Analyzing lithic raw material qualities and hominid selectivity in the Early Palaeolithic

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DECLARATION

I declare that this thesis is my own, unaided work. It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand. It has not been submitted before for any degree or examination at any other University.

Sherwood, N.L.

10th day of December 2019 in Johannesburg

ABSTRACT

Numerous studies have been employed to analyse early hominid lithic raw material selection using a variety of different methods, but have not been done for the large majority of sites throughout the world, with the main focus being on East African Oldowan sites. Thus, our knowledge of early hominid behaviour across the world and across time is not nearly as extensive and complete. In addition, a universal methodology to gauge raw material selection has not yet been presented. This is because each archaeological site is unique, making it difficult to do so. Some researchers have made use of rigorous engineering and geochemical testing methods to determine the quality of rock types selected and utilised, while others have applied more qualitative methods or included an experimental aspect to their research. The research presented in this thesis incorporates raw material studies from China and South Africa for both the Oldowan and Acheulean technological time periods. Most importantly it shows the significance of developing a methodology to gauge raw material selection that is unique for each particular site with the aid of experimental knapping. The inclusion of experimental knapping is not only important for determining quality characteristics of rocks for analyses, but it can also help in discovering behavioural aspects of early hominids by isolating specific reasons for their selection choices. Such knapping experiments were performed for the Cradle of Humankind sites Sterkfontein and Swartkrans, as well as for sites in the Danjiangkou Reservoir Region (DRR), central China. In the Cradle, experimental creation and use of tools made from the twelve different available rock types determined which of these rock types were best for tool creation. The experimentally created lithics also provided a basis for comparison with the artefacts from Oldowan and Acheulean assemblages at both sites showing that selection was present, and to what extent. The two time periods were compared to each other and differences between the two sites assessed. The results indicated that there was more selection during the Acheulean and that more selection was practiced at the Sterkfontein site. This is likely due to the larger distance from Sterkfontein to the main source of gravels in the area. Experimental knapping of materials in the DRR revealed that hominid selection for raw material is also present in Asia during the Middle Pleistocene and is just as complex as selection in Africa. Variables for analyses had to be adjusted to suit the uniqueness of the geology of the area as the rock types available in this region are different from the materials in East and South Africa. The rock type most often selected for large cutting tools (LCTs) at the DRR sites (terrace three) is one that frequently exhibits a multitude of visible flaws (quartz phyllite) and is the most common material

available from the local gravels. This might leave one to conclude that raw material selection was absent or highly expedient for the creation of LCTs at this Middle Pleistocene site. Experimental knapping of this material, and the others available, revealed that quartz phyllite was the most optimal for the creation of LCTs. The unique nature of the flaws allowed for cobbles to be easily split in half with little effort. The halves could then easily be shaped into functional LCTs with minimal further shaping, despite the flaws in the material. Furthermore, these flaws could be circumvented or further exploited with knapping skill. Another factor that contributed to this material's usefulness was the ease with which large flakes could be dislodged. Less force was needed to flake this material (much like glassy material) than the quartzites and igneous cobbles, which rarely exhibited flaws. Quartz phyllite is also durable and allowed for exceptionally sharp edges to be created. Experimentation with various knapping techniques indicated that bipolar flaking of quartz phyllite cobbles was the most successful method for blank creation for LCTs. The bipolar knapping of this material made it possible to determine a feature often unique to this technique, namely compression fractures, which could be used to identify which of the Acheulean LCTs were created from bipolar flakes. This technique was present in the assemblages, and shows flexible technological solutions among the Middle Pleistocene hominids living in the DRR. These experiments demonstrated the importance of experimental knapping being included within lithic raw material studies, as it helped show the intricacies of raw material reduction and its associated selection at the sites in this project. This thesis also presents information with regards to the complexities of raw material selection during the Acheulean and the Palaeolithic in Asia.

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CONTENTS

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Archaeologists study our ancestors with the aim of understanding our own journey through time and to bring to light challenges our ancestors might have faced in hope that we can learn from our past. In addition, with the aid of the paleoanthropologists, archaeology helps us to illuminate our evolutionary and cognitive development and what factors might have made us the successful species we are today, after all we are the only species on planet earth to have the cognition to want to study and understand our own existence. Research into human evolution have focused on hominid technology (Toth 1984; Dibble 1985; McBrearty and Brooks 2000), mobility (Merrick and Brown 1984; Ambrose 2006; Braun *et al.* 2008a), site variability (Stout *et al*. 2005; Goldman-Neuman and Hovers 2012), adaptability (Hay 1976; Merrick and Brown 1984; Dibble 1985; Brantingham *et al*. 2000; Harmand 2009; Nash *et al*. 2013), landscape utilisation (Blumenschine *et al*. 2008; Braun *et al.* 2008a; Braun *et al.* 2008b; Harmand 2009), knowledge transfer and learning (McBrearty and Brooks 2000; Luncz *et al*. 2018; Proffitt *et al.* 2018). Archaeologists study these aspects to understand why these behaviours exist and to document the variations of hominid behaviour through space and time. These questions are complex and require high resolution and nuanced multidisciplinary datasets that enable us to better understand variability and adaptive strategies in hominid behaviour. To gain an understanding of these complexities through time we need to study technologies left behind by our ancestors. Stone tool technology, an innovation started perhaps by pre-*Homo* hominids, provides us the opportunity to examine many of these themes when very little behavioural evidence is preserved. Stone tools are the most abundant evidence we have of hominid technology, as anything organic worked or used by them normally does not preserve in the archaeological record, or is extremely rare, such as worked bone (Brain 1993; Backwell and d'Errico 2001; Backwell and d'Errico 2003; Backwell and d'Errico 2008; Backwell and d'Errico 2009; Stammers *et al*. 2018). The success of tools made from stone is reliant on the type of rock that it is made from, as some rock types are easier to flake, more durable and sharper than others. Thus, studying rock sourcing and selective behaviours provide archaeologists with insights into hominid cognitive complexity with regards to their understanding of the properties of different rock types, as well as their mobility, landscape use and adaptability.

According to Goldman-Neuman and Hovers (2012:10), rock selection "can be viewed along a behavioural continuum from very simple exploitation, by default of raw material availability, to more complex patterns of behaviour, involving a large number of selection criteria". Therefore, to gauge the degree of hominid rock selection one needs to investigate multiple selection criteria and place these into an environmental and technological context. It is also paramount to investigate site variability and the changes from one techno-complex to another. Studying many different sites will give a bigger picture of hominid raw material selection for a particular time period, as not all sites will express the full complexity of early hominids due to different environmental challenges. This also enables archaeologists to determine what influences the landscape had on hominid choices. Gauging differences between techno-complexes will indicate whether hominid understanding of rock properties and associated behaviours became more complex through time (Sherwood 2013).

Random selection of rocks by early hominids would indicate that they had little capacity for gauging characteristics that assist or hinder the creation and use of stone tools. Lithic raw material selection for the Lomekwian (3.3 Ma) has yet to be studied in detail to indicate whether selection was present, and to what extent (Harmand *et al*. 2015). A number of studies has indicated that the Earlier Stone Age (ESA) hominids in East and South Africa not only selected certain rock types (Toth 1985; Kuman 1996; Isaac *et al.* 1997; Ludwig and Harris 1998; Field 1999; Semaw *et al.* 2003; Stout *et al*. 2005; Harmand 2009; Goldman-Neuman and Hovers 2012; Sherwood 2013; Braun *et al*. 2019), but they were also capable of selecting better quality varieties of those rock types (Stout *et al.* 2005; Braun *et al*. 2009; Goldman-Neuman and Hovers 2012; Sherwood 2013; Braun *et al*. 2019). This indicates that as early as 2.6 - 2.5 Ma hominids already knew that there are a variety of rock types and that some of these types knap more easily and could be better for certain uses. In addition, we have not as of yet conducted extensive raw material studies on Early Palaeolithic sites across the world or covered multiple Oldowan and Acheulean sites from a variety of different geographical locations to confirm that these behaviours were more widespread. Studies comparing behavioural difference from one techno-complex to another are also not done very often due to constraints, such as difference in location and environment. This and many other constraints also make it rather difficult to devise a universal methodology to guide raw material studies due to the varying nature of site locations and associated raw materials. The goal of this thesis is to show how current methods can be applied to sites of different periods and on different continents with the aid of experimental knapping and landscape surveyance.

1.2 Research goals

Before discussing the research goals, it is important to clarify the difference between the Early Stone Age (ESA), the Palaeolithic and the Middle Pleistocene periods to avoid later confusion. ESA (3.3 Ma – 300 ka) technology includes technologies synonymous with the Oldowan and Acheulean industries found in Africa, but the equivalent earliest technology in Asia is termed the Early Palaeolithic (from ca. 1.7 Ma). The technologies studied in this thesis from the Cradle of Humankind (South Africa) are Oldowan and Acheulean industries and are thus part of the ESA, whereas the technologies studied in the DRR in China is Acheulean technology, but dated within the Early Palaeolithic era during the Middle Pleistocene epoch (780 – 125 ka). Thus, when referring to ESA technology this thesis includes assemblages that were studied in the DRR in China.

As mentioned in the previous section, research with regards to raw material procurement has not been done in all parts of the world where ESA technology is present. This is especially true for some parts of Asia such as in China. Research into more ESA sites around the globe will help us gather a broader understanding of early hominid behavioural complexity. This thesis incorporates site locations from two continents and introduces more extensive raw material studies for the Early Palaeolithic in China as well as raw material selection in South Africa, which adds to the understanding of early hominid behaviours determined for East Africa.

Moreover, raw material studies are often conducted in a variety of different ways, as no universal method for doing so has been agreed upon. A universal methodology to gauge raw material studies would allow for easier comparisons between different sites around the world, but such a methodology would be difficult to implement as sites around the world are vastly different, not only in habitat, but also raw material availability. One thing that the research in this thesis brings to light is that the incorporation of extensive experimental knapping in a study gauging lithic raw material selection is exceptionally useful in helping understand early hominid raw material selection behaviours and why these behavioural decisions were made. Utilising geochemical and engineering methods to measure properties of rock, such as their hardness, coarseness and fracture toughness, would scale rocks according to these attributes and thus their usefulness for creating tools. However, this takes away human aspects that are used during knapping, such as skill which can improve, adjust and adapt. Knapping various materials provide an actualistic and holistic understanding of raw material flaking attributes and how they function together. Knapping of all locally available materials not only helps one to gain an actualistic perspective of the behaviours of the different raw materials, but knapped tools can also be used as a basis for comparison to the archaeological assemblages to gauge the degree of selection for quality present at a site. The knapping process also helps to isolate variables that can be measured to assess the quality of those specific rock types.

The studies in this thesis make use of the methodological framework set out by Sherwood (2013), which focusses heavily on experimental knapping and is used for the study locations in this thesis to show its importance in raw material investigations. Sherwood's methodology consists of using extensive knapping of locally available raw materials near a site, thus getting an actualistic experience with the available materials. This also allows for the creation of variables to measure that are unique to the local materials and challenges hominids would have faced using these specific materials. The project investigates selection in the Cradle of Humankind World Heritage Site (COHWHS) in South Africa for two sites, Sterkfontein and Swartkrans, as well as Middle Pleistocene sites in Danjiangkou Reservoir Region (DRR), central China. The Cradle sites were selected as the sites are close together (1 km apart) and both have Oldowan (ca 2 Ma) and Acheulean (ca 1.7-1 Ma) assemblages present. Moreover, tools from all these assemblages were made from the same geological sources, allowing for direct comparisons between the two sites with regards to raw material quality selection. The presence of both Oldowan and Acheulean technologies also allow for comparisons over time. Research by Sherwood (2013) for the Swartkrans site, shows that raw material selection was present during the Oldowan and Acheulean. This thesis now expands the research by including data for the Sterkfontein Oldowan and Acheulean to allow for inter-site comparisons and to broaden our understanding of raw material selection in this region during the ESA. These two sites will not only help to gather extensive data on rock sourcing and selection, but they will also aid in understanding site variability and hominid landscape use, as the Oldowan and Early Acheulean technologies of the two sites differ despite their comparable ages and proximity.

The research questions explored for the Cradle are:

1. Is selection for raw material quality present at Sterkfontein, as has been shown for the Swartkrans Oldowan and the Acheulean?

2. If there are selective differences between the two sites, what reasons could explain their existence?
3. Overall for the two sites, is there an increase in quality selection during the Acheulean, compared to the Oldowan?
4. What does this data add to our current understanding of hominid behaviours?
5. How have extensive knapping experiments aided this study?

The Middle Pleistocene sites in the DRR, were selected to test the application of the methodology set out by Sherwood (2013) to sites with a different geological setting, as well as to gauge lithic raw material selection in central China for this time period. Raw material sourcing and selection have not been studied extensively in East Asia, and Acheulean technologies in this part of the world are often considered less refined and distinct from their European counterparts. For example, Asian handaxes have been shown to be generally thicker and heavier (Kuman *et al*. 2014), and it is argued that the poorer quality materials available in East Asia is likely the reason why this dissimilarity exists (Leng and Shannon 2000; Leng 2001; Bar Yosef *et al*.2012).

Research questions explored in the DRR:

1. Is there selection for raw material quality in the DRR?
2. How have extensive knapping experiments aided this study and what technological behaviours can be inferred from the results?
3. What does this add to our current understanding of hominid behaviours in the DRR during the Middle Pleistocene?

The overall research goals are to test Sherwood's (2013) methodology for inter-site comparisons and diachronic comparisons to assess selection behaviour on two different continents, Africa and China. The research will also address selection and illuminate the complexity of hominid behaviours through time, which will be discussed in the concluding chapter.

1.3 Organisation of the thesis

Chapter Two provides the literature review and discusses the relevant studies pertaining to lithic raw material selection and associated hominid behaviour through time. A separate chapter on Materials and Methods is not included in the thesis because these topics are covered separately in the three following chapters (two of which have been published), where the methods have been catered to the specific sites and their raw materials. Chapter Three explores raw material selection in the Cradle of Humankind, South Africa, discussing the materials and appropriate methods for these sites and comparing the Oldowan and the Acheulean assemblages of Sterkfontein with that of a neighbouring site, Swartkrans. As Sherwood (2013) is not intended for separate publication, this chapter includes the methods in detail. This chapter is formatted as a journal paper which is intended for submission following thesis reviews. However, the relevant parts of the literature review will be added to Chapter Three before submission of a journal paper. This has been done to avoid repetition, as there is a separate chapter (Chapter Two) in the thesis which extensively discusses the available literature. Chapter Four consists of a published paper which investigates raw material selection for Middle Pleistocene artefacts from Terrace Three of the Han River in the DRR, central China. This paper in particular shows the importance of experimental knapping of the relevant raw material studies, as much of the selective decision process employed at this site was understood in more depth after extensive knapping of the available materials. Chapter Five consists of a published paper for the DRR, which investigates the rare presence of bipolar flake blanks being used during the Acheulean for the creation of LCTs. Experimental knapping was conducted to help understand why this is the case and to identify unique features that can be used to identify which LCTs were created on bipolar flake blanks. Chapter Six provides the overall discussion and conclusions of the thesis. The research questions presented above are discussed, comparisons with previous raw material studies are made, and general conclusions are drawn about hominid behaviour through time.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Rock properties play an important part in creating functional tools (Andrefsky 1994; Brantingham *et al*. 2000), as the quality of a particular rock relates to its flaking predictability, the durability and sharpness of the knapped tools (Braun *et al*. 2009; Wadley and Kempson 2011), and thus its usefulness for performing tasks. Therefore, gauging all aspects related to raw material selection is very important in understanding to what degree hominids understood the various properties of rock and how these affected tool creation and use. This chapter will cover previous raw material studies and discuss various behaviours documented for hominids from the inception of tool creation to modern day times for comparison. It also shows the various types of studies done on raw material studies. The chapter is divided into three time periods and discusses hominid and human behaviours with regard to all types of raw material selection that is documented in the archaeological record. The MSA and LSA are included to show the studies done on raw material selection during these time periods and, most importantly, to show that human adaptability and selective complexity extends to other materials. This is to place lithic raw material selection into the broader context of raw material selection behaviours.

2.2 Raw material selection and behaviours during the ESA

Studies on raw material selection during the Lomekwian have not yet been done in detail. Tools dating to 3.3 Ma uncovered at Lomekwi 3 in West Turkana, Kenya, were made from igneous rock that is locally available, making it uncertain if these rock types were specifically selected for. However, selection for the size of cobbles might have been practiced as larger cobbles were often used from the local sources, which had a variety of cobble sizes available (Harmand *et al*. 2015). The selection of rock during the Oldowan from 2.6 Ma has been assessed in detail for assemblages in East Africa (Isaac *et al.* 1997; Semaw *et al*. 2003; Stout *et al*. 2005; Braun *et al*. 2009; Harmand 2009; Stout *et al*. 2010; Goldman-Neuman and Hovers 2012; McHenry and de la Torre 2018). A recent paper documenting the earliest Oldowan assemblage in Ethiopia, at 2.61- 2.58 Ma (Braun *et al*. 2019), indicates selection for specific types of rock and better qualities of these rocks (predominantly rhyolite) was already present during the early Oldowan. These papers show that early hominids were already capable of selecting for suitable materials to be utilised for stone tool making, as selection was practised for rock types that were durable, finer grained and with fewer visible flaws present. Hominids also tended to select for the size and shape of a rock, as the shape of the rock intended for knapping influences the type of tools that can be created with ease, or determines the amount of shaping that is required prior to tool manufacture (Goldman-Neuman & Hovers 2012). Shape can be quantified mathematically (Barret 1980; Illenberger 1991; Benn & Ballantyne 1993) or placed into general shape classes by visual assessment, which is often preferred by archaeologists. It is noted by Goldman-Neuman & Hovers (2012) that early hominids in East Africa around 2.3 Ma preferred to select rocks that have some angularity, as it allows for a starting platform for knapping. A similar preference for angularity is noted by Delagnes & Roche (2005), who reconstructed cores from Lokalalei 2C in Kenya, and by Kuman (1996) and Field (1999), who conducted experiments to evaluate the reduction of certain shapes into cores for the local rocks at Sterkfontein, South Africa. The angularity, rather than the general shape of a rock is important because angularity allows for platforms with angles below 90 degrees, which according to Delagnes & Roche (2005), is the most important selection factor for rock shape during the Oldowan.

However, shape and size were not the only determinants of rock selection, as certain rock types were favoured by ESA hominids. These rock types (certain igneous material, chert, quartz and quartzite) are abundant, and they can often produce durable and sharp-edged tools that are more effective. Selection for better qualities of these rock types was also practiced at some sites. Stout *et al*. (2005) assessed six of the earliest sites from Gona, of which five date to between 2.6 and 2.5 Ma, whilst one site dates between 2.58 and 2.27 Ma. Samples from the local conglomerates available to the hominids were collected and analysed with variables listed below. The data were captured directly from cobble surfaces and were compared to the artefacts from each site. The authors examined rock type, percentage of phenocrysts present (area occupied by large crystals embedded in a fine-grained matrix), average size of phenocrysts, and groundmass texture (the size of the grains surrounding the phenocrysts). The majority of artefacts was finer grained than the rock samples collected from the conglomerates and also had smaller and fewer phenocrysts present. This study showed that selection of rock quality by late Pliocene hominids was indeed present in Gona at the beginning of the Oldowan and not random. If selection was random the assemblage would exhibit similar properties to the average of rocks found in the conglomerates. Goldman-

Neuman and Hovers (2012) used a similar approach to Stout *et al*. (2005) for assessing rock quality for the Oldowan in the Makaamitalu Basin, Hadar, Ethiopia. Two sites were assessed, one site dating to about 2.36 Ma, and one being slightly younger, based on stratigraphic considerations. Selection at the older of the two sites was mainly for homogenous material, while selection at the younger site was towards finer grained material with fewer phenocrysts present. Braun *et al*. (2009) tested if certain engineering techniques would be sufficient to determine rock quality selection for the Oldowan in Kanjera South, Kenya, which dates to between 2.3 - 1.95 Ma (Plummer 2004). This was done by applying both engineering and experimental methods to gauge edge durability and fracture predictability. Edge durability of the various materials available was assessed by the creation and experimental use of flakes. The flakes were used in a standardised experiment with a set number of strokes in various butchering activities. The percentage of area lost on flakes was calculated for each rock type and correlated with an American standard abrasion hardness test (ASTM C241) performed on the various rock types. Fracture predictability was measured using a rebound hammer (Schmidt hammer) on conglomerates that were cut into $10cm^3$ blocks to measure a rock's ability to absorb impact energy. These results were correlated with artefacts by making use of the Brantingham *et al.* (2000) method to determine impurity encounter rates on artefacts, by counting flake scars on a tool that exhibited flaws and dividing that by the total number of flake scars on that tool. The authors concluded that certain engineering techniques could be useful to help determine the degree of selectivity practiced by hominids as there was a high correlation between engineering techniques and experimental methods. The results indicated that hominids at Kanjera South preferred rock types that were both durable and predictable when flaking (Braun *et al*. 2009).

Raw material selectivity has also been demonstrated for Oldowan assemblages in South Africa. Hominids selected specific rock types, as 90.5 % of the Oldowan assemblage at Sterkfontein, Cradle of Humankind, South Africa consists of quartz (Kuman and Field 2009) (including small flaking debris). There were in fact 12 different rock types available from which they could have selected, with the majority being chert and siliceous dolomite (Sherwood 2013). This is also apparent for the Oldowan at Swartkrans (approximately 1 km from Sterkfontein), where 61.2 % of artefacts are made from quartz (Kuman *et al*. 2018). Sherwood (2013) made use of experimentally created lithics to compare to the Oldowan, Acheulean and MSA assemblages at Swartkrans. The experimental assemblages were created to represent lithic raw material quality that would be seen in an assemblage if rocks were randomly selected. The knapping experiments also aided in the selection of variables for analyses. The impurity encounter rates (as per Brantingham *et al.* 2000), fracture encounter rates, quartzite grain sizes and weathering of tools were analysed, as these attributes were found in experiments to have the greatest influence on knapping, shaping and use of tools. The study indicated that selection for rock quality was present in all three techno-complexes, as tools were predominantly made from three rock types that were most suitable for making stone tools and had a lower percentage of visible flaws present than the representative sample (experimentally created tools). The experimentally created sample consisted of tools made from the local geology to represent what the average quality of tools would be like if rocks were randomly selected from the landscape. This study also shows a progressive increase in selective practices towards better quality rock from the Oldowan to the MSA, as the same three rock types are selected in all three techno-complexes, yet there is a marked increase in the qualities of the individual rock pieces selected for tool creation through time (Sherwood 2013).

It is important to understand the interconnectivity between rock selectivity and habitat, and how this affected hominid technology and decision making (Braun *et al*. 2008b; Harmand 2009). Behaviours can be ascertained by studying landscape use and mobility, which is often done by determining transport distances of selected materials and tools, as well as potential stockpiles in the form of manuports. Oldowan hominids did not frequently transport rocks over large distances (>50 km), as is evident for some Middle Stone Age (MSA) sites (Merrick and Brown 1984; Nash *et al*. 2013; Nash *et al*. 2016). Sourcing was generally within a 10 km radius (Negash *et al.* 2006) and may not have been as extensive during the Oldowan, because hominids preferred closed habitats, most likely because of the abundance of plants for food, and for protection from carnivores and shelter (Sikes 1994). Furthermore, according to Hay (1976: 180), “archaeological sites are found principally in lithofacies with evidence of perennial supply of fresh water and relatively abundant game and vegetation”. Many studies of Oldowan sites in East and South Africa corroborate this statement (Hay 1976; Toth 1985; Peters and Blumenschine 1995; Semaw 2000; Avery 2003; Stout *et al.* 2005; Kuman 2007; Goldman-Neuman and Hovers 2012; Sherwood 2013; Prassack 2014). Importantly, the majority of these sites is near gravels, which could indicate that hominids also occupied areas close to water not just for food and water, but also for rock sources. Rivers, especially, offer cobbles of various shapes and sizes and a variety of rock types, which provide many selective options for hominids (Kuman 2003). Multiple Oldowan and

Early Acheulean sites also contain manuports (Potts 1988, 1991; Kuman 1996; Field 1999; de la Torre *et al.* 2003; Plummer 2004; Kuman 2007; Kuman and Field 2009) from a variety of sources (Braun *et al*. 2008b), which suggests that hominids had foresight and planned for future occupations.

Hominids often implemented different knapping strategies for specific rock types, such as bipolar reduction of quartz (Diez-Martín *et al.* 2011; Gurtov and Eren 2014; Manninen 2016). (Barham 1987: 49) discusses why the bipolar technique was often implemented on raw materials such as quartz and similar siliceous materials. This technique was used on resources that are good quality for tool creation but scarce, and often in a form that is not easy to flake with freehand percussion, such as small spherical nodules of quartz. This technique is also seen around 2900-1600 BP (albeit, modern humans refined this technique) in the eastern Mojave Desert where sources of Jaun Obsidian were often in the form of spherical cobbles approximately 4cm in diameter (Torres 1998). Furthermore, flake and tool morphology can be affected by raw material type and not just the size of nodules (Dibble 1985; Manninen 2016). Quartz, which is frequently used during the ESA, often fractures unpredictably and can shatter into multiple fragments. This is especially true when trying to produce thin flakes. Knappers avoided this by making thicker flakes or using certain knapping techniques, such as bipolar anvil reduction to obtain thinner flakes (Manninen 2016). Early hominids also used certain rock types for particular tools, such as quartzite for heavy duty tools and quartz and chert for smaller tools during the Acheulean in the Sterkfontein valley (Kuman 1996; Field 1999; Sherwood 2013). This behaviour is also seen at the Acheulean site Garba XIII, Ethiopia (1-0.8 Ma), where obsidian and porphyritic rock is used for large cutting tools (LCT) production, and basalt for flakes (Gallotti *et al.* 2014). The paleochannels rarely preserve large enough cobbles for the creation of large flake blanks, which were used for LCT creation. Flake blanks were thus likely gathered at the obsidian and porphyritic rock outcrops. Cobbles were selected from the channels for the creation of the flake tools, thus two types of *chaîne opératoires* exists at this site. Adjustment of knapping techniques to certain materials, as well as utilising specific rock types for particular functions, further show that ESA hominid technological repertoires were sensitive and intricate.

Raw material selection at Acheulean sites has not been assessed to the same extent as for the Oldowan, with most of the research focussing on raw material effects on handaxe shape, size and variation (Sharon 2008; Eren *et al*. 2014). However, McHenry and de la Torre (2018) assessed lithic raw material quality for two assemblages at the Oldowan-Acheulean transition in Bed II of Olduvai Gorge, Tanzania. One late Oldowan site (HWK EE) and one early Acheulean (EF-HR) site were selected. Artefacts were divided into rock type groups using hand-sample examination with a hand lens, which were further subdivided based on other characteristics (such as grain size, colour, mineralogy, and vesicularity). Geochemical and mineralogical analyses were applied to volcanic raw material to subdivide these into groups. This was also done on a small sample of un-modified artefacts to represent the archaeological assemblages. Selection at the late Oldowan site HWK EE was not based on rock texture. But more importance was placed on blank shape and availability of natural angles suitable for flaking. The Early Acheulean site EF-HR indicated that hominids selected high-quality fine-grained lavas for the production of LCTs (McHenry and de la Torre 2018).

It is noted that for most Acheulean sites in South Africa raw materials that were utilised were often sourced close to the site, within a 10 km distance (Klein 2000). However, see Deacon and Deacon (1999) and Braun *et al.* (2013) where sources used at Elandsfontein in the Western Cape of South Africa, may have come from 30 – 40 km away. Stone tool technologies change during this time period with the addition of LCTs. This technology remains typically standardised across the world, which could be due to a number of factors, such as social interactions and networks (McNabb *et al.* 2004) or controlled via genetic memory (Corbey *et al.* 2016).

Selection for the quality of raw material increased during the Acheulean, relative to the Oldowan, and further increased during the Middle Stone Age (MSA), as was determined by Sherwood (2013) for Swartkrans in the Cradle of humankind, South Africa. The assemblages (Oldowan, Acheulean and MSA) at this site were made from the same four rock types, but showed a significant increase in the materials quality over time, thus documenting an increase in complexity with regards to raw material selection over time in this part of the world.

Another behaviour that is seen during the Acheulean include the use and control of fire. In Africa bone burnt in campfires at the surface was discovered at Swartkrans dating approximately 1 Ma (Brain and Watson 1992; Brain 1993), and *in situ* burning is argued at Wonderwerk cave, northern Cape, South Africa (Berna *et al.* 2012), dating to 1.1 Ma. The earliest evidence of the use of fire outside Africa is found in Israel dating to 0.8-0.7 Ma at the site of Gesher Benot Yáaqov (Alperson-Afil *et al.* 2007; Alperson-Afil and Goren-Inbar 2010).

2.3 Raw material selection and behaviours during the MSA

It is argued by McBrearty and Brooks (2000) that modern human behaviour gradually makes its appearance in the archaeological record around 250 – 300 ka. This is visible in many MSA sites in the ways people selected and utilised raw materials. Technologies changed drastically during the MSA, seeing the introduction of prepared core technologies, blades, points and composite tools. In addition, a general increase in geographical range is seen at multiple sites, where some resources are selected from distances over many hundreds of kilometres. Raw material types other than stone, such as bone, were used more frequently and often for specific tasks. Other behaviours are also more apparent, such as specialised hunting, long distance trade, heat treatment of stone, more use of soft hammer percussion, the use of pigments, art and symbolism.

As mentioned above the onset of the Middle Stone Age (MSA) shows a drastic change in technology. This is often believed to be related to differences in foraging strategies and raw material procurement, as more exotic (further than 40 km away from a site) rocks were often selected or traded during the MSA (Ambrose & Lorenz 1990; Ambrose 2002, 2006; Nash *et al.* 2013; Lengyel 2015; Nash *et al.* 2016; Carter *et al.* 2018; Gendron *et al.* 2019), but not always (See Brantingham *et al.* 2000; Ekshtain *et al*. 2014; Wilkins 2017). This is evident for White Painting Shelter in the northern Kalahari Desert, Botswana, where silcretes from over 220 km away were preferred over closer sources of this material (Nash *et al.* 2013). Such long-distance transport of raw material is a widespread occurrence for this region as it is apparent for three other sites in the area. Silcretes were present in assemblages from Rhino Cave, Corner Cave, and ≠Gi that were transported from as far away as 295 km, as determined via geochemical signatures (Nash *et al*. 2016). The closer sources of silcretes were of equivalent quality, and thus it is possible that the silcretes used may have been acquired through trade (some pre-knapped). Therefore, complex social interactions with surrounding groups of humans might have existed. However, Middle Pleistocene foraging strategies at Kathu Pan 1, Northern Cape, South Africa, indicate that change in foraging strategies might not have been the initial drive in technological change (Wilkins 2017). Raw materials from the transitional Fauresmith bearing Stratum 4a (which dates to ~500 ka) were compared with the underlying Stratum 4b (Acheulean assemblage), showing that foraging strategies were similar during both these time periods. This suggests that different raw material selective strategies did not necessarily drive the technological innovations of the MSA and that the change in technology might have later driven increase selection for better quality stone. Nevertheless, the materials at Kathu Pan 1 were utilised differently and it is apparent that the occupants who created the Fauresmith technology strategically exploited the natural banding in the banded ironstone to create tools.

Raw material sourcing behaviours can be assessed by making use of a source attractiveness equation, created by Wilson (2007), which considers multiple variables that influence the choices humans had when selecting lithic resources, such as raw material quality, distance to source, size of raw material pieces and terrain difficulty. These factors are weighed up against one another and reduces these factors to a number that indicates a source's usefulness. This model was tested on the site Bau de l'Aubesier in southern France (assemblages dating from 200-100 ka) by Browne and Wilson (2011) with the inclusion of additional variables accounting for calories expended traveling to sources. The results suggest that early humans were more inclined to use source locations that had high quality material and had plenty raw material present, normally with large pieces. Sources that were hard to get to, resulting in more energy cost, were generally avoided. Early humans at Bau de l'Aubesier optimised their raw material sourcing to get the best quality goods for the lowest amount of time and energy spent in procuring it. The authors note that this model does not account for all factors involved in raw material procurement, such as trade networks, need for other resources or hunting strategies. However, the models "have yielded important insights into the geologic and geographic factors that mattered to the prehistoric groups" of Bau de l'Aubesier and "contribute to developing a better understanding of the overall picture, including other aspects of their organization of economic behaviour" (Browne and Wilson 2011: 606). The results were obtained for the site as a whole (all archaeological layers), thus the results reflect the overall tendency of early humans occupying the area through that time period (200-100 ka). This model was later applied to further test behaviour at Bau de l'Aubesier by Wilson and Browne (2014) on 11 archaeological layers. The lower six layers indicated that raw material selection was more heavily influenced by terrain characteristics, than raw material characteristics, for determining source locations. The reverse is, however true for the upper five layers. It should be noted that both terrain and raw material characteristics had an influence in determining source locations for all layers, but were weighted differently. The change in the upper layers are likely due to a change in subsistence as the climate became much cooler during the late Middle Pleistocene.

Energy expenditure is certainly one of the most important aspects of raw material selection to consider. Selection for rock that is not the absolute best quality (such as flint and obsidian) to make stone tools, does not by itself suggest that hominids were not behaviourally complex. Many late Middle Pleistocene sites in Germany show the abundant use of flints for the creation of lithics. However, quartzite tools made in central Germany during this time period are not studied in as much depth as the assemblages made from flint, which is considered the better-quality material to use. Sternke (2007) suggest that people occupying this region likely had a very localised social network that did not extend as far north to the flint sources (75-85 km away). Extended networks often require a high investment of energy and people might simply not have needed to make such efforts. The raw material constraints did not merit it, as the local quartzite performed well enough for tool manufacture and use. This is likely also the case with the Nöstvet axes in south-eastern Norway during the Late Mesolithic (6300 - 4000 BCE). Axes were made from basalt, hornfels or diabase instead of flint, which is considered a better-quality material. Flint materials were not readily available and would have required intense selection or trade networks to acquire. Eigeland (2007) experimentally replicated axes from these materials and indicated that the people likely preferred these materials rather than using them as supplements to flint. These materials require skill and practice to knap as they have a lower flaking predictability than flint. However, these materials are very durable and hard and will likely last longer under heavy duty tasks, thus investing time and energy into mastering knapping of these materials was likely preferred.

Raw material quality does not necessary impede a knapper's skill or prevent the improvement in their skill, as was tested by (Eren *et al.* 2011). Experimental knapping of preferential Levallois cores from two sets of raw material was conducted, one from large flakes of uniform chert with little internal and external flaws, and a more challenging material made from irregular chert nodules found in limestone, where parts of the nodules grade into limestone and the occasional flaw (void, concretion or cleavage plane) can be encountered. The knapper's skill was measured and determined by the knapper's ability to reach a set of predetermined goals. The first batch of experimentations was conducted with the good quality chert and then the knapper would switch to the second batch of the more challenging material. The switch to the more challenging material did not impede the knapper's ability and they adapted to the material and consistently removed "larger, more symmetrical Levallois flakes that consumed more of the core's upper surface, without overshooting the rim" (Eren *et al.* 2011: 2738). This study shows that the quality of a material does not necessarily restrict a knapper's ability to grow their skill level. If anything, poorer quality material might help improve a knapper's abilities, as it puts their skills to the test. The poorer quality material did yield more debitage due to more shaping work required, thus high amounts of debitage is not necessarily a reliable indicator of a knapper's skill. Additionally, tool morphology is not as drastically affected by raw material quality as first thought, as confirmed by Eren *et al.* (2014), with experimental replication of handaxes made form basalt, obsidian and flint, by the same knapper. Statistical tests indicated that the resulting handaxes show little variation in shape and size overall.

The above studies indicate that multiple factors influence raw material selection, one of them being the quality of rock. MSA people, like the ESA hominids, selected not only for particular types of rock, but sometimes also the qualities of these types of rock. This is apparent for the Howieson's Poort Industry at Klasies River Mouth (KRM) as there is a noticeable increase in fine-grained rocks that were gathered from distances over 40 km away (Ambrose 2002, 2006). Silcretes from this site were classed into coarse-and-fine grained varieties by Singer & Wymer (1982), which indicated that finer grained varieties were selected over the coarser ones. This was later confirmed by Villa *et al*. (2010) who created three categories according to the sorting and sizes of grains. The above studies took a more qualitative approach to access the qualities of the silcretes used at KRM, but other more quantitative techniques to access raw material selection during the MSA was employed by Wadley and Kempson (2011), who made use of engineering and geochemical testing to assess raw material selection for MSA lithics from Sibudu, KwaZulu-Natal, South Africa. The authors tested hardness, surface roughness and fracture toughness for the two predominant rock types found in the assemblages, hornfels and dolerite/diabase. Hardness tests are used to determine how durable certain raw materials are and measured using a Vickers Hardness Test, which tests the force a material can withstand before deforming. A pyramid shaped diamond is pushed onto the surface of a specific raw material with a predetermined force. The area of the indent made by the diamond is then measured to give a Vickers hardness value, which if low indicates a durable material. The Surface roughness of materials was determined by calculating the average grain size of that particular rock from thin sections, the larger the grains the higher the surface roughness. Fracture toughness was also determined by making use of a low energy Charpy pendulum impact testing machine, which measures the amount of energy a material absorbs before it fractures. The rock types are cut to specified dimensions and impacted by a swinging pendulum of certain weight from a set height. The device then measures the amount of energy the sample absorbs upon impact. The tests revealed that dolerite had a higher durability than hornfels, but was coarser grained. Dolerite is difficult to knap due to its hardness, but it ensures edges that will last, whereas hornfels is much easier to knap, but requires re-sharpening more often. The people at Sibudu often selected both of these materials, which varied with intended use of a tool (Wadley and Kempson 2011).

Moník and Hadraba (2016) also made use of engineering methods to determine aspects of rock quality, with regards to different flints and cherts used by Early Upper Palaeolithic (50-30 ka) populations in Moravia, Czech Republic. They used the Charpy V notch-impact test, as well as testing the micro-hardness using the Z2.5/HU0.2 (Zwick/Roell, Germany) indenter. Two types of flints were tested, erratic flints (EFs) and Krumlovský les I type chert (KL I). The EFs were tougher (does not break) under low velocity impacts than the KL I cherts, but under high velocities the KL I cherts were tougher. The results indicated that erratic flints were easier to knap with soft hammer percussion, which made it possible to acquire thin blades and bladelets. KL I cherts, however, was the favoured material for the creation of leaf points in Moravia, likely due to its ability to withstand higher impacts.

An innovative methodology was devised by Brantingham *et al.* (2000) to assess rock quality for a late Pleistocene site (Tsagaan Agui cave Lower Grotto) in northeast Asia, Mongolia, by determining the impurity encounter rates encountered on artefacts. The number of flake scars on all surfaces of an artefact that exhibited an impurity, such as a void or crystalline inclusion greater than 1cm (ISCAR), was divided by the total number of flake scars on that artefact (DSCAR), and multiplied by 100 to get a percentage. The majority of artefacts from this site had some impurities present with more than half of the artefacts having an impurity encounter rate of 40 % and above. This means that for every ten flakes removed, four would encounter an impurity or major flaw. However, despite the flaws present in the banded chert utilised at this site the people simply adapted by adjusting their flaking strategies rather than sourcing better quality materials from further away or trading. Perhaps this was not possible or the technologies were made for expedient uses or season occupations.

These studies show the remarkable ability early humans had to adapt, by changing the ways they use and/or knap raw materials during times when raw materials are scarce. This results in much technological variation across many MSA and Later Stone Age (LSA) sites around the world. When considering technological variation, it is often decided that either raw material or cultural variation comes to play a role in this variation. It is often a combination of the two, as suggested by Groucutt *et al.* (2017). This is seen in the case of a small rockshelter (CA SBr-6055) dating from 2900 - 1600 BP in the Mojave Desert (Torres 1998). Earlier occupations at the site show the use of larger obsidian pieces that were knapped via the freehand percussion technique, whereas later occupation at this site reduced obsidian from the Juan source differently, utilising bipolar reduction of small obsidian nodules. This change may have been driven by larger clasts of obsidian becoming scarcer over time, as modern-day surveys show fewer large clasts still available from the source location. However, this change may also have been driven by a change in hunting techniques. People started to manufacture arrow points, but the local cherts were of such poor quality that it required extensive reduction to create usable arrow points. The small obsidian clasts from the Juan obsidian source, however, could produce multiple arrow points via bipolar reduction, as was determined by Torres (1998) with experimental replication of the technology. It is also easier to knap smaller nodules with this technique than large obsidian clasts.

Site variation can also be attributed to changes in environment forcing people to adapt. Raw material procurement and consumption in the Kanto Plain, central Japan, prior to the Last Glacial Maximum (LGM), around 30 ka, shows more general exploitation of materials from over 200 km away by highly mobile hunter gatherer societies. During the LGM, as the environment degraded, a move towards more sedentary life styles are seen with only seasonal movements between resource rich areas and local exploitation (Kunitake 2016).

The use of different types of material, such as ivory and bone, to create certain types of tools is seen more frequently during the MSA as compared to the ESA. This also pertains to stone implements as certain rock types perform better at certain tasks than others, even if they are generally good materials to knap. This was experimentally tested by Loendorf *et al.* (2018), who created stone arrow tips from siltstone, basalt, chert and obsidian to test their effectiveness as arrow tips. They determined via the falling-weight impact tester and sample slabs which of the above mentioned materials were more elastic than others. Their effectiveness penetrating into various materials was tested by firing hafted arrows into skin, flesh, hide and bone. Stone tips with low impact energy, such as obsidian and chert, perform well penetrating into elastic materials such as skin and flesh, but they perform poorly when impacting inelastic material such as hide and bone. The more durable materials, basalt and siltstone, perform better penetrating into hide and bone. It was also determined that the shape of arrows and their hafting techniques has an impact on performance. More such research and experimentation will help to understand why certain materials were used for arrow tips by various prehistoric people and whether arrows were made for hunting (and various animal types) or warfare.

When stone is scare or of poor-quality people also adapted by making use of other types of material. The Alutiiqs in Alaska's Kodiak Archipelago during the last 7000 years often made use of various types of bone or antler to make tools. Margaris (2014) determined antler was predominantly used for the creation of harpoon points for fishing, whereas whale bone, bird bone (and antler) were used for the creation of arrows and other pointed tools. Tools that required sudden and sharp impacts were made from antler, whereas the tools that required low, but sustained stress, were predominantly made from whale or bird bone (Margaris 2014). The use of bone tools is not unique to this site and is also present during the MSA in Africa (d'Errico and Henshilwood 2007; d'Errico *et al.* 2012) and Europe (Cristiani and Borić 2016).

Extensive trade networks of raw materials and premade stone tools are present during this time period and can be seen at the site of Damnoni southwest Crete, where nine implements were found (no debitage or cores) that were made from obsidian, which is not available on the island (Carter *et al.* 2018). Using energy-dispersive X-ray fluorescence spectroscopy it was determined that the source location of this obsidian is from islands over 200 km away, a common source for the surrounding Aegean Mesolithic sites. This study adds information with regards to maritime activities of Mesolithic hunter-gatherers and possibly complex social interactions with neighbouring societies. This is also seen in a later time period at Sistema 7 Venado, Monte Albán, Mexico around 800 BCE, where premade pieces of obsidian (sourced from between 200 – 800 km away) were excavated with no cores or nodules (Gendron *et al.* 2019). Yet other materials such as quartzite, chalcedony and flint were knapped by the local people, which "could be interpreted as a commercial or political strategy to import material from selected sources, or a technical choice to obtain a better obsidian quality" (Gendron *et al.* 2019: 590). Trade networks between early people became very complex over time as is documented with the potlatch practiced by the Indigenous peoples of the Pacific Northwest Coast of the United States and Canada (Harkin 2001) and similar practices in Asia (Cooper 1982).

Human adaptational behaviour is also seen in the MSA by the use of heat treatment on stone to help alter raw material properties favourably (Wadley and Prinsloo 2014; Schmidt *et al.* 2015; Schmidt and Högberg 2018). The earliest evidence of heat-treated stone is seen at Pinnacle Point in South Africa around 164 – 72 ka (Brown *et al.* 2009). Evidence for heat treatment also exist in China at the Shuidonggou (SDG) site complex in Ningxia province, northwest China (Zhou *et al.* 2014). This confirms the appearance of heat treatment technology in East Asia around 32 ka, and could be evidence for the spread and distribution of heat treatment technology.

A study done by Lengyel (2015) suggests that groups of mobile humans during the MSA would often practice selection of raw materials on the move. Assemblages at Bodrogkeresztúre-Henye Gravettian site from northeast Hungary (28-26 ka) preserves high quality exotic materials not found in the surrounding Carpathian basin, which provides numerous raw materials for exploitation. This assemblage likely consists of mobile tool kits that were curated during travels, daily foraging and subsistence and discarded nearing their end (Lengyel 2015).

2.4 Raw material selection and behaviours from the LSA to present

Stone was not always used as tools in the traditional sense but was also used as a sign of status or hierarchy, adding more behavioural complexity to lithic raw material selection practices. Obsidian at The Postclassic Aztatlán centre of San Felipe Aztatán in Nayarit, Mexico might have been used as a sign of power. Both local and exotic sources were used and can be differentiated upon visual inspection. Pierce (2017) proposed that the more exotic obsidians were acquired and used by individuals who had greater status, thus showing their wealth and outside connections. Stone such as lapis lazuli (Rosen 1990), jade (Livingston *et al.* 2018) carnelian (So, in press), and turquoise served not only as trade commodities (Hull *et al.* 2014), but were also socially valuable objects often associated with one's identity. In the Chacoan and post-Chacoan times "ornaments played a vital role in negotiating various aspects of personal and social identification through practices of bodily adornment and ritual deposition." (Mattson 2016: 136). A large proportion of these ornaments were made from turquoise (60 %), indicating it was often sought after. These stones had multiple functions such as trade, identity and ritual. Rare examples of jade dagger-axes made in China during the Shang dynasty ca. 1600 BCE - 1046 BCE likely served as ceremonial objects or used by the elite as ritual symbols of power and prestige" (Livingston *et al.* 2018). This indicates that spiritual reasons were sometimes behind the acquisition of specific rock types. The Maya, for example, had a complex relationship with obsidian, which they would often source from over a hundred kilometres away. It was not only used for daily activities by commoners and elites alike, but also for decoration and blade creation for bloodletting rituals in caves (Stemp *et al. 2018;* Stemp *et al.* 2019). Flint (or stone) was often associated with the Kawak (Cauac) glyph in Mayan culture and was believed to contain the power of lightning (Bassie 2002, 14).

Furthermore, selection of particular rocks was also performed for the creation of pigments and later complex dyes (Barnett *et al.* 2006; Pagès-Camagna and Raue 2016). Early pigments were often created from charcoal and ochres, which are a rocks, clays or soils that contain iron oxide or iron hydroxide minerals that can produce a coloured streak (Wadley 2010; Zipkin 2017). The colours produced are earthy and range from browns to reds, orange and yellows. These rocks are generally not great for stone tool creation as they are brittle in nature and do not flake well or hold a sharp edge (personal experimentation). The discovery of large amounts of these rocks in an assemblage indicates possible symbolic reasons for its procurement, such as at the site GnJh-15 in the Kapthurin Formation, Kenya, where over 70 pieces of red ochre dating to 285 ka were discovered (McBrearty 2001). Pigments have also been reported at the site of Twin Rivers in Zambia dating to at least 230 ka (Barham & Smart 1996; Barham 1998), but possibly as early as 300 ka (Barham 2002), and are "frequently encountered at MSA sites in South Africa postdating 130 ka" (McBrearty 2001: 92). Ochres were often sourced from multiple locations, as is seen between and within various occupational periods at Blombos Cave, South Africa (Moyo *et al.* 2016), and may have been used for spiritual or practical purposes such as forming part of adhesives to haft stone pieces (Wadley 2005). Beads made from shells (some originate 240 Km away) show signs of pigment at Bushmen Rock Shelter, South Africa (12– 8 ka). Two types of pigment recipes were used at this site, one for adhesive another for pigment (Dayet *et al.* 2017).

The use of beads brings forth the behavioural complexity of early humans, but also points out that stone and stone tools were not always used purely for survival purposes but other uses such as drills for manufacture of beads (Werner and Miller 2018). The earliest definitive evidence we have of the use of beads date to about 78 -75 ka and were made from shell of sea snails (Henshilwood *et al*. 2004; d'Errico *et al.* 2005; Vanhaeren *et al.* 2013). Later (towards the end of the MSA around 50 ka) beads were made from other materials such as ostrich eggshell (Miller and Willoughby 2014).

Procurement of rock for tools eventually gave way to other materials such as metal, but it still has meaning in today's society and is sought after more than ever before, albeit for different reasons. At present rock and rock formations are sought after for minerals and elements used for energy, technology, construction, engineering and manufacture. Valuable gems are mined and sold to consumers as these are still used for various forms of symbolism. This is also shown by the use of dimension stone in our architecture, such as marble tiles for flooring and in works of art, such as pieces in the "Collezione Medicea di pietre lavorate", a collection of carved and polished stone ornaments from the members of the Medici family since the 15th century (Re *et al.* 2015). In addition, even today some people tie spiritual or healing energies to certain types of rocks, gems and minerals. This behaviour is not too surprising as stone has played an important role in human evolution and history and became part of our survival for most of our time on the planet.

