evidence from Klasies (Soriano et al, 2007). They observed no changes in raw material selection during the HP phase at RCC

whereas at KRM there was a marked shift in the proportions of coarse-grained quartzite compared to silcrete (Soriano et al., 2007). The backed pieces may have been used for domestic tasks due to the high frequency of tools that are not pointed and the fact that RCC has been identified as a residential site as opposed to a hunting encampment or ambush site (Soriano et al, 2007).

It was previously thought that the raw material selection pattern seen at Klasies was a response to the potentials of raw materials of better quality (Soriano et al, 2007). Additionally, it was thought that there may have been a systematic long-distance transport of exotic lithic raw material during HP, which was thought to be a reflection of a social system that consisted of information sharing and an increase in a foraging range. However, with RCC not conforming to this pattern of raw material selection it is thought that the raw material used at these two sites were transported over short distances (Soriano et al, 2007), further supporting the argument discussed above of Minichillo (2006).

At Sibudu, a rock shelter in Kwa-Zulu Natal (KZN) 15 km inland of the Indian Ocean in South Africa, researchers have noted the problems with typologically defining HP and attempt to aid/supplement its description through technological definitions by comparing various HP assemblages across South Africa (de la Peña, 2015). The main focus here is the Grey Rocky layer, the youngest HP layer in the stratigraphy, which shows a highly versatile example of reduction strategies that were influenced by the characteristics of the raw material they exploited (de la Peña, 2015). They compare the Grey Rocky layer HP to several sites including Klasies, Diepkloof, Rose Cottage Cave Klipdrift and older layers of HP at Sibudu (de la Peña, 2015). Bifacial pieces are a common characteristic in the Sibudu HP assemblage as well as the Diepkloof HP sequences (Porraz et al, 2013). The difference here is that the Sibudu bifacial pieces are made mostly from quartz whereas at Diepkloof they are made from silcrete (de la Peña, 2015). Another key difference between the two assemblages is that the Sibudu bifacial pieces occur in much younger stratigraphic layers whereas at Diepkloof they occur in much older layers and often referred to as early HP (de la Peña, 2015). The researchers attribute these differences to regional and functional variations within what has been characterized as typical and typological HP (de la Peña, 2015).

At Diepkloof, a rock shelter located 17 km from the current Atlantic coast in the Western Cape, researchers identify diachronic variability within the HP assemblage found there (Porraz et al,

2013). They identify three main phases, Early, Intermediate, and Late HP. The laminar reduction sequence linked with the Early HP is said to be similar to what has been identified as the HP of Klasies River (Porraz et al, 2013). This similarity between the two HP assemblages uncovers the existence of similar roots between regionally different sites. Additionally, it gives us an idea of the potential distribution of HP across southern Africa as Diepkloof with its Early HP may be evidence of the oldest evidence of this technology and may represent an initial stage of the HP technology (Porraz et al, 2013).

They surmise that this Early HP also shares similarities with the SADBS industry found at Pinnacle Point 5-6 (Brown et al, 2012). This industry has HP-like backed pieces however, lithic analysts at PP5-6 consider this its own entity as the blade length and width of these backed pieces were statistically different to what was found at Klasies (Brown et al, 2012). SADBS also occurred 6000 years before many other HP sites (Jacobs et al. 2008). The three above mentioned HP assemblages are separated by a large amount of time where the Early HP at Diepkloof Rock Shelter is dated to 110 000 years ago, Klasies HP is dated to 64 800 years ago and SADBS is dated to 71 000 years ago (Jacobs et al. 2008). Despite sharing similar typological roots, all three assemblages occurred at very different times and may allude to the HP lithic industry appearing at different locales at various periods in time.

Despite the above highlighted differences between HP assemblages, there are broad inter-regional consistencies in the basic form of implements such as backed pieces and the production of small blades using similar flaking systems (Mackay et al, 2014). Additionally, assemblage sizes are either proportionally very large in terms of the total number of lithic artifacts or very dense in terms of the number of artifacts per unit volume when compared to other industries (Mackay, 2010). Finally, HP assemblages usually have on-site reduction of cores and production of formal tools from blanks (Mackay et al, 2014).

2.5 The Meaning of the HP

The HP is one of the best defined and studied lithic technocomplexes in southern Africa, and grouping assemblages together within a technocomplex is generally considered to mean something with respect to cultural connectedness and/or interaction. However, Shea (2014) highlights flaws and problematic implications in what he terms NASTIES (Named Stone Tool Industries) such as the “Mousterian” which along with many others were identified and named nearly a century ago. These NASTIES were identified in the purpose of solving chronological and stratigraphic problems Western Europe faced in their archaeological collections. Recently, Wilkins (2020) has considered these concerns about NASTIES with respect to the HP.

According to Shea (2014) archaeology in and of itself lacks any kind of built-in constraint on identifying new NASTIES or any strict guidelines on retiring old ones. Case in point the HP is a result of the same inductive and intuitive methods that birthed the Mousterian in the first half of the 20th Century (Wilkins, 2020). Thus, it would carry the same problematic nature that haunts the NASTIES which were formulated in the absence of any guiding Middle Range Theory (Shea, 2014). Here, Middle Range is a concept of intermediate theory between observed empirical data and general theories (Atici, 2006). The archaeologists/researchers of the time that first identified the NASTIES were not privy to the behavioural significance of the variables whose values were expressed in the definitions of various NASTIES (Shea, 2014). Therefore, the uncertainties surrounding the definitive source of variability among these variables inhibit our ability to answer important questions pertaining to the similarities and differences between NASTIES (Shea, 2014). If we are having problems in comparing NASTIES, using them to infer and frame hominin behaviour would be equally as difficult and does not address imperative questions pertaining to human evolution. In light of this, Shea (2014) argues that we should do away with NASTIES of this nature and consider alternatives to investigating and interpreting the hominins that lived through the Pleistocene.

2.6 A New Approach to Characterizing HP Variability

An alternative method Shea (2014) suggests was used for the recent comparative study of European and Levantine Middle Paleolithic and early Upper Paleolithic assemblages which was conducted and reported by Tostevin (2011, 2012). Here, Tostevin (2011, 2012) divides the knapping procedure into five main behavioural domains namely; core modification, platform maintenance, direction of core exploitation, dorsal core convexity system and tool manufacture. He then further divides these behavioural domains into subdivisions of variable numbers (i.e. knapping steps where the variation is measured in terms of either discrete or continuous variables, Tostevin, 2012). Each of the variables used the comparison are linked by Middle Range Theory to social connectedness and intimacy. This theoretical outline is used for pairwise proxies of lithic assemblages and therefore the similarities and/or differences are expressed by a statistically weighted data point which combines data from all five behavioural domains (Tostevin, 2012). According to Shea (2014) this methodology has set up the above mentioned theoretical validation for assigning specific degrees of social intimacy to various steps within each of his domains. In light of this, I will also apply this theoretical framework in my statistical methodology when comparing the KP6 assemblage to other already established “HP” assemblages in southern Africa.

The Tostevin framework operates around domains of behaviour as opposed to typology. Tostevin defines and illustrates the use of the above mentioned behavioural domains through his own method (Tostevin, 2000a, b, 2003a, b, 2007, 2012, Tostevin et al., 2006) where reduction sequences in flintknapping were studied through a behavioural approach. Having comparative behavioural units of analysis within each archaeological lithic assemblage, this approach helps solve typological issues of comparing and studying lithic material. Additionally, it differs quite significantly in specifics when compared to both reduction sequences and *chaîne opératoire* traditional schools of thought (Tostevin, 2011). Each assemblage is considered and defined as the association of flintknapping behaviours enacted upon a particular spot on the landscape within the given time range of the site’s occupation (Tostevin et al., 2006). This definition is both epistemologically viable given Pleistocene site formation processes and analytically appropriate for the study of the evolution of specific

technical decisions between Paleolithic (and Stone Age) populations represented by successive individual assemblages (Tostevin, 2011).

With regards to blank production, these decisions can be seen as being made in temporal clusters, as listed above, during the process of flintknapping (Tostevin, 2011). Some of these clusters of decisions are being made on a flake-by-flake basis while others are made once or twice per core reduction (Tostevin, 2011). These clusters of knapping decisions, are represented by lithic artefact measurements and characterizations, which Tostevin (2000b, 2003a, b) termed as flintknapping domains and aim to structure the analysis of learned behaviours since these are physical acts used by an observer to learn a knapping method, with or without verbal cues and instructions (Ohnuma et al. 1997). These represent the behaviour by behaviour approach in order to quantify the evaluation of the degree of similarity or dissimilarity in blank production between assemblages (Tostevin, 2011).

Tool kit characterization of an assemblage requires its own domain of decisions which are enacted during the selection of blanks for inclusion into the tool kit which even include some pieces traditionally labelled as such despite the lack of retouch (Tostevin, 2011). The variables used to identify the tool kit decision-making are reflected in physical features of the tool shapes which are visible from a distance and are likely to affect the efficacy of the cutting edge (Bradbury et al., 1995). The statistical pair-wise comparisons of these domains will be elaborated on more in the methods chapter.

This method of inter and even intra-site assemblage comparisons by Tostevin is an attempt to connect the evolutionary study of culture history with the archaeological record of Pleistocene hominins. It is hoped that this method may shed some valuable insight as to how stone tool production behaviors may have differed over longer distances, at various site types and how it may have spread culturally. Tostevin goes on to list three main hypotheses that encompass evidence of cultural transmission and/or independent innovation between assemblages.

- The first hypothesis he lists is the independent innovation hypothesis (Tostevin, 2011). This hypothesis states that flintknapping behaviours changed due to in situ independent innovation without cultural transmission from neighbouring regions. Any similarities identified between assemblages in blank production and/or tool kit

morphology are considered to be a result of adaptive convergence and/or cultural drift (Tostevin, 2011).

- The second hypothesis he lists is the cultural transmission hypothesis (Tostevin, 2011). This hypothesis states that flintknapping behaviours in a region changed due to the expansion of said behaviours from one region to the next as a result of cultural transmission across the landscape (Tostevin, 2011).
- The third and final hypothesis is the combination of the two previously mentioned hypotheses. It states that the flintknapping behaviours changed due to independent innovation in one or more regions with the ensuing cultural transmission of the behaviours into neighbouring regions.

The three hypotheses described above are thus tested by assessing a goodness of fit between the archaeological record and an array of model expectations derived from a combination of Behavioural Archaeology, *Chaîne Opératoire*, and Organization of Technology approaches to material culture as applied to culture historical processes defined from cultural transmission theory (Tostevin, 2011). Each expectation is theoretically underpinned by how it predicts the intra-regional sequences and inter-regional sequences should appear given Hypothesis 1 (Innovation) or Hypothesis 2 (Cultural Transmission) (Tostevin, 2011). Hypothesis 3 (Combination) is what would reasonably follow Hypothesis 1 in some regions and Hypothesis 2 in others, it is not treated separately in the following descriptions of the model expectations (Tostevin, 2011)

Expectation 1 (Antecedents: Continuity in Technical Choices) states that any innovation is made up of pre-existing components. In terms of lithic technology, the presence or absence of certain flintknapping behaviours within a lithic assemblage in a particular region can be used to evaluate the probability that a subsequent lithic assemblage appeared in that region through independent innovation or cultural transmission (Tostevin, 2011). Antecedents of blank production behaviours can be seen as the continuity of an earlier enculturating environment while antecedents of tool kit morphologies within a region can be seen as continuity of tasks for which the cutting edge was a priority on the landscape at that time (Tostevin, 2011). The former being an example of cultural transmission and the latter being an example of independent innovation. With regards to HP, Early HP at Diepkloof would be an example of an antecedent as it is the oldest evidence of HP in southern Africa

Expectation 2 (Number of Changes in Technical Choices) states that a few technical choices (within blank production and/or tool kit morphology) found in two assemblages in neighbouring regions can be explained by independent innovation but as the number of such shared choices increases, so does the improbability of their independent recurrence (Taylor, 1896; Steward, 1929; Andrefsky, 1987) Thus, a quantitative measure of similar knapping behaviour can be used to assess the closeness of competing hypotheses. Cultural transmission is more likely as the number of similar blank choices between two assemblages increases. Similarly, fewer technical choices found to be similar between two assemblages makes independent innovation more probable.

