# A TECHNOLOGICAL STUDY OF THE LITHIC ARTEFACTS FROM THE EARLIER STONE AGE SITE OF MAROPENG IN THE CRADLE OF HUMANKIND, GAUTENG, SOUTH AFRICA


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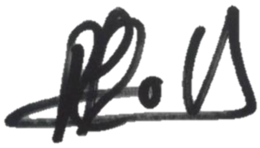
## Declaration

I, Rosa Matsileng Moll, hereby declare that this thesis is my own, unaided work and has not been submitted for a Masters (MSc) at any other university.



# Abstract

Maropeng is the only known open-air Earlier Stone Age site in the Cradle of Humankind, South Africa. Excavations yielded one of the largest Early Acheulean assemblages in the Cradle of Humankind, with 693 artefacts. This represents a small sample of the material in the artefact bearing horizon, which is estimated to cover an area of approximately 191200m². The assemblage is dominated by large cores and flakes, mainly on locally sourced quartzites. A combination of site formation processes has led to the removal of small flaking debris, and thus the previous analysis by Pollarolo *et al*. (2010) focused on large cutting tools and cores.

This study aimed to determine whether a dominant phase of the Acheulean techno-complex was evident from an in situ excavated assemblage, the hypothesis maintained by Pollarolo *et al.* (2010). A technological study of the specific production strategies was carried out, focusing on multiple attributes of cores, flakes and LCTs, and various methods for assessing reduction (e.g. Toth 1985; Kuman 2001; Braun *et al.* 2008b; De la Torre 2011). The analysed data was compared to well-established Early Acheulean sites both in eastern and southern Africa.

Results show that cores have been reduced in casual and multifacial strategies, following naturally available platforms. Reduction was limited with many cores having few flake scars and retaining large percentages of cortex. The relatively low flake scar count was consistent on all core sizes, but flake scar sizes increased with core size. Knappers were able to produce feather terminated flakes on cores most of the time but did not correct mistakes or rejuvenate platforms. The large cutting tools are few, with both unifacially and bifacially shaped pieces displaying primary and secondary removals. Secondary shaping is only found on handaxes and roughouts, where knappers unsuccessfully attempted to thin the central mass of the blank. Cleavers were made on large flake blanks with naturally flat, straight tips and possessed only primary shaping. The flakes, however, were found to associate technologically with the LCTs and more exploited cores. The majority corresponded with an intense reduction sequence, but very few flakes were found that correspond to the high number of casually reduced cores. The simple cores, and limited LCT shaping, represent an early phase of the Acheulean techno-complex, while many flakes derive from largely more complex core working. The implications for this complexity are a long-term accumulation on the landscape, with hominids displaying multiple behavioural traits within the lithic production.

## Acknowledgements

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# **Glossary**

ABH – Artefact bearing horizon

CoH – Cradle of Humankind

ESA – Earlier stone age

LCT – Large cutting tool

LSA – Later stone age

MSA – Middle stone age

Mya – Million years ago

SFD – Small flaking debris

QDC – A type of raw material classification where there is a contact of dolerite and quartzite on one artefact.

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# Chapter 1: Introduction

Maropeng (25°58'0.83"S, 27°39'7.45"E; Figure 1.1; Figure 1.2) is the only known open-air Earlier Stone Age (henceforth referred to as ESA) tool-bearing site in the Cradle of Humankind (henceforth referred to as CoH), Gauteng, South Africa. Artefacts were first discovered eroding out of an artefact bearing horizon (henceforth referred to as ABH) exposed by construction of the interpretive centre and hotel in 2005 by visiting scientists Professors Ronald Clarke and Kathleen Kuman from the University of the Witwatersrand. The horizon was seen in cuttings exposed on both sides of a tourist walkway leading from the marketplace to the interpretive centre (Figure 1.3). An initial study was conducted by Pollarolo *et al.* (2010) to clarify the archaeological nature of the site and consisted of surveying the construction spoil dumps, where many artefacts were redistributed, and excavating small test pits around the extensive earthworks at the market place (Figure 1.2). The initial study by Pollarolo *et al.* (2010) concluded that the assemblage was made up mostly of Early Acheulean tools that were deposited in a colluvial lag within about 200m of the excavation site.

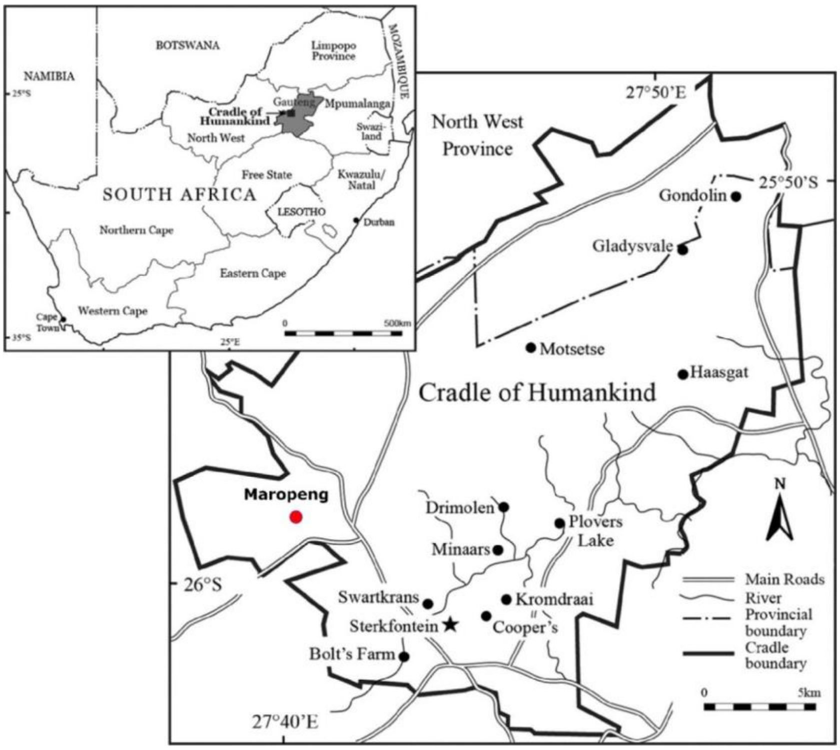


*Figure: 1.1: The Cradle of Humankind World Heritage Site, in Gauteng Province, with Maropeng and Sterkfontein, and other published sites indicated. Adapted from Stratford et al. (2014) and Morrissey (2015).*


*Figure 1.2: Map of the Maropeng property, outlined in black. Taken from Morrissey 2015.*


*Figure 1.3. Maropeng property with Marketplace and tumulus building (interpretive centre). Taken from Morrissey 2015.*

Small Acheulean assemblages of varying size and with age estimates of 1 to 1.6 Mya have been recovered from the cave sites of Sterkfontein, Swartkrans and Kromdraai in the CoH, but until Maropeng was discovered, only isolated examples of Acheulean artefacts had been found away from these cave deposits. Maropeng also differs with other Early Acheulean sites in South Africa due to the location, as it is not found in a cave, spring, or in river gravels (Pollarolo *et al.* 2010). Outside of the CoH, some noted

Early Acheulean sites include Canteen Kopje, Wonderwerk Cave, Cave of Hearths, and Amanzi Springs (Klein 2000; Kuman 2007, 2016). These sites have later Acheulean assemblages dating younger >0.6 Mya. As will be discussed later, the Maropeng assemblage is best assigned to the Early Acheulean, and so I do not feel the need to review all Acheulean sites in southern Africa. The reviews will be restricted to the other sites with published Early Acheulean assemblages.

Over the last five years, excavations at Maropeng under the direction of Dr Stratford, and myself from 2015, have focused on sampling the undisturbed artefact-bearing areas of Maropeng (Figure 2.3), and an artefact assemblage of 693 artefacts from in situ contexts has been recovered and prepared for analysis. The recovery of a large ESA assemblage from an open-air context in the CoH thus has the potential to improve our understanding of the distribution of the ESA across this important landscape, and it will also help develop our understanding of the technological capabilities, preferences and intentions and ultimately the behaviours demonstrated by the tool makers. Not only is it important to understand the Maropeng assemblage on its own, but to compare it to other sites in order to understand hominids within a specific landscape.

### 1.1. Aims

A larger, multi-disciplinary study of the archaeology and site formation processes of the Maropeng site from more extensive excavations and test pits has been conducted over the last two years. My research within this program consists of analysing the recovered lithic artefacts using a core reduction analytical perspective from a series of excavations of in situ assemblages.

Through controlled excavations done over the course of 2015 and early 2016, and a detailed techno-typological analysis of the assemblage from Maropeng, this project attempts to identify the techno-complex forms represented in the assemblage, while testing the hypothesis proposed by Pollarolo *et al.* (2010) that the assemblage is dominated by an Early Acheulean industry. A series of technological attributes as described by various researchers will be used (e.g. Toth 1985; Field 1999; Braun *et al.* 2008b; De la Torre 2011; Kuman *et al.* 2014). Identifying different contributing technological strategies will help clarify the extent to which this assemblage may be time-averaged and also help me to explore the technological capabilities, repertoires and behaviours of the Maropeng assemblage makers. From the analysis, I plan to develop my own hypothesis about the nature of the Maropeng knappers.

The project also aims to test the hypothesis of Pollarolo *et al.* (2010) that the assemblage is dominated by the Early Acheulean. If this is the case, then one would expect to find an assemblage characterised by roughly shaped LCTs on flake and cobble blanks (as described by Kuman 2014b and Pollarolo *et al.* 2010), an absence of flakes with intentional platform faceting, limited retouch on flakes, and the absence of clearly younger material, such MSA prepared cores, blades and points.

## 1.2. Research questions

This project is guided by three major questions.

1. Can a dominantly early phase of the Acheulean techno-complex be identified at Maropeng in the excavated material, as proposed by Pollarolo *et al.* (2010), or is there evidence in the technology of mixing of different time periods?

2. What reduction strategies can be identified in the Maropeng assemblage, and what behavioural traits, if any, of ESA hominids could be inferred from them?

3. What can raw material preferences tell us about hominin mobility on the landscape, and how might raw material availability have influenced the character of the assemblage?

## 1.3. Organisation of thesis

This thesis is divided into six chapters, including this introduction (chapter 1). Chapter 2 (literature review) opens with a review of the work done at Maropeng, then a discussion of ESA studies, with a focus on the Early Acheulean and its technological and typological diagnostic features. The main approaches to lithic analysis are described with a discussion of the core reduction method/s present in the Maropeng assemblage, and finally a discussion on other ESA and Early Acheulean sites in eastern and South Africa. Chapter 3 (materials and methods) describes the excavations and assemblage plus how all the attributes are measured and recorded. These are followed by the results and discussion chapters (chapters 4 and 5, respectively), and finally a short conclusion (chapter 6).

# Chapter 2: Literature review

This chapter starts with a discussion of Maropeng, then moves onto the ESA, with a focus on the Early Acheulean. The main approaches to lithic analysis are described within a discussion of dominant lithic analysis approaches. Chapter 2 ends with a discussion on other ESA and Early Acheulean sites in eastern and southern Africa, the question of raw material procurement, reduction strategies, and site formation processes.

Lithic studies have been undertaken by Chazan (2014) to seek answers to a series of general questions, as adapted from the mode system developed by J.G.D Clark[1] (Clark 1968). Concerning the ESA (Modes 1 and 2), these questions revolve around understanding the relationship between stone tool (henceforth referred to as lithic) production and human evolution, as well as the more specific studies of the relationship between the evolution of *Homo ergaster* and artefact shaping within the development of the Early Acheulean.

Maropeng has previously been classified as an Early Acheulean site (Pollarolo *et al.* 2010), and by studying the assemblage, I hope to answer specific questions of reduction patterns and technology at the site which would hopefully be a factor in answering broader questions of hominid behaviour in the area.

## 2.1. Maropeng

### 2.1.1. Geology and geoarchaeology

The Maropeng property covers an area of about 1 000 000m², and lies roughly 15km north-west from Krugersdorp (Figure 1.1). Geologically, Maropeng occupies an area of sedimentary deposits in found in the Transvaal Basin, within the Malmani Subgroup, at the base of the Pretoria Group. The site is found above the Malmani dolomites (in which the site of Sterkfontein is found) and has a range of rock types as it falls within the Rooihoogte Formation and has been intruded into by dolerite dykes. The upper

[1] Clark (1968) developed a method of classifying stone tool technological trends within five distinct modes. Mode 1 refers to simple core and flake industries, Mode 2 refers to biface production, Mode 3 refers to prepared core technology, Mode 4 refers to blade production, and Mode 5 to microlithic technology (Foley & Lahr 2003). Clark, J.G.D. 1968. *World prehistory: a new outline, 2nd ed*. Cambridge: Cambridge University Press.

part of this formation is rich in mainly quartzite, shale and quartz deposits (Eriksson 1988; Eriksson *et al.* 1993).

Even though this research project does not aim to analyse the geoarchaeology of Maropeng, the site formation processes are extremely important to consider as they effect the abundance, density and nature of the assemblages yielded from excavation. Pollarolo *et al.* (2010) proposed that the Maropeng ABH formed through colluvial processes, with the majority of archaeological and natural clasts sourced from a quartzite ridge southeast of Maropeng (Figure 2.2). The assemblage accumulated in a natural dip in the landscape, which was proposed by Pollarolo *et al.* (2010) as the depocentre of the colluvium resulting in the thickest accumulation of the horizon. A study of the ABH from test pits around the landscape, showed that it interbeds two layers of clayey, lateritic sediment formed from the decay of local abundant and outcropping dolerite. The horizon is around 5cm thick at the market place (Figure 2.3) but has been found to be as thick as 15cm in other areas (Morrissey 2015).

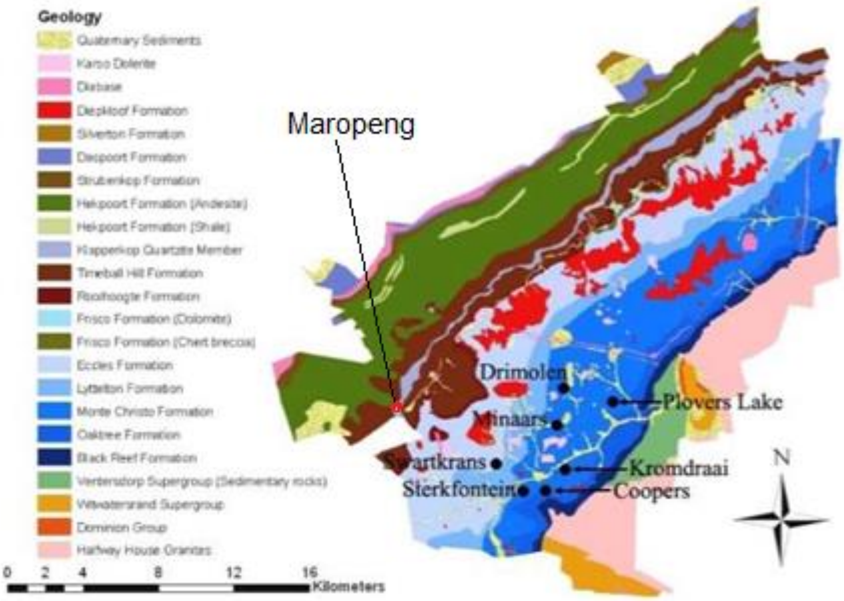


*Figure 2.1: Geological map of the Cradle of Humankind, with the major sites of Sterkfontein and Swartkrans represented, among others. Maropeng is located towards the western edge (Adapted from Stratford et al. 2011 and Morrissey 2015).*

Apart from Pollarolo *et al.* (2010), only one other piece of work has been produced about the Maropeng geoarchaeology. Peter Morrissey (2015) conducted a study of the area to determine the extent of the ABH, as well as to test the site formation hypothesis presented by Pollarolo *et al.* (2010). Through a series of test pits located throughout the area (Figure 2.3), it was shown that the ABH covers an area of at least

191 200m$^2$ (Figure 2.4). The results of the study not only showed that the horizon to be much larger than originally thought, but that the site formation hypothesis did not account for the varying degrees of weathering and possible multitude of artefact sources (Morrissey 2015).

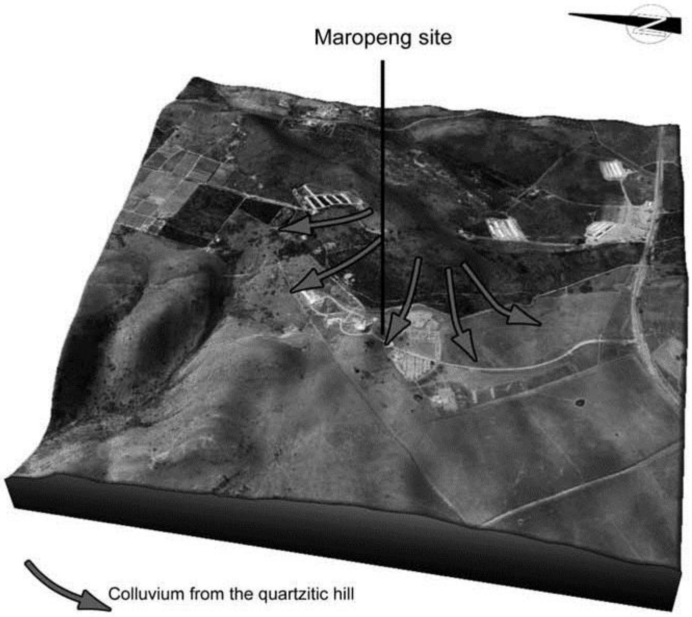


*Figure 2.2: Diagram of original site formation hypothesis as described in Pollarolo et al. (2010).*

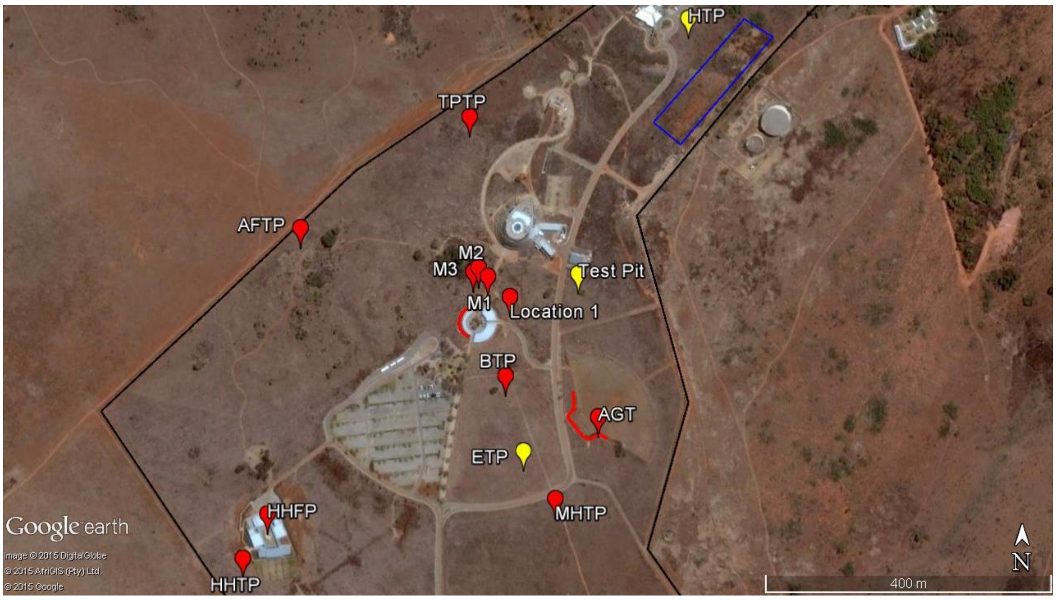


*Figure 2.3: Test pit locations for the geoarchaeological work done by Morrissey (2015). The excavations of M1, M2, and M3 are seen in the centre. The red lines indicate areas where the ABH was exposed due to construction, and the yellow markers are locations where the ABH was missing. The blue line shows the spoil heap where many artefacts were found for the Pollarolo et al. (2010) study. Image taken from Morrissey (2015).*


*Figure 2.4: The red line indicates the hypothesised minimum extent of the ABH (191 200m²), as described by Morrissey (2015). The yellow marker indicates a location where the ABH was missing. Taken from Morrissey (2015).*

Morrissey (2015) hypothesised that artefacts and clasts were brought into the site though low-energy slopewash from the east, originating from the quartzite ridge. The original site formation hypothesis of Pollarolo *et al.* (2010) (Figure 2.2) is very broad in its description of the ABH, but Morrissey (2015) showed that there was quite a lot of variability in the deposit, and mixing of the ABH due to post-depositional processes. From the geoarchaeological work, it is evident the artefacts came not from a single depositional unit but accumulated from various highpoints on the landscape within 1km through erosion from the slopewash, to accumulate at Maropeng (Morrissey 2015). the formation of the ABH caused much mixing of artefacts and clasts in situ. In situ breakage also occurred as the ABH compressed and deflation of the ABH into a single layer. This means that there is a high possibility of contamination of broken natural pieces in the ABH, along with distribution over far reaching areas of artefacts from the same origin. Due to this hypothesis, and the original hypothesis of Pollarolo *et al.* (2010), questions about mixing of technological trends within the ABH, and time-averaging were addressed in this thesis.

### 2.1.2. Site formation

Site formation studies are vital in southern African ESA archaeology as preservation of cultural material is often affected by depositional processes (Kuman 2003), as is shown at Maropeng (Morrissey 2015). Larger artefacts are common in the ex situ assemblage, such as LCTs and cores, while the smallest pieces of the in situ and ex situ assemblages range from 20-30mm. It was proposed that small flaking debris (<20mm) was lost through erosion of the coarse colluvium, as no evidence of it was recovered through excavations (Pollarolo *et al.* 2010). In the CoH, the major archaeological sites of Sterkfontein, Swartkrans and Kromdraai (Figure 1.1) have yielded assemblages that accumulated in secondary context in underground cave infills (Clark 1993; Kuman *et al.* 1997; Field 1999; Kuman 2003). Maropeng is an open-air assemblage but is also in secondary context, with excavated material providing an opportunity to address this context.

Distinct archaeological layers, such as the layer found at Maropeng, are not necessarily markers for precise periods in time, indicating specific behavioural markers in a single area (Dibble *et al.* 2016). This is due to two factors, the various site formation processes that can affect a deposit, and the fact that many tools can be used and discarded many times. At Maropeng, the lack of small flaking debris and evidence of significant depositional processes means that there are only certain traits which can be studied. If variations in reduction patterns are evident at Maropeng, it can be an indicator of multiple generations of stone tool production, either in the forms of distinctive productions or as reuse of discarded cores and artefacts. This reuse may, however, not be evident as there is significant weathering on many pieces with no further removals on the patina (Morrissey 2015).

### 2.1.3. Archaeology

The original artefacts used in the Pollarolo *et al.* (2010) study were collected primarily from surveys of the spoil heaps and tumulus (Figure 2.3). Diagnostically characteristic artefacts were collected, such as LCTs and cores, while many smaller and less obvious types (such as flakes and chunks) were often missed as they were not easy to distinguish. 200 of the 712 artefacts used in the Pollarolo *et al.* (2010) study were recovered from test pits, but none of these were LCTs, all of which came from surface collections.

Typologically, the LCTs found conform to Early Acheulean tools found at Sterkfontein, in the CoH (Kuman 1994, 1998, 2007), as well as Rietputs in the Vaal Basin (Leader 2009). The handaxes are specifically comparable to these sites as they tend to be thick and made predominantly through primary shaping removals from large flake blanks and cobbles (Figure 2.5). Hard-hammer percussion was used in their manufacture, as evidenced by large negative bulbs on the flake scars (Pollarolo *et al.* 2010). Two handaxes (Figure 2.6, numbers 1 and 2) have large side-struck removals which could indicate either shaping or use of the tool as a core (Pollarolo *et al.* 2010). Other artefact types from Maropeng were described as cleavers, polyhedral cores, irregular cores, and chopper-like cores. One core collected from the ex situ spoil heap could potentially be classified as a prepared core but Pollarolo *et al.* (2010) argued that the deposit contained no other evidence of a prepared core technology component, and so the piece was not analysed further.

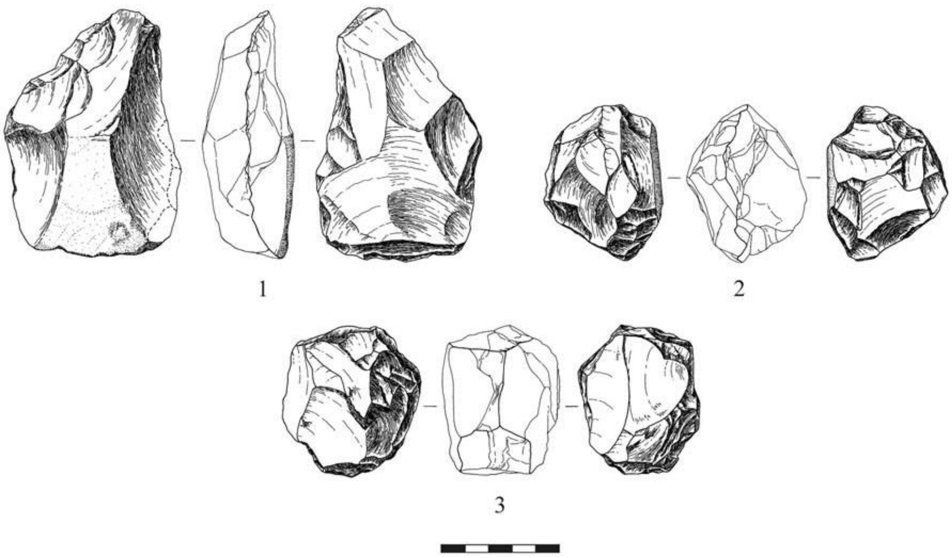


*Figure 2.5: Artefacts collected for the Pollarolo et al. (2010) analysis. Number 1 is a bifacially worked LCT with side-struck removals on the sides, and corner struck removals at the tip, number 2 and 3 are polyhedral cores with multiple removals. Image taken from Pollarolo et al. 2010.*

Pollarolo *et al.* (2010) used the Sterkfontein Early Acheulean assemblage as a comparison for the original study of the Maropeng assemblage. The Early Acheulean assemblage from Sterkfontein has 701 artefacts and was recovered from Member 5 West (Kuman 2003), 258 of which are cores, and 208 are manuports. Flakes comprise 49 of the artefacts including incomplete, complete and flaked flakes (Field 1999). Field (1999) defines the cores from this assemblage as not fully exploited which she interprets as a result of the proximity of the raw materials. Overall, the cores conform to the types found in both the Oldowan and Acheulean, and include polyhedrons, discoids, and irregular forms, which Field (1999) argues all have evidence of remaining platforms and few flake scars, demonstrating limited exploitation.

At Maropeng, there are many possible sources of quartzites close to the site, as is seen at Sterkfontein. However, no work has been done to ascertain precisely which sources were used, even though the geoarchaeology work has shown there are likely multiple sources and deposition spots around the area (Morrissey 2015, also see

Figure 2.4 of the ABH distribution). Generally, the quartzite is quite fined grained and light in colour, with the quartz most likely being vein quartz from outcropping in the area, with a few gravel pieces, as proposed by Pollarolo *et al.* (2010).

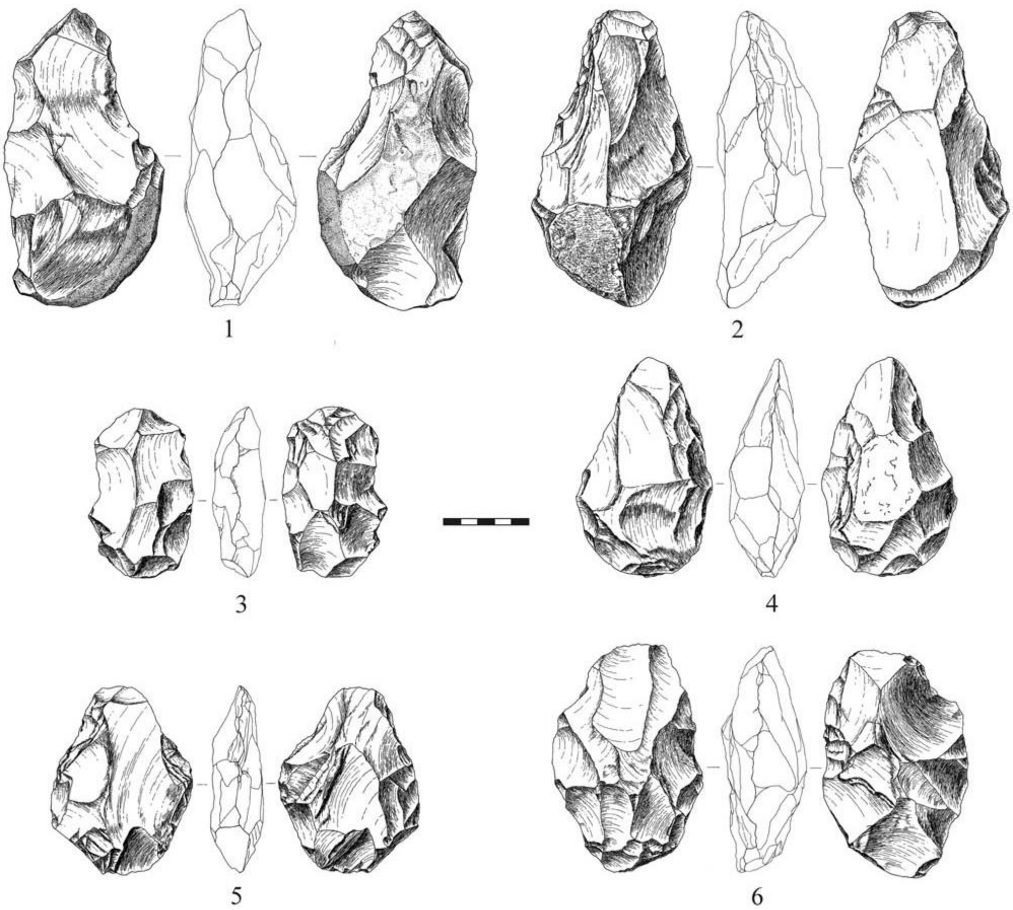


*Figure 2.6: Artefacts collected for the Pollarolo et al. (2010) analysis. 1 and 2 are handaxes with large side-struck removals, 3-6 are handaxes.*

## 2.2. The Early Acheulean

The ESA in Africa is characterised by three major industrial complexes: the Lomekwian from 3.3 Mya (Harmand *et al.* 2015), the Oldowan from 2.6 Mya (Leakey 1971; Semaw 2000), and the Acheulean from 1.76 to 0.3 Mya (Leakey 1971; Klein 2000; Stout *et al.* 2010). The Lomekwian was recently described by Harmand *et al.* (2015) as an industry dominated by battering patterns, bipolar core reduction, and passive percussion of cores which were struck against an anvil. Mary Leakey first described the Oldowan at Olduvai Gorge in 1971 as a simple core and flake industry (Leakey 1971, Kuman 2014a). The South African Oldowan has now been dated to ca 2.18 Mya at Sterkfontein (Granger *et al.* 2015) and at 2.19 Mya at Swartkrans (Gibbon *et al.* 2014). While Oldowan tools may be present in the Maropeng assemblage, it is not possible to isolate such material because core and flake types are simple, and cannot be dated. Mode 1 tool types represented by flakes and cores dominate both Oldowan and Acheulean assemblages (Kuman 2014b).

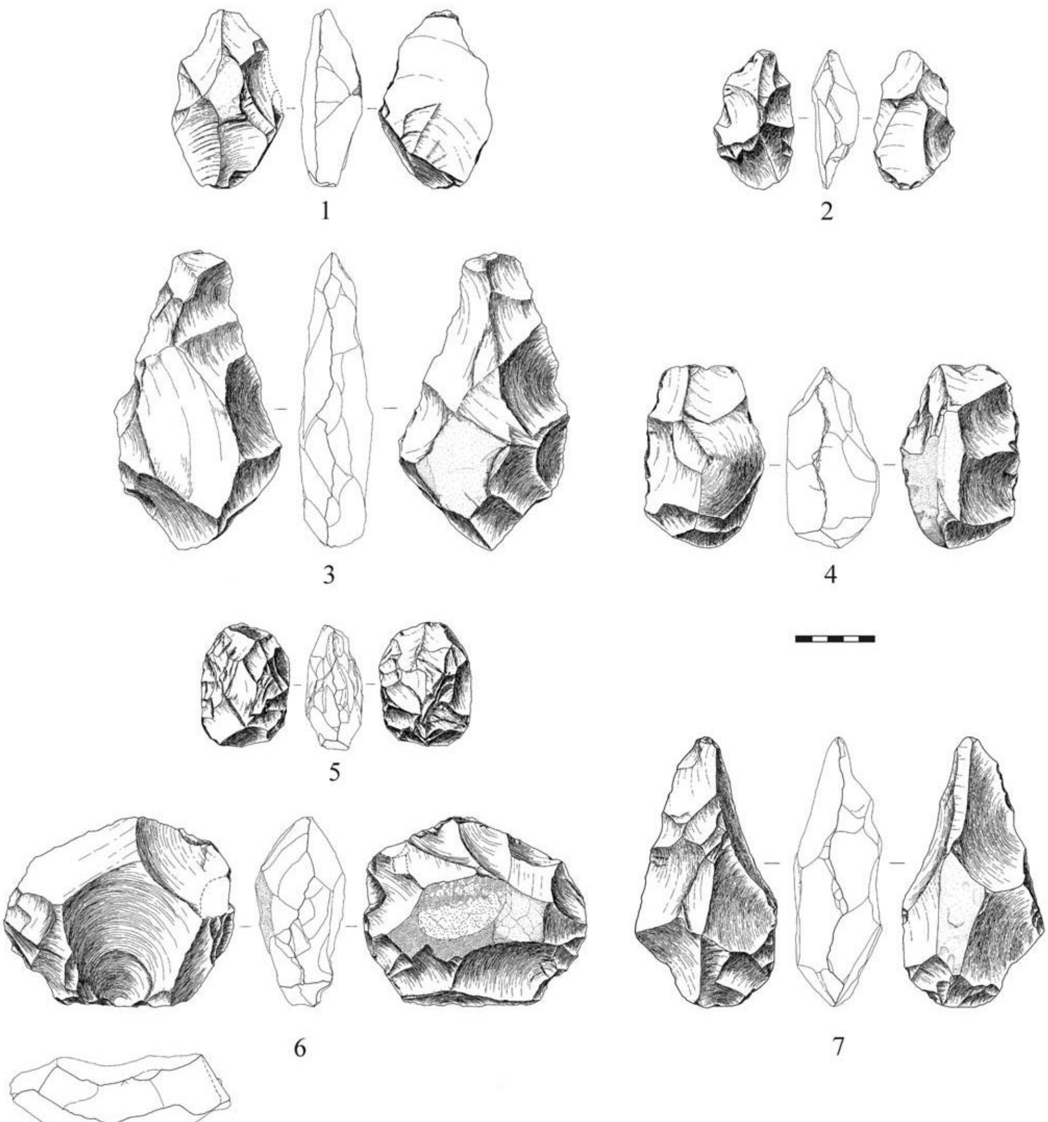


*Figure 2.7: Artefacts collected for the Pollarolo et al. (2010) analysis. 1 is a unifacial handaxe, 2 and 3 are handaxes, 4 is a bifacial chopper, 5 is a handaxe with a broken tip, 7 is the core with a preferential removal, and 7 is a handaxe.*

The Acheulean industry in Africa first appears during the lower Pleistocene at Kokiselei 4, Kenya at 1.76 Mya, and at Konso, Ethiopia at 1.7 Mya (Lepre & Kent 2010; Lepre *et al.* 2011). The Acheulean was defined by the emergence of the manufacture of large cutting tools (henceforth known as LCT/s) as shaped tools, exhibiting an increase in cognitive and behavioural capabilities beyond that observed in Oldowan tool-making (Semaw 2000; Lepre *et al.* 2011; Kuman 2014a; De la Torre 2016). Systematic and preplanned manufacture of flakes >10cm is a diagnostic feature of the Acheulean

(Isaac 1969; Toth 1982; Kuman 1994), as these flakes were often shaped to produce LCTs (Mason 1961; Wynn 1981; De la Torre and Mora 2005; De la Torre *et al.* 2008).