CHAPTER THREE: STUDY ONE

This section is formatted as a paper for forthcoming submission to the journal Archaeometry

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Thesis pages: 24 - 55

Lithic quality comparisons between Swartkrans and Sterkfontein in the Oldowan and Early Acheulean, South Africa

Lithic quality comparisons between Swartkrans and Sterkfontein in the Oldowan and Early Acheulean, South Africa

3.1 INTRODUCTION

This study compares lithic raw material quality between two important ESA sites in southern Africa through analyses of impurity encounter rates (IER), fracture encounter rates (FER), weathering states, and quartzite grains sizes. In addition, it incorporates an extensive experimental aspect to support the analytic results. As noted in Chapter 1, the paper is formatted as a publication (for submission following thesis reviews). Because the methods and results from Sherwood (2013) have not previously been published, they are included here. While the original data for Swartkrans is thus incorporated from Sherwood (2013), the number of specimens analysed for the Oldowan at this site has been expanded for the thesis to provide a more robust analysis, and the data for both Sterkfontein assemblages are entirely new. The two sites in question, Sterkfontein and Swartkrans in the Cradle of Humankind, South Africa, are ideal for comparing the selection of raw material qualities in the ESA, as both sites have Oldowan and Early Acheulean assemblages present. This allows for comparisons to be made between the two sites and evaluation of change through time from the Oldowan to the Early Acheulean at both sites. Sherwood (2013) developed and applied the methodological approach used in this paper for the Swartkrans assemblages, by comparing the Oldowan, Acheulean and Middle Stone Age for this site, documenting a progressive increase in selection for better quality raw material from the ESA to the MSA at Swartkrans.

3.2 MATERIALS: the site, their geology, and sampling details.

Swartkrans and Sterkfontein are neighbouring sites in the South Africa's Cradle of Humankind World Heritage Site (Figure 1). They are a 1 km apart on opposite sides of the Blaaubank River. Like all of the fossil sites that make up the World Heritage Site, they are karst caves filled with fossil-and artefact-bearing deposits. Lithics and fossils were washed into the caves from the landscape through open shafts accumulating deposits forming extensive talus cones. These two sites were selected as they both have sizable Oldowan assemblages, ca 2 Ma, and three Early Acheulean assemblages, ca 1.6 to 1.0 Ma, between them (Gibbon *et al*. 2014; Granger *et al.* 2015). Their close proximity to each other allowed for the tools from both sites to be made on raw materials from the same surrounding geology and the same gravels source. This makes it possible to compare the differences and similarities in rock quality selection between sites of similar age in similar geological contexts, as well as through a window of time between ca 2 and 1 Ma. Both sites also contain MSA tools. The Swartkrans MSA derives from a colluvial deposit <110, 000 years old (Sutton *et al.* 2009); however, the MSA from Sterkfontein is a small sample of artefacts in poor stratigraphic contexts (Reynolds *et al.* 2007), and thus the MSA is not included in this paper.

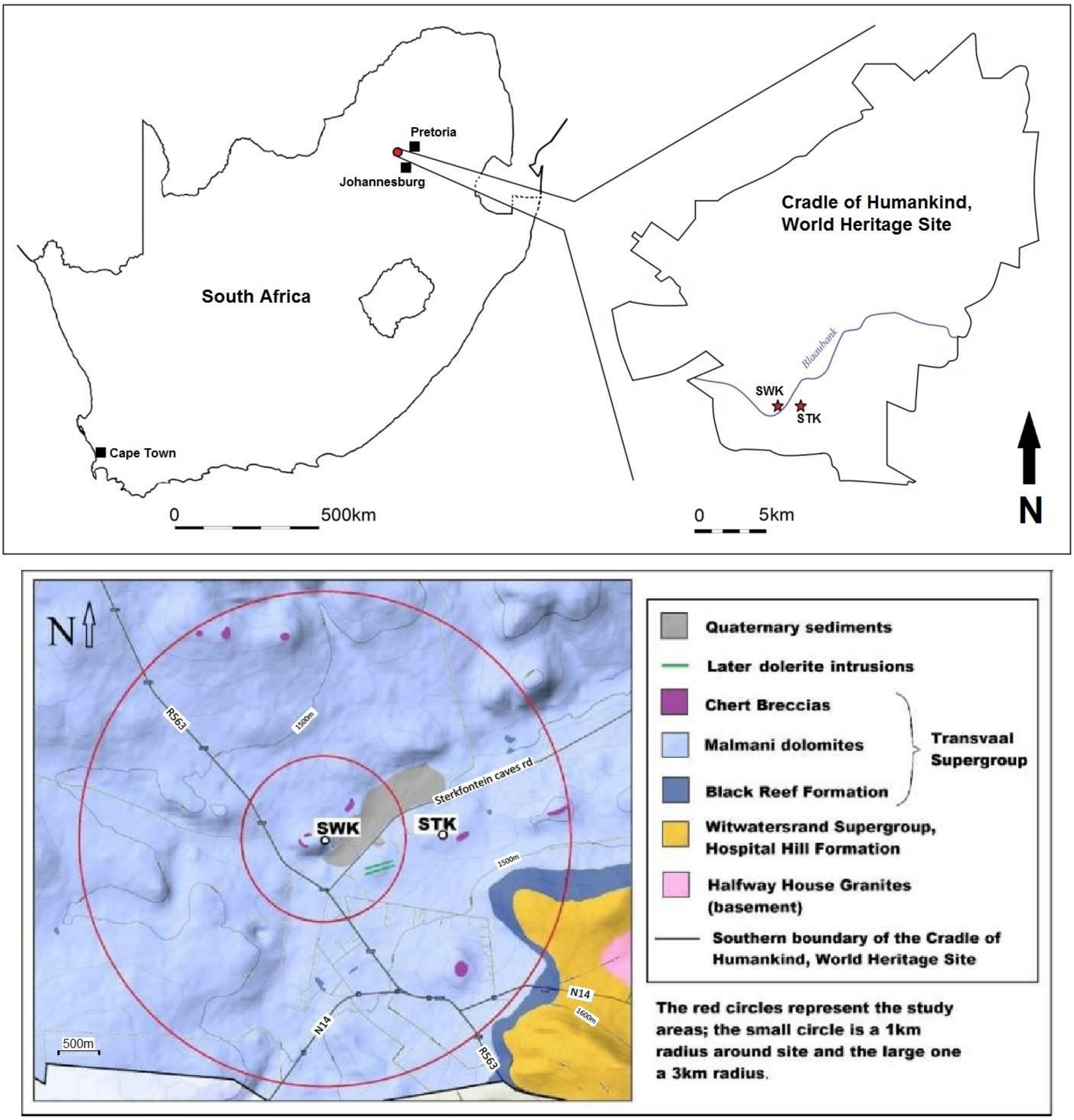

Fig. 1. The location of the Cradle of Humankind World Heritage Site showing the two major sites Swartkrans (SWK) and Sterkfontein (STK), as well as the geology surrounding the sites. (Adapted from Sherwood {2013}).

3.2.1 Swartkrans

Over the last 65 years, this site has produced many animal and hominid fossils (early *Homo* and *Paranthropus*), as well as cut- and percussion-marked bone showing hominid processing of some of the fauna from three Early Pleistocene geological members that also contain Oldowan and Early Acheulean assemblages (Brain 1993; Clark 1993; Field 1999; Pickering *et al*. 2008; Sutton 2012). In addition, the site has been argued to contain some of the earliest evidence for the controlled use of fire at 1 Ma (Brain and Sillen 1988). Swartkrans contains five members, but the Oldowan lithic assemblage is present only in the Lower Bank subunit of Member 1. Member 1 also includes a slightly younger sub-unit (the Hanging Remnant). The faunal age estimate for the entire member was originally published as ca 1.8 - 1.6 Ma (Vrba 1985). Subsequently, U-Pb dating by Pickering *et al*. (2011) on two flowstones capping and underlying the entire member provided dates of >1.7 Ma and <2.25 Ma. Most recently, dating by Gibbon *et al*. (2014), using the cosmogenic nuclide burial method on sediment and a quartzite manuport, has provided dates of 2.19 ± 0.08 and 1.8 ± 0.09 Ma for the Member 1 Lower Bank, consistent with the older dates for this deposit. Members 2 and 3 both contain Early Acheulean artefacts, with Member 2 dated to ca 1.5 Ma via biochronology (Vrba, 1985; Churcher and Watson, 1993), and Member 3 now well dated to ca 1 Ma (Gibbon *et al*. 2014).

The Swartkrans Oldowan Sample used in this study derives from excavations of the Member 1 Lower Bank directed by Travis Pickering from 2005 to the present (Kuman *et al*. 2018). This assemblage consists of 1849 pieces, but only pieces 2 cm or larger in maximum length were chosen for this study as little information can be gained from small flaking debris (SFD, <2cm), apart from details of assemblage preservation. In addition, manuports were not included as they were not knapped or utilised. The sample available without SFD and manuports is therefore 712 artefacts, of which 692 were analysed (Table 1). This sample consists of data from Sherwood's MSc (Sherwood 2013) as well as an additional 78 pieces. These are the remainder of all artefacts in the assemblage excavated since 2005, with the exception of a small number of pieces that were either extensively stained or weathered, such as the 13 artefacts that were made from diabase.

The Swartkrans Acheulean sample in this study samples pieces from Members 2 and 3 excavated by C.K. Brain from 1965 and 1986, which includes 687 pieces identified by Field (1999) as artefacts (462 pieces without SFD and manuports). A total of 112 pieces from this set were sampled at random for the Swartkrans Acheulean (Table 1) from both Members 2 and 3. The selected pieces from both members were combined, which could be done as the data for them were similar and not statistically different. All Swartkrans lithic material, including that excavated by Brain, is now curated in the School of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand.

Table 1: Sample sizes

Sample No.	Swartkrans	Sterkfontein	Experimental
Oldowan	692	255	1674
Acheulean	112	67	843

3.2.2 Sterkfontein

Sterkfontein is well known for its hundreds of specimens of hominid fossils (*Australopithecus* in the older members and a small number of early *Homo* and *Parathropus* fossils in younger members) and large assemblages of faunal remains. The Sterkfontein deposits are contained in six original members named the Sterkfontein Formation (Partridge 1978), a Post Member 6 infill (Kuman and Clarke 2000), the Jacovec Cavern (Partridge *et al*. 2003), and the Lincoln Cave (Reynolds *et al.* 2007). Member 5 (M5) contains the Oldowan and the Early Acheulean assemblages (Kuman 1994). The Oldowan is present only in the eastern section of M5 East, below a depth of 22 feet (Kuman and Clarke 2000). The most recent dating of the Oldowan in M5 East is based on a cosmogenic burial age for a manuport and places it at 2.18 ± 0.21 Ma (Granger *et al.* 2015), which is consistent with a faunal age estimate of ca 2 -1.7 Ma (Kuman and Clarke 2000). The sample used for this study comes from excavations of Member 5 East by R.J. Clarke and published by Kuman and Field (2009) as 3513 pieces. As the majority of these pieces is SFD, 255 artefacts were randomly chosen for study from 556 pieces 2cm or larger in size (Table 1).

The Acheulean is present in M5 West and also in M5 East above 22 feet in depth (Kuman 1998; Kuman and Clarke 2000). However, the context of the M5 East deposit has been disturbed above 22 feet with solution pockets that have admitted some younger (largely MSA) material (Kuman 1994; Kuman and Clarke 2000). Thus, only artefacts from Member 5

West were analysed in this study, with the exception of seven LCTs from other squares in the site judged to be in better context (see Kuman and Gibbon 2017). The Acheulean-bearing M5 West is estimated at 1.7 - 1.4 Ma (Kuman and Clarke 2000; Kuman 2007) and was excavated by Alan Hughes during the 1970s -1980s and then by R.J. Clarke from the 1990s. The number of Acheulean artefacts randomly sampled for analysis is 67 (Table 1) of 247 artefacts within an assemblage of 398 pieces (with SFD and manuports).

3.2.3 Experimental sample

In addition to two sets of Oldowan and Acheulean artefacts in this study, a large experimental assemblage was created for comparison of flaking properties and for testing in use. This allowed for the attributes of each raw material type to be assessed (see section 3.3.3). Each knapped rock and its detached elements were placed in individual sample bags. From this bag, the core (or LCT) was taken, two chunks, and three flakes, all chosen to best represent the entire rock. One of these flakes was then lightly retouched to replicate a formal tool. In cases where the core had shattered during knapping, one of the core chunks was taken instead. In some cases, rocks were so badly weathered that most of the knapped material resembled natural pieces or disintegrated pieces. Thus, only pieces that had characteristics of being knapped were taken for data from these rocks, but these would often not provide many flakes and few that would allow retouch or use. All of these pieces were analysed with the variables set out in this paper and two databases were created. The experimental Oldowan assemblage included cores, flakes, chunks and retouched pieces, whereas the Experimental Acheulean assemblage also included LCTs. The Experimental samples were created to represent the type of tools that can be found in each of the two techno-complexes (Oldowan and the Acheulean). Flakes, chunks, cores and retouched pieces are found in both the Oldowan and Acheulean, but LCTs are only found during the Acheulean. Tools, like the LCTs cannot be made from terrible material, as the process often fails. Therefore, to have a representative experimental sample for the Acheulean a separate set of data was created that incorporated LCTs. This brought the percentage of flawed material down a bit for the Acheulean experimental sample, as few LCTs could be made from poor raw materials, thus giving a more representative experimental database to compare with the archaeological assemblages from the Acheulean. The data for the experimental Oldowan pieces consisted of 811 pieces created for the MSc project (Sherwood 2013), plus with an additional 863 pieces for the PhD study. Thus, the Oldowan experimental sample was more than doubled in the current study. The experimental Acheulean assemblage consisted of 843 pieces, from Sherwood's MSc.

3.2.4 Geological considerations

The geology of the study area was formed by two separate shallow marine basins, namely, the Witwatersrand Basin (Eriksson *et al*. 1981; Winter and Brink 1991; Beukes and Nelson 1995; McCarthy 2006), consisting mainly of quartzite formations, and the succeeding Transvaal Basin (Eriksson *et al*. 2006), consisting primarily of dolomitic limestone and chert formations (Figure 1). A small portion of the lower Witwatersrand Supergroup is located southeast of Sterkfontein, with the rest of the geology in the study area belonging to the Transvaal Supergroup. Hence the foundation geology of Swartkrans and Sterkfontein consists primarily of dolomites and cherts with age ranges from 3 billion years ago (Robb and Meyer 1995) to approximately 2 billion years ago (Eriksson and Clendenin 1990). Many structural changes have occurred within the deposits over time, such as fluid movements (Phillips *et al*. 1990), extensive faulting (Stanistreet *et al*. 1986; Roering and Smit 1987; Stanistreet and McCarthy 1991; Reimold 2006; Dankert and Hein 2010) and ensuing metamorphism. There are also occurrences of other structures in the dolomite and chert due to their depositional nature, such as ooids (Button 1973; Eriksson and Clendenin 1990; Eriksson *et al*. 2006), tidal ripples and stromatolites (Eriksson 1977, Walter *et al.* 1974). Twelve different rock types are available in the study area (dolomite, chert, quartzite, arkose quartzite, vein quartz, slate, shale, banded iron, dolerite, breccia, ferricrete and flowstone) and numerous sub-varieties and qualities of each. The Oldowan and Acheulean archaeological assemblages from both sites consist primarily of four of the available rock types, namely: vein quartz, quartzite, chert and dolerite / diabase (classified as igneous by Field {1999} and Sutton {2012}). Some of the tools were made from quaternary gravels (Field 1999; Sutton 2012; Sherwood 2013), which lie at the foot of the Swartkrans cave and near the tourist entrance to the Sterkfontein site, just across the road from Swartkrans. These gravels are also derived from the local geology of the two above mentioned basins (Kuman 1996). The quaternary sediments include a range of rock quality varieties for nine of the twelve rock types from the study area and would thus have been an excellent source for raw material. Moreover, the river gravels are the closest source of quartzite as the nearest outcrops are approximately 2 kms away.

For this study to be practical, the same rock types available today should have been available to the hominids 2-1 Ma. In the last 2 million years, the landscape has been eroded down by at least 6 m to the current surface (Dirks *et al*. 2010; Gibbon *et al.* 2014; Granger *et al.* 2015). However, the geology of this landscape is at least 15 000 m deep (Button 1986; Eriksson *et al*. 1993) with similar depositional periods known as sequence stratigraphy, which subdivides a sedimentary pile into cyclical sequences of "genetically related strata displaying repetitive vertical profiles and stacking patterns" (Catuneanu and Eriksson, 1999: 216). The geology of this area was created in a shallow marine environment where sea levels periodically raised and retreated, creating a stratigraphy with multiple repeating layers stacked on top of each other. This means that, even with some of the surface eroded away since 2 Ma, the geology now exposed is similar. In addition, landscapes and geological formations do not erode evenly, thus, geological members that were exposed in certain areas 2 Ma have since been eroded away or potentially buried. However, similar geology from those stratigraphic layers should be exposed somewhere else on the landscape. For this reason, an area with a three-kilometre radius around each site was selected with various sample locations to ensure the selection of a large representation of the geology. Rock types from these locations were visually compared to the artefacts from Swartkrans and Sterkfontein to determine any significant differences, and none could be seen.

3.3 METHODS

3.3.1 Sampling

The overall aim of the sampling process was to sample at least one of each type of rock that was available in each sampling location in a three-kilometre radius of Swartkrans and of Sterkfontein, and to represent what was most commonly available. For example, if chert predominantly outcrops in that location, multiple pieces of chert would be randomly sampled. The sizes of rocks were selected to be large enough to knap and to represent the artefact dimensions of Oldowan and Acheulean tools from both sites. A total of 53 sample locations (Figure 2) was selected and multiple rocks were collected at each location. Each rock was assigned a sample location number and a number for that sample, which was written on the rock and its sample bag. At each sample location a walk around the landscape determined what rock types were outcropping to get an idea of the local geology. For example, if only formations of chert and dolomite were present at a certain location, both fresh (pieces with only surface weathering no more than 1mm in depth) and weathered pieces of the chert and dolomite were sampled. Exposed stratigraphic layers were also inspected to determine if any layers with unique features or structures were present, which would then be sampled. Rock types that were most common in a particular area were always sampled more often to represent what was most commonly available and thus more likely to be sampled randomly. The characteristics of rocks were identified visually upon sampling, with only occasional test knapping. The quaternary gravels were extensively sampled as multiple rock types and quality varieties of these were present. In addition, a test pit was dug in the quaternary sediments at the foot of the Swartkrans hill a meter down and sampled to compare with cobbles taken from the surface. Another sample was gathered near the public road entrance of the Sterkfontein site just opposite Swartkrans, where a large face of gravels was exposed up to 2 meters in depth. Rock types and sizes did not vary with depth and fresh pieces were available at all depths.

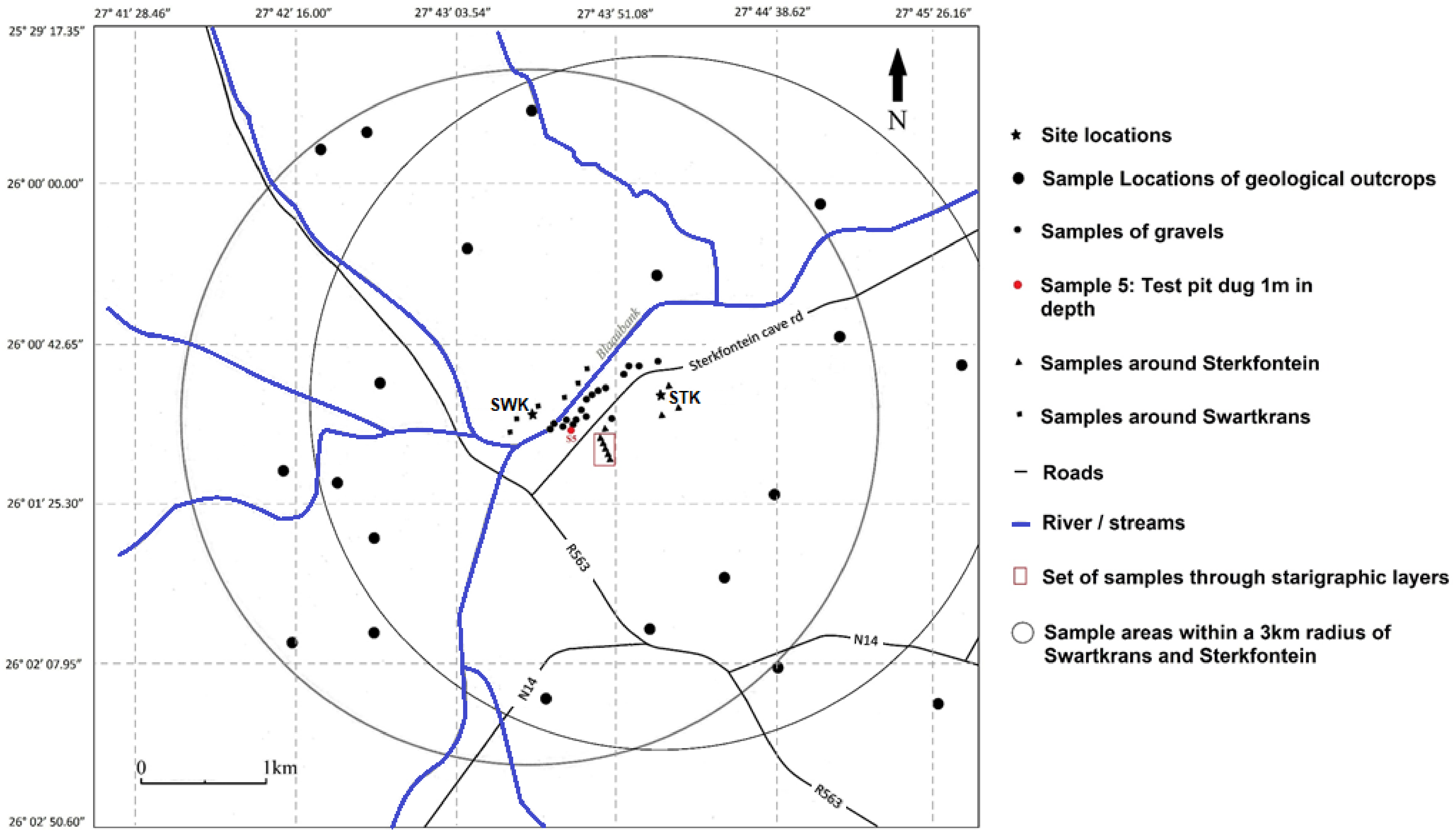

Fig. 2. Sample locations for the experimental knapping.

3.3.2 Knapping of the experimental assemblage

All of the sampled rocks (N = 550) were knapped into lithic types found in the Oldowan and Acheulean from both sites. These included cores, flakes, chunks, retouched pieces and large cutting tools (handaxes and cleavers). All of the knapping was done by the first author, who has over six years of knapping experience. The knapping was done over the course of four months with periods of rest in between knapping sessions to avoid working when tired or unfocussed. All sampled rocks were reduced to typical core types within the Swartkrans and Sterkfontein core reduction strategies, and these were not always fully reduced. The rocks selected for the creation of LCTs were ones that were most commonly found in each sample location in the form of a sizable cobble, flake blank or slab that could be reduced into an LCT. Hammerstones were selected that would make the knapping process most effective and were thus the kind most probably selected by hominids, as no hammerstones were identified from the assemblages at that stage. Consequently, some quartzite hammerstones were selected from the gravels near Swartkrans, with five large cobbles used for primary reduction of the cores and LCTs, and nine small rocks used for further reduction and shaping. The knapped rock and all its pieces were placed into a sample bag, with its sample location, for later analyses.

The knapping process was especially important to help identify features of the various rock types that either hindered or aided the creation of functional tools, and hence these features were isolated as variables that could be quantified. These variables were selected based on the experience NS had from knapping the various rock types and were features that would have been visible to hominids for their selective decisions. All 12 available different rock types were knapped to indicate which ones were easiest to knap. Some flakes of the different rock types were also used to perform various tasks to gauge their effectiveness as a tool. It was determined that tools made from diabase, quartzite, quartz and chert performed the best, as flakes from these rock types were both sharp and durable. These are also the four rock types present in the archaeological assemblages. The experimental samples consisted only of quartz, chert and quartzite as diabase was utilised in very small quantities at these two sites. In addition, the diabase tools had undergone extensive surface weathering since deposition and could thus not be analysed.

3.3.3 Analytic variables

The methodology and variables used in this paper were developed by the author during her MSc (Sherwood 2013) and will be described below.

3.3.3.1 Impurity encounter rate (IER)

Impurities, flaws and certain structures (referred to as impurities for simplicity hereafter) in rocks hinder a knapper's ability to create stone tools with ease and are thus less desirable than rocks that have none of these present. Various impurities were identified via the experimental knapping and include: joint planes (Figure 3A), bedding planes (Figure 3B), shatter cones (Figure 3C) quartz veins (Figure 3D and E), crystal inclusions (Figure 3F and G), cavities (Figure 3H and I), ooids (Figure 3J and K) and stromatolites (Figure 3L).

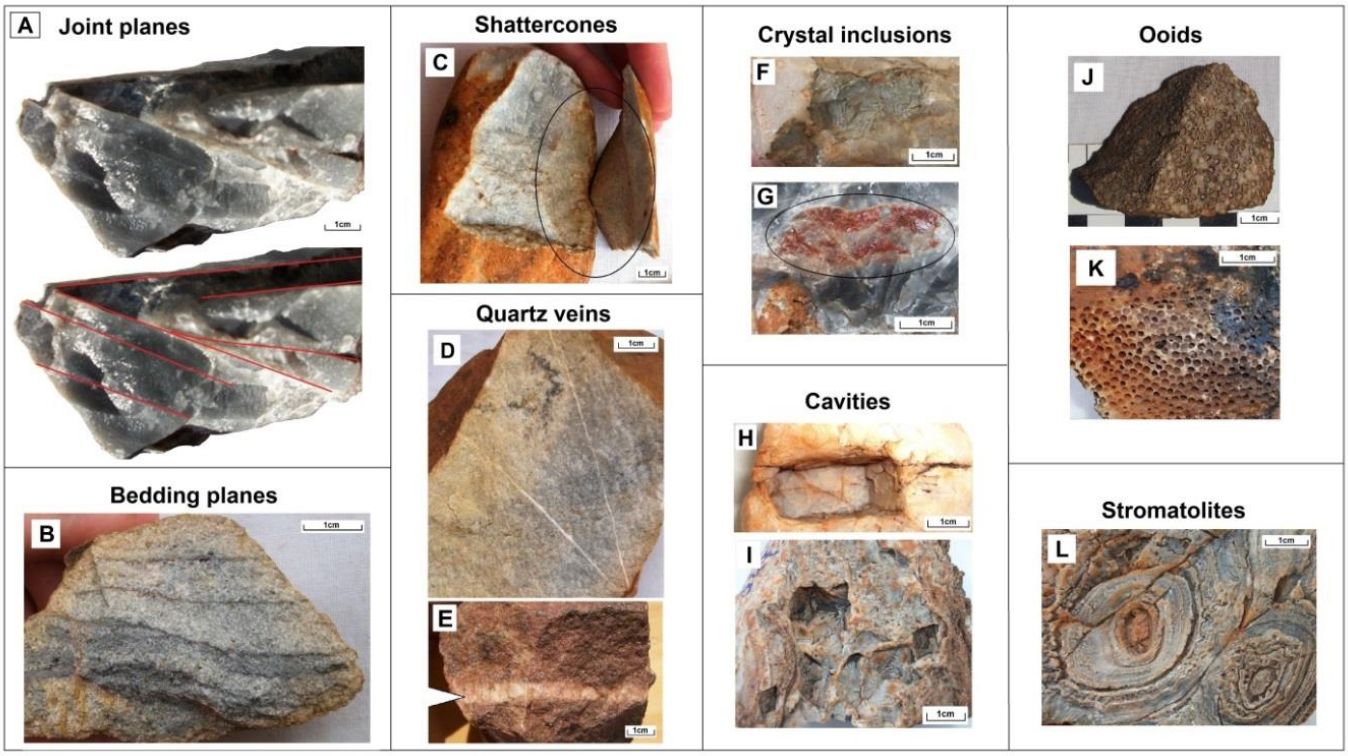

Fig. 3. Various impurities that can occur in rock types from the study area (Adapted from Sherwood {2013}).

This paper makes use of the method developed by Brantingham *et al*. (2000) to quantify the frequency of the above-mentioned impurities encountered during primary reduction of an artefact. The impurity encounter rate was calculated by Brantingham *et al.* (2000) by dividing the number of flake scars encountered on an artefact that exhibited impurities by the total number of flakes scars present. The percentage of impurities encountered was determined by multiplying this by 100 (formula below).

$$impurity\ encounter\ rate\ = \left(\frac{Scars\ with\ impurities}{Total\ no.of\ flake\ scars}\right) \times 100$$

Figure 4A shows examples of how the formula was applied for each lithic. These only show one side of each artefact as an example; however, during the collection of data all the flake scars for each face of an artefact were counted.

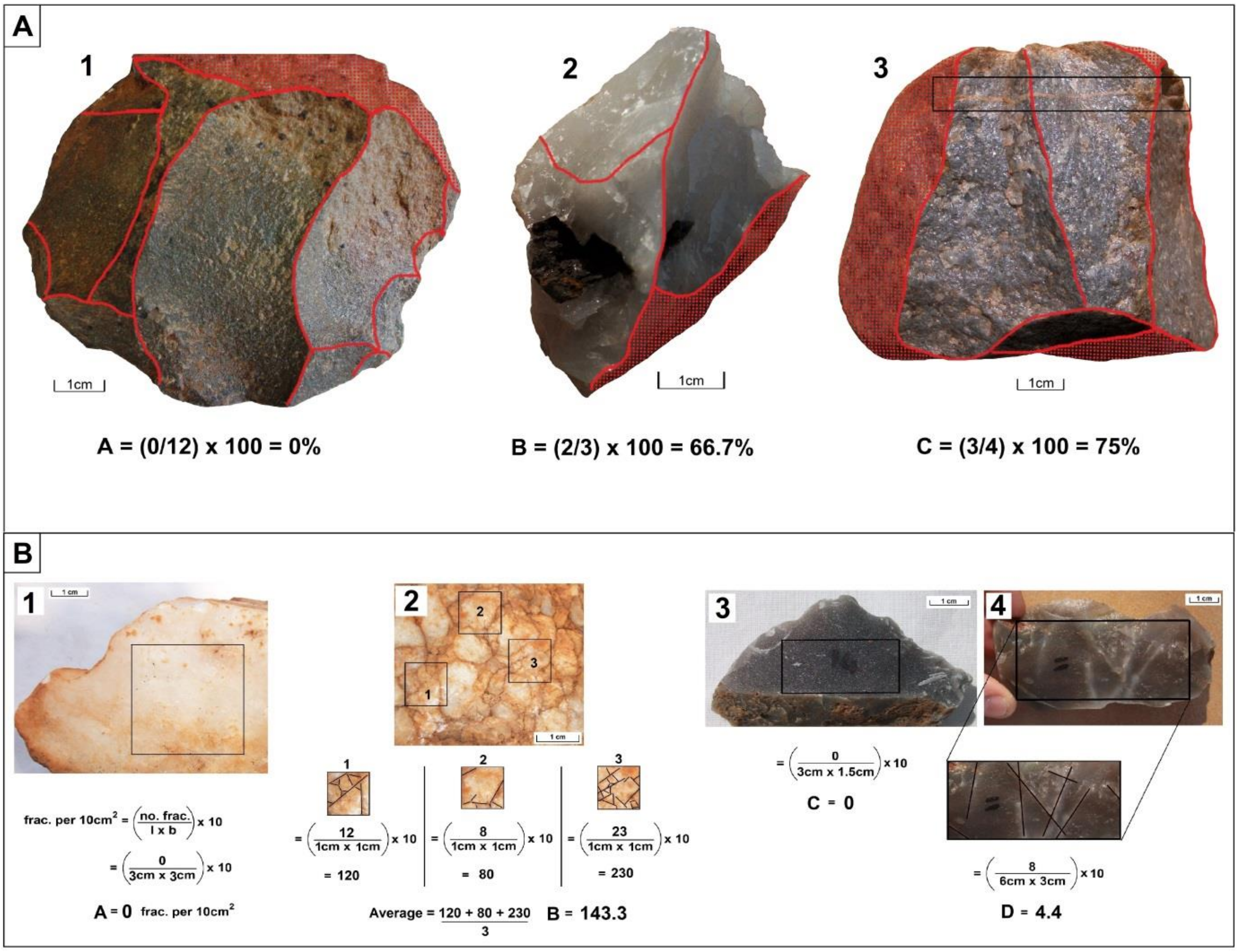

Fig. 4. A: Examples of how the IER's were analysed for the various materials, with Formula used as per Brantingham *et al.* (2000). Shaded areas represent where the cortex is located. B: Examples of how the fracture encounter rates were analysed for quartz and chert (Adapted from Sherwood 2013).

3.3.3.2 Fracture encounter rate (FER)

Even though joint planes, cavities and crystal inclusions were present in each of the three rock types, fractures (i.e., cracks) were only present in quartz and chert and were thus gauged separately for these two rock types. This was done to see if there was a correlation with joint planes, cavities and crystal inclusions with regards to selection. For artefacts with no visible fractures, a ratio of zero was assigned. For the rest of the artefacts, three flat areas were chosen. This was done on multiple faces of a lithic and not just the cortex. The areas consisted of a length and a breadth, chosen to represent what can be seen on all of the artefact's faces. The number of fractures was counted in each of these areas (Figure 4B). The lengths and the breadths were not always the same sizes due to the varying nature of artefact sizes and shapes. Areas were thus standardised by turning them into a ratio with the formula below.

$$fractures\ per\ 10cm^2 = \left(\frac{no. of\ fractures}{(\ l\ \times\ b\ )}\right) \times 10$$

To represent the data more clearly each ratio was multiplied by 10 to give fractures per 10 centimetres squared, so the fractions were not too small to deal with. For each artefact the average of all the ratios was taken to represent the fracture encounter rate of that piece. Fractures from the knapping process did occur on some of the more brittle chert pieces that were often lighter in colour due to some weathering and moisture trapped between the silica grains. However, fresh good quality chert did not fracture during knapping, so this was a good way to help quantify chert quality.

3.3.3.3 Weathering

Quartz, quartzite and chert are all silica-based, and thus they are reasonably resistant to weathering (particularly chemical weathering) over long time spans (Tricart 1972; Wray 1997; Sleep and Hessler 2006). Nevertheless, silica is slightly soluble in water, with some varieties more so than others (Krauskopf 1956; Siever 1962; Wray 1997). Two main categories of silica are the crystalline type (pure quartz) and an amorphous type (silica cement between grains), and both are found in all three of the rock types in this study. Amorphous silica is more soluble at lower temperatures than the crystalline type (Krauskopf

1956; Siever 1962). Although the three rock types have both kinds of silica present, they have unique structural compositions which facilitate different weathering patterns.

Quartz from the study area is made up of many interlocking macro quartz crystals, which were formed over time in rock formations due to various geological processes, such as pressure from overlying strata. The faces between the interlocking crystals act like planes of weakness (Tallavaara *et al*. 2010) into which water can penetrate and weaken chemical bonds between them. This is done via dissolution and by the precipitation of other minerals. Crystal interfaces have fairly strong bonds between them when unaffected by weathering, but as fluid penetrates, dissolves some of the quartz, and precipitates other minerals, these bonds weaken and crystals push apart (Tallavaara *et al*. 2010). This is visible in the quartz from the cradle as extensively weathered pieces have dark stained cracks clearly visible (Figure 4 bottom right). Flaking predictability is reduced when intersecting such crystal faces and often results in part of the rock shattering into individual crystal chunks when trying to detach flakes during experimental knapping.

Quartzite is a metamorphic rock made up of quartz sand grains in which the sand grains "become cemented and 'welded' together by silica solution that forms during metamorphism" (Cairncross 2004:264). This material weathers between individual grains as fluid penetrates between the grains and dissolves the amorphous silica cement holding the grains together, which eventually leads to the rock breaking down into its original components (Martini 1979; Wray 1997; Doerr 1999; Sleep and Hessler 2006). Dissolution in quartzites starts by fluids entering through joint planes and then proceeding along the boundaries of individual grains (Martini 1979; Wray 1997; Doerr 1999; Sleep and Hessler 2006). These planes are affected similarly to how the boundaries between crystals in quartz are affected. Therefore, quartzites with multiple joint planes will hamper the flaking predictability of a rock, since these boundaries are first to be compromised.

Chert is precipitated rock made up of microscopic silica crystals (cryptocrystalline) (Sleep and Hessler 2006). Chert can consist of either amorphous silica or less soluble microquartz (Siever 1962; Trewin and Fayers 2005). It is more likely that the rocks in our study area are made up of the latter due to the recrystallization (Siever 1962; Trewin and Fayers 2005) of amorphous silica, especially since they are 2.5 billion years old (Eriksson *et al*. 2001). Thus the chert from our study area would consist of microquartz crystals surrounded by amorphous silica cement and would weather similarly to quartzite, but much faster due to its smaller grain size.

Weathering of lithics was quantified by categorising each piece into fresh, intermediate or extensive weathering. This was done for each piece by looking at all the exposed surfaces and not just the cortex. A piece was categorised as fresh if only the cortex was weathered to a maximum depth of 1mm. If an artefact had one side with weathering, but only the fresh side was knapped, it was classified as fresh. Rocks that were weathered to such an extent that they would likely crumble when knapped were classified as extensively weathered. Everything in between was classified as intermediate, as these rocks can successfully produce useful tools. See Figure 5 for visual representations of weathering states.

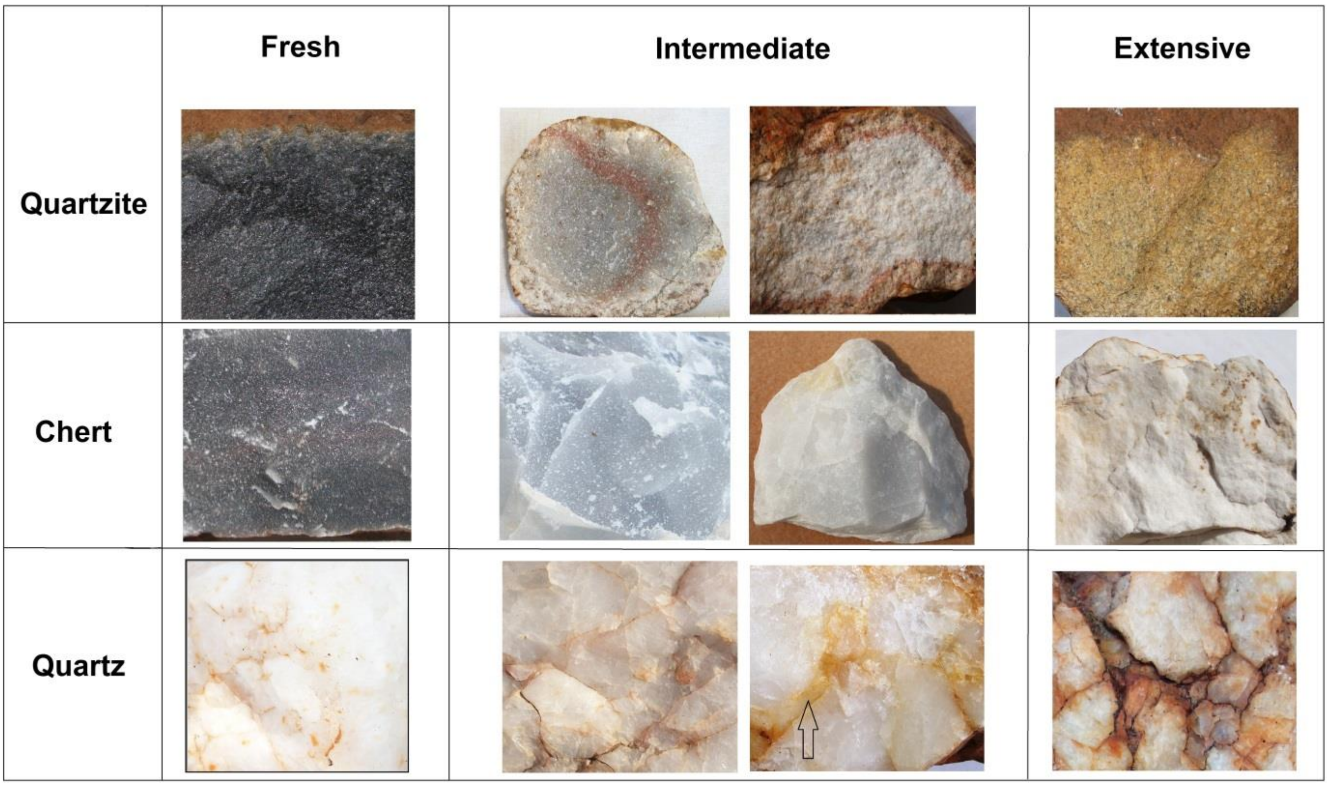

Fig. 5. Weathering states of quartzite, chert and quartz (Adapted from Sherwood {2013}).

3.3.3.4 Grain sizes of quartzite

This variable was only applied to quartzite because it is the only one of the three materials that exhibits a range of grain sizes between different cobbles. Individual quartzite formations from a certain depositional phase were largely homogenous, but different formations have smaller or larger grains sizes than other formations. Thus, individual cobbles exhibited homogeneity, but cobbles had a variety of size grains between them. The average grain size of an individual lithic was determined using a manual Macroscope M25, which could measure up to silt sized grains (Figure 6). The grain sizes were categorised in accordance with the Wentworth scale (Wentworth 1922; Table 2). A lithic piece was analysed on various faces and the average grain sizes were recorded visually. For example, in Figure 6A the average grain size is between 0.5 and 1mm which indicates it is composed mostly of coarse-grained sand. In Figure 6B the majority of grains is between 0.1 and 0.25mm, and thus the rock is comprised of fine-grained sand.

Table 2: Wentworth Scale

Diameter in millimetres	Wentworth scale	
256 - 2048mm	Boulders	
64 - 256mm	Cobbles	
4 - 64mm	Pebbles	
2 - 4 mm	Granules	
2 - 1mm 1 - 0.5mm 0.5 - 0.25mm 0.25 - 0.125mm 0.125 - 0.0625mm	Sand	Very coarse Coarse Medium Fine Very fine
0.0625 - 0.0039mm	Silt	
< 0.0039mm	Clay	

Fig. 6. Grain size visible using the Macroscope M25, the red line is 1mm (Adapted from Sherwood {2013}).

3.4 RESULTS

The results are discussed by attribute and compared accordingly between the archaeological and experimental assemblages.

3.4.1 Impurity encounter rate

The average IERs (Figure 7) indicate that both the Sterkfontein and Swartkrans Oldowan and Acheulean assemblages are different from the experimental assemblages. Statistical tests were run on the raw data between the necessary assemblages using the Mann-Whitney test, as the distributions of data sets were not normally distributed. These data sets approximate a normal bell curve, but with heavy tail ends. This is due to many of the lithic pieces exhibiting 0 % or 100 % flawed ratios with everything in between being normally distributed. The box plots in figure 7 show this to some extent. Half of the lithics made from quartzite from the Sterkfontein Oldowan, for example, have a 0 % IER, thus the first two quartiles of this box plot are on the 0 % line. The Mann-Whitney tests indicates a significant difference, above the 95 % level of confidence (Table 3), between the archaeological assemblages and the experimental samples for both the Oldowan and the Acheulean, and for each of the raw material types. This indicates that selection for the quality of lithics types was practiced at both Sterkfontein and Swartkrans during each time period. In addition, the IERs and the accompanying statistics indicate that the Oldowan lithics from Sterkfontein were made of better-quality materials than those in the Swartkrans Oldowan (Figure 7), with a confidence level >95 % using the Mann-Whitney test (Table 3). For the Acheulean, Sterkfontein lithics are overall of better quality (19.0 % vs 26.4 % averages), but this was not statistically confirmed with a p value of 0.087 using the Mann-Whitney test.

For Swartkrans the average IERs indicate that there is an increase in the quality of raw materials used in the Acheulean as compared to the Oldowan, although this is more clearly seen when all the lithics from the various raw materials are analysed together (Figure 8). However, the probability tests (Mann-Whitney) indicate that there is a slight chance (a p value of 0.073) that this could be due to sampling error (Table 3). The Acheulean at Sterkfontein only shows an improvement in quality over the Oldowan for quartz pieces with regards to the average IER (Figure 8). The probability tests indicate that there is little difference between quality selection during the Oldowan and the Acheulean at Sterkfontein (Table 3).

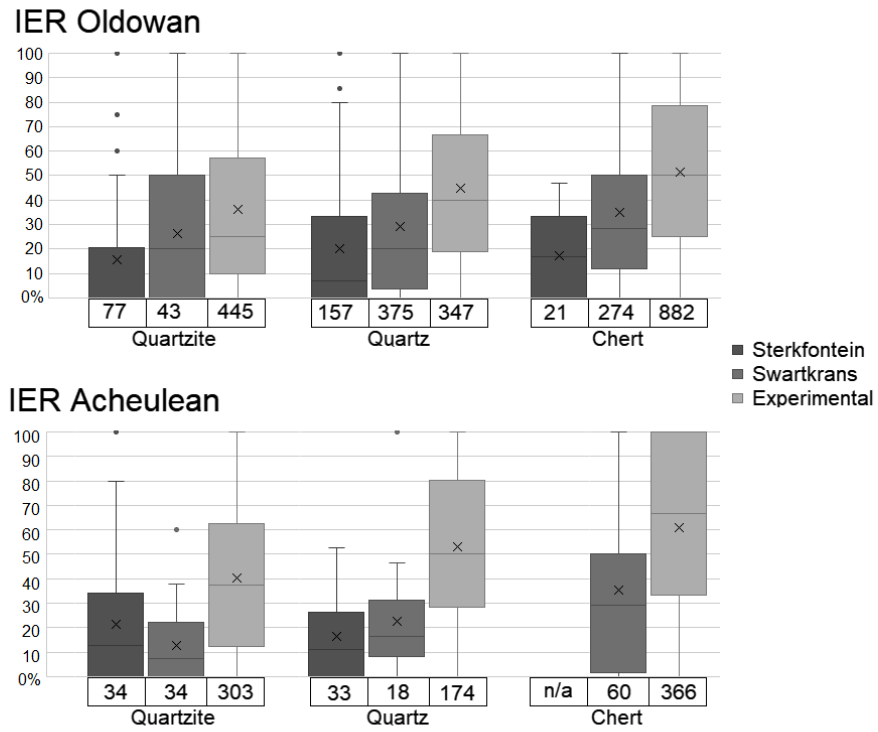

Fig.7. Impurity encounter rate (IER) distributions of raw data sets of lithics from the Oldowan, Acheulean and experimental assemblages compared for each raw material from each site. Numbers in squares are sample sizes and X's represent the means of the raw data.

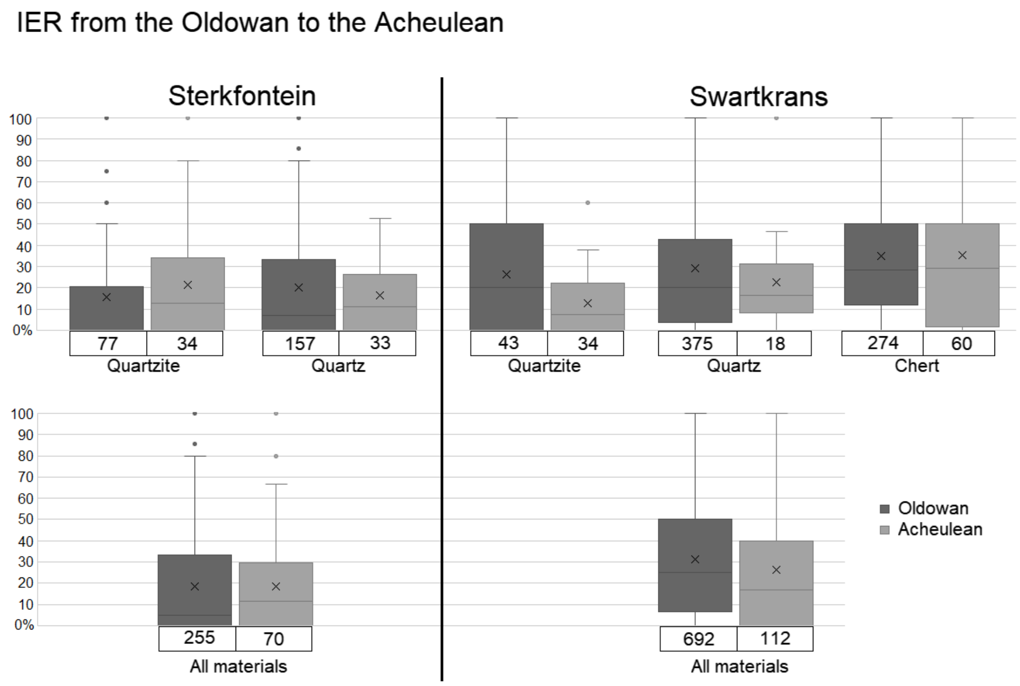

Fig. 8. Impurity encounter rate (IER) distributions of raw data sets for each site: Oldowan compared to the Acheulean for each individual raw material and all raw materials combined. Numbers in squares are sample sizes and X's represent the means of the raw data.

Table 3: P values from Mann-Whitney test of IERs between the various assemblages.

Sterkfontein vs Experimental			
Oldowan		**Acheulean**	
Quartzite	< 0.0001	Quartzite	0.0012
Quartz	< 0.0001	Quartz	< 0.0001
Chert	< 0.0001		
Swartkrans vs Experimental			
Oldowan		**Acheulean**	
Quartzite	0.0550	Quartzite	< 0.0001
Quartz	< 0.0001	Quartz	< 0.0001
Chert	< 0.0001	Chert	< 0.0001
Sterkfontein vs Swartkrans			
Oldowan		**Acheulean**	
Quartzite	0.0077	Quartzite	0.330
Quartz	< 0.0001	Quartz	0.373
Chert	0.0115		
All	< 0.0001	All	0.087
Sterkfontein Oldowan vs Acheulean		**Swartkrans Oldowan vs Acheulean**	
Quartzite	0.112	Quartzite	0.034
Quartz	0.858	Quartz	0.544
		Chert	0.881
All	0.377	All	0.073

3.4.2 Fracture encounter rate

The occurrence of fractures in quartz and chert from the Oldowan and Acheulean assemblages at both Sterkfontein and Swartkrans is less compared with the experimental samples, with the exception of the Swartkrans chert during the Acheulean, which shows a higher incidence of fractures (Figure 9). Statistical tests done with the Mann-Whitney probability test on the raw data indicate that selection for fewer fractures was present during the Oldowan at both sites (Table 4), but during the Acheulean this was only at Sterkfontein. Similarly, to the IER, both Sterkfontein assemblages have fewer average fractures present as compared to those from Swartkrans (Figure 9 and Table 4).