Expectation 3 (Number of Domains Affected by Change) states that cultural transmission results in many more types of material culture to be passed on together by the next generation than instances of independent innovation (Steward 1929; Linton 1936:372; Lechtman 1977; Carr 1995b:249). When looking at the Paleolithic record, it is quite clear that there is one dominant material culture, lithic technology. However, the principle of this expectation can be applied by viewing independent flintknapping domains as analogous to independent material culture domains (Tostevin, 2011). For example, the knapper's blank production choices can be separated from the perspective of what is learned into four independent domains (Tostevin, 2011). Platform maintenance and the dorsal surface convexity system, epitomize the tactical choices faced by a knapper on a flake-by-flake basis (Tostevin, 2011). Core modification and the direction of core exploitation represent strategic choices faced by the knapper over the course of reducing each core. Comparing these processes between assemblages allows for the quantification of the number of domains with similar knapping behaviours and can thus be used to evaluate competing hypotheses. Therefore, this expectation can predict the probability of cultural transmission hypothesis increases, and the independent hypothesis decreases in proportion to the number of the four blank production domains which possess technical choices shared between assemblages through time and in neighbouring regions.

Expectation 4 (Enculturation vs Stimulus Diffusion) states that pattern by which the changes in technical choices within blank production and the curated tool kit between two assemblages can be interpreted as evidence for stimulus diffusion versus changes in enculturing environments (Tostevin, 2011). An instance of cultural transmission in which the

individuals are not socially intimate results in the transmission of knowledge of the tool kit morphologies but not the blank production details into the next generation (Tostevin, 2011; Carr, 1995b). The pattern produced by pair-wise assemblage comparisons of similar tool kits but dissimilar blank production choices indicates the effect of several historical processes namely; stimulus diffusion or adaptive convergence (Tostevin, 2011). In both cases, the makers of the assemblages in question choose cutting edge morphologies similar to those of an earlier assemblage for use on the landscape as part of their own tool kit. The adoption of such a tool kit would have been possible through stimulus diffusion or asymmetrical transmission which does not require social intimacy. Independent innovation (Adaptive Convergence) is also a possibility where the idea of such a morphology may have been derived from a guided variation to satisfy a particular task in both contexts. Both possibilities (Stimulus Diffusion and Adaptive Convergence) can be distinguished through the evaluation of Expectation 1 listed and described above. If there is evidence for existing antecedents for the tool kit morphology in the region of the later assemblage makes adaptive convergence a more probable explanation while the lack of antecedents in the immediate region makes stimulus diffusion a more plausible explanation (Tostevin, 2011).

The 5th and final expectation does not fit the temporal scope of HP, thus does not apply and will not be described here. Nevertheless, the body of the method and the theoretical underpinnings which gave rise to the five model expectations provides an objective and replicable evaluation of the goodness of fit between the three hypotheses and the archaeological data derived from the lithic analysis that is currently available. Based on the resulting outcome of the pairwise comparisons following the lithic analysis of KP6 HP, these hypotheses and expectations will guide the interpretation of patterns if any that may be produced and what they may mean for what HP represents in the greater context of human evolution.

In summary, Tostevin's behavioural domains are another lens through which we can view lithic assemblages and comprehensively compare HP assemblages to answer more questions pertaining to variability within this unique period in the MSA.

In this thesis, I apply this approach to compare four HP assemblages across southern Africa. These comparisons will be made based on my analysis of the HP lithic assemblage from

Kathu Pan 6, and the published results of lithic analyses at Klipdrift Rock Shelter (KDS), Klasies River Mouth Cave 1A and Pinnacle Point 5-6 HP assemblages

2.7 Description of Sites

2.7.1 Kathu Pan 6 (KP6)

Presently, the majority of the sites that inform our knowledge on the MSA lithic technology are situated on or near present day coastlines and are mostly rock shelter and cave sites. In the case of Kathu Pan, it is unique in that it is an open-air site and is found far inland in the southern Kalahari Basin. KP6 is one of 11 sites located in the Kathu Pan area with the following coordinates $27^{\circ} 39' 50''\text{S} / 23^{\circ} 0' 30''\text{E}$ which is around 5.5 km north west of the small mining town of Kathu in the Northern Cape, South Africa (Figure 1). Kathu Pan is within the savannah biome (Mucina et al, 2006) on the edge of a marshland (Beaumont 1990; Beaumont & Morris 2004). Kathu Pan 6 in relation to Kathu Pan 1 is located 1.5m above and approximately 400m south east of Kathu Pan 1 (Beaumont 1990) (Figure 2). KP6 was first excavated in 1983 and 1985 and is located on an ethereal lake and was revealed by a sinkhole which was formed by the 1980 collapse of pre-existing sediments of about 3m in depth and 10 square meters in area (Beaumont 1990).



Figure 1: Map displaying the location of Kathu Pan in Northern Cape, Klipdrift Complex and Pinnacle Point in the Western Cape, and Klasies River Mouth in the Eastern Cape.

Recently, luminescence dating was done using single-grains from quartz samples from the KP6 site which produced an age of 79.4 ± 8.1 ka (Feathers, 2015). This estimate is much older than the limited age range of the HP assemblage (Jacobs et al. 2008), but remains within the less limited age of 100 000 – 50 000 year ago which was mentioned above and is supported by investigations at Diepkloof (Igreja & Porraz, 2013). However more recently, an OSL sample was taken from KP6 and found that the HP units are dated to 100 ± 6 and 74 ± 5 ka (Lukich et al., 2019), also in line with the early chronology reported for Diepkloof.

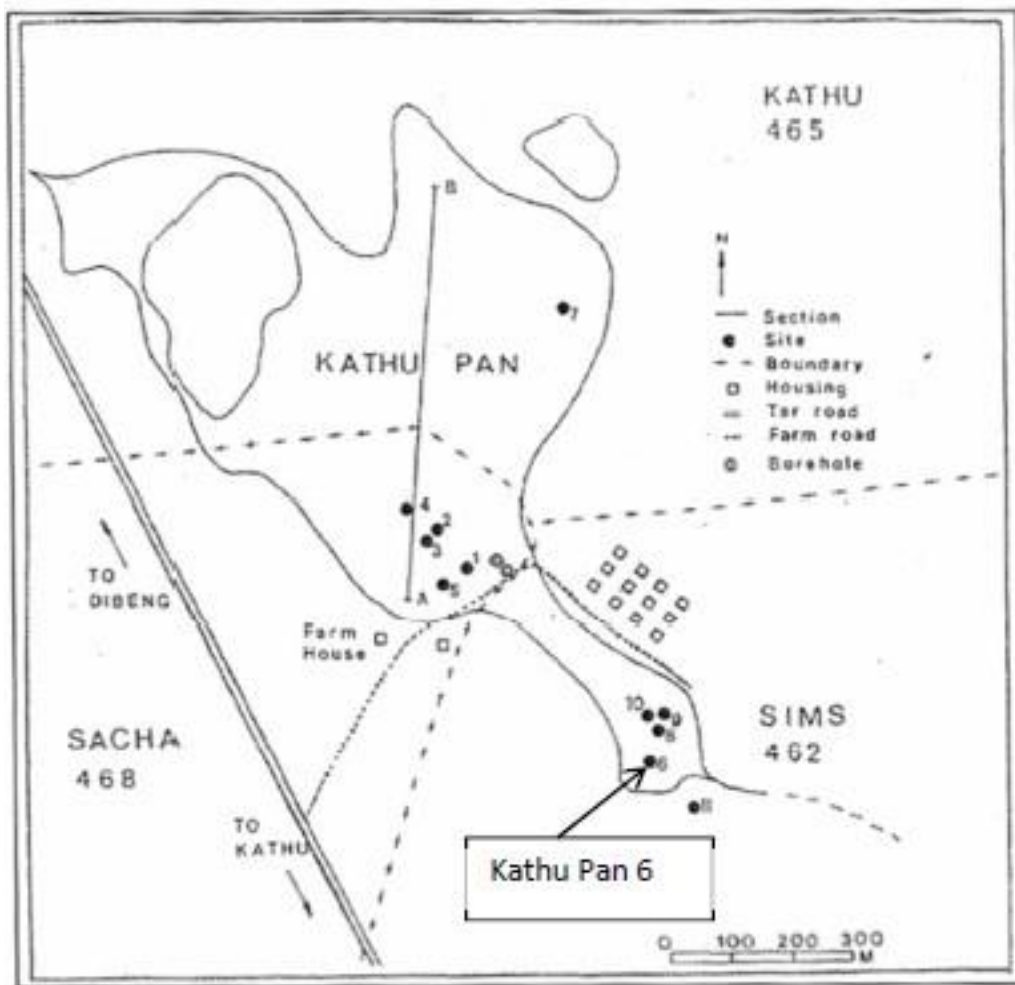


Figure 2: Map showing Kathu Pan and all the 11 sites, with the location of Kathu Pan 6 highlighted. Adapted from Beaumont 1990.

Beaumont (1990) described the lithostratigraphy at KP6 which included six strata each with very distinctive characteristics (Figure 3). Stratum 1 contains grey silty sands that is 1.5m deep. Stratum 2 has been measured 0.45m of soft calcrete with a relatively hard upper surface. Stratum 3 is approximately 0.6m of lightly calcified pale grey sand. Stratum 4 contains 0.15m

of grey-black peat and deep grey sand that progressively becomes paler and more calcified the deeper one goes. Stratum 5 contains about 0.65m of grey sand and becomes paler with depth. The last stratum, stratum 6 is measured at 2.3 m of calcified orange sand.

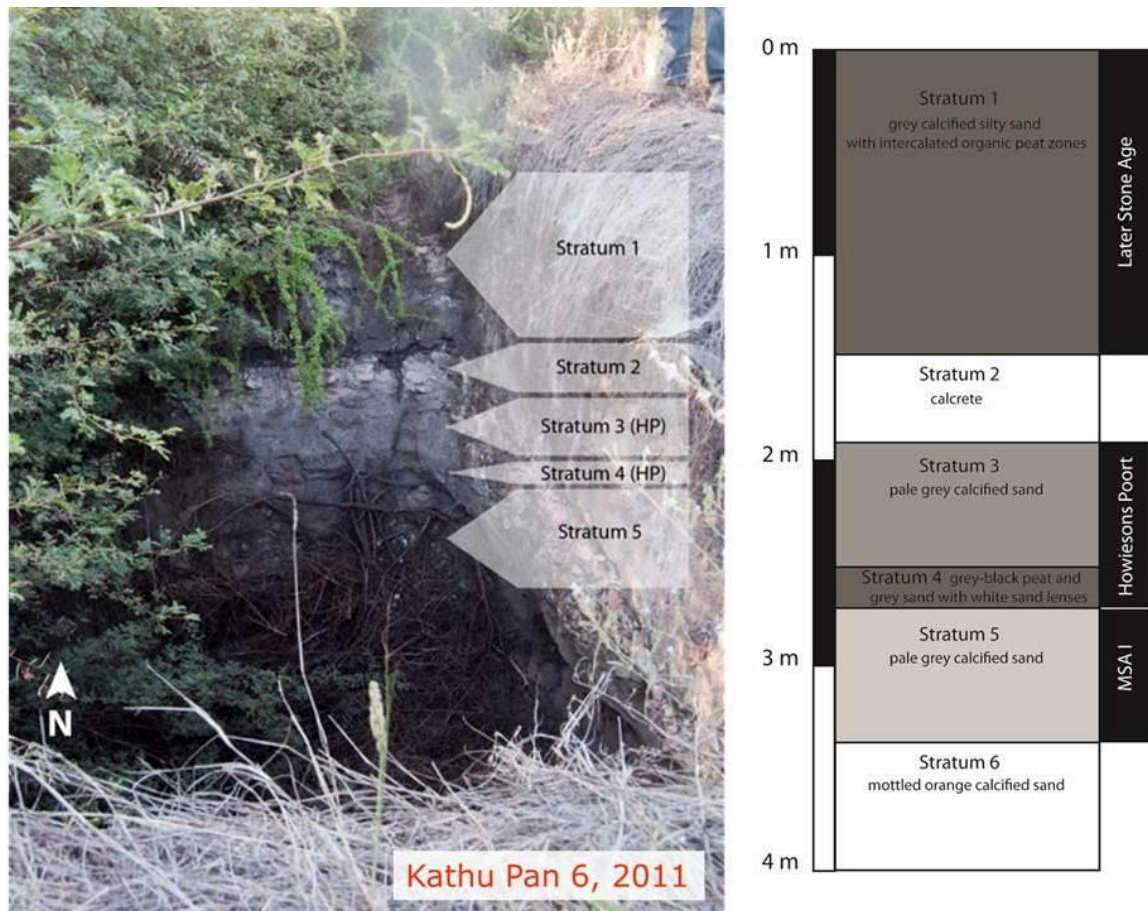


Figure 3: Photograph of KP6 stratigraphy (left) and diagram of KP6 stratigraphy (right) based on Beaumont (1990). From Mdludlu (2015).