The production of large flakes has often been described as a substantial evolutionary leap from the Oldowan, as many techniques and much skill was needed to achieve it (Isaac 1969). This corresponds to Isaac's (1969) argument that large flakes and blanks indicate a significant evolutionary leap in the form of preplanning and cognitive development. It has been argued that the appearance of large flake production in the Acheulean, together with the persistence of smaller flakes and cores represent two sets of manufacture processes (De la Torre *et al.* 2008). Judgements also have to be made concerning shaping in the form of manipulation of blanks, and evaluation of outcomes, factors pertinent to the use of working memory in tool production (De la Torre 2016).

Despite the evolutionary leap associated with the Acheulean, its appearance was not sudden, with many sites surrounding Kokiselei 4, Kenya and Konso, Ethiopia maintaining simple core and flake archaeological deposits dating from the same time around 1.7-1.4 Mya (De la Torre 2016). This pattern continues in South Africa, in the CoH. The Acheulean assemblage found at Sterkfontein dates from 1.7 Mya (Kuman 2014b), and is dominated by simple core and flake strategies with asymmetrical and crudely made LCTs. The persistence of Mode 1 technological patterns, along with low frequencies of LCTs, suggests a slow transition from the Oldowan to the Early Acheulean. In the case of Maropeng, Pollarolo *et al.* (2010) have argued that there is possible mixing of pieces from industries other than the Early Acheulean, and so it would be important to acknowledge the slow transition when interpreting results.

The emergence of the Acheulean is linked to the evolution of *Homo ergaster* in Africa. Originally named by Groves and Mazak (1975) as a sapient-like *Homo species* from the fossil KNM ER 992, dating to 1.49 Mya, and KNM ER 3733, dating back to 1.78 Mya, both from East Turkana, Kenya (Clarke 2012). In South Africa *Homo ergaster* assigned fossils are found at Swartkrans (SK 847, SK 45), and Sterkfontein (StW 80) associated with a cleaver from the Early Acheulean Member 5 deposit (Kuman and Clarke 2000; Clarke 2012). A clear link between *Homo ergaster* and artefact deposits is not always obvious in the eastern African record, however, multiple factors show they are likely responsible for the industry as they had the most opportunity to make the artefacts (De la Torre 2016).

*Homo ergaster* possessed modern post-cranial body proportions that allowed for walking over long distances (Kuman 2014b). The pre-frontal cortex of the brain grew in size with the evolution of *Homo ergaster* which allowed for the conceptual pre-planning of artefact production (Stout 2011). Apart from the increased brain size and widespread nature of the species, other developments seen in *Homo ergaster* that could correlate to the technological advancements were the longer maturation rates, increased group cooperation and sociability (De la Torre 2016).

There are multiple factors to consider in the transition from the Oldowan to the Acheulean, when discussing hominid evolution. As *Homo ergaster* evolved, population sizes increased and larger assemblages are noted, along with more sites than found for the Oldowan (Kuman 2014b). In the CoH, the appearance of the Early Acheulean is associated with a change in landscape to more open conditions (Luyt & Lee Thorp 2003). The implications for interpretation of a of new technological industry, from the evolution and development of a *Homo ergaster*, are that researchers must acknowledge the abilities of people to move across landscapes more easily, which would have significant impacts on raw material choice, and site location and size. This needs to be considered along with the cognitive, physical and population evolution, and environmental adaptation of the *Homo* genus.

### 2.2.1. Early Acheulean sites

The type series for Early Acheulean artefacts was first described by Mary Leakey (1971) at EFHR, Olduvai Gorge, Tanzania and dated to 1.5 Mya (De la Torre *et al.* 2008). This site was thought of as one of the earliest examples of the Acheulean until the discovery of sites such as Kokiselei 4 which pushed he date back even further to 1.76 Mya (Lepre *et al.* 2011). The EFHR LCTs are rare, and made on large flake blanks. They were mainly unifacially and asymmetrical, with a focus on edge working rather than reducing the overall mass of blanks. There are no bifacially worked tools at the sites, and the focus of knappers was on the production of large scrapper edges and heavy duty tools (De la Torre *et al.* 2008).

The earliest Acheulean sites in southern Africa are at Rietputs 15 in the Northern Cape at ca 1.7 Ma (Gibbon *et al*. 2009), and at Sterkfontein in Member 5 West estimated at around 1.7 to 1.4 Mya (evidence from faunal remains, and relative dating based on the absolute dates of the Oldowan) (Kuman & Clarke 2000; Granger *et al.* 2015). Some researchers argue for the emergence of the Middle Acheulean at 1 Mya (Kuman

2014b). In South Africa, the Early Acheulean is documented at a similar time of around 1.5 Mya at Swartkrans in the CoH (Partridge *et al.* 2003; Pickering *et al.* 2012). Acheulean sites are found throughout southern Africa (Kuman 2007) in varied secondary contexts, mainly as open-air sites (Mitchell 2002), and in karstic cave deposits (Kuman 1994; Kuman and Clarke 2000; Stratford 2011; Kuman 2014b).

There are far fewer ESA sites than later industries (Kuman 2014a, 2014b), so there are only a limited number of sites within Africa that could offer comparative assemblages for which to analyse the Maropeng assemblage, if it is shown to be mainly associated with the Early Acheulean. The Early Acheulean has been found in southern Africa at Canteen Kopje, Rietputs, and at Sterkfontein and Swartkrans in the Cradle of Humankind. In eastern Africa there are many sites in the Olduvai Gorge, Tanzania, as well as at Kokiselei, Kenya, and Gadeb, Ethiopia (De la Torre 2011, Kuman 2014).

### 2.2.2. Core reduction and flaking strategies of the Early Acheulean

Although change occurred very slowly over the course of the Acheulean, the handaxes and cleavers remained as diagnostic types, but became relatively more refined with morphologies that were more consistent (Stout 2011). Along with the refinement of LCT production, the development of organised reduction strategies are found in both eastern and southern Africa. De la Torre (2009) describes a method termed bifacial centripetal hierarchal flaking that developed about 1.4/1.5 Mya during the Early Acheulean whereby knappers would flake a core in an asymmetrical fashion in order to prepare the upper surface for radial flakes struck perpendicular to that surface. This method is further described as being the precursor for flaking techniques seen in later industries, such as prepared core technology (De la Torre *et al.* 2003; De la Torre 2009).

Organised core reduction in the Early Acheulean has also been described at Rietputs 15, South Africa, at 1.3 Mya and is argued to represent evidence of the uppermost limits of cognitive abilities at the time (Leader *et al.* in press). The cores are morphologically defined as asymmetrical with a bulging lower side and a flatter upper side which have removals ranging from one large preferential flake to many flake removals. This technique is described as similar to the hierarchal centripetal flaking strategy seen at Peninj, Tanzania as they both demonstrate the precursor behaviour to more developed technological industries seen in the younger archaeological record (De la Torre 2009; Leader *et al.* press).

Determining whether the centripetal hierarchal flaking discussed by De la Torre (2009), or the organised core reduction strategy from Rietputs (Leader *et al.* in press), were present at Maropeng, and how refined the method was if used, may constrain the assemblage to a relative time frame within the Acheulean. Thus, if the formal tool types were made with simple primary removals and had limited secondary flaking only, as Pollarolo *et al.* (2010) argued, then the strategies adopted comply more with the earliest Acheulean. If there is some evidence of organised flaking and platform rejuvenation/creation, then the assemblage may be more complex than previously thought and could compare better with the Early Acheulean after about 1.5 Mya. A mixture of various flaking strategies could also indicate a time-averaged assemblage, a possibility discussed by Pollarolo *et al.* (2010).

### 2.2.3. Early Acheulean in southern Africa

Two of the most prominent ESA sites in the CoH, and southern Africa as a whole are Sterkfontein and Swartkrans. They are useful as comparative assemblages not only because they contain similar artefacts that have been dated (Field 1999; Granger *et al*. 2015), and could be used to relatively date Maropeng, as was done by Pollarolo *et al*. (2010). The geoarchaeological contexts and previous studies should be known when trying to compare the assemblages as they differ dramatically from Maropeng, which could lead to possible biases in the results.

There are limitations in using the Sterkfontein and Swartkrans as comparative assemblages because of the nature of analysis of the assemblages. The archaeological assemblages at these sites were analysed using a methodology established by Kuman (1994, 1998, 2001, 2007) and used by others in their analyses (e.g. Field 1999; Stratford 2008, Kuman and Field 2009; Sutton 2012; Moll 2014), a methodology that differs to the one adopted in this thesis. To achieve a cohesive integrative comparison between the data sets, the Sterkfontein and Swartkrans assemblages would have to be reanalysed in the same way, as the differences in analysis allow for a general understanding of archaeological trends across the landscape. More detailed orientated comparisons will be explored further in future publications of Maropeng.

*Sterkfontein*

One of the most well known archaeological and palaeoanthropological sites in South Africa is the Sterkfontein Caves. Some of the fossils found at the site include the famous *Australopithecus africanus* skull Mrs Ples, and the oldest and most complete hominid fossil in South Africa *Australopithecus prometheus,* with the current oldest published Oldowan in South Africa from Member 5 East dating to 2.18 Mya (Clarke and Kuman 2000, Granger *et al.* 2015), and an Early Acheulean assemblage from circa 1.6-1.4 Mya.

Sterkfontein archaeology was first described by Mason (1962), then Leakey (1970), and has since been discussed by many researchers. The site has a large Oldowan assemblage (3513 pieces, 84.17% of which are SFD), with 3180 pieces (making up 90.52%) on quartz (Kuman and Field 2009). The assemblage is characterised by expedient and casual production, with raw materials acquired from locations close to the site (Kuman and Clarke 2000). The most common core types are polyhedral and irregular polyhedrals (referred to as multifacial cores in this thesis) making up 25% of the assemblage each. Chopper cores make up 17% of the assemblage, and bipolar cores 13%. The rest of the core assemblage is made up of casual (8%), discoidal (4%) and single platform cores (8%) (Kuman and Field 2009).

As discussed above, the Early Acheulean assemblage has a total of 701 pieces (208 of which are manuports (30%), 258 are cores (37%), and 21 flakes >20mm (3%)), while a large portion of the assemblage (14.55%) is made up of chunks (Figure 2.8). The assemblage is found in the Member 5 West deposit, made on locally sourced raw materials such as quartzite, quartz and chert (Kuman and Clarke 2000; Stratford 2008). Winnowing has affected the deposit, leaving only 4% of SFD in the assemblage, while 72% is made up of large flakes and cores (Stratford 2008). The main core types are all primarily made on fine-grained quartzite, with an average of 4-16 removals (Field 1999; Stratford 2008). Chopper cores and heavy duty tools are rare, with only seven examples in the assemblage (Stratford 2008), but this is found alongside a greater focus on heavy-duty tool production than seen in the Oldowan (Kuman and Clarke 2000).

Field (1999), Stratford (2008) and Moll (2014) have all argued that there is limited exploitation of platform angles on blanks within the Early Acheulean at Sterkfontein from the Member 5 West deposit as well as artefacts from Dump 21. A third of polyhedral/ multifacial cores having remaining flakeable platforms, and no evidence of organisation or preparedness in knapping strategies, and suggest a trend of expedient flake production (Stratford 2008), though not as casual as the Oldowan.

| Artefact Types | Chert | Quartzite | Quartz | Total | % |
|---|---|---|---|---|---|
| Small flaking debris <20mm | - | 1 | 18 | 19 | 2.71 |
| Chunks <20mm | 14 | 54 | 44 | 102 | 14.55 |
| Incomplete flakes ≥20mm | 2 | 8 | 23 | 33 | 4.71 |
| Complete flakes ≥20mm | - | 8 | 13 | 21 | 3 |
| Retouch Pieces | - | 2 | 1 | 3 | 0.43 |
| Core Fragments | - | 7 | 4 | 11 | 1.57 |
| Flaked Flakes | - | 4 | 1 | 5 | 0.71 |
| Cores | 9 | 171 | 78 | 258 | 36.8 |
| Irregularly Fractured Cobble | - | 21 | 7 | 28 | 3.99 |
| Core tools | - | 7 | - | 7 | 1 |
| Utilised Cobbles | - | 2 | - | 2 | 0.29 |
| Manuports | 21 | 170 | 17 | 208 | 29.67 |
| Uncertain types | 2 | 2 | - | 4 | 0.57 |
| **Total** | **48** | **447** | **206** | **701** | **100.00%** |
| % | 7% | 64% | 29% | 100% | |

*Figure 2.8: Table of artefact types from the Early Acheulean at Sterkfontein. The large collection of manuports is not a feature seen at Maropeng due to the nature of the deposit and site formation processes (discussed further in chapter 5, under general observations). Taken from Stratford 2008.*

*Swartkrans*

Swartkrans lies about 1km north west from Sterkfontein and contains a rich collection of artefacts and fossils, as well as evidence of possible controlled fire at 1.5 Mya (Brain 1993). Five members are found within the cave, with Member 1 constituting an Oldowan assemblage and Members 2 and 3 falling into the Early Acheulean (Field 1999; Sutton 2012; Sherwood 2013). Leakey (1970) originally studied material from the breccia dumps, and classified the assemblage as Developed Oldowan B, but through more meticulous analysis of the relationship of the members, and further excavations, Clark (1991) argued that Member 2 and 3 were Acheulean deposits, while Member 1 had Oldowan material. Field (1999) reanalysed the material and argued that the material at Member 1 was indeterminate, and more material had to be recovered in order to properly ascertain the appropriate techno-complex. Sutton (2012) argued instead that the Member 1 assemblage is Oldowan due to the evident technological elements, analysed using a larger sample size. Field (1999) argued that that Member 2 and 3 material was best assigned to the Early Acheulean, due to the limited nature of shaping on artefacts, as well as the lack of handaxes among other LCTs in the assemblage.

*Rietputs 15*

Outside of the Cradle of Humankind there are two known Early Acheulean complexes in South Africa; Rietputs 15 near Windsorton, and Canteen Kopje near Barkley West, both found in the Northern Cape (Gibbon *et al.* 2009). The contexts of these sites differ significantly to cave sites in the CoH as they are open air and found in the Vaal River basin.

Rietputs 15 is an alluvial site complex containing five pits and an Artefact Collection Pit (ACP), located within the deposits of the lower Vaal River basin. The dates associated to the pits range from ca 1.26-1.73 Mya, while the ACP is undated, but argued to be older than 1.3-1.5 Mya. The archaeological assemblage contains characteristic tool types of the Acheulean, including handaxes and cleavers made on cobbles and large flakes, along with cores and large flakes, but the majority of artefacts are under 9cm (Kuman and Gibbon *in prep*). As discussed, recent work on the core reduction has defined a series of organised core flaking strategies that suggest behavioural complexity in Early Acheulean hominids (Leader *et al.* 2016).

Evidence of raw material impact on flake and tool size is demonstrated by Kuman and Gibbon (in press) at Rietputs 15, South Africa. Multiple raw materials are represented in the ACP (not associated with the 1.3 Mya deposit containing organised core reduction) but local Ventersdorp lava dominates, in quantity, but also represents the largest flakes. Other common materials include, quartzite, chalcedony and hornfels, along with quartz, dolerite, and cryptocrystalline. The various raw materials affected the shape and size of flakes, with Ventersdorp lava producing the largest flakes, while being used in all reduction strategies, and the dominant raw material for LCT production. The dominant core reduction strategies were bipolar, multifacial and chopper cores, all considered ‘simple’ strategies (Kuman and Gibbon *in prep*). Considering the lack of organised core reduction, and focus on locally acquired raw materials, the ACP industry is older than the Early Acheulean at 1.3 Mya at Rietputs.

*Canteen Kopje*

Canteen Kopje is located in Barkly West, in the Northern Cape province of central South Africa. It has a long archaeological record including Early Acheulean artefacts from three assemblages, including the recent excavations which began in 2009 at Pit 6, a new location to previous excavations. Each assemblage displays different technological trends, with the Basal Early Acheulean dating to older than 1.51 Mya, the Organised Core Technology Assemblage layer dating to 1.2± 0.8 Mya, and the youngest Prepared Core Technology layer Victoria West at 1.2±0.7 Mya (Leader

2013). The site was originally excavated in 1997 by P. Beaumont (Beaumont and McNabb 2000). Further significant work has been done on the Victoria West and Organised core layers of the deposit, being the subject of the PhD of G.M Leader IV.

The Basal Early Acheulean consists of 1074 artefacts, and was excavated by Dr Leader in 2009. The date of the layer corresponds most closely to that suggested by Pollarolo *et al.* (2010) for Maropeng of ca.1.6 Mya and thus will be primarily considered. The layer consists mainly of flaking debris (77% of assemblage) and flakes. Simple core reduction strategies are most common in the form of casual and irregular cores, a term used by Leader (2013). LCTs make up 3.1% of the assemblage, with cleavers being more common than handaxes. The Basal Early Acheulean layer is described as having no markers of organised or prepared core technology, as seen in the other two layers (Leader 2013). When comparing to Maropeng, it would be useful to determine whether that reduction strategies, and artefact representations were similar between the sites, to determine is Maropeng is more likely part of the Early Acheulean. The comparison will be limited, as a different methodology was used to describe core reduction, as well as the fact that there is a large proportion of SFG, not seen at Maropeng.

<u>2.2.4. Earlier Stone Age in eastern Africa</u>

The first work done of ESA was based on sites from eastern Africa (Leakey 1971; Isaac 1977) De la Torre *et al.* (2011-2012) focused on the emergence of the Acheulean at Olduvai Gorge, Tanzania. Researchers aimed to better understand how the Oldowan and Acheulean are connected. The Olduvai assemblage would be useful as there is evidence of multiple industrial complexes at Maropeng. Understanding the contexts and technological strategies adopted at various sites in East Africa would offer insight into whether there are also multiple industrial complexes in southern Africa during the ESA, as is suggested by Leader *et al.* (2016) for the Rietputs 15 organised core strategies.

Determining the context of the Maropeng archaeology, and how it fits into the already established work on the ESA, will only be possible if one understands how lithic analysis is approached and interpreted. The following assemblages from eastern Africa have all been significant in defining the general ESA, and the Early Acheulean, and for the basis of the technological archaeological work done at Maropeng, for both this thesis and Pollarolo *et al.* (2010).

### *Kokiselei 4, Kenya and Konso, Ethiopia*

The earliest known Acheulean comes from the site of Kokiselei 4 in Kenya and dates to 1.76 Mya (Lepre *et al.* 2011), and Konso, Ethiopia at 1.75 Mya (Beyene *et al.* 2013; Kuman 2014b; De la Torre 2016). Kokiselei is a complex made up of ten sites, most of which contain only Oldowan type tools. Kokiselei 4 is the only site in the complex with Acheulean type artefacts, and is contemporaneous to Oldowan sites. This suggesting that the two industries are not completely distinct but that the Acheulean developed out of the changing technological behaviours of ESA stone tool makers (Lepre *et al.* 2011). The Early Acheulean assemblage is made up of pick-like tools and crudely made handaxes along with simple core and flake types, made on locally acquired raw materials (De la Torre 2016). Shaping is limited, and often restricted to half of the piece, with hardly any shaping on ventral surfaces of flake blanks.

The Acheulean at Konso dates back to 1.75 Mya and is dominated by picks, then handaxes and cleavers. Handaxes are made on flakes blanks >15cm, with minimal shaping on ventral surfaces (De la Torre 2016), and is argued by Beyene *et al.* (2013) to be technologically and chronologically identical to Kokiselei 4. Because of the work from these sites, the technological components of the Early Acheulean were defined as an industry with crudely made LCTs, large flake and cobble blanks, and artefact shaping that focused on the shape of the original blank (Kuman 2014b).

### *Gadeb, Ethiopia*

Gadeb is located in the Upper Webi-Shebelle region of east-central Ethiopia, and is a complex of sites dating to between 1.45-0.7 Mya (De la Torre 2011). It was originally excavated in the 1970s under the direction of Stone Age archaeologist J. Desmond Clark, who mainly focused on typological analysis. More recent work aimed to study the same assemblages from technological point of view. The work of De la Torre (2011) showed a similarity in technological strategies across all the sites, indicating they all come from the same time period and techno-complex. There is evidence of two distinct lithic production modes at Gadeb, one for small flake production, and the other focused on LCT manufacture. The LCTs are generally unifacially worked, with little shaping and minimal symmetry. The flakes were generally produced in short reduction sequences, and the presence of only one or two dorsal flake scars dominates, however they vary in shape and size (De la Torre 2009).

Geoarchaeologically, there is much bias in the Gadeb assemblages due to the post-depositional processes. At various Gadeb sites there was heavy winnowing of deposits leading to a near absence of small flaking debris, and so a reliance on analyses of core reduction was necessary (De la Torre 2011). Maropeng shows similar patterns of disturbance and assemblage bias due to site formation and post-depositional processes, and so the final conclusions of this could be compared.

The technological diacritic analysis performed on the Gadeb assemblage from Ethiopia by De la Torre (2011) has formed the outline of core reduction strategies analysis used in this thesis. The image below details the multiple reduction strategies defined in the study, and how these patterns were achieved. The models of core reduction focus on the directionality of flaking and exploitation of the blank rather than the final morphological shape. Figure 3.11 represents the idealised versions of these cores on cubic blanks. These core types are divided not by morphological differences but by the pattern of flake removals, so cores with vastly different shapes but similar removal patterns will have the same core type.

Neither the unifacial nor bifacial patterns described by de la Torre (2011) are strategies which allow for long reduction sequences, they tend to run out of knapping platforms relatively quickly. Reduction patterns with bifacial working, represent cores that were exploited by rotating the surfaces and targeting as many platform angles as possible, both natural and those that appeared through knapping. This does not mean that knapper organised flake removals so to exploit the entire volume of the cores, which is evident at Gadeb 8D, whereby bifacially reduced cores had to be abandoned relatively early as angles became depleted while the central core mass remained (De la Torre 2011).

### 2.4. Raw material procurement

Raw material selection and transport have been used in studies regarding hominid behaviour and skill (e.g. Toth 1985; Jones 1994; Braun *et al.* 2008a, 2008b; Blumenschine *et al.* 2012). Choices regarding raw materials can provide an understanding of landscape use and movement of hominids (Toth 1985; Field 1999; Braun *et al.* 2008a; Stratford 2008; Blumenschine *et al.* 2012; Kuman and Gibbon *in press*). For example, at Sterkfontein, raw material sources of quartzite and quartz were easily available near to the site, and are the most common raw material types (Field 1999; Kuman and Clarke 2000; Kuman and Field 2009; Stratford 2008). It is also a vital factor to consider in technological studies as the quality of materials can dictate how and to what extent reduction occurs (Clarkson *et al.* 2006; Sherwood 2015). Differing raw materials flake in various ways due to their composition and shapes, which factors into core reduction (Jones 1994; Braun *et al.* 2008b; Sherwood 2015). For the example at Sterkfontein, there was a change from the Oldowan to the Early

Acheulean, as quartzite became more prominent in the Early Acheulean, whereas quartz significantly dominated in the Oldowan (Field 1999; Kuman and Clarke 2000; Stratford 2008; Kuman and Field 2009). Thus, despite the close proximity of both raw materials, knapper actively selected raw materials based on their needs and abilities (better quality quartzite to produce large flakes for LCTs, as well as heavy duty tools and edges) (refer to Sherwood 2015 for a discussion on raw material selection and quality).

Jones (1994) argues that depending on how the knapper is able to reduce a particular raw material, one may be able to infer cognitive capabilities and behavioural patterns. The organisation of flake scars often relates to raw material quality and so selection of particular raw materials could indicate cognition and behaviour. Thus, raw material choices are extremely important when understanding core reduction and flaking patterns because they could be a determining factor in the choices the knappers make throughout production.

At Swartkrans, as seen at Sterkfontein, there is a predominance of quartz in the Oldowan, with quartzite becoming more common in the Acheulean, while still not dominant (Sherwood 2015). However, quartz again becomes highly dominant in the MSA deposit, but at this time the selection process is more refined with knappers seeking out high quality quartz. Sherwood (2015) conducted experiments to understand the variations in raw material selectivity, and deduced it related to tool type production (as LCTs for the Acheulean, and scrapping activities in the MSA). For the Oldowan, the reasons for the dominance of quartz is most likely due to it being easy to locate and break, suggesting less developed technological abilities (Sherwood 2015).

In addition, distance from raw material sources can have a direct influence on the extent of core reduction (Newman 1994; Field 1999; Stratford 2008; Blumenschine *et al.* 2012). The further one is from a raw material source the smaller and thinner flakes become due to the need to preserve material from a distant source, as well as the fact that tools made on raw material procured from a distance are more likely to be reworked and resharpened. This model argues that the use of a certain raw material use decreases as distance increases (Blumenschine *et al.* 2012). Braun *et al.* (2008a) argue that reduction intensity is affected by distance, not only the amount of representation of a raw material. If one were to consider the general size of flakes and how they get smaller overall as distance increases, then it one could use it to possibly understand reduction intensity.

This thesis focused on the reduction strategies and considered reduction intensity of the assemblage from the in situ excavations. It did not address the sourcing the raw materials, so trying to determine how the source specifically affected the assemblage cannot be fully addressed. Morrissey (2015) describes how a quartzite ridge 200m away is a likely source for Maropeng, but further research is required to understand it better, and to apply distance models at the site, and determine how the observed reduction strategies and intensity are affected by the raw materials source locations.

## 2.5. Technological analysis

Studies of technological patterns within ESA assemblages need to consider multiple variables, such as the manufacture, use, and disposal of artefacts. The combination of these variables is defined by De la Torre and Mora (2009: 15) as the 'technological strategies' researchers aim to understand, and much work has been done as to argue how this is achieved. There are many arguments as to what influences tool makers to conceptualise and manufacture artefacts, such as ecological constraints versus cultural practices (De la Torre and Mora 2009). Despite the ongoing debates in lithic research, it is agreed that one needs to understand the advantages and limitations of the approach they adopt as this affects the interpretations and conclusions of analysis (De la Torre and Mora 2009).

### 2.5.1. Typology within technological analysis

Typological classification was first used by Mary Leakey (1971) to describe and analyse the type sites of the Oldowan at Gona, Ethiopia, and of the Acheulean at EFHR in Olduvai Gorge, Tanzania. This approach focuses on categorising the assemblage according to morphological traits (Krieger 1944), and was developed by the archaeologist F. Bordes (1961). Typology was used in many lithic studies and influenced some of the work of other researchers such as Isaac (1977a) in Olorgesailie, Tanzania, and has persisted to some degree in all subsequent lithic studies. In southern Africa, ESA assemblages have been classified using typological categories, such as seen as Sterkfontein (Kuman 1994, Field 1999; Kuman 2014a and 2014b), as well as at Maropeng (Pollarolo *et al.* 2010).

Typology is important when classifying and comparing assemblages as it can simplify the overall data by creating comparable, homogenised morphological groups, and aid identification of basic assemblage trends in intended artefact production (De la Torre and Mora 2009). As well as being useful for comparisons between sites and assemblages, the typological approach aided in differentiating the stratigraphic layers at Olduvai Gorge and defining chronological changes (De la Torre and Mora 2009).

Alone, however, typology does not allow for detailed analysis of specific interpretations of the behaviours of knappers, as morphological forms and categories are created by the archaeologist and often do not reflect details of raw material shapes and properties, knapper skill, or intra and inter-site variability (Humphreys & Thackeray 1983). Typological classifications may be useful when defining archaeological stages, but it relies heavily on a unilinear description of lithic evolution (De la Torre and Mora 2009). Because of the many limitations of purely typological analyses, they are no longer common in lithic studies, but the use of typological groups is still common for the purposes of comparisons.

### 2.5.2. Technological approaches

Researchers realised the limitations of the typological approach, and began to develop structures by which to study lithic assemblages in consideration of other variables such as site formation processes, interaction with and movement on the landscape, and technological variability (Isaac 1977b; Toth 1985; De la Torre and Mora 2009). Toth (1982, 1985, 1987) showed that knapping strategies and tools were relatively similar in shape and manufacture, but multiple factors influenced the way in which these processes occurred; such conclusions could not have been made using only a typological approach (De la Torre and Mora 2009).

Toth (1982, 1985, 1987) developed a system of studying core reduction patterns through flakes, by assigning into groups according the amount of cortex on both the platform and dorsal sides, defined as technological flake categories. There were six types in the model: type 1 has a cortical platform and fully cortical dorsal side, type 2 has a cortical platform and a partially cortical dorsal side, type 3 has a cortical platform and non-cortical dorsal side, type 4 has a non-cortical platform and a fully cortical dorsal side, type 5 has a non-cortical platform and a partially cortical dorsal side, and type 6 has no cortex on the platform or dorsal side (Toth 1982, 1985, 1987). The dominance of certain technological flake categories indicates not only the extent and patterns of reduction, but also if there were either natural processes or human interaction that affected the integrity of the artefacts and assemblage as a whole. Toth (1987) argues that if types 1-3 are present, they tend to be larger and suggest they large flakes were either unused or unmoved. It could also suggest smaller pieces (generally types 4-6) were winnowed out. When smaller more reduced types dominate, the opposite is true and larger more cortical flakes were removed or transported. However, Braun *et al.* (2008b) showed that the number of types 4-6 may depend on cores size, and not on exploitation, so that larger, less reduced cores can produce the same amount as smaller, more reduced cores, as it does not consider all the allometric effects. This needs to be considered in the results, as it may affect how we interpret the flake patterns.

Technological approaches have been used and developed for analysis of all archaeological periods with lithic material, but as we go further back in time analyses become harder, and explanations try to encompass general conclusions (Braun and Hovers 2009). It is therefore important to adopt approaches that can allow for the most data to be collected, and interpretations made for the specific site and study.

Technological studies centre around two main approaches, *chaîne opératoire* (e.g. Sellet 1993; Soriano *et al.* 2007; Soressi & Geneste 2011; Tostevin 2011) and reduction sequence approach (e.g. Shott and Weedman 2006). For the purposes of this project, the reduction sequence approach will mainly be followed. Because this approach focuses specifically on flaking strategies preserved on cores, it is suitable for addressing questions of the presence of certain techno-complex/es that may be represented in an assemblage biased by depositional processes and lacking smaller components of the archaeological record, *i.e.* complete and small flakes.

### *Chaîne opératoire*

The *chaîne opératoire* approach focuses on the need to reconstruct the process of reduction in order to understand an entire life cycle of an artefact and assemblage, and the approach necessarily requires well-preserved assemblages with high degrees of completeness (Shott and Weedman 2006; Tostevin 2011). Originally developed in the context of Middle and Upper Palaeolithic assemblages of Europe by Leroi-Gourhan (1964), it has subsequently become on the fundamental approaches by which archaeologists study lithic assemblages (Pelegrin 1985, 1990, 1991; Geneste 1985; Delagnes and Roche 2005; Tixier 2012).

The general explanation of the approach centres on the idea that cognitive ability can be measured through the various steps within a manufacture process, and that assemblages can reveal a know-how of artefact manufacture (Pelegrin 1990, 1991). The approach is a highly theoretical one whereby one aims to deduce the relationship of social factors, along with the physical and environmental factors that determine each stage of tool manufacture (De la Torre and Mora 2005). Despite all the advantages of c*haîne opératoire*, the reliance on complete assemblages limits the use of the approach on a site such as Maropeng, as is it unlikely the deposit comes from a single accumulation representing a single production (refer to Morrissey 2015 and the discussion above on the geoarchaeology of Maropeng).

*Reduction sequence approach*

Reduction sequence studies focus on how the core was worked and flakes were removed in order to infer what was happening in the mind of the knapper and surrounding environment (Bleed 2001; Shott 2003; Shott *et al.* 2011; Tostevin 2011). The approach focuses on the overall irreversible reduction of mass of an original blank, and the study of the detail of the physical and cognitive behaviours and skills demonstrated by the knappers (De la Torre and Mora 2005), and analysis includes "… a number of factors, including raw material accessibility, differential transport, patterns of site use, and tool function" (Kuhn 1991: 76). Quantitative analysis is significant in core reduction studies as it allows one to determine the extent of reduction and types of debitage production for specific localities and sites (Braun *et al.* 2008a and 2008b).