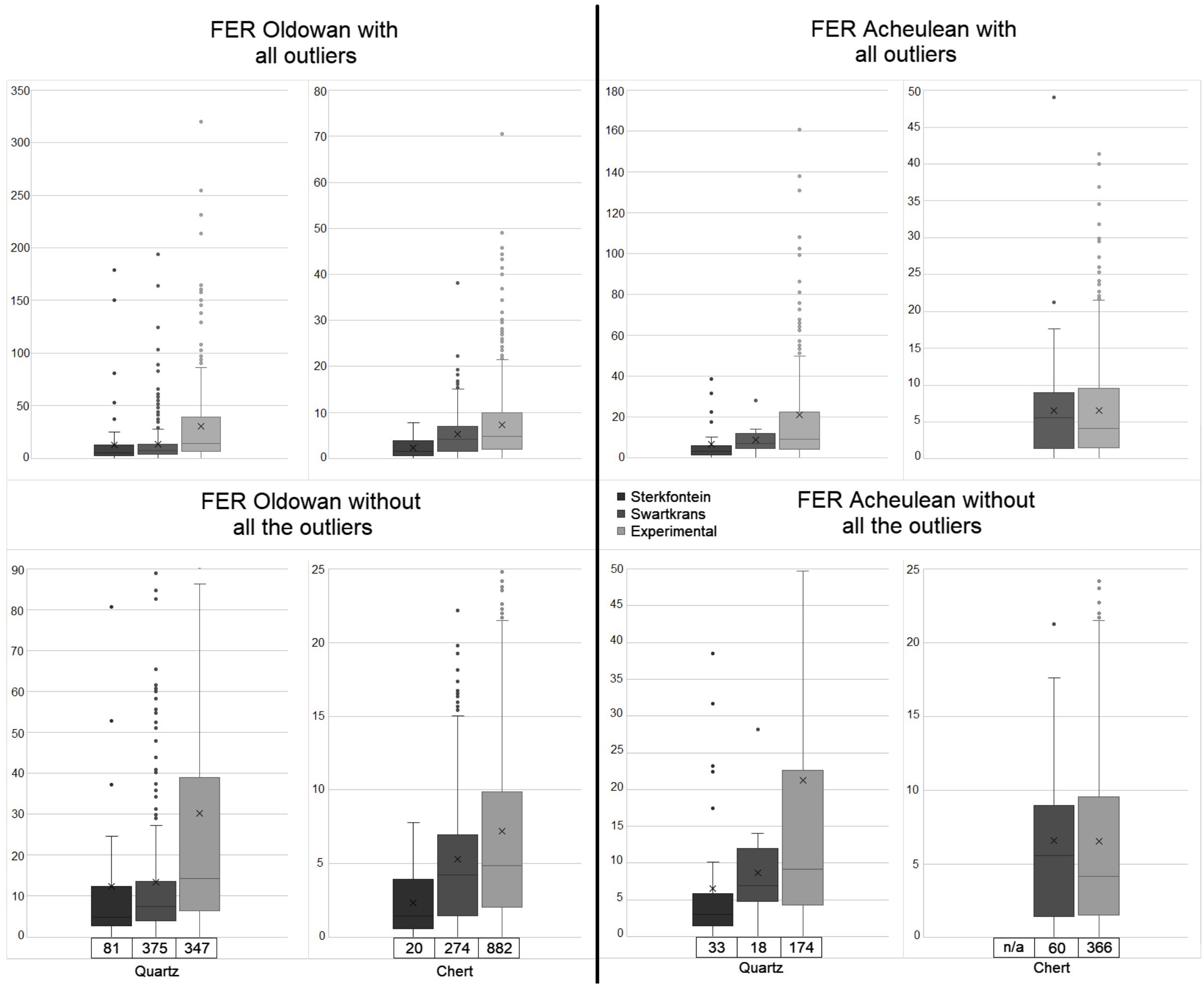

Fig. 9. Fracture encounter rate (FER) distributions of raw data sets of lithics from the Oldowan, Acheulean and experimental assemblages compared for quartz and chert. Numbers in squares are sample sizes and X's represent the means of the raw data.

There are fewer fractures present during the Acheulean, compared with the Oldowan, for both sites, which is clearer when all materials are combined (Figure 10). However, there is a chance that this difference might be due to sampling error, as suggested by the statistical tests (Mann-Whitney).

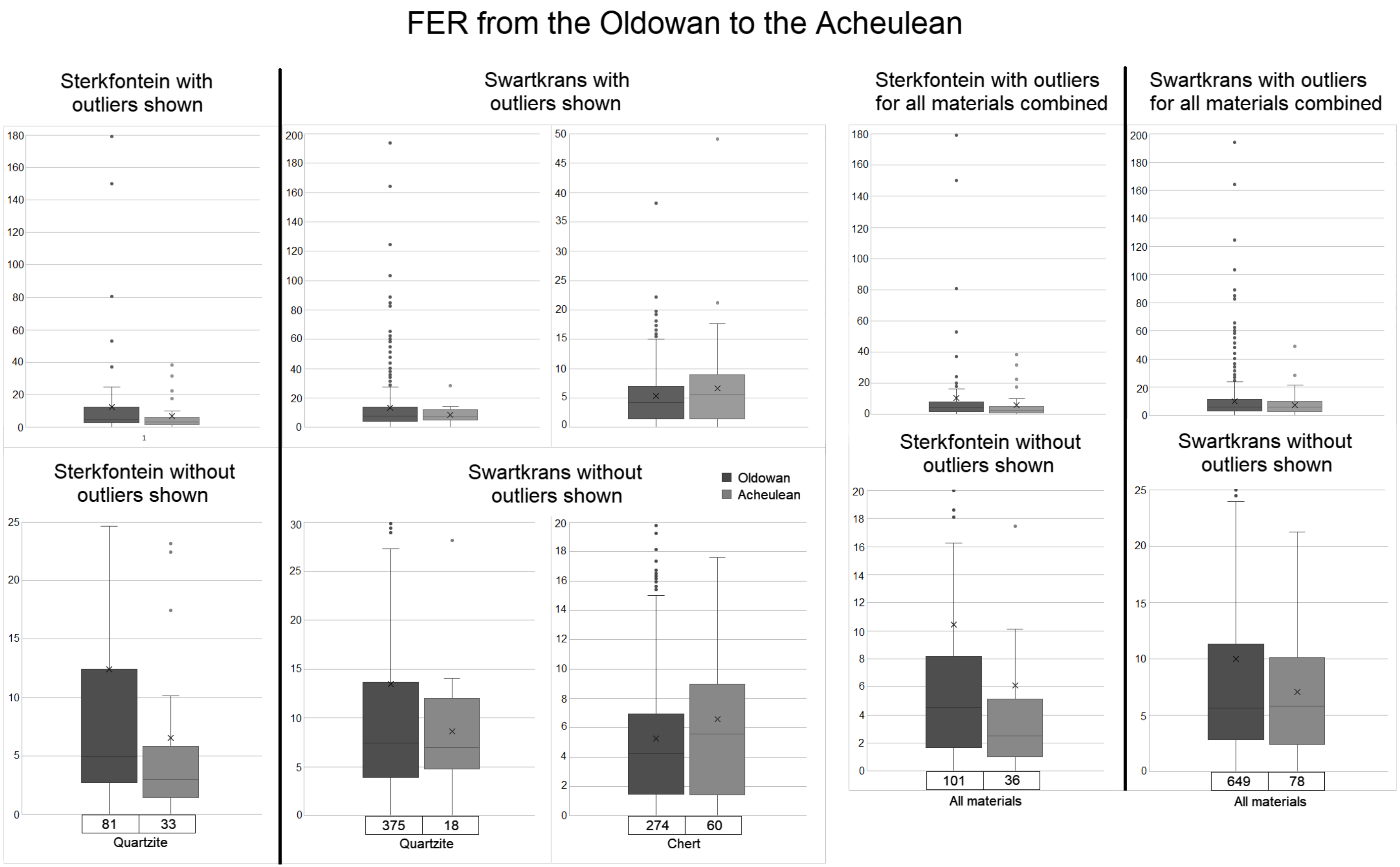

Fig. 10. Fracture encounter rate (FER) distributions of raw data sets for each site: Oldowan compared to the Acheulean for quartz and chert material and both combined. Numbers in squares are sample sizes and X's represent the means of the raw data.

Table 4: P values from the Mann-Whitney test of FERs between the various assemblages.

Sterkfontein vs Experimental			
Oldowan		**Acheulean**	
Quartz	< 0.0001	Quartz	< 0.0001
Chert	0.0002		
Swartkrans vs Experimental			
Oldowan		**Acheulean**	
Quartz	< 0.0001	Quartz	0.320
Chert	0.0007	Chert	0.753
Sterkfontein vs Swartkrans			
Oldowan		**Acheulean**	
Quartz	0.013	Quartz	0.006
Chert	0.007	Chert	n/a
All	0.039	All	0.034
Sterkfontein Oldowan vs Acheulean		**Swartkrans Oldowan vs Acheulean**	
Quartz	0.049	Quartz	0.896
Chert	n/a	Chert	0.208
All	0.151	All	0.496

3.4.3 Weathering

Both the Oldowan and Acheulean assemblages from Sterkfontein and Swartkrans have less weathered material present than the experimentally created lithics (Figure 11), which were made to represent the average freshness of material that can be sampled from random selection. Chi-square tests between the various samples confirm that the differences are significant (Table 5) despite potential post-depositional weathering that might have occurred on some of the pieces.

Overall the Sterkfontein assemblages consist of fresher material than those of Swartkrans, with the exception of quartzite lithics during the Oldowan (Figure 11). Combining the weathering data for all raw material types indicates that the Sterkfontein assemblages are indeed slightly fresher than those of Swartkrans, which is confirmed by the Chi-square tests (Figure 12 and Table 5). There may be other contributing factors, such as the material at Sterkfontein being deposited at a faster rate.

There is less weathered material during the Acheulean at both sites. The difference is significant at Sterkfontein when all the materials are combined (Table 6). Even though there is fresher material used during the Acheulean at Swartkrans, the overall difference is not significant, but it is significant for quartzite and chert (Table 6). Fresher material during the Acheulean might be due to selection.

Table 5: Chi-square tests of weathering states between the various assemblages for each raw material type and combined. STK: Sterkfontein; SWK: Swartkrans; EXP: Experimental.

Oldowan	Quartzite	Quartz	Chert	**Acheulean**	Quartzite	Quartz	Chert
STK vs EXP	0.000	0.000	0.000	STK vs EXP	0.000	0.000	
SWK vs EXP	0.000	0.000	0.000	SWK vs EXP	0.000	0.000	0.000
STK vs SWK	0.000	0.000	0.242	STK vs SWK	0.000	0.000	
SWK vs STK	0.000	0.000	0.000	SWK vs STK	0.048	0.000	

Combined	**Oldowan**	**Acheulean**
STK vs SWK	0.000	0.000
SWK vs STK	0.026	0.000

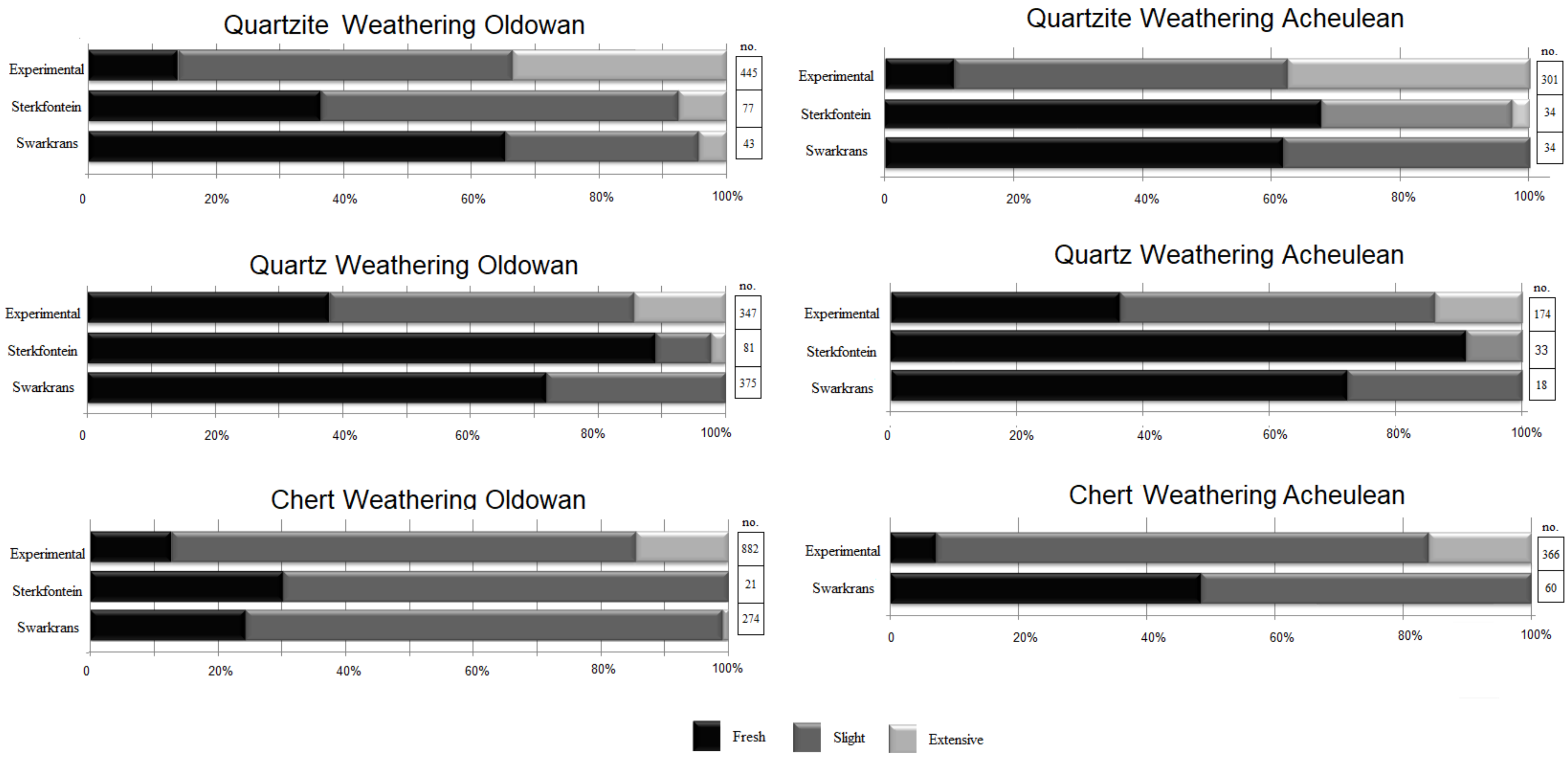

Fig. 11. Weathering states of all materials compared to the experimental assemblages, shown as percentages of fresh, slightly weathered and extensively weathered material in each assemblage. Numbers in boxes are sample sizes.

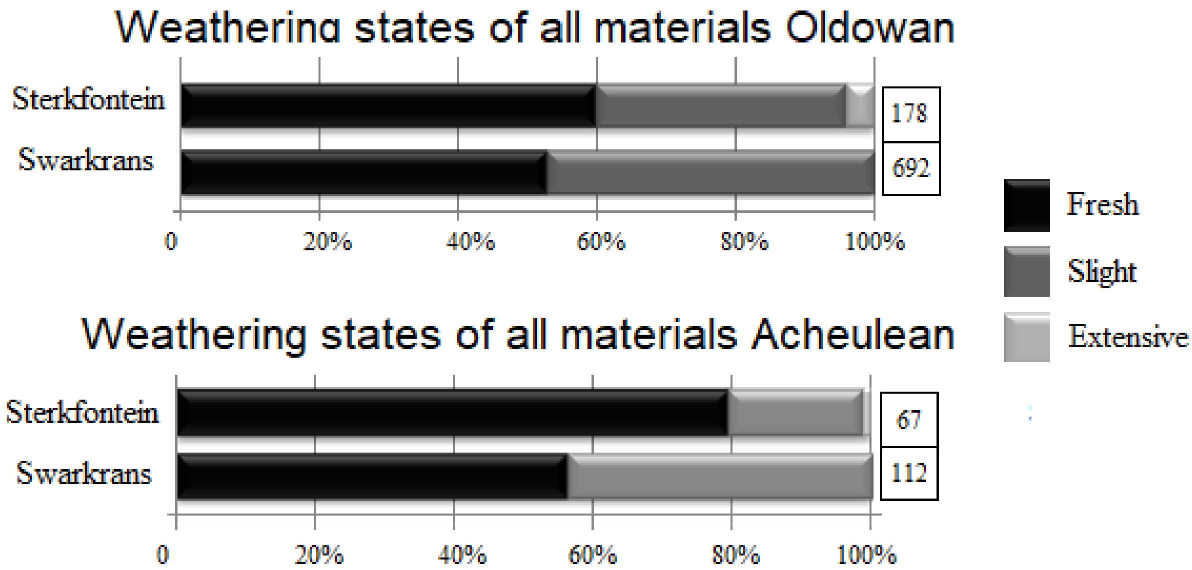

Fig. 12. Weathering states of all material combined for Sterkfontein and Swartkrans: shown as percentages of fresh, slightly weathered and extensively weathered material making up each assemblage.

Table 6: Chi-square tests of weathering states between the Oldowan and Acheulean assemblages for both sites.

Sterkfontein Oldowan vs Acheulean	
Quartzite	0.000
Quartz	0.281
All	0.004
Swartkrans Oldowan vs Acheulean	
Quartzite	0.031
Quartz	0.994
Chert	0.000
All	0.549

3.4.4 Grain size of quartzite

Quartzite lithics in the Sterkfontein and Swartkrans Oldowan and Acheulean assemblages are significantly finer grained than those in the experimental assemblages (Figure 13 and Table7), indicating selection for finer grained quartzites during all time periods. The difference between the Sterkfontein and Swartkrans Oldowan is not significant enough to conclude that more selection for finer grained material was definitely present at Sterkfontein during the Oldowan. This is clear when Swartkrans is compared to Sterkfontein with Sterkfontein as the expected range (Table 7 bold) with a 77 % chance of there being a significant difference. However, the difference between the Sterkfontein and Swartkrans Acheulean is significant, indicating that more selection for finer grained quartzite was likely present at the Sterkfontein site. The tests also indicate that there is an increase in selection for finer quartzites in the Acheulean as compared to the Oldowan at both sites.

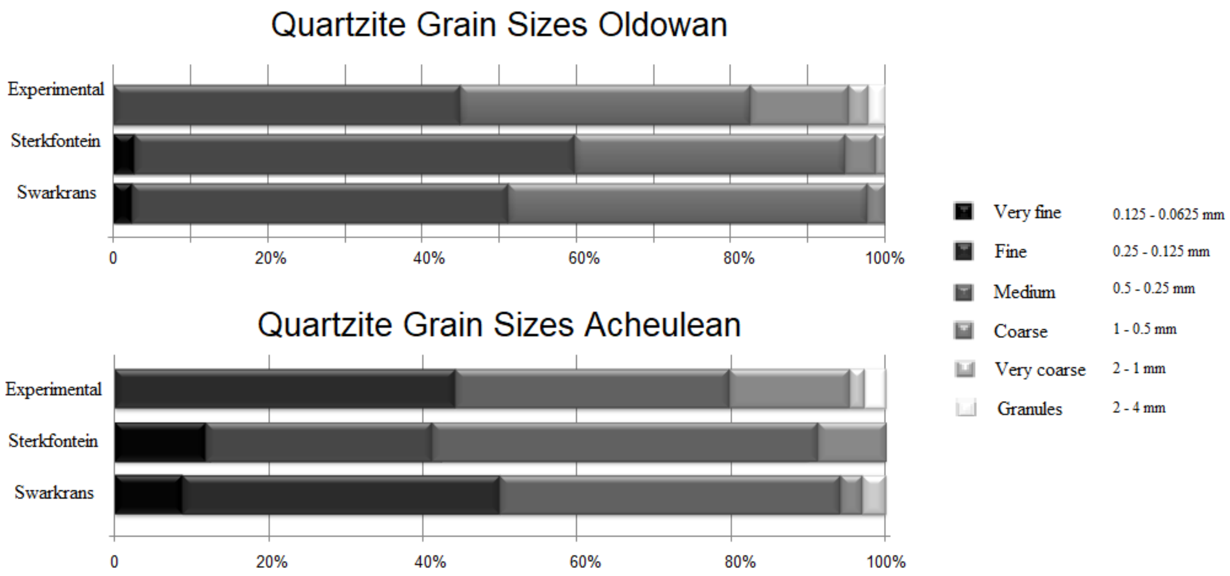

Fig. 13. Quartzite grain sizes compared for the various assemblages.

Table 7: Chi-square tests of the grain size range of quartzite lithics present in the various assemblages.

Oldowan		**Acheulean**	
STK vs EXP	0.000	STK vs EXP	0.000
SWK vs EXP	0.000	SWK vs EXP	0.000
STK vs SWK	0.000	STK vs SWK	0.001
SWK vs STK	0.229	SWK vs STK	0.000

Oldowan vs Acheulean	
Sterkfontein	0.000
Swartkrans	0.000

3.5 DISCUSSION

3.5.1 Overall Selection

The average values for the data, as well as the probability tests conducted on the raw data, indicate that selection of lithic raw material quality from the available rocks on the landscape was indeed present at both Sterkfontein and Swartkrans in the Oldowan and Acheulean assemblages. The summary below demonstrates that hominids selected for multiple facets with regards to rock quality.

- IER: Selection of rocks exhibiting fewer flaws was practiced at both sites during the Oldowan and the Acheulean.
- FER: Selection of less fractured rocks was practiced at both sites during the Oldowan and the Acheulean, except for Swartkrans chert during the Acheulean, which shows a higher occurrence than the experimental assemblage.
- Weathering: Selection for less weathered rocks appears to have been practiced at both sites during the Oldowan and the Acheulean. Despite possible post-depositional weathering of artefacts taking place, the archaeological data still shows significantly fresher weathering states than the experimental assemblage, which represents weathering states when rocks are more randomly selected.
- Grains: Selection of finer grained quartzite was practiced at both sites during the Oldowan and the Acheulean.

As noted above, the average FER of the Swartkrans chert pieces during the Acheulean is slightly higher than the experimental pieces. However, the IER is significantly lower. The rest of the data suggest that there is a direct correlation between selection of the IER and the FER. Clark (1991, 1993) suggests that some pieces from members 2 and 3 could have been broken or fractured from pressure of overburden due to the position of these Members. The majority of chert lithics from the Swartkrans Acheulean is flakes, which are more susceptible to fractures from pressure as they are thinner than cores and chunks. FERs for chert flakes from the Acheulean are almost four times greater than those from the cores, whereas the FERs of flakes from the Oldowan are almost the same as the cores. The FERs from the Acheulean chert flakes are also double that of the Oldowan chert flakes at this site. This is seen to a lesser extent in the quartz pieces analysed; however, there are more quartz cores in relation to flakes, and thus it is not reflected substantially in the data. This could indicate that there was indeed pressure of overburden on some of the Acheulean pieces, causing post-depositional fractures, particularly for flakes. But, since the IER and FER were analysed separately, we can see that selection for quality of raw materials was still present as the IERs were significantly lower than expected from random selection, despite the occurrence of fractures.

Materials with minimal weathering seemed to have been selected by early hominids when Oldowan and Acheulean assemblages are compared to the experimental samples. The experimental sample shows what the average weathering states of randomly selected rocks would be on the landscape. This might not have been exactly the same for the landscape two million years ago, but it would be a decent approximation, as weathering is a continuous cycle. One issue that needed to be addressed is whether post-depositional weathering had an impact on the results. Figure 14 shows lithic pieces from the Swartkrans Oldowan (A) and the Swartkrans MSA (B). It is clear that there is more surface weathering present on the MSA lithics (approximately 100ka), which accumulated in surface colluvium before it washed into the cave, as compared to the Oldowan lithics (approximately 2Ma) which had spent more of their life history within the cave deposit. Weathering states of lithics from the Oldowan and the Acheulean (which look similar to the Oldowan pieces) seem to have undergone little post depositional weathering, as few pieces exhibit the surface weathering that is seen in the MSA lithics.

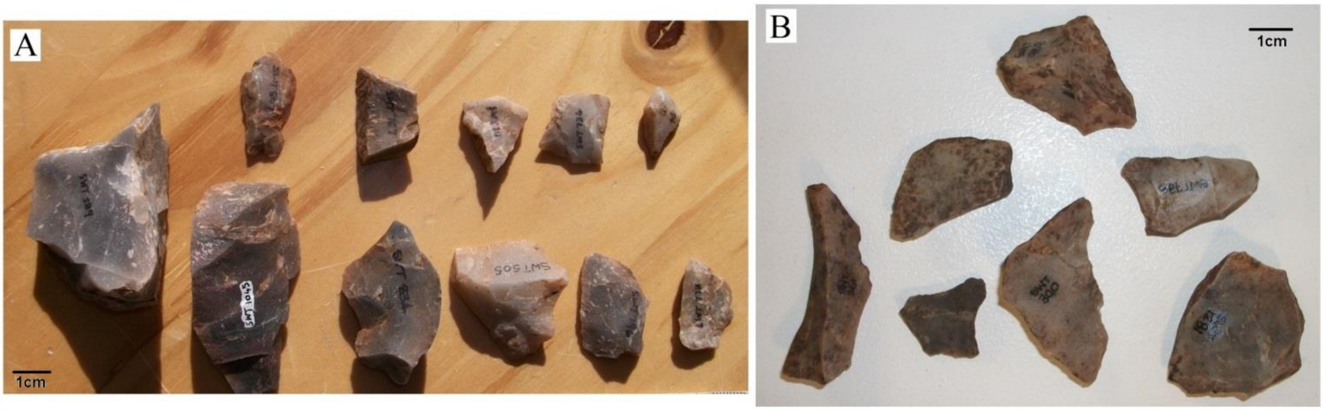

Fig. 14. Chert pieces from the Swartkrans Oldowan (A) and Chert pieces from the Swartkrans Middle Stone Age (B).

3.5.2 Differences between sites

Overall both the Oldowan and the Acheulean assemblages found at Sterkfontein are of better quality that their Swartkrans counterparts, as summarised below:

- IER: Oldowan and Acheulean lithics from Sterkfontein were made of better-quality materials than those found at Swartkrans.
- FER: The Sterkfontein Oldowan and Acheulean assemblages had slightly fewer fractures present than found in Swartkrans material overall, but this difference might be due to the samples at the sites not necessary representing the full complexity of selection at each site, as the difference is not statistically significant
- Weathering: Overall the Sterkfontein assemblages consist of fresher material than those of Swartkrans, but this might be due to post-depositional factors and not necessarily due to selection.
- Grains: The difference between the Sterkfontein and Swartkrans Oldowan is not significant enough to conclude that greater selection for finer grained material was definitely present at Sterkfontein. The difference between the Acheulean assemblages is, however significant, indicating that more selection for finer grained quartzite was present at the Sterkfontein site.

The differences between the sites could be due to a variety of reasons:

- One site having a more expedient technology.
- One site having closer access to raw materials vs. the other site requiring greater transport of raw materials.
- Personal preferences of different groups of hominids.
- Time differences between the two sites sampling differing behaviours, perhaps even different behaviours of separate species.

Kuman *et al.* (2018) indicate that the Oldowan at Swartkrans was significantly more expedient in nature than the Oldowan technology found at Sterkfontein. In addition, Swartkrans is located very close to the quaternary sediments (river cobbles), whereas Sterkfontein is roughly a half a kilometre away (*ibid*). Raw materials from the river gravels would have been easily accessible at Swartkrans and less distance was be required to transport materials, thus there was probably less interest in selection. However, chert outcrops are readily available close to each site and would have been easily accessible near Sterkfontein. While quartz exists in the surrounding landscape in the form of the occasional vein, it is more abundant in the river gravels (along with quartzite and chert) (Kuman *et al*. 2018) and of better quality. The majority of each assemblage consists of quartz, which indicates that distance to the main source of raw material may have had a contributing factor to better selection at Sterkfontein. Other unknown conditions around the sites may also have contributed to the selection patterns, such as the presence of more predators in a wetter, more wooded landscape at Swartkrans, leaving less time to select optimal quality rocks.

Selection for quality during the Acheulean at Sterkfontein is slightly better than at Swartkrans; however, this is not as pronounced as during the Oldowan. Also, the sample sizes of artefacts excavated at the sites might not fully represent the entirety of hominid behaviour, as some flakes, cores and formal tools, such as LCTs, might have been transported around the landscape and not made their way into the cave deposits. This is possible for Swartkrans as fewer LCT's were present in the assemblage.

3.5.3 Differences through time

There is an overall improvement in the quality of rocks selected during the Acheulean at both sites. The average IERs and FERs are lower during this time period, although this is not confirmed by the probability tests. Finer grained quartzites were selected at both sites, which probability tests confirm. The weathering states were also significantly fresher during the Acheulean, although we cannot account for the influence of site formation on artefact conditions.

3.6 CONCLUSION

In conclusion, selection for better raw material quality was present at both the Sterkfontein and Swartkrans sites for all Oldowan and Acheulean assemblages. From the landscape around the sites and from river gravels, hominids selected raw material types that were best for tool making and exhibited fewer flaws, such as joints, cavities, mass crystal inclusions and fractures. They also seem to have favoured fresher material, as well as finer grained quartzites. The Sterkfontein assemblages are overall of better quality than the ones from Swartkrans, which is possibly due to a larger distance from the main source of raw material.

There is an improvement in quality selection from the Oldowan to the Acheulean, but this is mainly visible in the averages for each variable. It should be noted that the degree of raw material selectivity does not necessarily reflect the degree of cognitive complexity, as other factors, such as knapping skill and habitat location, have an impact on selective decisions and would need to be explored extensively and integrated into such studies.

CHAPTER FOUR: STUDY TWO

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Lithic raw material quality of Middle Pleistocene artefacts from the Han River, Danjiangkou Reservoir Region, central China

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ABSTRACT

The East Asian Acheulean is often considered distinct from African and European Acheulean technologies as large cutting tools (LCTs) are thicker and heavier on average. This distinction is generally true, but exceptions occur, particularly in thickness, as more Chinese sites are reported. It has been suggested that the raw materials available in East Asia have played a part in determining this dissimilarity. Extensive raw material studies on East Asian technologies have not yet been done to determine if this is indeed the case. It is thus important to investigate the impact of raw materials quality on the East Asian Acheulean. This paper focuses on raw material attributes for LCTs from the Danjiangkou Reservoir Region, central China (DRR), with specific focus on Middle Pleistocene artefacts from Terrace 3 of the Han River. Extensive experimental studies were done to determine raw material attributes and how those attributes affect the knapping process in the creation of LCTs. A set of variables was recorded for the experimental tools and compared with a sample of archaeological LCTs. The variables recorded included: the impurity encounter rates of various raw materials, their weathering states, grain sizes and shapes. The results indicated that hominids occupying the DRR exhibited selective behaviours for the raw materials they used to make LCTs, despite not having a wide variety of materials from which to select. It is also evident that they showed adaptability and made strategic decisions with regards to the selected raw materials for manufacture of LCTs to meet their needs.

1. Introduction

The East Asian Acheulean has not been as extensively researched as the Acheulean in other parts of the world. According to Li et al. (2014), this is largely due to the “Movius Line” model (Movius, 1948, 1969), which argues that East and Southeast Asia in the Palaeolithic was a cultural backwater, as well as the assumption that Chinese LCTs are an indigenous development without influence from Acheulean populations (Gao, 2012). East Asian LCTs are often considered distinct from African and European Acheulean technologies as they are thicker and heavier on average, with greater weight being the most consistent difference (Kuman et al., 2014). It has long been argued that the poorer quality raw materials available in East Asia has played a major part in determining this dissimilarity (Leng and Shannon, 2000; Leng, 2001; Bar Yosef et al., 2012.) Extensive raw material studies on East Asian technologies have, however, not yet been done to determine if this is the case. The purpose of this paper is thus to determine more accurately if and how raw materials have affected the nature of the East Asian Acheulean in the Danjiankou Reservoir Region.

This paper makes use of the term large cutting tools (LCTs) as a general term for handaxes, picks and cleavers, particularly because not all handaxes in the Acheulean are bifaces. In addition, the exact definition of each of these types varies. For example, some Chinese researchers define unifacial convergent tools as picks rather than handaxes (Lin, 1994; Pei et al., 2008; Zhou et al., 2009), whereas the flaking pattern of picks is less important to other researchers than the morphology of the piece. The typological approach to LCTs used in this paper follows Kuman et al. (2014), based on Kleindienst (1962) and Clark and Kleindienst (2001) for the African Acheulean. They define tools such as handaxes, cleavers and picks as “large cutting tools” with the emphasis on the cutting edges or points. This definition is based on morphology and not technique. In our definitions, handaxes have more overall shaping of the body

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of a piece, whereas picks have more focus on a narrow distal end. Cleavers have a wide cutting bit and usually shaping of at least one lateral. Handaxes are further classified into bifacial, partly bifacial and unifacial, in contrast to the popular use of the term ‘bifaces’ for handaxes, particularly in China (see Kuman et al., 2014 for a detailed discussion). Therefore, to avoid confusion, any tools that could be classified as handaxes, picks and cleavers were classed generically as LCTs in this study, and these included bifacial and unifacial tools.

Another complication in the comparison of LCT traits between eastern and western sites has been the tendency to focus only on western Later Acheulean assemblages instead of considering the variability present throughout this industrial complex. After 600ka, Later Acheulean LCTs in the West are usually more “well-made” when compared to the earlier Acheulean (Roe, 1994; Klein, 2000; Kuman, 2014). Moreover, less refined handaxes also exist in the Later Acheulean and are likely due to a “least effort” approach (e.g., McNabb et al., 2004), exhibiting the variability present even in advanced stages of the technology (Kuman et al., 2014). Despite the overall rarity of more “refined” LCTs in East Asia, some well-made pieces have been discovered, particularly at younger Acheulean sites such as Dingcun and Luonan (Yang et al., 2014, 2016). The LCTs at these sites and in northern parts of China are generally thinner because the tools were made on flake blanks rather than cobbles (Yang et al., 2016). The study by Yang et al. (2016) for Dingcun performed experimental knapping of hornfels, the predominant raw material used at these sites. They confirmed that hard hammer flaking produced the large flake blanks used in this industry, and that soft hammer percussion was not used. Yang et al. (2016) also indicate that LCTs in the south of China from Bose (ca. 0.8 Ma), and at many other East Asian sites, are thicker on average than those found in the northern parts of China because of the greater use of cobble blanks. The LCTs documented in the Danjiangkou Reservoir Region (DRR) in northern central China, however, are thinner, even though many are made directly on cobbles–a phenomenon directly linked to the properties of those cobbles (Kuman et al., 2014).

The importance of experiments to bringing understanding of lithic industries cannot be over-estimated (Flenniken and White, 1985; Toth, 1985; Schick and Toth, 1994; Kuman, 1996; Ludwig and Harris, 1998; Field, 1999; Brantingham et al., 2000; Stout et al., 2005; Braun et al., 2009; Harmand, 2009; Diez-Martín et al., 2011; Goldman-Neuman and Hovers, 2012; Sherwood, N. 2013; Gurtov and Eren, 2014; Byrne et al., 2015; Yang et al., 2016). It is for this reason that extensive experimental knapping was performed to help understand the technology at DRR.

1.1. The DRR site complex

This paper analyses LCTs both collected and excavated from Terrace 3 of the Han River in the Danjiangkou Reservoir Region (DRR) by the field team of IVPP (Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences) from the following sites: Datubaozi, Waibiangou and Guochachang (Fig. 1). Approximately 100 Paleolithic sites have been surveyed, of which 30 have *in situ* atrtefacts that have been excavated. The DRR is located on the southern edge of the Qinling mountains, which forms the border between the North and South of China and is fed by the Han River (Li et al., 2014). Sedimentary studies of Terrace 3 place it in the Middle Pleistocene (Yuan et al., 2008; Li et al., 2013), while Electron Spin Resonance (ESR) and palaeomagnetic data

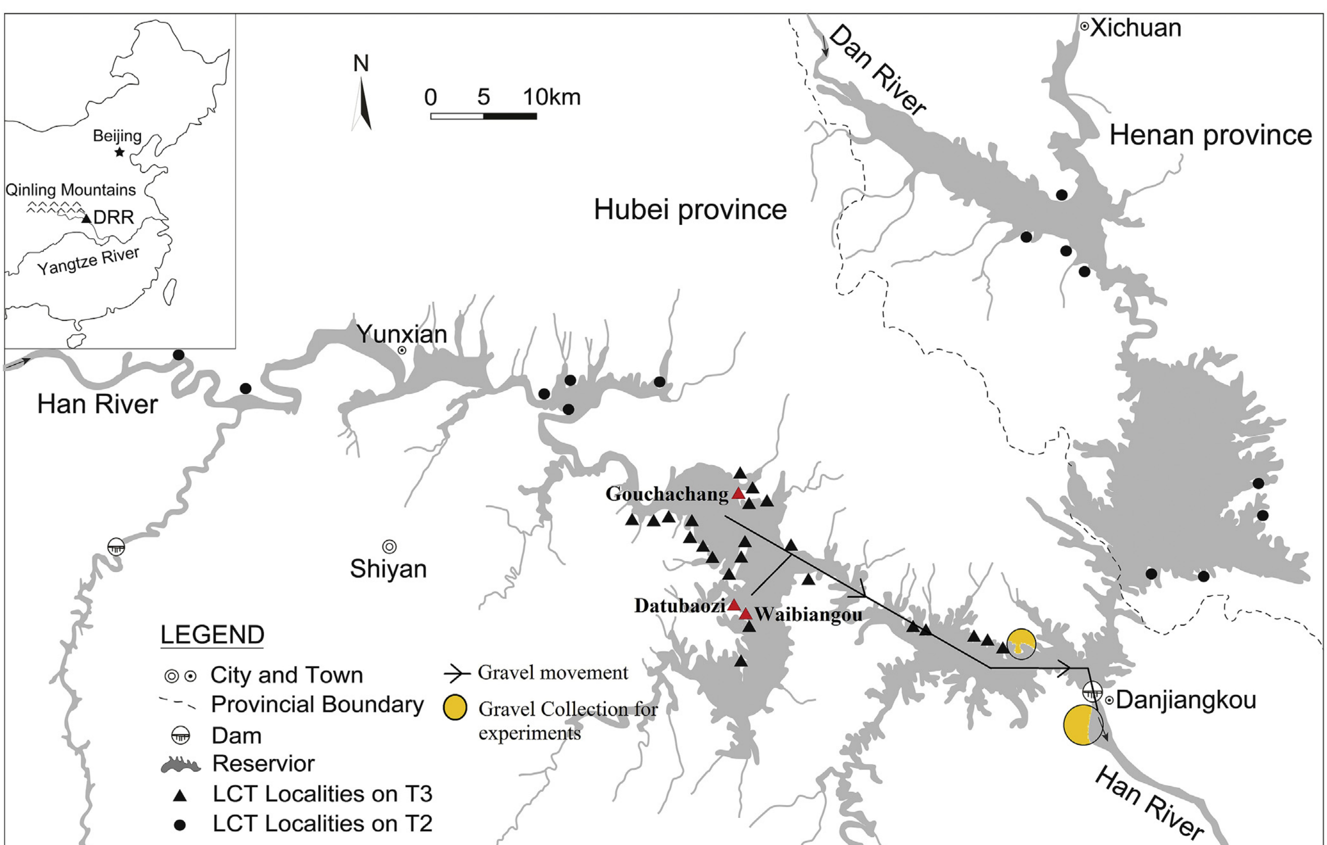

Fig. 1. LCT sites in the DRR region, with the three sites used in red. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

indicate that it falls into the early to middle part of the Middle Pleistocene (Li et al., 2014). While bone is not preserved in T3, the older T4 site of Yunxian has produced human fossils (Wu and Dong, 1980; Qiu et al., 1982; Wu and Wu, 1982; Vialet et al., 2010; Li and Etler, 1992), as well as stone tools and faunal remains (de Lumley and Li, 2008; Feng, 2008; Li et al., 2014).

Li et al. (2014) determined that five types of raw materials were used to make DRR LCTs from T3 [quartz phyllite (70.8%), trachyte (20.8%), other igneous rocks (5.6%), quartzite (1.4%), quartz (1.4%)]. DRR LCTs exhibit more secondary flaking scars than primary ones, especially on the distal and middle parts of LCTs (Li et al., 2014), thus showing that more focus was given to refinement of working edges. In the archaeological sample of surface collected LCTs analysed by Kuman et al. (2014), the handaxes made in these materials had a mean length of 172.7 mm (Range 121–226 mm), while other LCTs (mainly picks) showed were somewhat larger in size (see Kuman et al., 2014 for details). For the three excavated assemblages used in this study, the combined LCTs (N = 24) had a mean length of 169.5 mm (range 108–260 mm). The surface collections from those sites (N = 43) had a slightly larger mean of 175.4 (range 117–232 mm). These sizes provided a guide for collection of appropriately sized cobbles for the experiments. The resultant experimental LCTs produced only by Sherwood were similar to the archaeological samples, (N = 35; mean length 166 mm, range 100–245 mm). Because the smallest LCTs were just over 100 mm, experimental cobbles were sleceted from that size upwards.

There is a preference for hominids to select quartz phyllite for LCTs, with 80% of Kuman (2014) sample made from it. This material is the most abundant in the local river banks, but it can often make the knapping process difficult due to its platy structure (Li et al., 2014). According to Pellant (1992), phyllite is a metamorphic rock that belongs to the schist family. It is formed through the metamorphism of rocks such as slates and mudstones and is characterised by a foliated structure due to the preferred orientation of mica within the rock (Farndon, 2006; Marshak, 2013; and see Kuman et al., 2014 pg. 135). Temperature during metamorphism gets high enough to allow mica to recrystallize (Marshak, 2013) and thus creates the foliation (Farndon, 2006). The material from DRR is termed quartz phyllite because it has a high proportion of quartz present (Kuman et al., 2014). The selection of this rock type indicates that the available raw materials did not constrain the making of LCTs in East Asia (Schick, 1994; Lycett and Bae, 2010; Li et al., 2014). The material did, however, influence the morphology and the technology of the tools (Li et al., 2014). Bar Yosef et al. (2012) argue that expert knappers could produce western looking forms on local raw materials in China, such as prepared cores, but the poor quality of the materials imparts its own unique character to an industry, and such is the case for DRR. One such characteristic is the predominance of initial blank types used to make the LCTs. According to a study done by Li et al. (2014), the predominant blank type used was cobbles (47.2%), with large flake blanks (25%) being less frequent. However, a large number of LCTs made on flake blanks consisted of quartz phyllite because LCTs were easier to create thanks to splitting forces that follow the platey stucture of this material. This "is a special adaptation to the local raw material" (Li et al., 2014 p. 168). Quartz phyllite cobbles in the region have a large proportion of flat, amygdaloid shaped pieces, and with well-rounded edges. Since archaeological LCT shapes are usually amygdaloid, elongated and flat, such cobble shapes were selected for flaking because this "can provide a suitable platform and angle for direct invasive flaking of the laterals" and such shapes would be comfortable for holding the tools (Li et al., 2014, p. 68). Thus selecting these cobbles for LCT blanks made sense.

2. Methodology and techniques

2.1. Experimental knapping

All experiments in this study were performed by Sherwood, and thus knapper variability was not introduced. Rock samples for

Fig. 2. Various sampling locations of gravels: Upper left: cobble layer of Han River T3 exposed under the construction of a road. Upper right: clasts dug out from the ancient Han River cobble layer dug out for construction of a building. Lower left: clasts from a quarry sorting factory on the bank of the Han River. Lower right: cobbles distributed on the eroded surface of the Han River terrace three.

experimental knapping were collected from various locations near the city of Danjiangkou from gravels of the Han River (Fig. 2). However, these were of the same geological composition as gravels that are present within the excavated sites, as confirmed by CL and HL, as well as by close inspection of the archaeological material. The Danjiangkou Reservoir Region is located in the southern Qinling tectonic belt, which consists of the intermediate volcanic-sedimentary formations of Precambrian to Mesozoic age. Due to the tectonic movement in the Mesozoic era, northwest-southeast inter-montane fault basins formed deep fault lines in DRR. The Han River flows through the DRR from west to east. It originally formed in the late Tertiary, and the Pleistocene is the primary period for its development. Intermittent neo-tectonic uplift and fluvial erosion caused the development of several river terraces along the Han River in Pleistocene times. In the meantime, alluvial and piedmont sediments deposited on these terraces (Zhu, 1955; Shen, 1956; Chen et al., 1997). The sites were further upstream than the area that cobbles were collected (Fig. 1), which resulted in slightly smaller cobbles downstream on average, however there was still a sizable mix of small and large cobbles (even boulders) to select from.

Cobbles were collected from all the available rock types (Table 1) and extensively knapped to determine their different characteristics and to decide which materials were best for creating LCTs. This was done to compare the rock flaking properties across the materials available to make the LCTs. Hominids preferred quartz phyllite and igneous rock despite quartzite having the least amount of flaws and better flaking predictability, and thus experimental LCTs were primarily made from these two materials for comparison to the archaeological LCTs. The experimental LCTs were made to mimic the typology and technology of the DRR sites as can be seen in Fig. 3. The archaeological LCTs were made by primarily employing the free hand hard hammer technique, thus experimental knapping techniques for the primary shaping process included mostly free-hand hard hammer percussion. However, rod shaped quartz phyllite cobbles were split using the bipolar on an anvil technique, but this technique did not prove to be as effective on quartzite and igneous rock. It required two people to execute, as one person (in this case HL) would hold the elongated cobble on an anvil with its long axis vertical and another person used a hammerstone to strike from above, thus directing forces between the two poles along a cobble's long axis. The passive hammer technique, described in Harmand et al. (2015), where a core is held in both hands and struck against a stationary and fairly large rock, was used on quartzite and igneous rock when initial flake removal proved difficult with the free hand hard hammer technique. The experimental tools were then compared to the artefacts from T3.

2.2. Data sets

Several variables were collected from two sets of data: experimental LCTs and archaeological LCTs. The archaeological sample consisted of LCTs from the T3 sites of Datubaozi, Waibiangou and Guochachang. LCTs from these three sites were analysed, including the excavated *in situ* LCTs, as well as surface collections surrounding the sites (See Table 2 for sample sizes). The LCTs from the three sites were treated as one archaeological sample as they were all similar in typology and technology. The experimental sample was created by knapping LCTs from quartz phyllite and igneous rock and to compare the overall quality of the rocks selected for the LCTs in the archaeological material. Cobbles of these materials were selected semi-randomly, thus not selecting for their quality, although the

Table 1
Raw material frequencies in the gravels.

Cobbles >10 cm	Sample A	Percentage	Sample B	Percentage	Total	Percentage
Quartz Phyllite	33	42.9	24	37.5	57	40.4
Quartzite	18	23.4	19	29.7	37	26.2
Igneous material	18	23.4	16	25.0	34	24.1
Quartz	3	3.9	3	4.7	6	4.3
Dolomite	3	3.9	1	1.6	4	2.8
Chert	2	2.6	1	1.6	3	2.1
Total	77		64		141	

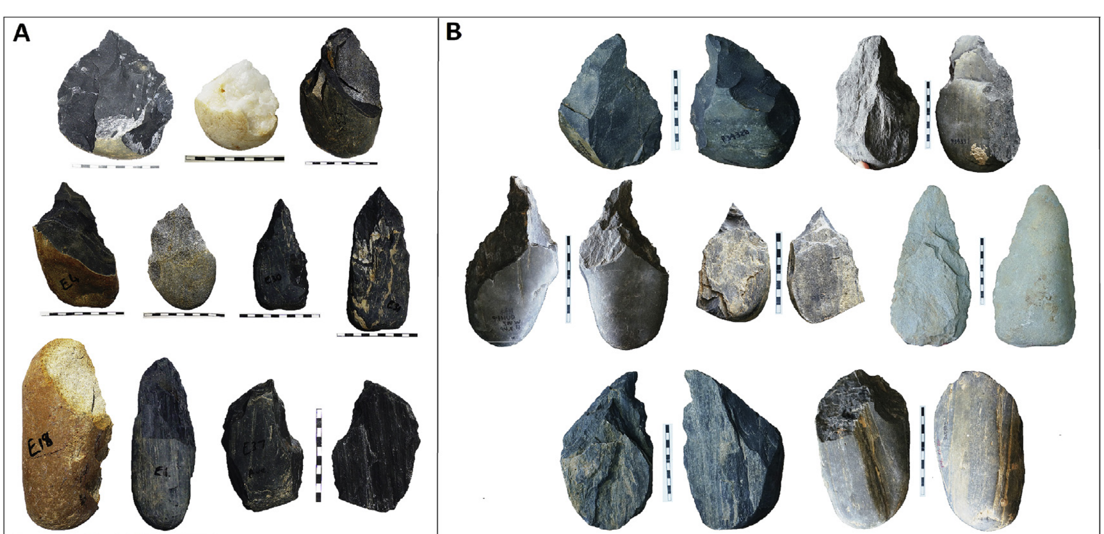

Fig. 3. Some of the experimentally knapped stone tools (A) representative of the LCTs found in the Danjiangkou Reservoir Region, central China (B).