Beaumont (1990, 2004) identified lithic artefacts found in strata 3 and 4 at KP6 as HP based on the discovery of artefacts such as blades and a segment.

Some hypotheses have been put forth about the paleoenvironmental factors that caused the formation of the strata seen at KP6. Beaumont (1990) describes the strata as 6 being the bedrock and 1 being the top of the formation. Stratum 6 contains a doline which was formed by calcified aeolian deposits which may have occurred during a period of rainfall that was lower than the

present. The doline was filled partially and yet in a quick fashion by oxidized orange sands. All of the peat found at KP is considered to be the result of the mean annual position of the water-table however it may seem that stratum 4 peat was formed in a much drier period as compared to the peat in found in stratum 1. When stratum 2 is compared to 1 and 3 it becomes increasingly evident that there was an extended period of time where the ground surface was static and the mean annual evaporation was much greater than mean annual precipitation. In stratum 1 the peat found there is highly organic which is indicative of a much wetter climate as compared to the present climate. Despite KP being a dry savannah landscape today, it may have been wetter in the past, and it may have been attractive to hunter-gatherer groups in dry periods due to the water-table access there.

Kathu Pan has historically been a transient source of water and has likely gone through several drying spells as well as increased rainfall causing in full sediment saturation (Lukich et al., 2019). Recently however, the extensive pumping by the increasing mining activity around the locale pan itself over the last 30 years has caused a rapid decrease in the groundwater table and subsequently caused the sinkhole formation we see at the site today (Lukich et al., 2019). The formation of these sinkholes exposed valuable archaeological material that would have been otherwise hidden (Lukich et al., 2019).

In previous studies of the KP6 HP lithic assemblage, researchers quantitatively analyzed and compared this HP to Rose Cottage Cave HP, Sibudu HP and Klipdrift Rock Shelter HP assemblages (Makalima et al., 2017). They evaluated the appropriateness of assigning this KP6 lithic assemblage the HP designation and subsequently investigated inter-site variability by comparing this site to the above mentioned well established HP sites (Makalima et al., 2017). The researchers found that while the KP6 HP assemblage shares key characteristics with typical HP assemblages, it also exhibits important differences when compared to these three HP assemblages (Makalima et al., 2017). The KP6 HP assemblage differed from each site in different ways and researchers concluded that more studies of this kind should be conducted in order to better understand the variability observed (Makalima et al., 2017).

Based on previous studies, the dominant raw material in the KP6 HP assemblage is banded ironstone formation (BIF) with low frequencies of quartz, quartzite and volcanic materials (cite Beaumont, 2004; Makalima et al., 2017). BIF is a sedimentary rock consisting of layered bands of chert and iron-rich magnetite or haemetite (Wilkins, 2017). The chert layers in the BIF are

according to Wilkins (2017), fine-grained and homogenous. BIF can be found in primary context in the Kuruman Hills east of Kathu Pan (Wilkins, 2017). The closest marked outcrop to Kathu Pan is the northernmost hills of the western flank of the Kuruman Hills 7.3 km away (Chazan et al., 2012). The archaeological site of Kathu Townlands 6.6 km away is located atop a BIF outcrop and the site has been interpreted as a quarry location based on the abundance of flaking debris (Beaumont, 2004; Walker et al., 2014). This site is the closest known primary source of BIF to Kathu Pan's cluster of archaeological sites (Wilkins, 2017).

The potential secondary sources of raw material for the KP6 are intermittent waterways in the form of streams and river beds around Kathu (Wilkins, 2017). Based on the evidence that the landscape around Kathu is relatively stable with little to no volcanic activity, one can sensibly assume that major drainage basins observed in the area today correspond with those major drainage basins during the early Middle Pleistocene, despite the exact location of streams and river beds not corresponding with those of the early Middle Pleistocene (Wilkins, 2017). Additionally, the presence of large cobbles indicates that there may have been occasional high energy transporters of raw material (Wilkins, 2017).

KP6 is considered to be an open-air site which was located close to a fresh water source described above by the Lukich et al., (2019) study and may have been occupied temporarily by those that produced the HP assemblage at this site. It may have been an extraction/kill site as the fauna they exploited may have congregated here. This is reflected in the kinds of tools found within this assemblage which is indicative of on-site reduction with a lower core to flake ratio and fewer retouched tools (Kuhn, 1994).

2.7.2 Pinnacle Point 5-6 (PP 5-6)

In this thesis, I will be comparing the KP6 lithic artefacts to the published data from three other HP assemblages, more specifically assemblages from coastal cave/ shelter sites. This will provide interesting similarities and contrasts of the lithic artifacts found at both sites and inform us about intra-HP variability due potentially to site function and geography. This will also help alleviate the lack of comparative studies mentioned a little earlier between open-air and coastal sites (HP sites). The first of which is Pinnacle Point 5-6. This site is on the south coast of South Africa in the Western Cape near Mossel Bay (Brown et al. 2012). It is a rockshelter in quartzitic cliffs, where the main deposit is referred to as the Long Section within PP5-6 North (Brown et

al. 2012). It is about 30 m cone of sediment built against a cliff face and partially under a rock shelter (Brown et al. 2012). The Long Section is an uninterrupted 13.4 m section of exposed and excavated MSA deposit, and is divided into 7 stratigraphic units (Brown et al. 2012). The HP material can be found in the Dark Brown Compact Sand (DBCS) and this unit is dated using OSL methods between 58 ± 4 ka and 65 ± 4 ka (Brown et al., 2012).

During the HP occupation of PP5-6, the site itself was usually far from the coastline with mean distances ranging from a modelled minimum of 1.1 km and the maximum 20.7 km (Karkanas et al., 2015). An increase in summer rains followed by an increase in C4 grasses during MIS 4 saw a potential ungulate faunal community appear on the exposed Palaeo Aghulus plain (Bar-Matthews et al., 2010; Copeland et al., 2016). These conditions during MIS 4 at PP5-6 may have influenced population growth, or longer intense site occupation and decreased residential mobility (Karkanas et al., 2015, Wilkins et al. 2017). . Researchers also associated MIS 4 at PP5-6 with increased use of quartz, increased evidence for earlier stages of reduction in silcrete, increased flaking efficiency in all raw material types and changes in tool types and function for silcrete (Wilkins et al., 2017).

In terms of site function, PP5-6 with the presence of extremely dense archaeological finds in the form of high lithic artefacts, faunal fragments, and firm dark layers composed of combusted material in the Dark Brown Compact Sand (DBCS) stratigraphic unit is evidence of a residential occupation (Brown et al, 2012).

The dominant raw materials at PP5-6 are as follows; silcrete (80%), quartzite (14%), quartz (2%) and chert (2%) (Brown et al. 2012). The silcrete found in and around PP5-6 was fine grained and of sufficient quality, once heated, for flaking. The closest known silcrete primary source to PP5-6 is located 8.5 km away and silcrete cobbles have also been regularly found at Dana Bay which is 5.4 km away from the site itself and considered a secondary source for raw material acquisition (Brown et al. 2012). The majority of lithic material made from quartzite at PP5-6 were made from Robberg quartzite which is considered to be fine grained as compared to the coarse quartzite found in the cobbles on Dana Bay (Brown et al. 2012). The closest primary source outcrop of flakeable quartzite for PP5-6 occurs 6.4 km to 8 km away from the site (Brown et al. 2012). The closest secondary source would be 5.4 km at Dana Bay in cobble form (Brown, 2011).

2.7.3 Klipdrift Rock Shelter (KDS)

The second site considered for comparison is Klipdrift Shelter (KDS). KDS is part of the Klipdrift Complex (KDC) (Figure 4) which is a major depository for Late and Terminal Pleistocene sediments and archaeological deposits which are visible both on the surface and in eroded sections (Henshilwood et al 2014). KDC (34°27'05.8"S 20°43'27.5"E) is situated in coastal cliffs 12-15m above from the Indian Ocean (Henshilwood et al 2014). The larger western cave is 21m deep and contains currently two sites namely Klipdrift Cave and Klipdrift Cave Lower (Henshilwood et al 2014). KDS is a 7m deep shelter separated from KDC and KDCL by a quartzite outcrop (Henshilwood et al., 2014).

KDS was first excavated in 2011 and was excavated again in 2012 and 2013 (Henshilwood et al 2014). In its entirety the volume of 2.3 cubic meters over an area of 6.75 square meters has been excavated at KDS to depths from 30 cm to 100 cm (in individual quadrates) (Henshilwood et al 2014). The youngest and uppermost dated layer produced an optically stimulated luminescence (OSL) date of 51.7 ± 3.3 ka, the middle layer and most relevant to this thesis because it contains the HP assemblage, produced OSL dates of from 65.5 ± 4.8 ka and 59.4 ± 4.6 ka (Henshilwood et al 2014).

The HP layers correspond to the latter part of Marine Isotope Stage 4 (MIS 4). Chase (2010) & Stuut et al. (2004) have argued that the shifting westerly storm-cycle during glacial periods may have developed wetter conditions during MIS 4 as compared to the more arid MIS 3. Bar-Matthews et al. (2010) have also argued that glacial periods along the southern Cape near Pinnacle Point were characterized by more frequent summer rain and an expansion of C4 grasses. Ungulate indices point to significant variation in paleoenvironmental conditions during the HP at KDS (Reynard et al., 2016). Evidence of eland and alcelaphines in the oldest HP layer implies an open to mixed terrain (Reynard et al., 2016). The presence of size 1 bovids, hyrax and tortoise found in a younger layer of HP just above the oldest suggest a change in paleoenvironment to a more closed and bushy terrain (Reynard et al., 2016). The prevalence of equid and alcelaphines in the intermediate layers of HP imply a grass dominated terrain in these layers (Reynard et al., 2016). Evidence of cape dune mole rat in the youngest layers of HP

suggest an expansion of dune or sea-sand during this particular time at KDS (Reynard et al., 2016).

In terms of site function, KDS has been interpreted to have been a residential site where the fauna they exploited were dismembered and consumed, shellfish were collected, extensive use of a variety of ochre types and the use and consumption of ostrich eggs are all common throughout the HP layers (Reynard et al, 2016).