The reduction sequence methodology often rejects the idea that there are universal processes (such as the know-how for *chaîne opératoire*) within the production of stone tools, and rather considers that the stages of production manifest variably (Shott 2003; Shott *et al.* 2011). This can account for the ever emerging inter and intra-site variability in earlier lithic assemblages (Braun and Hovers 2009). Although the reduction sequence approach accounts for diversity of individual technological strategies, Shott *et al.* (2011) argue that the method does not reject the idea that overarching cognitive principals can influence and/or dictate technological decisions. The approach emphasises the flaking techniques adopted, and seeks to contextualise the specific artefact and its flaking patterns within a general reduction process (Shott *et al.* 2011).

Criticism of the reduction sequence approach often revolves around the fact that cores represent the finality of the reduction sequence, and if there are little to no flakes in an assemblage, one would not be able to study the entire life cycle of a particular core or assemblage (Braun *et al.* 2005; De la Torre and Mora 2005; Dibble *et al.* 2016). However, even when one cannot reconstruct an entire process of manufacture it would be possible to discern some information on reduction strategies because the focus would be on specific attributes rather than the overarching influences. Along with instances where assemblages are limited, the approach is useful when cores are generally exploited to a lesser degree (more expediently), such as described for Maropeng. In such cases, one could use individual attributes to infer general reduction strategies (De la Torre and Mora 2005, Pollarolo *et al.* 2010).

Dibble *et al.* (2016) argue that there are many problems within lithic analysis, which needs to be considered in any given study. One of the arguments is that researchers focus on the product found in the archaeological record as the final intended tool thought of by the original knapper. If one were to consider lithic production within a universal cognitive process, as discussed above for the *chaîne opératoire*, then it would be logical to assume each tool was made as it was found following a specific intention and production. The criticism of this idea revolves around the fact that stone does not disintegrate and so tools could be used over generations through resharpening and reduction and therefore their original form would not be evident in the final piece (Dibble *et al.* 2016).

Adopting a reduction sequence approach for the analysis if the Maropeng assemblage would also bypass need for a complete assemblage, as the focus would be specifically on the reduction strategies of cores and flakes. It would also be hard to deduce the social context of the site, due to the biasing from site formation processes, and general condition of the assemblage. De la Torre and More (2005) argue that in the earliest ESA it is difficult to understand the social structures from only the preserved inorganic remains (as is seen at Maropeng) and so the *chaîne opératoire* approach would not be appropriate.

# Chapter 3: Materials and methods

This chapter is divided into two main sections. First, the materials section will discuss the excavations and analysed assemblage, and then discuss the comparative assemblages. Second, the methods section will describe the excavation, then the analytical methods employed for this research.

## 3.1. Materials

### 3.1.1. Analytical assemblage

The assemblage that provided the primary data set for this project was recovered from in situ excavations at the Maropeng site since 2005. Excavations were conducted as part of an annual field school for archaeology undergraduates at the University of the Witwatersrand. These excavations were completed during the course of this research project.

The five trench excavations cover a total of 20 m² and yielded large numbers of cores and flakes and 12 LCTs. Artefacts were also yielded from geoarchaeological test pits located across the Maropeng site (Morrissey 2015). The excavated material analysed here comes the trenches and consists of 247 artefacts from the M1 trench excavation, 216 artefacts from M2, 139 artefacts from M3, 45 artefacts from M4 and 46 artefacts from South Pit (Figure 3.1). Once the excavated assemblage is analysed, comparisons will be made between this expanded, in situ assemblage and the original assemblage described by Pollarolo *et al.* (2010). In total, the assemblage size yielded from the five excavations from the ABH at Maropeng is 693 artefacts.

*M1*

M1 is an excavation of 8m² (4m x 2m) expanded from an initial test pit for the Pollarolo *et al.* (2010) study (Figure 3.2). It is located on the southern side of the walkway (the path seen between M1 and M2), and is the area where artefacts were initially discovered. M1 was excavated under the supervision of Dr Stratford over three years during the aforementioned Wits University archaeology field schools and closed in 2013. M1 was one of two controlled excavations closed before the start of this research project.

| | M1 | % | M2 | % | M3 | % | M4 | % | South Pit | % | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bipolar chunk** | 5 | 2% | 3 | 1.4% | 4 | 2.9% | 0 | | 0 | | 12 |
| **Bipolar core** | 2 | 0.9% | 1 | 0.5% | 1 | 0.7% | 0 | | 0 | | 4 |
| **Chunk** | 56 | 22.7% | 46 | 21.3% | 53 | 38.1% | 6 | 13.3% | 7 | 15.2% | 168 |
| **Core** | 22 | 8.9% | 52 | 24% | 29 | 20.9% | 1 | 2.2% | 7 | 15.2% | 111 |
| **Core chunk** | 10 | 4% | 11 | 5.1% | 2 | 1.4% | 0 | | 2 | 45.7% | 25 |
| **Flake** | 108 | 43.7% | 72 | 33.3% | 37 | 26.6% | 12 | 26.7% | 21 | 2.2% | 250 |
| **Flake fragment** | 28 | 11.3% | 11 | 5.1% | 0 | | 0 | | 3 | 6.5% | 42 |
| **Indeterminate** | 15 | 6.1% | 11 | 5.1% | 12 | 1.4% | 26 | 57.8% | 6 | 13% | 70 |
| **LCTs** | 1 | 0.4% | 9 | 4.2% | 1 | 0.7% | 0 | | 0 | | 12 |
| **Total** | 247 | | 216 | | 139 | | 45 | | 46 | | **693** |

*Figure 3.1: Breakdown of artefactual pieces yielded from in situ trench excavations of the ABH at Maropeng.*


*Figure 3.2: The Maropeng museum area with excavations M1, M2, M3, M4, and South Pit. Image taken from Google Earth Pro.*

The initial test pit excavated by Pollarolo *et al.* (2010) consisted of a 4m² area with one square excavated deeper than the ABH. M1 was then expanded east into an 8m² pit running roughly along a west east axis (Figure 3.3). The final two squares excavated only exposed the surface of the ABH in the north-west corner in order to clarify the topography of the deposit surface. Figure 3.4 shows the picture of the ABH that was drawn and used to describe the deposit in Pollarolo *et al.* (2010).

*Figure 3.3: West view of the M1 excavation after completion of excavations in 2013. The deepest part of the excavation is the small square on the north side of the site (right wall of excavation in image), which is seen in greater detail in the image below. The excavation covers an area of 8m². The ABH is clearly visible around the edge of the excavation. Photograph courtesy of Dr Dominic Stratford.*

*M2*

M2 is located on the opposite side of the walkway from M1 (Figure 3.2) and consists of 4m² (2m x 2m), with the top right corner of the excavation facing a north-west direction (Figure 3.5). The location was chosen as a test pit for the Pollarolo *et al.* (2010) study and was later expanded under the direction of Dr Stratford. It was originally expanded to a 6m² excavation but the two squares closest to the walkway were abandoned before the ABH was exposed in order to reduce water erosion and run off onto the walkway (Figure 3.5). I took over the excavations of M2 at the beginning of 2015 after the ABH had been exposed in all squares (Figure 3.6) and only a small number of artefacts had been removed. The excavation was completed in October 2015 after excavating through the ABH and reaching the sterile sediments below.

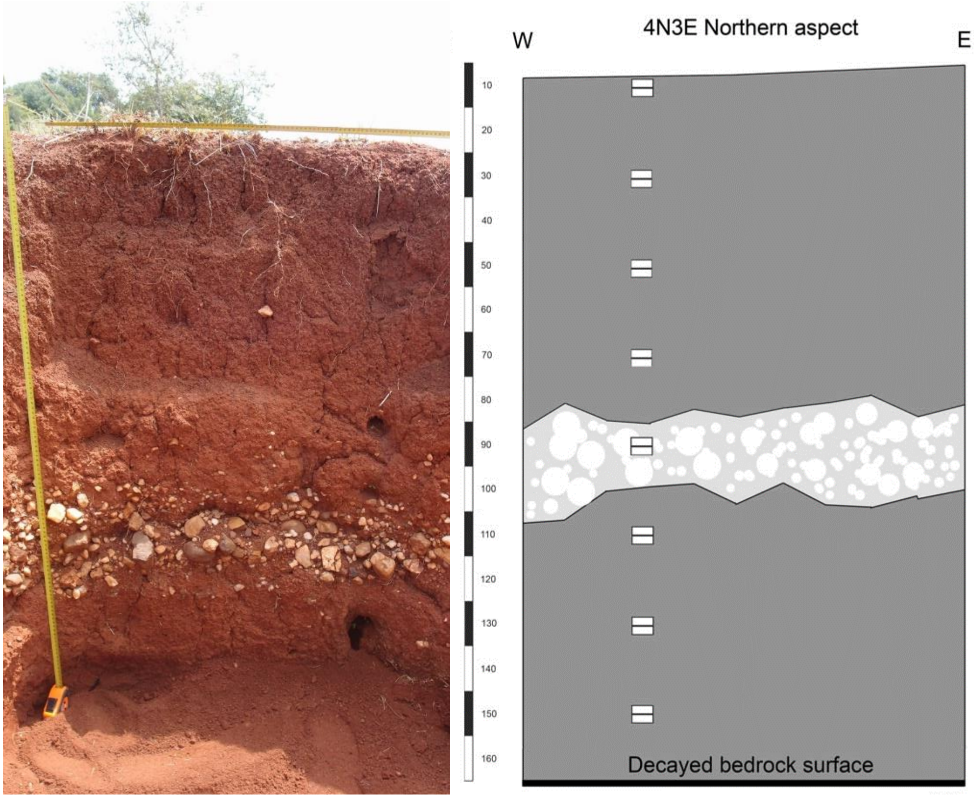


*Figure 3.4: Close-up of north section of wall in M1 at the deepest part of the excavation. The ABH begins at a depth of 80cm. This image was used as the basis of the ABH description in Pollarolo et al. (2010) (right), and clearly shows the distinct ABH layer.*

*Figure 3.5: View of the north wall from a southerly direction of the M2 excavation prior to the removal of the ABH. The pit covers an area of 2m x 2m. Photograph courtesy of Dr Dominic Stratford.*

*Figure 3.6: A view of M2 excavation facing north (2m x 2m) showing the exposed ABH. The two squares abandoned to avoid run off are shown on the bottom right side of the excavation. Photographs courtesy of Dr Dominic Stratford.*

*M3*

M3 is located a few metres south west of M2 (Figure 3.2) and consists of a 4m$^2$ (4m x 1m) trench orientated along a north south axis. The ABH was exposed at a depth of around 60cm from the surface (Figure 3.7). It was expanded northwards from a test pit set up for the initial Pollarolo *et al.* (2010) study under the direction of Dr Stratford, to understand the extension of the ABH around the marketplace. I again took over the excavation in 2015 and completed it in January 2016, when the ABH had been removed.

*M4*

The M4 excavation was expanded from the Triassic park test pit (TPTP, Figure 2.3), located to the north of M1, M2 and M3 (Figure 3.2). The initial test pit was excavated as part of the geoarchaeology study undertaken by Peter Morrissey in 2015, and it was expanded to a 3m$^2$ (3m x 1m) trench orientated roughly north south. The ABH is thicker than in other locations in this area and also appears to have a more varied size range of artefacts and clasts (Figure 3.8). The excavation did not descend through the entire ABH due to time constraints, but a representation of artefacts within the ABH was collected.

*Figure 3.7: Plan view of the M3 excavation with the original test pit excavated by Pollarolo et al. (2010) at the bottom (at the south end of the trench). Right (figure 3.5b): South view of completed excavation of M3. Photograph courtesy of Dr Dominic Stratford.*

### *South Pit*

South Pit is located south west of M2 and M3, on the opposite side of the marketplace (Figure 3.2). It consists of a 3m² excavation orientated along a north south axis (Figure 3.9). It was excavated during the field schools and completed in 2013 when the relatively sparse ABH had been fully excavated. This excavation, along with M1 was closed before the start of my MSc.

*Figure 3.8: Plan view of the M4 excavation with the original TPTP test pit on the north end (left side of trench). The excavation has halted at this point now, and so the excavated assemblage will only be a representation of the ABH at this location. Grid squares measure 1m x 1m. Photograph courtesy of Dr Dominic Stratford.*

*Figure 3.9: North facing view of the South Pit excavation after the ABH had been removed. This excavation had fewer clasts and artefacts than other locations in Maropeng, which is shown in the photograph, as there is no clear ABH. Photograph courtesy of Dr Matt Caruana.*

## 3.2. Comparative assemblages

### 3.2.1. Maropeng

The assemblage presented in Pollarolo *et al.* (2010) was recovered primarily from ex situ locations created by construction, such as the tumulus and spoil heaps (Figure 3.1), and consisted of mainly large artefacts, with a large proportion of LCTs (30.5%). There are 21 LCTs, 19 of which are >10cm (discussed in chapter 2) (Pollarolo *et al.* 2010). This is a much higher percentage of LCTs than found in the in situ excavated assemblage (refer to Figure 3.1 for the in situ assemblage sizes). The smallest artefacts recovered during the initial study range between 20-30mm, which indicates an absence of SFD, due to the colluvial site formation processes which would have winnowed it away. Much of the assemblage was also lost in construction, as there is a much higher representation of smaller artefacts such as flakes and chunks in the excavated assemblage. The collected Pollarolo *et al.* (2010) assemblage was thus biased and shows only a portion of the data seen in the excavated material.

### 3.2.2. Sterkfontein

Another comparative assemblage that will be used is the Early Acheulean assemblage of Sterkfontein (Kuman 1994; Field 1999). Comparisons will be made in greater detail than by Pollarolo *et al.* (2010). In particular, the core reduction strategies will be addressed based on the studies done by Field (1999) and Moll (2014) of the Sterkfontein material. These studies argued that the Early Acheulean polyhedral quartzite cores not fully exploited and the platforms not rejuvenated, most likely due to the proximity of the raw material sources to the site. More detailed and nuanced comparison are limited as the Early Acheulean assemblage from Sterkfontein has not been fully analysed and published, (see discussion in chapter 2). The assemblage has a number of roughly made LCTs, including pick-like shapes, a trait seen at Maropeng. Both these assemblages also fall within the date ranges of c. 1.7-1.0 Mya indicating an Early Acheulean time frame (Pollarolo *et al.* 2010) (see chapter 2 for more detail of the technological trends and reduction strategies at Maropeng and Sterkfontein).

Much of the technological research on reduction strategies in the ESA is based on eastern African assemblages (discussed in chapter 2, under Early Acheulean sites in eastern Africa). This analysis draws on published data for comparisons in this study, presented below under core analysis attributes (De la Torre *et al.* 2003; Braun *et al.* 2008b; De la Torre *et al.* 2008; Stout *et al.* 2010).

## 3.3. Methods

### 3.3.1. Excavation and documentation methods and techniques

The test pit excavations were conducted using arbitrary 'spit' depths below landscape surface. The top and bottom of the ABH was recorded as depth below landscape surface (using a DGPS) and artefacts removed from the ABH were isolated for study. The in situ excavations under Dr Stratford and myself were conducted in a stratigraphically sensitive manner with the use of a total station for artefact piece plotting. In all excavations, the ABH was exposed and recorded in situ before being excavated independently of other sediments or layers. A high-resolution spatial documentation protocol was used during excavation of the ABH to clarify processes of site formation affecting lateral and vertical distribution and orientation and dip of artefacts and clasts on the landscape. Using a digital documentation procedure developed from McPherron (2005), we employed a total station to plot orthogonal axes and upper and lower central points from individual artefacts and natural, elongated pieces of different size classes (Appendix 1).

This high resolution data allowed for sediment fabric data such as orientation and dip of clasts and artefacts, along with piece size and basic shape, to be recorded digitally in situ. This procedure took time, but it provided a resolution that satisfied the needs of the geoarchaeological component of the greater Maropeng research project, while also ensuring the detailed documentation of individual artefacts in situ. All artefacts measuring >20mm in maximum dimension were plotted using the total station, as well as documented through a system of paperwork for both individual artefacts in a catalogue and a field bag log. Once plotted and bagged, each bag was labelled with the same information as the artefact catalogue. Artefacts smaller than 20mm were recovered through dry sieving using a 2mm mesh. Sieved materials were inspected by hand for SFD. All stratigraphically relevant features were recorded with the total station and documented using georeferenced photogrammetry. Both stratigraphically sensitive and spot samples of sediments were also taken throughout the excavations.

## 3.4. Analytical methods

### <u>3.4.1. Typology</u>

As discussed in chapter 2, typology is useful as it allows for comparisons between assemblages based on artefact morphology (Stratford 2008). The typological terminology and classifications used in this study remain simple in that only a basic artefact type will be given (core, flake, handaxe, cleaver, pick, LCT roughout, and chunk) to conform to the existing classifications of the ESA at sites in South Africa, such as the Sterkfontein caves (Kuman 1994, 1998; Field 1999; Kuman and Field 2009), as Pollarolo *et al.* (2010) used at Maropeng. Further groupings of cores, flakes and LCTs will be done according to technological groups, as discussed below. There are of course limitations to using a typological comparison as Maropeng has such a biased representation of morphological types due to the nature of site formation processes.

### <u>3.4.2. Technology</u>

The analysed features of the technological types have been interpreted using a series of basic quantitative and statistical analyses along with some qualitative analysis. The attributes analysed are listed in the table below (Figure 3.10), along with descriptions of how each attribute was recorded. Because SFD does not appear to be preserved in the Maropeng assemblage, and small artefacts (20-30mm) proportions are low, this technological approach focuses specifically on evidence of core reduction strategies and flaking techniques preserved on flakes, cores and LCTs, as discussed in chapter 2 (a size range profile is presented at the beginning of chapter 4). Various attributes were studied from a technological approach that were used to identify a possible presence of organised core reduction (De la Torre 2009; Leader *et al.* submitted). These attributes include angle of remaining flakeable platforms, reduction intensity of cores, flake scar organisation, flake termination on cores, and raw material selectivity (as see in the Figure 3.2 and in the list of attributes below). The attributes laid out below all relate to the reduction of cores and tools and production of flakes by using technological analyses as discussed above.

The attributes analysed are suitable because they all relate to determining core reduction strategies (Braun *et al.* 2008b; De la Torre 2011). They are particularly suited to this research because they can be applied despite the assemblage limitations. Analysing features such as artefact type proportions within the overall assemblage cannot be conducted in this case because the site formation processes have resulted in the accumulation of a biased assemblage, and an incomplete chain of production (Pollarolo *et al.* 2010; see Dibble *et al.* 2016 for more information on factors that affect selection of appropriate lithic analysis).

### 3.4.3. Quantitative analysis

Linear regression analysis is used when one tries to understand how sets of data relate to each other. Data is arranged as a scatter plot along two axes, then a trendline is plotted through the data that follows the minimum distance between all the plotted points. From here the r-value is calculated, which determines how close the points are to each other. If the r-value is close to 1 or -1 then there is a strong positive or negative correlation, respectively (Drennan 2009). For this thesis, bi-variate linear regression analysis has been used when two sets of data are compared, such as maximum core length versus LFS length.

An example of how multiple linear regression analysis has been used in core reduction studies was demonstrated by Braun *et al.* (2008a), whereby they showed there was a correlation between lower core mass and more observable technological flake categories within raw material types. For accurately deducing core reduction intensity using this type of statistical analysis, one should adopt multiple linear regression. Bi-variate linear regression analysis focuses on only two features and how they relate to each other. In the focus of this thesis, the use of linear regression analysis is not to predict intensity of reduction, but rather to assess the relationship of specific variables, to determine the reduction strategies and patterns but understanding the factors that affect it.

### 3.4.4. Technological attributes

| **Cores** | **Flakes** | **LCTs** |
|---|---|---|
| *Quantitative features* | *Quantitative features* | *Quantitative features* |
| Amount of cortex | Dorsal flake scar pattern | Flake scars |
| Angles of remaining | Maximum length | Maximum length |
| platforms | Maximum width | Maximum thickness |
| Maximum length | Number of dorsal flake scars | Maximum width |
| Maximum width | Retouch/ Shaping | |
| Number of flake scars | Technological length | *Qualitative features* |
| Number of remaining | Technological thickness | Blank type |
| flakeable platforms | Technological width | Raw material |
| | | Shaping |
| *Qualitative features* | *Qualitative features* | |
| Blank type | Flake axis | |
| Core type | Flake completeness | |
| Raw material | Raw material | |
| Simple v. Organised | Terminations | |
| | Toth type | |

*Figure 3.10: Table of the attributes analysed in this thesis.*

Raw material – Selectivity and quality of raw material factor into the reduction processes and flaking techniques, as discussed in chapter 2 (Jones 1994; Sharon 2008; Brantingham *et al.* 2000; Blumenschine *et al.* 2012). If raw materials found at Maropeng are generally of a good quality, then the knapper may have actively selected the blanks. If there is a mixture of good and bad quality raw materials then there was a range of behaviours at the site.

*Cores and LCTs*

Amount of remaining cortex – Differing quantities of remaining cortex on cores and LCTs reflect the degree of reduction for cores or shaping for LCTs; therefore lower amounts of cortex on cores suggest more intense reduction reduced (De la Torre 2011; Goren-Inbar & Saragusti 1996), while large amounts of cortex on LCTs suggest minimal shaping. Remaining cortex quantities were proportionally documented using a percentage method (Goren-Inbar & Saragusti 1996), whereby no cortex is marked as 0, 1-25% remaining cortex is 1, 26-50% is 2, 51-75% is 3, and above 76% is 4.

Blank type – The blank shape and type would factor into how the core is reduced or the LCT shaped. The term blank refers to the shape of the rock from which an artefact is produced. An example of a blank would be a large flake that a handaxe was made on (De la Torre 2011). The blank types that will be considered are large flake, cobble, or angular block (following De la Torre 2011).

Core reduction strategies – Identifying to what extent cores are reduced and exploited would factor into the behavioural patterns of the stone tool makers (Field 1999), and cores will be classified according to the system developed by De la Torre (2011), which classifies cores according to the patterns of flake scars, rather than the general morphology of the core. Identifying if the cores belong to an organised or a simple reduction strategy can be determined using this model, and would help place the assemblage in a techno-complex time frame (De la Torre 2009). Along with determining the reduction strategy, the number of remaining flakeable platforms will be counted. These count as angles on a core up to 90°, and are used to infer the extent of reduction (Field 1999).

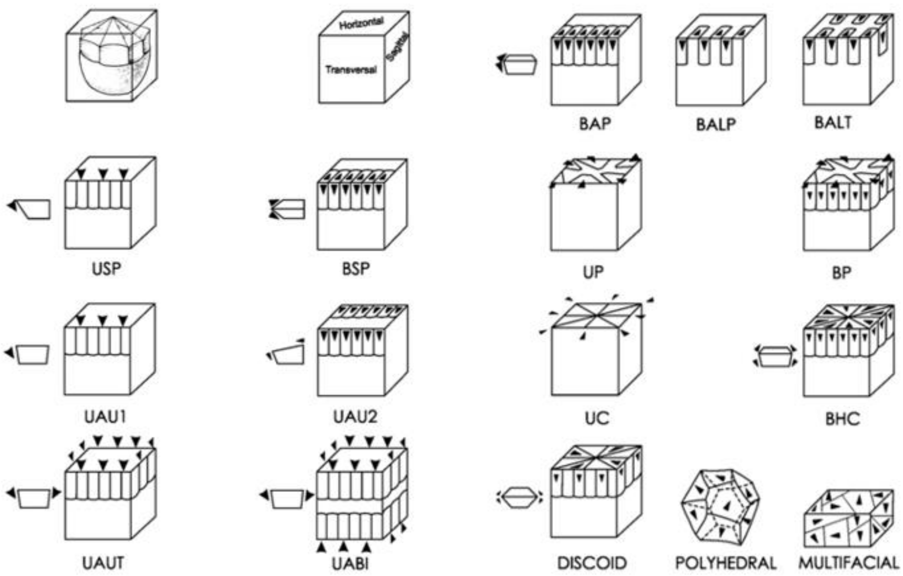


*Figure 3.11: The models by which De la Torre (2011) classified the reduction strategies for Gadeb, Ethiopia. Descriptions of the models are listed below.*

Strategies of free-hand core reduction (expanded from De la Torre *et al.* 2003; De la Torre and Mora 2005) (Figure 3.11). The list below gives the full title of each model set out in Figure 3.11, while the full descriptions are listed under Appendix 2. Taken from De la Torre (2011: 773).

1. USP: Unifacial simple partial exploitation.
2. BSP: Bifacial simple partial exploitation.
3. UAU1: Unidirectional abrupt unifacial exploitation on one knapping surface.
4. UAU2: Unidirectional abrupt unifacial exploitation on two independent knapping surfaces.
5. UAUT: Unifacial abrupt unidirectional total exploitation.
6. UABI: Unifacial abrupt bidirectional exploitation.
7. BAP: bifacial abrupt partial exploitation.
8. BALP: bifacial alternating partial exploitation.
9. BALT: bifacial alternating total exploitation.
10. UP: Unifacial peripheral exploitation.
11. BP: bifacial peripheral.
12. UC: Unifacial centripetal exploitation.
13. BHC: Bifacial hierarchical centripetal.
14. Discoid.
15. Polyhedral.

16. Multifacial.
17. Casual.
18. Bipolar.

Flake scars – This attribute analysis refers to the flakes removed in shaping an LCT or working a core (Kuman *et al.* 2014; De la Torre 2009 defines these as intermediate flakes). Following the work from De la Torre (2011) discussed in chapter 2, the number of flakes scars is counted and the dominant pattern of removals is described.

LCT length, width, thickness – These factors all contribute to analysing the technological patterns present in an assemblage, as it has been argued that raw materials and blank shape both influence the sizes of LCTs. If there is a consistency in the range of measurements despite raw material and blank differences, then it can be assumed that similar reduction strategies were adopted on all blanks (Sharon 2008, 2009). These features will be measured using digital callipers in millimetres.

Secondary removals and retouch/ Shaping for LCTs – This category includes both primary and secondary removals that relate to shaping of the blank (Kuman 2014; De la Torre 2011; Braun *et al.* 2008b), and this process is described in chapter 2.

Simple vs. organised cores – This classification determines whether there is an organised core component (as discussed above) in the assemblage and what kind of organisation may be used to place the assemblage within a techno-complex (De la Torre 2009 and Leader *et al.* submitted). As discussed in chapter 2, an organised core shows some forms of preparation for further removals from a particular platform, either in exploiting a suitable blank form, as seen at Rietputs 15 (Leader *et al.* 2016), or through a pattern that creates platforms as flakes are removed, as seen with the centripetal hierarchal cores from Peninj, Ethiopia (De la Torre 2008).

*Flakes*

Axes of flakes – The axes refer to the angle in which a flake was removed from the core. The axes are defined as end-struck, side-struck and corner-struck. If the flake is end-struck it is longer than wider, if it is side-struck it is wider than longer, and corner-struck refers to a flake with a diagonal maximum length (Isaac & Keller 1968; Mason 1965). The platform will be orientated along the horizontal axis. The placement of the point of impact on a flake can indicate the type of flakes the knappers aimed to get (e.g. wide and short, or long and thin), as well as give an indication of the type of platforms available on the cores.

Dorsal flake scars (pattern and number) – The flake scar number and pattern evident on the dorsal face of a flake indicate at what stage of core reduction it was removed. (Toth 1985; De la Torre 2009; Braun *et al.* 2008b). The number of flake scars is counted, along with a description of the actual pattern of flake removal, by orientating the platform horizontally. The specific directionality of dorsal flake scars referred to in this thesis come from Kuman (2001), where she explains that dorsal scar patterns indicate the stage of production from which that particular flake came. The patterns are listed below and come directly from Kuman (2001: 16).

1. Unidirectional: one direction, from the platform end.
2. Unidirectional-transverse: from the platform end and transverse (i.e., across this direction).
3. Convergent: converging distally.
4. Radial: centripetal or generally towards the centre.
5. Transverse-opposed: flaking directed from both laterals.
6. Parallel-opposed: flaking directed from proximal and distal ends.
7. Complex: varied directions combined.
8. Transverse: across from one lateral.

Flake terminations – There are four termination types: feather, hinge, step and overshoot (Figure 3.12). They relate to how the flake detaches from the core and can show the skill of knapper by how often they were able to produce complete flakes with good (feather) terminations (Andrefsky 2005).

Maximum length – The longest distance from the striking platform when aligned along a horizontal plane (Isaac & Keller 1968) (Figure 3.13). This will be measured using a callipers.

Maximum width – The longest distance adjacent to the maximum length (Isaac & Keller 1968) (Figure 3.13). This will be measured using a callipers (Figure 3.13).

Technological length – The length from the point of percussion, when the platform is aligned along the horizontal axis, to the distal end along a perpendicular axis (Braun *et al.* 2008b). They will be measured using callipers (Figure 3.13).

Technological width – The width perpendicular to the technological length (Braun *et al.* 2008b). They will be measured using a callipers (Figure 3.13).

Technological thickness – Thickness at the point where the technological length and width cross (Dibble 1997). They will be measured using a callipers (Figure 3.13).

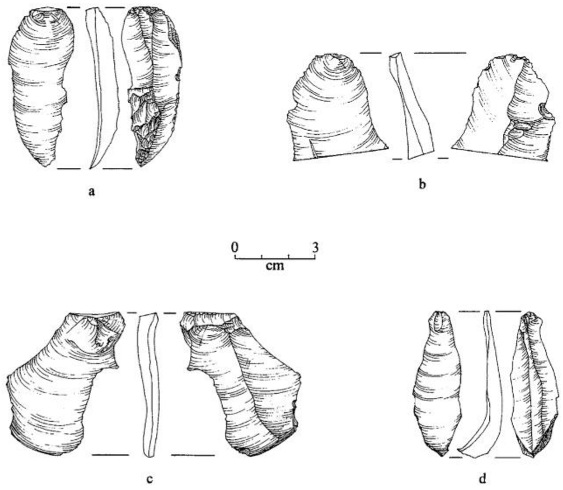


*Figure 3.12: Definitions of flake termination as used in this thesis. 1: feather termination, 2: step termination, 3: hinge termination, and 4: overshoot termination. Image taken from Andrefsky 2005.*

Technological flake categories – The location of cortex present on the dorsal face or platform of a flake will indicate at what stage of reduction the flake was removed (Toth 1985, 1987). There are six classifications that all reflect whether the flake was cortical or not and at what stage of reduction it was removed (Figure 3.13). This analysis does not account for allometric effects like mass, and can sometimes not be completely accurate in indicating reduction intensity in cores (Braun *et al.* 2008a). If there are a significant percentage of flakes from types 4-6, it could suggest an intense reduction sequence. However, if there is a dominance of type 3 flakes, it has been shown through experimental work that is indicates a predominance of unifacial core reduction, resulting in single platform type cores (Toth and Schick 2011).

Using size measurements focused solely on length, width and thickness do not account for allometric effects. Mass is a variable often considered in lithic analysis to understand size ranges across sites, and in the case of reduction, to understand intensity. In the case of this thesis, this variable will not be considered due to the size range bias in the assemblage from formation and post-depositional processes, and thus the mass of artefacts was not originally recorded. The focus of this work is on identifying the reduction strategies, and the dominant techno-complex of the assemblage, which is evident through the models of De la Torre and Mora (2005). This does mean that the final interpretations will be limited, but they will be tempered with the limitations. Due to the size and time constraints of this work, these allometric variables in relation to reduction intensity will not be addressed here, but will be explored when publishing this work, as they could allow for detailed insights into the specific technological behaviours at Maropeng, as well as add to the already detailed geoarchaeological work.

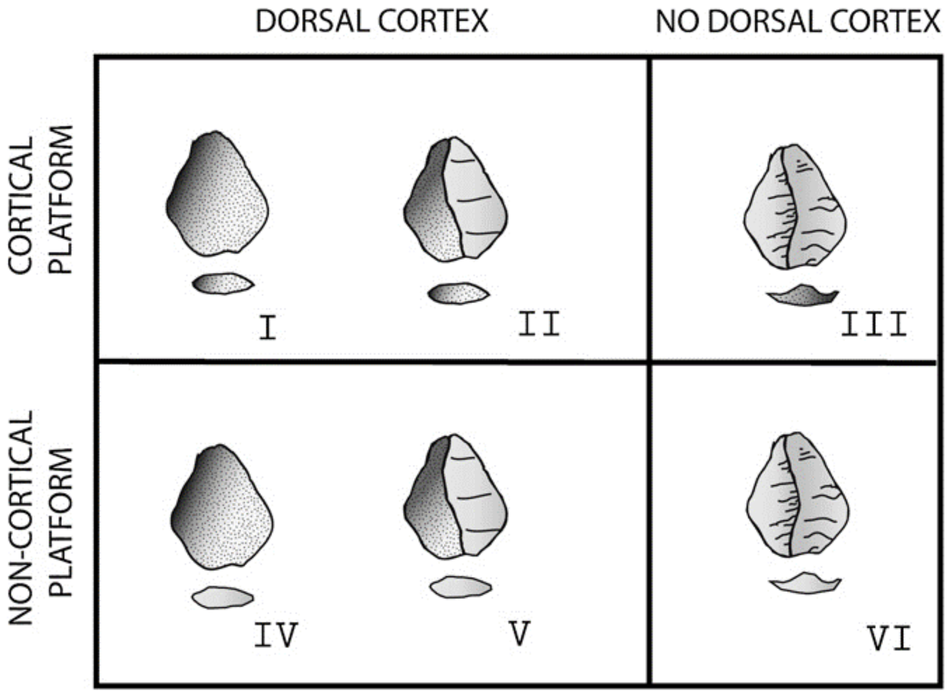


*Figure 3.13: Technological flake categories descriptions as used in this thesis. Image taken from Braun et al. 2008b (adapted from Toth 1985).*

# Chapter 4: Results

Following the geoarchaeological work of Morrissey (2015) which is described in chapter 2, this chapter will present the data individually from all the sites, then bring them together for a general assessment of the assemblage. It will first discuss the raw materials and general artefact types, then the LCTs, then the cores, and lastly the flakes. Under each of these sections, the specific technological types and strategies will be discussed, and will consider the excavated assemblage as a whole in order to properly ascertain the general reduction strategies. As discussed in chapters 2 and 3, the methods of Braun *et al.* (2008), Kuman (2001), De la Torre (2011), and others will be used to study the core reduction strategies, as well as other indicators of reduction.