Table 2
Data sample sizes.

Artefact sample	No.	Experimental sample	No.
Quartz Phyllite	15	Quartz Phyllite	20
Surface Quartz Phyllite	35		
Igneous material	9	Igneous	15
Surface Igneous	8		
Total	**67**	**Total**	**35**

size and the shapes of the cobbles were selected with the intent of creating functional LCTs.

2.3. Variables

The variables discussed here apply only to experimental and archaeological LCTs made on quartz phyllite and igneous material. The other rock types were also analysed but are presented only in the discussion section of this paper.

2.3.1. Impurity encounter rate (IER)

The presence of macroscopic impurities (flaws) in a rock impedes the knapping process considerably. Flaking becomes unpredictable and often terminates with snap fractures, which become problematic when shaping and thinning LCTs. Impurities that were identified for quartz phyllite via the experimental knapping included: extensive foliation and joint planes (Fig. 4A and B). Cavities were only present in some quartz varieties (Fig. 4C). Joint planes were present in all the different rock types, but not in all specimens. A joint plane is defined as "a single fracture in a rock with or without a small amount (<1 cm) of either dilational or shear displacement" (Hoinkes et al., 2005: 390). In this study a plane refers to any uniform surface of weakness which separates a rock into two pieces, and this includes foliation. Since the archaeological assemblage did not include any LCTs made from quartz, only foliations and joint planes were present in the archaeological specimens.

These flaws were quantified by counting all flake scars that intersect a plane or foliation. The IER was then calculated for each LCT using a similar method to Brantingham et al. (2000) and Sherwood (2013) to quantify the frequency of impurities encountered during primary flaking of an artefact. Brantingham et al. (2000) calculated this rate by dividing the number of flake scars encountered on an artefact exhibiting impurities (ISCAR) by the total number of flakes scars present (DSCAR) and multiplying this by 100 to give a percentage (formula below). Sherwood (2013) provides multiple examples of how the formula is applied.

$$impurity\ encounte\ rate = \left(\frac{Scars\ with\ impurities}{Total\ no.of\ flake\ scars}\right) \times 100$$

2.3.2. Laminae/foliations

Since quartz phyllite is unique in that it is characterised by multiple foliations and was the material most abundantly used to make LCTs, additional variables along with the IER were taken with regards to the lamina. This was done by determining the frequency with which foliations were encountered and the average distance between them.

The frequency was determined by counting the total number of clearly visible laminae on multiple large flattish surfaces of the tool and calculating the average laminae per centimetre. It was done perpendicularly to the lamina, as they are generally parallel to each other (Fig. 5), using a set of dental callipers. Thus the tools with higher numbers of lamina per centimetre will be of worse quality and thus also likely to have smaller average distances between lamina. Tools with no lamina will have a low or zero count and are thus of the best quality.

2.3.3. Weathering

Weathering is important to establish as raw materials become more difficult to knap when extensively weathered. Weathering on tools was determined visually and divided into three categories: fresh, slightly weathered and heavily weathered (Fig. 6).

2.3.4. Igneous rock grain sizes

This variable was applied to igneous material only since the

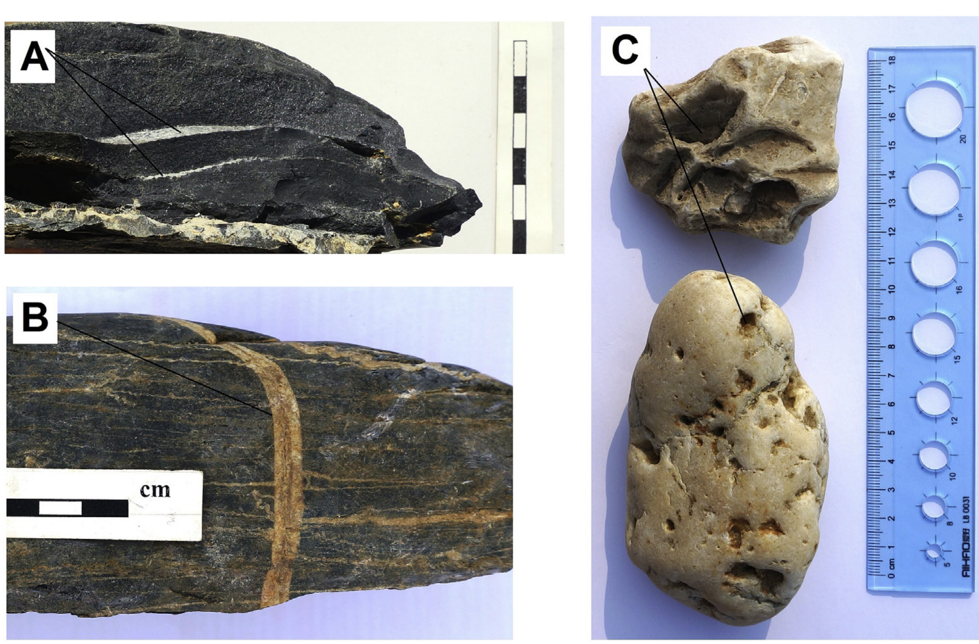

Fig. 4. Impurities present in raw materials. A: Foliations; B: Joint plane (foliations also present running perpendicular to plane) and C: Cavities.

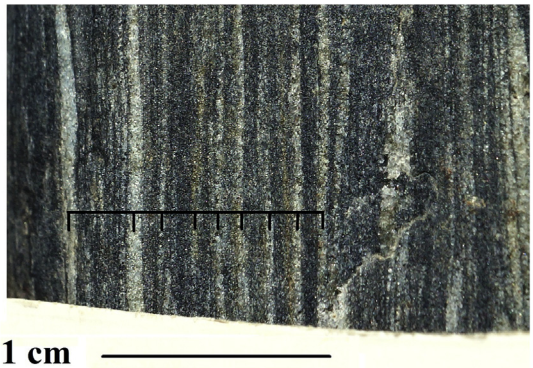

Fig. 5. Frequency of laminae per centimetre and average distance between laminae.

quartz phyllite was exceptionally fine grained, but igneous material exhibited some variation (Fig. 7).

The average grain size of an individual artefact was determined by using a Macroscope M25, which could easily measure up to 0.01 mm. The gravels contain at least two different types of igneous material (trachyte and alkali feldspar granite). The majority of these rocks are fine grained, but coarser varieties are available, and these generally have a fine grained matrix with larger crystals embedded in the matrix (phenocrysts), such as in Fig. 7 A. Thus the matrix grain size was recorded for each artefact as well as the average size for the coarser crystals in rocks where they were present.

2.3.5. Shape

The creation of LCTs is made easier by the utilisation of certain initial blank shapes. For example, it is obvious that a large flake blank or an amygdaloid cobble would be easier to turn into a handaxe than a thick cube like block of rock. The LCTs from DRR are perfect for determining the selection of blank shapes as much of the original shape remains. Shapes were quantified by being placed into one of the eight categories by visual reference to the shape types in Fig. 8. To determine if there was selection of certain shapes for the DRR LCTs, their shapes were compared to the frequencies of the different shapes obtainable in the gravels.

3. Results

3.1. Impurity encounter rate (IER)

For both quartz phyllite and igneous material the IER was higher in the experimental sample than in the artefact sample (Table 3). However the IER for the archaeological LCTs made from quartz phyllite were on average exceptionally high at 62.5%. This indicates that this particular material contains many characteristics that inhibit or restrict the knapping process. Artefacts made from igneous materials exhibited a much lower IER on average, indicating that this is a good material for making LCTs. In addition, no artefacts from terrace three were made from quartzite, which had the lowest IER of all the materials experimentally knapped.

The most abundant material in the gravels is quartz phyllite, followed by quartzite and igneous material (Table 1). However, the artefact assemblage sampled had no quartzite present and consisted mainly of quartz phyllite pieces (75%) and igneous material (25%). Quartzite was occasionally used as is evident from LCTs from terrace one and two, but more quartzite should occur if materials were randomly selected for the creation of LCTs. This indicates that the Middle-Pleistocene people predominantly selected quartz phyllite, as the abundance in the archaeological sample is much greater than its occurrence in the gravels (Table 1).

However, quartz phyllite has the highest IER of all the available material and is thus of the worst quality for knapping. It is obvious that the people selected this material for other reasons, as it makes little sense to purposely select for the most flawed material available. Interestingly though the average IER of the sampled archaeological LCTs is lower than the experimental sample of a random selection of quartz phyllite pieces. A Student's T Test confirms that the two samples are significantly different, with a P value of 0.046. This indicates that the people did select quartz phyllite pieces that were on average less flawed than what was randomly available.

3.2. Weathering

The experimental sample indicated that quartz phyllite gravels tend to be rather resistant to weathering with 95% of the sample being fresh (Table 4). This is followed by quartz with 71.4% fresh pieces, then igneous rocks (60%) and quartzite (57.1%). All the artefacts made from quartz phyllite were fresh, even after deposition;

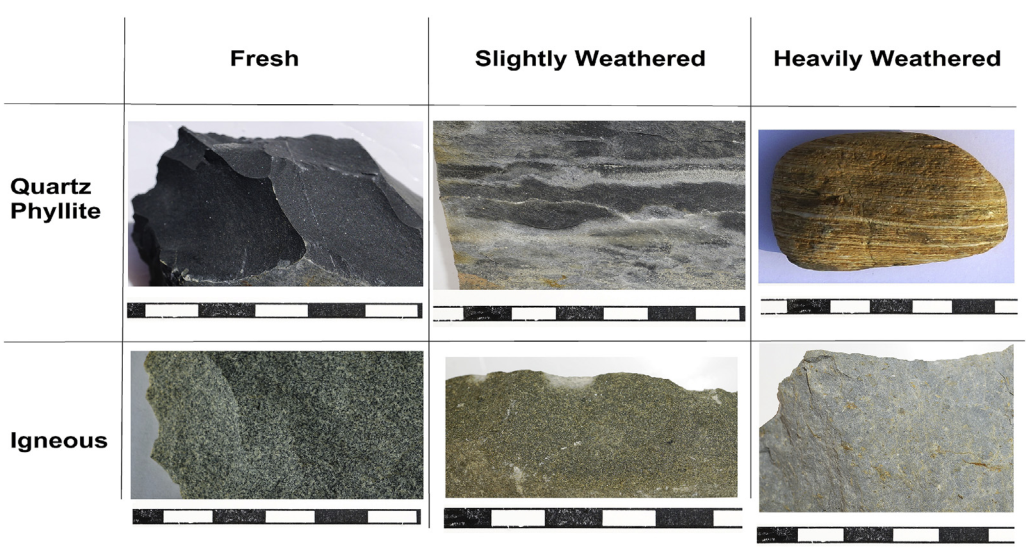

Fig. 6. Weathering states of quartz phyllite and igneous material.

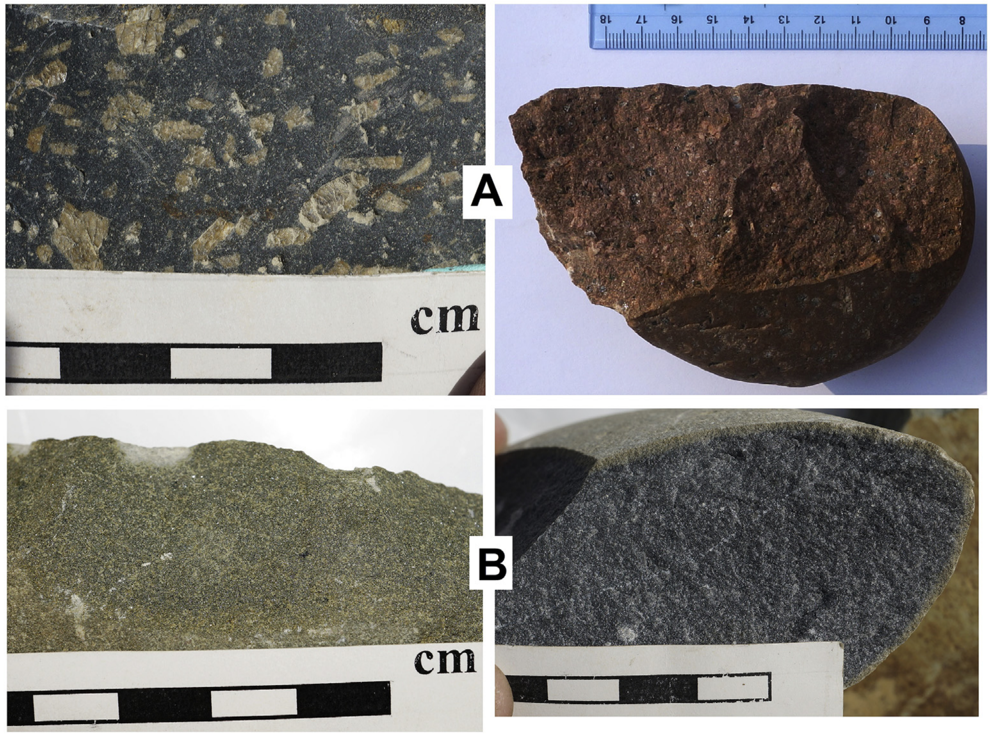

Fig. 7. Various grain sizes of igneous material. A: coarse varieties; B: fine-grained varieties.

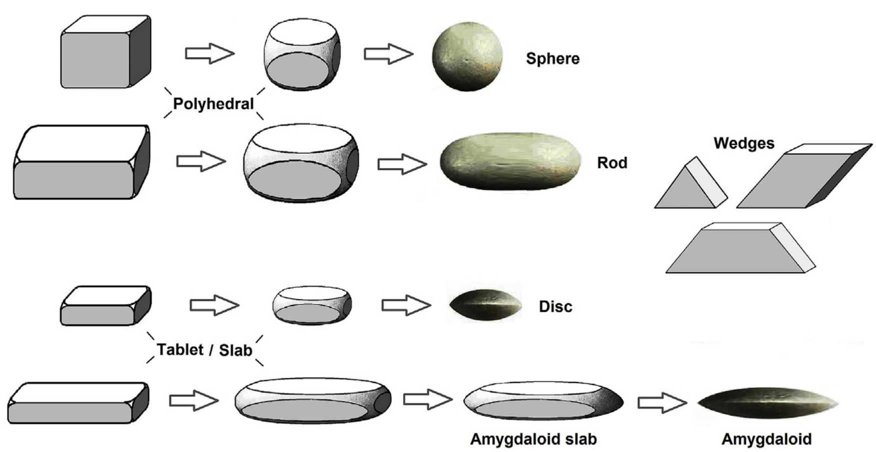

Fig. 8. Shape categories for cobbles and artefacts. Polyhedral shapes were generally cube like but could have more than six faces and had angles approaching 90° or greater than 90°. In addition the height of each side would have to be greater than 5 cm, whereas with tablet/slab shapes the height was less than 5 cm. This was determined to be a reasonable height for knapping to attain invasive flakes that could thin the tool.

Table 3
Impurity encounter rates of artefacts and experimental tools.

Artefacts	Sample size	IER	Experimental	Sample size	IER
Quartz phyllite	50	62.5	Quartz phyllite	20	74.8
Igneous material	17	13.6	Igneous	15	26.6
			Quartzite	14	16.4
			Quartz	7	34.2
			Chert	5	65.8

however of the 17 LCTs made from igneous material analysed, only 10 could be undoubtedly classified as fresh. The remaining seven had slight weathering on the surface of the tools, but it was not possible to determine if the weathering was already present before knapping or due to post depositional processes. Two of the LCTs in a fresh condition had slight weathering on the surface of the tool but had some of the underlying surface exposed due to modern damage. The interior was exceptionally fresh, with only a thin layer of surface weathering, which was likely post depositional. This could indicate that some of the pieces classified as slightly weathered may have been fresh when knapped.

3.3. Laminae

The laminae in the experimental sample were encountered on average more frequently and were closer together (Table 5). The archaeological sample included five tools that had no laminae present or only one on the entire tool. These are exceptionally rare

Table 4
Weathering states of the artefacts and experimental LCTs. F: fresh, S: slight, C: Complete.

Artefacts	Sample size	F	S	C	Experimental	Sample size	F	S	C
Quartz phyllite	50	100	0	0	Quartz phyllite	20	95.0	5.0	0.0
Igneous material	17	58.8	41.2	0	Igneous	15	60.0	40.0	0.0
					Quartzite	14	57.1	42.9	0.0
					Quartz	7	71.4	28.6	0.0
					Chert	5	20.0	80.0	0.0

Table 5
Number of lamina per centimetre squared and average distance between lamina on artefacts and experimental LCTs.

	No. Lamina per 1 cm	Average distance between visible lamina, mm
Artefacts	2.4	10.3
Experimental	3.2	5.3

and require extensive searching to locate as only one was sampled for the experimental LCTs and was purposely sought out to represent the best quality of this material in the experimental sample. Student's T Tests indicate a significant difference between the experimental and archaeological samples, with P values of 0.06 for number of lamina per centimetre, and $p = 0.03$ for the average distance between laminae. This further indicates that prehistoric people carefully selected the best quality cobbles of quartz phyllite available.

3.4. *Grain size*

The majority of igneous material available in the gravels was fine grained trachyte. Thus random selection of igneous material would still yield mostly fine grained rocks. This is evident from the experimental sample where the average grain size of the matrix was 0.054 mm (Table 6). The average grain size of the matrix for the archaeological sample was a little lower with 0.047 mm. This was due to two samples being very fine grained (0.025 mm). Only four artefacts had phenocrysts present, with the average size being 3.1 mm. The experimental sample had five specimens with phenocrysts present and an average of 3.2 mm (Table 6). Student's T Tests indicated that there was little statistical difference between the two samples, and thus igneous raw material selection was not primarily based on grain size.

3.5. *Shape*

The majority of artefacts was made on amygdaloidal, rod and tablet shapes (Table 7). However, the shapes most prominent in the gravels were polyhedral or wedge-like (Table 8). Amygdaloidal cobbles made up 16.3% of the sampled gravels, tablets 10.6% and rods only 7.1%. None of the LCTs was made from a polyhedral shape and only one artefact was wedge-shaped and thus 1.5% of the sample. If cobbles were randomly selected, the artefact sample would show many more pieces made from polyhedral and wedge shaped gravels. There was a clear preference for certain shapes. The experimental knapping revealed that amygdaloidal gravels were most efficient for the creation of LCTs, followed closely by disc and tablet forms. Disc shaped cobbles, however, created LCTs that were much shorter and wider than their amygdaloidal counterparts. In addition, rod shapes were best used for quartz phyllite as the cobbles split fairly easily, but this shape proved difficult to split with igneous material. This is reflected to some degree in the results as most LCTs made from quartz phyllite were made from amygdaloidal and rod shapes, whereas LCTs in igneous material were largely made from amygdaloidal shapes.

Table 6
Grain sizes of matrix and phenocrysts of igneous material.

	Matrix grains size mm	Phenocryst grain size mm
Artefacts	0.047	3.1
Experimental	0.054	3.2

Table 7
Frequency of blank shapes used to make artefacts.

Artefact Shape	All	Quartz phyllite	Igneous
Ovoid	26.9%	24.0%	35.3%
Rod	22.4%	24.0%	17.6%
Tablet	19.4%	20.0%	17.6%
Ovoid tablet	13.4%	12.0%	17.6%
Total	**82.1%**	**80.0%**	**88.1%**

Table 8
Frequencies of cobble shapes naturally found in the gravels.

Gravels	All material	Quartz phyllite	Igneous
Polyhedral	20.6%	33.3%	5.9%
Wedge	19.1%	12.3%	35.3%
Ovoid	16.3%	15.8%	14.7%
Disc	14.9%	5.3%	23.5%
Tablet	10.6%	15.8%	11.8%
Rod	7.1%	8.8%	2.9%

4. Discussion and conclusion

Hominids of DRR practiced the selection of two types of rock for LCT production: quartz phyllite and igneous material, with a predominant preference for quartz phyllite. However, this material exhibited the highest impurity encounter rates of all available materials due to its foliated structure. The least flawed material available in the gravels was quartzite, but it was rarely selected because the cobbles took more effort to flake. Despite the selection of quartz phyllite, the IERs of the archaeological artefacts were still lower on average than the quartz phyllite cobbles selected at random, which is evident from the experimental sample. This indicates that hominids did occasionally select for the better quality quartz phyllite. This is confirmed for the archaeological LCTs by the number of laminae per centimetre and the average distance between laminae, which was less and further apart compared with the experimental sample.

The materials most resistant to weathering were quartz phyllite and quartz, followed by igneous material. Knapping experiments indicated that quartz, however, proved very difficult to knap into LCTs, as large enough cobbles often crumbled unpredictably into smaller pieces, making the shaping process next to impossible. The experiments confirmed that weathered materials did not knap as predictably as their fresh counterparts and did not have very durable edges. This could explain the predominant selection of quartz phyllite and igneous material over quartzite, as many quartzite cobbles were prone to weathering, especially the thinner cobbles with rounded edges, which were the ideal shapes for the creation of LCTs. Both quartzite and igneous materials took more effort to knap than quartz phyllite, especially in the initial shaping process. However, it was easier to acquire thinner cobbles of igneous material that were fresh as opposed to finding quartzite cobbles that were thin and unweathered.

There was a definite selection for specific cobble shapes, with the most common shapes being amygdaloidal, rod, tablet and amygdaloidal tablets, whereas a substantial amount of the available nodules were polyhedral and wedge-shaped. This is to be expected for the creation of LCTs as their shaping and functionality depend on their form. Experimental knapping of the different available shapes in the gravels indicated that the shapes selected by the hominids were in fact the best shapes to achieve the creation of functional LCTs.

There was no statistical evidence to suggest specific selection for grain size when archaeological LCTs in igneous rocks were compared to randomly selected igneous material in the gravels. However, granite varieties were avoided (but they are rare in the gravels) and trachyte was preferred.

It is evident from the results that most selection took place for the raw material type, shape and weathering state of particular materials. Possible reasons are given below:

- The blank shape for the creation of an LCT is exceptionally important, as these shapes form the blueprint for functional LCT forms. The shapes selected were generally elongated and thin (rod being the exception), as visible in the LCTs, and have ideal starting platforms allowing for invasive flaking.
- Rods were selected because they can be easily split (mainly for quartz phyllite) in half along the longitudinal axis, thus creating two blanks that can be turned into LCTs. These halves then have good starting platforms for shaping a working edge and the correct shape for a functional LCT.
- Selection for fresh material was also important as weathered material is more difficult to shape, but also because working edges were less durable and more likely to crumble under heavy duty work. The predominant selection of quartz phyllite thus makes sense, as this was the most resistant to weathering.
- The raw material types selected depended on a combination of different characteristics. Even though the best quality materials, with regard to the amount of impurities present, were quartzite, igneous material and quartz rock, the raw material with the highest amount of impurities was selected more often (quartz phyllite). This was because, despite these impurities, the material had some advantages over the others. As mentioned above, it is more resistant to weathering, which is due to the presence of microscopic quartz crystals. This also makes the material fairly hard and durable, as well as allowing for easy flaking, owing to the nature of quartz fracturing conchoidally. In addition, the nature of the flaws was such that, if the cobbles were knapped strategically, it aided the shaping of LCTs. The foliations being orientated parallel to each other allowed for the splitting of large pieces of this rock and the removal of exceptionally large flakes with less effort and not much percussive force. This was confirmed with the experimental knapping, which proved that knapping and shaping the same size cobbles of quartzite and igneous material needed very large amounts of force to dislodge large and invasive flakes for the initial shaping of the LCT, which likely only the stronger individuals would have been able to accomplish. Furthermore, the experiments also revealed that quartz phyllite could produce edges that are quite sharp and thus exceptional for cutting or getting into places where thick edges would restrict the tool. It was also evident that shaping the finer detail of an edge was rather easy on this material.

The question remains, though, why are the LCTs from this time period not as "refined" as their African counterparts? To answer this question, more refined LCTs were created from the various materials available to see if they would allow for the creation of such tools. It was indeed possible to create more "advanced" LCTs from quartzite, igneous material and quartz phyllite, as can be seen in Fig. 9.

A few likely reasons why tools from DRR are not as extensively shaped are listed below:

Fig. 9. Experimentally created refined LCTs.

- Extensively shaped LCTs would have a much larger edge area for use and could have a longer lifespan as a tool. It seems that raw material was abundant and perhaps the hominids of the DRR had no need for tools that required a long use-duration and thus there was no need to expend energy to extensively shape LCTs (Li et al., 2015).
- The LCTs of the region may also have been made for specific or more expedient uses, as the DRR LCTs exhibit more concentration on secondary shaping of a working edge rather than primary shaping of the tool (Li et al., 2014).
- It is important to note that although there is an abundance of gravels available, there are few outcrops of bedrock in the area. This means it would have been difficult to find outcrops where large flake blanks could have been dislodged for making LCTs. Hominids occupying the area were thus restricted to the use of cobbles, which can be shaped into more "refined' tools but are often much thicker and require more effort to extensively shape and refine.

Hominids occupying the DRR certainly exhibited selective behaviours for the raw materials they used to make LCTs. This study revealed that much thought and strategy went into the selection and creation processes to meet their needs. Hominids in the region did not have a wide variety of materials from which to select (such as high quality flint, obsidian and chert), but they adapted to what they had and optimally utilised the materials available to suit their needs.

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CHAPTER FIVE: STUDY THREE

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Experimental flaking in the Danjiangkou Reservoir Region (central China): A rare case of bipolar blanks in the Acheulean

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ABSTRACT

The exploration of techniques used to produce large flakes has long been a focus in Acheulean studies, especially from an experimental perspective. In this study we develop an experimental methodology to analyze Acheulean materials from the Danjiangkou Reservoir Region (DRR) in central China. The results show that large flakes experimentally produced with the bipolar technique can be easily distinguished from flakes produced by the other techniques due to the compression fracture unique to this method of flaking. These bipolar flakes show features consistent with those observed on a portion of the DRR archaeological handaxes. We suggest that the internal flaws and foliated structure found in quartz phyllite can actually assist in splitting cobbles, and consequently, they make bipolar flaking easier and effective. The anvil and throwing techniques have the next most successful ratio in detaching large flakes. The freehand technique is the least successful. Overall, the experimental study reported in this paper clearly demonstrates that raw materials influence the choice of flaking techniques, and the bipolar technique is a unique characteristic of the DRR Acheulean.

1. Introduction

The ability to detach large flakes (maximal size generally ≥10 cm) is widely accepted as distinguishing the Acheulean technocomplex from the earlier Oldowan technocomplex (e.g., Isaac, 1969; Semaw et al., 2009; Beyene et al., 2013). As a result, the exploration of technologies used to produce large flakes has long been a focus in Acheulean studies, especially from an experimental perspective, which can provide direct evidence to reconstruct the flaking strategies (Jansen, 1926; Goodwin, 1929, 1934; Corvinus, 1983; Schick and Toth, 1993; Texier and Roche, 1995; Toth, 2001; Madsen and Goren-Inbar, 2004; Sharon, 2007; Shipton et al., 2009; Mourre and Colonge, 2009–10).

Early experimental studies mainly focused on the physical actions involved in the techniques used to produce large flakes (see Inizan et al., 1999 [p.30]). The Chinese Palaeolithic specialist Pei Wenzhong (also known as W.C. Pei among western scholars) was a pioneer in this work. He systematically undertook experiments by using three techniques, namely, freehand, bipolar and anvil (also known as the block-on-block technique, or the anvil-chipping technique; Pei, 1936). After comparing experimental flakes produced with each technique, he summarized three characteristics for anvil products—namely, large platform size and angles (interior angles from 90° up to 170°), large bulbar scars, and strong force waves on the ventral face; and further argued that these features can be used to distinguish flakes produced by freehand versus anvil techniques (Pei, 1936; Pei and Jia, 1958). Based on Pei's work, Breuil and Lantier (1965) redefined the anvil technique and confirmed the results achieved by Pei. Importantly, they claimed that the anvil technique is more suitable and effective than freehand percussion for producing large sized flakes. They further thought that this technique was widely used in the European Clactonian and Abbevillian cultures, due to the large flake tools found at these two sites.

However, different opinions have arisen since François Bordes' (1968) replication experiments using anvil and freehand techniques. He concluded that the same features can be produced by either technique. Bordes' experimental study has been influential, and debate is ongoing on how to distinguish large flakes produced by different techniques accurately, or if it is even possible to do so (Wang, 1989; Schick and Toth, 1993; Shen and Wang, 2000; Clark and Kleindienst, 2001; Wang, 2004; Yang et al., 2016). Regardless of opinions held, we demonstrate that experimental study is a method essential to understanding the technological choices of Acheulean hominids.

Another aspect of experimental studies that attracts great interest is the concept of technological organization for the working of cores prior to the detachment of large flakes (i.e., the knapping methods as defined by Inizan et al., 1999). Currently, various flaking strategies are identified, with the term "Acheulean giant core technology" adopted to encompass all known strategies (Sharon, 2007). A well-known example is the

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experimental study of reduction methods in Gesher Benot Ya'aqov (GBY). The bifacial core method and the sliced slab method were identified through experimental reconstructions of core reduction, and clearly, different methods are flexible adaptations to the specific qualities and shapes of available raw materials in this region (Madsen and Goren-Inbar, 2004; Sharon, 2007). This example demonstrates well that experimental study is a key means for reconstructing the reduction strategies of giant cores in the Acheulean.

1.1. Large flake production in the Danjiangkou Reservoir Region (DRR)

Danjiangkou Reservoir Region (DRR) is a handaxe-bearing region in central China and is currently studied by the authors (Kuman et al., 2014; Li et al., 2014a, 2014b, 2014c). Handaxes are buried in the fine clay deposits of the third terraces of the Han River, which flows through and feeds the DRR (Fig. 1). Palaeomagnetic and ESR dating have placed the third terrace deposits to the earlier half of the Middle Pleistocene (Li et al., 2014c). To date, 105 handaxes are both surface-collected and excavated from 22 sites in DRR. Fig. 1 shows all the palaeolithic sites (with and without handaxes) currently discovered in DRR. According to Sharon's (2007) definition, the raw materials used in DRR were giant (>30 cm) to medium (from 10 to 30 cm) sized clasts collected from the nearby gravel layers of the Han River (Fig. 2). Random sampling to determine the proportions of different raw materials in DRR shows that 39.1% (N = 34/87) is quartz phyllite (see Fig. 2:b). In our archaeological samples, quartz phyllite is the predominant raw material used for DRR handaxes, with a proportion of 73.3% (N = 77/105). It is a metamorphic rock that belongs to the schist family. Thus, the foliated structure is very developed in most of these rocks (see Kuman et al., 2014 for a detailed description of this raw material).

In a detailed study of handaxes retrieved from recent investigations in this region, Li et al. (2014b) show that large flake blanks, which comprised 47.6% of the handaxe collection, were systematically used to make handaxes, along with cobbles and split cobbles as the other types of blank. Our analysis also shows that most of the handaxes were actually made on primary flakes, or cobble opening flakes. Specifically, nine out of 10 of those for which the striking platform can be identified have a cortical platform, and only one has a plain platform. The preservation of cortex on the dorsal face averages 23%, with some examples having up to 80% (Li et al., 2014b). This evidence shows that the cobble opening method was the main strategy chosen in the DRR for detaching large flakes. Fig. 3 presents archaeological examples of cobble opening flakes and handaxes made on these blanks. As commented by Sharon (2007), the cobble opening method for producing large flakes is less complicated than other well organized technologies. However, this does not mean it is not sophisticated; attention was paid to raw material size and shape, and to the systematic removal of a single, pre-planned primary flake (Sharon, 2007). Elsewhere, we also concluded that this method required an intentional selection of the original shape and size of the clasts to be used (Li et al., 2014b). Because the cobble opening method was used in producing large flakes, our research in this paper focuses on which physical actions or flaking techniques were used to detach large flakes from cobbles in the initial stage of reduction, and on the efficiency of different techniques in a comparative context.

We have also observed that large bipolar flakes were notably used as blanks to make handaxes in the DRR (Kuman et al., 2014; Li et al., 2014a, 2014b, 2014c). Among the 77 handaxes made of quartz phyllite, 46.8% (N = 36) were made on flakes, including 15.6% (N = 12) that were clearly made on bipolar flakes (see Supplemental Online Material [SOM] Table S1 for raw data). Although the proportion of the bipolar flakes is not high, this is a significant component in the DRR large flake production system. Large bipolar flakes are seldom reported from other Acheulean regions as blanks for handaxes. Therefore, if this conclusion can be further confirmed from an experimental perspective, it will contribute to our understanding of the technological flexibility and diversity during the Acheulean stage.

The experimental flaking in this study is goal-directed. We set out to address two questions: 1) to confirm the existence of bipolar technique in DRR large flake production; and 2) to compare the efficiency of four flaking techniques (freehand, bipolar, anvil and throwing) for quartz phyllite and determine which techniques were probably more frequently used by hominids. Both questions are closely related to the understanding of how the DRR hominids adapted their technology to the local raw materials.

2. Materials and methods

Both experimental and archaeological materials (see references above) were used in this study. For experimental materials, 80 flake production experiments were conducted (see SOM Table S2 for raw data). The experimental protocol included the initial stage of raw material procurement, with cobbles mainly collected in the region. Fig. 2 shows gravels that we accessed, which were exposed during the construction of roads, bridges or other facilities. Because of the predominance (73.3%) of quartz phyllite handaxes in the DRR, we focused on investigating the influence of quartz phyllite on the flaking techniques used in the replications. In selecting raw materials, flat and oval gravels were preferred, while those with a spheroidal shape were used less due to the lack of suitable angles for striking platforms. Both giant and

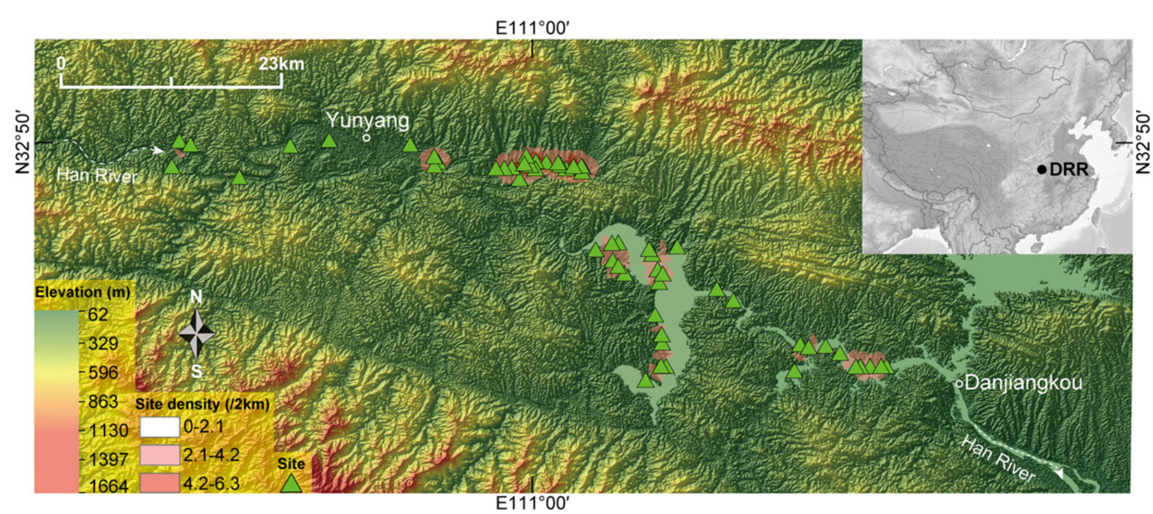

Fig. 1. Location of the Danjiangkou Reservoir Region (DRR) and distribution of the Palaeolithic sites in this area.

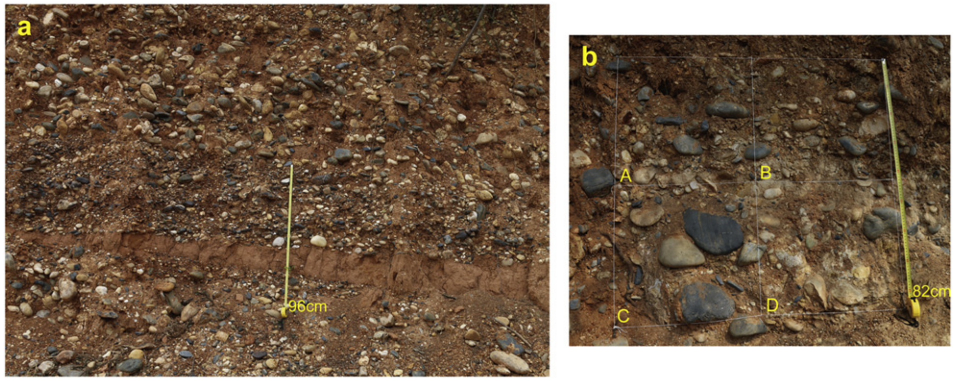

Fig. 2. Raw materials exposed in gravel layers along the Han River. "a" shows an exposed gravel layer in profile; "b" shows how the proportions of raw materials were calculated in this study. The proportion of quartz phyllite in quarter-square "A" is 46.7% (N = 14/30), quarter-square "B" is 36.4% (N = 8/22), quarter-square "C" is 20% (N = 4/20), quarter-square "D" is 53.3% (N = 8/15). The total proportion of quartz phyllite is 39.1% (N = 34/87).

medium sized clasts were collected. Prior experience guided us in selecting the most appropriate raw material sizes for each technique. For example, larger clasts were used for the anvil technique than for bipolar, with size differences being statistically significant ($p < 0.001$; see Table 1 and SOM Table S2). The most appropriate stone hammers and anvils were also selected according to technique (see Fig. 4 for examples).

Three knappers, H.L, C.L and N.S engaged in the experiments, all of whom have good experience in knapping and in the study of Acheulean materials and have a deep understanding of the different techniques used in our replications. To avoid individual variation, however, H.L was the main knapper who has conducted more than half of experiments for each flaking technique. Knappers corresponding to each group of experimental products are documented in SOM Table S1. Four techniques, namely, the bipolar, freehand, anvil and throwing techniques, were employed to detach cobble opening flakes in an initial stage of the reduction process. Twenty experimental flake production attempts were conducted with each of the four techniques (see SOM Table S2 for raw data), and each sample was struck until a flake detached, regardless of whether it was useful or not. Such a design fits the nature of cobble opening flake blanks observed on the archaeological samples (Li et al., 2014b). Occasionally repeated flaking failed to produce a flake or other product and was classed as failed along with the unusable products. Fig. 5 shows the knapping motion for each technique. For the bipolar technique, two persons were involved in the knapping process. One person holds the core on a stable anvil, while the other uses a large hammer to strike the core longitudinally from the top. Freehand percussion consists of putting a core on one leg and holding it firmly with one hand, while striking the core with a hammer held in the other hand. The other two techniques, anvil and throwing, are distinguished as follows. In the anvil technique the core is held continuously in the hands and struck repeatedly against a stationary anvil

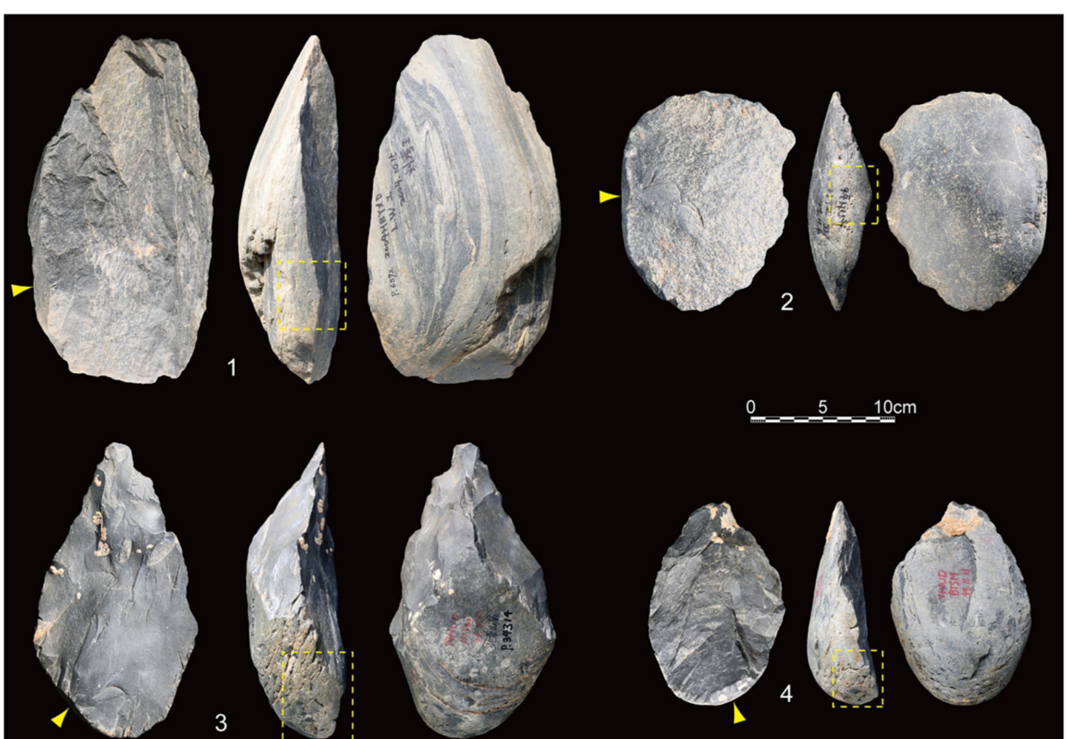

Fig. 3. Archaeological examples of cobble opening flakes (1 and 2) and handaxes made on these blanks (3 and 4). Yellow triangles show the striking direction, and yellow rectangles show the cortical striking platform. Numbers 1 and 2 show side-struck flake blanks, and numbers 3 and 4 show a corner-struck and an end-struck flake blank respectively.

Table 1
Comparisons of weight and size of raw materials between each two flaking techniques. See SOM Table S2 for raw data.

Weight			Length		Width		Thickness	
	Mann-Whitney U	*p*-Value	Mann-Whitney U	*p*-Value	Mann-Whitney U	*p*-Value	Mann-Whitney U	*p*-Value
Bipolar vs. freehand	195	0.899	157.5	0.256	121	<0.05	182.5	0.644
Bipolar vs. anvil	42	<0.001	73.5	<0.001	7.5	<0.001	63	<0.001
Bipolar vs. throwing	100	<0.05	175.5	0.516	93.5	<0.05	115	<0.05
Freehand vs. anvil	53	<0.001	72	<0.001	94	<0.05	43	<0.001
Freehand vs. throwing	121	<0.05	136.5	0.087	190.5	0.805	104.5	<0.05
Anvil vs. throwing	94	<0.05	113	<0.05	87	<0.05	163	0.324

on the floor—also known as passive hammer technique (Harmand et al., 2015). In the throwing technique, the core is thrown out of the hands towards an anvil on the floor.

The technological and morphological attributes used in this study are presented in Table 2. For large flakes suitable to use as a blank, the technological attributes consist of the type of platform, the presence or absence of the bulb of percussion, and the direction of blow in relation to the long axis of the piece are all recorded (see Fig. 3 for different types of the direction of blow). For morphological attributes, the original weight, length, width and thickness of raw materials are first documented. The same observations are then applied to the detached flakes, regardless of their usefulness or not for making handaxes.

Previous studies of fracture properties for different techniques have revealed that bipolar flaking produces a compression fracture, where force has been applied to both ends of a core, and therefore negative scars or fractures can often (but not always) be observed on both ends of the detached flakes, and a prominent bulb of percussion is absent or diffuse when identified (Lowe, 1946; Cotterell and Kamminga, 1987, 1990; Odell, 2004; Diez-Martín et al., 2011; Gurtov and Eren, 2014; de la Peña, 2015; see Fig. 6 for examples). In contrast, all other techniques in this study (namely, the freehand, anvil and throwing techniques) result in a hertzian fracture, characterized by a prominent bulb of percussion on the ventral face of a flake (see Fig. 5 for illustrations of fracture pattern). Therefore, bipolar flakes are readily distinguished from flakes made by all other techniques used in this study. To document the bipolar technique, experimental flakes produced by this technique were compared with archaeological specimens.

Because it is more difficult to distinguish flakes made by the freehand, anvil and throwing techniques from one another due to the same resulting fracture type, we suggest that it is meaningful to compare the efficiency of each technique in detaching large flakes, as such practical data can suggest the frequency of each in archaeological samples. Here, we use the ratio of successful flaking to indicate efficiency of the technique. For calculating this ratio, we use the number of usable large flakes produced, divided by the number of detached flakes. In particular, we define usable large flakes as those where maximum length is ≥10 cm, maximum width is larger than 5 cm, and maximum thickness is >2 cm. This criterion is derived from the archaeological handaxes made on large flakes, which have an average length of 15.7 cm and only one specimen is <10 cm (see SOM Table S1 for raw data). Our experiments also suggest that these criteria include the smallest sized flakes that can be used to make handaxes.

For the quantitative comparison with archaeological specimens, 105 handaxes were available, but to correspond with the experimental

Fig. 4. Hammers and anvil used for percussion. At right is a giant stone used for both anvil and throwing techniques. The yellow circle shows traces of anvil flaking, while red circles show traces of throwing.

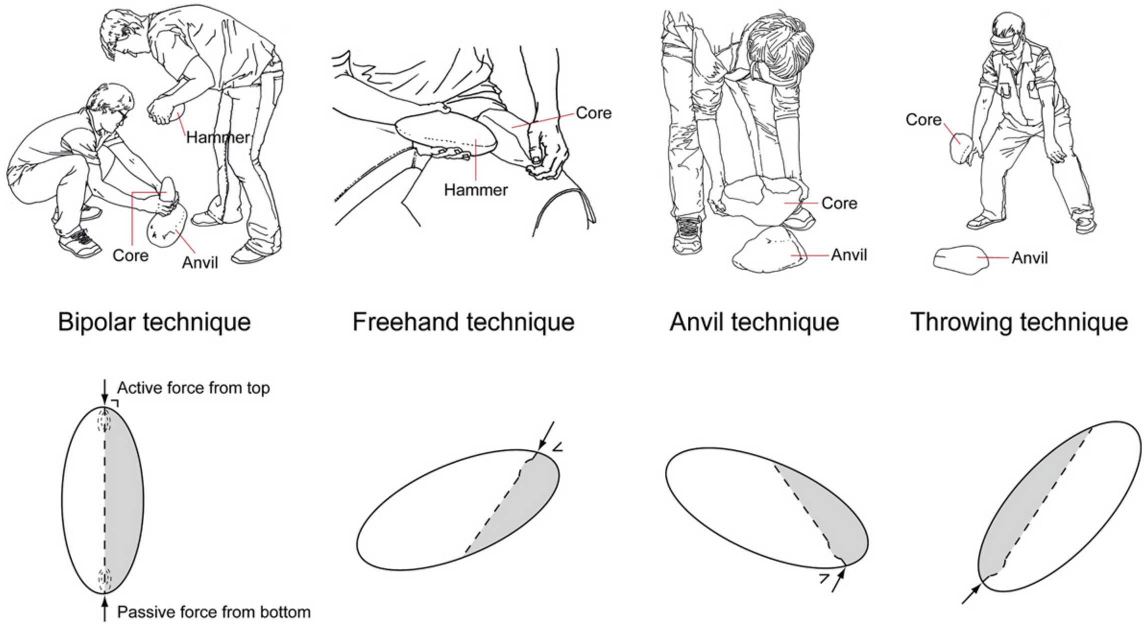

Fig. 5. Techniques used in the experimental replications.

design, only those made on large flake blanks (including bipolar flakes) of quartz phyllite were used for this study (N = 36/105; see SOM Table S1 for raw data).

3. Results

The experimental data for each technique will not be shown separately, but incorporated in the subsections below to avoid repetition.

3.1. Comparison of ratios for successful detaching of large flakes

Table 3 shows that the bipolar technique has a success ratio of 17:20 flakes (or 85%), and therefore it is the most successful flaking method for quartz phyllite. In contrast, freehand percussion produces the least successful ratio (7:20, or 35%). Anvil (12:20, or 60%) and throwing (11:20, or 55%) techniques have similar proportions, both >50%, and they fall in the middle range of ratios.

A detailed record of the types of failed products in Table 2 shows that the low successful ratio for freehand percussion is mainly due to the small size of products (N = 8; see SOM Table S1 for raw data). This is probably related to the striking action of freehand percussion, where hand-held hammerstones are limited in size and thus do not release sufficient force for this raw material. On the other hand, failed products from the anvil and throwing techniques mainly consist of chunks (N = 10) and split flakes (N = 4). These are probably the result of unintentional breaks along the internal flaws of quartz phyllite (see Fig. 6 for flaws typical of this raw material). In addition, the relatively less accurately control of the desired point of percussion in the anvil and throwing techniques may be another reason for the failed products.

3.2. Technological characteristics of experimental large flakes and comparison with handaxes made on large flake blanks

According to the technological attributes listed in Table 2, only usable large flakes are used for analysis. Our observation first shows that almost all experimental flakes possess a cortical platform, with only one exception, a plain platform flake produced by the anvil technique (Table 4). This is because of flaking failed in the very initial stage and created a plain striking platform for the next detachment. This pattern shown in the platform is generally consistent with the archaeological materials, which also have a high proportion of handaxes made on large cobble opening flakes with cortical platforms (86.7% in Li et al., 2014b). Fig. 3 shows good examples of this kind of handaxe.

For the bulb of percussion, all bipolar flakes show an absence of this attribute (Fig. 6). This contrasts with flakes produced by the anvil technique, which possess a relatively greater number of clear bulbs of percussion (N = 8, 66.7%). Flakes produced by freehand percussion show an intermediate number of clear bulbs (N = 2, 28.6%), and those produced by the throwing technique show an even lower proportion (N = 1, 9.1%; Table 4). Flakes produced by the bipolar technique belong to the compression fracture type and show negative scars or fractures on both ends of flakes and cores in these experiments. The results of our experimental flaking of quartz phyllite fit this principle well, and importantly, further confirm the use of the bipolar technique in the DRR Acheulean samples. Fig. 6 shows the comparison of experimental bipolar products with the archaeological handaxes made on bipolar flakes. They all show features described in bipolar flaking. The other three techniques used in this study belong to the hertzian fracture type, which is characterized by a clear bulb of percussion on the ventral faces of flakes (Fig. 7). Although the proportion of samples with and without a bulb of percussion varies for each technique, we suggest

Table 2
Technological and morphological attributes documented in this study. Weight is in grams; length, width and thickness are in mm.