The dominant raw materials at KDS during the HP period are as follows; silcrete (29%), coarse quartzite (33%) and milky quartz (33%) (Douze et al, 2018). The milky quartz at KDS is highly homogenous in structure and is considered fine-grained (Douze et al, 2018). The source for the milky quartz is located within the vicinity of the shelter. The coarse quartzite corresponds better with the quartzite found in the shelter walls and as compared to the fine-grained quartzite cobbles available/seen on the beach below the shelter (Douze et al, 2018). However, the cobbles exclusively selected for blade production were almost all fine-grained quartzite presumably brought in from the beach (Douze et al, 2018). The silcrete is also considered fine grained and was said to have been sourced near rocky hills where silcrete outcrops occur, within a 10 km radius of the shelter (Douze et al, 2018). These cobbles do not occur anywhere else nearer to the site itself so that may suggest that it was also brought in by the knappers.

2.7.4 Klasies River Mouth Cave 1A

The third and final HP coastal site in this comparative study is Klasies River Mouth Cave 1A. It is located in the Eastern Cape Province in South Africa, (34°, 06' S, 24°, 24' E) and is a series of coastal caves numbered 1 through 5 with the main site of interest being Cave 1A (Villa et. al., 2010). The main site is well-stratified with 20 m of deposit banked against a quartzite cliff and filling cave openings in the cliff labelled Caves 1, 1A, 1B, 1C and 2 (Villa et. al., 2010). Cave 1A was comprehensively excavated in 1967-1968 by Singer and Wymer and the material coming from this excavation are stored in the collections at Iziko Museums in Cape Town. It has since been excavated, dated and stratigraphically analysed in even more detail by Hilary Deacon between 1984 and 1996, and since 1997, Sarah Wurz (Deacon, 1995b, 2001; Deacon and Geleijnse, 1988; Deacon and Wurz, 2001; Feathers, 2002; Grine et

al., 1998; Grun et al., 1990; Rightmire and Deacon, 2001; Tribolo et al., 2005; Wurz, 1997, 1999, 2000, 2002).

In 2009, Villa et. al analysed the lithic artefacts from the Howiesons Poort (HP) and the MSA III excavated by the above mentioned Singer and Wymer in Cave 1A and by Hilary Deacon in squares adjoining the initial cutting of Singer and Wymer (Villa et. al., 2009). According to Villa et. al. (2009) Deacon's debitage material allowed them to study in greater detail the core and blade production of the HP and the MSA III which was preceded by the research done by Sarah Wurz (1997, 1999, 2000, and 2002) at Klasies. Tribolo et. al. (2005a,b) presented 13 ages of burnt stones selected throughout the HP layers in Cave 1A at Klasies where the individual thermo-luminescence (TL) age estimates range between 50 ± 4 and 62 ± 7 ka with a weighted mean of 56 ± 3 ka (Tribolo et. al., 2006). According to Feathers (2002), OSL samples taken from the same layer give a 55-60 ka range for the date of HP which correlates with the TL age for the same layer.

The HP stratigraphic levels in Cave 1A are divided into three subunits; Lower, Middle and Upper, based on the consideration of the technological changes or appearance of new elements (Villa et. al., 2010). The HP lithic assemblage here is dominated by a single type of product; blades (Villa et. al., 2010). In the Lower HP layer blades and blade fragments represent about 77.7% of the sample and blade and bladelet cores are the most frequent (Villa et. al., 2009). However, a particular number of cores show only flake removals which may imply an independent production strategy (Villa et. al., 2010).

Paleoenvironmental studies conducted by Reynard et al (2020) at KRM during the HP period found that there was an increase in grazing ungulates from the MSA II to the HP suggesting a more open environment during certain periods of the HP. This claim is supported by the decrease in the frequency of micromammals which indicate closed environments and the abundance of large bovid such as eland, buffalo in the Singer-Wymer samples (Reynard et al., 2020).

Micromammal data and sea surface temperatures (SST) models indicate that this period may have been cooler than MSA II period (Thackeray, 1987; Ninnemann et al., 1999; Bard et al., 2009; Braun et al., 2019). Some researchers have argued that conditions during MIS 4 in this region may have been more humid due to the influence of the warmer southern Indian Ocean SST and the effects of westerly storm fronts (Avery, 1983; Deacon, 1989). This claim is

supported by data from marine core evidence which shows much wetter conditions in the Eastern Cape around the same period with arid events interspersed in between (Simon et al., 2015; Ziegler et al., 2013).

In terms of site function, KRM is said to have been a residential site where during the Deacon (1989, 1995b) excavations of Cave 1A, the HP layers show evidence of a domestic space with ash lenses carbonized hearths and thin layers of plant food debris burnt into and carbonized in the aforementioned hearths.

The dominant raw material at KRM Cave 1A during the HP period is quartzite (73%), silcrete, quartz, hornfels and chalcedony make up 27% of the remainder of the assemblage (Wurz, 1999). The quartzite at KRM is found in abundance in the form of cobbles on the adjacent beach (Villa et al, 2010). This is considered as the secondary source and the primary source is thought to be a weathered terrace 30 km upstream from the site itself (Villa et al, 2010). The primary and secondary source of the silcrete at KRM is not known however, the silcrete found here is described as fine-grained which is good knapping quality when heated and is the second most frequent raw material exploited by the knappers (Villa et al, 2010). The coarse silcrete which is of low knapping quality is never common throughout the KRM assemblage (Villa et al, 2010).

Chapter 3: Methods

The KP6 material that is analysed and presented here was found within stratum 3 and 4 from various levels more specifically; levels 1 through 6 in stratum 3 and levels 1 and 2 in stratum 4 in square B6. These levels contain lithic material found during Beaumont's excavation of KP6. These levels all contain Howieson's Poort lithic artifacts, hence they underwent a sample analysis. As a result, I focused my attention on the lithic material found in these strata and levels and I did not analyze materials such as ochre, ostrich eggshell, bone and tooth fragment as this thesis focuses on lithic analysis only.

All the material coming from KP6 had been marked in order to indicate the stratum and level from which it came. The marked material analyzed by several analysts since 2014 (Mdludlu, 2014; Makalima 2016; Matlhoko, 2016) has been collected and compiled into a database to which I contributed and used in this study. The methodology applied here includes qualitative and quantitative observations where one can identify the shape, typological assignment and metrical properties of the stone tools in question.

For collecting data from the lithic material I have used the Pinnacle Point 5-6 Lithic Analytical Methods (Wilkins et al. 2017). More specifically, this method provides trait definitions which have been collected from the analysis of the Pinnacle Point 5-6 North Long Section in order for them to be compiled in a coding scheme. The contributors to this compilation are Jayne Wilkins, Kyle S. Brown, Simoen Oestmo, Telmo Pereira, Kathryn Ranhorn, Benjamin J. Schoville and Curtis W. Marean which is used in conjunction with the open-source E4 data entry program designed by Shannon McPherron and Harold Dibble. Using the E4 codes concurrently with the compiled trait definitions allows for the recording of the lithic morphology and the detail of their current state with very little transcription error and efficacy.

During this process I assigned to each piece of lithic its own unique identity number which makes for efficient referencing . The key categories that were set up for the analysis of the KP6 samples are raw material and lithic artifact class. These two main characteristics allow

for the identification of discrete features attributed to HP tools in general. The typical raw materials found in the Northern Cape area are banded ironstone, chalcedony, quartz, chert and a small amount of other raw material types. As a result, these raw materials eventually give rise to the production of stone tools of a particular lithic artifact class. The lithic artifact classes are as follows; complete flakes/flake fragments, blades/blade fragments, cores, retouched pieces and shatter pieces. More specifically, the retouched pieces include sub-classes namely, backed pieces, points, burinated and truncated pieces.

Additionally, there are subcategories associated with the key categories to allow for recording of fundamental details of the stone artifact in question. These subcategories include completeness, evidence of bipolar percussion, cortex shatter, evidence of post-depositional burning, dorsal scar count, profile shape, flake termination type, platform preparation and delineation as defined by Soriano and Villa et al. (2007), diagnostic fractures as defined by (Fischer, Vemming Hansen et al. 1984), banding orientation (if any) as defined by (Wilkins, 2017), mass and other metric properties.

As mentioned earlier, I compared the KP6 HP assemblage to several other well established HP sites in Southern Africa. To do this, I have extracted the relevant data from various publications that represent the afore mentioned HP sites. Specific qualitative and quantitative data were thus extracted from these publications. Core orientation, core management, late and early debitage exploitation are examples of qualitative data that were extracted, platform treatment, external platform angle, platform thickness, maximum length to maximum width ratio, profile, maximum width to maximum thickness ratio and flake to blade ratio are examples of quantitative data that were extracted although unfortunately, not all this data was made available in these publications, enough was available for statistical comparisons to be made between assemblages.

The PP5-6 information was extracted from material given to me by Dr Jayne Wilkins. The HP material was found in the DBCS layer at PP5-6 (Brown et al., 2012). The lithic analysis on the PP5-6 HP assemblage did not have a 20 mm cut off and thus all the KP6 HP data was used for the comparison between the two assemblages. Lateral edges, cross section and distal terminus were all unavailable variables and were thus excluded from the comparison. Flake/blade ratio, blade core/all core ratio, backed piece frequency and backed piece

distribution were again considered as viable variables as they capture typical characteristics of an HP assemblage.

The data for the KDS HP assemblage was extracted from : Henshilwood et al.(2014) and Douze et al. (2018) coming from the following layers (from lowest level): PCA, PBE, PBD, PBC, PBA/PBB, PAZ, PAY (Henshilwood et al., 2014; Douze et al., 2018). The lithic analysis for the KDS HP material only considered pieces larger than 20 mm, however they considered and analyzed retouched pieces and bladelets <20 mm. This meant for the comparison to be valid, I excluded any pieces below 20 mm from the KP6 HP data set during the blank production comparison between the two assemblages. I did however include all the KP6 data during the toolkit morphology comparison due to there being no cut offs for retouched pieces and bladelets at KDS. As I have previously stated, not all information was made available through these publications, therefore some variables were excluded during the comparison between KP6 and KDS assemblages. Platform treatment, lateral edges, cross-section and distal terminus were all unavailable variables and were thus excluded from the comparison. Flake/blade ratio blade core/all core ratio, backed piece frequency and backed piece distribution were considered instead as viable variables as they capture typical characteristics of an HP assemblage.

The information for the KRM Cave 1A was extracted from the following publications; Wurz, , (1999, 2000); Villa et al., (2010). I strictly extracted data from the Deacon-sample (D-Sample) excavations of Cave 1A. The HP material at KRM Cave 1A came from the following layers (From the lowest level): J51YSX1 – J51YSX6, H51CP6 – J51CPX1, H51YS1- H51CP5/YS5, E50CP5 – E50CP18 and E50CP5 – E50CP11 (E50, H51 and J51 are the square names) (Wurz, 2000). The lithic analysis for the KRM Cave 1A HP did not have a 20 mm cut off and thus all KP6 HP data were used for the comparison between the two assemblages. Lateral edges, cross section, distal terminus and profile (Toolkit morphology) were all unavailable variables and were thus excluded from the comparison. Flake/blade ratio, blade core/all core ratio, backed piece frequency and backed piece distribution were again considered as viable variables as they capture typical characteristics of an HP assemblage.

The above mentioned qualitative and quantitative traits were compared between sites using the approach outlined by Tostevin (2011b, 2012). These domains are: Core Modification, Platform Maintenance, Direction of Core Exploitation, Dorsal Convexity System and Toolkit Morphology. Data extracted from the various publications were guided by these domains and were thus used during my statistical tests between KP6 and various HP assemblages in southern Africa.

Following Tostevin (2011b, 2012), the statistical comparisons or tests that I conducted here were t-tests for metric data and Chi^2 for categorical data. Significantly different variables within each domain between KP6's assemblage and the other HP assemblages in question were summed within each domain and then divided by the number of variables within each domain in order to report the degree of difference of the individuals knapping within each domain. A higher value means more difference. Thus, the maximum difference in blank production between assemblages is therefore the number of domains which is 4.0.