## 4.1. General observations

A total of 693 artefacts was excavated and recorded from the in situ excavations, which are presented in chapter 3 (Figure 3.1). 596 of those were individually recorded pieces plotted in situ. M1 and M2 had the largest assemblages, as well as the largest excavations, even though these factors were not dependent on each other. South Pit was a 3m x 1m excavation (only slightly smaller than M3) but had the fewest artefacts from a fully removed ABH (the full ABH at M4 had not been removed).

No manuports or hammerstones were recovered in the excavations or initial Pollarolo *et al.* (2010) surveys. As there are many chunks of natural rocks found within the ABH, multiple raw material sources in proximity, and no clear evidence that the ABH represents a manufacture site, it would be impossible to ascertain if rocks were deliberately carried to the area or battered. The identification of battering was not possible as the artefacts are generally decayed and weathered, and it is clear that there was a great deal of syndepositional and post-depositional in situ breakage (site context is described in detail in chapter 2 under the geoarchaeology of Maropeng).

The dominating types at all excavations are flakes and chunks, with very few LCTs (n=12), bipolar pieces (n=15), and retouched pieces (n=7). There were also many pieces categorised as ‘indeterminate’ because they appeared to have been broken during the reduction process, but due to factors such as abrasion and weathering, cannot be analysed (n=70).

### 4.1.2. Raw material

Quartzite dominates the entire assemblage with 65.4% of in situ artefacts, with a significant proportion of quartz (28.2%), followed by dolerite (4.4%), and unidentified materials (1.5%) (Figure 4.1). The very few instances of artefacts made on the contact of quartzite and dolerite (henceforth referred to as QDC) make up 0.5%, and are only found in M2 (Figure 4.2). Quartz is most common for chunks (n=81, 13.6% of total assemblage), and quartzite is used for LCT and core production (Figure 4.3).

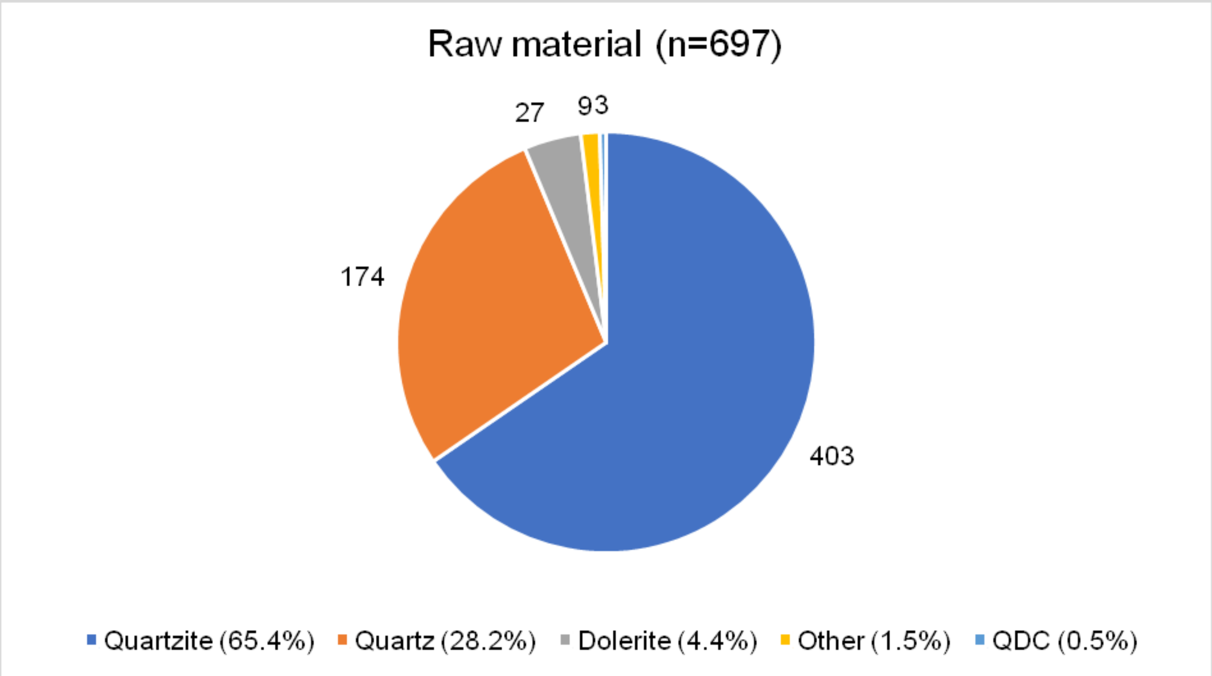


*Figure 4.1: Raw material of the entire Maropeng assemblage.*

This project did not deal directly with the questions of raw material sources and quality, but both could heavily influence the technological strategies. As discussed in chapter 2 under the raw materials section, ESA hominids made active choices in selecting raw materials, and these changed depending on the time period, species and techno-complex (Field 1999; Kuman and Field 2009; Sherwood 2015). The data collected for this thesis shows that quartzite and quartz dominated the assemblage, however, quartzite was more common. These two raw materials were readily available in the area and CoH (Field 1999; Stratford 2008; Sherwood 2013).

The raw material distributions between the excavations reflected the predominance of quartzite (Figure 4.2), however in M4 there are slightly more quartz artefacts (n=8) than quartzite (n=6), although this sample is not yet large enough to consider representative. At M1, the presence of quartzite (n=167, 76%) more than triples that of quartz (n=49, 22%), with only two examples of dolerite. M2 has more of a representation of quartzite (n=134, 62%) than quartz (n=65, 30%), and has the most examples of dolerite (n=11).

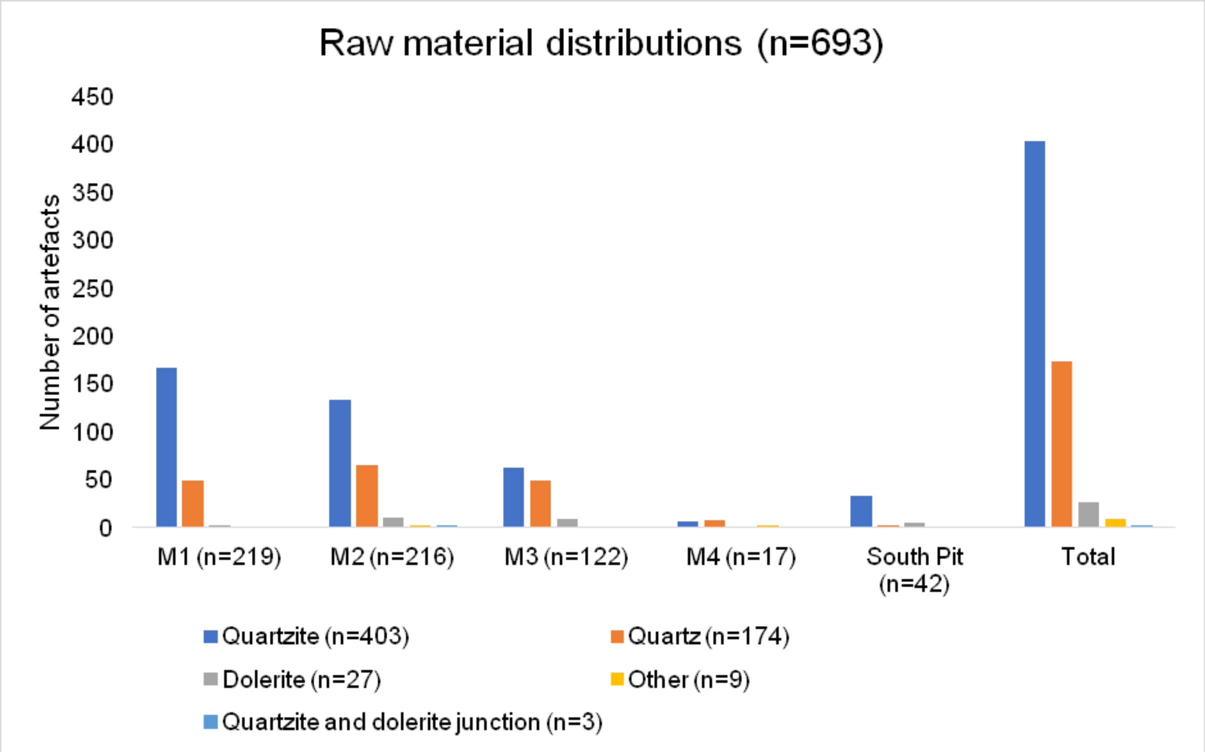


*Figure 4.2: Bar graph of the raw material distributions throughout the Maropeng excavations. It shows the number of pieces of each raw material type across the sites.*

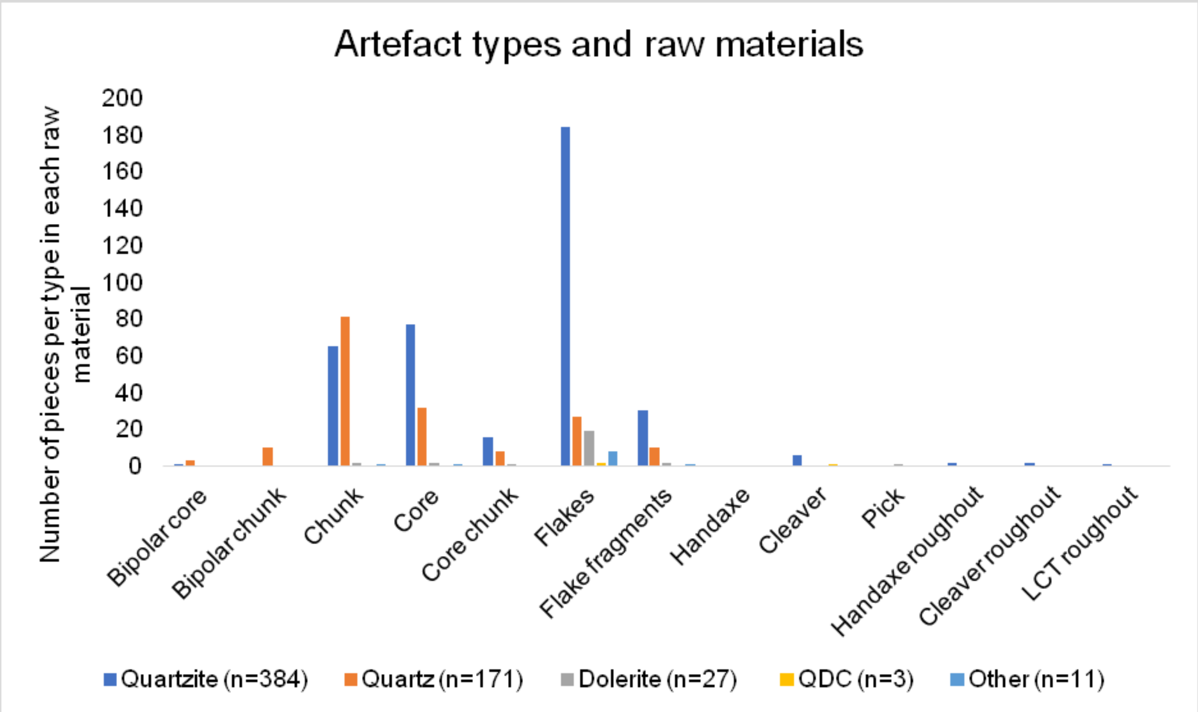

*Figure 4.3: Figure showing total assemblage of 596 individually recorded pieces and their corresponding raw material.*

4.1.3. Size profiles

All the flakes fall within the size range of 20-120mm (Figure 4.4), with the majority around 30-70mm. The average maximum flake lengths group from 20-79mm (Figure 4.5), while the maximum widths range between 10-69mm (Figure 4.6). These size ranges suggest that flakes were quite varied in shape, with many being wider than longer, or fairly square in shape. Further data on the technological measurements of flakes is presented in this chapter, under the section on flakes. The cores vary much more significantly in size range, with most of the cores around 60-69mm and 110-119mm for both maximum length and width, indicating that generally blocky clasts were used for the assemblage (Figures 4.7 and 4.8). The size ranges show that the cores generally get wider as they get longer. Both the cores and flake sizes need to be considered alongside the other information presented in this chapter in order to determine whether the differences are based on specific reduction strategies.

Figure 4.4a

| Flakes | | M1 | M2 | M3 | M4 | South Pit |
|---|---|---|---|---|---|---|
| Maximum length (mm) | Max | 118.7 | 134.7 | 113.3 | 118.7 | 85.6 |
| | Med | 46.4 | 60.1 | 61 | 45.6 | 57.4 |
| | Min | 31.9 | 25.6 | 20.9 | 23.6 | 38.5 |
| Maximum width (mm) | Max | 86.6 | 89.1 | 84.9 | 84 | 61.5 |
| | Med | 44.3 | 44.2 | 42.5 | 34.2 | 42.8 |
| | Min | 19 | 16.6 | 18 | 14.2 | 27.3 |
| Technological length (mm) | Max | 94.8 | 94.5 | 72.7 | 72.2 | 75.1 |
| | Med | 41.9 | 45.7 | 42.9 | 32.4 | 42.7 |
| | Min | 19.4 | 16.6 | 13.4 | 15.4 | 28.5 |
| Technological width (mm) | Max | 96 | 124.6 | 97.5 | 107.1 | 76.4 |
| | Med | 43.7 | 47.3 | 43.8 | 38.7 | 45.6 |
| | Min | 18 | 15.1 | 15.3 | 15.3 | 23.7 |
| Technological Thickness (mm) | Max | 33.9 | 50.6 | 37.1 | 30.1 | 130 |
| | Med | 12.1 | 16.9 | 14 | 11.5 | 14.8 |
| | Min | 3.5 | 2.7 | 4.8 | 6 | 3.4 |

Figure 4.4b

| Cores | | M1 | M2 | M3 | M4 | South Pit |
|---|---|---|---|---|---|---|
| Maximum length(mm) | Max | 128.8 | 226.5 | 165 | 45.3 | 104.2 |
| | Med | 80.4 | 92.7 | 84.45 | 45.3 | 86.4 |
| | Min | 34.8 | 36.7 | 39.5 | 45.3 | 47.7 |
| Maximum width (mm) | Max | 109.3 | 116.6 | 155 | 39.7 | 77.6 |
| | Med | 65.7 | 69 | 75 | 39.7 | 63.6 |
| | Min | 29.9 | 32.9 | 32.5 | 39.7 | 38 |
| **LCTs** | | | | | | |
| Maximum length(mm) | Max | 135.5 | 136 | 136.2 | N/A | N/A |
| | Med | 135.5 | 126.9 | 125.7 | N/A | N/A |
| | Min | 135.5 | 113.3 | 113.3 | N/A | N/A |
| Maximum width (mm) | Max | 77.6 | 113 | 80.9 | N/A | N/A |
| | Med | 77.6 | 91.2 | 74.9 | N/A | N/A |
| | Min | 77.6 | 72.3 | 68.7 | N/A | N/A |
| Maximum thickness (mm) | Max | 39.8 | 49.9 | 47.6 | N/A | N/A |
| | Med | 39.8 | 42.2 | 36.4 | N/A | N/A |
| | Min | 39.8 | 28.3 | 28.3 | N/A | N/A |

*Figure 4.4: Tables of the maximum, minimum and median of each size measurement has been given in millimetres.*

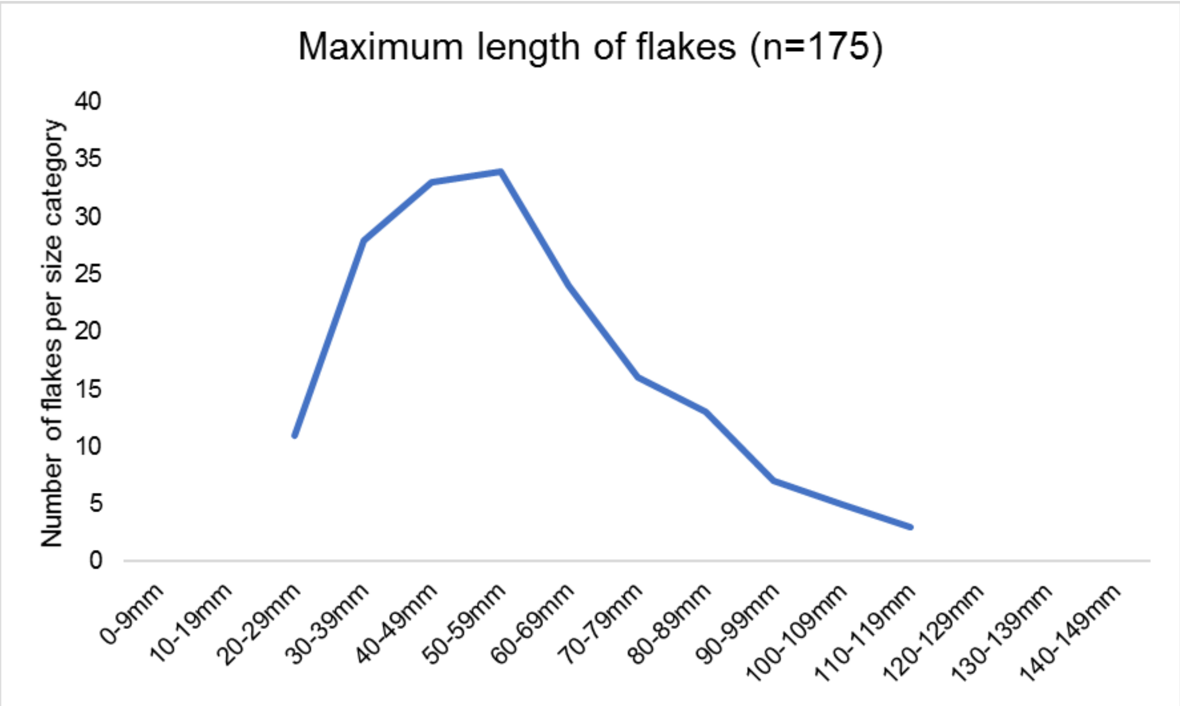


*Figure 4.5: Ranges of the maximum length of complete flakes.*

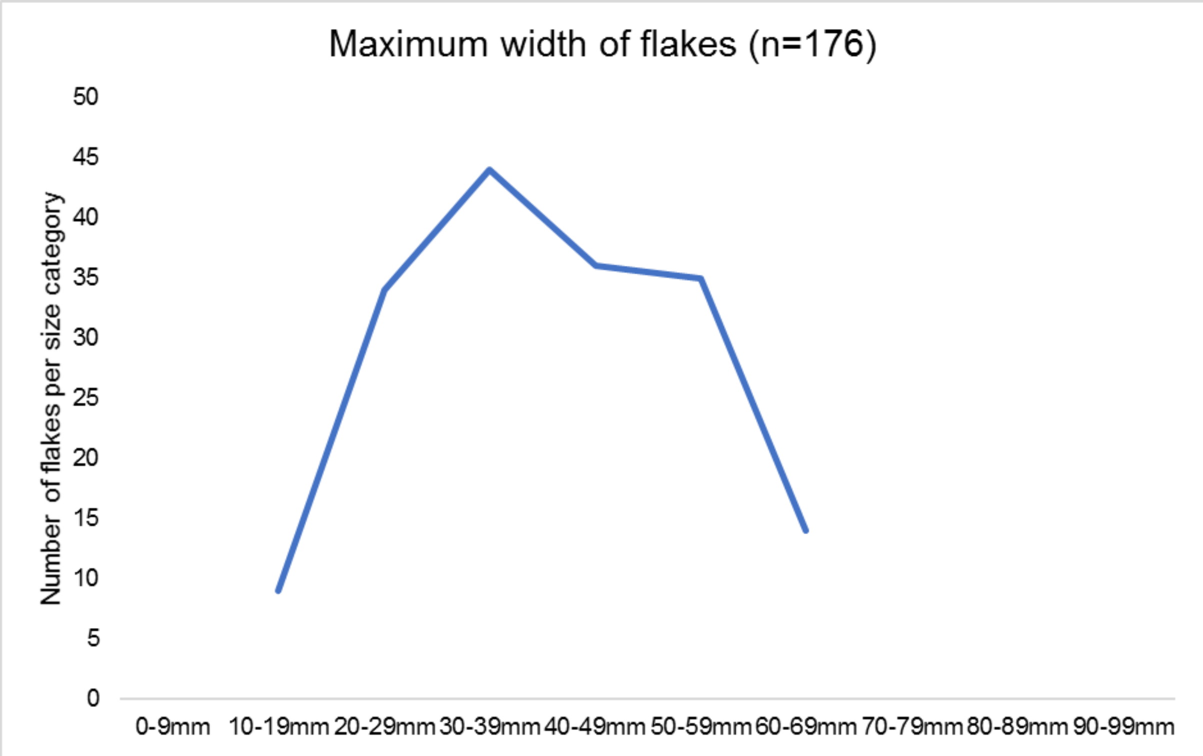


*Figure 4.6: Ranges of the maximum width of complete flakes.*

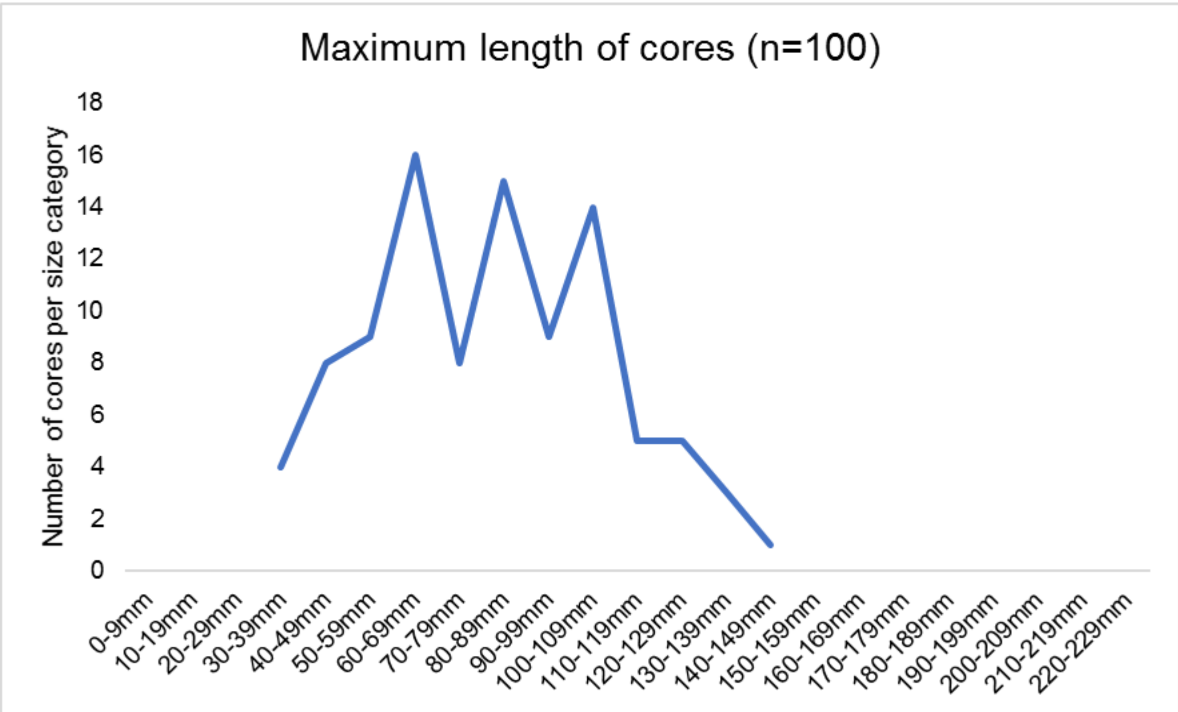


*Figure 4.7: Ranges of the maximum length of cores from a total assemblage of 131 cores. There is one core from M2 with a maximum length of 226mm, which is not pictured on the graph.*

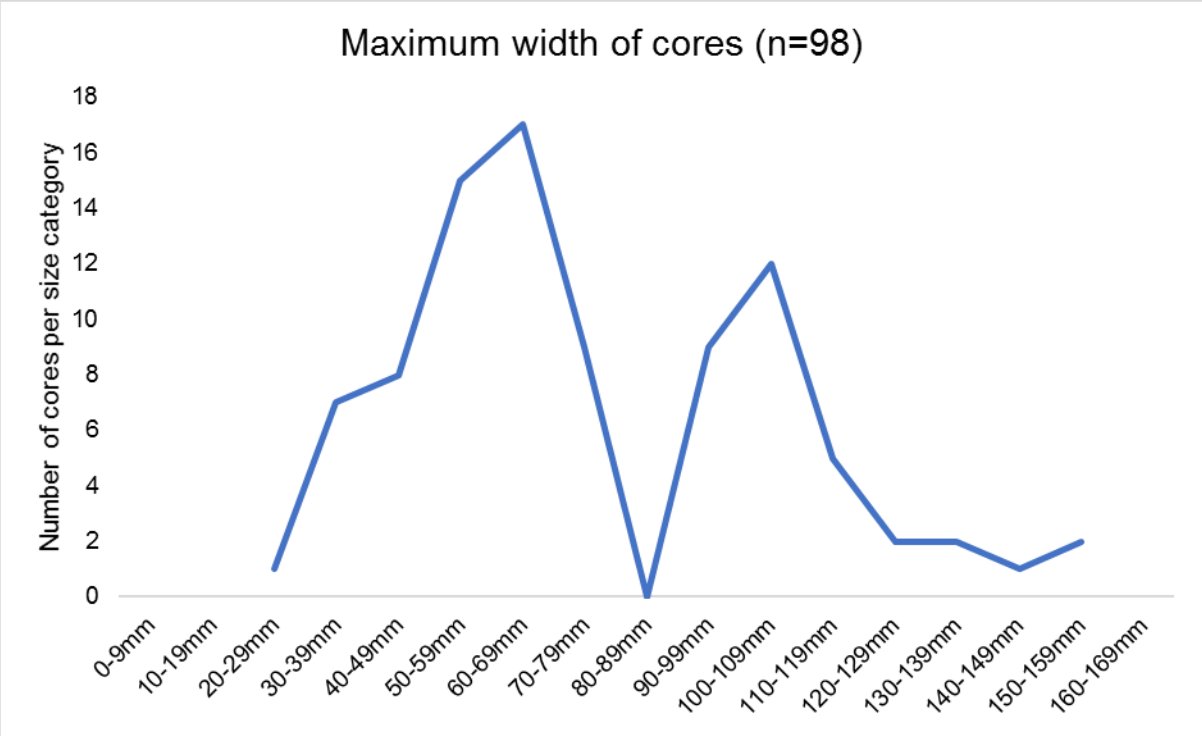


*Figure 4.8: Ranges of the maximum width of cores from a total assemblage of 131 cores.*

*M1*

Within M1 (n=247) there is consistency in flake size. Both the average maximum and technological lengths, as well as the average maximum and technological widths fall within the range of 40-50mm. Figure 4.4 shows that the average flake thickness is one of the lowest at Maropeng (12.1mm), with only the average thickness of M4 as lower (11.5mm). The cores tend to be much larger (86.4 mm) than the flakes (42.4mm), and follow a similar pattern of size throughout the excavations. The LCT is the largest throughout the excavations, with a maximum length of 135 (Figure 3.1), but as it is a single piece it may not be a significant representation of size distribution.

*M2*

M2 (n=216) has the largest artefacts among cores and flakes by both average length (90.0mm) and width (68.0mm), except for the average maximum flake lengths, and core width, where M3 is slightly larger (Figure 4.4). It also has the smallest LCTs when compared with M1 and M3, but as discussed this may not be significant when compared to M2.

*M3*

M3 (n=139) follows the same patterns seen in M2 (Figure 4.3), with similarly sized artefacts across all measurements (average maximum flake length of 61.0mm, flake width of 42.5mm, core length of 85.1mm, and core width of 71.6mm). The average width and thickness of the LCTs is significantly larger at M3, but are not the longest. The cores are generally quite large, around the same range as M1, M2, and South Pit.

*M4*

M4 (n=45) has the smallest artefacts of all categories (Figure 4.4). The maximum average core length is 45.3mm, and maximum average flake length is 45.6mm. All average sizes range between 32.4mm (average maximum flake width) and 45.6mm (average maximum flake length), minus average technological thickness (11.5mm). M4 is the most isolated excavation (Figure 1.2), which needs to be considered when discussing results, as the location could have gone through different post-depositional processes to the other excavations, and represent a more mixed part of the ABH (see Morrissey 2015 and chapter 2, under the Maropeng section, for details on the geoarchaeology of the area).

*South pit*

South pit (n=46) artefacts fall into the same size ranges as M1, M2, and M3 but is the smallest assemblage to come out of the excavations around the marketplace (n= 48; Figure 1.2). Like M4, South Pit does not have any LCTs, but this is most likely due to the fact that it is a small assemblage.

## 4.2. LCTs

A total of 12 LCTs was found in the in situ controlled excavations (1.6% of the overall assemblage), one from M1, six from M2, three from M3, and none from either M4 or South Pit (Figures 4.8 and 4.9). These 12 include three handaxes, three cleavers and one pick, as well as two cleaver roughouts, two handaxe roughouts, and one LCT roughout (Figure 4.10).

### 4.2.1. LCT size ranges

The size ranges of maximum length, width and thickness are quite consistent among all the LCT types. The measurements all fluctuate within a 20mm range. The minimum length of LCTs is 113.3mm and the maximum length is 136.2mm. The minimum width is 68.7mm and the maximum width is 85.4mm. The maximum thicknesses of the LCTs is the most inconsistent measurement (within the range of 20mm), ranging between 28.3mm and 49.9mm. Once all the data is presented, the size ranges can be interpreted as to how they affect the reduction strategies. Size ranges of handaxes and cleavers have been used to understand the refinement of shaping, as well as to compare LCTs across sites and continents (Kuman *et al.* 2014). Length has the most range, and the width is quite limited. It is clear that the LCTs get longer but not necessarily wider, while none of the measurements vary significantly from the average size. The thickness of the LCTs, like the length, varies more than the width but does not range widely (no more than 10mm between the minimum and maximum sizes of all measurements). Generally, all the pieces have a similar length to thickness ratio, suggesting there was not much refinement, which could suggest limited or no thinning of blanks.