	Weight	Length	Width	Thickness	Platform type	Bulb of percussion	Direction of blow
Hammerstone	X						
Raw material before reduction	X	X	X	X			
Detached flake	X	X	X	X	X	X	X

Fig. 6. Examples of bipolar-flaked products (see SOM Table S2 for corresponding numbers). Numbers 6, 7, 8, 9 and 15 show experimental examples of bipolar flaking. In the lower right are examples of DRR handaxes made on bipolar flakes.

this is mainly influenced by the quality of the individual raw materials and the specific motions of each technique in flaking, which we will discuss in detail in the last section. For example, a majority of the freehand experimental flakes lack a bulb of percussion in quartz phyllite.

Regarding the direction of blow, i.e., the position of the bulb in relation to the long axis of flakes, only flakes with a clear bulb of percussion are recorded in Table 4. Results show that for 11 such flakes (two from freehand, eight from anvil and one from throwing), no preferential blow direction can be observed. Four of the 11 are end-struck flakes, two are corner-struck and five are side-struck. The differences in number are likely caused by sample bias. This is consistent with the archaeological materials, in which different types of blow direction can be identified (Kuman et al., 2014; Li et al., 2014b) (see Fig. 3 and SOM Table S1). Fig. 7 shows examples of experimental flakes with different types of blow direction.

3.3. Morphological comparison of experimental large flakes with handaxes made on large flakes

In total, 47 experimental large flakes and 36 archaeological handaxes made on large flakes are used for comparison. Results are shown in boxplots in Fig. 8 and in Table 5. For weight, length and width, both bipolar and non-bipolar experimental flakes have significantly greater values than the corresponding archaeological handaxes (Table 5). This fits the inference that to make a handaxe, a large flake will be reduced to a smaller size and weight during the reduction process. In addition, although the original weight and size of raw materials for bipolar and non-bipolar techniques differ to varying degrees (Table 1), there are no statistically significant differences between bipolar and non-bipolar experimental flakes (except thickness), or between the archaeological handaxes made on bipolar and non-bipolar flakes (Table 5). This may indicate that at least for weight, length and width, the production of handaxes made on bipolar flakes involved a similar reduction process as for handaxes made on non-bipolar flakes.

The exception is the thickness for both bipolar and non-bipolar samples. First, in contrast to weight, length and width, the experimental bipolar flakes have significantly smaller thickness values ($p < 0.05$) than the handaxes made on bipolar flakes (see Fig. 8 and Table 5). We interpret this as a result of a preference for thick bipolar flakes in blank selection. Second, there is no significant difference ($p = 0.668$) in thickness between the experimental non-bipolar flakes and archaeological handaxes made on such flakes (Fig. 8 and Table 5). This is probably an indication that there was no intentional thinning during the reduction of the DRR handaxes.

4. Discussion and conclusions

Along with the discovery of new handaxe-bearing sites in China, the study of Acheulean technology is becoming an attractive topic in Chinese Palaeolithic archaeology (Hou et al., 2000; Wang, 2005; Yang et al., 2014; Kuman et al., 2014; Li et al., in press). To supplement the detailed study of excavated materials from the DRR sites, in this paper we have used knapping experiments to explore in depth the technology and associated human behaviour. As a result, the experimental materials in this study provide strong evidence to support our previously published observations on handaxe production technology. They also

Table 3
Flaking products and percentages of successful results for each technique. Raw data is provided in SOM Table S2.

Flaking technique	Number of experiments	Number of usable large flakes	Chunk	Split flake	Small sized flake	Failed flaking	Successful products
Bipolar	20	17	0	0	1	2	85%
Freehand	20	7	0	5	8	0	35%
Anvil	20	12	4	4	0	0	60%
Throwing	20	11	6	0	3	0	55%

Table 4
Technological attributes for the usable large flakes produced in the experiments, according to techniques. Raw data is shown in SOM Table S2.

Flaking technique	Number of flakes	Type of platform		Bulb of percussion		Direction of blow*		
		Cortical	Plain	Absent	Prominent	End-struck	Corner-struck	Side-struck
Bipolar	17	17	0	17	0	0	0	0
Freehand	7	7	0	5	2	0	0	2
Anvil	12	11	1	4	8	3	2	3
Throwing	11	11	0	10	1	1	0	0

Note: Direction of blow* only documents flakes with prominent bulb of percussion, due to the easily discernible nature on these flakes.

provide greater insight into the flexibility of behaviour by Acheulean hominids in DRR.

4.1. Experimental evidence to support the existence of the bipolar technique in the DRR

A basic distinction between the principles of fracture mechanics is applied to quartz phyllite and allows us to distinguish the bipolar technique from other techniques. As bipolar flaking produces a form of compression fracture, it is characterized by damage shown on both ends of a core by the highly diffused or absent bulb of percussion (Cotterell and Kamminga, 1987, 1990; Odell, 2004; Diez-Martín et al., 2011; Gurtov and Eren, 2014; de la Peña, 2015). The motion of the bipolar technique is shown in Fig. 4. The force received by the cores is from two (bipolar) directions, namely, the active striking force from the top produced by the hammer and the passive force from the bottom created by the stationary anvil. The other techniques (i.e., freehand, anvil and throwing) used in this study are characterized by the hertzian fracture, which in most materials produces a prominent bulb of percussion, but which is more variable in the case of quartz phyllite due to its foliated and often flawed structure. In our previous studies, we identified DRR handaxes made on bipolar flakes according to the features described for compression fractures. Here, our experimental samples using bipolar technique also show these consistent features (see Fig. 6 for examples). This provides further evidence that the bipolar technique was used in the DRR.

It is generally believed that bipolar flaking was widely used to reduce cores too small to hold in the hand and was mainly applied to quartz raw material which is easily shattered (e.g., the well-known Zhoukoudian Locality 1 in China; see Pei and Zhang, 1985). Reports of this technique used to produce Acheulean large flakes are quite rare, and there is no such documentation for it in the other well studied Acheulean regions in China (namely, Bose, Luonan and Dingcun—see Li et al., in press). The use of the bipolar technique in the DRR is closely related to the physical properties of quartz phyllite, which is the dominant raw material in the DRR. The foliated structure and often quite developed internal flaws or faults in quartz phyllite assist in splitting cobbles and make bipolar flaking much easier. The use of the bipolar

Fig. 7. Experimental examples of non-bipolar flaking (see SOM Table S2 for corresponding numbers). Numbers 43, 46 and 51 show large flakes detached with the anvil technique; number 75 shows a large flake produced with the throwing technique; numbers 31 and 40 show large flakes produced by freehand percussion. The yellow circles show the prominent bulb of percussion.

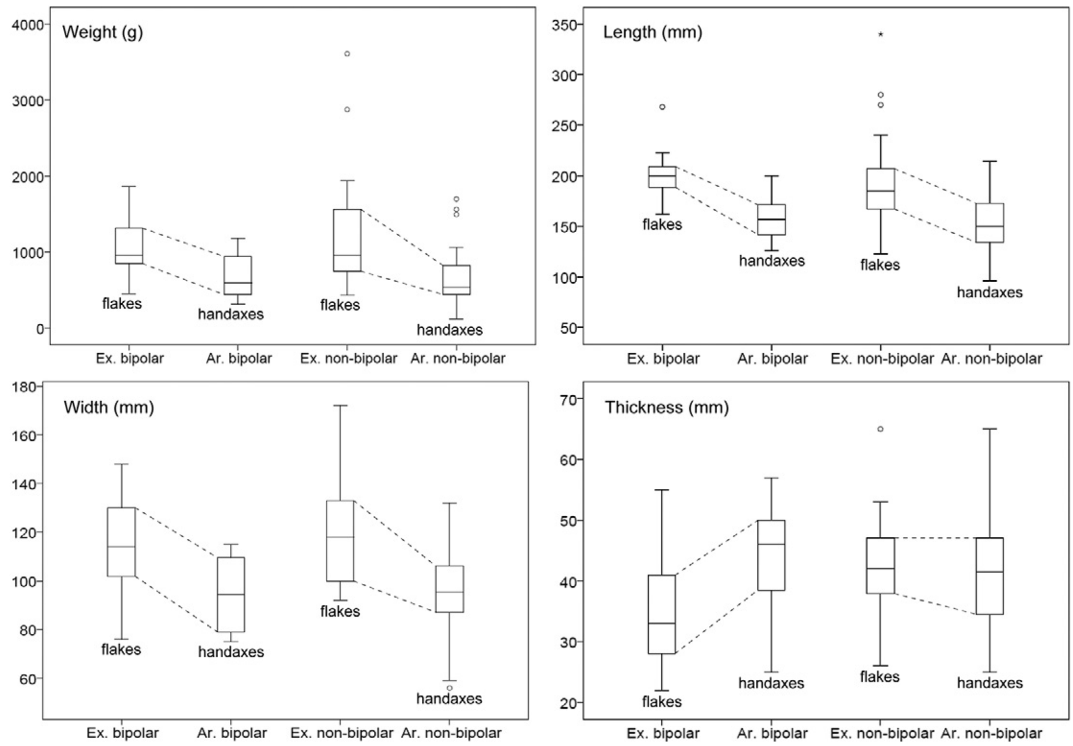

Fig. 8. Comparison of bipolar and non-bipolar products between experimental large flakes and archaeological handaxes made on large flakes.

technique is good evidence of the flexible technological solutions used by Acheulean hominids in the DRR.

4.2. Other possible flaking techniques used in the DRR

In addition to the unquestionable use of bipolar technique in the DRR, other techniques (i.e., freehand, anvil and throwing) were likely to have been adopted. However, due to the hertzian fracture principle that characterizes all of these techniques, it is more difficult to link a specific technique to individual archaeological specimens. In particular, it needs to be emphasized that although the prominence of the bulb of percussion is regarded as a key feature of a hertzian fracture, it is not always applicable to flakes detached from raw materials with developed flaws or planes. The easily shattered nature of quartz and the foliated structure of quartz phyllite are examples of this. Our experimental data show that flakes produced by the freehand and throwing techniques have a relatively low proportion of clear bulbs, while the anvil technique shows a relatively higher proportion of 66.7%. We suggest that this is either related to the specific striking motion of each technique, or is just simply related to the physical properties of the rock creating variability in this attribute. More experimental data accumulated in future studies will help to answer this question.

Although it may be difficult to identify a specific technique used for some individual flakes or handaxes made from a large flake in DRR, the replications in this study provide information on the effectiveness of each technique, and thus we can infer which technique was probably more frequently used in the DRR. The results show that the anvil and throwing techniques have a higher rate of success (60% and 55% respectively) than freehand percussion (35%) in detaching large flakes. Therefore, we argue that freehand percussion was likely to have been used less in DRR than the anvil and throwing techniques. And interestingly, the anvil technique shows the highest rate of success among these three techniques. This is consistent with some researchers' conclusion that the anvil technique is an effective mode in detaching large flakes (Breuil and Lantier, 1965; Zhang, 1986; Shen and Wang, 2000; Odell, 2004; Mourre and Colonge, 2009–10). Detailed analysis reveals that there are two main causes for producing unusable flakes. The first is the overly small size of flakes produced by non-bipolar techniques, and this is most common in freehand percussion. Only hammerstones of a limited weight and size can be held in the hand, which probably explains the failure, as this kind of hammerstone cannot provide enough force to detach large flakes. Other factors, such as platform depth and exterior platform angle, are also potential reasons in affecting the flake size (Dibble and Rezek, 2009). The second is the accidental breaking of products during flaking, which leads to the detaching of chunks and

Table 5
Comparisons of weight and size for experimental and archaeological data. Raw data is shown in SOM Tables S1 and S2. EBF stands for Experimental bipolar flakes; HBF stands for Handaxes made on bipolar flakes; ENF stands for Experimental non-bipolar (i.e., freehand, anvil and throwing) flakes; HNF stands for Handaxes made on non-bipolar flakes.

Weight			Length		Width		Thickness	
	Mann-Whitney U	*p*-Value	Mann-Whitney U	*p*-Value	Mann-Whitney U	*p*-Value	Mann-Whitney U	*p*-Value
EBF vs. HBF	46.5	<0.05	12.5	<0.05	48	<0.05	43	<0.05
ENF vs. HNF	133.5	<0.05	163	<0.05	124	<0.05	335	0.668
EBF vs. ENF	250	0.917	177	0.085	226	0.528	125.5	<0.05
HBF vs. HNF	106.5	0.733	107.5	0.762	143	0.98	114	0.322

split flakes. This can apply to all three techniques. The developed foliated structure in quartz phyllite is a likely reason for this high proportion of breaks.

4.3. Additional behavioural information inferred from the experimental data

The experimental study described in this paper also provides other relevant information about human behaviour in the DRR. One is the random pattern seen in blow directions, which indicates that blow direction in the DRR was an unintentional behaviour, and that the variety in blow directions is most likely decided by the original shape of clasts. The technological behaviour seen in well-organized core reduction through a desired direction of blow, such as the side-struck flakes detached from Victoria West cores in South Africa (Goodwin, 1929, 1934; McNabb, 2001; Sharon, 2007) and the Chirki core method in India (Corvinus, 1983; Sharon, 2007), was therefore absent in the DRR.

In addition, weight and size comparisons of usable large flakes with the handaxes show that most attributes (i.e., weight, length and width) decreased to a similar extent from experimental samples to the archaeological handaxes, for both bipolar and non-bipolar samples. Therefore, we can speculate that in the following flaking or shaping stage, there was no preference for blanks produced by a specific technique. However, there is a difference in thickness between the experimental bipolar flakes and the archaeological handaxes made on bipolar products. This may indicate a purposeful selection of thicker bipolar flakes to produce DRR handaxes, as thickness in the archaeological materials is even higher than in the experimental samples. For the non-bipolar cases, the values of thickness are similar between the experimental and the archaeological samples, which suggest there is no thinning in the following reduction process.

To conclude, the systematic experimental study in this paper extends our methodology and provides us with strong evidence to support our former observations regarding the DRR, especially the use of bipolar technique in detaching large flake blanks. Moreover, other information about technology and human behaviour in the DRR has been revealed or can be inferred. Experimental analysis in the DRR clearly demonstrates that raw material was a very important factor in the choice of technological strategies employed by ancient knappers. Given that raw materials are highly variable in different regions of the Acheulean in China, we suggest that it is essential to conduct a similar experimental study in each individual region, which will give us a better understanding of the overall relationship between raw materials and flaking technology.

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CHAPTER SIX: DISCUSSION AND CONCLUSIONS

The research in this thesis brings more information with regards to lithic raw material selection in the Earlier Stone Age, using two sites in South Africa for the Oldowan and Early Acheulean, and one large Acheulean site in central China. The methodology, which incorporates experimental knapping as an important component, successfully provided insight into raw material selection from the ESA spanning different continents. Making use of extensive sourcing of available rock sources, taking note of important landscape features and utilising experimental knapping have proved to be useful in studying raw material selection for ESA sites. This methodology can also be applied to MSA and LSA sites but might need additional data determining rock sources, as later sites often source rocks from great distances (>10 km), whereas rock sourcing at most ESA sites are often within a 10 km radius of a site. Human behaviours for later time periods also become more complex, such as heat treatment of stone (Schmidt *et al.* 2013; Wadley and Prinsloo 2014; Zhou *et al.* 2014; Schmidt *et al.* 2015; Schmidt and Högberg 2018) and trade (Nash *et al.* 2013, Nash *et al.* 2016; Will and Mackay 2017), which must also be considered in raw material studies for these sites.

The research questions presented in Chapter one will be answered and discussed below for each study. A comparison with research findings from other ESA and middle Pleistocene sites will also be made and general conclusions will then be drawn about hominid behaviours through time.

6.1 Answers to the research questions in this thesis

Study 1

1. *Is selection for raw material quality present at Sterkfontein, as has been shown for the Swartkrans Oldowan and Acheulean?*

There is selection for quality of rock present at both Sterkfontein and Swartkrans, for both the Oldowan and the Acheulean. Hominids predominantly selected specific rock types (quartz, quartzite and chert) from the 12 that are available. In addition, they selected better qualities of these rock types by avoiding ones that were too flawed and weathered. Fine grained varieties of the quartzites were also selected. These selective practices were present for both the Oldowan and the Acheulean, at both sites.

2. *If there are selective differences between the two sites, what reasons could explain their existence?*

There is greater selection for the quality of raw material at the Sterkfontein site, which is true for both the Oldowan and the Acheulean, than there is at Swartkrans. However, it is important to comprehend the palaeo-environments and landscapes of the Blaaubank River valley to help contextualize rock selection behaviours for the different techno-complexes. Botanical remains in Member 4 at Sterkfontein suggest that the environment between 2.8 and 2.6 Ma, prior to the tool-bearing deposits, was moist with a dense tropical to subtropical gallery forest surrounding a river (Bamford 1999a, b; Kuman & Clarke 2000). Deposited faunal remains (ca 2.8 - 2.6 Ma) from woodland, open woodland and grassland habitats indicate that these landscape components were also present not too far from the site (Kuman & Clarke 2000). A study conducted on carbon isotope ratios of bovid fossils from Sterkfontein indicated that the environment consisted of medium density woodland during the Oldowan, which is now dated ca 2.18 Ma (Granger *et al*. 2015). The environment became markedly open around 1.7 Ma (Luyt and Lee-Thorp 2003). The increase in faunal remains adapted to open woodland and grassland habitats deposited at Sterkfontein around 1.7 - 1.4 Ma and Swartkrans between 1.7 - 1 Ma indicate a trend towards a drier climate around this time (Kuman & Clarke 2000). Furthermore, faunal remains of some water-dependent animals are present at Kromdraai around 2 - 1.5 Ma and at Swartkrans around 1.8 - 1 Ma (Kuman 2007), indicating that between ca 2 - 1 Ma the Blaaubank River was robust enough to support large water-dependent animals, and would have been an attractive place for hominids, prey and predators. The course of the current Blaaubank River runs roughly from East to West and separates the Swartkrans site from Sterkfontein. This was likely also the case ca 2 Ma, as the placement of the preserved gravels run parallel to the current Blaaubank River (Sherwood 2013). A possible explanation for better quality selection seen at Sterkfontein during the Oldowan is possibly related to the palaeo-environment at that time, and the locations of each site relative to the primary gravel source. The Swartkrans site is very close to this source, whereas Sterkfontein is further away from the nearest gravels (300m distance and more), and thus materials would have needed to be transported a further distance to the Sterkfontein site, meaning that poor selection of material would result in a wasted trip. Other factors may have contributed, such as predators lurking in the woodland near Swartkrans, which might have limited the time for selective decisions. Availability of raw material sources through time should also be considered (Dibble 1991), as these materials may have been less accessible during certain occupations at either site. The Swartkrans Oldowan (Sutton 2012; Kuman *et al*. 2018) and the Member 2 Acheulean technologies are possibly more expedient than similar technology found at Sterkfontein (Field 1999), which could also be as a result of being at risk closer to the river at Swartkrans, as not only was it a steep, densely vegetated terrain (Pickering 2002; Pickering *et al*. 2004; Pickering *et al.* 2008), but leopards frequently occupied the area and often prayed on *Paranthropus* (Brain 1981; Brain 1993). This could also explain the larger amount of manuports found at Swartkrans during the Oldowan and the Member 2 Acheulean occupation, as rocks would likely have been stockpiled for future use (Field 1999). It is also possible that Swartkrans captures test knapping of various materials or the undesired by-products of knapping and hominids took the better flakes, cores or LCTs with them somewhere else on the landscape. Few formal tools and LCTs are present at Swartkrans during the Acheulean indicating that this is also likely the case during the Acheulean.

The problem with time averaging at sites is that it makes it difficult for archaeologists to determine specific behavioural patterns in an assemblage, as multiple occupations spanning many hundreds or thousands of years appear synchronous in the geological record (Brantingham 2003). Thus, the quality differences at Sterkfontein and Swartkrans may be more complex than what we can observe. For example, there may have been an occupational period at Swartkrans that shows better selection than some occupations at Sterkfontein, which are represented by a handful of better-quality tools in the assemblage. It is however difficult to determine specific occupations given the depositional nature of these cave systems, and thus assemblages of a specific technocomplex (Oldowan or Acheulean) are studied as one, with the assemblage providing the average of the occupations. It is important to note that behaviour was almost certainly more complex, as environments change over millions of years and different groups of early hominids would have consisted of differing individuals who would have influenced selective decisions. However, see Byrne (2004) where climatic conditions do not always result in differing behaviour or lithic reduction techniques over different occupations, as seen at the Middle Pleistocene (570-400 ka) site of Arago cave, Tautavel (Pyrénées-Orientales in France), where technology and raw material acquisition remain fairly consistent in all layers of the site, despite changes in climate.

3. *Overall for the two sites, is there an increase in quality selection during the Acheulean, compared to the Oldowan?*

There is an increase in the selection for the quality of material during the Acheulean at both sites, but this was only seen in the averages for each variable, whereas the statistical tests were not significant enough to conclude this with absolute certainty.

4. *What does this data add to our current understanding of hominid behaviours?*

This study confirms that the ESA hominids at these sites understood rock properties fairly well and knew that certain rock types are better for tool manufacture and use. They were also capable of selecting for the quality of these different rock types even though they did not always do so. They understood that certain materials, their shapes and or sizes might need different knapping techniques to produce flakes more frequently and successfully. Acheulean hominids also understood that certain materials were better to use for the creation of LCTs, such as quartzite being preferred over quartz and chert, as it produced large flakes more consistently, held a durable edge and most LCTs were made in this material. Manuports are also present, especially during the Acheulean, indicating they had the capacity for foresight and planning.

5. *How have extensive knapping experiments aided this study?*

The experimental knapping of lithics helped to explain differences in the properties of materials available at the site locations relating to both tool-making and use. It also aided in understanding how flaws affect the flaking process and thus helped to isolate variables for analyses that could be identified visually from a knapper's perspective. These variables were determined using extensive knapping of the various materials, and they were used to gather more data for the Swartkrans Oldowan, in the experimentally created lithics and the Sterkfontein Oldowan and Acheulean, which could then be used for comparisons between the two sites. Use of each of the various materials also indicated which raw material types were best for specific tool functions. It was determined that quartzite, quartz, diabase and chert were the best of the 12 materials available for use, due to a combination of high flaking predictability, durability and sharpness. These four materials were the ones selected for the production of stone tools at both Swartkrans and Sterkfontein. Diabase, however, was used in very small proportions, despite a high durability and sharpness. Knapping of this material revealed a possible reason for why this material was not as frequently selected. This rock type is incredibly hard and requires immense force to flake, as opposed to the three other materials that were selected. Using more force to flake a material decreases the accuracy of impact by the knapper as a larger swing further away from the impact area is often required, and thus flaking predictability is reduced. This material can be flaked by a skilled knapper, but a lack of selection for this material does not indicate a lack of hominid cognitive complexity or skill. In fact, it could indicate the presence of skill and higher cognition, as it makes more sense to select materials that will effectively function as tools and are easier and more predictable to flake, thus putting in less energy for the same end result. The knapping experiments also helped in gaining an understanding of the complexity of selection with regards to flaws in the materials. Extensively flawed materials proved to be more trouble to flake than was worth the energy and effort. In addition, extensive selection for materials that entirely lacked flaws also took time and energy. Materials that had a flaw or two proved to be easy enough to predictably flake when using knapping skill to circumnavigate flaws or to strategically flake a material, such as directing an impact down a joint to force a flake to break off along that joint. This required less effort to knap than extensively flawed material and takes less time to select for than perfectly flawless material. It thus makes sense that selectivity was present during the Oldowan, but materials still had flaws present, as it might have been risky for hominids to extensively select for flawless materials, as staying too long in one place might attract predators (river). Thus, a balance between energy required to select, knap and utilise material was likely obtained that suited their unique survival situation best. The slight increase in selection of quality during the Acheulean can also be explained from the knapping experiments. LCTs in particular required reasonably good quality material to create, as opposed to flakes for example. In addition, the best material to create an LCT from was quartzite, as quartz and the kind of chert available at the sites tend to be unpredictable when shaping into a large tool. This is seen in the Sterkfontein assemblage as most LCTs were made from quartzite and had a low impurity encounter rate. There were unfortunately not any *in situ* LCTs from Swartkrans to draw any conclusions on.

Studies 2 and 3

1. *Is there selection for raw material quality in the DRR?*

Middle Pleistocene hominids living around Terrace 3 of the Danjiangkou Reservoir Region favoured a particular type of rock for the creation of LCTs that was available in abundance (quartz phyllite), but one which exhibited the highest number of flaws. However, hominids did practice quality selection for lithic raw material, as the randomly collected sample of this material exhibited significantly higher abundance of flaws present than the ones used to make artefacts. Selection for other materials was also practiced for the creation of smaller tools, as these consist predominantly of quartz (Li *et al*. 2014a), which is a rarer material in the natural gravels. The reasons for selection of quartz phyllite for LCTs are fairly complex, and are discussed below.

2. *How have extensive knapping experiments aided this study and what technological behaviours can be inferred from the results?*

Experimental knapping of the various raw materials available at the sites was essential for determining why the hominids in this area selected such poor-quality material for the creation of LCTs. Good quality materials, such as quartzite and igneous varieties, were rarely used likely due to the effort it took to knap these cobbles into LCTs, as compared to the quartz phyllite cobbles, which flaked with ease despite the abundance of flaws present. Quartzite and igneous material took considerably more force to shape into LCT's due to the hardness of these materials. As noted for study one, when more force is required to dislodge a flake the accuracy of one's strike is reduced, making the shaping of LCT's more difficult, but flaking can be accomplished with sufficient skill and patience. Knapping experiments also demonstrated that weathered material had reduced flaking predictability. Flaking weathered material resulted in flakes not being as invasive, which are essential for the initial shaping of an LCT. In addition, cutting edges of such tools were often more brittle and thus not as durable as their unweathered counterparts, with only surface weathering up to 1mm. Both quartzite and igneous material were more susceptible to weathering than the quartz phyllite, especially if cobbles were well rounded and thinner (disk or amygdaloidal in shape), which made up a sizable proportion of the natural gravels.

Initial cobble shapes were also selected for and proved to be important, as the shape of a cobble formed the blueprint for the creation of a functional LCT. Certain shapes were more effective for creating LCTs than others. The majority of gravels were polyhedral or wedge-like in shape, but amygdaloidal, disk, tablet, amygdaloidal tablets and rods were more often selected for. These shapes proved to be best for the creation of LCTs as they were often flatter/thinner and thus had a more accessible starting platform, with rods being the exception. However, rods were selected and split into two halves via bipolar knapping to provide the knapper with a starting platform and two flatter pieces already resembling the rough shape of an LCT. LCTs made from large flake blanks acquired via bipolar flaking are generally uncommon in China, but a large proportion of LCTs from the DRR was made on bipolar flake blanks, as determined via experimental investigations (Kuman *et al*. 2014), thus showing the diversity and flexibility of the Acheulean technology in this region. The unique nature of the flaws in the quartz phyllite was advantageous here as there is parallel banding in this material, which is often along the longitudinal axis of a cobble, making splitting this material easy and with minimal effort. In addition, this material flaked very easily due to its siliceous cryptocrystalline matrix, as little force was needed to detach flakes, which also facilitated the splitting of large cobbles. Banding did occasionally compromise further shaping of an LCT, but with repeated knapping of the material it became easier to predict flaking and how to use the inherent banding to one's advantage. The DRR LCTs were not extensively shaped, with a few initial large removals to achieve the general shape, and most of the flaking was directed to the shaping of the tip or the working edge (Li *et al.* 2014b). This would minimize compromising the entire LCT, as extensive flaking could eventually result in the tool breaking unfavourably when encountering a flaw during knapping. The experimental knapping made it clear that the banding mostly affected the initial large removals, but rarely affected smaller removals around the edges of a tool. Use of some of the experimentally created LCT's furthermore indicated that quartz phyllite also had the most durable and sharpest edges of all the available materials, which is likely due to its substantial content of cryptocrystalline silica, and potentially metals from the original rock (shale/mudstone) that had undergone metamorphism. Experiments also indicated that all available materials could be shaped into refined LCTs, but this was likely not done due to the abundance of materials available, and there was no need for tools with long lifespans. It is also possible that this industry was more expedient in nature, and thus extensively shaped or refined tools were not important.

These DRR studies showed that raw material selection is very complex and that later hominids were adaptable and could make strategic decisions with regards to the raw materials available to them. It also shows the importance of extensive knapping experiments to get a better grasp of raw material selective decision.

3. What does this add to our current understanding of hominid behaviours?

Middle Pleistocene hominids living in central China, like ESA hominids living in Africa, had an understanding of raw material behaviour and practiced selection for particular materials for the creation of LCTs. Despite the flawed nature of the materials favoured there was selection for quality, as quartz phyllite cobbles were selected that on average had fewer flaws present than what can be obtained at random. Hominids were complex enough cognitively to realise that the nature of the flaws in this material can be used advantageously and that this was the best material to create the most effective LCTs with the least amount of effort. Different knapping techniques (occasional bipolar) were implemented, indicating they had a sufficient understanding of rock flaking and differing rock mechanics. These two studies showed that hominids living in Asia were more complex than first believed, and that raw material "quality" or the unrefined nature of tools should not be a sole determiner of hominid behavioural complexity, but that closer investigations of assemblages are required.

6.2 Early hominid behaviour

The behavioural complexities that modern humans exhibit appeared gradually over the course of our evolution, not in a linear fashion, but more like a complex web (McBrearty and Brooks 2000). Early hominids present more technological and cognitive complexity than modern great apes (orangutan, chimpanzee, bonobo and gorillas), and thus their industries represent a transitional cognition between great apes and *Homo sapiens* (Toth and Schick 2018). We do not know much about early hominid behaviour prior to the Lomekwian, as only fossils are preserved from this pre-stone tool time period. It is possible that early hominids used rock to crush nuts and seeds, much like certain groups of chimpanzees do today (Luncz *et al*. 2018; Proffitt *et al.* 2018). Very little is known about the behaviours of our ancestors living 3.3 Ma during the Lomekwian, which will likely improve over time if more Lomekwian or other such early sites are discovered. However, we do see the first appearance of deliberate creation of stone tools. Flakes were obtained from large cores that were struck against anvils, bipolar flaking and the occasional freehand flaking (Harmand *et al*. 2015). Selection for the sizes of cores and anvils may have been present and possibly the types of rock, however, this is yet to be confirmed with further studies.

Detailed research on lithic raw material quality has been performed on Oldowan assemblages. Comparisons can prove to be complicated as there is a diversity of methodologies employed to describe selection during this industrial complex. Assemblages in East African Oldowan sites consist of different materials (predominantly igneous) than the ones used for stone tool making in South Africa. This makes direct comparisons of findings even more difficult, but some patterns are evident. Selection for lithic quality is present during the Oldowan in Gona and Makaamitalu Basin, showing selection of fine-grained rocks with smaller and fewer crystal inclusions (Stout *et al*. 2005; Stout *et al*. 2010; Goldman-Neuman and Hovers 2012). The shape of a blank could also have been an important contributing factor as some selection for this is seen (Delagnes and Roche 2005; Stout and Semaw 2006). Hominids at Kanjera South selected material that had durable edges over material with higher fracture predictability, but rock types that were both durable and predictable were preferred (Braun *et al*. 2009). The selection at Sterkfontein and Swartkrans reflects some similarities as finer grained material was often used, as well as rocks that were both predictable and durable. Oldowan hominids in both east and southern Africa very rarely selected raw materials beyond several to 10 km from a site, and thus they did not expend a lot of energy hunting for raw materials that were exceptionally rare and of high quality (Negash *et al.* 2006). Their needs were easily met with local rocks that were decent enough to create useful flakes that did not have to be top quality. Early hominids also tended to make and use tools expediently, further demonstrating that they did not expend energy unnecessarily. For example, it makes little sense to exploit a high-quality chert from 50 km away when a quartz cobble in the vicinity will do for a quick task. Later humans would sometimes carry pre-flaked material (Lengyel 2015) with them that were selected or traded from a source much farther away and often of higher quality. It is not clear if early hominids also practiced this over large distances, as it is not clearly seen in the archaeological record. Stone caches do however exist at some sites in the form of manuports that were carried to a site location, but never knapped. Knapping strategies are already fairly complex during the Oldowan, including freehand hard hammer percussion and bipolar reduction. These techniques are seen to some extent during the Lomekwian (along with striking rock against anvils) but with less accuracy (Harmand *et al*. 2015). Free hand percussion, especially, offered more control of flaking and thus more accuracy.

Only a few studies extensively compare raw material quality selection between neighbouring sites to add to selection behaviours in similar habitat and geological settings. Goldman-Neuman and Hovers (2012) compared two late Pliocene Oldowan sites at Makaamitalu Basin (Hadar, Ethiopia), A.L. 666 and A.L. 894. Selectivity was present to some extent at both sites, but the slightly younger of the two sites, A.L. 666, shows greater selectivity of better-quality materials. Unlike Sterkfontein and Swartkrans, the two sites are a similar distance to raw material sources, and thus the difference in selectivity at A.L.666 is likely due to other factors. McHenry and de la Torre (2018) compared lithic raw material quality for two assemblages at the Oldowan-Acheulean transition in Bed II of Olduvai Gorge, Tanzania. One late Oldowan sites (HWK EE) and one early Acheulean (EF-HR) site were studied. Selection at HWK EE was predominantly for the blank shape of a rock and availability of natural angles suitable for flaking. The Early Acheulean site EF-HR, however, showed that hominids selected high quality fine-grained lavas for the production of LCTs, showing increase selection during the Acheulean, much like at Swartkrans and Sterkfontein.

The Acheulean shows the appearance of LCTs, which involve more complex reduction strategies than that of simple flake production. Selection for better material is thus seen to some extent during the Acheulean and some materials are selected from further away (Deacon and Deacon 1999; Braun *et al.* 2013). Evidence for the use and control of fire also makes an appearance in the archaeological record during this time period, indicating another aspect of hominid cognitive complexity. The later Acheulean, especially in Europe, shows more selection for better quality materials (Lamotte *et al*. 2017) and a general trend to better refinement of LCTs (although see McNabb and Cole 2015). Soft hammer percussion is more apparent in the later Acheulean (Méndez-Quintas *et al.* 2019) and longevity of tools is generally more important, as is apparent from more extensive retouch and reuse. Hominids also show a remarkable ability for adaptability to varying circumstances, as is seen in the DRR.

It is apparent that Middle Pleistocene hominids living in the DRR made strategic selective decisions with regards to the raw materials they utilised for the creation of tools, despite not having the best raw materials to select from. Quartz was used predominantly for small-to-medium sized tools, but it was not a good material to successfully create LCTs consistently.

The hominids thus opted for quartz phyllite, which despite being heavily banded proved to be the best material for the creation of LCTs. Selection of this material might also have affected the knapping strategies employed to create LCTs, as more extensive focus was given to shape a working edge than the overall refinement of an LCT's shape. Similar behaviour is seen at the Middle Palaeolithic site, Tsagaan Agui cave Lower Grotto, in northeast Asia, Mongolia, where despite the local chert exhibiting heavy banding the people simply adjusted their flaking strategies to prepare cores (Brantingham *et al.* 2000).

Stone technologies in China have often been seen as more expedient and made of poor-quality materials. Shuidonggou locality 2, north China (42-27 ka), shows expedient use of pebbles from local river beds. This is likely because the area had both an abundance of food and rock sources, thus spending excessive amounts of energy and time to procure exceptional quality rock is unwarranted. "In sum, the persistence of comparatively simple and expedient lithic technology in north China until around 25 ka could be both an active response to local environments in which raw materials and food could generally be found in the same places, and a by-product of resource distributions which channelled human foraging movement along linear drainages" (Li *et al.* 2016: 91). Despite a stasis in the technology of Late Palaeolithic site of Shuidonggou Locality 2, selection is seen for raw material (Lin *et al.* 2019). Early Pleistocene sites in the Nihewan Basin, northern China, show simple but adaptive strategies, demonstrating that hominid behaviour in Asia is more complex than originally thought (Lui *et al.* 2013). Study two in this thesis indicates that it was indeed possible to create "refined" LCTs from the available materials at DRR. This indicates that the lack of extensively shaped LCTs in Asia is not due to the overall poorer quality raw materials available, as compared to flints and cherts found in Europe for example. Shaping the LCTs extensively did require more skill, patience and energy to create, but could perform similar tasks to LCT's not extensively shaped. As mentioned previously the lack of extensively shaped LCT's at DRR does not indicate a lack of complex thinking in this region, as particular raw materials were selected and strategically knapped. It was probably not necessary to expend the energy to create "refined" LCTs, as raw materials were abundant and these LCT's may have only been required for expedient tasks, thus not demanding the extra energy to create.

Behaviours discussed above are briefly summed up below for reference purposes. It should be noted that this list does not indicate a linear progression of behaviours, but it does show a general increase in complexity over time. However, only four samples were compared for the Oldowan and the Acheulean change and much more and larger comparisons would need to be studied to address the complexity of progression of behaviours from the Oldowan to the Acheulean in greater detail. It should also be noted that it does not show absolutely every behaviour of our ancestors, as that is a thesis on its own. It pertains to the predominant behaviours studied with regards to raw material selection, tool knapping and use that are visible in the archaeological record during the early Palaeolithic.

Oldowan:

- Selection for rock type is often seen.
- Selection for the size of cobbles and cores is apparent.
- Selection for the initial shape of a core might have been practiced.
- Selection for quality of rock is seen in some assemblages.
- Rocks were generally acquired from the local environment (distances <10 km from a site).
- Caches of unknapped material or manuports do exist at some sites.
- Knapping strategies changed from mainly striking rock against anvils at 3.3 Ma to predominantly freehand hard hammer percussion. These techniques offered more control of flaking and thus more accuracy.
- More variety in core reduction strategies is seen than the Lomekwian.
- Generally expedient technology with occasional retouch and reuse was practiced.

Acheulean:

- All of the above behaviours that are seen in the Oldowan are present, with the addition of LCTs, which involve more complex reduction strategies than that of flake production.
- Evidence for the use and control of fire makes an appearance in the archaeological record.
- Soft hammer percussion is more apparent in the later Acheulean as well as the use of better-quality rock material.
- Longevity of tools is generally more important as is apparent from more extensive retouch and reuse.

6.3 Conclusion

By 3.3 Ma our hominid ancestors understood that sharp flakes from a rock can be used as a tool and had enough capacity to realise they can actively create such flakes by striking a large rock against another freestanding rock (anvil) and with freehand percussion. It is possible that rock selection already began during the Lomekwian for durable and sizable cobbles of igneous rocks that were effective enough to create large durable flakes as tools (Harmand *et al*. 2015). This gave our hominid ancestors a better chance at survival, which drove them to try out different materials and better more accurate knapping techniques, thus giving birth to the Oldowan technology. The selection of specific rock types during the Oldowan and the more frequent use of freehand hard hammer percussion likely led to its success and thus led to its widespread use (Stout *et al*. 2005). Hominid minds were already complex by the Oldowan, indicating an understanding that certain rock types are better for making stone tools than others. They could visually identify these rock types, but were also capable of understanding that certain attributes or flaws found in rocks could hinder the knapping process or use as a tool, and often avoided rocks that had too many of these flaws or attributes present. Early hominids also understood the importance of the shape and size of rocks used for the initial core (Delagnes & Roche 2005; Goldman-Neuman & Hovers 2012). Other behavioural complexities include the deliberate retouch of tools, curation and transport of stone and the processing of large animal carcasses (Toth and Schick 2018). The continued use of stone tools later led to more and more complex knapping techniques and tools, which often required better material to be selected for, such as for prepared cores. The exception being the lower Palaeolithic Victoria West industry found in South Africa (Lycett *et al.* 2010; Li et al 2017b), which were prepared cores made for handaxe blanks and made from fairly touch igneous material that is difficult to knap (personal experimentation with Ventersdorp andesites) This industry is however a perfect example of how hominid progression was complex and not linear. The Victoria West industry is essentially a prepared core industry and is approximately 1 million years old, thus it predates the prepare cores technology which is seen during the MSA 800 000 years later (Li *et al*. 2017b). Hominids were thus capable of the kind of thinking required to create prepared cores long before the MSA, even though the practise of it was not widespread till the MSA. This is also an example of when good quality material was not present hominids had the capacity to adapt and alter their flaking strategies, or even use inherent flaws within rocks to their advantage as is seen in the DRR.

Raw material studies are thus important for us to help understand these behavioural complexities of the hominid mind and their adaptability from various time periods and regions of the world. Moník and Hadraba (2016) argue that geochemical and mechanical testing methods used to test certain raw material attributes do not suffice when on their own, as multiple factors contribute to raw materials being a better quality for knapping and tool use. For example, diabase is harder and more durable than flint, thus making it the "better" material for tool creation. However, knapping diabase is much more difficult than flint due to its exceptional hardness (personal experimental flaking of both materials). Removal of sizable flakes from diabase requires a lot more strength than with flint, this extra strength comes from a percussive blow that is a greater distance from the platform, which can in turn affect the accuracy of the knapper's strike. Moník and Hadraba (2016) suggest that, for this reason, dynamic tests should be employed to measure raw material quality. Using only geochemical and mechanical tests, even a multitude of them, does not always suffice when trying to understand complex adaptive behaviour employed by hominids. This is why utilising experimental knapping in studies are important for gaining experience with certain material in an actualistic way. In addition, a knapper would experience a material's quality in a holistic fashion, with all the various characteristic of raw material quality working together. Factors that mechanical and geochemical tests cannot account for are things like impact absorption and direction of force in a flexible, movable humanoid hand, skill and problem solving, among many. This is why experimentation was implemented and focussed on in the studies within this thesis. The methodology and techniques set out in this thesis can be used on any Stone Age site and could provide valuable insights into human and hominid selective behaviours with regards to the lithic raw material used for making stone tools. The set of studies shows us how complex raw material selection can be and how many factors need to be considered, as well as how they work in combination. By including experimental knapping of the same materials and selecting variables unique to the geology of a particular site, one can determine selective behaviours practiced at a site from a more holistic and actualistic viewpoint. A limitation to such a study is that one would need to be (or hire) a proficient knapper to be able to replicate tools from assemblages being studied and to have that first-hand experience with the variety of rocks used. Experimental studies like this also have an element of subjectivity. Future studies over time will help to refine the methodology used in this thesis as different sites and time periods are incorporated. In addition, more research done on raw material selection for sites not yet studied will make our understanding of hominid and human raw material acquisition and use clearer. Future developments in the field are already underway with technologies advancing and now becoming closer to being incorporated into the field of archaeology more consistently. Surveying techniques such as LIDAR, infrared and hyperspectral devices are becoming more accessible and can fit onto drones, which make surveying much more effective than on foot (Parcak 2019: 165-184). These kinds of surveys can be useful for potentially finding new sites as well as giving environmental contexts to sites, such as discovering raw material sources and ancient watercourses that are covered by modern sediments (Parcak *et al.* 2016). This will help us to better understand hominid behaviours and give more information and context over the next few decades to help us understand human cognitive development over time, which will help us understand our own origins and development as a species.

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APPENDIX: Complements of reviewer two, may they have eternal happiness.