Chapter 4: Results

4.1 Overview of the KP6 HP Assemblage

The sample analyzed from the Kathu Pan 6 HP assemblage consists of 2194 pieces of lithic material, the vast majority of which were made from banded ironstone formation (BIF) followed by black tuff, quartz, quartzite and volcanic. The majority of cores were reduced using the Levallois core reduction technique. The majority of retouch tool types that were identified were minimally retouched pieces followed by backed pieces, side scarpers and other tool types which will further be illustrated by the Tostevinian toolkit morphology table later in this chapter.

As stated above the majority of lithic material found in the Kathu Pan 6 assemblage are made from the banded ironstone formation followed by various other raw materials. This is substantiated by the Wilkins & Chazan 2012 & Wilkins 2017 publications which focused on the lithic raw material foraging strategies at Kathu Pan 1. Both publications identified potential primary and secondary sources for the raw materials used for lithic reduction at both sites. They found that the BIF was the closest and most readily available raw material source for that area and this correlates with what we see at Kathu Pan 6. The closest identified BIF outcrop is around 7 km east of Kathu Pan 1 which is in the same cluster of sites as Kathu Pan 6 (Wilkins, 2017). To be more specific 84.53 % of the lithic material found in the Kathu Pan 6 assemblage was made from the BIF, 7.29 % Galaxy Tuff, 1.64 % Quartz, 1.93 % Calcedony, 1.34 % Quartzite, 0.45 % Volcanic, 0.25 % Silcrete and 2.58 % Other material.

The majority of cores identified in the Kathu Pan 6 assemblage were reduced using the Levallois core reduction technique. This is indicative of the extensive preparation of the cores for blank production. However, there are 8 cores out of the 30 that were identified as blade cores. In terms of core management, the cores found in this assemblage were not maintained

with second generation crested flakes as these blade types cannot be found in this particular assemblage. Instead, *debertant* flakes and blades are present within this assemblage.

Bidirectional dorsal scars occur on the on the bigger flakes/blades, and both unidirectional and bidirectional dorsal scars occur on the smaller flakes and blades indicating a shift from bidirectional to unidirectional as reduction proceeds.

The most abundant retouched tool type in this assemblage is that of minimally retouched pieces. These make up 40.00% of the retouched tool types in the assemblage, followed by backed pieces which make up 22.85% of the tool types, side scrapers 17.14%, notched pieces 11.43%, retouched points 5.71% and *pieces esquillees* 2.86%.

4.2 Inter-site comparisons

4.2.1 Pinnacle Point 5-6 (KP6 v PP 5-6)

Statistical comparisons, qualitative and their outcomes according to Tostevin's Flint Knapping Domains between KP6 and PP5-6 are shown in (Table 1, Table 2). The domains are split into four and are represented by Core Modification, Platform Maintenance, Direction of Core Exploitation and the Dorsal Surface Convexity System. The standout differences between the two sites are as follows; the core orientation at PP5-6 shows a use of both Levallois and Narrow Longitudinal Surface removals compared to the Levallois removals at KP6. The platform angle is another difference with statistical significance where the mean external platform angle at PP5-6 is steeper than that of KP5-6. The direction of core exploitation particular with early debitage exploitation is unidirectional at PP5-6 and bidirectional at KP6. Under the dorsal convexity system, the profile at PP5-6 is mostly curved whereas at KP6 it is mostly straight and this difference is statistically significant. The flake/blade ratio at PP5-6 is 2.93 and at KP6 it is 1.34, this difference is statistically significant. Blades are relatively more frequent at KP6 (Figure 4).

Table 1: Pair-Wise Comparison of Blank Production Choices according to Tostevin’s Flint Knapping Domains between KP6 and PP5-6 are shown in the table below. Significant results are indicated in bold.

Flintknapping Steps by Domain	Kathu Pan 6	Pinnacle Point 5-6
Domain 1: Core Modification		
Core Orientation	Use of Levallois	Use of Levallois and Narrow Longitudinal Surface
Core Management	Debordant	Debordant
Number of Differences/2 Steps		1/2 = 0.5
Domain 2: Platform Maintenance		
Platform Treatment	Unprepared: 50.31% Prepared: 49.69% n: 487	Unprepared: 54.77% Prepared: 45.23% n: 199 p= 0.67 Fisher’s Exact
External Platform Angle	mean: 83.43 s.d: 17.66 n: 46	mean: 73.66 s.d: 11.67 n: 310 p= <0.0001 t= 17.54 df= 354
Platform Thickness	mean: 3.66 s.d: 2.08 n: 60 n: 50	mean:4.21 s.d: 16.71 n: 856 p= 0.30 t= -1.04 df= 914
Number of Differences/3 Steps		1/3 = 0.33

Table 2: Pair-Wise Comparison of Blank Production according to Tostevin’s Flint Knapping Domains between KP6 and PP5-6 continued are shown in the table below. Significant results are indicated in bold.

	Kathu Pan 6	Pinnacle Point 5-6
Domain 3: Direction of Core Exploitation		
Early Debitage Exploitation	Bidirectional	Unidirectional
Late Debitage Exploitation	Bidirectional & Unidirectional	Unidirectional
Number of Differences/2 Steps		½ = 0.5
Domain 4: Dorsal Surface Convexity System		
Length/Width Ratio	mean: 1.57 s.d: 0.95 n: 123	mean: 1.70 s.d: 1.58 n: 605 p= 0.28 t= -1.08 df= 726
Profile	Straight: 58.53% Curved: 28.05% Twisted: 13.40% n: 82	Straight: 32.79% Curved: 54.10% Twisted: 13.11% n: 361 p= <0.0001 Chi² = 15.755 df= 2
Width/Thickness Ratio	mean: 3.61 s.d: 2.24 n: 224	mean: 3.65 s.d: 1.56 n: 767 p= 0.69 t= -11.13 df= 989
Flake/Blade Ratio	Flakes: 1009 Blades: 751 Ratio: 1.34	Flakes: 1218 Blades: 416 Ratio: 2.93 p= <0.0001 Chi²= 111.26 df = 1
Blade Core/All Core Ratio	Blade Cores: 8 All Cores: 30 Blade Core Percentage: 26.67%	Blade Cores: 3 All Cores: 24 Blade Core Percentage: 12.50% p= 0.29
Number of Differences/5 Steps		2/5= 0.4

The total difference across the 4 domains of behavior in blank production is 1.9 out of 4.0 (47.50 %). This value is the lowest out of the three comparisons with regards to blank production.

The Toolkit Morphology table below (Table 3), illustrates statistical comparisons and their outcomes between KP6 and PP5-6, the only major difference we see here is the backed piece frequency. KP6 has a higher percentage of backed pieces as compared to PP5-6 and this difference is statistically significant and is illustrated in (Figure 5) below.

Table 3: Pair-Wise Comparison of Toolkit Morphologies between KP6 and PP5-6 are shown in the table below. Significant results are indicated in bold.

	Kathu Pan 6	Pinnacle Point 5-6
Length/Width Ratio	mean: 1.83 s.d: 0.66 n: 11	mean: 1.87 s.d: 0.69 n: 48 p= 0.89 t= -0.15 df= 57
Width/Thickness Ratio	mean: 3.10 s.d: 0.85 n: 14	mean: 3.24 s.d: 1.06 n: 18 p= 0.62 t= -0.50 df= 30
Backed Piece Frequency	Backed Piece: 22.85% Minimally Retouched: 40.00% Notched Piece: 11.43% Retouched Point: 5.71% Side Scrapers: 17.14% PiecesEsquillees: 2.86% End Scrapers: 0.00% n: 35	Backed Piece: 16.54% Minimally Retouched: 46.62% Notched Piece: 30.08% Retouched Point: 0.00% Side Scrapers: 0.75% PiecesEsquillees: 2.86% End Scrapers: 0.75% n: 133 p = <0.0001 Chi² = 32.132 df = 5
Retouch Flake/Blade Ratio	Flake: 31.04% Blade: 68.97% n: 29	Flake: 30.65% Blade: 69.35% n: 124 p= 0.99 Fisher's Exact
Backed Piece Distribution	Completely Backed: 50.00% Partially Backed: 50.00% n: 4	Completely Backed: 42.86% Partially Backed: 57.14% n: 14 p= 0.57 Fisher's Exact
Profile	Straight: 41.67% Flat: 58.33% Curved: 0.00%	Straight: 31,25% Flat: 50,00% Curved: 18,75% p= <0.0001 Chi²= 19.98 df= 2
Number of Differences/6 Steps		2/6 = 0.33

The total number of differences in toolkit morphology between the two assemblages is 2.0 out of 6.0 (33.00 %). This value illustrates that while there are some differences between the two assemblages, the similarities outweigh the dissimilarities and thus the toolkit morphology at KP6 when compared to PP5-6 is quite similar behavior wise.

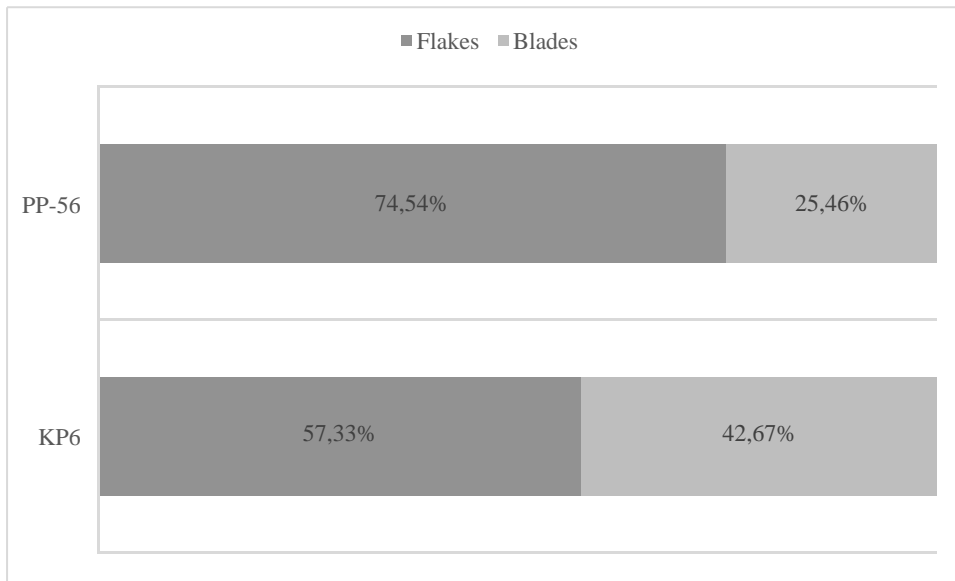


Figure 4: Bar graph illustrating flake and blade frequencies in Kathu Pan 6 and Pinnacle Point 5-6 HP assemblages



Figure 5: Bar graph illustrating retouched tool frequencies in Kathu Pan 6 and Pinnacle Point 5-6 HP assemblages.

4.2.2 Klipdrift Rock Shelter (KP6 v KDS)

Statistical comparisons, qualitative comparisons and their outcomes according to Tostevin's Flint Knapping Domains between KP6 and KDS are shown in (Table 4, Table 5). The domains are again split into four and remain the same as the (Table 1, Table 2. The difference here however, is that an adjustment had to be made to the pieces that were compared to KDS as the researchers there had minimum size cut offs of 20 mm. This means we could only compare pieces above that threshold. The standout differences between KP6 and KDS are as follows; KDS has a higher length/width ratio as compared to KP6 and this difference was found to be statistically significant. (Note: at KDS only the blades were measured when they calculated the length/blade ratio thus I only included the blades within this comparison. This was also done for the width/thickness variable). KDS has a lower width/thickness compared to KP6 and this difference is statistically significant. KDS has a higher flake/blade ratio compared to KP6 this difference is statistically significant and is illustrated in (Figure 6) below.