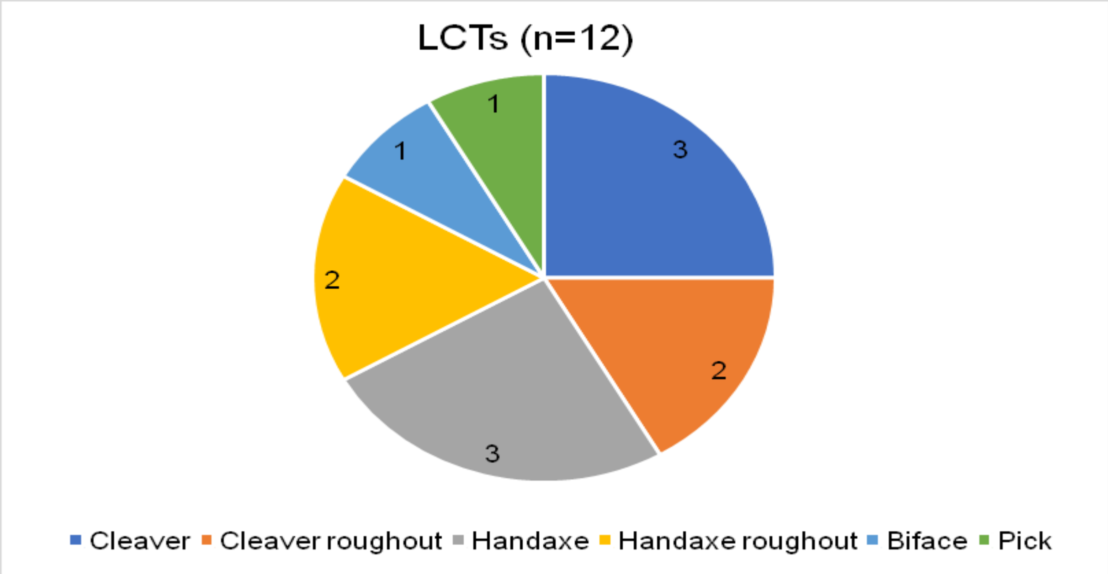


*Figure 4.9: LCT tool types distributions for all of Maropeng.*

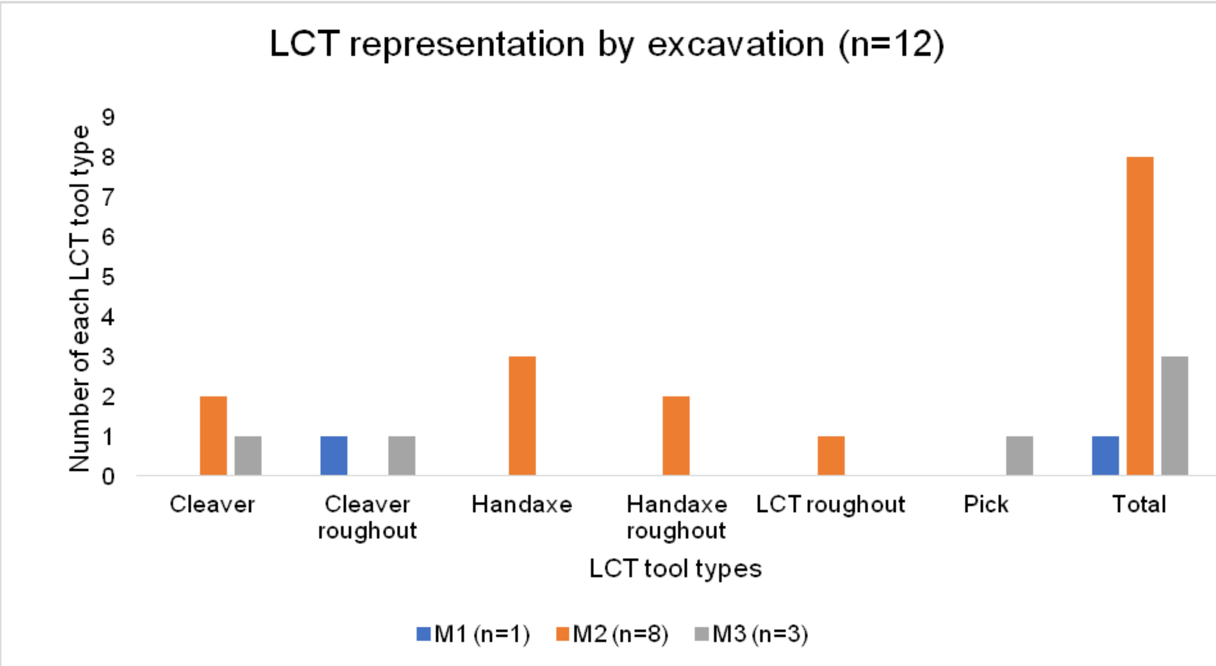


*Figure 4.10: LCT tool types distributions across all excavations.*

4.2.2. Blanks

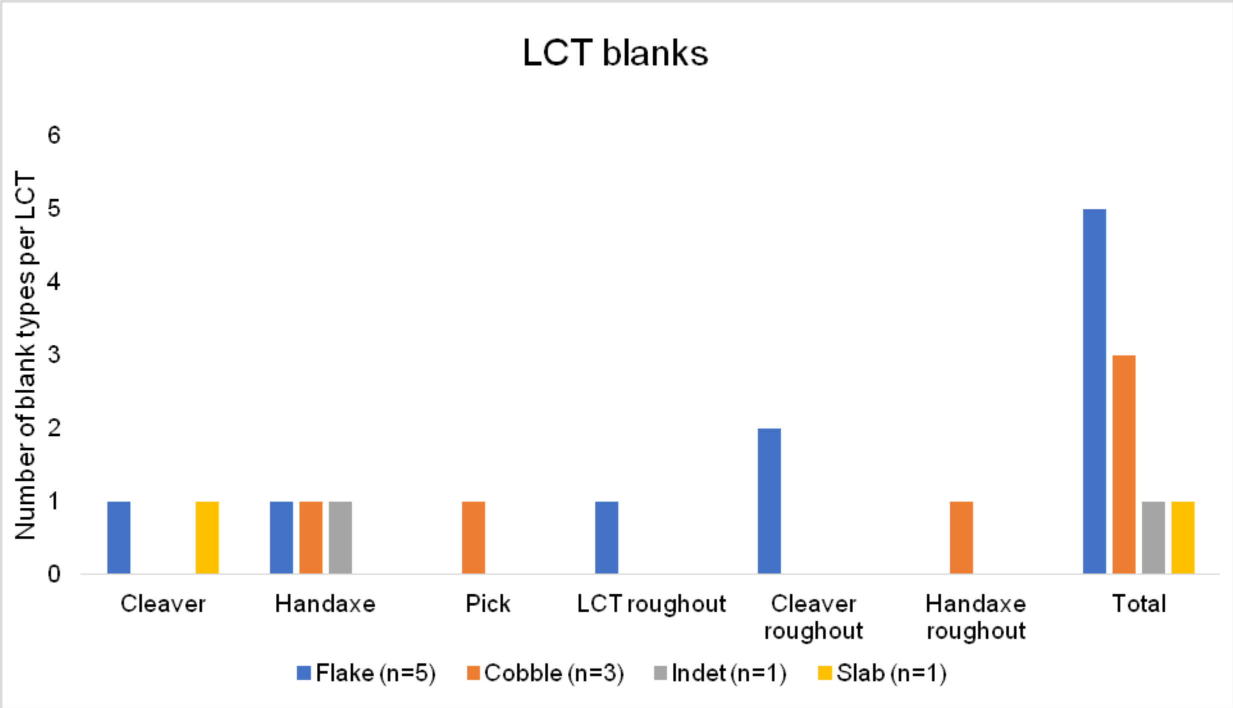


*Figure 4.11: Bar graph showing the LCT blanks and tool types made on those blanks.*

*Figure 4.12: Front and back view of a cleaver made on a natural slab. The left side shows how only primary shaping was used in shaping the tool (photographs by R. Moll).*

The majority of LCT blanks was made up of large side-struck flakes (n=7), a few cobbles (n=3), and one unidentifiable blank (Figure 4.11). Cleavers were all made on large flakes, except for one case where the blank was a quartzite tabular piece (Figure 4.12). The only damage on this cleaver is found along the tip, which was already naturally thin and somewhat flat. At the base of the flat side (right image) there is a chunk missing, and the piece is not very rounded. Shaping of the piece is unifacially restricted along the edges and base (left image).

Three cleavers and three handaxes were found in the in situ excavations, with two roughouts of each type. The handaxes were produced on all three of the blank types (one flake, one cobble, and one unidentified blank), and the handaxe roughouts on one flake blank and one cobble. The pick was made from an angular cobble (Figure 4.13) and the LCT roughout was on a large flake. As the LCTs are not heavily reduced, the original blank shapes are retained, and they are found to be longer than they are wider, for both large flakes and cobbles.

*Figure 4.13: Front and back view of a pick made on an angular cobble (photographs by R. Moll).*

4.2.3. Shaping

Figure 4.14 shows the number of removals for all the LCTs. One roughout has only one removal on the base of the artefact, and is not assigned to any particular LCT type. One handaxe roughout (Figure 4.15), one handaxe, and the pick have the most removals (32, 21, and 20, respectively). The majority of LCTs fall within the range of 7-13 removals (n=6), and the average number of removals is 11.3 (calculated including the piece with no flake scars).

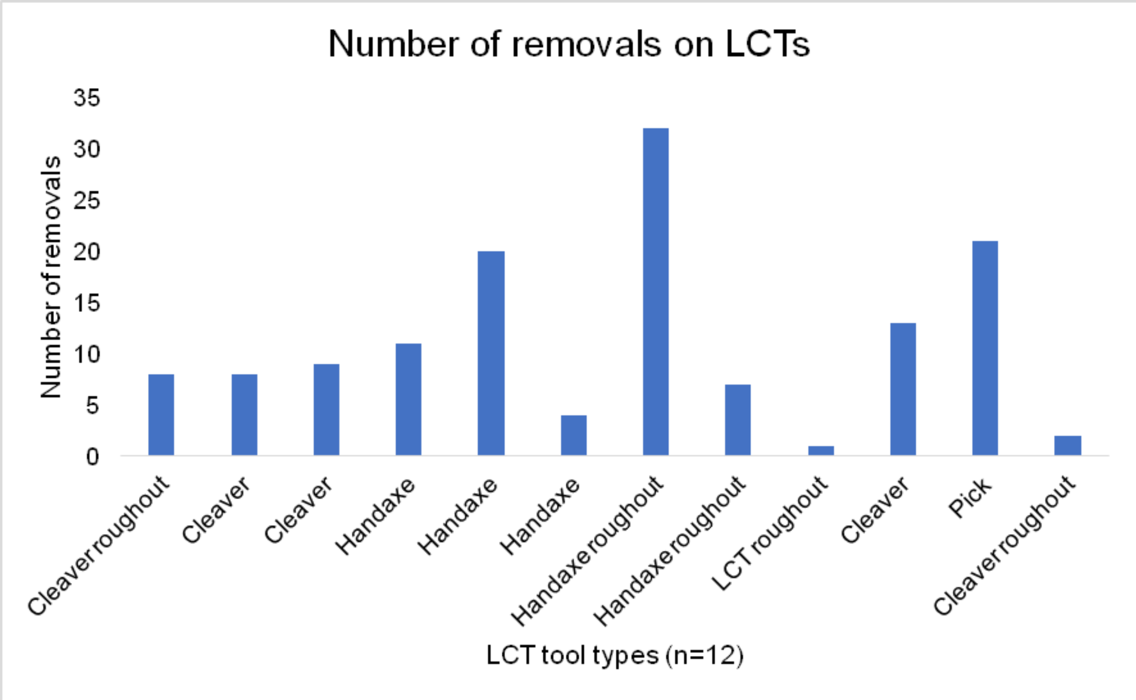


*Figure 4.14: Bar graph showing the number of removals for individual LCT tools.*

*Figure 4.15: Front and back view of a handaxe roughout made on cobble. The left side shows large primary shaping to thin the central mass. And right image shows further attempts of thinning that failed (photographs by R. Moll).*

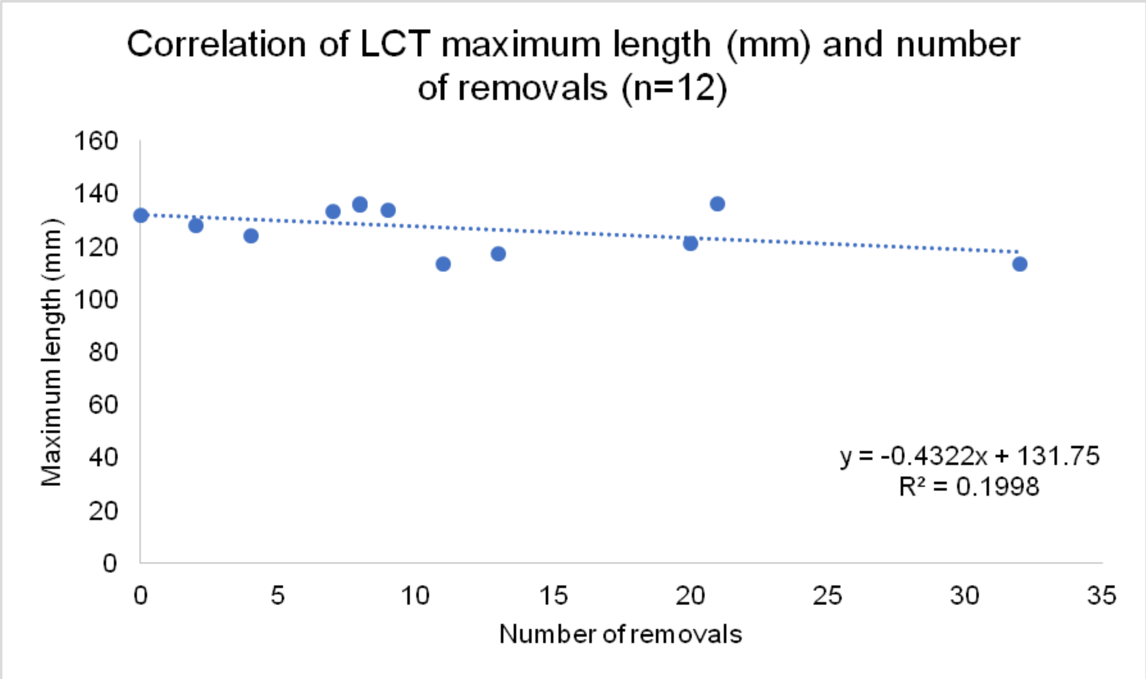


*Figure 4.16: Regression analysis showing the correlation of LCT maximum length (mm) and the number of removals.*

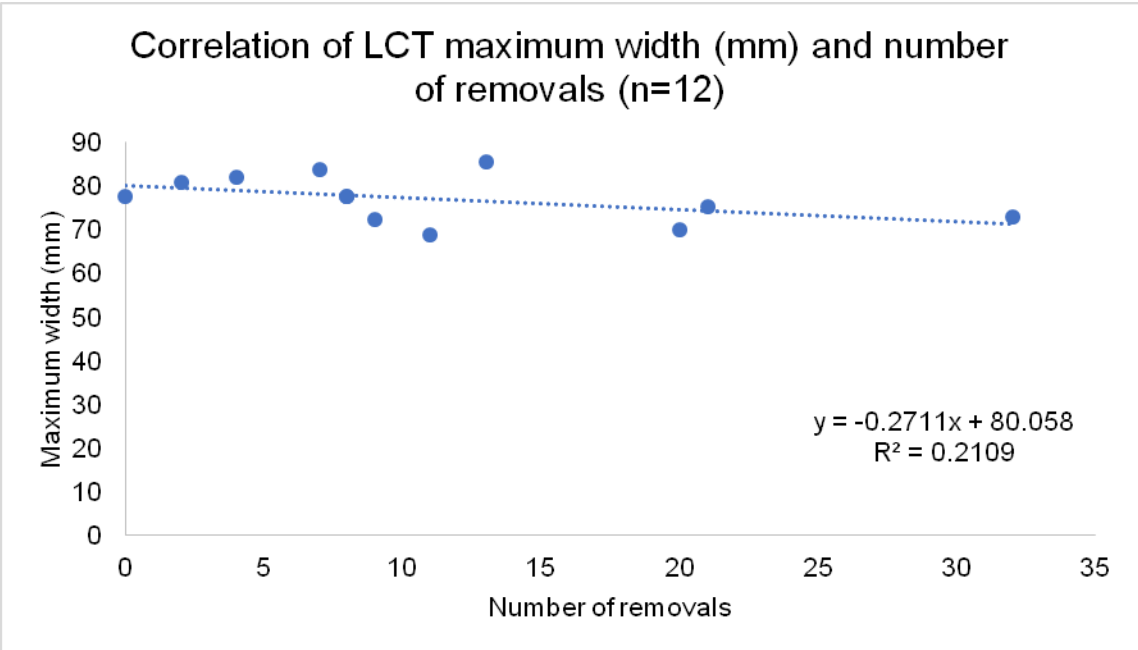


*Figure 4.17: Regression analysis showing the correlation of LCT maximum width (mm) and the number of removals.*

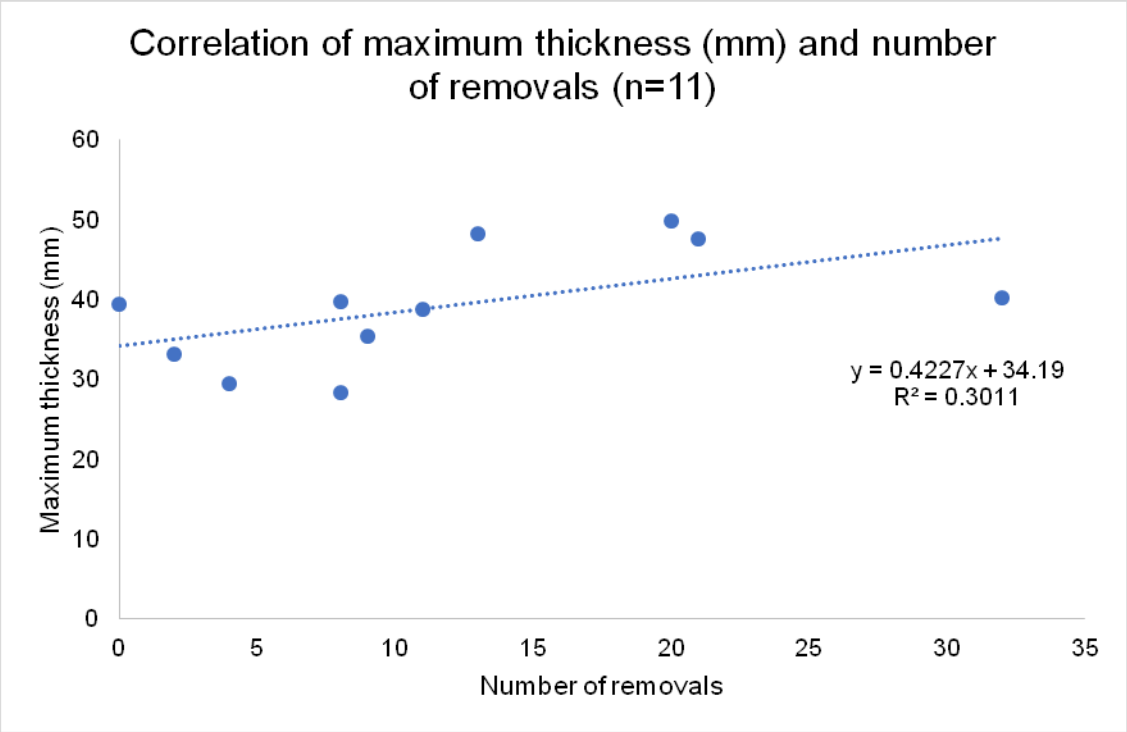


*Figure 4.18: Regression analysis showing the correlation of LCT maximum thickness (mm) and the number of removals.*

The above three graphs (Figures 4.16, 4.17 and 4.18) show that there is very little correlation between overall LCT size and the number of removals, which is evident from the wide range of numbers of removals shown on Figure 4.14 (bar graph), and the general consistency in size ranges, (as seen in Figure 4.10). There is no significant correlation between LCT maximum length (r-value of 0.1998), width (r-value of 0.2109), and thickness (r-value of 0.0292) to the number of removals. Knappers aimed to remove flakes and shape LCTs in order to create a working edge or tip, but they were either not trying to or unable to thin the piece.

While considering the work done by Pollarolo *et al.* (2010), the LCTs from the in situ excavations were studied with a more in depth analysis of tool production and shaping, in order to address reduction of LCTs (described in chapter 3). In addition to analysing the extent of primary and secondary shaping (Figure 4.19), the LCT types and blanks to which these are attributed will also be considered (Figure 4.20). The reduction strategy is also considered, to determine whether there is a similarity between the types of limited working of LCTs and cores.

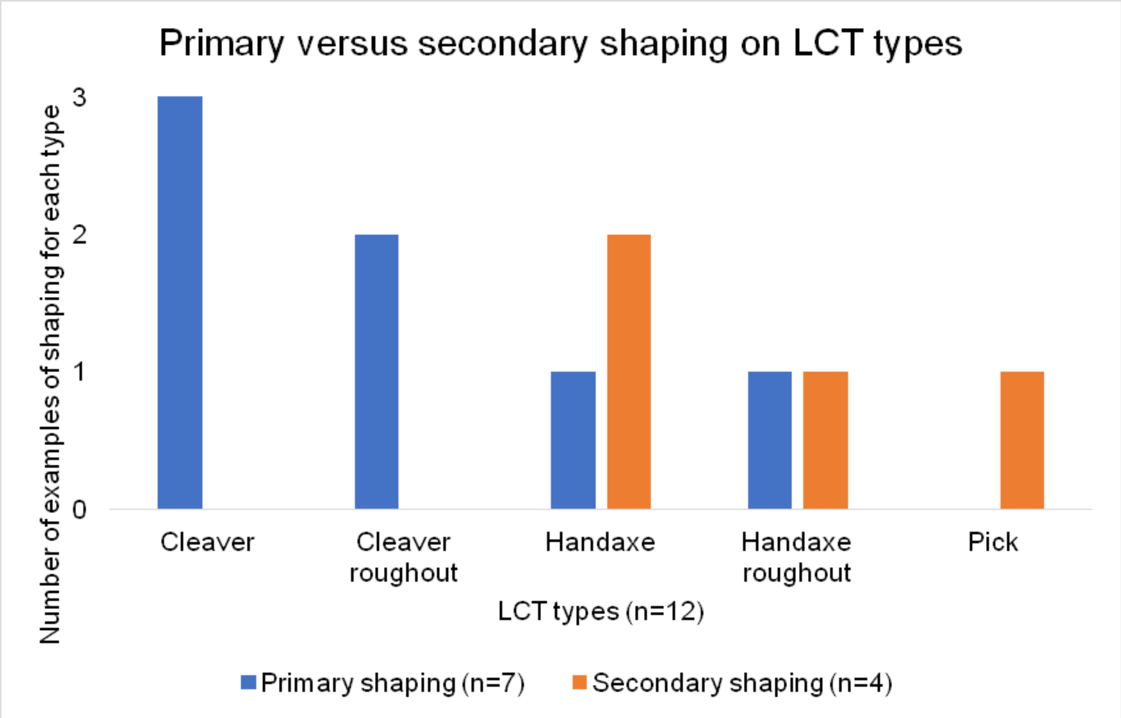


*Figure 4.19: Distribution of primary and secondary shaping on LCT tool types.*

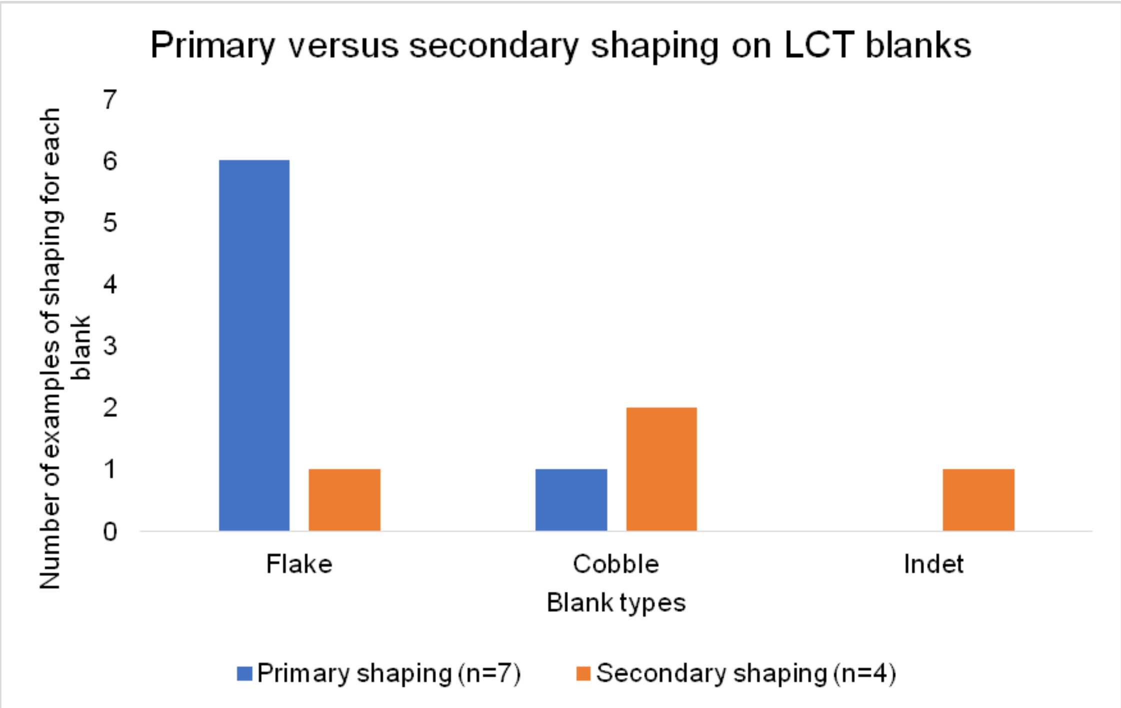


*Figure 4.20: Distribution of primary and secondary shaping on LCT blanks.*

*Figure 4.21: Front and back views of a handaxe from M2 that shows the limited nature of shaping (photographs by R.Moll).*

*Handaxes*

The intensity of shaping varies between the LCTs, with handaxes having between four and thirty-two removals. Only one handaxe (made on a large flake) has fewer than five removals, which are all large and constitute primary shaping. The main shaping is found along the lateral edges of the LCTs, with little to no shaping on the distal end of the tools.

Figure 4.15 is a quartzite handaxe roughout made on a cobble that was abandoned during the knapping stages. The right image shows a naturally flat surface with removals, which knappers attempted to thin but failed, abandoning the piece. The shaping is bifacial and unidirectional along one edge, with the flakes on the left image round and short. The shape of the blank on the left image had greater volume, and the knappers did not appear to try and thin the piece from this side, instead the focus was on creating a trimmed edge.

Figure 4.21 shows a quartzite handaxe made on a cobble, which is thick and pick-like. Shaping is primarily focused along the side towards the tip (right), and some shaping, also towards to the tip, on the opposite side (left). The pattern of shaping is radial, with the largest removals seen on the right image as large side-struck flakes directed towards the centre. Other shaping is only found on the edges towards to centre and base of handaxe shown in Figure 4.21 (right).

In the cases of multiple removals, reduction strategies followed a radial pattern and the flakes are short and wide. Figure 4.22 (below) is a bifacially worked quartzite LCT with multiple removals (likely a handaxe roughout) which was most likely abandoned during production. There are multiple removals going around the piece, with large removals seen on the left side, top, and right side of the base. On the right side of the piece there is evidence of multiple removals and step fractures where knapping was abandoned.

In all cases of multiple removals (save for one example, the handaxe in Figure 4.21), shaping is abandoned as the flakes become small, with hinge fractures. These flakes do not aid to the thinning of the piece, as they do not intrude far into the central mass. The flakes follow a horizontal angle, with the one case of a longitudinal removal along the length of the piece made in an attempt to thin the tip (Figure 4.22, top of LCT). These are similar patterns as seen on some of the cores, and could suggest they were made in the same production process.


*Figure 4.22. LCT roughout made on quartzite (photographs by R. Moll).*

*Cleavers*

The cleavers were all shaped using only primary flakes, with no more than thirteen removals on any of cleavers. The reduction strategies follow a radial pattern, with flakes being short and wide, and in the case of the quartzite cleaver in Figure 4.23, rounded. Bifacial intensive shaping is not evident on the cleavers, even as previous shaping on the dorsal side of the blank.

The cleaver in Figure 4.23 is long and wide, and made on a flake blank. Shaping in restricted to the ventral surface (right image) except for one very wide and short removal on the dorsal face that ended in a hinge fracture, and the ventral face is shaped in a radial pattern. Evidence of thinning the business ends of cleavers is limited, and only obvious in the example of Figure 4.23 (right), where the flake scars meet at the centre. On the right side of the tip (on the right image of Figure 4.23) there is evidence of multiple removals that snapped off with step fractures and eventually abandoned. These removals again follow a horizontal plane form the lateral edges, and appear to be an attempt to thin the tip. The right image shows the larger removals used to thin the central mass.

*Figure 4.23: Front and back views of a cleaver from M2 that shows attempted shaping of the tip (photographs by R.Moll).*

*Picks*

Figure 4.13 shows a crudely made pick on an angular cobble. The photograph appears to show multiple removals, but there are only four identifiable conchoidal flake scars, seen in the left image along the base of the piece. Many other removals were either the results of flaking or natural damage but the piece is quite weathered and so many removals may not be clear. Despite these instances, the general morphology of the piece, along with the placement of the obvious removals located around the edge, suggests it is a possible pick tool. The flake scars are rounded, short and wide, and not positioned in such a way as to create a working edge (flake scars are evident on the left image of Figure 4.13, at the base). Flaking and shaping appear to have been abandoned, due to the nature of the rock morphology as there are many natural flaws and step fractures evident around the tip. The flakes go straight inwards along a horizontal angle, with no vertical shaping/ thinning on the tip.

### 4.3. Cores

4.3.1. Core reduction patterns

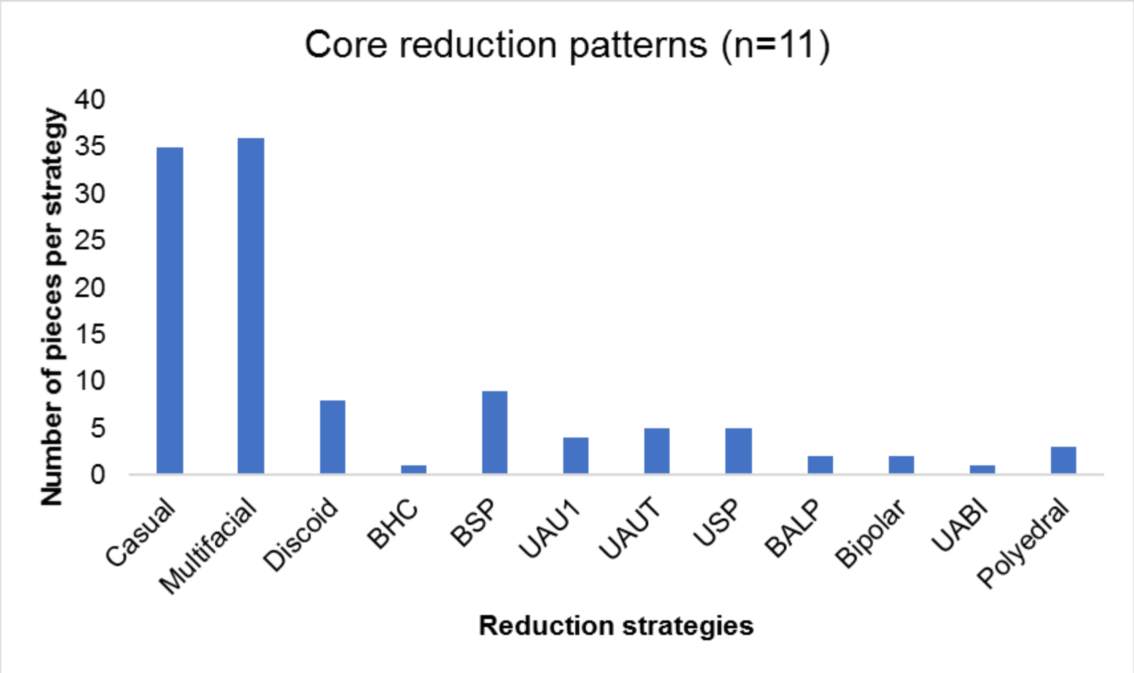


*Figure 4.24: Graph showing the core reduction strategies at Maropeng, and their distribution throughout the various excavations.*

As multifacial (n=33, 29.7%) and casual cores (n=35, 31.5%) dominate throughout the excavations, it can be said that reduction relied on the natural angles available to the knappers. Even though other strategies are present and need to be accounted for, they are much less significant than casual or multifacial cores (Figure 4.24). Many have more than 50% cortex remaining, and there are remaining platforms on a large majority of the cores (90.08% of cores), when compared to the exploitation trends of the core reduction strategies, it is argued that there was generally a trend towards expedient exploitation. This is a pattern whereby the knappers exploited naturally available angles and were unable to rejuvenate angles and platforms for further reduction. The fact that not all naturally available angles were knapped also suggests the absence of intense reduction.

*M1*

M1 consists of the largest assemblage (n=283) of all the sites, but has very few cores (n=18). The two dominant core reduction strategies are casual (n=8) and multifacial (n=4), with six other cores falling under discoid. There are two examples of bifacially worked cores, including the only example of BHC (bifacial hierarchal centripetal) in the entire assemblage. Following the work of De la Torre (2011) this core fits an organised reduction pattern, however, as it is unique in the in situ assemblage it is not considered significant. Pollarolo *et al.* (2010) described a core from the ex situ assemblage that fitted with the definition of a prepared core (Figure 2.9, number 6). However, it was also a unique specimen and not considered significant. It is important to note that the specific in situ BHC core was found quite high up in the ABH, along the junction with the above sediments, and therefore could represent a later accumulation in the deposit.

*M2*

At M2 casual cores dominate (n=21, 37.5%) along with multifacial cores (n=14, 25%), Unifacially worked cores (UAU1, UAUT, and USP) made up 16.1% (n=11), and bifacially (BSP and BALP) made up 12.5% (n=6). None of the cores apart from multifacial and casual cores has been classified as organised following the definition of Leader *et al.* (2016). There is one example of a BSP (bifacial simple partial exploitation), the reduction strategy by which classic bifacial chopper cores are manufactured (De la Torre 2011). The unifacially worked cores could produce a number of technological flake categories type 3 (Toth and Schick 2011), and it would be interesting to see if these are represented in the flake assemblage.

*M3*

M3 is dominated by multifcacial (n=11, 36.7%) and casual cores (n= 5, 16.7%), with many other types present (Figure 4.24). There are both unifacially and bifacilly worked cores, but overall, cores tended to be exploited following the naturally available platforms, and follows the same pattern as observed at M1 and M2. There is an example of a chopper core, a polyhedral, and various examples of unifacially worked pieces; UAUT (unifacial abrupt unidirectional total exploitation), USP (Unifacial simple partial exploitation), and UABI (Unifacial abrupt bidirectional exploitation). UAUT is considered a single platform reduction strategy, while USP is a unifacially knapped chopper core. UABI represent a cores with two unrelated platforms but a single surface (De la Torre 2011).

*M4 and South Pit*

There is only one identifiable complete core at M4 that was knapped in a discoid pattern. At South Pit there were only five cores, so no table has been drawn up. Four of the cores had a multifacial reduction pattern while the one other had a casual pattern, again following the trends of the other sites.

4.3.2. Blanks

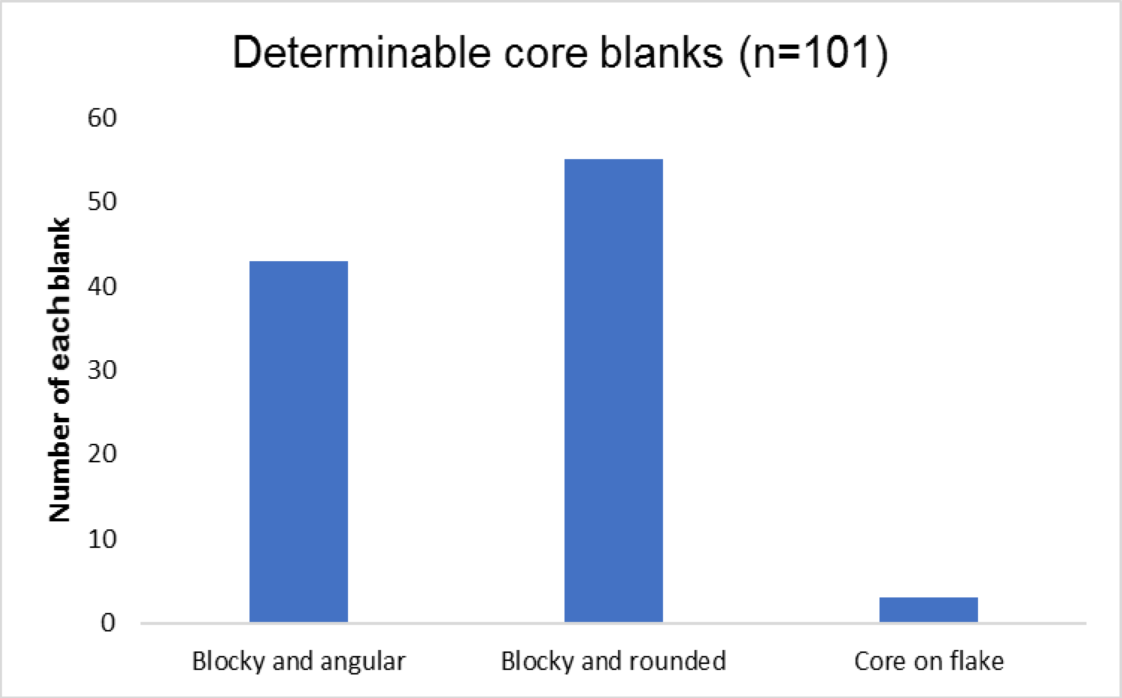


*Figure 4.25: Table showing the distributions of identifiable core blanks found in the in situ excavations. M4 is not shown as there were no cores with discernible blanks.*

The core blank types are few, with only three general groups identified, as shown in Figure 4.25. The blocky and angular blanks refer to tabular and chunky blanks with more defined edges. The blocky and rounded pieces refer also to chunky pieces with more rounded and soft edges, and were probably rolled before being used. There are only three examples of identifiable cores on flakes, as these blanks tend to be used for LCT production. The representation of angular (n=49) and rounded (n=50) blanks is almost identical, and both are primarily reduced in multifacial and casual patterns. The angular blanks tend to have more multifacial cores associated, while more casual cores are found on rounded blanks. This could indicate that reduction followed naturally available platforms, and because angular pieces have more obvious platforms, they were more likely to be intensely reduced (see below, section 4.3.6 for further discussion).