Table 1: Sterkfontein Oldowan quartzite raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; vf – very fine grained; f – fine grained; m – medium grained; c – coarse grained; vc – very coarse grained; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**vf**	**f**	**m**	**c**	**vc**	**Sn**	**Tt**	**N**	**S**	**E**
2371	Proto biface	0	14	0.0	**2371**	Proto biface	1					**2371**	Proto biface	1		
2502	Chopper	3	4	75.0	**2456**	retouch		1				**2456**	retouch	1		
2932	Chopper	0	20	0.0	**2502**	Chopper				1		**2502**	Chopper	1		
4920	Chopper	5	19	26.3	**2503**	flake		1				**2503**	flake		1	
2533	chunk	1	2	50.0	**2532**	flake			1			**2532**	flake		1	
2938	chunk	2	17	11.8	**2533**	chunk		1				**2533**	chunk	1		
3683	chunk	1	5	20.0	**2630**	retouch			1			**2630**	retouch		1	
6010	chunk	1	11	9.1	**2647**	retouch			1			**2647**	retouch	1		
8198	chunk	1	10	10.0	**2695**	flake		1				**2695**	flake	1		
8199	chunk	3	5	60.0	**2722**	flake			1			**2722**	flake	1		
8904	chunk	3	3	100.0	**2739**	retouch		1				**2739**	retouch		1	
10054	chunk	3	6	50.0	**2740**	chunk		1				**2740**	chunk		1	
2789	cutting	1	10	10.0	**2770**	flake		1				**2770**	flake		1	
2722	flake	0	3	0.0	**2789**	cutting		1				**2789**	cutting		1	
2740	flake	5.5	11	50.0	**2812**	retouch			1			**2812**	retouch		1	
2770	flake	2	2	100.0	**2885**	retouch		1				**2885**	retouch		1	
3050	flake	0	5	0.0	**2886**	retouch		1				**2886**	retouch		1	
3102	flake	2.5	5.5	45.5	**2932**	Chopper			1			**2932**	Chopper	1		
3347	flake	0	8	0.0	**2938**	chunk		1				**2938**	chunk		1	
3348	flake	1	6	16.7	**3019**	Irregular polyhedral			1			**3019**	Irregular polyhedral			1
3350	flake	0	3	0.0	**3049**	retouch			1			**3049**	retouch	1		

3351	flake	0	5	0.0	**3050**	flake		1				**3050**	flake	1		
3352	flake	0	5	0.0	**3051**	retouch		1				**3051**	retouch	1		
3384	flake	1	6	16.7	**3102**	flake	1					**3102**	flake	1		
3385	flake	1	7	14.3	**3239**	flake		1				**3239**	flake		1	
3480	flake	0	4	0.0	**3347**	flake		1				**3347**	flake	1		
3676	flake	0	7	0.0	**3348**	flake			1			**3348**	flake		1	
3803	flake	0	6	0.0	**3349**	retouch		1				**3349**	retouch	1		
5886	flake	0	5	0.0	**3350**	flake				1		**3350**	flake	1		
5887	flake	0	5	0.0	**3351**	flake			1			**3351**	flake	1		
5913	flake	0	6	0.0	**3352**	retouch		1				**3352**	retouch	1		
5949	flake	0	8	0.0	**3381**	flake			1			3381	flake		1	
5951	flake	0	6	0.0	**3382**	flake		1				**3382**	flake		1	
6091	flake	0	6	0.0	**3384**	flake		1				**3384**	flake		1	
6099	flake	0	6	0.0	**3385**	flake		1				**3385**	flake		1	
6122	flake	3	6	50.0	**3479**	flake			1			**3479**	flake		1	
7962	flake	0	7	0.0	**3480**	flake		1				**3480**	flake	1		
8521	flake	0	11	0.0	**3676**	flake		1				**3676**	flake		1	
8847	flake	2	4	50.0	**3683**	chunk		1				**3683**	chunk		1	
8849	Flake	3	11	27.3	**3794**	retouch			1			**3794**	retouch	1		
8851	flake	2	5	40.0	**3803**	flake			1			**3803**	flake		1	
8905	flake	1	2	50.0	**4920**	Chopper		1				**4920**	Chopper		1	
9073	flake	0	1	0.0	**5069**	retouch			1			**5069**	retouch		1	
9074	flake	1	1	100.0	**5886**	flake		1				**5886**	flake	1		
2951a	flake	2	10	20.0	**5887**	flake		1				**5887**	flake		1	
2503	Flake	1	4	25.0	**5892**	retouch		1				**5892**	retouch		1	
3239	flake	0	5	0.0	**5913**	retouch			1			**5913**	retouch		1	
2456	flake used	0	14	0.0	**5949**	flake			1			**5949**	flake	1		
2532	Flake used	0	10	0.0	**5951**	flake			1			**5951**	flake	1		
2630	flake used	0	7	0.0	**6010**	chunk		1				**6010**	chunk		1	

2885	flake used	0	12	0.0	**6085**	retouch		1				**6085**	retouch		1	
2886	flake used	0	21	0.0	**6091**	flake		1				**6091**	flake		1	
3349	flake used	0	9	0.0	**6099**	flake			1			**6099**	flake		1	
3479	flake used	0	10	0.0	**6101**	flake		1				**6101**	flake		1	
6085	flake used	1	20	5.0	**6120**	retouch		1				**6120**	retouch	1		
6120	flake used	0	13	0.0	**6122**	flake		1				**6122**	flake		1	
3049	flake used/retouch	0	15	0.0	**6197**	retouch		1				**6197**	retouch		1	
3051	flake used/retouch	4	19	21.1	**6211**	retouch		1				**6211**	retouch	1		
7975	Flake, used	1	20	5.0	**7962**	flake			1			**7962**	flake		1	
2739	Flake, used /retouch	1.5	10.5	14.3	**7975**	retouch			1			**7975**	retouch	1		
2812	flake/ used	0	9	0.0	**8198**	chunk			1			**8198**	chunk		1	
3381	flake/ used	4	10	40.0	**8199**	chunk					1	**8199**	chunk			1
3382	flake/ used	0	7	0.0	**8432**	retouch			1			**8432**	retouch		1	
6101	flake/ used	1	8	12.5	**8521**	flake			1			**8521**	flake		1	
3019	Irregular polyhedral	4	12	33.3	**8841**	Irregular polyhedral				1		**8841**	Irregular polyhedral	1		
8841	Irregular polyhedral	0	5	0.0	**8847**	flake		1				**8847**	flake	1		
8854	Irregular polyhedral	1	18	5.6	**8848**	retouch		1				**8848**	retouch		1	
2647	retouch	0	7	0.0	**8849**	retouch		1				**8849**	retouch	1		
3794	retouch	0	17	0.0	**8851**	flake		1				**8851**	flake			1
5069	retouch	0	18	0.0	**8854**	Irregular polyhedral		1				**8854**	Irregular polyhedral		1	
5892	retouch	1	20	5.0	**8904**	chunk			1			**8904**	chunk			1
6197	retouch	0	8	0.0	**8905**	flake		1				**8905**	flake		1	
6211	retouch	1	21	4.8	**8907**	retouch		1				**8907**	retouch		1	
8432	retouch	1	14	7.1	**9073**	flake			1			**9073**	flake			1
8848	retouch	1	17	5.9	**9074**	flake		1				**9074**	flake			1

8907	retouch	0	8	0.0	**10054**	chunk		1				**10054**	chunk		1	
2695	used flake	0	6	0.0	**2951a**	flake			1			**2951a**	flake		1	
n				**Mean**	**n**							**n**				
77				26.4%	**77**		2	44	27	3	1	**77**		28	43	6
						Percentage of sample	2.6	57.1	35.1	3.9	1.3		Percentage of sample	36.4	55.8	7.8

Table 2: Sterkfontein Oldowan quartz raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**W, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
3372	chunk	3	3	100.0	**2457**	core, p	6	36	31	11.2	0.5	5.4	**2457**	core, p	1		
3677	chunk	3	9	33.3	**2487**	core, pi	2	26	26	6.8	0.3	3.0	**2487**	core, pi	1		
3796	chunk	2	2	100.0	**2629**	core, p	3	29	29	8.4	0.4	3.6	**2629**	core, p	1		
6236	chunk	1	5	20.0	**2693**	core, casual	0	23	23	5.3	0.0	0.0	**2693**	core, casual	1		
6238	chunk	1	4	25.0	**2696**	flake	1	17	10.8	1.8	0.5	5.4	**2696**	flake	1		
7978	chunk	1	7	14.3	**2771**	core, bip	1	25	20	5.0	0.2	2.0	**2771**	core, bip	1		
7982	chunk	4	14	28.6	**2792**	core, cent	1	22	20	4.4	0.2	2.3	**2792**	core, cent	1		
7987	chunk	2	10	20.0	**2810**	flake	2	26	17	4.4	0.5	4.5	**2810**	flake	1		
8071	chunk	2	3	66.7	**2811**	flake	1	22	17	3.7	0.3	2.7	**2811**	flake	1		
8074	chunk	0	10	0.0	**2903**	core, p	5	50	44	22.0	0.2	2.3	**2903**	core, p	1		
8076	chunk	1	8	12.5	**2943**	flake	4	25	21	5.3	0.8	7.6	**2943**	flake		1	
8994	chunk	0	8	0.0	**2979**	cutting	7	11.5	11.5	1.3	5.3	52.9	**2979**	cutting		1	

9142	chunk	1	9	11.1	**3065**	core, cent	1	33	33	10.9	0.1	0.9	**3065**	core, cent	1		
9227	chunk	0	8	0.0	**3206**	scraper	0	22	15	3.3	0.0	0.0	**3206**	scraper	1		
10250	chunk	0	4	0.0	**3353**	flake	3	12.3	10	1.2	2.4	24.4	**3353**	flake			1
2771	core, bip	0	14	0.0	**3354**	flake	1	18	14.3	2.6	0.4	3.9	**3354**	flake	1		
3708	core, bip	11	19	57.9	**3355**	retouch	1	15.3	15	2.3	0.4	4.4	**3355**	retouch	1		
6212	core, bip	1	3	33.3	**3366**	scraper	4	21.5	12	2.6	1.6	15.5	**3366**	scraper	1		
2693	core, casual	0	13	0.0	**3368**	flake	1	28	27	7.6	0.1	1.3	**3368**	flake	1		
2792	core, cent	3	16	18.8	**3369**	retouch	2	18	14.5	2.6	0.8	7.7	**3369**	retouch	1		
3065	core, cent	4	22	18.2	**3370**	flake	1	17.2	12.4	2.1	0.5	4.7	**3370**	flake	1		
3977	core, cent	1	13	7.7	**3371**	retouch	1	20.7	10.4	2.2	0.5	4.6	**3371**	retouch	1		
5003	core, frag	7	18	38.9	**3705**	core, p	3	50	50	25.0	0.1	1.2	**3705**	core, p	1		
8075	core, frag	3	11	27.3	**3708**	core, bip	4	46	32	14.7	0.3	2.7	**3708**	core, bip		1	
2457	core, p	5	21	23.8	**3977**	core, cent	1	57	42	23.9	0.0	0.4	**3977**	core, cent	1		
2629	core, p	5	18	27.8	**4965**	core, p	5	100	77.7	77.7	0.1	0.6	**4965**	core, p	1		
2903	core, p	15	31	48.4	**5003**	core, frag	5	38	38	14.4	0.3	3.5	**5003**	core, frag	1		
3705	core, p	1	9	11.1	**5914**	flake	5	19.6	13.7	2.7	1.9	18.6	**5914**	flake	1		
4965	core, p	6	35	17.1	**6212**	core, bip	15	10	10	1.0	15.0	150.0	**6173**	flake	1		
7334	core, p	4	17	23.5	**7229**	scraper	2	10	10	1.0	2.0	20.0	**6212**	core, bip			1
2487	core, pi	5	14	35.7	**7334**	core, p	2	40	40	16.0	0.1	1.3	**6233**	flake	1		
2979	cutting	1	8	12.5	**7970**	retouch	1	29.7	15	4.5	0.2	2.2	**6236**	chunk	1		
2419	flake	0	2	0.0	**7971**	flake	2	20	15	3.0	0.7	6.7	**6238**	chunk	1		
2421	flake	0	6	0.0	**7978**	chunk	2	27	25	6.8	0.3	3.0	**6253**	flake		1	
2460	flake	0	5	0.0	**7982**	chunk	3	21	13	2.7	1.1	11.0	**6559**	flake		1	
2490	flake	0	5	0.0	**7983**	retouch	1	16.2	12	1.9	0.5	5.1	**6560**	retouch	1		
2504	flake	0	2	0.0	**7987**	chunk	3	20.2	11.7	2.4	1.3	12.7	**7082**	retouch	1		
2530	flake	0	6	0.0	**8068**	flake	4	14.7	13.4	2.0	2.0	20.3	**7181**	flake	1		
2531	flake	0	3	0.0	**8069**	flake	2	25	14.3	3.6	0.6	5.6	7191	retouch	1		
2581	flake	0	11	0.0	**8070**	flake	1	17	14.2	2.4	0.4	4.1	**7229**	scraper	1		
2675	flake	0	5	0.0	**8071**	chunk	4	20.5	12	2.5	1.6	16.3	**7334**	core, p	1		

2696	flake	2	7	28.6	**8072**	retouch	1	23.3	10.6	2.5	0.4	4.0	**7970**	retouch	1		
2741	flake	4	7	57.1	**8073**	retouch	3	19.8	14.5	2.9	1.0	10.4	**7971**	flake	1		
2742	flake	0	4	0.0	**8074**	chunk	3	31	19.7	6.1	0.5	4.9	**7978**	chunk	1		
2774	flake	0	3	0.0	**8075**	core, frag	2	24.4	16	3.9	0.5	5.1	**7982**	chunk	1		
2799	flake	3	9	33.3	**8076**	chunk	1	22.2	11	2.4	0.4	4.1	**7983**	retouch	1		
2801	flake	2	3	66.7	**8192**	flake	1	18.2	11.2	2.0	0.5	4.9	**7987**	chunk	1		
2811	flake	0	5	0.0	**8193**	flake	0	14.5	9	1.3	0.0	0.0	**8068**	flake	1		
2888	flake	0	6	0.0	**8195**	flake	0	16.1	14	2.3	0.0	0.0	**8069**	flake	1		
2890	flake	0	6	0.0	**8197**	flake	4	18.3	12	2.2	1.8	18.2	**8070**	flake	1		
2943	flake	3	8	37.5	**8571**	flake	1	22	22	4.8	0.2	2.1	**8071**	chunk	1		
2946	flake	1	6	16.7	**8990**	flake	1	19.6	16	3.1	0.3	3.2	**8072**	retouch	1		
2981	flake	2	6	33.3	**8991**	flake	1	24	14.8	3.6	0.3	2.8	**8073**	retouch	1		
3057	flake	0	7	0.0	**8992**	flake	1	28	7	2.0	0.5	5.1	**8074**	chunk	1		
3066	flake	0	4	0.0	**8993**	flake	1	17	11	1.9	0.5	5.3	**8075**	core, frag	1		
3067	flake	0	10	0.0	**8994**	chunk	0	18.6	9.7	1.8	0.0	0.0	**8076**	chunk	1		
3068	flake	0	7	0.0	**8995**	retouch	2	31.5	13.6	4.3	0.5	4.7	**8192**	flake	1		
3069	Flake	0	5	0.0	**8996**	flake	1	21.6	5.5	1.2	0.8	8.4	**8193**	flake	1		
3099	flake	3	5	60.0	**8997**	retouch	1	18	14.2	2.6	0.4	3.9	**8195**	flake	1		
3109	flake	2	2	100.0	**8998**	flake	16	9.6	9.3	0.9	17.9	179.2	**8197**	flake	1		
3172	flake	0	5	0.0	**9072**	flake	1	13.8	13	1.8	0.6	5.6	**8571**	flake	1		
3173	flake	2	5	40.0	**9140**	retouch	2	16.5	11	1.8	1.1	11.0	**8990**	flake	1		
3174	flake	0	5	0.0	**9141**	retouch	0	17.2	14.5	2.5	0.0	0.0	**8991**	flake	1		
3201	flake	6	12	50.0	**9142**	chunk	1	21	6	1.3	0.8	7.9	**8992**	flake	1		
3203	flake	0	2	0.0	**9226**	retouch	3	18	12.8	2.3	1.3	13.0	**8993**	flake	1		
3205	flake	0	6	0.0	**9227**	chunk	1	21	9.7	2.0	0.5	4.9	**8994**	chunk	1		
3253	Flake	1	6	16.7	**10250**	chunk	14	17	10.2	1.7	8.1	80.7	**8995**	retouch	1		
3304	flake	1	6	16.7	**10251**	flake	1	25.4	11.8	3.0	0.3	3.3	**8996**	flake	1		
3305	flake	0	4	0.0	**10272**	retouch	11	19.7	15	3.0	3.7	37.2	**8997**	retouch	1		
3312	flake	0	6	0.0	**10273**	flake	5	21	15.8	3.3	1.5	15.1	**8998**	flake		1	

3313	flake	2	7	28.6	**10280**	flake	4	22	15	3.3	1.2	12.1	**9072**	flake	1		
3353	flake	5	5	100.0	**7191**	retouch	2	18.6	14.7	2.7	0.7	7.3	**9140**	retouch	1		
3354	flake	1	4.5	22.2	**7181**	flake	0	15	12.2	1.8	0.0	0.0	**9141**	retouch	1		
3368	flake	0	10	0.0	**7082**	retouch	0	18.4	8.2	1.5	0.0	0.0	**9142**	chunk	1		
3370	flake	0	7	0.0	**6173**	flake	10	24.4	16.6	4.1	2.5	24.7	**9226**	retouch	1		
3383	flake	0	4	0.0	**6560**	retouch	6	28.6	15.4	4.4	1.4	13.6	**9227**	chunk	1		
3386	flake	0	8	0.0	**6559**	flake	4	20	13.6	2.7	1.5	14.7	**10250**	chunk	1		
3412	flake	3	4	75.0	**6253**	flake	3	21.3	20.6	4.4	0.7	6.8	**10251**	flake	1		
3450	flake	4	8	50.0	**6236**	chunk	3	16.3	13.2	2.2	1.4	13.9	**10272**	retouch	1		
3477	flake	2	4	50.0	**6238**	chunk	1	15.7	9.1	1.4	0.7	7.0	**10273**	flake		1	
3478	flake	0	2	0.0	**6233**	chunk	10	31.4	17.6	5.5	1.8	18.1	**10280**	flake	1		
3675	flake	0	6	0.0													
3678	Flake	4	7	57.1													
3680	flake	2	3	66.7													
3711	flake	0	5	0.0													
3712	flake	0	4	0.0													
3855	flake	2	4	50.0													
3857	flake	6	7	85.7													
4969	Flake	0	8	0.0													
4971	flake	0	4	0.0													
5005	flake	0	1	0.0													
5006	flake	0	2	0.0													
5872	flake	1	5	20.0													
5902	flake	1	1	100.0													
5914	flake	2	5	40.0													
5953	flake	0	2	0.0													
6048	flake	0	2	0.0													
6049	flake	3	9	33.3													
6090	flake	0	6	0.0													

6103	flake	3	7	42.9													
6104	flake	0	4	0.0													
6129	flake	1	7	14.3													
6173	flake	3	3	100.0													
6233	flake	3.5	6	58.3													
6253	flake	1	1	100.0													
6559	flake	2	5	40.0													
7971	flake	2	6	33.3													
8068	flake	0	4	0.0													
8069	flake	0	6	0.0													
8070	flake	0	4	0.0													
8072	flake	0	4	0.0													
8192	flake	0	4	0.0													
8193	flake	0	3	0.0													
8195	flake	1	4	25.0													
8197	flake	0	4	0.0													
8339	flake	0	6	0.0													
8483	flake	4	5	80.0													
8526	flake	0	7	0.0													
8564	flake	0	5	0.0													
8571	flake	0	2	0.0													
8855	flake	4	11	36.4													
8990	flake	5	11	45.5													
8991	flake	2	8	25.0													
8992	flake	0	6	0.0													
8993	flake	0	10	0.0													
8996	flake	0	2	0.0													
8997	flake	0	8	0.0													
8998	flake	3	6	50.0													

9072	flake	0	7	0.0													
10251	flake	0	9	0.0													
10273	flake	3	10	30.0													
10280	flake	0	7	0.0													
2808	flake used	1	13	7.7													
5007	flake used	0	5	0.0													
2904	flake/ used /retouched	0	12	0.0													
3371	flake/ used /retouched	0	9	0.0													
3369	retouch	0	12	0.0													
3656	retouch	1	4	25.0													
6560	retouch	1	7	14.3													
7082	retouch	1	14	7.1													
7187	retouch	1	13	7.7													
7191	retouch	2	5	40.0													
7970	retouch	4	16	25.0													
7983	retouch	0	12	0.0													
8073	retouch	0	12	0.0													
8995	retouch	3	9	33.3													
9140	retouch	0	8	0.0													
9141	retouch	0	8	0.0													
9226	retouch	0	6	0.0													
10272	retouch	3	14	21.4													
2810	retouched	3	8.5	35.3													
3206	scraper	0	8	0.0													
3355	scraper	0	8	0.0													
3366	scraper	5	25	20.0													
3388	scraper	0	14	0.0													
6121	scraper	0	15	0.0													

7229	scraper	11	17	64.7													
n				**Mean**	**n**							**Mean**	**n**				
157				20.1%	**81**							12.4	**81**		72	7	2
														Percentage of sample	88.9	8.6	2.5

Table 3: Sterkfontein Oldowan chert raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**W, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
2580	flake	1	6	16.7	**2832**	flake	0	23.6	19.6	4.6	0.0	0.0	**2832**	flake		1	
8795	chunk	2	7	28.6	**2833**	flake	0	41.8	37.6	15.7	0.0	0.0	**2833**	flake		1	
7282	cutting	6	14	42.9	**3238**	retouch	1	47.3	38.4	18.2	0.1	0.6	**3238**	retouch		1	
2832	flake	0	1	0.0	**3338**	flake	0	39.2	21	8.2	0.0	0.0	**3338**	flake		1	
2833	flake	1	3	33.3	**3411**	flake	1	33.4	31.8	10.6	0.1	0.9	**3411**	flake		1	
3338	flake	0	9	0.0	**3594**	flake	1	23.2	21.2	4.9	0.2	2.0	**3594**	flake		1	
3411	flake	4	8.5	47.1	**3639**	retouch	3	26	14.8	3.8	0.8	7.8	**3639**	retouch		1	
6230	flake	0	4	0.0	**3641**	retouch	1	24.8	14.3	3.5	0.3	2.8	**3641**	retouch		1	
7318	flake	0	8	0.0	**6230**	flake	1	43.4	29.8	12.9	0.1	0.8	**6230**	flake	1		
7337	flake	3	7	42.9	**7282**	cutting	2	33.8	32.6	11.0	0.2	1.8	**7282**	cutting		1	
8740	flake	0	6	0.0	**7318**	flake	1	27.8	25.7	7.1	0.1	1.4	**7318**	flake		1	
8784	flake	1	6	16.7	**7337**	flake	1	18.7	8.8	1.6	0.6	6.1	**7337**	flake	1		
9261	flake	0	7	0.0	**8724**	retouch	1	38.2	37.5	14.3	0.1	0.7	**8724**	retouch		1	
3594	flake used	3.5	9	38.9	**8740**	flake	1	24	27	6.5	0.2	1.5	**8740**	flake	1		

3238	retouch	2	22	9.1	**8743**	retouch	1	17.2	14	2.4	0.4	4.2	**8743**	retouch	1		
3641	retouch	1.5	7.5	20.0	**8752**	retouch	0	41.1	37	15.2	0.0	0.0	**8752**	retouch		1	
8724	retouch	2	6	33.3	**8784**	flake	1	18.7	16.5	3.1	0.3	3.2	**8784**	flake		1	
8743	retouch	0	10	0.0	**8795**	chunk	1	16	11	1.8	0.6	5.7	**8795**	chunk	1		
8752	retouch	1	13	7.7	**9261**	flake	1	33	24	7.9	0.1	1.3	**9261**	flake	1		
10544	retouch	1	11	9.1	**10544**	retouch	1	16.7	10.4	1.7	0.6	5.8	**10544**	retouch		1	
3639	retouched	2.5	13.5	18.5													
n				**Mean**	**n**							**Mean**	**n**				
21				17.4%	**20**							2.3	**20**		6	14	0
														Percentage of sample	30.0	70.0	0.0

Table 4: Sterkfontein Acheulean quartzite raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; vf – very fine grained; f – fine grained; m – medium grained; c – coarse grained; vc – very coarse grained; g – granules; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	vf	f	m	c	vc	g	Sn	Tt	N	S	E
9232	chunk	1	3	33.3	9232	chunk		1					9232	chunk		1	
9484	chunk	0	2	0.0	9484	chunk				1			9511	chunk		1	
9511	chunk	2	2	100.0	9511	chunk			1				9484	chunk			1
2060	cleaver	0	21	0.0	2060	cleaver			1				10363	cleaver	1		
2066	cleaver	1	26	3.8	2066	cleaver			1				10521	cleaver	1		
10016	cleaver	0	19	0.0	10016	cleaver	1						2060	cleaver	1		
10363	cleaver	3	17	17.6	10363	cleaver			1				10016	cleaver	1		
10520	cleaver	3	26	11.5	10520	cleaver		1					10520	cleaver	1		
10521	cleaver	0	24	0.0	10521	cleaver		1					2066	cleaver	1		
153	core	1	17	5.9	153	core		1					9520	core	1		

9231	core	1	6	16.7	9231	core				1			10147	core	1		
9347	core	1	9	11.1	9347	core			1				10039	core	1		
9385	core	4	5	80.0	9385	core		1					153	core	1		
9448	core	0	5	0.0	9448	core	1						9347	core	1		
9520	core	0	23	0.0	9520	core		1					9670	core	1		
9619	core	5	22	22.7	9619	core		1					9385	core	1		
9670	core	4	5	80.0	9670	core		1					9619	core		1	
10022	core	1	21	4.8	10022	core			1				10022	core	1		
10039	core	0	24	0.0	10039	core	1						9448	core	1		
10042	core	0	22	0.0	10042	core	1						10042	core		1	
10097	core	2	12	16.7	10097	core			1				9231	core	1		
10147	core	5	14	35.7	10147	core			1				10097	core	1		
336	core chunk	3	8	37.5	336	core chunk				1			10041	core chunk	1		
9701	core chunk	0	5	0.0	9701	core chunk			1				9701	core chunk		1	
10041	core chunk	2	3	66.7	10041	core chunk		1					336	core chunk		1	
S9460	core chunk Bipolar?	2	5	40.0	S9460	core chunk			1				S9460	core chunk		1	
9399	core chunk, bipolar?	1	2	50.0	9399	core chunk, bipolar?			1				9399	core chunk, bipolar?	1		
9398	core chunk/ handaxe tip	0	15	0.0	9398	core chunk/ handaxe tip			1				9398	core chunk/ handaxe tip		1	
9611	cunky flake/scraper	3	11	27.3	9611	cunky flake			1				9611	cunky flake		1	
9523	flake	5	17	29.4	9523	flake or handaxe piece			1				9523	flake		1	
S341	flake, bipolar	0	4	0.0	S341	flake, bipolar		1					S341	flake, bipolar	1		
2054	handaxe	1	7	14.3	2054	handaxe			1				2054	handaxe	1		
2373	handaxe	10	41	24.4	2373	handaxe			1				2373	handaxe	1		
9690	proto biface	0	15	0.0	9690	prot biface			1				9690	proto biface	1		

n				Mean	n								n				
34				21.5%	34		4	10	17	3	0	0	34		23	10	1
						Percentage of sample	11.8	29.4	50.0	8.8	0.0	0.0		Percentage of sample	67.6	29.4	2.9

Table 5: Sterkfontein Acheulean quart raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**W, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
S9269	chunk	1	6	16.7	S9269	chunk	1	26	18.2	4.7	0.2	2.1	S9269	chunk	1		
S10357	chunk	1	7	14.3	S10357	chunk	2	37.9	29.3	11.1	0.2	1.8	S10357	chunk	1		
S6974	chunk	2	4	50.0	S6974	chunk	4	39	31.7	12.4	0.3	3.2	S6974	chunk	1		
S393	chunk	0	7	0.0	S393	chunk	2	29.6	27.4	8.1	0.2	2.5	S393	chunk	1		
S7154	chunk	3	7	42.9	S7154	chunk	1	20.8	15.5	3.2	0.3	3.1	S7154	chunk	1		
S9629	chunk	1	3	33.3	S9629	chunk	2	30.6	14.6	4.5	0.4	4.5	S9629	chunk	1		
S9631	chunk	1	4	25.0	S9631	chunk	9	16.5	17.2	2.8	3.2	31.7	S9631	chunk	1		
S9532	chunk	0	8	0.0	S9532	chunk	3	31.5	20.7	6.5	0.5	4.6	S9532	chunk	1		
S7863	chunk	0	12	0.0	S7863	chunk	12	46	40.8	18.8	0.6	6.4	S7863	chunk	1		
S7869	chunk	1	4	25.0	S7869	chunk	8	15.7	22	3.5	2.3	23.2	S7869	chunk	1		
S7786	chunk	0	7	0.0	S7786	chunk	1	22.7	17.5	4.0	0.3	2.5	S7786	chunk	1		
S9453	chunk	2	4	50.0	S9453	chunk	1	25.3	15.7	4.0	0.3	2.5	S9453	chunk		1	
S9537	chunk	0	8	0.0	S9537	chunk	13	41.8	30.7	12.8	1.0	10.1	S9537	chunk	1		
S2105	chunk	1	5	20.0	S2105	chunk	4	23.6	25.7	6.1	0.7	6.6	S2105	chunk	1		
S7862	chunk	0	3	0.0	S7862	chunk	9	26	19.8	5.1	1.7	17.5	S7862	chunk	1		
S9271	chunk	1	11	9.1	S9271	chunk	1	24.6	19.5	4.8	0.2	2.1	S9271	chunk	1		
S9307	chunk	1	9	11.1	S9307	chunk	1	21.3	19.3	4.1	0.2	2.4	S9307	chunk	1		

S9652	chunk, bipolar?	1	2	50.0	S9652	chunk, bipolar?	10	14.6	17.8	2.6	3.8	38.5	S9652	chunk, bipolar?		1	
S9408	chunk, posible tip	1	8	12.5	S9408	chunk, posible tip	1	18.5	11.9	2.2	0.5	4.5	S9408	chunk, posible tip	1		
7870	core	3	35	8.6	7870	core	3	76	46	35.0	0.1	0.9	7870	core	1		
S9677	core	0	10	0.0	S9677	core	1	39.5	29.7	11.7	0.1	0.9	S9677	core	1		
S9530	core	3	11	27.3	S9530	core	7	51.6	37	19.1	0.4	3.7	S9530	core	1		
S9430	core	10	19	52.6	S9430	core	10	49	38.7	19.0	0.5	5.3	S9430	core	1		
S9529	core	0	6	0.0	S9529	core	1	34	28.8	9.8	0.1	1.0	S9529	core	1		
S9662	core	0	16	0.0	S9662	core	1	63.3	56	35.4	0.0	0.3	S9662	core	1		
s9370	core	2	10	20.0	s9370	core	4	57.5	64.7	37.2	0.1	1.1	s9370	core	1		
S1146	core chunk	0	4	0.0	S1146	core chunk	3	50	32	16.0	0.2	1.9	S1146	core chunk	1		
S9663	core chunk	1	4	25.0	S9663	core chunk	5	41	40.4	16.6	0.3	3.0	S9663	core chunk	1		
S9452	core chunk, bipolar, retouch	0	14	0.0	S9452	core chunk, bipolar	1	40	24.7	9.9	0.1	1.0	S9452	core chunk, bipolar	1		
S7022	core cunk, bip?	0	2	0.0	S7022	core cunk, bip?	0	20.6	23.6	4.9	0.0	0.0	S7022	core cunk, bip?	1		
S9413	core, chunk	1	9	11.1	S9413	core, chunk	1	40	34.6	13.8	0.1	0.7	S9413	core, chunk	1		
S9613	flake	2	5	40.0	S9613	flake	7	21.8	14.3	3.1	2.2	22.5	S9613	flake		1	
S9639	flake in	0	5	0.0	S9639	flake in	1	12.12	17.6	2.1	0.5	4.7	S9639	flake in	1		
n				**Mean**	**n**							**Mean**	**n**				
33				16.5%	**33**							6.6	**33**		30	3	0
														Percentage of sample	90.9	9.1	0.0

Table 6: Sterkfontein Acheulean chert raw data.
Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	f	L, mm	W, mm	a cm2	f/cm2	f/10 cm2	Sn	Tt	N	S	E
4108	handaxe	0	25	0.0	4108	handaxe	1	118.0	71.0	83.8	0.0	0.1	4108	handaxe		1	
2053	handaxe	0	26	0.0	2053	handaxe	1	93.0	45.0	41.9	0.0	0.2	2053	hanaxe		1	
759	flake	3	10	30.0	759	flake	2	34.0	25.6	8.7	0.2	2.3	759	flake	1		
n				**Mean**	**n**							**Mean**	**n**				
3				10.0%	**3**							0.9	**3**		1	2	0
														Percentage of sample	33.3	66.7	0.0

Table 7: Swartkrans Oldowan quartzite raw data.
Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; vf – very fine grained; f – fine grained; m – medium grained; c – coarse grained; vc – very coarse grained; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	vf	f	m	c	vc	Sn	Tt	N	S	E
SWT 652	chopper core	6	15	40.0	**SWT 652**	chopper core			1			**SWT 652**	chopper core		1	
SWT 588	core, casual	0	9	0.0	**SWT 795**	chunk		1				**SWT 795**	chunk	1		
SWT 373	core, flat	0	11	0.0	**SWT 949**	chunk			1			**SWT 949**	chunk	1		
SWK 833	flake	0	7	0.0	**SWT 998**	chunk			1			**SWT 998**	chunk	1		
SWT 1071	flake	0	3	0.0	**SWT 588**	core, casual			1			**SWT 588**	core, casual		1	
SWT 688	flake	0	11	0.0	**SWT 689**	core, casual			1			**SWT 689**	core, casual	1		

SWT 997	flake	0	6	0.0	**SWT 527**	core, cent		1				**SWT 527**	core, cent	1		
SWT 153	retouch	0	26	0.0	**SWT 373**	core, flat				1		**SWT 373**	core, flat	1		
SWT 259	retouch	0	9	0.0	**SWT 699**	core, flat		1				**SWT 699**	core, flat	1		
SWT 444	retouch	0	11	0.0	**SWT 1002**	core, frag			1			**SWT 1002**	core, frag	1		
SWT 805	retouch	0	8	0.0	**SWT 733**	core, frag			1			**SWT 733**	core, frag		1	
SWT 1044	scraper	0	33	0.0	**SWT 50**	core, p			1			**SWT 50**	core, p		1	
SWT 1134	scraper	0	21	0.0	**SWT 709**	core, p			1			**SWT 709**	core, p		1	
SWT 553	retouch	0	9	0.0	**SWT 1025**	core, pi			1			**SWT 1025**	core, pi	1		
SWT 1100	retouch	1	32	3.1	**SWT 737**	core, pi		1				**SWT 737**	core, pi		1	
SWT 249	retouch	1	12	8.3	**SWT 650**	core, thrown / casual		1				**SWT 650**	core, thrown / casual		1	
SWT 1050	retouch	2	19	10.5	**SWT 216**	core,pi			1			**SWT 216**	core,pi	1		
SWT 1002	core, frag	1	9	11.1	**SWK 833**	flake			1			**SWK 833**	flake		1	
SWT 1101	flake	1	8	12.5	**SWT 1071**	flake			1			**SWT 1071**	flake	1		
SWT 1015	scraper	2	16	12.5	**SWT 1101**	flake		1				**SWT 1101**	flake		1	
SWT 603	scraper	3	19	15.8	**SWT 23**	flake		1				**SWT 23**	flake		1	
SWT 527	core, cent	4	24	16.7	**SWT 454**	flake			1			**SWT 454**	flake	1		
SWT 709	core, p	6	30	20.0	**SWT 563**	flake	1					**SWT 563**	flake			1
SWT 737	core, pi	2	10	20.0	**SWT 688**	flake		1				**SWT 688**	flake	1		
SWT 1059	retouch	8	33	24.2	**SWT 843**	flake			1			**SWT 843**	flake	1		
SWT 650	core, thrown / casual	2	8	25.0	**SWT 970**	flake		1				**SWT 970**	flake		1	
SWT 1025	core, pi	7	24	29.2	**SWT 997**	flake		1				**SWT 997**	flake	1		
SWT 50	core, p	2	6	33.3	**SWT**	retouch		1				**SWT 1050**	retouch	1		

					1050											
SWT 23	flake	2	6	33.3	**SWT 1059**	retouch			1			**SWT 1059**	retouch	1		
SWT 525	retouch	3	9	33.3	**SWT 1100**	retouch			1			**SWT 1100**	retouch	1		
SWT 529	retouch	9	24	37.5	**SWT 153**	retouch		1				**SWT 153**	retouch	1		
SWT 733	core, frag	4	10	40.0	**SWT 249**	retouch		1				**SWT 249**	retouch	1		
SWT 454	flake	1	2	50.0	**SWT 259**	retouch		1				**SWT 259**	retouch		1	
SWT 563	flake	2	4	50.0	**SWT 319**	retouch		1				**SWT 319**	retouch		1	
SWT 843	flake	1	2	50.0	**SWT 444**	retouch		1				**SWT 444**	retouch	1		
SWT 319	retouch	4	8	50.0	**SWT 529**	retouch		1				**SWT 529**	retouch	1		
SWT 795	chunk	6	10	60.0	**SWT 805**	retouch		1				**SWT 805**	retouch			1
SWT 699	core, flat	3	5	60.0	**SWT 1015**	scraper		1				**SWT 1015**	scraper	1		
SWT 949	chunk	2	3	66.7	**SWT 1044**	scraper		1				**SWT 1044**	scraper	1		
SWT 689	core, casual	2	3	66.7	**SWT 1134**	scraper			1			**SWT 1134**	scraper	1		
SWT 970	flake	2	3	66.7	**SWT 603**	scraper		1				**SWT 603**	scraper	1		
SWT 216	core,pi	15	17	88.2	**SWT 525**	retouch			1			**SWT 525**	retouch	1		
SWT 998	chunk	1	1	100.0	**SWT 553**	retouch			1			**SWT 553**	retouch	1		
n				**Mean**	**n**							**n**				
43				26.4%	**43**		1	21	20	1	0	**43**		28	13	2
						Percentage of sample	2.33	49	47	2	0		Percentage of sample	65.1	30.2	4.7

Table 8: Swartkrans Oldowan quartz raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	f	L, mm	W, mm	a cm2	f/cm2	f/10 cm2	Sn	Tt	N	S	E
SWT 1012	chunk	0	3	0.0	**SWT 1012**	chunk	9	13.6	6.4	0.9	10.3	103.4	**SWT 1012**	chunk		1	
SWT 1024	chunk	0	5	0.0	**SWT 1024**	chunk	2	15.2	10	1.5	1.3	13.2	**SWT 1024**	chunk	1		
SWT 1026	chunk	2	6	33.3	**SWT 1026**	chunk	1	16.7	10.2	1.7	0.6	5.9	**SWT 1026**	chunk	1		
SWT 1068	chunk	1	14	7.1	**SWT 1068**	chunk	4	21.7	13.5	2.9	1.4	13.7	**SWT 1068**	chunk	1		
SWT 1074	chunk	1	6	16.7	**SWT 1074**	chunk	2	19.8	11.3	2.2	0.9	8.9	**SWT 1074**	chunk	1		
SWT 1075/ 6?	chunk	0	11	0.0	**SWT 1075**	chunk	1	16.7	11.8	2.0	0.5	5.1	**SWT 1075**	chunk	1		
SWT 1095	chunk	2	4	50.0	**SWT 1095**	chunk	4	22.2	15.5	3.4	1.2	11.6	**SWT 1095**	chunk	1		
SWT 1105	chunk	1	7	14.3	**SWT 1105**	chunk	3	17.2	11.4	2.0	1.5	15.3	**SWT 1105**	chunk	1		
SWT 1106	chunk	5	10	50.0	**SWT 1106**	chunk	2	18.8	14	2.6	0.8	7.6	**SWT 1106**	chunk	1		
SWT 1109	chunk	0	14	0.0	**SWT 1109**	chunk	4	15.7	15.7	2.5	1.6	16.2	**SWT 1109**	chunk	1		
SWT 1164	chunk	5	8	62.5	**SWT 1164**	chunk	6	28.4	15	4.3	1.4	14.1	**SWT 1164**	chunk	1		
SWT 251	chunk	2	3	66.7	**SWT 251**	chunk	6	33	18.3	6.0	1.0	9.9	**SWT 251**	chunk		1	
SWT 264	chunk	0	15	0.0	**SWT 264**	chunk	1	17	13	2.2	0.5	4.5	**SWT 264**	chunk	1		
SWT 308	chunk	1	7	14.3	**SWT 308**	chunk	5	21.4	20.1	4.3	1.2	11.6	**SWT 308**	chunk		1	
SWT 463	chunk	1	7	14.3	**SWT 463**	chunk	2	28.1	16.6	4.7	0.4	4.3	**SWT 463**	chunk	1		
SWT 710	chunk	5	17	29.4	**SWT 710**	chunk	3	26	15.3	4.0	0.8	7.5	**SWT 710**	chunk	1		
SWT 755	chunk	5	5	100.0	**SWT 755**	chunk	2	19.7	17.2	3.4	0.6	5.9	**SWT 755**	chunk	1		
SWT 876	chunk	5	5	100.0	**SWT 876**	chunk	4	15	13.2	2.0	2.0	20.2	**SWT 876**	chunk		1	
SWT 881	chunk	3	3	100.0	**SWT 881**	chunk	2	17	12.5	2.1	0.9	9.4	**SWT 881**	chunk		1	
SWT 922	chunk	1	7	14.3	**SWT 922**	chunk	5	18	13.8	2.5	2.0	20.1	**SWT 922**	chunk	1		
SWT 946	chunk	0	6	0.0	**SWT 946**	chunk	2	18.2	10.4	1.9	1.1	10.6	**SWT 946**	chunk		1	

SWT 952	chunk	1	12	8.3	**SWT 952**	chunk	8	35	25.2	8.8	0.9	9.1	**SWT 952**	chunk		1	
SWT 979	chunk	5	12	41.7	**SWT 979**	chunk	4	25.6	13.6	3.5	1.1	11.5	**SWT 979**	chunk		1	
SWT 1096	Chunk	0	2	0.0	**SWT 1096**	Chunk	1	39.8	29.1	11.6	0.1	0.9	**SWT 1096**	Chunk	1		
SWT 612	Chunk	3	3	100.0	**SWT 612**	Chunk	6	39.4	20	7.9	0.8	7.6	**SWT 612**	Chunk		1	
SWT 104	Chunk	1	1	100.0	**SWT 104**	Chunk	3	17	11.4	1.9	1.5	15.5	**SWT 104**	Chunk	1		
SWT 787	Chunk	1	2	50.0	**SWT 787**	Chunk	1	24.2	16.3	3.9	0.3	2.5	**SWT 787**	Chunk	1		
SWT 975	chunk	1	3	33.3	**SWT 975**	chunk	5	15.2	11	1.7	3.0	29.9	**SWT 975**	chunk		1	
SWT 827	chunk	1	1	100.0	**SWT 827**	chunk	11	21.3	12.6	2.7	4.1	41.0	**SWT 827**	chunk		1	
SWT 604	chunk	2	3	66.7	**SWT 604**	chunk	5	27.5	14.7	4.0	1.2	12.4	**SWT 604**	chunk	1		
SWT 607	chunk	1	4	25.0	**SWT 607**	chunk	1	10.1	8.5	0.9	1.2	11.6	**SWT 607**	chunk	1		
SWT 628	Chunk	1	1	100.0	**SWT 628**	Chunk	3	16.3	11.7	1.9	1.6	15.7	**SWT 628**	Chunk	1		
SWT 645	chunk	0	6	0.0	**SWT 645**	chunk	1	15.7	14.7	2.3	0.4	4.3	**SWT 645**	chunk	1		
SWT 751	chunk	3	3	100.0	**SWT 751**	chunk	8	21	15.9	3.3	2.4	24.0	**SWT 751**	chunk	1		
SWT 453	Chunk	0	5	0.0	**SWT 453**	Chunk	4	13.4	12.2	1.6	2.4	24.5	**SWT 453**	Chunk	1		
SWT 284	chunk	2	2	100.0	**SWT 284**	chunk	5	21.4	6.4	1.4	3.7	36.5	**SWT 284**	chunk		1	
SWT 248	chunk bip	1	3	33.3	**SWT 248**	chunk bip	13	22.8	19.7	4.5	2.9	28.9	**SWT 248**	chunk bip	1		
SWT 37	chunk, bip	2	2	100.0	**SWT 37**	chunk, bip	6	22	15	3.3	1.8	18.2	**SWT 37**	chunk, bip	1		
SWT 269	chunk. Bip	5	8	62.5	**SWT 269**	chunk	2	37.8	18	6.8	0.3	2.9	**SWT 269**	chunk		1	
SWT 1010	core, bip	0	15	0.0	**SWT 1010**	core, bip	4	33.1	30.1	10.0	0.4	4.0	**SWT 1010**	core, bip	1		
SWT 275	core, bip	4	7	57.1	**SWT 275**	core, bip	4	36	28.7	10.3	0.4	3.9	**SWT 275**	core, bip	1		
SWT 279	core, bip	1	9	11.1	**SWT 279**	core, bip	10	24	18.2	4.4	2.3	22.9	**SWT 279**	core, bip	1		
SWT 347	core, bip	1	12	8.3	**SWT 347**	core, bip	1	26.2	15	3.9	0.3	2.5	**SWT 347**	core, bip	1		
SWT1035	core, bip	3	15	20.0	**SWT1035**	core, bip	2	22.5	17	3.8	0.5	5.2	**SWT1035**	core, bip	1		
SWT 692	core, bip	0	2	0.0	**SWT 692**	core, bip	4	17.8	16.8	3.0	1.3	13.4	**SWT 692**	core, bip	1		
SWT 286	core, bip	3	10	30.0	**SWT 286**	core, bip	7	18.1	11.3	2.0	3.4	34.2	**SWT 286**	core, bip		1	
SWT 978	core, bip frag	0	11	0.0	**SWT 978**	core, bip frag	3	34.1	30.3	10.3	0.3	2.9	**SWT 978**	core, bip frag	1		
SWT 789	Core, cas	1	1	100.0	**SWT 789**	Core, cas	2	23.5	13.2	3.1	0.6	6.4	**SWT 789**	Core, cas	1		
SWT 1031	core, casual	0	2	0.0	**SWT 1031**	core, casual	0	14	18.3	2.6	0.0	0.0	**SWT 1031**	core, casual	1		

SWT 735	core, casual	1	1	100.0	**SWT 735**	core, casual	4	32	28.9	9.2	0.4	4.3	**SWT 735**	core, casual		1	
SWT 771	core, casual	8	10	80.0	**SWT 771**	core, casual	10	11	11	1.2	8.3	82.6	**SWT 771**	core, casual		1	
SWT 951	core, casual	4	9	44.4	**SWT 951**	core, casual	7	26	24.3	6.3	1.1	11.1	**SWT 951**	core, casual		1	
SWT 11	core, cent	6	11	54.5	**SWT 11**	core, cent	12	47	38	17.9	0.7	6.7	**SWT 11**	core, cent	1		
SWT 121	core, cent	3	25	12.0	**SWT 121**	core, cent	3	50.3	47	23.6	0.1	1.3	**SWT 121**	core, cent	1		
SWT 392	core, cent	6	37	16.2	**SWT 392**	core, cent	21	20	18.7	3.7	5.6	56.1	**SWT 392**	core, cent	1		
SWT 4	core, cent	6	10	60.0	**SWT 4**	core, cent	2	26	23.2	6.0	0.3	3.3	**SWT 4**	core, cent	1		
SWT 792	core, cent	1	10	10.0	**SWT 792**	core, cent	2	43.9	28.9	12.7	0.2	1.6	**SWT 792**	core, cent	1		
SWT 911	core, cent	1	21	4.8	**SWT 911**	core, cent	2	60	34	20.4	0.1	1.0	**SWT 911**	core, cent	1		
SWT 815	core, chunk	2	4	50.0	**SWT 815**	core, chunk	4	32	24.4	7.8	0.5	5.1	**SWT 815**	core, chunk	1		
SWT 558	core, chunk	4	4	100.0	**SWT 558**	core, chunk	9	25.13	17.7	4.4	2.0	20.2	**SWT 558**	core, chunk		1	
SWT 1058	core, chunk, bip	2	4	50.0	**SWT 1058**	core, chunk	15	36.5	29.3	10.7	1.4	14.0	**SWT 1058**	core, chunk	1		
SWT 1023	core, pi	2	11	18.2	**SWT 1023**	core, pi	1	65	39	25.4	0.0	0.4	**SWT 1023**	core, pi	1		
SWT 1063	core, pi	2	26	7.7	**SWT 1063**	core, pi	13	29.4	14.1	4.1	3.1	31.4	**SWT 1063**	core, pi	1		
SWT 1080	core, pi	5	6	83.3	**SWT 1080**	core, pi	5	36.2	31	11.2	0.4	4.5	**SWT 1080**	core, pi		1	
SWT 250	core, pi	8	27	29.6	**SWT 250**	core, pi	4	28.4	27.5	7.8	0.5	5.1	**SWT 250**	core, pi	1		
SWT 376	core, pi	4	20	20.0	**SWT 376**	core, pi	11	18.8	9.7	1.8	6.0	60.3	**SWT 376**	core, pi		1	
SWT 387	core, pi	3	12	25.0	**SWT 387**	core, pi	2	45	36.6	16.5	0.1	1.2	**SWT 387**	core, pi	1		
SWT 53	core, pi	6	10	60.0	**SWT 53**	core, pi	4	50	33	16.5	0.2	2.4	**SWT 53**	core, pi		1	
SWT 557	core, pi	7	12	58.3	**SWT 557**	core, pi	14	20.2	13.2	2.7	5.3	52.5	**SWT 557**	core, pi	1		
SWT 642	core, pi	7	10	70.0	**SWT 642**	core, pi	4	41.6	33.5	13.9	0.3	2.9	**SWT 642**	core, pi	1		
SWT 865	core, pi	4	18	22.2	**SWT 865**	core, pi	4	48.6	40.8	19.8	0.2	2.0	**SWT 865**	core, pi	1		
SWT 704	core, split	1	1	100.0	**SWT 704**	core, split	8	36.6	29.5	10.8	0.7	7.4	**SWT 704**	core, split	1		
SWT 717	core, split, bip	1	2	50.0	**SWT 717**	core, split, bip	5	22.3	23.7	5.3	0.9	9.5	**SWT 717**	core, split, bip		1	
SWT 995	core. Bip	2	5	40.0	**SWT 995**	core. Bip	13	36.9	22.6	8.3	1.6	15.6	**SWT 995**	core. Bip	1		

SWT 1057	denticulate	0	15	0.0	**SWT 1057**	denticulate	3	31	14	4.3	0.7	6.9	**SWT 1057**	denticulate	1		
SWT 1	flake	1	5	20.0	**SWT 1**	flake	1	38	19.8	7.5	0.1	1.3	**SWT 1**	flake	1		
SWT 101	flake	0	8	0.0	**SWT 101**	flake	12	20.3	14.7	3.0	4.0	40.2	**SWT 101**	flake	1		
SWT 1017	flake	3	3	100.0	**SWT 1017**	flake	20	42.4	23	9.8	2.1	20.5	**SWT 1017**	flake		1	
SWT 1021	flake	0	1	0.0	**SWT 1021**	flake	1	20.8	18.1	3.8	0.3	2.7	**SWT 1021**	flake	1		
SWT 1053	flake	2	4	50.0	**SWT 1053**	flake	4	21.7	15.7	3.4	1.2	11.7	**SWT 1053**	flake		1	
SWT 1056	flake	2	6	33.3	**SWT 1056**	flake	1	21	17	3.6	0.3	2.8	**SWT 1056**	flake		1	
SWT 1066	flake	3	5	60.0	**SWT 1066**	flake	3	22.6	20.6	4.7	0.6	6.4	**SWT 1066**	flake		1	
SWT 107	flake	3	3	100.0	**SWT 107**	flake	13	20.8	11.4	2.4	5.5	54.8	**SWT 107**	flake		1	
SWT 1070	flake	2	5	40.0	**SWT 1070**	flake	1	37.5	34.4	12.9	0.1	0.8	**SWT 1070**	flake		1	
SWT 1073	flake	2	2	100.0	**SWT 1073**	flake	7	12.8	9.8	1.3	5.6	55.8	**SWT 1073**	flake		1	
SWT 1077	flake	0	3	0.0	**SWT 1077**	flake	13	7.7	8.7	0.7	19.4	194.1	**SWT 1077**	flake		1	
SWT 1081	flake	1	1	100.0	**SWT 1081**	flake	3	28.2	22	6.2	0.5	4.8	**SWT 1081**	flake	1		
SWT 1087	flake	2	3	66.7	**SWT 1087**	flake	5	19.6	18.4	3.6	1.4	13.9	**SWT 1087**	flake	1		
SWT 1116	flake	0	3	0.0	**SWT 1116**	flake	0	23	7.4	1.7	0.0	0.0	**SWT 1116**	flake	1		
SWT 1130	flake	5	14	35.7	**SWT 1130**	flake	2	36.7	28.8	10.6	0.2	1.9	**SWT 1130**	flake	1		
SWT 1160	flake	1	4	25.0	**SWT 1160**	flake	1	26.8	14.7	3.9	0.3	2.5	**SWT 1160**	flake	1		
SWT 1175	flake	6	7	85.7	**SWT 1175**	flake	4	30.4	12.5	3.8	1.1	10.5	**SWT 1175**	flake		1	
SWT 1178	flake	2	9	22.2	**SWT 1178**	flake	3	18.4	13.2	2.4	1.2	12.4	**SWT 1178**	flake	1		
SWT 1200	flake	0	4	0.0	**SWT 1200**	flake	5	19.5	16.3	3.2	1.6	15.7	**SWT 1200**	flake		1	
SWT 14	flake	2	6	33.3	**SWT 14**	flake	3	18.5	16.7	3.1	1.0	9.7	**SWT 14**	flake	1		
SWT 155	flake	1	4	25.0	**SWT 155**	flake	1	19.3	13.2	2.5	0.4	3.9	**SWT 155**	flake	1		
SWT 159	flake	3	5	60.0	**SWT 159**	flake	8	22	18	4.0	2.0	20.2	**SWT 159**	flake		1	
SWT 16	flake	3	13	23.1	**SWT 16**	flake	4	29.5	21.8	6.4	0.6	6.2	**SWT 16**	flake	1		
SWT 177	flake	4	4	100.0	**SWT 177**	flake	3	16.8	15	2.5	1.2	11.9	**SWT 177**	flake		1	
SWT 22	flake	1	6	16.7	**SWT 22**	flake	1	15.8	14.3	2.3	0.4	4.4	**SWT 22**	flake	1		
SWT 220	flake	2	4	50.0	**SWT 220**	flake	5	24.6	10	2.5	2.0	20.3	**SWT 220**	flake		1	
SWT 257	flake	2	8	25.0	**SWT 257**	flake	6	46.7	23.7	11.1	0.5	5.4	**SWT 257**	flake	1		
SWT 277	flake	4	8	50.0	**SWT 277**	flake	2	17.4	11.3	2.0	1.0	10.2	**SWT 277**	flake	1		