Table 4: Pair-Wise Comparison of Blank Production according to Tostevin's Flint Knapping Domains between KP6 and KDS are shown in the table below. Significant results are indicated in bold.

Flintknapping Steps by Domain	Kathu Pan 6	Klipdrift Rock Shelter
Domain 1: Core Modification		
Core Orientation	Use of Levallois	Use of Levallois & Blade/Bladelet unidirectional cores
Core Management	Debordant	Debordant
Number of Differences/2 Steps		½ = 0.5
Domain 2: Platform Maintenance		
External Platform Angle	>=20 mm cut off: mean: 83.71 s.d: 18.80 n: 35	<90 (Douze et. al. 2018)
Platform Thickness	>=20 mm cut off: mean: 3.95 s.d: 2.09 n: 40	Relatively thin platforms (Douze et. al. 2018)
Number of Differences/2 Steps		½ = 0.5

Table 5: Pair-Wise Comparison of Blank Production according to Tostevin's Flint Knapping Domains between KP6 and KDS continued are shown in the table below. Significant results are indicated in bold.

	Kathu Pan 6	Klipdrift Rock Shelter
Domain 3: Direction of Core Exploitation		
Early Debitage Exploitation	Bidirectional & Unidirectional	Unidirectional
Late Debitage Exploitation	Bidirectional & Unidirectional	Unidirectional
Number of Differences/2 Steps		½ = 0.5
Domain 4: Dorsal Surface Convexity System		
Length/Width Ratio	>=20 mm cut off Blades Only mean: 1.93 s.d: 0.64 n: 25	mean: 2.32 s.d: 0.20 n: 398 p= <0.0001 t= -3,99 df= 421
Width/Thickness Ratio	>=20 mm cut off: Blades Only mean: 3.15 s.d: 1.49 n: 25	mean: 2.76 s.d: 0.32 n: 398 p= 0.003 t= 3.04 df=4213
Flake/Blade Ratio	>=20 mm cut off: Flakes: 288 Blades: 163 Ratio: 1.77	Flakes: 6460 Blades: 2279 Ratio:2.83 p= <0.0001 Chi²= 36.525 df = 1
Blade Core/All Core Ratio	>=20 mm cut off: Blade Cores: 7 All Cores: 29 Blade Core Percentage: 24.14%	Blade Core: 26 All Cores: 203 Blade Core Percentage: 13.00% p= 0.17 Chi²= 1.87 df = 1
Number of Differences/4 Steps		¾ = 0.75

The total difference across the 4 domains of behavior in blank production is 2.25 out of a possible 4.0 (56.25 %). This value slightly higher than that of PP5-6 v KP6.

The Toolkit Morphology table below (Table 6) shows statistical comparisons and their outcomes between KP6 and KDS. As I have stated in the methods section, some variables were unavailable in the KDS publications and therefore some comparisons were excluded. I then introduced backed piece frequency and backed piece distribution. These variables can tell us a lot more about the typical toolkit morphologies of HP assemblages.

Table 6: Pair-Wise Comparison of Toolkit morphologies between KP6 and KDS are shown in the table below. Significant results are indicated in bold.

	Kathu Pan 6	Klipdrift Rock Shelter
Backed Piece Frequency	Backed Piece: 22.85% Minimally Retouched: 40.00% Notched Piece: 11.43% Retouched Point: 5.71% Side Scrapers: 17.14% PiecesEsquillees: 2.86% End Scrapers: 0.00% n: 35	Backed Piece: 41.67% Minimally Retouch Notched Piece Retouche Side
Backed Piece Distribution	C	
Number o		

The total number of differences is 0. This illustrates how similar the tool kit morphologies in both KDS and KP6 HP assemblages are.

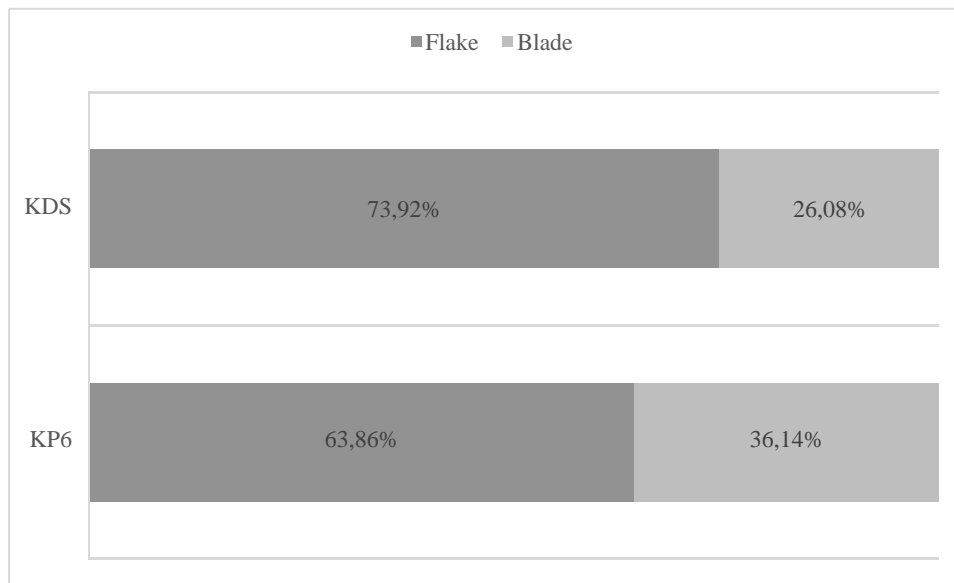


Figure 6: Flake/blade frequencies in the Kathu Pan 6 and Klipdrift Rock Shelter HP assemblages

Figure 7: Retouched tool frequencies in Kathu Pan 6 and Klipdrift Rock Shelter HP assemblages.

4.2.3 Klasies River Mouth Cave 1A (KP6 v KRM)

Statistical comparisons, qualitative comparisons and their outcomes according to Tostevin's Flint Knapping Domains between KP6 and KRM are shown in the tables below (Table 7, Table 8). The domains are again split into four and remain the same as the tables above (Table 1, Table 2). There were no observable size cut-offs for the analysis of KRM so the

data was not adjusted as with KDS. The standout differences are as follows; under the second domain, namely platform maintenance, KP6 has more prepared platforms compared to KRM and this difference is statistically significant. KRM has on average thicker platforms compared to KP6 and this difference is statistically significant. Under the fourth domain namely, the dorsal surface convexity system, the length/width ratio for KRM is higher compared to KP6 and this difference is statistically significant. KRM has a lower flake/blade ratio compared to KP6. Blades are more frequent at KRM (Figure 8).

Table 7: Pair-Wise Comparison of Blank Production between KP6 and KRM are shown in the table below. Significant results are indicated in bold

Flintknapping Steps by Domain	Kathu Pan 6	Klasies River Mouth
Domain 1: Core Modification		
Core Orientation	Use of Levallois	Use of Levallois & Blade/Bladelet unidirectional cores
Core Management	Debordant	Debordant
Number of Differences/2 Steps		½ = 0.5
Domain 2: Platform Maintenance		
Platform Treatment	Unprepared: 49.34% Prepared: 50.66% n: 302	Unprepared: 84.00% Prepared: 16.00% n: 383 p= <0.0001 Fisher's Exact (Wurz, 2000) Cave 1A
External Platform Angle	mean: 83.43 s.d: 17.66 n: 46	50-85
Platform Thickness	mean: 2.44 s.d: 1.75 n: 50	mean: 3.70 s.d: 2.3 n: 383 p = <0.0001 t = -5.60 df = 441 (Wurz, 2000) Cave 1A
Number of Differences/3 Steps		2/3 = 0.67

Table 8: Pair-Wise Comparison of Blank Production between KP6 and KRM continued are shown in the table below. Significant results are indicated in bold.

	Kathu Pan 6	Klasies River Mouth
Domain 3: Direction of Core Exploitation		
Early Debitage Exploitation	Bidirectional & Unidirectional	Unidirectional
Late Debitage Exploitation	Bidirectional & Unidirectional	Unidirectional
Number of Differences/2 Steps		½ = 0.5
Domain 4: Dorsal Surface Convexity System		
Length/Width Ratio	mean: 1.71 s.d: 0.55 n: 675	mean: 2.58 s.d: 16.44 n: 177 p= <0.0001 t= -5.26 df= 850
Profile	Straight: 51.11% Curved: 33.33% Twisted: 15.56% n: 45	Mostly straight (Villa et. al. 2010)
Width/Thickness Ratio	mean: 3.86 s.d: 1.68 n: 682	mean: 3.83 s.d: 5.32 n: 714 p= 0.77 t= 0.30 df=1394
Flake/Blade Ratio	Flakes: 1009 Blades:751 Ratio: 1.34	Flakes: 536 Blades: 614 Ratio: 0.87 p= <0.0001 Chi²= 32.1 df = 1 (Villa et. al. 2010)
Blade Core/All Core Ratio	Blade Cores: 8 All Cores: 30 Blade Core Percentage: 26.67%	Blade Core:223 All Cores: 507 Blade Core Percentage: 43.98% p= 0.21 Chi²= 1.55 df = 1
Number of Differences/5 Steps		2/5 = 0.4

The total difference across the 4 domains of behavior in blank production is 2.07 out of a possible 4.0 (51.75 %). This is slightly higher than the comparison between PP5-6 and KP6, and slightly lower than the previous comparison between KDS and KP6.

With regards to the Toolkit Morphology table below, which shows statistical comparisons and their outcomes between KP6 and KRM. The length/ratio for retouched tools is higher for KRM compared to KP6 and this difference is statistically significant. The width/thickness ratio in the KRM assemblage is higher than that of the KP6 assemblage and this difference is statistically significant. Finally, KRM has a higher backed piece frequency compared to KP6 and this difference is statistically significant and illustrated in (Figure 9).

Table 9: Pair-Wise Comparison of Toolkit Morphologies between KP6 and KRM are shown in the table below. Significant results are indicated in bold.

	KP6	Klasies River Mouth
Length/Width Ratio	mean: 1.83 s.d: 0.66 n: 11	mean: 2.66 s.d: 6.69 n: 630 p= 0.001 t= -1.06 df=639
Width/Thickness Ratio	mean: 3.10 s.d: 0.85 n: 14	mean: 3.46 s.d: 2.55 n: 828 p= 0.03 t= -0.95453 df= 840
Backed Piece Frequency	Backed Piece: 22.85% Minimally Retouched: 40.00% Notched Piece: 11.43% Retouched Point: 5.71% Side Scrapers: 17.14% PiecesEsquillees: 2.86% End Scrapers: 0.00% Burin: 0.00% n: 35	Backed Piece: 72.54% Minimally Retouched: 19.44% Notched Piece: 9.40% Retouched Point: 9.10% Side Scrapers: 0.60% PiecesEsquillees: 6.26% End Scrapers 2.08% Burin: 1.34% n: 670 p = <0.0001 Chi² = 44,483 df = 5
Backed Piece Distribution	Completely Backed: 50.00% Partially Backed: 50.00% n: 4	Completely Backed: 52.03% Partially Backed: 47.97% n: 763 p=0.78 Fisher's Exact
Number of Differences/4 Steps		3/4 = 0.5

The total number of differences in toolkit morphology between the two assemblages is 3.0 out of 4.0 (75.00 %). This is the highest out of the three comparisons and also indicates a significant difference between KP6 and KRM with regards to toolkit morphology.