4.3.3. Flake scar

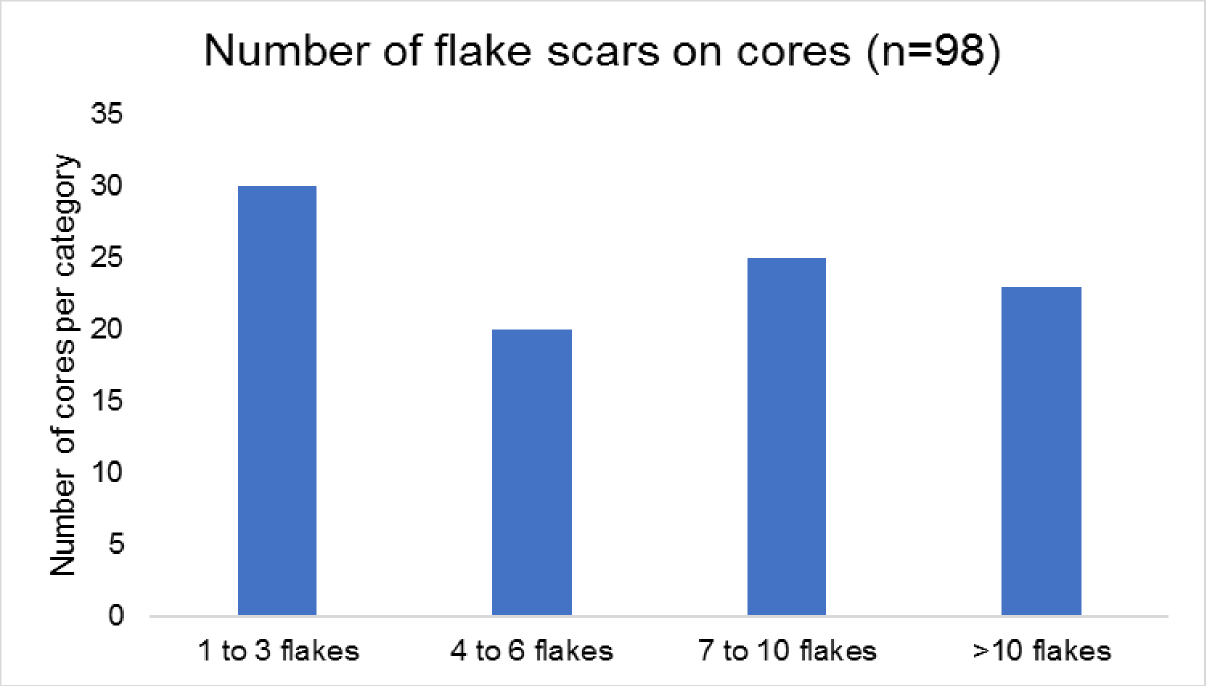


*Figure 4.26: Bar graph showing the number of flake scars on cores.*

The cores tend to have few removals, with just over half having no more than six removals (Figure 4.26). As discussed, casual cores are described as having three or less removals, hence they all fall under the first group in Figure 4.26. This trend is understandable, as cores tends to have a large amount of remaining cortex (this will be discussed below under section 4.3.5). Generally there is little exploitation of the full surface of the core blanks which could further the argument that the knappers were using naturally available platforms, and not significantly reducing the blanks.

4.3.4. Largest flake scar (LFS)

The largest flake scar maximum lengths on all the cores falls between 30 and 89mm, with the majority between 40-49mm (Figure 4.27). when the LFS sizes are compared with the maximum lengths of cores, it is clear that they correlate, with an r-value of 0.7442, demonstrating that as core size increases, LFS size increases (Figure 4.28). This could possibly mean that the knappers were able to manipulate all size blanks, and has the skill to remove larger and smaller flakes. This will be discussed further below under section 4.4, but initial conclusions suggest the knappers understood the fracture mechanics of the raw materials.

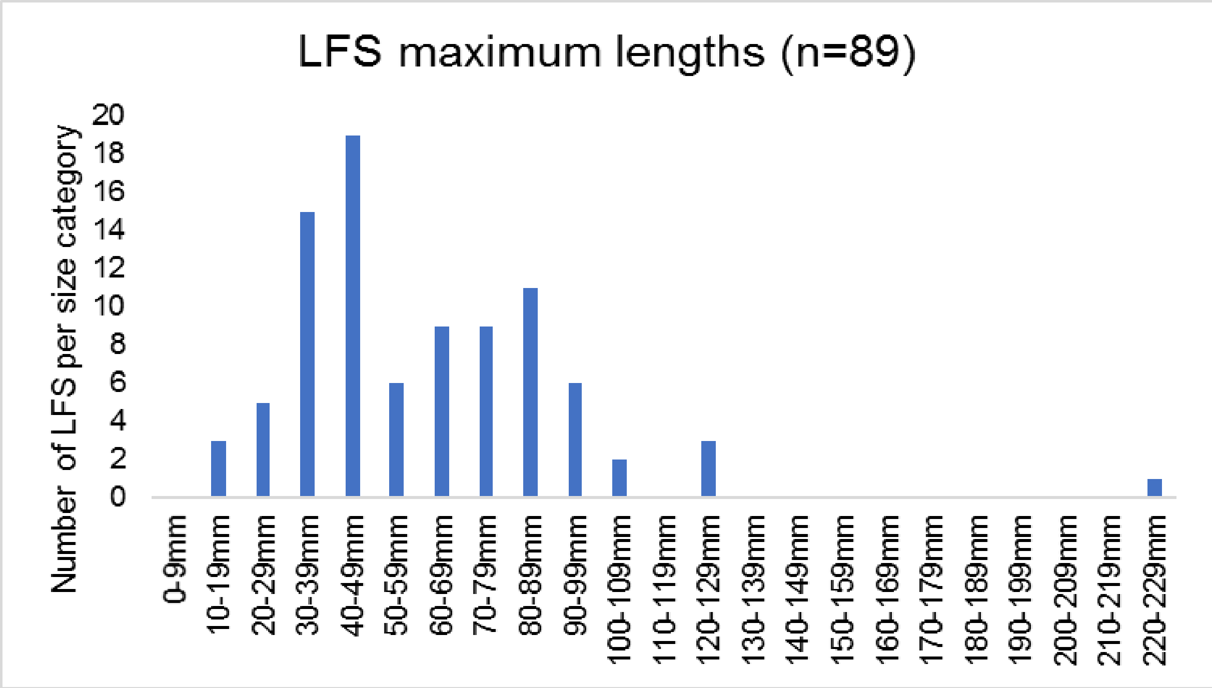


*Figure 4.27: Bar graph showing the sizes of the identifiable LFS (largest flake scar) across all excavations.*

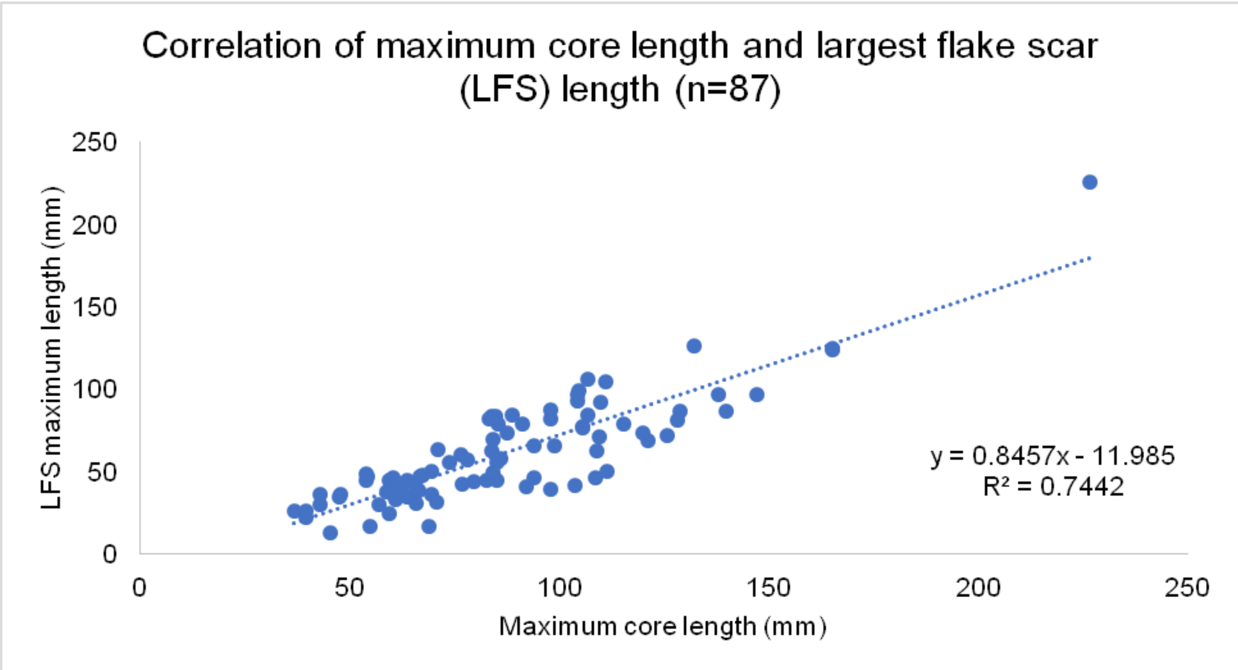


*Figure 4.28: Regression analysis of correlation between maximum core length and LFS on cores.*

4.3.5. Remaining cortex

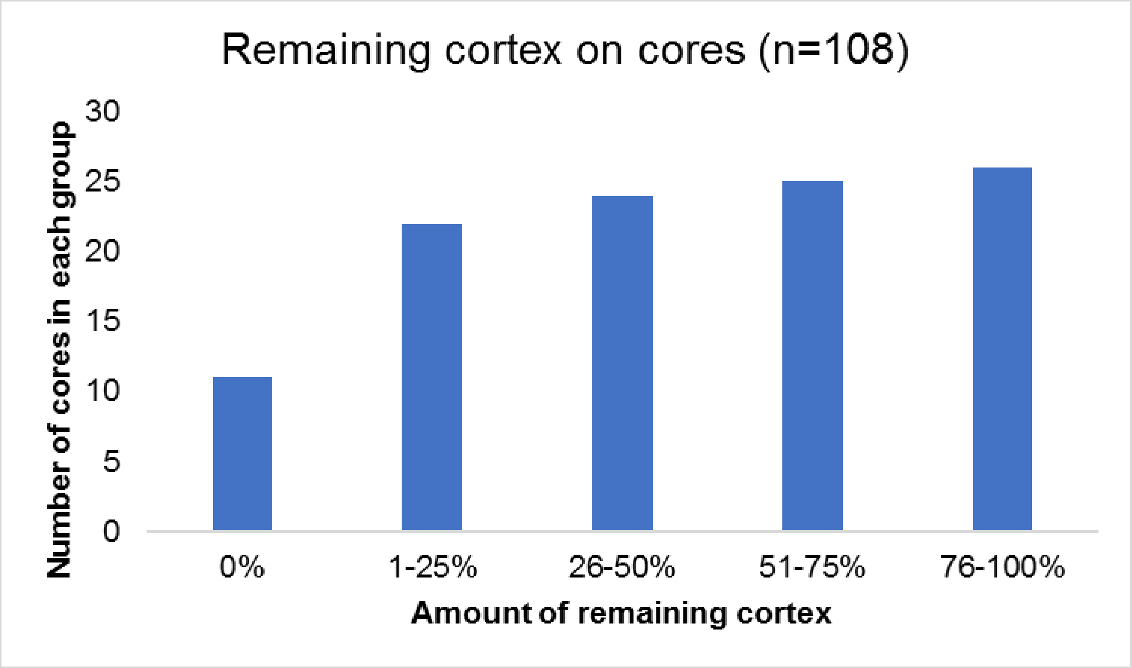


*Figure 4.29: Figure showing the distributions of remaining cortex on cores.*

Overall, the majority of cores had remaining cortex (n=97) from 108 cores (Figure 4.29). The most common percentage of cortex was 76-100%, on 26 cores (24.1%). 22 cores (20.4%) had 1-25% cortex on them, 24 had 26-50% (22.2%), and 25 had 51-75% of their cortex remaining (23.1%). Only 11 cores had no cortex, only representing 10.2% of the core assemblage. Even though there is not a huge difference in the number of cores with less or more than 50% cortex remaining, the cores with more than 50% cortex make up nearly half of the assemblage (47.2%). This pattern shows an expedient use of raw material.

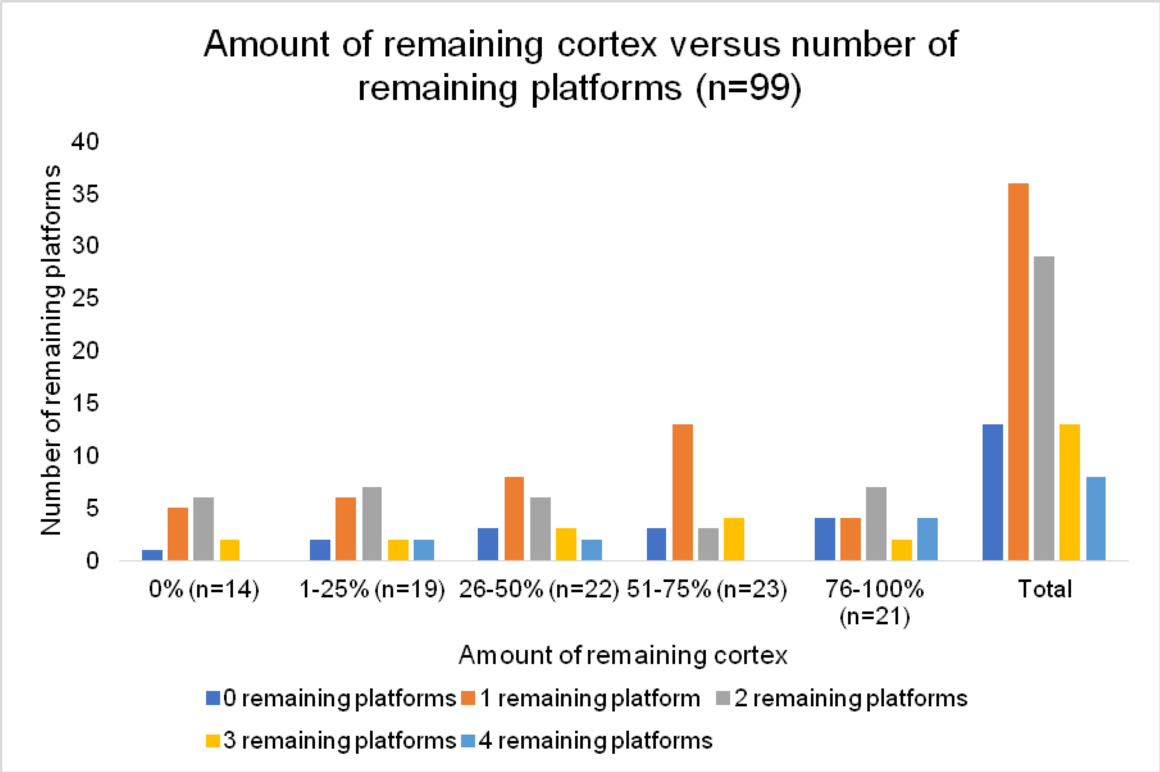


*Figure 4.30: Bar graph showing the relationship of remaining cortex and remaining platforms on cores. The legend indicates the numbers of remaining platforms, while the y-axis shows the number of cores with each number of remaining platforms.*

The majority of cores have over 25% remaining cortex (Figure 4.30) and it would be useful to determine how many remaining platforms are on those cores to determine whether cores were abandoned due to a lack of flakeable platforms. Figure 4.30 shows that cores with both one flakeable platform and 26-50% (n=8) or 51-75% (n=13) cortex remaining were the most common. Five cores with one remaining platform had no cortex, and six had 1-25%. Only four cores from this group had 76-100% cortex. Cores with only two platforms were fairly equally distributed, with six both in the 0% and 51-75% categories, and seven in both the 1-25% and 76-100% categories. Only three examples of these were in the 51-75% category.

### 4.3.6. Reduction patterns

A total of 102 cores with discernible core reduction strategies from across the Maropeng landscape were excavated. Following the work of De la Torre (2011) and the categories of core reduction patterns created for Gadeb, Ethiopia (discussed in the literature review, under Early Acheulean sites in eastern Africa), the Maropeng cores were put into types (see chapter 3, Figure 3.11 for definitions and abbreviations). Not all the types described by De la Torre (2011) were present, with types such as multifacial and casual reduction strategies being the most common.

Figure 4.31 shows the relationship between blank shape and reduction sequence strategy. As was discussed above, the dominant blank shape is blocky, with either rounded or angular edges. When compared with the reduction strategies, casual and multifacial are primarily made on these blocky pieces, but there is a slight variation between them in regards to blank type. Casual cores are more commonly made on rounded blocky pieces, while multifacial pieces are more commonly made on angular pieces. Rounded blanks provide fewer platforms, and could hinder the knappers abilities to exploit the blank surface, meaning fewer removals were made on those pieces.

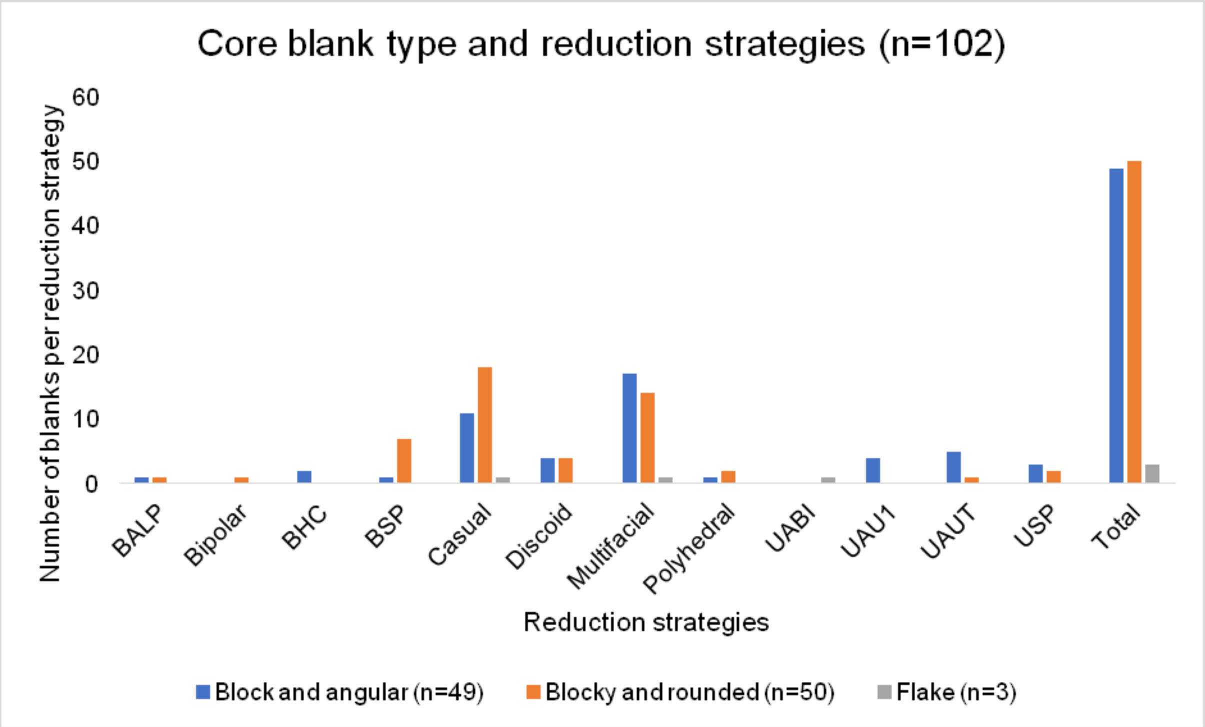


*Figure 4.31: Bar graph showing relationship of core blank types and reduction strategies.*

## 4.3.7. Number of remaining platforms

The bar graph below (Figure 4.32) shows the distributions of remaining platforms throughout the excavations. A good marker of exploitation can be seen in the flakeable platforms of cores (Field 1999; Moll 2014). When compared with the range flake scar numbers on a core, as well as remaining cortex, one can see that the cores were probably exploited for their natural platforms and then abandoned.

There are predominantly between one and two remaining platforms on the cores, 35 (36.5%) and 29 (30.2%), respectively. Twelve cores have no remaining platforms (12.5%), while twelve have three remaining platforms (12.5%), and only eight cores have four remaining platforms (8.3%). Figure 4.33 shows that casual cores have mainly one remaining platforms, suggesting the knappers could only remove a few flakes before discarding the blanks. Multifacial cores had more naturally available platforms, as evidenced by the fact that there are generally more than one remaining platform. However, many have one or no available platforms, suggesting again that the knappers exploited all the natural platforms.

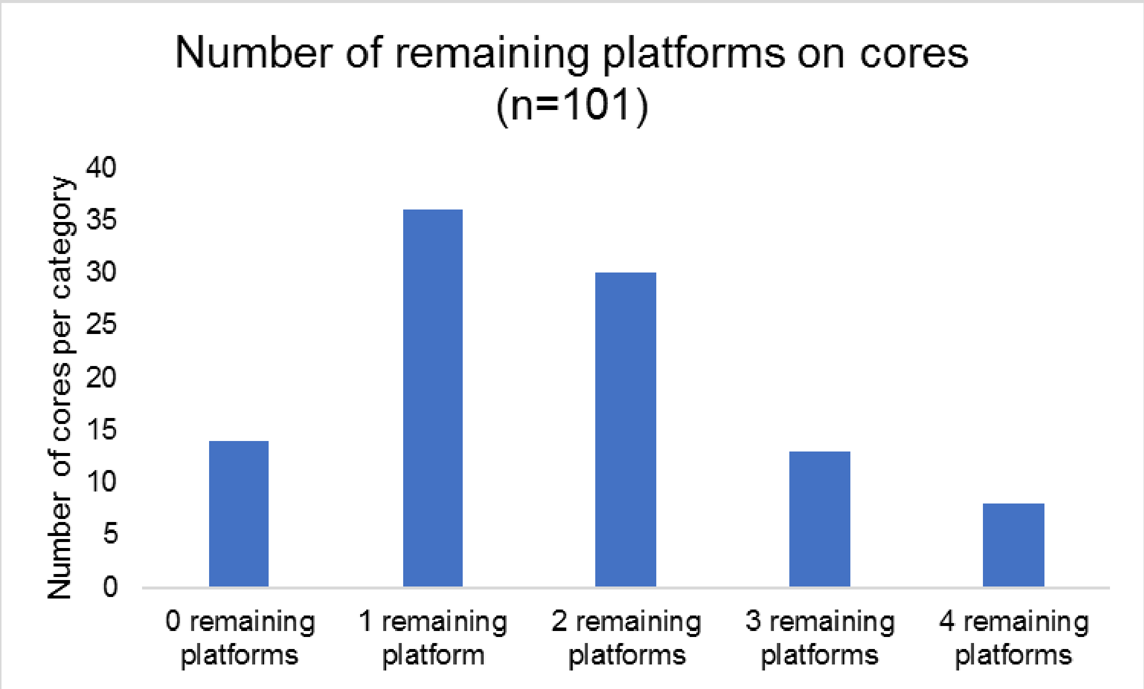


*Figure 4.32: Bar graph showing the distributions of remaining platforms throughout the Maropeng assemblage.*

There is no clear link between core reduction and the size of the LFS (largest flake size). Figure 4.34 shows that if there are more flakes scars on a core, it does not necessarily mean the LFS is smaller, because the core would be more exploited. When compared with the data showing that LFS are larger as cores get longer, it would suggest that the knappers were removing flakes that conformed to the core blanks sizes available to them on cores, but not necessarily exploiting the entire surface of the cores. Overall the main relationship between the cores and their flake scars is that core size determined flake size, but not the extent of exploitation, however, as has been discussed, this does not account for the volume of cores in relation to flake scar size, a variable to be explored for publication.

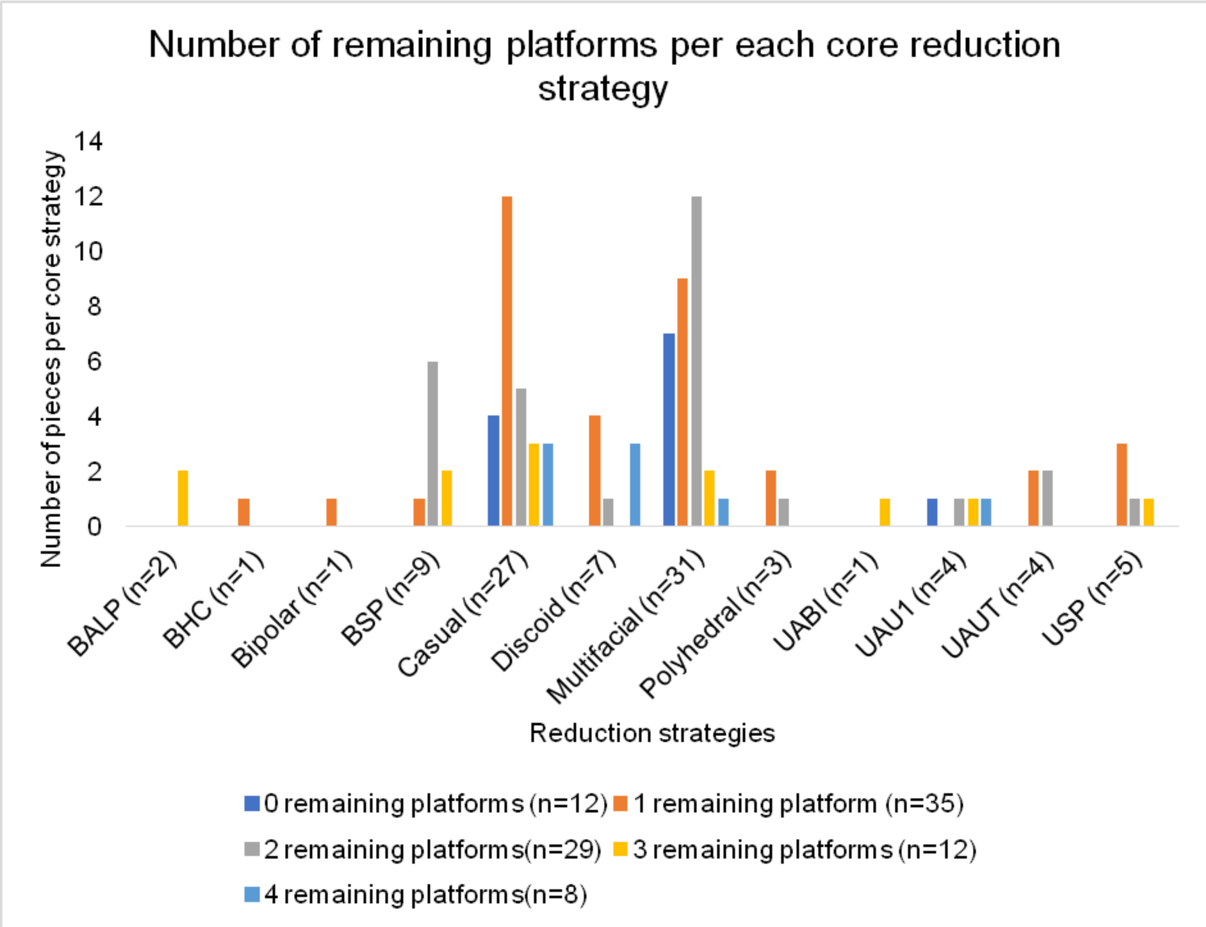


*Figure 4.33: Bar graph showing the relationship of remaining platforms and core reduction strategies throughout the Maropeng assemblage.*

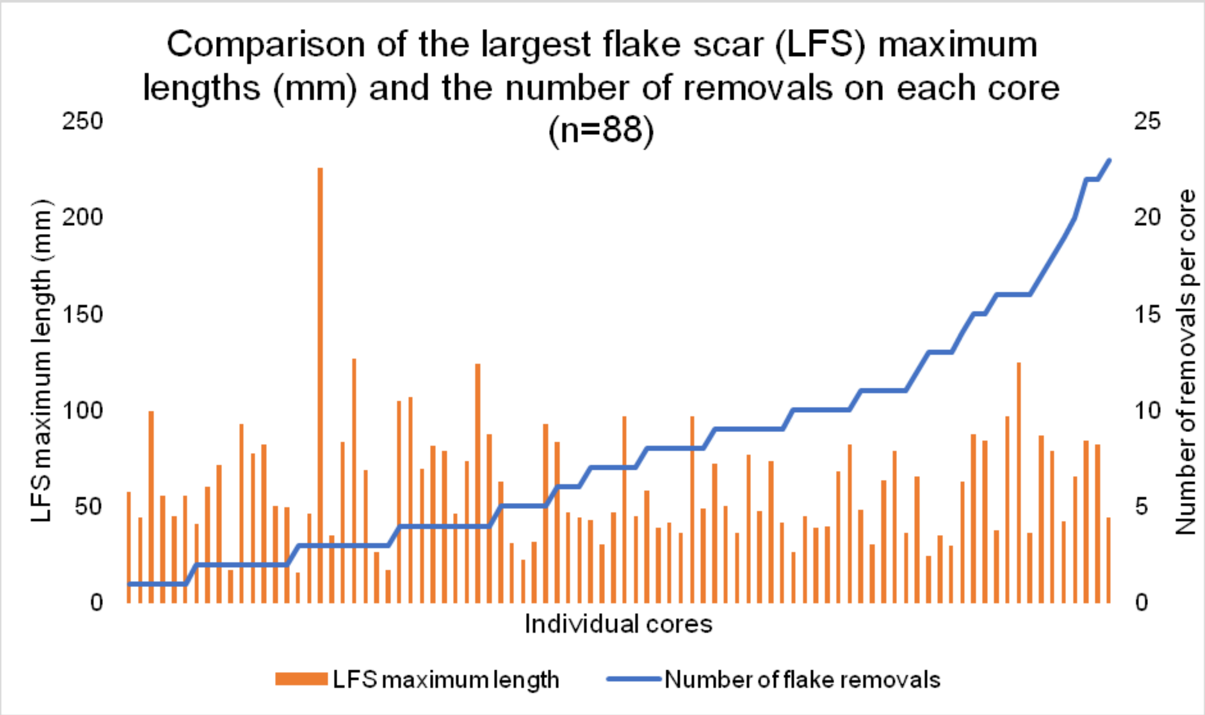


*Figure 4.34: Graph showing the relationship between the LFS (Largest flake scar) size and number of flakes scars on a core. These data do not directly correlate so they were drawn up to show the relationship by putting the size of the largest flake scars (LFS) of individual cores in ascending order (orange, series 1), with the respective number of flake scars for the corresponding core (blue, series 2).*

### 4.3.8. Cores with an abrupt single platform component

A core type that is not included in the De la Torre (2011) work is the abrupt single platform core. These refer to cores with a single platform component on an abrupt edge (right-angled), but these do not necessarily constitute the main reduction pattern. A total of six cores had this pattern of reduction. This is not a major component of the overall assemblage but it is found throughout the depths of the ABH. As it is found within the entire depth range of the deposit, it must be understood. It could provide information on the uppermost behavioural and cognitive abilities of the stone tool makers (McPherron 2000; McNabb *et al.* 2004), as it represents consistent flaking of an edge, not seen in other reduction strategies.

The definition of this reduction strategy used in this thesis is one whereby an initial flake was removed along one side of an abrupt edge to create a platform from which flakes going in a perpendicular direction were removed. It differs to any of the strategies laid out by De la Torre (2011) as the initial flake removal adjacent to the knapping surface appears to have been uses as a platform itself. Figure 4.35 shows a single platform edge on a multifacial core. The left photograph shows the surfaces with unidirectional removals from one platform. The right photograph shows the platform from which the unidirectional flakes were removed, while the flake that was removed to create the platform surface is seen at the top of the right image. The platform was created by knapping, but there is no evidence of any point of impact or bulb of percussion.

Figure 4.36 shows another example of a core with an abrupt single platform edge. The core has little remaining cortex, along with a dominant multifacial reduction strategy, of which the directionality of some removals is not fully identifiable. The single platform component is found on two surfaces of the piece, both sharing the same large removal as a platform as seen on the top right of Figure 4.36 (albeit from different side of the platform removal). Unlike the piece described above and shown in Figure 4.35, the bulb of percussion of the platform removal is evident, despite the impact point not being obvious.