SWT 280	flake	0	9	0.0	**SWT 280**	flake	0	24.2	9.6	2.3	0.0	0.0	**SWT 280**	flake	1		
SWT 289	flake	0	1	0.0	**SWT 289**	flake	0	18.4	18.2	3.3	0.0	0.0	**SWT 289**	flake	1		
SWT 292	flake	1	4	25.0	**SWT 292**	flake	2	16	11.1	1.8	1.1	11.3	**SWT 292**	flake		1	
SWT 293	flake	1	1	100.0	**SWT 293**	flake	3	18.6	14.1	2.6	1.1	11.4	**SWT 293**	flake		1	
SWT 294	flake	1	6	16.7	**SWT 294**	flake	1	18.7	10.2	1.9	0.5	5.2	**SWT 294**	flake	1		
SWT 3	flake	2	4	50.0	**SWT 3**	flake	4	19.7	17.1	3.4	1.2	11.9	**SWT 3**	flake		1	
SWT 30	flake	3	5	60.0	**SWT 30**	flake	10	39.7	21	8.3	1.2	12.0	**SWT 30**	flake		1	
SWT 31	flake	1	4	25.0	**SWT 31**	flake	5	34.2	25.8	8.8	0.6	5.7	**SWT 31**	flake		1	
SWT 310	flake	0	7	0.0	**SWT 310**	flake	3	18	10.7	1.9	1.6	15.6	**SWT 310**	flake	1		
SWT 313	flake	3	18	16.7	**SWT 313**	flake	8	38.4	31.5	12.1	0.7	6.6	**SWT 313**	flake	1		
SWT 33	flake	0	1	0.0	**SWT 33**	flake	1	19.2	14.5	2.8	0.4	3.6	**SWT 33**	flake	1		
SWT 372	flake	1	8	12.5	**SWT 372**	flake	1	16.8	10.1	1.7	0.6	5.9	**SWT 372**	flake	1		
SWT 39	flake	0	10	0.0	**SWT 39**	flake	1	22	11.2	2.5	0.4	4.1	**SWT 39**	flake	1		
SWT 41	flake	2	7	28.6	**SWT 41**	flake	9	19	13.7	2.6	3.5	34.6	**SWT 41**	flake		1	
SWT 435	flake	0	4	0.0	**SWT 435**	flake	1	18.3	8.2	1.5	0.7	6.7	**SWT 435**	flake	1		
SWT 44	flake	1	6	16.7	**SWT 44**	flake	3	36	18.5	6.7	0.5	4.5	**SWT 44**	flake	1		
SWT 468	flake	3	6	50.0	**SWT 468**	flake	4	17.6	12.4	2.2	1.8	18.3	**SWT 468**	flake		1	
SWT 503	flake	4	7	57.1	**SWT 503**	flake	20	24.8	22.5	5.6	3.6	35.8	**SWT 503**	flake		1	
SWT 507	flake	2	3	66.7	**SWT 507**	flake	19	16.7	12.8	2.1	8.9	88.9	**SWT 507**	flake		1	
SWT 510	flake	1	6	16.7	**SWT 510**	flake	15	23	24.8	5.7	2.6	26.3	**SWT 510**	flake	1		
SWT 560	flake	5	13	38.5	**SWT 560**	flake	2	18.7	10	1.9	1.1	10.7	**SWT 560**	flake	1		
SWT 562	flake	2	3	66.7	**SWT 562**	flake	2	14.6	12.8	1.9	1.1	10.7	**SWT 562**	flake	1		
SWT 587	flake	1	2	50.0	**SWT 587**	flake	8	25	14	3.5	2.3	22.9	**SWT 587**	flake		1	
SWT 609	flake	2	2	100.0	**SWT 609**	flake	19	22.3	13	2.9	6.6	65.5	**SWT 609**	flake	1		
SWT 63	flake	2	13	15.4	**SWT 63**	flake	3	22	14.5	3.2	0.9	9.4	**SWT 63**	flake	1		
SWT 665	flake	1	4	25.0	**SWT 665**	flake	4	21.2	15.3	3.2	1.2	12.3	**SWT 665**	flake	1		
SWT 682	flake	1	4	25.0	**SWT 682**	flake	3	15.7	11.3	1.8	1.7	16.9	**SWT 682**	flake	1		
SWT 684	flake	2	7	28.6	**SWT 684**	flake	1	19	15.8	3.0	0.3	3.3	**SWT 684**	flake	1		
SWT 698	flake	3	3	100.0	**SWT 698**	flake	2	22.4	13	2.9	0.7	6.9	**SWT 698**	flake	1		

SWT 702	flake	6	6	100.0	**SWT 702**	flake	4	37.5	16.1	6.0	0.7	6.6	**SWT 702**	flake	1		
SWT 71	flake	1	2	50.0	**SWT 71**	flake	4	23	14.2	3.3	1.2	12.2	**SWT 71**	flake		1	
SWT 714	flake	5	7	71.4	**SWT 714**	flake	4	17.4	11.7	2.0	2.0	19.6	**SWT 714**	flake	1		
SWT 73	flake	2	5	40.0	**SWT 73**	flake	4	33.2	29.8	9.9	0.4	4.0	**SWT 73**	flake	1		
SWT 731	flake	0	8	0.0	**SWT 731**	flake	3	22.5	13.5	3.0	1.0	9.9	**SWT 731**	flake	1		
SWT 74	flake	4	7	57.1	**SWT 74**	flake	8	32.5	23.7	7.7	1.0	10.4	**SWT 74**	flake		1	
SWT 753	flake	0	16	0.0	**SWT 753**	flake	12	34	21	7.1	1.7	16.8	**SWT 753**	flake	1		
SWT 758	flake	4	4	100.0	**SWT 758**	flake	6	12.4	8.7	1.1	5.6	55.6	**SWT 758**	flake		1	
SWT 774	flake	1	7	14.3	**SWT 774**	flake	2	16.8	15	2.5	0.8	7.9	**SWT 774**	flake	1		
SWT 776	flake	5	7	71.4	**SWT 776**	flake	2	17.5	11.1	1.9	1.0	10.3	**SWT 776**	flake	1		
SWT 804	flake	0	4	0.0	**SWT 804**	flake	1	17.7	9.9	1.8	0.6	5.7	**SWT 804**	flake		1	
SWT 838	flake	4	4	100.0	**SWT 838**	flake	3	25.8	20.2	5.2	0.6	5.8	**SWT 838**	flake		1	
SWT 839	flake	1	1	100.0	**SWT 839**	flake	1	17.6	13	2.3	0.4	4.4	**SWT 839**	flake	1		
SWT 850	flake	2	8	25.0	**SWT 850**	flake	1	20.3	18.4	3.7	0.3	2.7	**SWT 850**	flake	1		
SWT 853	flake	1	4	25.0	**SWT 853**	flake	2	21	15.8	3.3	0.6	6.0	**SWT 853**	flake		1	
SWT 854	flake	2	8	25.0	**SWT 854**	flake	3	23.7	21.1	5.0	0.6	6.0	**SWT 854**	flake	1		
SWT 856	flake	0	5	0.0	**SWT 856**	flake	1	17.6	17.2	3.0	0.3	3.3	**SWT 856**	flake	1		
SWT 858	flake	0	1	0.0	**SWT 858**	flake	0	30.6	11.2	3.4	0.0	0.0	**SWT 858**	flake	1		
SWT 884	flake	2	3	66.7	**SWT 884**	flake	1	25.7	13.7	3.5	0.3	2.8	**SWT 884**	flake		1	
SWT 89	flake	3	16	18.8	**SWT 89**	flake	4	18.3	12.4	2.3	1.8	17.6	**SWT 89**	flake	1		
SWT 929	flake	0	7	0.0	**SWT 929**	flake	3	17	13.9	2.4	1.3	12.7	**SWT 929**	flake	1		
SWT 932	flake	0	6	0.0	**SWT 932**	flake	1	18.1	16	2.9	0.3	3.5	**SWT 932**	flake	1		
SWT 936	flake	1	1	100.0	**SWT 936**	flake	6	24	16	3.8	1.6	15.6	**SWT 936**	flake		1	
SWT 954	flake	2	10	20.0	**SWT 954**	flake	3	20.2	16.0	3.2	0.9	9.3	**SWT 954**	flake		1	
SWT 958	flake	1	1	100.0	**SWT 958**	flake	2	24.2	13.5	3.3	0.6	6.1	**SWT 958**	flake		1	
SWT 963	flake	0	9	0.0	**SWT 963**	flake	2	20.7	7.3	1.5	1.3	13.2	**SWT 963**	flake	1		
SWT 965	flake	2	5	40.0	**SWT 965**	flake	1	22.2	9.7	2.2	0.5	4.6	**SWT 965**	flake	1		
SWT 967	flake	0	6	0.0	**SWT 967**	flake	15	21	18.7	3.9	3.8	38.2	**SWT 967**	flake	1		
SWT 969	flake	3	7	42.9	**SWT 969**	flake	6	10	10	1.0	6.0	60.0	**SWT 969**	flake		1	

SWT 97	flake	0	3	0.0	**SWT 97**	flake	1	14.6	7.4	1.1	0.9	9.3	**SWT 97**	flake	1		
SWT 973	flake	0	11	0.0	**SWT 973**	flake	1	21	18.2	3.8	0.3	2.6	**SWT 973**	flake	1		
SWT 980	flake	2	5	40.0	**SWT 980**	flake	3	23.2	18.7	4.3	0.7	6.9	**SWT 980**	flake		1	
SWT 982	flake	2	11	18.2	**SWT 982**	flake	1	18	16.5	3.0	0.3	3.4	**SWT 982**	flake	1		
SWT 983	flake	3	6	50.0	**SWT 983**	flake	5	20.5	18.2	3.7	1.3	13.4	**SWT 983**	flake		1	
SWT 984	flake	3	4	75.0	**SWT 984**	flake	3	21.7	13.8	3.0	1.0	10.0	**SWT 984**	flake	1		
SWT 985	flake	1	1	100.0	**SWT 985**	flake	3	14.2	12	1.7	1.8	17.6	**SWT 985**	flake		1	
SWT 991	flake	2	5	40.0	**SWT 991**	flake	0	21.7	7	1.5	0.0	0.0	**SWT 991**	flake	1		
SWT 992	flake	1	4	25.0	**SWT 992**	flake	2	20.5	11.2	2.3	0.9	8.7	**SWT 992**	flake		1	
SWT 10	Flake	0	1	0.0	**SWT 10**	Flake	3	24	10.1	2.4	1.2	12.4	**SWT 10**	Flake	1		
SWT 135	Flake	0	5	0.0	**SWT 135**	Flake	1	15.6	14.9	2.3	0.4	4.3	**SWT 135**	Flake	1		
SWT 520	Flake	1	6	16.7	**SWT 520**	Flake	0	22	14	3.1	0.0	0.0	**SWT 520**	Flake	1		
SWT 48	Flake	0	1	0.0	**SWT 48**	Flake	3	22.7	15.6	3.5	0.8	8.5	**SWT 48**	Flake	1		
SWT 62	Flake	1	1	100.0	**SWT 62**	Flake	5	23.5	17.1	4.0	1.2	12.4	**SWT 62**	Flake	1		
SWT 498	Flake	2	2	100.0	**SWT 498**	Flake	2	18.3	15	2.7	0.7	7.3	**SWT 498**	Flake	1		
SWT 905	Flake	1	3	33.3	**SWT 905**	Flake	2	13	9.6	1.2	1.6	16.0	**SWT 905**	Flake	1		
SWT 1104	Flake	0	1	0.0	**SWT 1104**	Flake	5	16.4	15.6	2.6	2.0	19.5	**SWT 1104**	Flake	1		
SWT 643	Flake	1	2	50.0	**SWT 643**	Flake	5	29.4	17.4	5.1	1.0	9.8	**SWT 643**	Flake	1		
SWT 655	Flake	1	1	100.0	**SWT 655**	Flake	6	21.3	15.6	3.3	1.8	18.1	**SWT 655**	Flake	1		
SWT 663	Flake	2	2	100.0	**SWT 663**	Flake	9	35.2	8.7	3.1	2.9	29.4	**SWT 663**	Flake	1		
SWT 816	Flake	2	3	66.7	**SWT 816**	Flake	2	20.2	19.4	3.9	0.5	5.1	**SWT 816**	Flake	1		
SWT 136	Flake	0	4	0.0	**SWT 136**	Flake	3	18.3	11.7	2.1	1.4	14.0	**SWT 136**	Flake	1		
SWT 619	Flake	0	1	0.0	**SWT 619**	Flake	2	21.3	13	2.8	0.7	7.2	**SWT 619**	Flake	1		
SWT 644	Flake	1	6	16.7	**SWT 644**	Flake	3	21.4	15.1	3.2	0.9	9.3	**SWT 644**	Flake	1		
SWT 819	Flake	2	2	100.0	**SWT 819**	Flake	3	19.3	8.7	1.7	1.8	17.9	**SWT 819**	Flake	1		
SWT 1035	Flake	2	6	33.3	**SWT 1035**	Flake	3	19.6	16.3	3.2	0.9	9.4	**SWT 1035**	Flake	1		
SWT 772	Flake	1	1	100.0	**SWT 772**	Flake	1	15.7	13.4	2.1	0.5	4.8	**SWT 772**	Flake	1		
SWT 140	Flake	0	4	0.0	**SWT 140**	Flake	1	14.2	13	1.8	0.5	5.4	**SWT 140**	Flake	1		
SWT 978	Flake	0	4	0.0	**SWT 978**	Flake	0	1	1	0.0	0.0	0.0	**SWT 978**	Flake	1		

SWT 1007	retouch	1	12	8.3	**SWT 1007**	retouch	0	18.7	5.3	1.0	0.0	0.0	**SWT 1007**	retouch	1		
SWT 1008	retouch	1	15	6.7	**SWT 1008**	retouch	5	25	25	6.3	0.8	8.0	**SWT 1008**	retouch	1		
SWT 1009	retouch	2	10	20.0	**SWT 1009**	retouch	10	27.5	25.3	7.0	1.4	14.4	**SWT 1009**	retouch		1	
SWT 103	retouch	0	17	0.0	**SWT 103**	retouch	2	21.6	12.8	2.8	0.7	7.2	**SWT 103**	retouch	1		
SWT 1030	retouch	0	11	0.0	**SWT 1030**	retouch	1	21.6	7.3	1.6	0.6	6.3	**SWT 1030**	retouch	1		
SWT 1032	retouch	2	19	10.5	**SWT 1032**	retouch	2	24.5	14.4	3.5	0.6	5.7	**SWT 1032**	retouch	1		
SWT 1037	retouch	4	17	23.5	**SWT 1037**	retouch	14	27.5	23.4	6.4	2.2	21.8	**SWT 1037**	retouch		1	
SWT 1039	retouch	0	6	0.0	**SWT 1039**	retouch	1	20	15.8	3.2	0.3	3.2	**SWT 1039**	retouch	1		
SWT 1047	retouch	0	14	0.0	**SWT 1047**	retouch	3	30.2	17	5.1	0.6	5.8	**SWT 1047**	retouch	1		
SWT 1048	retouch	2	6	33.3	**SWT 1048**	retouch	2	22	16.4	3.6	0.6	5.5	**SWT 1048**	retouch		1	
SWT 1049	retouch	0	21	0.0	**SWT 1049**	retouch	1	23.5	19.5	4.6	0.2	2.2	**SWT 1049**	retouch	1		
SWT 1054	retouch	2	12	16.7	**SWT 1054**	retouch	2	21	19.7	4.1	0.5	4.8	**SWT 1054**	retouch	1		
SWT 1055	retouch	1	15	6.7	**SWT 1055**	retouch	1	22.6	16	3.6	0.3	2.8	**SWT 1055**	retouch	1		
SWT 1065	retouch	0	5	0.0	**SWT 1065**	retouch	1	29.4	9	2.6	0.4	3.8	**SWT 1065**	retouch	1		
SWT 1075	retouch	0	10	0.0	**SWT 1075**	retouch	1	20	10.8	2.2	0.5	4.6	**SWT 1075**	retouch	1		
SWT 1079	retouch	1	15	6.7	**SWT 1079**	retouch	3	33.3	18.2	6.1	0.5	5.0	**SWT 1079**	retouch	1		
SWT 108	retouch	4	11	36.4	**SWT 108**	retouch	2	25.3	17.3	4.4	0.5	4.6	**SWT 108**	retouch	1		
SWT 1084	retouch	0	19	0.0	**SWT 1084**	retouch	2	18	12.3	2.2	0.9	9.0	**SWT 1084**	retouch	1		
SWT 1088	retouch	1	26	3.8	**SWT 1088**	retouch	15	21	10.8	2.3	6.6	66.1	**SWT 1088**	retouch	1		
SWT 1090	retouch	1	5	20.0	**SWT 1090**	retouch	11	15.3	15	2.3	4.8	47.9	**SWT 1090**	retouch	1		
SWT 1091	retouch	6	11	54.5	**SWT 1091**	retouch	3	28	20.7	5.8	0.5	5.2	**SWT 1091**	retouch		1	
SWT 1094	retouch	4	18	22.2	**SWT 1094**	retouch	3	21.5	15.7	3.4	0.9	8.9	**SWT 1094**	retouch	1		
SWT 1097	retouch	2	13	15.4	**SWT 1097**	retouch	1	19.3	12.4	2.4	0.4	4.2	**SWT 1097**	retouch	1		
SWT 1099	retouch	3	12	25.0	**SWT 1099**	retouch	2	19.7	12.7	2.5	0.8	8.0	**SWT 1099**	retouch	1		
SWT 1110	retouch	2	7	28.6	**SWT 1110**	retouch	0	15	12.4	1.9	0.0	0.0	**SWT 1110**	retouch	1		
SWT 1113	retouch	0	16	0.0	**SWT 1113**	retouch	3	26.7	13.5	3.6	0.8	8.3	**SWT 1113**	retouch	1		
SWT 1120	retouch	6	12	50.0	**SWT 1120**	retouch	2	28.7	16.7	4.8	0.4	4.2	**SWT 1120**	retouch	1		
SWT 1132	retouch	1	1	100.0	**SWT 1132**	retouch	3	18.4	18.3	3.4	0.9	8.9	**SWT 1132**	retouch	1		
SWT 1135	retouch	1	3	33.3	**SWT 1135**	retouch	2	24	20.5	4.9	0.4	4.1	**SWT 1135**	retouch	1		

SWT 1146	retouch	2	9	22.2	**SWT 1146**	retouch	1	16.8	12.3	2.1	0.5	4.8	**SWT 1146**	retouch		1	
SWT 115	retouch	0	14	0.0	**SWT 115**	retouch	1	18	15	2.7	0.4	3.7	**SWT 115**	retouch	1		
SWT 1154	retouch	2	17	11.8	**SWT 1154**	retouch	2	27	10.3	2.8	0.7	7.2	**SWT 1154**	retouch	1		
SWT 1155	retouch	0	7	0.0	**SWT 1155**	retouch	3	18.6	13	2.4	1.2	12.4	**SWT 1155**	retouch	1		
SWT 1156	retouch	2	10	20.0	**SWT 1156**	retouch	14	27	14.4	3.9	3.6	36.0	**SWT 1156**	retouch	1		
SWT 1172	retouch	1	9	11.1	**SWT 1172**	retouch	5	24.6	14.6	3.6	1.4	13.9	**SWT 1172**	retouch		1	
SWT 1173	retouch	1	10	10.0	**SWT 1173**	retouch	3	18.8	14.7	2.8	1.1	10.9	**SWT 1173**	retouch	1		
SWT 1180	retouch	10	15	66.7	**SWT 1180**	retouch	2	36.5	25	9.1	0.2	2.2	**SWT 1180**	retouch	1		
SWT 1181	retouch	0	19	0.0	**SWT 1181**	retouch	1	25	18	4.5	0.2	2.2	**SWT 1181**	retouch	1		
SWT 12	retouch	2	16	12.5	**SWT 12**	retouch	4	28	17.5	4.9	0.8	8.2	**SWT 12**	retouch		1	
SWT 124	retouch	9	21	42.9	**SWT 124**	retouch	4	48.2	35.4	17.1	0.2	2.3	**SWT 124**	retouch		1	
SWT 125	retouch	5	20	25.0	**SWT 125**	retouch	5	40	18.7	7.5	0.7	6.7	**SWT 125**	retouch	1		
SWT 126	retouch	5	17	29.4	**SWT 126**	retouch	2	42	30.3	12.7	0.2	1.6	**SWT 126**	retouch		1	
SWT 179	retouch	4	14	28.6	**SWT 179**	retouch	36	78	50.5	39.4	0.9	9.1	**SWT 179**	retouch	1		
SWT 18	retouch	3	11	27.3	**SWT 18**	retouch	1	39.8	28	11.1	0.1	0.9	**SWT 18**	retouch	1		
SWT 182	retouch	0	5	0.0	**SWT 182**	retouch	17	16.7	12	2.0	8.5	84.8	**SWT 182**	retouch	1		
SWT 187	retouch	0	17	0.0	**SWT 187**	retouch	0	16.3	10.4	1.7	0.0	0.0	**SWT 187**	retouch	1		
SWT 2	retouch	1	8	12.5	**SWT 2**	retouch	14	15	15	2.3	6.2	62.2	**SWT 2**	retouch		1	
SWT 20	retouch	0	30	0.0	**SWT 20**	retouch	0	31.5	16	5.0	0.0	0.0	**SWT 20**	retouch	1		
SWT 21	retouch	1	10	10.0	**SWT 21**	retouch	1	18.5	16.5	3.1	0.3	3.3	**SWT 21**	retouch	1		
SWT 210	retouch	14	22	63.6	**SWT 210**	retouch	3	34.4	29.5	10.1	0.3	3.0	**SWT 210**	retouch		1	
SWT 213	retouch	7	31	22.6	**SWT 213**	retouch	1	18.6	15.8	2.9	0.3	3.4	**SWT 213**	retouch	1		
SWT 219	retouch	0	10	0.0	**SWT 219**	retouch	13	9	8.8	0.8	16.4	164.1	**SWT 219**	retouch	1		
SWT 252	retouch	0	11	0.0	**SWT 252**	retouch	0	20.4	13.7	2.8	0.0	0.0	**SWT 252**	retouch	1		
SWT 253	retouch	0	11	0.0	**SWT 253**	retouch	1	19	12.2	2.3	0.4	4.3	**SWT 253**	retouch	1		
SWT 256	retouch	9	27	33.3	**SWT 256**	retouch	5	37.2	28.6	10.6	0.5	4.7	**SWT 256**	retouch		1	
SWT 260	retouch	4	8	50.0	**SWT 260**	retouch	3	19	15	2.9	1.1	10.5	**SWT 260**	retouch		1	
SWT 267	retouch	5	23	21.7	**SWT 267**	retouch	6	29.2	15	4.4	1.4	13.7	**SWT 267**	retouch		1	
SWT 271	retouch	1	19	5.3	**SWT 271**	retouch	1	22	20	4.4	0.2	2.3	**SWT 271**	retouch	1		

SWT 276	retouch	0	12	0.0	**SWT 276**	retouch	0	16.2	14.4	2.3	0.0	0.0	**SWT 276**	retouch	1		
SWT 282	retouch	4	14	28.6	**SWT 282**	retouch	3	25	16.8	4.2	0.7	7.1	**SWT 282**	retouch		1	
SWT 285	retouch	0	15	0.0	**SWT 285**	retouch	9	20.4	8	1.6	5.5	55.1	**SWT 285**	retouch		1	
SWT 291	retouch	1	8	12.5	**SWT 291**	retouch	4	26.4	17	4.5	0.9	8.9	**SWT 291**	retouch		1	
SWT 297	retouch	1	9	11.1	**SWT 297**	retouch	3	22.8	10.4	2.4	1.3	12.7	**SWT 297**	retouch		1	
SWT 309	retouch	3	8	37.5	**SWT 309**	retouch	4	18.5	16.7	3.1	1.3	12.9	**SWT 309**	retouch	1		
SWT 311	retouch	2	23	8.7	**SWT 311**	retouch	0	20	11.1	2.2	0.0	0.0	**SWT 311**	retouch	1		
SWT 314	retouch	0	15	0.0	**SWT 314**	retouch	2	27	24.3	6.6	0.3	3.0	**SWT 314**	retouch	1		
SWT 318	retouch	7	11	63.6	**SWT 318**	retouch	8	12.7	10.8	1.4	5.8	58.3	**SWT 318**	retouch		1	
SWT 34	retouch	5	13	38.5	**SWT 34**	retouch	2	22.4	10.3	2.3	0.9	8.7	**SWT 34**	retouch	1		
SWT 345	retouch	2	16	12.5	**SWT 345**	retouch	2	25.8	16.8	4.3	0.5	4.6	**SWT 345**	retouch	1		
SWT 346	retouch	2	11	18.2	**SWT 346**	retouch	1	20.4	8.6	1.8	0.6	5.7	**SWT 346**	retouch	1		
SWT 348	retouch	4	15	26.7	**SWT 348**	retouch	4	32.2	19	6.1	0.7	6.5	**SWT 348**	retouch		1	
SWT 349	retouch	3	20	15.0	**SWT 349**	retouch	2	18.5	15.3	2.8	0.7	7.1	**SWT 349**	retouch	1		
SWT 35	retouch	0	15	0.0	**SWT 35**	retouch	8	25	5.2	1.3	6.2	61.5	**SWT 35**	retouch	1		
SWT 350	retouch	0	13	0.0	**SWT 350**	retouch	1	22.2	21	4.7	0.2	2.1	**SWT 350**	retouch	1		
SWT 359	retouch	0	7	0.0	**SWT 359**	retouch	1	18	10	1.8	0.6	5.6	**SWT 359**	retouch	1		
SWT 36	retouch	3	10	30.0	**SWT 36**	retouch	1	29	17	4.9	0.2	2.0	**SWT 36**	retouch	1		
SWT 371	retouch	4	10	40.0	**SWT 371**	retouch	6	31.6	23.8	7.5	0.8	8.0	**SWT 371**	retouch		1	
SWT 38	retouch	2	7	28.6	**SWT 38**	retouch	2	17.2	12.1	2.1	1.0	9.6	**SWT 38**	retouch	1		
SWT 380	retouch	3	8	37.5	**SWT 380**	retouch	3	22.7	17	3.9	0.8	7.8	**SWT 380**	retouch		1	
SWT 388	retouch	0	11	0.0	**SWT 388**	retouch	5	20.7	13	2.7	1.9	18.6	**SWT 388**	retouch	1		
SWT 390	retouch	0	16	0.0	**SWT 390**	retouch	0	15.6	9.1	1.4	0.0	0.0	**SWT 390**	retouch	1		
SWT 393	retouch	1	27	3.7	**SWT 393**	retouch	1	25.8	20	5.2	0.2	1.9	**SWT 393**	retouch	1		
SWT 398	retouch	3	11	27.3	**SWT 398**	retouch	9	16	15	2.4	3.8	37.5	**SWT 398**	retouch		1	
SWT 399	retouch	0	13	0.0	**SWT 399**	retouch	0	23.4	9.4	2.2	0.0	0.0	**SWT 399**	retouch	1		
SWT 40	retouch	1	9	11.1	**SWT 40**	retouch	1	21.4	12.3	2.6	0.4	3.8	**SWT 40**	retouch	1		
SWT 403	retouch	5	10	50.0	**SWT 403**	retouch	6	31.6	22	7.0	0.9	8.6	**SWT 403**	retouch		1	
SWT 404	retouch	1	19	5.3	**SWT 404**	retouch	8	30	23	6.9	1.2	11.6	**SWT 404**	retouch	1		

SWT 411	retouch	1	15	6.7	**SWT 411**	retouch	4	41.1	23	9.5	0.4	4.2	**SWT 411**	retouch	1		
SWT 412	retouch	0	7	0.0	**SWT 412**	retouch	0	15.5	15.3	2.4	0.0	0.0	**SWT 412**	retouch	1		
SWT 42	retouch	3	16	18.8	**SWT 42**	retouch	4	29.4	17	5.0	0.8	8.0	**SWT 42**	retouch	1		
SWT 421	retouch	1	8	12.5	**SWT 421**	retouch	3	17.2	13.7	2.4	1.3	12.7	**SWT 421**	retouch	1		
SWT 423	retouch	9	9	100.0	**SWT 423**	retouch	0	19.7	15	3.0	0.0	0.0	**SWT 423**	retouch	1		
SWT 43	retouch	2	26	7.7	**SWT 43**	retouch	3	31.5	20.5	6.5	0.5	4.6	**SWT 43**	retouch	1		
SWT 434	retouch	0	25	0.0	**SWT 434**	retouch	6	29	16.1	4.7	1.3	12.9	**SWT 434**	retouch	1		
SWT 436	retouch	3	9	33.3	**SWT 436**	retouch	3	16.5	14	2.3	1.3	13.0	**SWT 436**	retouch	1		
SWT 437	retouch	3	11	27.3	**SWT 437**	retouch	7	24.7	22.3	5.5	1.3	12.7	**SWT 437**	retouch	1		
SWT 438	retouch	6	17	35.3	**SWT 438**	retouch	5	30.7	24.7	7.6	0.7	6.6	**SWT 438**	retouch		1	
SWT 442	retouch	1	4	25.0	**SWT 442**	retouch	0	16	9	1.4	0.0	0.0	**SWT 442**	retouch	1		
SWT 446	retouch	0	24	0.0	**SWT 446**	retouch	4	30	15.8	4.7	0.8	8.4	**SWT 446**	retouch	1		
SWT 473	retouch	5	10	50.0	**SWT 473**	retouch	2	34.6	18.4	6.4	0.3	3.1	**SWT 473**	retouch	1		
SWT 474	retouch	2	11	18.2	**SWT 474**	retouch	3	18.9	17.5	3.3	0.9	9.1	**SWT 474**	retouch	1		
SWT 5	retouch	3	16	18.8	**SWT 5**	retouch	6	29	17	4.9	1.2	12.2	**SWT 5**	retouch	1		
SWT 506	retouch	2	8	25.0	**SWT 506**	retouch	3	26.5	11.2	3.0	1.0	10.1	**SWT 506**	retouch	1		
SWT 532	retouch	2	15	13.3	**SWT 532**	retouch	2	25.8	21.2	5.5	0.4	3.7	**SWT 532**	retouch	1		
SWT 535	retouch	2	10	20.0	**SWT 535**	retouch	18	19.6	15.1	3.0	6.1	60.8	**SWT 535**	retouch		1	
SWT 556	retouch	1	6	16.7	**SWT 556**	retouch	19	25.6	14.5	3.7	5.1	51.2	**SWT 556**	retouch		1	
SWT 559	retouch	3	11	27.3	**SWT 559**	retouch	11	22.3	18.3	4.1	2.7	27.0	**SWT 559**	retouch	1		
SWT 564	retouch	2	17	11.8	**SWT 564**	retouch	7	26.8	22	5.9	1.2	11.9	**SWT 564**	retouch	1		
SWT 6	retouch	0	16	0.0	**SWT 6**	retouch	1	23.7	11.2	2.7	0.4	3.8	**SWT 6**	retouch	1		
SWT 604	retouch	6	19	31.6	**SWT 604**	retouch	6	38.1	26.1	9.9	0.6	6.0	**SWT 604**	retouch	1		
SWT 610	retouch	1	19	5.3	**SWT 610**	retouch	7	25.7	18	4.6	1.5	15.1	**SWT 610**	retouch		1	
SWT 630	retouch	0	15	0.0	**SWT 630**	retouch	3	23.2	14	3.2	0.9	9.2	**SWT 630**	retouch	1		
SWT 64	retouch	0	20	0.0	**SWT 64**	retouch	1	26.5	15	4.0	0.3	2.5	**SWT 64**	retouch	1		
SWT 65	retouch	1	7	14.3	**SWT 65**	retouch	16	17.2	15.2	2.6	6.1	61.2	**SWT 65**	retouch		1	
SWT 675	retouch	1	6	16.7	**SWT 675**	retouch	3	20.4	15.5	3.2	0.9	9.5	**SWT 675**	retouch	1		
SWT 687	retouch	3	11	27.3	**SWT 687**	retouch	3	15	14	2.1	1.4	14.3	**SWT 687**	retouch	1		

SWT 701	retouch	4	16	25.0	**SWT 701**	retouch	1	24	19	4.6	0.2	2.2	**SWT 701**	retouch	1		
SWT 726	retouch	2	10	20.0	**SWT 726**	retouch	2	20.8	16.3	3.4	0.6	5.9	**SWT 726**	retouch	1		
SWT 728	retouch	0	6	0.0	**SWT 728**	retouch	3	18.7	13.2	2.5	1.2	12.2	**SWT 728**	retouch	1		
SWT 748	retouch	2	5	40.0	**SWT 748**	retouch	1	15.2	12.8	1.9	0.5	5.1	**SWT 748**	retouch	1		
SWT 75	retouch	6	23	26.1	**SWT 75**	retouch	11	36	15.6	5.6	2.0	19.6	**SWT 75**	retouch		1	
SWT 752	retouch	0	12	0.0	**SWT 752**	retouch	2	27.5	17	4.7	0.4	4.3	**SWT 752**	retouch	1		
SWT 76	retouch	0	20	0.0	**SWT 76**	retouch	20	32.4	22.6	7.3	2.7	27.3	**SWT 76**	retouch	1		
SWT 769	retouch	4	8	50.0	**SWT 769**	retouch	4	31.3	18.6	5.8	0.7	6.9	**SWT 769**	retouch		1	
SWT 773	retouch	3	21	14.3	**SWT 773**	retouch	5	35.1	27.8	9.8	0.5	5.1	**SWT 773**	retouch	1		
SWT 78	retouch	0	16	0.0	**SWT 78**	retouch	3	29	11.3	3.3	0.9	9.2	**SWT 78**	retouch	1		
SWT 801	retouch	4	15	26.7	**SWT 801**	retouch	6	32	21.6	6.9	0.9	8.7	**SWT 801**	retouch		1	
SWT 802	retouch	4	11	36.4	**SWT 802**	retouch	1	24.5	11.5	2.8	0.4	3.5	**SWT 802**	retouch	1		
SWT 826	retouch	2	15	13.3	**SWT 826**	retouch	1	24.2	9.8	2.4	0.4	4.2	**SWT 826**	retouch	1		
SWT 829	retouch	3	11	27.3	**SWT 829**	retouch	3	21.3	20	4.3	0.7	7.0	**SWT 829**	retouch		1	
SWT 832	retouch	1	5	20.0	**SWT 832**	retouch	2	20.2	16.2	3.3	0.6	6.1	**SWT 832**	retouch		1	
SWT 840	retouch	0	11	0.0	**SWT 840**	retouch	0	20	9.6	1.9	0.0	0.0	**SWT 840**	retouch	1		
SWT 848	retouch	1	15	6.7	**SWT 848**	retouch	0	13.7	9.5	1.3	0.0	0.0	**SWT 848**	retouch	1		
SWT 849	retouch	1	16	6.3	**SWT 849**	retouch	2	22.6	15.5	3.5	0.6	5.7	**SWT 849**	retouch	1		
SWT 85	retouch	2	5	40.0	**SWT 85**	retouch	2	29.5	17.6	5.2	0.4	3.9	**SWT 85**	retouch	1		
SWT 859	retouch	2	16	12.5	**SWT 859**	retouch	7	41	29	11.9	0.6	5.9	**SWT 859**	retouch	1		
SWT 869	retouch	4	7	57.1	**SWT 869**	retouch	1	25	14	3.5	0.3	2.9	**SWT 869**	retouch		1	
SWT 872	retouch	6	16	37.5	**SWT 872**	retouch	1	24	20	4.8	0.2	2.1	**SWT 872**	retouch	1		
SWT 874	retouch	3	30	10.0	**SWT 874**	retouch	17	55.5	44.2	24.5	0.7	6.9	**SWT 874**	retouch	1		
SWT 885	retouch	4	18	22.2	**SWT 885**	retouch	10	29.3	18.5	5.4	1.8	18.4	**SWT 885**	retouch	1		
SWT 898	retouch	2	12	16.7	**SWT 898**	retouch	1	24	14.3	3.4	0.3	2.9	**SWT 898**	retouch	1		
SWT 90	retouch	8	32	25.0	**SWT 90**	retouch	6	44.2	39.8	17.6	0.3	3.4	**SWT 90**	retouch	1		
SWT 907	retouch	2	15	13.3	**SWT 907**	retouch	0	16.7	11.6	1.9	0.0	0.0	**SWT 907**	retouch	1		
SWT 924	retouch	1	13	7.7	**SWT 924**	retouch	2	21	13.5	2.8	0.7	7.1	**SWT 924**	retouch	1		
SWT 930	retouch	2	25	8.0	**SWT 930**	retouch	1	20.7	19.6	4.1	0.2	2.5	**SWT 930**	retouch	1		

SWT 950	retouch	2	20	10.0	**SWT 950**	retouch	3	19.3	8.7	1.7	1.8	17.9	**SWT 950**	retouch	1		
SWT 955	retouch	2	11	18.2	**SWT 955**	retouch	3	37.5	28.7	10.8	0.3	2.8	**SWT 955**	retouch		1	
SWT 96	retouch	1	13	7.7	**SWT 96**	retouch	2	24.5	13.2	3.2	0.6	6.2	**SWT 96**	retouch	1		
SWT 964	retouch	1	14	7.1	**SWT 964**	retouch	2	18.5	15	2.8	0.7	7.2	**SWT 964**	retouch	1		
SWT 966	retouch	1	4	25.0	**SWT 966**	retouch	6	20.4	15.6	3.2	1.9	18.9	**SWT 966**	retouch		1	
SWT 968	retouch	0	6	0.0	**SWT 968**	retouch	4	16.2	15	2.4	1.6	16.5	**SWT 968**	retouch	1		
SWT 976	retouch	3	7	42.9	**SWT 976**	retouch	1	17	9	1.5	0.7	6.5	**SWT 976**	retouch	1		
SWT 977	retouch	2	14	14.3	**SWT 977**	retouch	2	28.4	16	4.5	0.4	4.4	**SWT 977**	retouch	1		
SWT 98	retouch	1	14	7.1	**SWT 98**	retouch	1	44.3	24.5	10.9	0.1	0.9	**SWT 98**	retouch	1		
SWT 981	retouch	2	13	15.4	**SWT 981**	retouch	2	22	18.7	4.1	0.5	4.9	**SWT 981**	retouch	1		
SWT 989	retouch	9	13	69.2	**SWT 989**	retouch	11	9.5	9.3	0.9	12.5	124.5	**SWT 989**	retouch		1	
SWT 994	retouch	5	22	22.7	**SWT 994**	retouch	4	30.2	23	6.9	0.6	5.8	**SWT 994**	retouch	1		
SWT 996	retouch	6	21	28.6	**SWT 996**	retouch	4	30	17.5	5.3	0.8	7.6	**SWT 996**	retouch	1		
SWT 999	retouch	3	22	13.6	**SWT 999**	retouch	1	17.7	14	2.5	0.4	4.0	**SWT 999**	retouch	1		
SWT 526	Retouch	0	3	0.0	**SWT 526**	Retouch	4	17.4	13.2	2.3	1.7	17.4	**SWT 526**	Retouch	1		
SWT 492	Retouch	1	7	14.3	**SWT 492**	Retouch	6	19.8	10	2.0	3.0	30.3	**SWT 492**	**Retouch**		1	
SWT 770	Retouch	0	7	0.0	**SWT 770**	Retouch	0	12.2	11.3	1.4	0.0	0.0	**SWT 770**	Retouch	1		
SWT 697	Retouch	2	8	25.0	**SWT 697**	Retouch	2	26.1	16.3	4.3	0.5	4.7	**SWT 697**	Retouch	1		
SWT 857	Retouch	2	11	18.2	**SWT 857**	Retouch	7	23.9	11.7	2.8	2.5	25.0	**SWT 857**	Retouch		1	
SWT 300	Retouch	2	13	15.4	**SWT 300**	Retouch	5	25.3	12.8	3.2	1.5	15.4	**SWT 300**	Retouch		1	
SWT 1098	scraper	6	21	28.6	**SWT 1098**	scraper	2	24.8	23.3	5.8	0.3	3.5	**SWT 1098**	scraper		1	
SWT 1196	scraper	2	16	12.5	**SWT 1196**	scraper	2	15.4	13.5	2.1	1.0	9.6	**SWT 1196**	scraper	1		
SWT 123	scraper	0	10	0.0	**SWT 123**	scraper	0	20.5	16.4	3.4	0.0	0.0	**SWT 123**	scraper	1		
SWT 218	scraper	0	20	0.0	**SWT 218**	scraper	5	25.6	18.4	4.7	1.1	10.6	**SWT 218**	scraper	1		
SWT 354	scraper	8	16	50.0	**SWT 354**	scraper	3	41.2	18.8	7.7	0.4	3.9	**SWT 354**	scraper	1		
SWT 703	scraper	3	20	15.0	**SWT 703**	scraper	13	50.4	23.5	11.8	1.1	11.0	**SWT 703**	scraper		1	
SWT 745	scraper	4	10	40.0	**SWT 745**	scraper	4	19.4	10	1.9	2.1	20.6	**SWT 745**	scraper	1		
SWT 760	scraper	0	16	0.0	**SWT 760**	scraper	0	16.2	10.2	1.7	0.0	0.0	**SWT 760**	scraper	1		
SWT 79	scraper	1	15	6.7	**SWT 79**	scraper	3	23.8	13.7	3.3	0.9	9.2	**SWT 79**	scraper	1		

SWT 837	scraper	3	17	17.6	**SWT 837**	scraper	0	20.8	13.8	2.9	0.0	0.0	**SWT 837**	scraper	1		
SWT 845	scraper	3	14	21.4	**SWT 845**	scraper	15	28	13	3.6	4.1	41.2	**SWT 845**	scraper		1	
SWT 889	scraper	0	10	0.0	**SWT 889**	scraper	0	24	15.2	3.6	0.0	0.0	**SWT 889**	scraper	1		
SWT 904	scraper	1	11	9.1	**SWT 904**	scraper	2	13.8	13.2	1.8	1.1	11.0	**SWT 904**	scraper	1		
SWT 927	scraper	0	5	0.0	**SWT 927**	scraper	1	19.5	12	2.3	0.4	4.3	**SWT 927**	scraper	1		
SWT 971	scraper	3	16	18.8	**SWT 971**	scraper	11	17.5	14.3	2.5	4.4	44.0	**SWT 971**	scraper		1	
SWT 721	Scraper	0	6	0.0	**SWT 721**	Scraper	3	19.2	15.8	3.0	1.0	9.9	**SWT 721**	Scraper	1		
SWT 485	scraper	0	9	0.0	**SWT 485**	scraper	2	14.7	11	1.6	1.2	12.4	**SWT 485**	scraper	1		
SWT 344	Scraper	6	19	31.6	**SWT 344**	Scraper	5	17	13	2.2	2.3	22.6	**SWT 344**	Scraper	1		
SWT287	Scraper	2	9	22.2	**SWT287**	Scraper	3	19.4	18	3.5	0.9	8.6	**SWT287**	Scraper		1	
SWT 1197	Scraper	0	12	0.0	**SWT 1197**	Scraper	1	17.6	14.7	2.6	0.4	3.9	**SWT 1197**	Scraper	1		
n				**Mean**	**n**							**Mean**	**n**				
375				29.2%	**375**							13.5	**375**		269	106	0
														Percentage of sample	71.7	28.3	0.0

Table 9: Swartkrans Oldowan chert raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**w, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
SWT 1153	chunk	4	4	100.0	**SWT 1153**	chunk	1	21.5	20.2	4.3	0.2	2.3	**SWT 1153**	chunk		1	
SWT 119	chunk	0	15	0.0	**SWT 119**	chunk	2	37.2	21.8	8.1	0.2	2.5	**SWT 119**	chunk		1	
SWT 169	chunk	3	14	21.4	**SWT 169**	chunk	2	34.6	23.1	8.0	0.3	2.5	**SWT 169**	chunk		1	
SWT 265	chunk	1	7	14.3	**SWT 265**	chunk	1	22	7.6	1.7	0.6	6.0	**SWT 265**	chunk	1		

SWT 763	chunk	1	4	25.0	**SWT 763**	chunk	1	16.2	12	1.9	0.5	5.1	**SWT 763**	chunk		1	
SWT 830	chunk	3	8	37.5	**SWT 830**	chunk	3	24.3	13.7	3.3	0.9	9.0	**SWT 830**	chunk		1	
SWT 859	chunk	3	6	50.0	**SWT 859**	chunk	1	15.5	15	2.3	0.4	4.3	**SWT 859**	chunk		1	
SWT 882	chunk	1	5	20.0	**SWT 882**	chunk	1	25.6	20.6	5.3	0.2	1.9	**SWT 882**	chunk		1	
SWT 893	chunk	0	3	0.0	**SWT 893**	chunk	0	16	12.3	2.0	0.0	0.0	**SWT 893**	chunk		1	
SWT 901	chunk	0	4	0.0	**SWT 901**	chunk	0	19.3	7.7	1.5	0.0	0.0	**SWT 901**	chunk		1	
SWT 953	chunk	1	2	50.0	**SWT 953**	chunk	2	52	12.5	6.5	0.3	3.1	**SWT 953**	chunk		1	
SWT 818	Chunk	0	2	0.0	**SWT 818**	Chunk	1	13.6	9.9	1.3	0.7	7.4	**SWT 818**	Chunk	1		
SWT 738	Chunk	1	8	12.5	**SWT 738**	Chunk	4	29.3	17.8	5.2	0.8	7.7	**SWT 738**	Chunk		1	
SWT 750	core on chunk	1	3	33.3	**SWT 750**	core on chunk	4	28.1	20.5	5.8	0.7	6.9	**SWT 750**	core on chunk		1	
SWT 634	core, bip	3	3	100.0	**SWT 634**	core, bip	9	33	30.8	10.2	0.9	8.9	**SWT 634**	core, bip		1	
SWT 207	core, casual	2	4	50.0	**SWT 207**	core, casual	1	58.5	55.3	32.4	0.0	0.3	**SWT 207**	core, casual		1	
SWT 303	core, casual	3	7	42.9	**SWT 303**	core, casual	6	45.4	34.2	15.5	0.4	3.9	**SWT 303**	core, casual		1	
SWT 543	core, casual	3	8	37.5	**SWT 543**	core, casual	1	69.4	47.3	32.8	0.0	0.3	**SWT 543**	core, casual	1		
SWT 938	core, cent	3	8	37.5	**SWT 938**	core, cent	0	44.2	40.5	17.9	0.0	0.0	**SWT 938**	core, cent		1	
SWT 405	core, frag	4	18	22.2	**SWT 405**	core, frag	6	53.2	26	13.8	0.4	4.3	**SWT 405**	core, frag	1		
SWT 408	core, pi	3	6	50.0	**SWT 408**	core, pi	5	37.4	29	10.8	0.5	4.6	**SWT 408**	core, pi		1	
SWT 1118	core, pi / retouch	8	24	33.3	**SWT 1118**	core, pi / retouch	3	39.2	33.6	13.2	0.2	2.3	**SWT 1118**	core, pi / retouch		1	
SWK 851	flake	1	2	50.0	**SWK 851**	flake	2	22.8	21.3	4.9	0.4	4.1	**SWK 851**	flake		1	
SWT 100	flake	1	3	33.3	**SWT 100**	flake	1	22.8	12	2.7	0.4	3.7	**SWT 100**	flake	1		
SWT 1001	flake	0	1	0.0	**SWT 1001**	flake	0	17.3	14	2.4	0.0	0.0	**SWT 1001**	flake	1		
SWT 1004	flake	1	4	25.0	**SWT 1004**	flake	1	17.7	11.6	2.1	0.5	4.9	**SWT 1004**	flake		1	
SWT 1005	flake	0	1	0.0	**SWT 1005**	flake	6	27	17.8	4.8	1.2	12.5	**SWT 1005**	flake	1		
SWT 1011	flake	0	1	0.0	**SWT 1011**	flake	3	19.8	19.6	3.9	0.8	7.7	**SWT 1011**	flake		1	
SWT 1013	flake	3	7	42.9	**SWT 1013**	flake	6	24.4	18.5	4.5	1.3	13.3	**SWT 1013**	flake		1	
SWT 1014	flake	1	2	50.0	**SWT 1014**	flake	4	23	12.6	2.9	1.4	13.8	**SWT 1014**	flake		1	