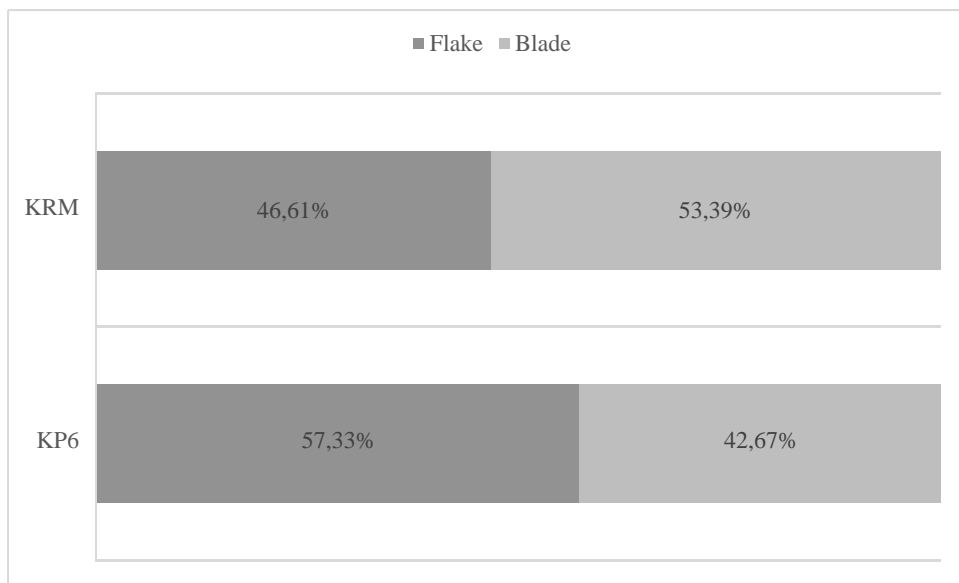


Figure 8: Flake and blade frequencies in the Kathu Pan 6 and Klasies River Mouth Cave 1A HP assemblages.

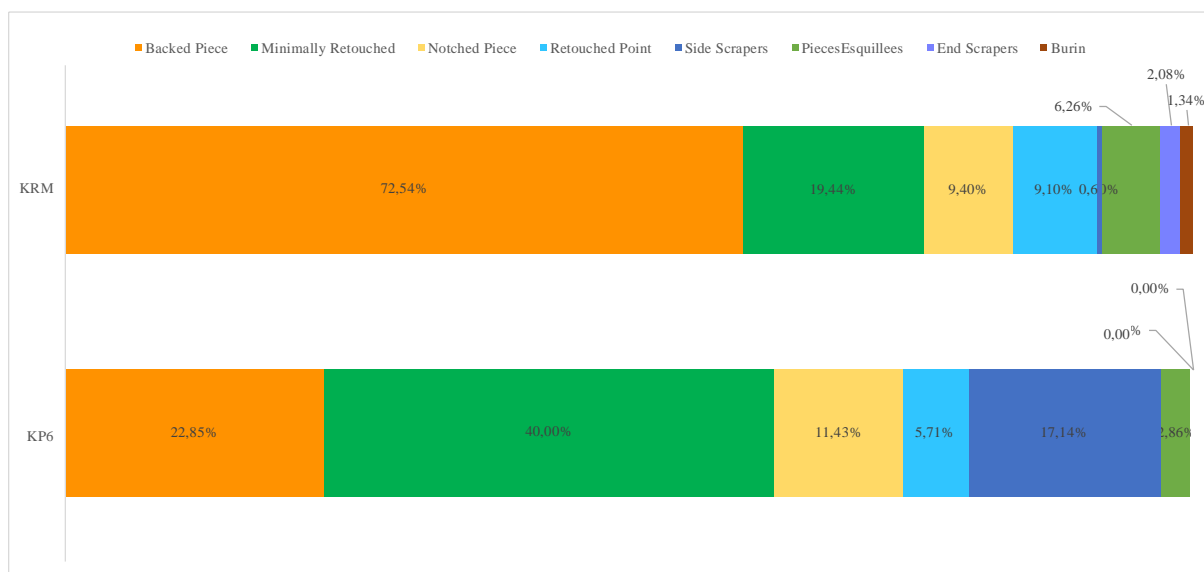


Figure 9: Retouched tool frequencies in the Kathu Pan 6 and Klasies River Mouth Cave 1A HP assemblages.

4.3 Summary:

The KP6 HP assemblage differs from each of the three coastal cave sites considered here (KDS, KRM, and PP5-6) in a different way. KP6 has higher relative blade and backed piece frequencies compared to PP5-6. KP6 has a higher relative blade frequency compared to KDS, but no observable differences in toolkit morphologies. KP6 has lower blade and backed piece frequencies compared to KRM. These differences are reflected in the total number of differences in each pair-wise comparison across both domains. KDS has the highest blank production difference value of 56.25 % and the lowest difference of 0.00 % with regards to toolkit morphologies. KRM has the highest toolkit morphology difference with a value of 75.00 % and PP5-6 has the lowest blank production difference value, 47.50 %. KDS is thus the most similar and KRM is the most different based on these values. Therefore, there is variability in differences when KP6 is compared to other HP assemblages.

Chapter 5: Discussion

5.1 The HP at Kathu Pan 6:

As mentioned earlier the lithic artifacts found in HP assemblages are well-known to have a range of innovative technological features such as blade/bladelet production through marginal percussion, the presence of backed tools and the selection of fine grained raw materials which includes the heat treatment of silcrete (Henshilwood, 2012, Wurz, 2013, Soriano et al, 2015, Delagnes, 2016). This makes the HP unique within the MSA. It was thought to have been a short lived cultural episode in the MSA, although it had techno-cultural characteristics that were widespread across southern Africa during the MIS 4 phase through to MIS 3 (Douze et al, 2018). The HP in southern Africa is generally dated between 80 000 to 60 000 years ago (Lombard, Wadley et al 2012). Although more recently, researchers at Diepkloof have placed their HP between 109 000 and 52 000 years ago (Porraz et al. 2013b; Tribolo et al. 2013).

The designation of HP to the KP6 lithic assemblage that was analyzed for this study is appropriate. The KP6 HP assemblage has relatively high frequencies of blades with a presence of backed pieces and small blades/bladelets made on mostly fine grained raw material banded ironstone (BIF). Additionally, the KP6 HP assemblage dates to between 100 ± 6 and 74 ± 5 ka which falls within the time period put forward by the researchers at Diepkloof (Lukich et al., 2019; Porraz et al. 2013b; Tribolo et al. 2013). KP6 does differ from other HP sites in that it is an open air non-coastal site that is located in an arid region. Many well-studied HP sites are rockshelter/cave sites located on the coast. My results show that the KP6 HP assemblage differs in various ways from those sites. In the following section I elaborate on this observation and possible reasons as to why.

5.2 How do core reduction strategies vary between HP sites:

5.2.1 KP6 v PP 5-6

In the results chapter the core reduction strategies reflected in the HP at PP5-6 were focused on the production of small blades, retouched into backed blade segments and notched pieces which are said to have been similar in length to other HP sites in southern Africa (Brown et al., 2012). The core orientation during reduction at PP5-6 is Levallois and the narrow longitudinal surface where the early and late debitage exploitation was predominantly unidirectional with an increase toward bidirectionally. KP6 HP core reduction strategies were also focused on the production of small blades and flakes, some retouch into backed pieces, notched pieces and side scrapers. The core orientation during reduction at KP6 is Levallois where the early debitage exploitation is bidirectional and the late debitage is both bi and unidirectional. The majority of blanks produced at PP5-6 have a curved profile, whereas at KP6 the majority of blanks produced have a straight profile. Lastly, KP6 has a lower flake-to-blade ratio as compared to PP5-6 i.e. KP6 has more blades per flake produced when compared to PP5-6

5.2.2 KP6 v KDS

The core reduction strategies reflected in the HP found at KDS were also focused on small blades, flakes, *Débordant* blades, and a few crested blades (Douze et. al., 2018). The core orientation during reduction at KDS is Levallois/blade core where the early and late debitage exploitation was predominantly unidirectional. The mean length-to-width ratio for KDS HP is higher when compared to KP6 HP. The mean width-to-thickness ratio is higher for KP6 HP when compared to KDS HP. Lastly, KP6 has a lower flake-to-blade ratio as compared to KDS i.e. KP6 has more blades per flake produced compared to KDS. The differences in blank production behaviour between KP6 and KDS are the highest of the three comparisons.

5.2.3 KP6 v KRM

The core reduction strategies reflected in the HP found at KRM (Cave 1A) were mostly focused on small blades and flakes (Villa et. al., 2009). The core orientation during reduction at KRM is mostly Levallois/blade core where the early and late debitage exploitation was predominantly unidirectional. The mean length-to-width ratio for KRM HP (Cave 1A) is

higher compared to KP6 HP. Additionally, KP6 has a higher flake-to-blade ratio when compared to KRM HP.

5.3 How do toolkits vary between HP sites:

In the background chapter, I point out that tool kit characterization of an assemblage requires its own domain of decisions which are enacted during the selection of blanks for inclusion into the tool kit which even include some pieces traditionally labelled as such despite the lack of retouch (Tostevin, 2011). The variables used in the toolkit morphology pair-wise table demonstrate toolkit choices reflected in the physical features of the tool shapes which are visible from a distance and likely affect the efficacy of the cutting edge (Carr, 1995; Tostevin, 2007, 2012; Tostevin et. al., 2006)

When I compare the KP6 HP toolkit to the PP5-6 HP, I find that the KP6 HP has a higher backed piece frequency than PP5-6 HP. When I compare the KP6 HP toolkit to the KDS HP, I find that there no observable differences between assemblages. Lastly, when I compare KP6 HP toolkit to the KRM HP, I find that the width/thickness ratio, length/width ratio and backed piece frequency were all higher for KRM HP than KP6 HP.

5.4 Significance of HP for Model Expectations 1-4:

Now that pairwise comparisons between KP6 HP blank production choices and tool kit morphologies and other HP assemblages has been completed and described, it is possible to assess how some of the model expectations for these comparisons. The model expectations were:

1. Antecedents (Continuity in Technical Choices).
2. Number of Changes in Technical Choices (Independent Innovation).
3. Number of Domains Affected by Change (Cultural Transmission).
4. Enculturation v. Stimulus Diffusion

For KP6 HP v PP5-6 HP, statistically significant differences as I have stated before lie mainly in the blank production and the two assemblages are most similar in terms of tool kit morphology. From Expectation 3 (Number of Domains), blank production for KP6 HP show

at least one difference for each domain when compared to PP5-6 HP. The total difference across the 4 domains of behavior in blank production is 1.9 out of 4.0 (47.50 %). This value is the lowest out of the three comparisons with regards to blank production. This result itself is evidence of a similar use of tools on the landscape by the makers of KP6 HP and the makers of PP5-6 HP without the commonality to the enculturing environment. With 5 out of the 7 tool kit morphologies being the same between both assemblages, it is unlikely that the degree of similarity was caused by adaptive convergence rather by cultural transmission based on the number of similarities in technical choices (four blank production domains). Shared by both KP6 and PP 5-6.

For KP6 HP v KDS HP, statistically significant differences lie mainly in the blank production and the two assemblages are most similar in terms of their tool kit morphologies. From Expectation 3 (Number of Domains), blank production for KP6 HP show at least one difference for each domain when compared to KDS HP. The total difference across the 4 domains of behavior in blank production is 2.25 out of a possible 4.0 (56.25 %) which is the highest of the three comparisons. This result itself is also evidence of a similar use of tools on the landscape by the makers of KP6 HP and the makers of KDS HP with some commonality to the enculturing environment. With two out of the two tool kit morphologies being the same between both assemblages, it is unlikely that this degree of similarity was caused by adaptive convergence rather by cultural transmission based on the number of similarities in technical choices (four blank production domains). Shared by both KP6 and KDS

For KP6 v KRM HP, statistically significant differences lie mainly in the blank production and the two assemblages are most similar in terms of their tool kit morphologies. From Expectation 3 (Number of domains), blank production for KP6 HP at least one difference for each domain when compared to KDS HP. The total difference across the 4 domains of behavior in blank production is 2.07 out of a possible 4.0 (51.75 %). This result itself is also evidence of a similar use of tools on the landscape by the makers of KP6 and the makers of KRM HP. With three out of the four tool kit morphologies being significantly different between both assemblages it is likely that this was caused by adaptive convergence rather by cultural transmission based on the number of similarities in technical choices (four blank production domains). Shared by both KP6 and KRM.