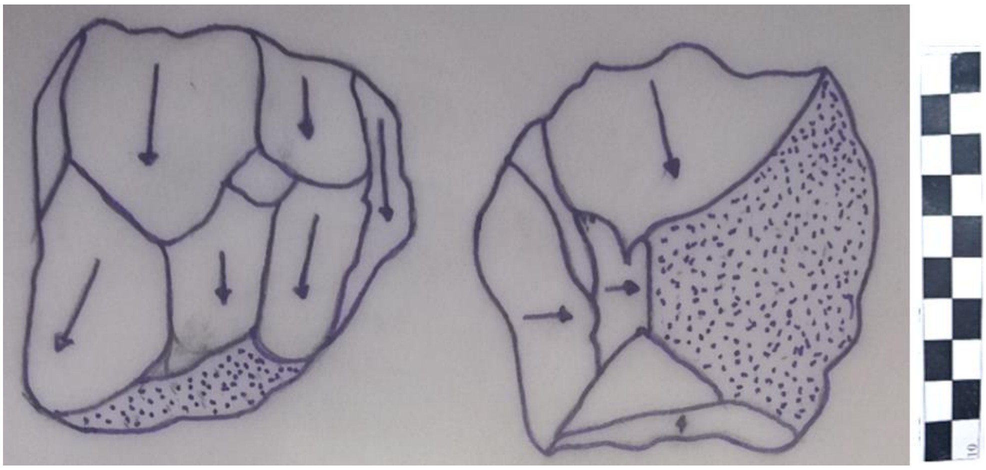

*Figure 4.35: Photograph of a single platform surface (left) and abrupt angle removal (right). The abrupt angle removal for the removal is seen on the right side of the surface photographed on the right photograph (image by R. Moll).*

*Figure 4.36: Multifacial core with an abrupt single platform edge. Top left: side view of core, top right: platform surface of core manufactured through the removal of a large side-struck flake. Bottom left: other side from image in top left, bottom right: distal view of core showing unidirectional removals. The bottom left photograph shows various flake scar going in multiple directions, hence the dominant multifacial reduction strategy, while the top left photograph shows more unidirectional removals (image by R.Moll).*

## 4.4. Flakes

### 4.4.1. Technological flake categories

Technological flake categories can be useful in determining at which point in reduction a certain flake was removed, if considered along with other factors, as discussed under chapter 3 (Toth 1985, 1987; Braun *et al.* 2008b). In the case of all the excavations at Maropeng, the majority of flakes had both a platform and a dorsal face with no visible cortex, falling under types 5 and 6 (Figure 4.37). This means that the majority of flakes possibly came from a relatively intense reduction sequence, or in the case of the radial dorsal patterns, shaping from LCT production (as discussed above). Type 3 flakes are the least represented, and as discussed by Toth and Schick (2011), this could correspond to the smaller percentages of unifacially worked cores (UAU1, UAUT, USB, UABI, and the abrupt cores) described in figure 4.24.

When compared to the amount of cortex remaining on the cores, the flakes appear to generally come from further in the reduction sequence than what the majority of the cores show. Many of the flakes with radial dorsal patterns, and these follow the reduction of LCT shaping, as well as the more exploited multifacial and discoidal cores. There is a fair amount of cortex left on cores (>25%, Figure 4.29), with larger flakes on larger cores (Figure 4.28). One could argue that this shows that the flakes and these less reduced cores do not necessarily correspond and are from different production strategies, however it would need to be discussed in conjunction with the other evidence, such as average flake size, and flake terminations on both cores and flakes to do so.

### 4.4.2. Dorsal flake scars

The dorsal flake scar patterns indicate that there was a range of knapping strategies adopted (Figure 4.38). Predominantly radial patterns were most common, with equal and significant amounts of unidirectional and transverse patterns also present. Knappers were both turning the cores as they knapped and removing flakes from the same directions (following De la Torre 2011). As cores are reduced, it is not possible to tell whether these dorsal flake scar patterns dominated the entire core, but it could be used when comparing the reduction of cores and flakes.

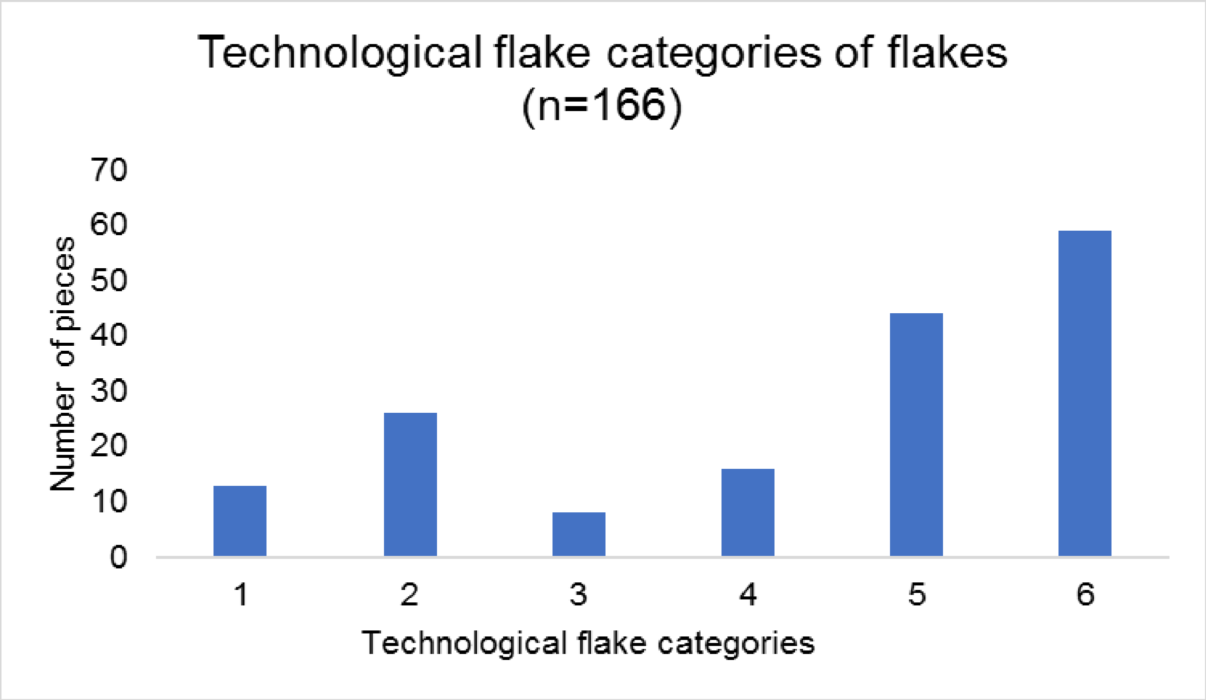


*Figure 4.37: Table of technological flake categories. There are more flakes with knapped platforms and little to no cortex, indicating that many flakes come from far along the reduction sequence.*

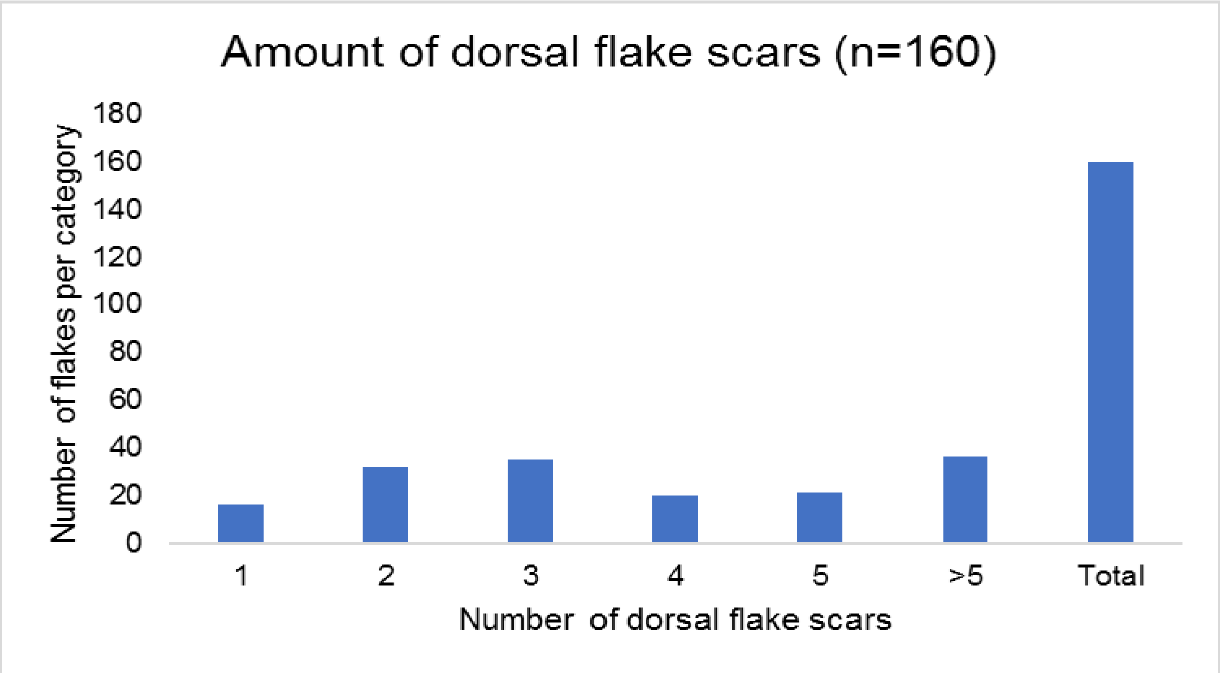


*Figure 4.38: Bar graph showing the amounts of dorsal flake scars.*

Dorsal flake scar patterns, along with Technological flake category analysis, can also show the general reduction strategy adopted for the core. The most common dorsal scar patterns evident on the flakes throughout Maropeng are radial, which dominate in all sites (n=61), unidirectional (n=36), transverse (n=29), and complex (20) (see chapter 3 for descriptions of dorsal flake scar terms) (Figure 4.39). Outside of these four patterns, there is no significant representation of any other pattern. All other types are only represented at one or two excavations, and in small numbers (none more than two examples). Three of these extra patterns (parallel-opposed, modified-unidirectional and bidirectional) were found at M2, the site with the largest assemblage of complete flakes with identifiable dorsal flake scar patterns.

At M3 and South Pit the same patterns dominate, as found in M2, but overall fewer patterns are found. The presence of radial dorsal flake scar patterns, along with significant numbers of unidirectional, transverse, and complex patterns, indicates that the knappers varied in their reduction strategies. The dominance of radial dorsal scar patterns, however, is suggestive of significant amounts of LCT shaping, as this is as prominent feature of these tools.

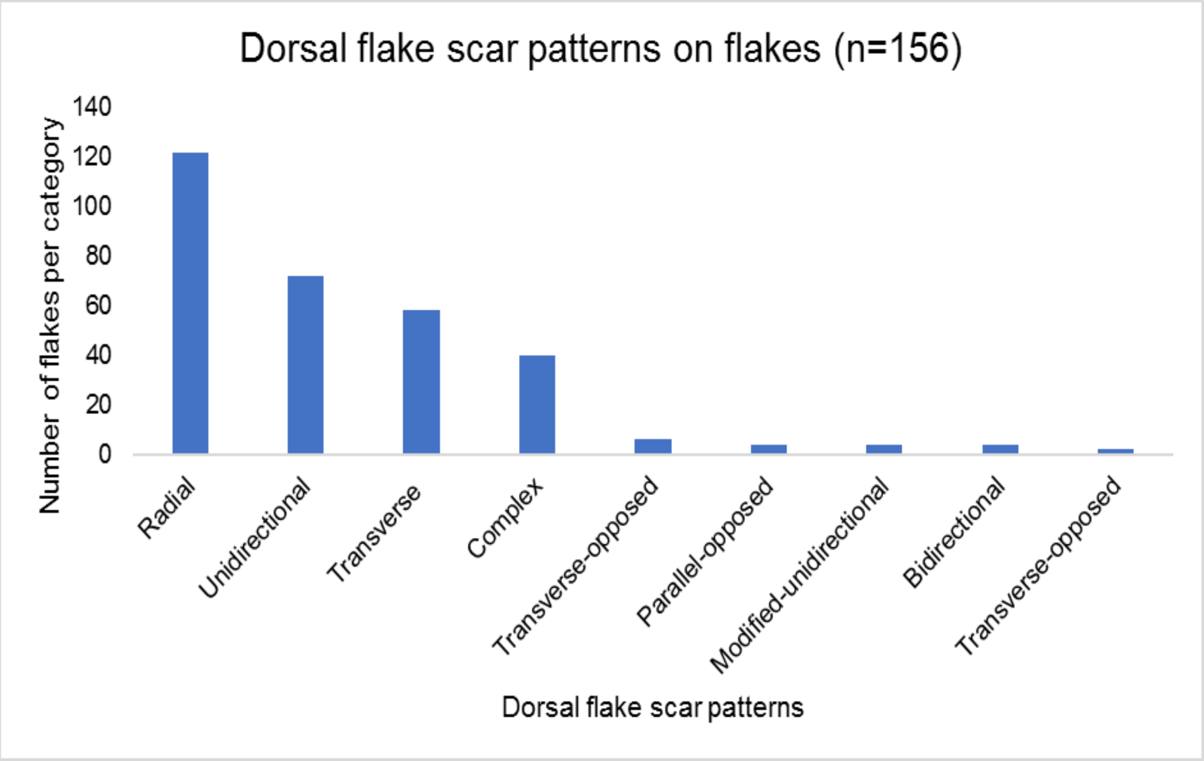


*Figure 4.39: Bar graph showing the distribution of dorsal flake scars patterns on flakes with discernible dorsal scar patterns.*

4.4.3. Correlation of platform thickness and technological measurements

A common feature of flaking in Mode 2/Acheulean industries is for flakes to become relatively longer, less wide, and thinner than in Mode1/Oldowan knapping strategies, though this is not a standard rule (Mason 1961; Isaac 1969). At Maropeng, the average technological width is larger than the technological length across all sites. This would suggest that flakes tended to be side-struck and short, a feature more commonly associated with earlier industries (Mason 1961). There is no significant correlation between the width of flakes and the thickness of platforms, suggesting that flakes did not necessarily increase in size as platforms got thicker.

Throughout the Maropeng assemblage, there are three types of flake platforms represented (Figure 4.40). As discussed in chapter 3, these three types are: 1) cortical; 2) flaked (for lack of a better term, here defined as having evidence of at least two scars, but not in a unidirectional pattern across the platform that would suggest platform preparation); and 3) plain (a non-cortical surface). Plain platform types dominate, with cortical flakes being the next most common. The platforms are mainly between 6-15mm, with very few spanning more than 20mm (Figure 4.41).

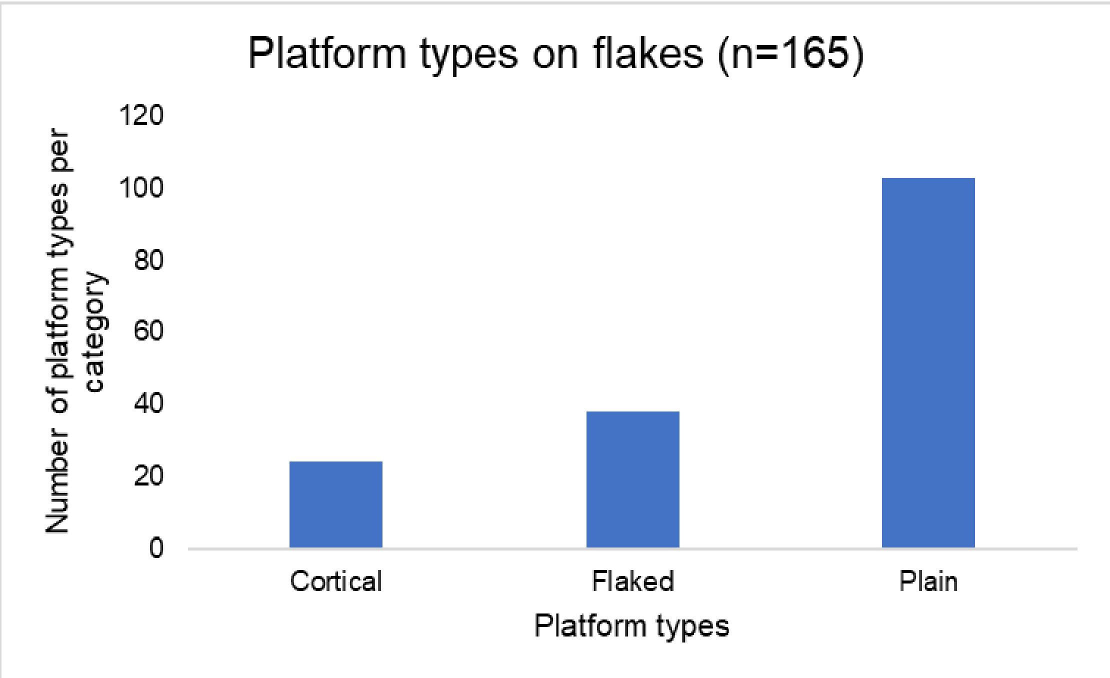


*Figure 4.40: Bar graph showing the flake platform types from the complete flakes.*

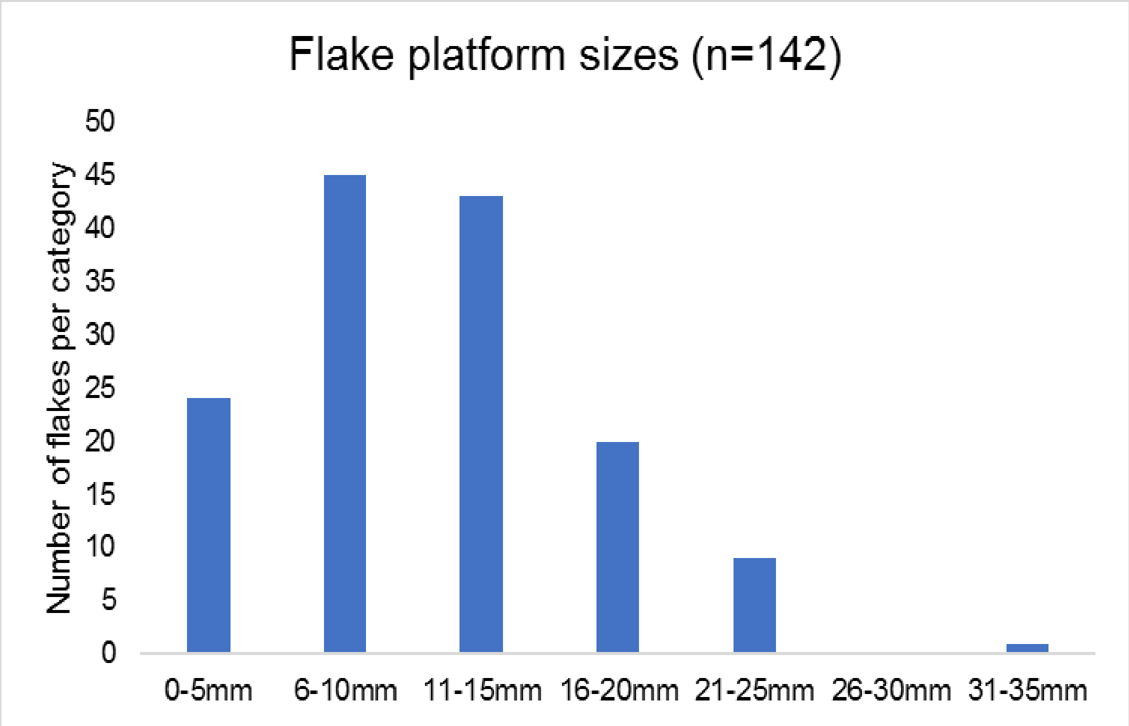


*Figure 4.41: Bar graph showing the platforms sizes of the flakes.*

Not all the platforms were in good condition. Some had evidence of weathering and damage, hence the platform thickness was not taken on those flakes to avoid mistakes and bias.

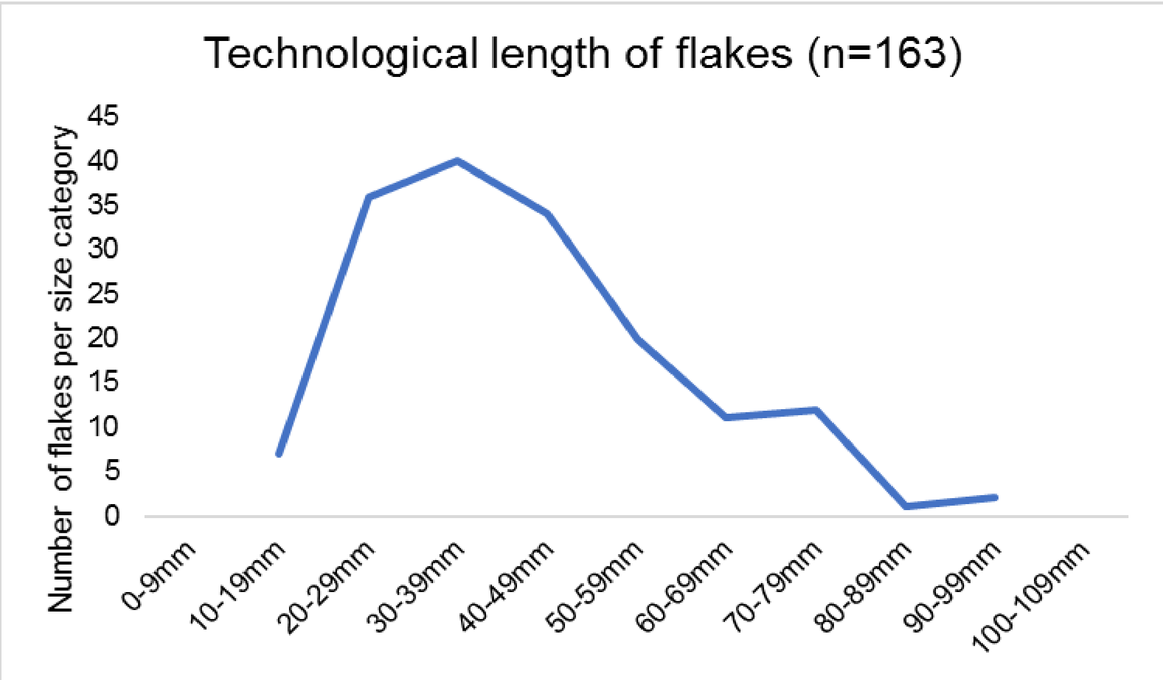


*Figure 4.42: Size ranges of technological length of flakes.*

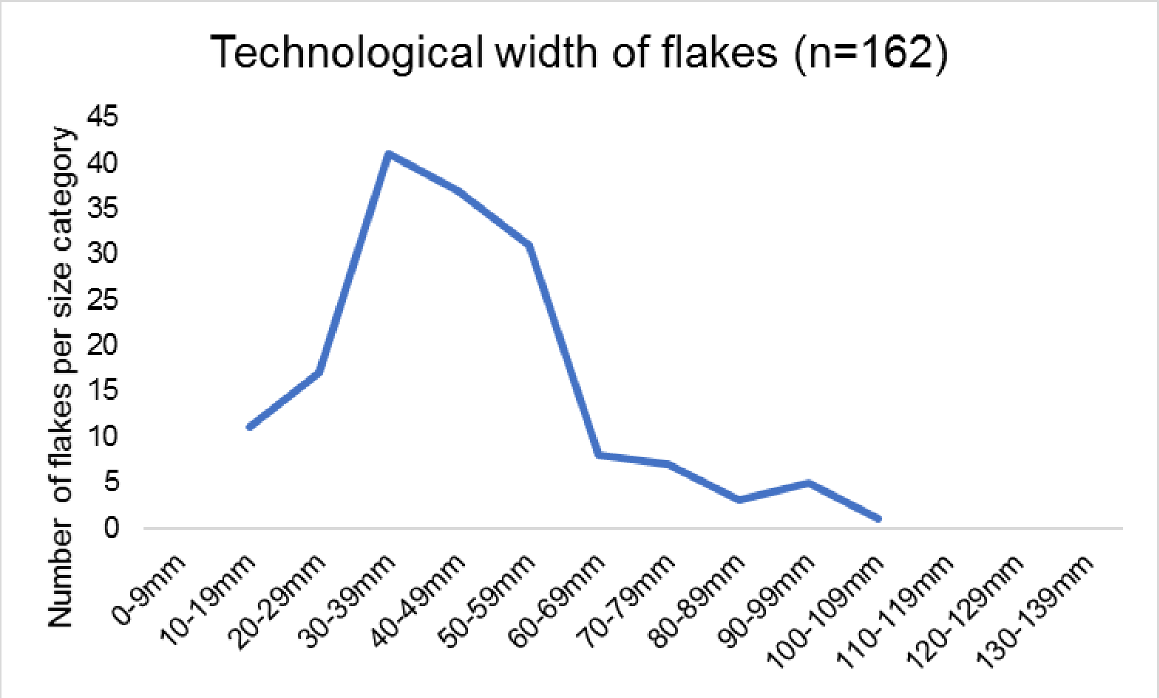


*Figure 4.43: Size ranges of technological width of flakes.*

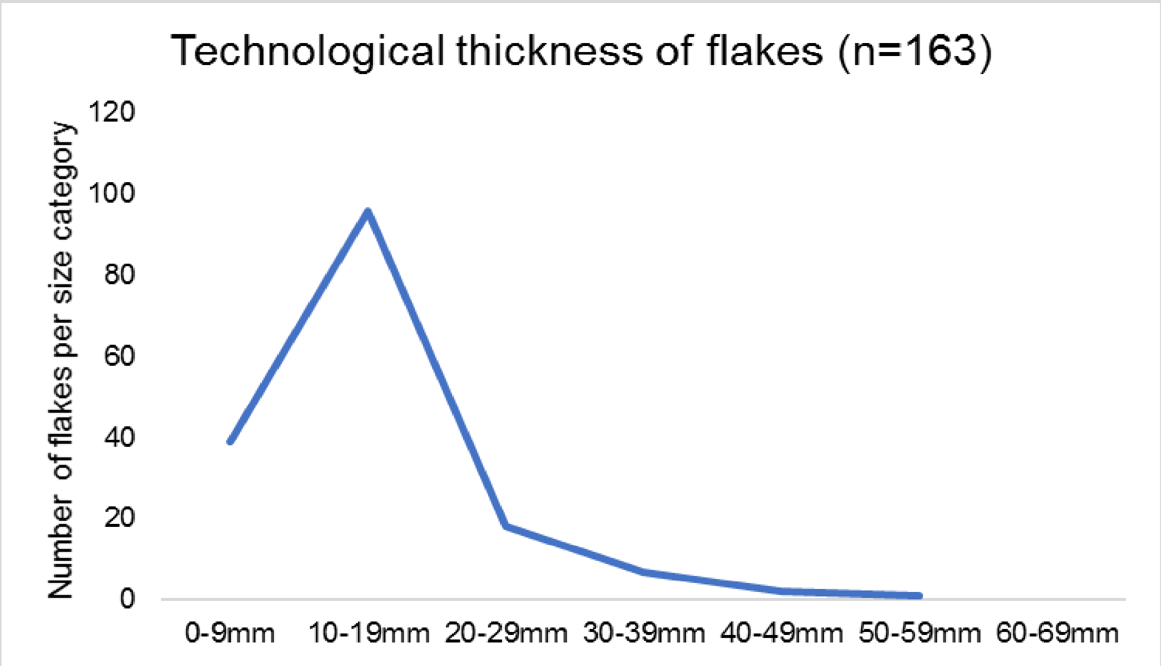


*Figure 4.44: Size ranges of technological thickness of flakes.*

The most consistent technological length across all the excavations is thickness, where the majority of flakes are between 10-19mm thick. Technological length has a large number of flakes between 10-59mm, and technological width mainly ranges between 30-59mm.

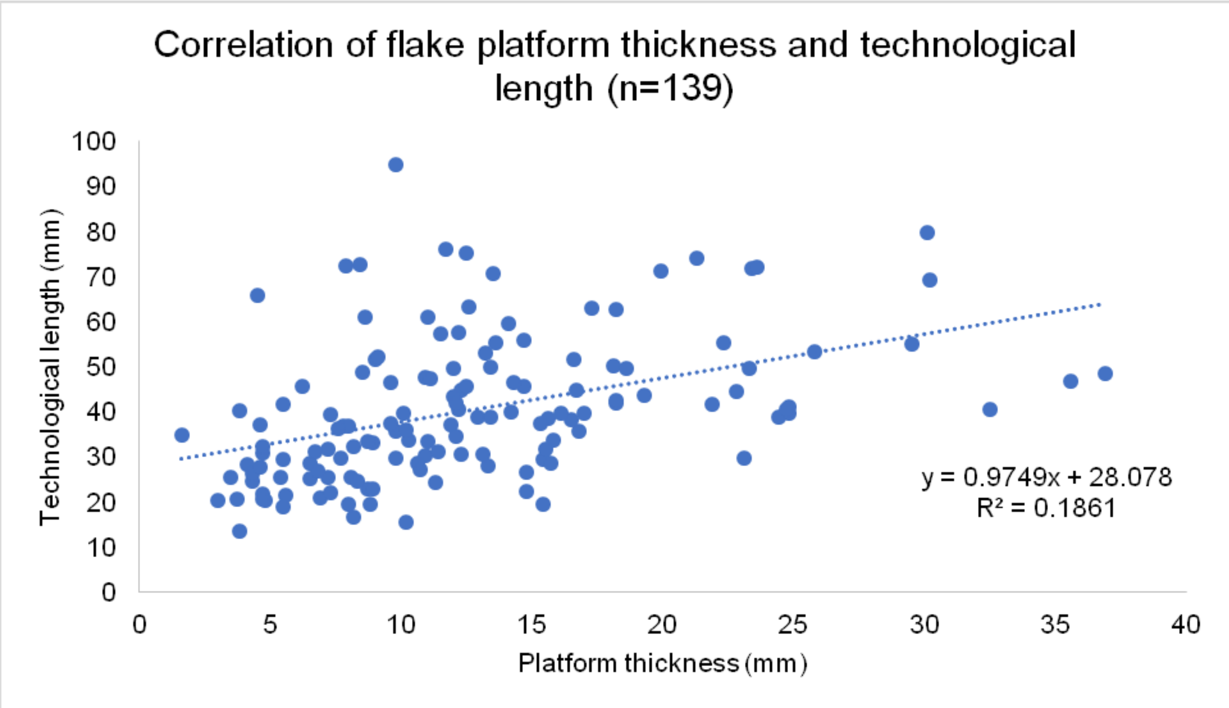


*Figure 4.45: Regression analysis showing the Correlation of platform thickness and technological length.*

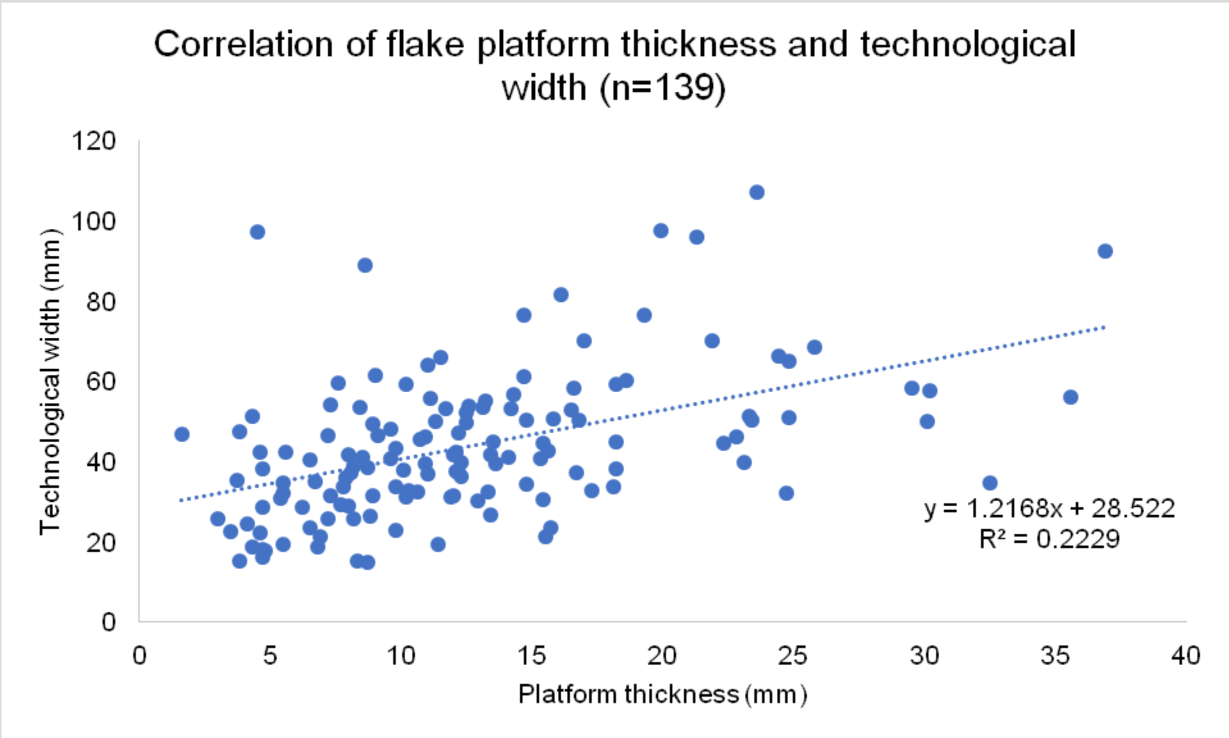


*Figure 4.46: Regression analysis showing the Correlation of platform thickness and technological width.*

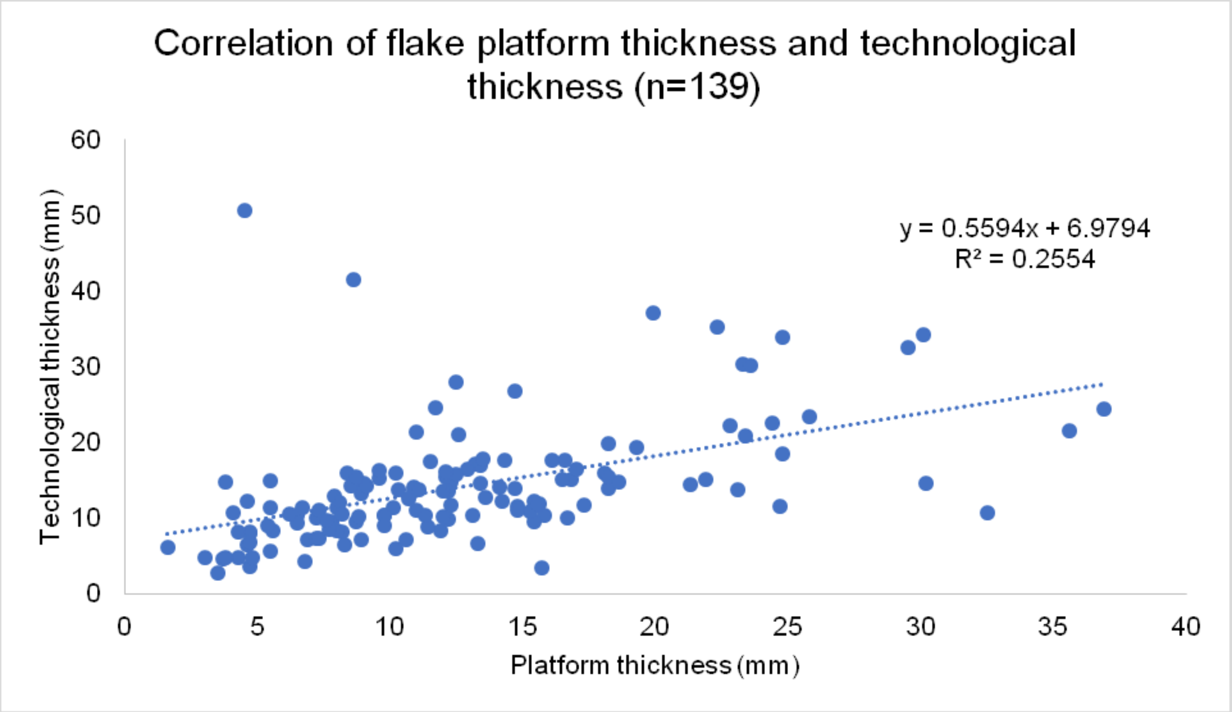


*Figure 4.47: Regression analysis showing the Correlation of platform thickness and technological thickness.*

The correlation of the platform thickness and various technological flake measurements (Figures 4.42, 4.43, 4.44), can indicate trends in flake production. The above three graphs (Figures 4.45, 4.46 and 4.47) represent the relationships between the platform thicknesses on flakes to the technological sizes of those flakes. Overall, there is not a significant correlation and platform thickness does not directly influence the size of the flakes. However, there is a slight trend towards flakes being thicker at their centre with thicker platforms. The technological width of flakes is somewhat dependent on platform thickness, more so than technological length.