Based on the above results of the comparisons it is quite clear that KP6 HP varies in different ways from these sites. It is likely that Expectation 3 is the closest explanation to how HP may have moved across southern Africa. Expectation 3 states that the flintknapping behaviours changed due to independent innovation in one or more regions with the ensuing cultural transmission of the behaviours into neighbouring regions.

5.5 Other potential factors/explanations that may have likely played a role in variation between KP6 and other HP assemblages:

One potential explanation for why KP6 differs from other HP sites is chronology. This may be due to how much older the KP6 HP assemblage may be compared to the other HP assemblages. KP6 HP is similar in age as compared to Diepkloof's Early HP assemblage. Researchers at Diepkloof have observed diachronic variability over time in their HP assemblage and have thus split the HP into three main phases; early intermediate and late HP (Porraz et al., 2013b). The researchers then suggested that the HP in southern Africa is older than previously thought and does not appear everywhere at the same time (Porraz et al., 2013b). There may have been groups of people who co-existed in neighboring environments that shared similar traditional behaviors that gave rise to HP however, there is a temporal gap between the first observation of HP particularly at Diepkloof where the earliest evidence for HP was around 106 ± 10 ka whereas, its subsequent expansion and disappearance date around 52 ± 5 ka at Diepkloof (Porraz et al., 2013b). This gap in time and space may serve to explain variation seen between HP assemblages across the landscape at different points in time representing different groups of people. The researchers then found that although the laminar reduction sequence of the Early HP at Diepkloof is similar to the HP at Klasies their data suggest that it is possible to differentiate between the two assemblages (Porraz et al., 2013b). The variability in backed pieces between Diepkloof's Early HP assemblage and KRM HP could be due to distinct functional purposes where the backed pieces may have been used in different ways, different adaptive forms where the backing of these pieces could have been adapted based on environmental differences from site to site or different regional/temporal expressions based on style or cultural norms (Porraz et al., 2013b). Although, these potential reasons require further examination through similar comparative studies to the one conducted for this thesis .

This seems consistent with the observations made above where, despite sharing similar laminar reduction roots with different ‘classic HP’ sites, KP6 varies quite differently from each site. The KP6 HP assemblage may be an early form or initial stage of HP similar to what has been observed with Diepkloof’s Early HP assemblage. Both assemblages occur in similar time periods (106 ± 10 ka Diepkloof & 100 ± 6 KP6). Both assemblages, share similar typological roots with ‘classic’ intermediate or late HP assemblages such as Rose Cottage Cave and KRM which have been established through various studies including comparisons made in this thesis (Mdludlu, 2015; Porraz et al., 2013b), but differ in the morphology of backed pieces, blades or the frequency of blades. These differences may boil down to variations in behavior at different times on the same landscape particularly cultural transmission or a regional style developed over time over many a generation.

Another potential explanation for why KP6 HP may differ from these HP sites could be a difference in raw material used. At Rose Cottage Cave, the HP assemblage found there is made mostly out of opaline (Soriano et al., 2007). Researchers argued that the size of the small opaline blocks, from which the blades were produced, restricted the knappers from making blades similar in size to those at sites such as Klasies and Sibudu (Soriano et al., 2007). At Sibudu, a similar argument is made where the main knapping method identified with assemblages at the site does coincide with other HP sites (de la Peña et al., 2015). Researchers argue that although blade production from ‘HP’ cores is represented, the predominant blade production method is prismatic and this may be due to among other reasons, differences in raw material (de la Peña et al., 2015).

Mackay et al., (2014) state that there is some subtle variability between climate regions in southern Africa during HP. The HP sites in winter and year-round rainfall zones (WRZ & YRZ) are associated with a high frequency of fine-grained raw material often from non-local sources (Volman, 1980; Singer and Wymer, 1982; Deacon, 1995; Mackay, 2010; Brown et al., 2012; Porraz et al., 2013a; Minichillo, 2006). This may not be because such fine-grained raw material is essential for the production of small blades and backed pieces due to the presence of quartz in subsequent periods of blade and backed piece production in the region (Mackay et al., 2014). This however, was not the case for summer rainfall zone (SRZ) until sites like Rose Cottage Cave and KP6 were discovered where it is quite clear that fine grained raw material was indeed prevalent in the region. Further raw material surveys should be

conducted in the SRZ of southern Africa to get a fuller picture on HP raw material selection. I do believe that differences in raw material may have an effect on blank production and the subsequent tool kit morphology as is evident at Sibudu and Rose Cottage Cave. At KP6, the BIF could have had an effect on how blanks were produced and how tool kits were eventually chosen. The difference in raw material may have played a role in regional expressions of HP across the landscape.

Despite these differences, all four of these sites share interregional consistencies in the fundamental form of tools such as backed pieces and the culture of small blade production using relatively similar flaking systems. This theme is reflected in all three comparisons and points to more similarity than difference in overall toolkit morphology. Differences may boil down again to style and/or the passage of time.

5.6 Why does the KP6 assemblage vary in different ways from the other HP assemblages?:

It is thus quite clear that the differences between the KP6 HP assemblage and the three selected HP assemblages vary from comparison to comparison. Earlier in the chapter, the KP6 lithic material analyzed for this particular study was appropriately designated as HP according to the current definition of this stone tool industry. Consistency in variability across all three comparisons to this assemblage was expected based on the current definition of HP, but this was not the case. This may be reflective of the variation that exists in the technocomplex of HP which may be regional based on comparative studies at Sibudu, Rose Cottage Cave, Diepkloof and now Kathu Pan 6 (de la Peña et al., 2015; Soriano et al., 2007; Porraz et al., 2013; Mdludlu, 2015; Makalima et al., 2016). All these sites report various different ways in which they are different to the 'classic HP'. At Diepkloof, researchers found it necessary to separate the HP assemblage there into three distinct chronological units; Early, Intermediate and Late HP based on present use-wear analysis and chronological differences between each unit (Porraz et al., 2013). They made this comparison with Klasies HP, and

found that even though they share similar laminar reduction roots there are morphological differences in backed pieces and small blades (Porraz et al., 2013). They argue that morphological variation in backed pieces could boil down to functional differences as use-wear studies show that backed pieces were used for a variety of tasks outside of composite tools for hunting (Wadley et al., 2008; Wurz, 1999). At Sibudu, they argue that variation in the HP particularly between the classic HP and what is seen the HP at Sibudu could be regional and at Rose Cottage Cave they argue differences are based on raw material exploited. These arguments are all possible explanations as to why KP6 HP varies differently from each HP site. KP6 HP could be a regional expression of this technocomplex which was derived from a guided variation to satisfy a particular task while exploiting readily available fine grained raw material. Chronologically, it is significantly older than all three HP sites chosen for comparison, and if we are to follow the Diepkloof model for HP than KP6 HP would represent an initial stage in HP. Considering all these possibilities, it shows how much variation exists from site to site during the HP period and how much more can be revealed if more studies like this are conducted.

5.7 Strengths and Limitations of this Study:

Each of the variables used during the comparisons are linked by Middle Range Theory to social connectedness and intimacy (Tostevin, 2011b). The Tostevinian approach to comparative inter and intra site research was meant to get at aspects of human behaviour that typology failed to capture in lithic analysis. This approach also aims at solving common epistemological problems related to typological descriptions of various lithic assemblages. The definition of HP has not changed much since its discovery in 1927. The description of HP remains mostly typological, with backed pieces being the hallmark of this lithic industry. This definition excels at identifying similarities between HP assemblages but struggles with identifying and providing reasons for variation.

Earlier in this chapter I established that Tostevin's Hypothesis 3 is the most likely explanation for what I am seeing with these comparisons. It is possible that HP appeared through regional innovation across the landscape and may have spread/moved these behaviours along as the knappers navigated the region over a significant amount time. A

typological comparison alone in this case would not have revealed this and it would be interesting to see the results if this framework is applied to all available HP assemblages for a similar comparative study.

This study did however have its limitations. I did not have access to all the data needed for a broader comparative analysis and this is based purely on the fact that not all data is published. Some researchers do not analyse all the debitage in their assemblages, they have minimum size cut offs. Due to these cut offs, I had to exclude debitage or artifacts that do not meet that minimum size cut offs in order for the comparison to be valid often reducing my samples size significantly. Another limitation that plagues all researchers interested in HP is the chronostratigraphic position of HP and the debate around which model is most accurate between Jacobs et al., (2008, 2015) and Tribolo et al., (2005, 2013). This uncertainty in chronological models for HP make it difficult to define as a relatively short lived cultural phenomenon (5k years) or a 45-50k yearlong lithic tradition. This additionally makes it difficult to correlate HP with climatic models. KP6 and its sister sites also had the same issue with the latest date being much older than what was previously found by Feathers et al., (2015) as I have previously stated. Lastly, I was unable to compare KP6 to all HP assemblages based on the scope and time I was allocated to complete this research. Having a bigger sample size in a comparative study like this would paint a clearer picture and help us better understand variability within the HP.

5.6 Future work

I would like to suggest more studies of this nature should be considered. Ideally, KP6 should be fully analyzed in order to see how the HP may have appeared and disappeared, and compare it to other well documented HP sites. This way, the comparative study could expand beyond the scope of HP and delve into debates surrounding Still Bay and its relationship if any with HP.

I would also suggest agreeing on a standard chronostratigraphic position of HP by perhaps dating all HP sites again using the same method to avoid any future confusions as to how long HP may have lasted and where/when it may have appeared/disappeared. This would allow more accurate paleoenvironmental studies to be conducted to better understand the different conditions in which the makers of HP may have been living under over. It would be

particularly interesting to see differences between assemblages that occur in Winter, Year Round and Summer Rainfall Zones in southern Africa and potential variation that may be seen between sites.

I would suggest attempting to find more open air sites HP sites in various regions of southern Africa but particularly in the interior. Although discovering well preserved open air sites in general is difficult I still think finding another site like KP6 in the interior would be interesting and could alleviate the clear bias towards sites closer to the coast. As it stands there are only two sites found in the interior and I believe there are a lot more out there.

Lastly, I would suggest more studies on ochre and residue analyses, macrotrace use wear analysis on assemblages such as KP6 to see what those backed pieces may have been used for.

2. Conclusion

In summary, the HP at KP6 demonstrates variability when compared to other geographically, regionally and functionally different HP sites in southern Africa. More studies of this nature need to be conducted to better understand the variability of the HP as a brief, innovative and complex time for the human populations that occupied and spread across the landscape during the MSA.

The broader issue highlighted here is that the current definition of HP does not adequately accommodate HP variability. The typological NASTIES issues identified by Shea (2014) is evident here where issues around variability that could be answered through the identification of particular behaviors is limited by its very definition. Typology by its very nature centers around similarities and struggles when it comes to explaining differences and variation. The definition of HP has been around since 1927 (Stapleton & Hewitt) and not much has changed in regards to taking into account variability and attempting to explain what it means in a broader comprehensive sense. Tostevin's approach shed light on potential behavioral differences between HP assemblages in southern Africa that would not have been otherwise found purely through typology. I strongly believe that this kind of approach should be applied elsewhere with other lithic technocomplexes to uncover behavioral variation between assemblages and how these behaviors may have spread on across the landscape

Future research can focus on creating a framework that would take into account the differences between assemblages through comparisons of this nature. More research should be conducted on comparisons between assemblages where the focus is on variation as opposed to aiming to designate MSA sites with backed pieces as HP and stopping there.

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