### 4.4.4. Flake terminations

Throughout the assemblage there is a dominance of feather terminations on flakes, but there are also many broken or step-fracture terminations, as well as large chunky flakes, here called core edge flakes (Figure 4.48). These are quite wide for the flake size and have no termination that follows the prescribed definitions.

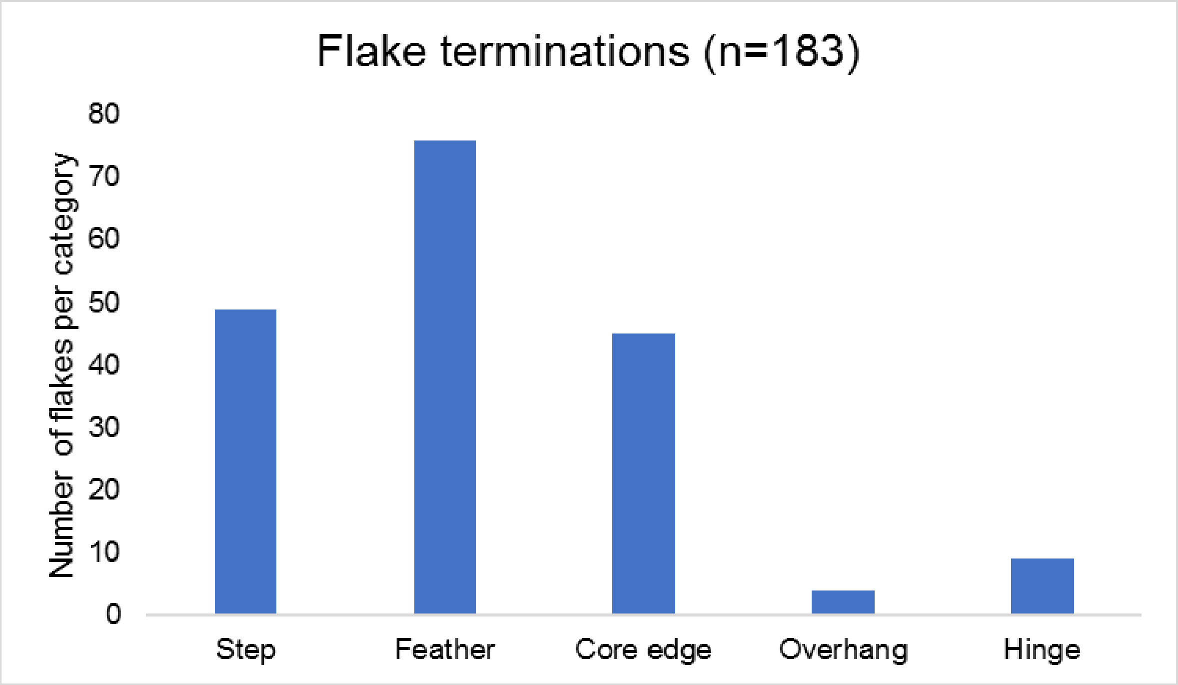


*Figure 4.48: Bar graph of flake terminations of the complete flakes.*

4.4.5. Core size vs flake scar number

There is no significant correlation at all between the core size (represented through maximum core length) and number of flake scars per core. Figure 4.49 shows a decreasing trendline, with an r-value of 0.037, showing no significant correlation (r-values become more significant close to 0.1). The knappers were not exploiting large core blanks for multiple flake production. Furthermore, there is good evidence that naturally available angles of core blanks were being exploited, and little to no rejuvenation or central core mass reduction was done at Maropeng.

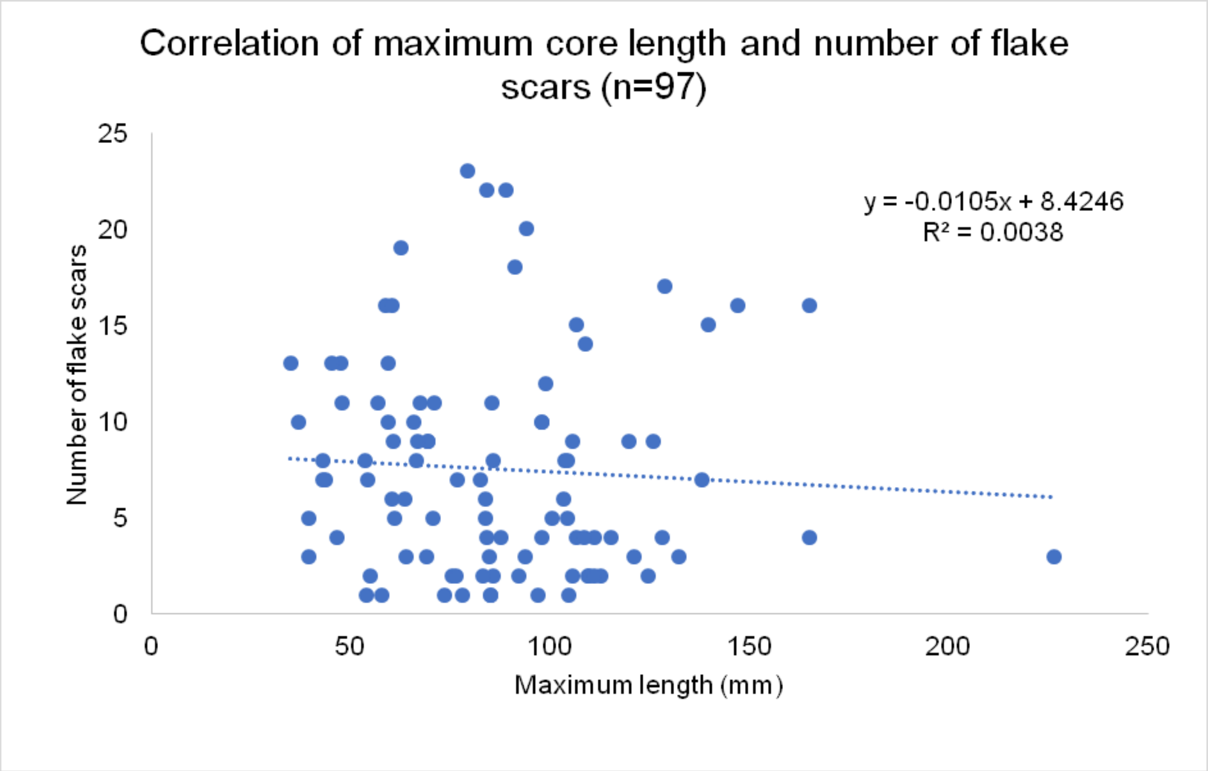


*Figure 4.49: Correlation of core size in maximum length (mm) and the number of flake scars on cores.*

### 4.4.6. Retouch

There are few pieces with retouch found throughout Maropeng (n=7), but this could be a symptom of the geoarchaeological context because many pieces are damaged, and retouch may be obscured by this. As described by Morrissey (2015) and discussed before, the site formation processes led to varying degrees of weathering and abrasion states of artefacts, as well as in situ breakage. In the case of retouched pieces, it was often difficult to tell the difference between damaged and retouched pieces as many artefacts were damaged to some degree. Pieces that were conclusively determined to have retouch were generally quite fresh in nature and had no other evidence of damage.

The retouched pieces described here do not include LCTs with secondary shaping as they are discussed elsewhere. These types tend to be flakes and chunks with scrapper and/or notched edges. There is one convergent scrapper with retouch on two edges. An example of retouch is seen in Figure 4.50, on the distal end of a side-struck flake. The retouch is at a sharp angle, making a scrapper edge, and there is no other modification on the piece.

*Figure 4.50: Quartzite flake with retouch. The retouch is seen along the edge of the bottom image.*

# Chapter 5: Discussion

## 5.1. Discussion

The main question of this thesis focused on defining the techno-complex/es and time-averaging of the assemblage found in the ABH using a technological core reduction analysis of an excavated in situ assemblage. It also aimed to test the original hypothesis of Pollarolo *et al.* (2010) that the Maropeng lithic assemblage was predominantly from the Early Acheulean. Defining the specific technological strategies adopted is necessary, as the strategies already defined are very broad which limits interpretation. In order to answer these questions, an assessment of the assemblage as a whole had to be made, as individual analyses of a tool type or technological attribute cannot detail a techno-complex alone (De la Torre 2011). In this chapter, each category of flake, core, and LCT will be discussed, followed by raw materials, and comparisons with other sites. All the factors that relate across the artefact types and are presented under each section, will be discussed together in a final section.

Maropeng archaeology is significant because it provides information on the nature of ESA technology in a context outside of the underground cave systems. Other ESA sites in the CoH have preserved material that accumulated in dolomitic limestone karst systems when material fell in from the surface. The site formation and post-depositional processes identified show that the ABH accumulated from various locations (Morrissey 2015) in and around the landscape from up to 1km, and is it likely hugely time-averaged and may have evidence of multiple techno-complexes.

### 5.1.1. Flakes

Flakes were the most dominant artefacts in the in situ assemblage. The Technological flake category analysis shows that the flakes mainly come from an advanced stage in the reduction sequence, with the majority falling under categories 5 and 6, indicating that there was no cortex on the platforms and little to none on the dorsal sides. Toth (1987) showed that these representations of various technological flake categories could indicate either a series of behavioural traits, such as transporting raw material or large flake blanks, or that natural processes affected to assemblages post-depositionally. Over half of the platforms had no cortex on them, indicating that the cores they came from were already quite reduced, but there was no evidence of faceting (defined here as three or more removals and therefore reflecting core preparation). Flaking did not conform to one axis, with a mixture of side, end and corner struck flakes represented. The dorsal flake scar patterns show a dominance of radial removals, and many complex and transverse-opposed patterns. When one combines the dorsal scar patterns, small number of cortical flakes, and flake axes, it is possible to infer a mix of reduction strategies that included multifacial, radial and complex patterns, for the cores the flakes would have come from. The technological flake categories type 3 flakes could be associated to the unifacially worked, single platforms cores, as described by Toth and Schick (2011), and thus demonstrates another reduction strategy.

Kuman (2001) discusses how dorsal flake scars detail the reduction sequence at the stage in which a flake was removed. The flakes found at Maropeng represent an intense reduction, as they have little to no cortex. Because of the flake attributes discussed, I cannot say that the flakes come from a later industry than the cores, but that they associate technologically to the LCT radial production and more exploited multifacial and radial cores. Toth (1987) used various experiments to show that flake representation is affected by both human and natural interaction. If the site is dominated by technological flake category types 5 and 6, then flakes came from a more reduced production. If there was more of a representation of the types 1-4 then there was a preference for shorter reductions. The presence of smaller flakes (from types 5 and 6) would also suggest that either these specific pieces were unaffected by serious site formation processes, or that larger cortical flakes from the production process were carried away for use elsewhere (Toth 1987).

5.1.2. Cores

The Maropeng cores are dominated by multifacial (29.7%) and casual (31.5%) reduction strategies, and were made on blocky tabular pieces, and more rounded pieces. The natural shape of the blank was followed, and naturally available platforms were exploited, as seen on the multifacial and casual cores. There are many other types, such as discoids, and both unifacially and bifacially worked cores, but none is very numerous, with no more than five examples at any site. The next most common core reduction type is BSP (bifacial simple partial exploitation; n=8, (7.2%), the strategy adopted to make chopper-cores (refer to chapter 3 for details of reduction strategies). There is a clear distinction between this small proportion and that of multifacial and casual cores, which conform to the shape of natural clasts. Core size ranges from 30-150mm (maximum length), but this does not influence the number of removals. The average number of flake scars is 4-6, but when compared to the maximum length of cores on a correlation graph, there is an r-value of 0.0035. This, as discussed in chapter 3, under quantitative analysis, indicates no significance for the two attributes, and smaller cores do not necessarily indicate more reduction.

Instead core size affects largest flake scar (LFS) size, specifically the maximum length of the LFS size. A correlation graph of the two attributes shows an r-value of 0.7442, indicating a strong correlation whereby LFS lengths increased as cores got longer. Such a correlation could possibly indicate that knappers were able to manipulate their manufacture techniques to the core they were reducing. Obviously, it was impossible to identify any hammerstones in the ABH, so any inferences about percussion depend on the evidence from cores and flakes.

The central mass of cores was maintained throughout the assemblage, which relates to the limited nature of reduction. Cores were not exploited fully, and over 60% have evidence of one or two remaining flakeable platforms. This that there must have been raw material sources near to the Maropeng location. If more intense work on raw material procurement shows sources at a distance, then it could be argued that knappers did not have to ability to rejuvenate platforms and surfaces (similar conclusions are discussed in Field 1999 concerning Sterkfontein). The combination of evidence showing cores had remaining flakeable platforms, as well as large proportions of cortex (>50%) remaining), furthers the argument of limited exploitation of core blanks.

Cores with an abrupt single platform edge with sustained flaking are not very common in the assemblage but comprise a somewhat organised reduction strategy. Along with the one bifacially hierarchal organised core (BHC) found in M1, one could suggest that the Maropeng knappers on occasion were able to manipulate the raw material and reduction patterns to further exploit certain surfaces. As discussed, one needs to consider the upper limits of the cognitive abilities of knappers (McPherron 2000), which at Maropeng could be seen in the these more organised cores, although rare. The sample is too small to be considered significant by itself, but when compared to other assemblages with similar technological strategies, it could indicate a more organised technological strategy (see discussion on Kokiselei 4 below).

The data from the cores suggests an expedient technological strategy, with a focus on flake production. The associated flakes would have quite a bit of cortex on the dorsal sides, and mainly casual and complex dorsal patterns. Some of the flakes with more complex dorsal patterns or predominantly cortical surfaces may be technologically associated, but the majority of the flakes and cores have different amount of cortex. The amount of cortex, a selection of good quality quartzite, along with flakes scars with feather terminations, suggests the knappers understood basic fracture mechanics and used this to their advantage for tool production. Despite knappers being able to understand the raw material properties and produce complete flakes, knappers were either unable or it was not necessary to rejuvenate cores or correct mistakes. This of course could be due to the proximity of raw material sources (as discussed in Blumenschine *et al.* 2012), but there is no distinct evidence of platform rejuvenation on any of the simple core reduction strategies, and could also be a sign of a limited cognition in the knappers.

### 5.1.3. LCTs

Early Acheulean archaeological sites in the CoH have yielded few LCTs, with only 14 from Sterkfontein and 12 from Swartkrans. Maropeng LCTs proportions are also few in number, with only 12 LCTs recovered from the in situ deposits, and 19 recorded in the Pollarolo *et al.* (2010) assemblage. Cleavers and handaxes are both present in the in situ assemblage, a similar pattern as is seen at other CoH sites such as Sterkfontein and Swartkrans (Field 1999). Such small numbers are often associated with the Early Acheulean (Sutton 2014).

The few LCTs with multiple removals (>10) in radial and multifacial reduction patterns, from blanks such as large flakes and cobbles, are similar to the cores in that knappers encountered many flaws and failed to reduce the central mass. Many of the flakes with radial and multifacial dorsal patterns could be associated with the LCT production as they have many flake scars, like the LCTs, and follow the same patterns of reduction.

Maropeng LCTs are assigned to an early phase of the Acheulean techno-complex, due to the expedient forms of reduction, as well as the limited shaping. Limited shaping is evident on a number of LCTs, specifically in cases where the knappers did not succeed in thinning the central mass of the blank. Primary and secondary shaping are found, with primary flaking of lateral edges exclusively found on cleavers made on large flake blanks, but not present on the working edge (cleaver bit). Secondary shaping was used on the handaxe shown in Figure 4.22, and also on the pieces where thinning was attempted, as multiple removals were made in order to achieve it.

Pollarolo *et al.* (2010) argued that the mainly primary shaping with minor secondary shaping was the standard for handaxes and cleavers. I argue that this instead depended on the type of desired tool, and the blank, and hence the type of shaping was used in specific ways. Cleavers were made on large, thin flakes that already had flat, sharp, and functional tips, only requiring shaping along the edge. The bifacially worked pieces, such as the handaxes and the pick, were made on both large flakes and cobbles, which did not naturally have a convergent tip, and had thicker centres, so required more shaping and thinning. Differences in shaping of LCTs therefore relied on the initial shape of the blank and desired tool types, as opposed to being a single manufacture strategy.

5.1.4. Raw materials

The raw material variability is limited within the assemblage, and from the geoarchaeological hypotheses of Pollarolo *et al.* (2010) and Morrissey (2015), it is proposed that the sources of material were close to the Maropeng area. Fine grain quartzite dominates, so the knappers were making active choices about raw material quality. However, this can only be tested with a specific study focusing on raw material sourcing. The cores are generally of a blocky shape. For the artefacts made on the junction of quartzite and dolerite (QDC), there is a possible source known on the property. According to Dr Stratford, this junction is located at the north-east side of the tumulus (Figure 1.2), within the possible extent of the ABH. There is definite opportunity for future work in locating these raw material sources.

5.1.6 Comparisons with other sites

To reiterate what was said in the literature review, nuanced comparisons between Maropeng and other CoH sites Sterkfontein and Swartkrans are not possible to achieve in the scope of this thesis. The methodologies applied by Kuman (1994, 1998, 2001, 2003) and others (Field 1999; Stratford 2008; Kuman and Field 2009; Moll 2014), measure and analyse certain variables differently, meaning that analyses would have to be redone in order to have cohesive data sets. The Early Acheulean at Sterkfontein is still to be fully described and published, thus a full comparison of the technological patterns is not yet possible. Maropeng results are presented as a single assemblage, and so these analyses were not applied to other assemblages, and thus comparisons discussed below speak to more general patterns that can be used to identify overall archaeological trends across the CoH landscape, rather than detailed behavioural changes.

### *Sterkfontein, South Africa*

As discussed in chapter 2, Sterkfontein is one of the most important palaeontological and archaeological sites in the CoH, with a large ESA assemblage with both Oldowan and Early Acheulean material (Kuman 1994; Field 1999; Kuman and Clarke 2000; Stratford 2008). It was used by Pollarolo *et al.* (2010) as the main comparative assemblage for the Maropeng lithics, as it has similarly shaped LCTs made on similar blanks. The Early Acheulean at Sterkfontein is dominated by quartz but fine grain quartzite is common and was most likely selected for the purposes of LCT and core production (Stratford 2008). At Maropeng, the dominant raw material is fine grain quartzite, and is used in the same technological strategies. Overall, the similarities between the Early Acheulean of these two sites is significant because the LCTs productions are alike, as well as similarities in core and flake types. The distinctions between them revolve around raw material dominances, and differences in site formation processes (e.g. winnowing of lighter quartz pieces, and lack of SFD in the Maropeng ABH).

### *Swartkrans, South Africa*

Comparisons with Swartkrans are most valuable for raw material selectivity. Similarly to Sterkfontein, quartz dominates in all the techno-complexes, but quartzite becomes more prominent in the Early Acheulean, having possibly been selected for the purposes of LCT production, but the assemblage is small and may be unrepresentative of the actual raw material distributions (Sherwood 2015). At Maropeng, the LCTs were produced on fine grain quartzite, indicating knappers were possibly selecting the raw material for this purpose.

### *Gadeb, Ethiopia*

Gadeb, Ethiopia is a complex of sites that date between 1.45-0.7 Mya. The model devised by De la Torre (2011) was used to assess reduction in the Maropeng cores, and so a comparison of the cores is necessary to understand the reduction strategies at Maropeng. At Gadeb, all the models described by De la Torre (2011) are present, with unifacially and bifacially worked cores the most common. At Maropeng, multifacial and casual reduction strategies are most common, with a small representation of unifacial, bifacial and discoid cores. Bifacially and unifacially worked cores could be classified as choppers and chopper cores, while the discoidal core are not intensely reduced, with working focused on the naturally available platforms. Overall, even though Maropeng has the same type of reduction strategies as Gadeb, they tend to be simpler and less intensely exploited.

De la Torre (2011) found that there were two distinct reduction sequences evident in the material at Gadeb, one for the production of small flakes, and the other for the production of LCTs, including large flake blanks. Site formation processes have also seriously affected the deposit at the site, with some smaller material winnowed out, and a larger representation of artefacts >20mm. De la Torre (2011) notes that the site formation processes not only biased the artefact representations, it created a co-occurrence of various archaeological material including lithics, fossils and natural pieces. Maropeng does not have any organic material or fossils preserved on the site, but it is comparable as it also has evidence of at least two technological strategies (flake production, and LCT production), and an assemblage biased by site formation processes. Taking the conclusions from both sites, and the relative dates suggested for both deposits, one could argue that Maropeng would fit within the same techno-complex as Gadeb.

The small flake production at Gadeb is argued to represent short reduction sequences, while at Maropeng it is argued that the flakes largely represent LCT shaping. Gadeb has evidence of a range of shaped tools across the various sites, with many LCTs showing limited shaping, and asymmetry. There are examples of more shaped LCTs, but these are found in specific sites and not representative of the entire complex (De la Torre 2011). At Maropeng only examples of simply made LCTs are found in situ, with more intense, yet crude shaping only found on a few handaxes. At Gadeb, this is argued to represent an Acheulean deposit with intra-site variability (De la Torre 2011), and a similar conclusion for Maropeng can be reached, as there too is a mixture of core reduction, as well as possibly significant LCT production, all of which are simple in nature.

*Konso, Ethiopia and Kokiselei 4, Kenya*

The earliest known Acheulean sites are of interest for comparison if Maropeng falls within the same industry. Konso, Ethiopia (Beyene *et al.* 2013; De la Torre 2016) and Kokiselei 4, Kenya (Lepre *et al.* 2011), have crudely made pick and pick-like LCTs, on large flake blanks with minimal shaping of ventral surfaces. These LCTs are accompanied by simple core and flake reductions. Maropeng has the same combination of minimally shaped LCTs and simple core and flake strategies, but the LCTs are not dominated by pick-like morphologies. The LCT flake blanks from Maropeng are long and relatively thin suggesting knappers understood how to manufacture these blanks.

Kokiselei 4 has LCTs and other Early Acheulean type artefacts in one site complex, among multiple Oldowan deposits. These deposits are clearly defined and date to the same time period of Kokiselei 4, suggesting a slow development of Acheulean technological strategies co-existing with more simple strategies. At Maropeng, there is also evidence of some organised cores alongside simpler reduction strategies as seen in the cores, and this could possibly indicate the slow progression of technological evolution and represent a transition from the Oldowan to the Early Acheulean. However, unlike Kokiselei 4, there are no absolute dates for Maropeng and this cannot be confirmed.

5.1.6. General observations

Core and LCT technology is predominantly Early Acheulean, with technological strategies showing limited skill in rejuvenation of core platforms and LCT thinning, and a focus of flake manufacture from naturally available platforms and surfaces. The flakes from the assemblage possibly come mainly from LCT and more intense core reduction.  Even though the flake dorsal scar patterns correspond mainly with LCT production and more exploitative core reduction, there are still no examples of core preparation, such as platform faceting. There is also almost no retouch or formal tool production, which suggests that though it is possible the flakes may come from a more intense reduction, they constitute an early industry. As definitions of industries rely heavily on cores and LCTs, it would be hard to classify the specific industry of the flakes alone. A similarity between the reduction sequences of cores and flakes is that they both have a majority of feather terminations, on the actual flakes, and the LFS of cores. The knappers were consistent in their flaking abilities.

At Maropeng, the predominance of later stage flakes (technological flake categories 5 and 6) shows that they come from in an intense reduction process. Some of the flakes that could be technologically associated to some cores are the large side-struck flakes with cortical dorsal surfaces, as there are a few large casual cores with large side struck flake scars. Toth (1987) demonstrates that flakes such as these (technological flake categories 1-3) would imply short reduction sequences, as is seen in the majority of cores. Obviously, none of these were possible to refit, but the similarities in size, shape, and cortex between cores and these flakes suggest they came from the same reduction strategy, and would have likely been used as LCT blanks.

Considering how Maropeng compares to other well defined ESA and Early Acheulean sites, we can place it firmly within the lower Pleistocene. As with Gadeb, Maropeng has two main reduction strategies evident of cores and flakes, one for flake production on naturally available platforms of flakes, and one for LCT production and shaping and those do not necessarily come from different techno-complexes, but from different productions. The LCTs are crudely made on flake and cobble blanks, such as seen at Sterkfontein and Swartkrans, but are not dominated by pick-like morphologies, as seen at Kokiselei 4 and Konso. The best sites to compare Maropeng to would be the CoH sites, because of the core reduction in artefact production, similar raw material uses, and general artefact similarities.

# **Chapter 6: Conclusion**

The previous work done at Maropeng by Pollarolo *et al.* (2010), on the archaeology and site formation, has been shown to be correct but limited in its descriptions of the ABH deposit. The simple LCT production and few organised cores demonstrate an early phase of the Acheulean techno-complex for those types. While the flakes represent a more intense reduction, they can be associated to LCT production and more intense core reduction, they can also be categorised to an earlier industry because of the lack of platform faceting or preparation.

There is much opportunity for further work and research at the site around raw material sourcing and quality, as well as work around abrasion and weathering difference in cores and flakes. There is clearly a preference for fine grain quartzite to make larger cores and flakes, as well as to produce LCTs and shaped pieces. It would be interesting to discover the actual sources as it would provide information of the choices of hominids, and whether they were selecting raw materials based on locality, or quality alone. This data, along with the geoarchaeological and technological work, would have implications for better understanding hominid behaviour in an open-air context. Determining whether there are differences in abrasion and weathering of flakes versus cores would either prove or disprove the argument that they are from different reduction processes.

The significance of the Maropeng archaeological site is one of continued use of the landscape over the course of the ESA with specific selection processes regarding raw material selectivity and variety in the reduction processes. The focus on simple flake production, limited LCT shaping, the small presence of organisation of cores, and the various stages of weathering, suggests a long time-average assemblage and a complex site-formation history on the landscape. Even though there is evidence of complexity and variety in the technological strategies, the most obvious techno-complex demonstrated by the majority of the artefacts is the Early Acheulean.

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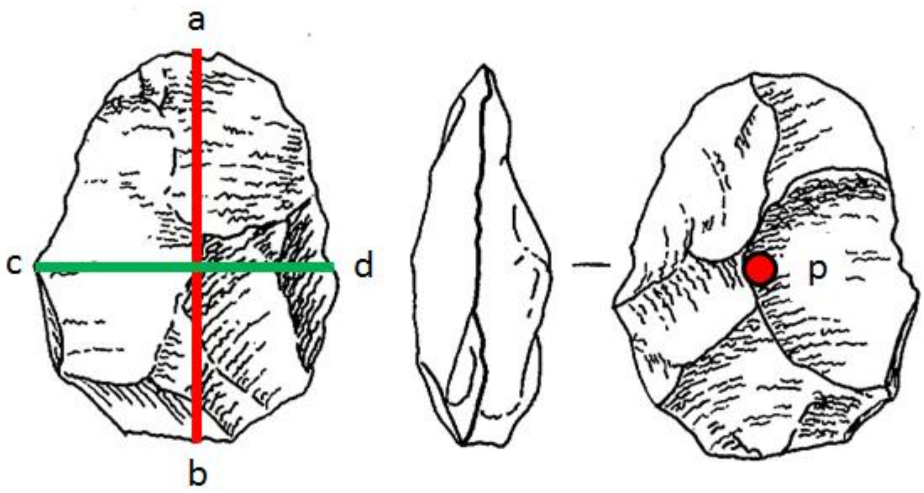
# Appendix

Appendix 1

**Maropeng EDM Protocol**

**All artefacts measuring >20mm are piece plotted with the EDM. When a piece is plotted, the EDM will prompt for layer and features. These MUST be followed to avoid data loss.**

**Layer corresponds to the specific site from which the artefact is being recorded (i.e. M2EXCAVATION). Features will ask for the different attributes of the artefact. For redundancy's sake the same data should be filled in on all points on a single artefact.**




**Artefact Number suffixes – to be placed after artefact number in the EDM records, e.g. 234b; 234c; 234d; 234p**

**a – the higher (shallower) of the long axis ends**

**b – the lower (deeper) of the lower of the long axis ends**

**c – the higher (shallower) of the short axis**

**d – the lower (deeper) of the short axis**

**If no dip is visible then it doesn't matter which end is plotted first.**

**p – bottom centre of artefact. p is taken at the centre point of where the artefact is removed from.**

**<u>Artefacts 21mm – 50mm</u>**

**Piece Plotted with the EDM.**

- **If elongated (roughly 1.6 length : 1 width), then three points are taken with artefact number plus suffix a,b,p.**
- **If not elongated then piece is plotted by a single point at p (centre bottom of artefact).**

**<u>Artefacts > 50mm</u>**

**Piece Plotted with the EDM.**

- **If elongated (roughly 1.6 length: 1 width), then five points are taken with artefact number plus suffixes a,b,c,d & p (see diagram above for description of point placement).**

  **a to b – down long axis (from higher to lower)**

  **b to c – down short axis (from higher to lower)**

- **If not elongated then a,b,c & d are taken across perpendicular axes of the artefact plus p at the bottom centre of the artefact.**

## Appendix 2

Idealized schemes of free-hand core reduction (expanded from de la Torre et al, 2003; de la Torre and Mora, 2005). Words directly from De la Torre (2011).

19. USP: Unifacial simple partial exploitation. Flaking is unidirectional and restricted to one plane, from a natural striking platform, and the angle between the striking platform and the knapping surface is simple ($<45^{\circ}$). Classic choppers fall into this category.
20. BSP: Bifacial simple partial exploitation. Flaking is unidirectional but in two adjacent surfaces, separated by a simple-angled bifacial edge. Chopping tools or bifacial choppers (Leakey, 1971) fall into this category.
21. UAU1: Unidirectional abrupt unifacial exploitation on one knapping surface: Flaking is unidirectional and limited to one surface, and the angle between the striking platform and the knapping surface is abrupt ($>45^{\circ}$). Many of Leakey's (1971) heavy-duty scrapers fall into this category.
22. UAU2: Unidirectional abrupt unifacial exploitation on two independent knapping surfaces: although there are two exploitation planes, there is no interaction between their respective striking platforms and knapping surfaces. Flaking is unidirectional, and the angle between the striking platform and the knap- ping surface is abrupt.
23. UAUT: Unifacial abrupt unidirectional total exploitation. There is only one striking platform, an abrupt angle of interaction between the striking and knapping surfaces, and flaking takes place all over transversal and sagittal planes of the core.
24. UABI: Unifacial abrupt bidirectional exploitation: Two opposed striking platforms are used to flake the same knapping surface, but there is no exchange between the striking and the knapping surfaces (hence unifacial).
25. BAP: bifacial abrupt partial exploitation. Flaking takes place in two adjacent surfaces separated by an abrupt angle, and the volume is exploited partially (i.e., some planes remain unworked). Some of Leakey's (1971) heavy-duty scrapers fall into this category.
26. BALP: bifacial alternating partial exploitation. Two adjacent surfaces are partially knapped by means of alternate flaking, using scars on the knapping surface of one plane as the striking platform for obtaining flakes on the other plane.
27. BALT: bifacial alternating total exploitation. The whole circumference of the core

is exploited following the same bifacial alternating strategy as in the previous method.

28. UP: Unifacial peripheral exploitation. The horizontal plane is exploited unifacially through the rotation of the transversal and sagittal planes, but extractions do not meet in the centre of the volume and reduction is limited to the edge of the core.
29. BP: bifacial peripheral. Exploitation concentrates on the horizontal plane but there are two interactive surfaces, with the transversal and sagittal planes sometimes acting as preparation striking platforms for extractions on the horizontal plane.
30. UC: Unifacial centripetal exploitation. The horizontal plane is exploited unifacially through the rotation of the transversal and sagittal planes, and extractions are radial and usually meet towards the centre of the knapping surface, facilitating the reduction of the volume.
31. BHC: Bifacial hierarchical centripetal. An intersection plane divides the core into two asymmetrical and hierarchized volumes. Transversal and saggital planes act as a subordinated volume (preparation surface) to obtain flakes in the main exploitation surface (see full discussion of this method and its implications in de la Torre, 2009).
32. Discoid: this method is similar to the BHC, except for the unclear hierarchization of surfaces and the systematic alternating of strikes on the bifacial edge.
33. Polyhedral: cores with three or more knapping surfaces, which become spherical, whether intentional (Texier and Roche, 1995) or the unplanned result of continued reduction sequences (Schick and Toth, 1994).
34. Multifacial: cores with three or more knapping surfaces which show no clear organization of flaking but the irregular use of any available flaking angles. IRREGULAR
35. Casual
36. Bipolar