SWT 1016	flake	1	6	16.7	**SWT 1016**	flake	0	25.4	22	5.6	0.0	0.0	**SWT 1016**	flake		1	
SWT 1022	flake	0	8	0.0	**SWT 1022**	flake	1	30.8	12.7	3.9	0.3	2.6	**SWT 1022**	flake		1	
SWT 1033	flake	0	2	0.0	**SWT 1033**	flake	0	26.3	12.8	3.4	0.0	0.0	**SWT 1033**	flake		1	
SWT 1036	flake	4	4	100.0	**SWT 1036**	flake	5	20	17.6	3.5	1.4	14.2	**SWT 1036**	flake	1		
SWT 1038	flake	1	7	14.3	**SWT 1038**	flake	0	21.1	13	2.7	0.0	0.0	**SWT 1038**	flake		1	
SWT 1040	flake	2	5	40.0	**SWT 1040**	flake	3	22	12.8	2.8	1.1	10.7	**SWT 1040**	flake	1		
SWT 1042	flake	0	4	0.0	**SWT 1042**	flake	0	22	6	1.3	0.0	0.0	**SWT 1042**	flake	1		
SWT 1045	flake	1	1	100.0	**SWT 1045**	flake	4	58	26.8	15.5	0.3	2.6	**SWT 1045**	flake	1		
SWT 1072	flake	0	12	0.0	**SWT 1072**	flake	0	30.3	21	6.4	0.0	0.0	**SWT 1072**	flake	1		
SWT 1083	flake	1	1	100.0	**SWT 1083**	flake	3	21.4	18	3.9	0.8	7.8	**SWT 1083**	flake		1	
SWT 1085	flake	1	4	25.0	**SWT 1085**	flake	0	28.4	15	4.3	0.0	0.0	**SWT 1085**	flake		1	
SWT 1086	flake	4	11	36.4	**SWT 1086**	flake	1	46.3	42.5	19.7	0.1	0.5	**SWT 1086**	flake		1	
SWT 1102	flake	1	2	50.0	**SWT 1102**	flake	1	14.4	10.3	1.5	0.7	6.7	**SWT 1102**	flake		1	
SWT 1103	flake	1	4	25.0	**SWT 1103**	flake	1	17.2	9.5	1.6	0.6	6.1	**SWT 1103**	flake		1	
SWT 1107	flake	1	6	16.7	**SWT 1107**	flake	0	22.3	12.2	2.7	0.0	0.0	**SWT 1107**	flake		1	
SWT 1115	flake	1	5	20.0	**SWT 1115**	flake	7	22.4	18	4.0	1.7	17.4	**SWT 1115**	flake		1	
SWT 1119	flake	3	6	50.0	**SWT 1119**	flake	3	40	20.8	8.3	0.4	3.6	**SWT 1119**	flake		1	
SWT 1121	flake	5	9	55.6	**SWT 1121**	flake	3	23.7	20.1	4.8	0.6	6.3	**SWT 1121**	flake	1		
SWT 1122	flake	5	7	71.4	**SWT 1122**	flake	7	29	14.6	4.2	1.7	16.5	**SWT 1122**	flake		1	
SWT 1123	flake	1	8	12.5	**SWT 1123**	flake	6	23	13.5	3.1	1.9	19.3	**SWT 1123**	flake		1	
SWT 1127	flake	4	4	100.0	**SWT 1127**	flake	0	15.1	14	2.1	0.0	0.0	**SWT 1127**	flake	1		
SWT 1131	flake	0	7	0.0	**SWT 1131**	flake	0	29	15.2	4.4	0.0	0.0	**SWT 1131**	flake		1	
SWT 1138	flake	4	13	30.8	**SWT 1138**	flake	4	32.4	29.6	9.6	0.4	4.2	**SWT 1138**	flake	1		
SWT 1139	flake	6	9	66.7	**SWT 1139**	flake	2	23.6	12	2.8	0.7	7.1	**SWT 1139**	flake	1		
SWT 1141	flake	6	12	50.0	**SWT 1141**	flake	6	30	19.6	5.9	1.0	10.2	**SWT 1141**	flake		1	
SWT 1142	flake	1	3	33.3	**SWT 1142**	flake	4	19.5	11.3	2.2	1.8	18.2	**SWT 1142**	flake		1	
SWT 1147	flake	3	13	23.1	**SWT 1147**	flake	1	30.3	16	4.8	0.2	2.1	**SWT 1147**	flake		1	
SWT 1152	flake	3	16	18.8	**SWT 1152**	flake	5	32.6	28.4	9.3	0.5	5.4	**SWT 1152**	flake		1	
SWT 1157	flake	2	5	40.0	**SWT 1157**	flake	0	15.2	11.1	1.7	0.0	0.0	**SWT 1157**	flake		1	

SWT 1167	flake	1	1	100.0	**SWT 1167**	flake	1	31.8	27.2	8.6	0.1	1.2	**SWT 1167**	flake		1	
SWT 1168	flake	1	3	33.3	**SWT 1168**	flake	1	22.3	10	2.2	0.4	4.5	**SWT 1168**	flake		1	
SWT 1169	flake	1	13	7.7	**SWT 1169**	flake	1	21.4	13.5	2.9	0.3	3.5	**SWT 1169**	flake		1	
SWT 1177	flake	1	2	50.0	**SWT 1177**	flake	1	22.4	12.1	2.7	0.4	3.7	**SWT 1177**	flake	1		
SWT 1179	flake	2	4	50.0	**SWT 1179**	flake	0	18.6	10.3	1.9	0.0	0.0	**SWT 1179**	flake	1		
SWT 1190	flake	1	1	100.0	**SWT 1190**	flake	1	18.6	13.6	2.5	0.4	4.0	**SWT 1190**	flake		1	
SWT 1199	flake	4	6	66.7	**SWT 1199**	flake	1	18.6	9.6	1.8	0.6	5.6	**SWT 1199**	flake		1	
SWT 120	flake	0	2	0.0	**SWT 120**	flake	1	46.8	27.4	12.8	0.1	0.8	**SWT 120**	flake	1		
SWT 133	flake	2	10	20.0	**SWT 133**	flake	4	21	11.8	2.5	1.6	16.1	**SWT 133**	flake		1	
SWT 134	flake	4	10	40.0	**SWT 134**	flake	2	26.4	28.2	7.4	0.3	2.7	**SWT 134**	flake		1	
SWT 141	flake	1	2	50.0	**SWT 141**	flake	0	19	16.7	3.2	0.0	0.0	**SWT 141**	flake			1
SWT 150	flake	2	7	28.6	**SWT 150**	flake	2	29	20.8	6.0	0.3	3.3	**SWT 150**	flake		1	
SWT 152	flake	3	7	42.9	**SWT 152**	flake	4	24.7	9.6	2.4	1.7	16.9	**SWT 152**	flake		1	
SWT 156	flake	2	3	66.7	**SWT 156**	flake	11	53.1	49.7	26.4	0.4	4.2	**SWT 156**	flake	1		
SWT 162	flake	4	5	80.0	**SWT 162**	flake	6	41.1	28	11.5	0.5	5.2	**SWT 162**	flake		1	
SWT 167	flake	1	6	16.7	**SWT 167**	flake	4	21.4	11.6	2.5	1.6	16.1	**SWT 167**	flake		1	
SWT 170	flake	1	4	25.0	**SWT 170**	flake	0	21.1	17	3.6	0.0	0.0	**SWT 170**	flake		1	
SWT 185	flake	0	9	0.0	**SWT 185**	flake	1	35	26	9.1	0.1	1.1	**SWT 185**	flake	1		
SWT 192	flake	1	1	100.0	**SWT 192**	flake	12	32.2	16.8	5.4	2.2	22.2	**SWT 192**	flake		1	
SWT 200	flake	2	2	100.0	**SWT 200**	flake	5	20	16.2	3.2	1.5	15.4	**SWT 200**	flake		1	
SWT 205	flake	2	3	66.7	**SWT 205**	flake	2	34	27.7	9.4	0.2	2.1	**SWT 205**	flake		1	
SWT 206	flake	3	5	60.0	**SWT 206**	flake	7	30.7	17.3	5.3	1.3	13.2	**SWT 206**	flake		1	
SWT 228	flake	1	5	20.0	**SWT 228**	flake	3	20.4	16.6	3.4	0.9	8.9	**SWT 228**	flake		1	
SWT 230	flake	4	11	36.4	**SWT 230**	flake	5	33	30.8	10.2	0.5	4.9	**SWT 230**	flake		1	
SWT 233	flake	1	4	25.0	**SWT 233**	flake	2	14.7	14.5	2.1	0.9	9.4	**SWT 233**	flake	1		
SWT 240	flake	3	12	25.0	**SWT 240**	flake	7	21.3	16.6	3.5	2.0	19.8	**SWT 240**	flake		1	
SWT 245	flake	3	3	100.0	**SWT 245**	flake	2	27	14.2	3.8	0.5	5.2	**SWT 245**	flake		1	
SWT 26	flake	3	4	75.0	**SWT 26**	flake	1	32.5	26.8	8.7	0.1	1.1	**SWT 26**	flake		1	
SWT 261	flake	3	4	75.0	**SWT 261**	flake	1	26	10.7	2.8	0.4	3.6	**SWT 261**	flake	1		

SWT 266	flake	3	8	37.5	**SWT 266**	flake	4	18.2	15	2.7	1.5	14.7	**SWT 266**	flake		1	
SWT 278	flake	5	12	41.7	**SWT 278**	flake	9	38.7	33	12.8	0.7	7.0	**SWT 278**	flake		1	
SWT 298	flake	1	5	20.0	**SWT 298**	flake	1	37.6	19.2	7.2	0.1	1.4	**SWT 298**	flake		1	
SWT 299	flake	0	9	0.0	**SWT 299**	flake	1	36.3	12.5	4.5	0.2	2.2	**SWT 299**	flake		1	
SWT 358	flake	0	5	0.0	**SWT 358**	flake	0	13	11.4	1.5	0.0	0.0	**SWT 358**	flake		1	
SWT 369	flake	0	8	0.0	**SWT 369**	flake	1	29.2	25	7.3	0.1	1.4	**SWT 369**	flake		1	
SWT 370	flake	2	3	66.7	**SWT 370**	flake	3	23.6	15	3.5	0.8	8.5	**SWT 370**	flake		1	
SWT 389	flake	1	1	100.0	**SWT 389**	flake	2	44.3	39.8	17.6	0.1	1.1	**SWT 389**	flake			1
SWT 407	flake	0	1	0.0	**SWT 407**	flake	0	22	13	2.9	0.0	0.0	**SWT 407**	flake		1	
SWT 409	flake	7	8	87.5	**SWT 409**	flake	2	22.1	17.2	3.8	0.5	5.3	**SWT 409**	flake	1		
SWT 414	flake	2	4	50.0	**SWT 414**	flake	2	40	27.7	11.1	0.2	1.8	**SWT 414**	flake		1	
SWT 415	flake	2	4	50.0	**SWT 415**	flake	3	18	12	2.2	1.4	13.9	**SWT 415**	flake		1	
SWT 422	flake	2	2	100.0	**SWT 422**	flake	3	22.2	19.5	4.3	0.7	6.9	**SWT 422**	flake	1		
SWT 440	flake	0	3	0.0	**SWT 440**	flake	0	19.7	12.1	2.4	0.0	0.0	**SWT 440**	flake		1	
SWT 451	flake	3	3	100.0	**SWT 451**	flake	4	31.2	26.8	8.4	0.5	4.8	**SWT 451**	flake		1	
SWT 462	flake	1	12	8.3	**SWT 462**	flake	1	42.7	40	17.1	0.1	0.6	**SWT 462**	flake	1		
SWT 678	flake	3	3	100.0	**SWT 678**	flake	3	19	17.7	3.4	0.9	8.9	**SWT 678**	flake		1	
SWT 686	flake	0	6	0.0	**SWT 686**	flake	2	23	16	3.7	0.5	5.4	**SWT 686**	flake		1	
SWT 72	flake	0	1	0.0	**SWT 72**	flake	1	26	17.6	4.6	0.2	2.2	**SWT 72**	flake		1	
SWT 734	flake	1	3	33.3	**SWT 734**	flake	5	17.4	17.1	3.0	1.7	16.8	**SWT 734**	flake		1	
SWT 741	flake	3	8	37.5	**SWT 741**	flake	3	21.3	17	3.6	0.8	8.3	**SWT 741**	flake		1	
SWT 778	flake	2	3	66.7	**SWT 778**	flake	6	24.3	16.6	4.0	1.5	14.9	**SWT 778**	flake		1	
SWT 781	flake	1	2	50.0	**SWT 781**	flake	3	24.8	18	4.5	0.7	6.7	**SWT 781**	flake		1	
SWT 782	flake	1	1	100.0	**SWT 782**	flake	3	29.6	21.1	6.2	0.5	4.8	**SWT 782**	flake		1	
SWT 788	flake	1	3	33.3	**SWT 788**	flake	0	25	16.4	4.1	0.0	0.0	**SWT 788**	flake	1		
SWT 790	flake	4	4	100.0	**SWT 790**	flake	3	32.4	15.1	4.9	0.6	6.1	**SWT 790**	flake		1	
SWT 796	flake	0	5	0.0	**SWT 796**	flake	7	26	17.2	4.5	1.6	15.7	**SWT 796**	flake		1	
SWT 797	flake	3	7	42.9	**SWT 797**	flake	0	21.3	11.7	2.5	0.0	0.0	**SWT 797**	flake		1	
SWT 834	flake	2	8	25.0	**SWT 834**	flake	1	34	23.8	8.1	0.1	1.2	**SWT 834**	flake	1		

SWT 842	flake	2	3	66.7	**SWT 842**	flake	2	20	18.5	3.7	0.5	5.4	**SWT 842**	flake		1	
SWT 844	flake	1	4	25.0	**SWT 844**	flake	1	17	11.6	2.0	0.5	5.1	**SWT 844**	flake	1		
SWT 846	flake	2	2	100.0	**SWT 846**	flake	2	22	13	2.9	0.7	7.0	**SWT 846**	flake		1	
SWT 847	flake	1	1	100.0	**SWT 847**	flake	1	35	19.5	6.8	0.1	1.5	**SWT 847**	flake	1		
SWT 852	flake	1	1	100.0	**SWT 852**	flake	2	24.4	24.1	5.9	0.3	3.4	**SWT 852**	flake		1	
SWT 861	flake	5	9	55.6	**SWT 861**	flake	1	20.8	19.1	4.0	0.3	2.5	**SWT 861**	flake		1	
SWT 868	flake	0	6	0.0	**SWT 868**	flake	0	15.3	13.8	2.1	0.0	0.0	**SWT 868**	flake		1	
SWT 870	flake	6	11	54.5	**SWT 870**	flake	3	30.8	25.2	7.8	0.4	3.9	**SWT 870**	flake		1	
SWT 873	flake	0	2	0.0	**SWT 873**	flake	0	26.4	17.7	4.7	0.0	0.0	**SWT 873**	flake		1	
SWT 877	flake	4	6	66.7	**SWT 877**	flake	1	16.8	16	2.7	0.4	3.7	**SWT 877**	flake	1		
SWT 878	flake	1	2	50.0	**SWT 878**	flake	0	17	15.2	2.6	0.0	0.0	**SWT 878**	flake		1	
SWT 879	flake	1	5	20.0	**SWT 879**	flake	0	21	9.4	2.0	0.0	0.0	**SWT 879**	flake		1	
SWT 883	flake	0	5	0.0	**SWT 883**	flake	2	26	14.1	3.7	0.5	5.5	**SWT 883**	flake		1	
SWT 890	flake	2	4	50.0	**SWT 890**	flake	0	21.4	8.4	1.8	0.0	0.0	**SWT 890**	flake	1		
SWT 892	flake	2	3	66.7	**SWT 892**	flake	4	16.3	17.3	2.8	1.4	14.2	**SWT 892**	flake		1	
SWT 895	flake	1	1	100.0	**SWT 895**	flake	4	33.5	25	8.4	0.5	4.8	**SWT 895**	flake		1	
SWT 896	flake	0	3	0.0	**SWT 896**	flake	0	16.8	16.4	2.8	0.0	0.0	**SWT 896**	flake		1	
SWT 900	flake	0	14	0.0	**SWT 900**	flake	2	20.4	13.4	2.7	0.7	7.3	**SWT 900**	flake		1	
SWT 902	flake	1	1	100.0	**SWT 902**	flake	3	15	13.3	2.0	1.5	15.0	**SWT 902**	flake		1	
SWT 903	flake	1	6	16.7	**SWT 903**	flake	1	24	10.2	2.4	0.4	4.1	**SWT 903**	flake		1	
SWT 912	flake	1	4	25.0	**SWT 912**	flake	1	18	12	2.2	0.5	4.6	**SWT 912**	flake		1	
SWT 915	flake	0	2	0.0	**SWT 915**	flake	0	14.7	7.2	1.1	0.0	0.0	**SWT 915**	flake	1		
SWT 917	flake	2	4	50.0	**SWT 917**	flake	1	15.2	10	1.5	0.7	6.6	**SWT 917**	flake	1		
SWT 918	flake	2	5	40.0	**SWT 918**	flake	1	25	11	2.8	0.4	3.6	**SWT 918**	flake		1	
SWT 918	flake	1	1	100.0	**SWT 918**	flake	0	18	15	2.7	0.0	0.0	**SWT 918**	flake		1	
SWT 919	flake	2	4	50.0	**SWT 919**	flake	1	13	13	1.7	0.6	5.9	**SWT 919**	flake		1	
SWT 920	flake	3	6	50.0	**SWT 920**	flake	1	19.3	8.4	1.6	0.6	6.2	**SWT 920**	flake		1	
SWT 926	flake	0	4	0.0	**SWT 926**	flake	2	20.7	14.3	3.0	0.7	6.8	**SWT 926**	flake		1	
SWT 93	flake	4	7	57.1	**SWT 93**	flake	5	40	10	4.0	1.3	12.5	**SWT 93**	flake		1	

SWT 94	flake	1	15	6.7	**SWT 94**	flake	2	17.7	17.2	3.0	0.7	6.6	**SWT 94**	flake		1	
SWT 940	flake	1	1	100.0	**SWT 940**	flake	0	22.7	17.7	4.0	0.0	0.0	**SWT 940**	flake			1
SWT 942	flake	3	4	75.0	**SWT 942**	flake	1	57.7	18	10.4	0.1	1.0	**SWT 942**	flake		1	
SWT 944	flake	5	5	100.0	**SWT 944**	flake	7	15.8	11.6	1.8	3.8	38.2	**SWT 944**	flake		1	
SWT 945	flake	3	7	42.9	**SWT 945**	flake	1	22.6	9.8	2.2	0.5	4.5	**SWT 945**	flake	1		
SWT 948	flake	1	3	33.3	**SWT 948**	flake	1	16	15	2.4	0.4	4.2	**SWT 948**	flake		1	
SWT 959	flake	2	6	33.3	**SWT 959**	flake	1	39.2	33	12.9	0.1	0.8	**SWT 959**	flake		1	
SWT 972	flake	1	1	100.0	**SWT 972**	flake	1	22	14.4	3.2	0.3	3.2	**SWT 972**	flake	1		
SWT 986	flake	0	2	0.0	**SWT 986**	flake	1	23	8	1.8	0.5	5.4	**SWT 986**	flake		1	
SWT 988	flake	0	5	0.0	**SWT 988**	flake	3	21.6	9.7	2.1	1.4	14.3	**SWT 988**	flake		1	
SWT 990	flake	4	17	23.5	**SWT 990**	flake	2	25.8	17	4.4	0.5	4.6	**SWT 990**	flake		1	
SWT 138	Flake	0	6	0.0	**SWT 138**	Flake	2	34.7	27	9.4	0.2	2.1	**SWT 138**	Flake	1		
SWT 499	Flake	1	1	100.0	**SWT 499**	Flake	1	21.4	13.9	3.0	0.3	3.4	**SWT 499**	Flake		1	
SWT 546	Flake	1	1	100.0	**SWT 546**	Flake	7	21	19.9	4.2	1.7	16.8	**SWT 546**	Flake	1		
SWT 570	Flake	1	2	50.0	**SWT 570**	Flake	1	18.6	10.7	2.0	0.5	5.0	**SWT 570**	Flake	1		
SWT 590	Flake	3	3	100.0	**SWT 590**	Flake	8	39.9	34.3	13.7	0.6	5.8	**SWT 590**	Flake	1		
SWT 518	Flake	1	3	33.3	**SWT 518**	Flake	1	23	11.6	2.7	0.4	3.7	**SWT 518**	Flake	1		
SWT 1019	Flake	0	4	0.0	**SWT 1019**	Flake	2	26.3	14	3.7	0.5	5.4	**SWT 1019**	Flake		1	
SWT 459	Flake	0	3	0.0	**SWT 459**	Flake	6	19	16.4	3.1	1.9	19.3	**SWT 459**	Flake		1	
SWT 180	Flake	1	2	50.0	**SWT 180**	Flake	1	16.6	13.2	2.2	0.5	4.6	**SWT 180**	Flake		1	
SWT 514	Flake	4	4	100.0	**SWT 514**	Flake	3	17.6	12.5	2.2	1.4	13.6	**SWT 514**	Flake		1	
SWT 786	Flake	0	1	0.0	**SWT 786**	Flake	0	27	20	5.4	0.0	0.0	**SWT 786**	Flake		1	
SWT 1126	Flake	0	1	0.0	**SWT 1126**	Flake	1	16.8	8.5	1.4	0.7	7.0	**SWT 1126**	Flake	1		
SWT 1089	Flake	0	2	0.0	**SWT 1089**	Flake	2	24.8	16.5	4.1	0.5	4.9	**SWT 1089**	Flake		1	
SWT 811	Flake	2	9	22.2	**SWT 811**	Flake	1	26	15.6	4.1	0.2	2.5	**SWT 811**	Flake		1	
SWT 594	Flake	0	4	0.0	**SWT 594**	Flake	0	13.6	9.8	1.3	0.0	0.0	**SWT 594**	Flake		1	
SWT 9	flake/ blade	1	2	50.0	**SWT 9**	blade	3	38.8	14.7	5.7	0.5	5.3	**SWT 9**	blade		1	
SWT 1000	retouch	1	7	14.3	**SWT 1000**	retouch	1	20.7	15.8	3.3	0.3	3.1	**SWT 1000**	retouch		1	

SWT 1003	retouch	0	14	0.0	**SWT 1003**	retouch	2	16	12.8	2.0	1.0	9.8	**SWT 1003**	retouch		1	
SWT 1006	retouch	0	4	0.0	**SWT 1006**	retouch	1	26.5	19.8	5.2	0.2	1.9	**SWT 1006**	retouch		1	
SWT 1020	retouch	2	9	22.2	**SWT 1020**	retouch	2	25	17.7	4.4	0.5	4.5	**SWT 1020**	retouch	1		
SWT 1028	retouch	0	1	0.0	**SWT 1028**	retouch	2	18.8	11.6	2.2	0.9	9.2	**SWT 1028**	retouch		1	
SWT 1052	retouch	0	15	0.0	**SWT 1052**	retouch	0	39	23	9.0	0.0	0.0	**SWT 1052**	retouch	1		
SWT 1060	retouch	2	5	40.0	**SWT 1060**	retouch	2	31.1	26	8.1	0.2	2.5	**SWT 1060**	retouch		1	
SWT 1061	retouch	0	10	0.0	**SWT 1061**	retouch	1	21.5	18.6	4.0	0.3	2.5	**SWT 1061**	retouch		1	
SWT 1064	retouch	0	10	0.0	**SWT 1064**	retouch	0	26	22	5.7	0.0	0.0	**SWT 1064**	retouch		1	
SWT 1067	retouch	1	8	12.5	**SWT 1067**	retouch	3	34	30.7	10.4	0.3	2.9	**SWT 1067**	retouch		1	
SWT 1069	retouch	4	6	66.7	**SWT 1069**	retouch	5	37	22.6	8.4	0.6	6.0	**SWT 1069**	retouch		1	
SWT 1078	retouch	3	17	17.6	**SWT 1078**	retouch	11	40.4	40	16.2	0.7	6.8	**SWT 1078**	retouch		1	
SWT 1108	retouch	7	12	58.3	**SWT 1108**	retouch	4	24.5	10	2.5	1.6	16.3	**SWT 1108**	retouch	1		
SWT 1111	retouch	6	21	28.6	**SWT 1111**	retouch	1	30.4	23	7.0	0.1	1.4	**SWT 1111**	retouch	1		
SWT 1114	retouch	6	19	31.6	**SWT 1114**	retouch	2	23	19.3	4.4	0.5	4.5	**SWT 1114**	retouch	1		
SWT 1124	retouch	5	12	41.7	**SWT 1124**	retouch	1	16	8.7	1.4	0.7	7.2	**SWT 1124**	retouch		1	
SWT 1125	retouch	3	8	37.5	**SWT 1125**	retouch	2	19.8	13.7	2.7	0.7	7.4	**SWT 1125**	retouch		1	
SWT 1133	retouch	2	9	22.2	**SWT 1133**	retouch	3	25.5	20	5.1	0.6	5.9	**SWT 1133**	retouch		1	
SWT 114	retouch	4	21	19.0	**SWT 114**	retouch	4	26	24	6.2	0.6	6.4	**SWT 114**	retouch		1	
SWT 1143	retouch	3	11	27.3	**SWT 1143**	retouch	4	31	26.3	8.2	0.5	4.9	**SWT 1143**	retouch		1	
SWT 1162	retouch	1	17	5.9	**SWT 1162**	retouch	4	26.7	15.5	4.1	1.0	9.7	**SWT 1162**	retouch		1	
SWT 1165	retouch	4	11	36.4	**SWT 1165**	retouch	2	20	15.5	3.1	0.6	6.5	**SWT 1165**	retouch	1		
SWT 1174	retouch	3	9	33.3	**SWT 1174**	retouch	2	20.4	10.7	2.2	0.9	9.2	**SWT 1174**	retouch		1	
SWT 135	retouch	3	7	42.9	**SWT 135**	retouch	3	26.6	24.2	6.4	0.5	4.7	**SWT 135**	retouch		1	
SWT 138	retouch	2	5	40.0	**SWT 138**	retouch	1	20.4	15.2	3.1	0.3	3.2	**SWT 138**	retouch		1	
SWT 146	retouch	0	19	0.0	**SWT 146**	retouch	1	52.6	27.5	14.5	0.1	0.7	**SWT 146**	retouch		1	
SWT 148	retouch	3	15	20.0	**SWT 148**	retouch	4	21	16.5	3.5	1.2	11.5	**SWT 148**	retouch		1	
SWT 160	retouch	1	5	20.0	**SWT 160**	retouch	2	52	25	13.0	0.2	1.5	**SWT 160**	retouch		1	
SWT 171	retouch	4	17	23.5	**SWT 171**	retouch	2	36	23	8.3	0.2	2.4	**SWT 171**	retouch		1	
SWT 172	retouch	4	17	23.5	**SWT 172**	retouch	7	29	21.8	6.3	1.1	11.1	**SWT 172**	retouch		1	

SWT 181	retouch	7	19	36.8	**SWT 181**	retouch	3	21.8	16.3	3.6	0.8	8.4	**SWT 181**	retouch		1	
SWT 201	retouch	2	14	14.3	**SWT 201**	retouch	4	26	16.6	4.3	0.9	9.3	**SWT 201**	retouch		1	
SWT 202	retouch	7	10	70.0	**SWT 202**	retouch	3	22.7	12.5	2.8	1.1	10.6	**SWT 202**	retouch		1	
SWT 204	retouch	3	10	30.0	**SWT 204**	retouch	2	31	16.4	5.1	0.4	3.9	**SWT 204**	retouch	1		
SWT 227	retouch	7	9	77.8	**SWT 227**	retouch	1	31.5	23.6	7.4	0.1	1.3	**SWT 227**	retouch		1	
SWT 229	retouch	3	18	16.7	**SWT 229**	retouch	6	35	34.8	12.2	0.5	4.9	**SWT 229**	retouch	1		
SWT 244	retouch	0	7	0.0	**SWT 244**	retouch	0	14.7	12	1.8	0.0	0.0	**SWT 244**	retouch		1	
SWT 263	retouch	1	7	14.3	**SWT 263**	retouch	0	23.3	19.6	4.6	0.0	0.0	**SWT 263**	retouch		1	
SWT 27	retouch	3	9	33.3	**SWT 27**	retouch	2	45	21	9.5	0.2	2.1	**SWT 27**	retouch		1	
SWT 296	retouch	4	14	28.6	**SWT 296**	retouch	2	22.4	18	4.0	0.5	5.0	**SWT 296**	retouch		1	
SWT 305	retouch	6	19	31.6	**SWT 305**	retouch	7	43.7	41	17.9	0.4	3.9	**SWT 305**	retouch		1	
SWT 307	retouch	7	20	35.0	**SWT 307**	retouch	3	50.6	45.3	22.9	0.1	1.3	**SWT 307**	retouch	1		
SWT 316	retouch	4	14	28.6	**SWT 316**	retouch	5	29	22	6.4	0.8	7.8	**SWT 316**	retouch		1	
SWT 317	retouch	3	5	60.0	**SWT 317**	retouch	6	44.7	28.8	12.9	0.5	4.7	**SWT 317**	retouch		1	
SWT 32	retouch	3	6	50.0	**SWT 32**	retouch	5	48.5	29	14.1	0.4	3.6	**SWT 32**	retouch		1	
SWT 324	retouch	4	18	22.2	**SWT 324**	retouch	1	51.4	26	13.4	0.1	0.7	**SWT 324**	retouch	1		
SWT 338	retouch	2	15	13.3	**SWT 338**	retouch	9	52.4	30.5	16.0	0.6	5.6	**SWT 338**	retouch		1	
SWT 340	retouch	5	20	25.0	**SWT 340**	retouch	4	32.7	27	8.8	0.5	4.5	**SWT 340**	retouch		1	
SWT 341	retouch	3	13	23.1	**SWT 341**	retouch	2	22.6	20.7	4.7	0.4	4.3	**SWT 341**	retouch		1	
SWT 352	retouch	0	21	0.0	**SWT 352**	retouch	6	32.8	26.8	8.8	0.7	6.8	**SWT 352**	retouch	1		
SWT 353	retouch	2	13	15.4	**SWT 353**	retouch	2	22.3	18.8	4.2	0.5	4.8	**SWT 353**	retouch		1	
SWT 356	retouch	1	12	8.3	**SWT 356**	retouch	3	32	26	8.3	0.4	3.6	**SWT 356**	retouch		1	
SWT 360	retouch	3	12	25.0	**SWT 360**	retouch	10	27.5	22.8	6.3	1.6	15.9	**SWT 360**	retouch	1		
SWT 362	retouch	2	9	22.2	**SWT 362**	retouch	1	15	15	2.3	0.4	4.4	**SWT 362**	retouch		1	
SWT 363	retouch	1	12	8.3	**SWT 363**	retouch	3	44.4	36.2	16.1	0.2	1.9	**SWT 363**	retouch		1	
SWT 377	retouch	3	14	21.4	**SWT 377**	retouch	2	23	13	3.0	0.7	6.7	**SWT 377**	retouch		1	
SWT 379	retouch	4	18	22.2	**SWT 379**	retouch	3	24	14	3.4	0.9	8.9	**SWT 379**	retouch		1	
SWT 381	retouch	6	11	54.5	**SWT 381**	retouch	7	21.7	21.7	4.7	1.5	14.9	**SWT 381**	retouch		1	
SWT 383	retouch	5	15	33.3	**SWT 383**	retouch	5	22.7	19	4.3	1.2	11.6	**SWT 383**	retouch		1	

SWT 384	retouch	0	11	0.0	**SWT 384**	retouch	4	19.8	13.8	2.7	1.5	14.6	**SWT 384**	retouch		1	
SWT 397	retouch	2	10	20.0	**SWT 397**	retouch	1	22	17	3.7	0.3	2.7	**SWT 397**	retouch		1	
SWT 417	retouch	6	12	50.0	**SWT 417**	retouch	3	31.2	20	6.2	0.5	4.8	**SWT 417**	retouch		1	
SWT 449	retouch	3	12	25.0	**SWT 449**	retouch	0	46.8	14.5	6.8	0.0	0.0	**SWT 449**	retouch	1		
SWT 450	retouch	1	7	14.3	**SWT 450**	retouch	3	31	18	5.6	0.5	5.4	**SWT 450**	retouch	1		
SWT 457	retouch	3	8	37.5	**SWT 457**	retouch	2	26	23	6.0	0.3	3.3	**SWT 457**	retouch		1	
SWT 464	retouch	4	15	26.7	**SWT 464**	retouch	0	18.7	16.8	3.1	0.0	0.0	**SWT 464**	retouch		1	
SWT 476	retouch	1	13	7.7	**SWT 476**	retouch	1	17.6	13.5	2.4	0.4	4.2	**SWT 476**	retouch	1		
SWT 505	retouch	5	25	20.0	**SWT 505**	retouch	2	27	22.5	6.1	0.3	3.3	**SWT 505**	retouch		1	
SWT 508	retouch	2	16	12.5	**SWT 508**	retouch	1	39.4	34	13.4	0.1	0.7	**SWT 508**	retouch		1	
SWT 52	retouch	6	20	30.0	**SWT 52**	retouch	2	30.4	27	8.2	0.2	2.4	**SWT 52**	retouch		1	
SWT 533	retouch	9	25	36.0	**SWT 533**	retouch	8	43.6	41.3	18.0	0.4	4.4	**SWT 533**	retouch		1	
SWT 589	retouch	4	14	28.6	**SWT 589**	retouch	8	42.6	36.6	15.6	0.5	5.1	**SWT 589**	retouch		1	
SWT 636	retouch	2	5	40.0	**SWT 636**	retouch	2	22	11.3	2.5	0.8	8.0	**SWT 636**	retouch		1	
SWT 676	retouch	1	14	7.1	**SWT 676**	retouch	1	18	11.5	2.1	0.5	4.8	**SWT 676**	retouch	1		
SWT 748	retouch	2	15	13.3	**SWT 748**	retouch	1	35.3	20.7	7.3	0.1	1.4	**SWT 748**	retouch	1		
SWT 765	retouch	0	19	0.0	**SWT 765**	retouch	0	39.7	22.2	8.8	0.0	0.0	**SWT 765**	retouch	1		
SWT 767	retouch	3	17	17.6	**SWT 767**	retouch	3	24	13	3.1	1.0	9.6	**SWT 767**	retouch		1	
SWT 77	retouch	2	6	33.3	**SWT 77**	retouch	1	60	28.6	17.2	0.1	0.6	**SWT 77**	retouch		1	
SWT 807	retouch	3	16	18.8	**SWT 807**	retouch	4	24.6	13.3	3.3	1.2	12.2	**SWT 807**	retouch	1		
SWT 831	retouch	0	1	0.0	**SWT 831**	retouch	0	20	12	2.4	0.0	0.0	**SWT 831**	retouch		1	
SWT 867	retouch	0	19	0.0	**SWT 867**	retouch	0	35.3	24.5	8.6	0.0	0.0	**SWT 867**	retouch		1	
SWT 880	retouch	5	12	41.7	**SWT 880**	retouch	1	24.2	24.1	5.8	0.2	1.7	**SWT 880**	retouch	1		
SWT 887	retouch	6	10	60.0	**SWT 887**	retouch	2	32	30	9.6	0.2	2.1	**SWT 887**	retouch		1	
SWT 888	retouch	2	6	33.3	**SWT 888**	retouch	2	42.6	25.3	10.8	0.2	1.9	**SWT 888**	retouch	1		
SWT 897	retouch	1	14	7.1	**SWT 897**	retouch	4	43.6	32	14.0	0.3	2.9	**SWT 897**	retouch		1	
SWT 899	retouch	0	16	0.0	**SWT 899**	retouch	0	32.3	16	5.2	0.0	0.0	**SWT 899**	retouch		1	
SWT 934	retouch	0	10	0.0	**SWT 934**	retouch	1	22.7	14.3	3.2	0.3	3.1	**SWT 934**	retouch		1	
SWT 937	retouch	5	17	29.4	**SWT 937**	retouch	1	32.5	27.4	8.9	0.1	1.1	**SWT 937**	retouch		1	

SWT 955/6	retouch	5	16	31.3	**SWT 955/6**	retouch	1	34	19.4	6.6	0.2	1.5	**SWT 955/6**	retouch		1	
SWT 974	retouch	3	14	21.4	**SWT 974**	retouch	3	33.4	21	7.0	0.4	4.3	**SWT 974**	retouch		1	
SWT 993	retouch	2	4	50.0	**SWT 993**	retouch	2	22.4	13.2	3.0	0.7	6.8	**SWT 993**	retouch		1	
SWT 494	Retouch	0	11	0.0	**SWT 494**	Retouch	2	30.7	27.8	8.5	0.2	2.3	**SWT 494**	Retouch		1	
SWT 820	Retouch	1	10	10.0	**SWT 820**	Retouch	2	31	21	6.5	0.3	3.1	**SWT 820**	Retouch	1		
SWT 812	Retouch	0	13	0.0	**SWT 812**	Retouch	0	23	10.6	2.4	0.0	0.0	**SWT 812**	Retouch	1		
SWT 1029	scraper	3	11	27.3	**SWT 1029**	scraper	1	18.4	17.2	3.2	0.3	3.2	**SWT 1029**	scraper		1	
SWT 1136	scraper	4	14	28.6	**SWT 1136**	scraper	2	23.6	20	4.7	0.4	4.2	**SWT 1136**	scraper		1	
SWT 189	scraper	2	7	28.6	**SWT 189**	scraper	4	46.5	23.5	10.9	0.4	3.7	**SWT 189**	scraper		1	
SWT 221	scraper	5	17	29.4	**SWT 221**	scraper	1	30.3	23.8	7.2	0.1	1.4	**SWT 221**	scraper		1	
SWT 245	scraper	1	13	7.7	**SWT 245**	scraper	2	34.2	15.7	5.4	0.4	3.7	**SWT 245**	scraper		1	
SWT 382	scraper	2	28	7.1	**SWT 382**	scraper	3	38.9	20	7.8	0.4	3.9	**SWT 382**	scraper		1	
SWT 604	Scraper	0	8	0.0	**SWT 604**	Scraper	7	26.2	23.6	6.2	1.1	11.3	**SWT 604**	Scraper	1		
n				**Mean**	**n**							**Mean**	**n**				
274				34.9%	**274**							5.3	**274**		66	205	3
														Percentage of sample	24.1	74.8	1.1

Table 10: Swartkrans Acheulean quartzite raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; vf – very fine grained; f – fine grained; m – medium grained; c – coarse grained; vc – very coarse grained; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**vf**	**f**	**m**	**c**	**vc**	**Sn**	**Tt**	**N**	**S**	**E**
2139	chopper	0	41	0.0	2139	chopper			1			2139	chopper		1	
2039	chopper	0	6	0.0	2039	chopper	1					2039	chopper		1	
sk7996	chopper	11	29	37.9	sk7996	chopper			1			sk7996	chopper	1		
sk3961	chopper core	1	16	6.3	sk3961	chopper core		1				sk3961	chopper core		1	

sk3950	chopper core	2	24	8.3	sk3950	chopper core			1			sk3950	chopper core	1		
3955	chopper, core	8	25	32.0	3955	chopper, core			1			3955	chopper, core		1	
skx263	core, cent	0	17	0.0	skx263	core, cent			1			skx263	core, cent	1		
3958	core, chopper, handaxe	5	42	11.9	3958	core, chopper, handaxe		1				3958	core, chopper, handaxe	1		
3947	core, flat	6	10	60.0	3947	core, flat		1				3947	core, flat	1		
sk8039	core, flat, pi	9	30	30.0	sk8039	core, flat, pi			1			sk8039	core, flat, pi	1		
34866	core, p	0	29	0.0	34866	core, p	1					34866	core, p	1		
3981	core, p	9	24	37.5	3981	core, p			1			3981	core, p		1	
31060	core, pi	6	19	31.6	31060	core, pi					1	31060	core, pi		1	
sk3971	core, pi	0	23	0.0	sk3971	core, pi	1					sk3971	core, pi	1		
3965	core, pi	3	20	15.0	3965	core, pi		1				3965	core, pi		1	
12454	denticulate	2	16	12.5	12454	denticulate		1				12454	denticulate	1		
skx262	denticulate	1	18	5.6	skx262	denticulate		1				skx262	denticulate	1		
19097	denticulate	0	10	0.0	19097	denticulate			1			19097	denticulate		1	
skx260	flake	0	5	0.0	skx260	flake		1				skx260	flake	1		
31931	flake	0	1	0.0	31931	flake		1				31931	flake	1		
sk3946	flake	0	10	0.0	sk3946	flake		1				sk3946	flake	1		
31789	retouch	2	17	11.8	31789	retouch			1			31789	retouch		1	
17044	retouch	1	20	5.0	17044	retouch				1		17044	retouch	1		
19059	retouch	5	23	21.7	19059	retouch			1			19059	retouch	1		
19168	retouch	0	19	0.0	19168	retouch		1				19168	retouch	1		
2369	retouch	4	17	23.5	2369	retouch		1				2369	retouch		1	
2581	retouch	5	18	27.8	2581	retouch		1				2581	retouch		1	
1650	retouch	5	38	13.2	1650	retouch			1			1650	retouch	1		
25177	retouch	3	15	20.0	25177	retouch			1			25177	retouch	1		
33859	retouch	2	20	10.0	33859	retouch			1			33859	retouch	1		
sk3968	retouch	0	10	0.0	sk3968	retouch			1			sk3968	retouch		1	

sk3969	retouch	1	17	5.9	sk3969	retouch			1			sk3969	retouch		1	
19053	scraper	0	21	0.0	19053	scraper		1				19053	scraper	1		
2367	scraper	0	16	0.0	2367	scraper		1				2367	scraper	1		
n				**Mean**	**n**							**n**				
34				12.6%	**34**		3	14	15	1	1.0	**34**		21	13	0
						Percentage of sample	8.8	41.2	44.1	2.9	2.9		Percentage of sample	61.8	38.2	0.0

Table 11: Swartkrans Acheulean quartz raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**W, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
37101	chopper core, with retouch	3	16	18.8	37101	chopper core, with retouch	9	29.7	24.2	7.2	1.3	12.5	37101	chopper core, with retouch	1		
7876	chopper, core	0	42	0.0	7876	chopper, core	12	63.4	42.9	27.2	0.4	4.4	7876	chopper, core	1		
19034	core, casual	1	1	100.0	19034	core, casual	2	29.4	18.1	5.3	0.4	3.8	19034	core, casual		1	
2033	core, cent	4	27	14.8	2033	core, cent	9	38.8	34.4	13.3	0.7	6.7	2033	core, cent	1		
6049	core, p	7	15	46.7	6049	core, p	10	32	26.4	8.4	1.2	11.8	6049	core, p		1	
7999	core, pi	15	38	39.5	7999	core, pi	6	41.1	28.2	11.6	0.5	5.2	7999	core, pi	1		
24700	handaxe	4	19	21.1	24700	handaxe	11	46.8	33	15.4	0.7	7.1	24700	handaxe	1		
3973	handaxe	6	43	14.0	3973	handaxe	9	30.5	21	6.4	1.4	14.1	3973	handaxe	1		
25738	retouch	0	25	0.0	25738	retouch	4	22.7	22.3	5.1	0.8	7.9	25738	retouch	1		
33918	retouch	1	12	8.3	33918	retouch	4	21.2	18.7	4.0	1.0	10.1	33918	retouch	1		

35899	retouch	4	9	44.4	35899	retouch	5	24.4	16	3.9	1.3	12.8	35899	retouch		1	
34942	retouch	0	18	0.0	34942	retouch	0	26.4	22.7	6.0	0.0	0.0	34942	retouch	1		
30054	retouch	5	28	17.9	30054	retouch	10	44.2	39.1	17.3	0.6	5.8	30054	retouch	1		
2034	retouch	1	9	11.1	2034	retouch	3	31.2	22.1	6.9	0.4	4.4	2034	retouch	1		
2638	retouch	8	42	19.0	2638	retouch	5	22.8	20	4.6	1.1	11.0	2638	retouch		1	
37915	scraper	1	13	7.7	37915	scraper	2	23.6	17.2	4.1	0.5	4.9	37915	scraper	1		
26494	scraper	6	21	28.6	26494	scraper	5	33	31.2	10.3	0.5	4.9	26494	scraper	1		
32726	scraper	2	16	12.5	32726	scraper	10	19.2	18.5	3.6	2.8	28.2	32726	scraper		1	
n				**Mean**	**n**							**Mean**	**n**				
18				22.5%	**18**							8.6	**18**		13	5	0
														Percentage of sample	72.2	27.8	0.0

Table 12: Swartkrans Acheulean quartz raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**w, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
27636	chopper	9	19	47.4	27636	chopper	7	39.4	54.7	21.6	0.3	3.2	27636	chopper	1		
2193	chopper	2	15	13.3	2193	chopper	4	75.2	59.8	45.0	0.1	0.9	2193	chopper		1	
14040	chopper core	15	34	44.1	14040	chopper core	8	73.8	71.2	52.5	0.2	1.5	14040	chopper core		1	
35831	chunk	4	10	40.0	35831	chunk	2	30.2	12	3.6	0.6	5.5	35831	chunk		1	
28078	chunk	2	5	40.0	28078	chunk	2	24.2	22.8	5.5	0.4	3.6	28078	chunk		1	
27989	chunk	2	8	25.0	27989	chunk	2	39.6	28.1	11.1	0.2	1.8	27989	chunk		1	

35649	chunk	1	3	33.3	35649	chunk	2	26.1	7.2	1.9	1.1	10.6	35649	chunk	1		
31553	chunk	0	6	0.0	31553	chunk	1	14.5	9.4	1.4	0.7	7.3	31553	chunk	1		
25448	chunk	4	4	100.0	25448	chunk	2	17.5	16.8	2.9	0.7	6.8	25448	chunk		1	
37183	chunk	4	4	100.0	37183	chunk	2	16.8	5.6	0.9	2.1	21.3	37183	chunk	1		
27700	chunk	8	9	88.9	27700	chunk	5	23.2	19.8	4.6	1.1	10.9	27700	chunk		1	
32974	chunk	1	6	16.7	32974	chunk	0	22.3	18	4.0	0.0	0.0	32974	chunk	1		
35864	chunk	0	5	0.0	35864	chunk	2	18	8.9	1.6	1.2	12.5	35864	chunk		1	
36087	chunk	0	3	0.0	36087	chunk	1	22.7	5.3	1.2	0.8	8.3	36087	chunk		1	
33984	chunk	0	4	0.0	33984	chunk	1	12.6	7.7	1.0	1.0	10.3	33984	chunk	1		
26009	chunk	5	6	83.3	26009	chunk	3	19	9	1.7	1.8	17.5	26009	chunk		1	
33789	chunk	1	2	50.0	33789	chunk	1	28	7.5	2.1	0.5	4.8	33789	chunk	1		
25306	cleaver	10	40	25.0	25306	cleaver	2	59.2	31.1	18.4	0.1	1.1	25306	cleaver	1		
32237	core, casual	2	3	66.7	32237	core, casual	14	50.7	49.1	24.9	0.6	5.6	32237	core, casual	1		
33130	core, casual	5	9	55.6	33130	core, casual	3	60.7	58	35.2	0.1	0.9	33130	core, casual	1		
29754	core, casual	3	6	50.0	29754	core, casual	5	57.1	42	24.0	0.2	2.1	29754	core, casual		1	
29224	core, casual	3	7	42.9	29224	core, casual	7	44	39.6	17.4	0.4	4.0	29224	core, casual		1	
29389	core, flat	9	21	42.9	29389	core, flat	2	38.4	43.6	16.7	0.1	1.2	29389	core, flat	1		
24702	core, p	4	17	23.5	24702	core, p	1	50.4	43.6	22.0	0.0	0.5	24702	core, p		1	
33991	core, pi	11	14	78.6	33991	core, pi	7	55.4	34.4	19.1	0.4	3.7	33991	core, pi		1	
27851	flake	1	2	50.0	27851	flake	3	34.2	35.4	12.1	0.2	2.5	27851	flake		1	
32849	flake	0	11	0.0	32849	flake	1	38.6	18.5	7.1	0.1	1.4	32849	flake	1		
26441	flake	1	10	10.0	26441	flake	7	32	17.5	5.6	1.3	12.5	26441	flake		1	
28896	flake	0	4	0.0	28896	flake	3	23.5	14.3	3.4	0.9	8.9	28896	flake	1		
32139	flake	0	3	0.0	32139	flake	0	19.2	17.4	3.3	0.0	0.0	32139	flake	1		
27826	flake	1	1	100.0	27826	flake	2	20.7	16.3	3.4	0.6	5.9	27826	flake	1		
37623	flake	1	1	100.0	37623	flake	10	27	21	5.7	1.8	17.6	37623	flake	1		
28008	flake	0	4	0.0	28008	flake	0	21.6	19	4.1	0.0	0.0	28008	flake	1		

32090	flake	1	3	33.3	32090	flake	0	23	10.3	2.4	0.0	0.0	32090	flake	1		
22937	flake	2	3	66.7	22937	flake	3	20	16.7	3.3	0.9	9.0	22937	flake		1	
22745	flake	1	1	100.0	22745	flake	3	23.3	9.9	2.3	1.3	13.0	22745	flake	1		
28608	flake	3	4	75.0	28608	flake	2	20.4	11.2	2.3	0.9	8.8	28608	flake	1		
26455	flake	0	2	0.0	26455	flake	0	14.1	9	1.3	0.0	0.0	26455	flake	1		
37632	flake	1	1	100.0	37632	flake	2	18.4	12.1	2.2	0.9	9.0	37632	flake		1	
26665	flake	0	3	0.0	26665	flake	0	24.7	6.8	1.7	0.0	0.0	26665	flake	1		
28252	flake	1	1	100.0	28252	flake	2	27.3	7.2	2.0	1.0	10.2	28252	flake		1	
25023 / 25022	handaxe	6	21	28.6	25023	handaxe	11	64.8	29.4	19.1	0.6	5.8	25023	handaxe		1	
31725	handaxe / retouch	2	20	10.0	31725	handaxe / retouch	1	102.6	95.3	97.8	0.0	0.1	31725	handaxe / retouch		1	
31088	retouch	0	10	0.0	31088	retouch	6	44.4	39.2	17.4	0.3	3.4	31088	retouch		1	
28488	retouch	1	9	11.1	28488	retouch	10	44.7	30.9	13.8	0.7	7.2	28488	retouch		1	
26937	retouch	2	19	10.5	26937	retouch	4	41.4	31.5	13.0	0.3	3.1	26937	retouch	1		
30070	retouch	1	14	7.1	30070	retouch	6	34	18.8	6.4	0.9	9.4	30070	retouch	1		
33000	retouch	3	8	37.5	33000	retouch	8	38	25.2	9.6	0.8	8.4	33000	retouch		1	
26393	retouch	5	17	29.4	26393	retouch	12	16.3	15	2.4	4.9	49.1	26393	retouch		1	
28077	retouch	2	6	33.3	28077	retouch	2	33.7	17.2	5.8	0.3	3.5	28077	retouch	1		
28254	retouch	0	12	0.0	28254	retouch	6	24.4	21.5	5.2	1.1	11.4	28254	retouch	1		
37673	retouch	2	12	16.7	37673	retouch	1	21.2	17.1	3.6	0.3	2.8	37673	retouch		1	
32178	retouch	0	6	0.0	32178	retouch	0	21.7	15.7	3.4	0.0	0.0	32178	retouch		1	
30620	retouch	1	6	16.7	30620	retouch	3	22.6	11.3	2.6	1.2	11.7	30620	retouch	1		
23315	retouch	4	10	40.0	23315	retouch	2	23.7	10.7	2.5	0.8	7.9	23315	retouch	1		
27898	retouch	1	4	25.0	27898	retouch	1	13.2	12.6	1.7	0.6	6.0	27898	retouch		1	
33526	retouch	0	8	0.0	33526	retouch	0	15.3	9.3	1.4	0.0	0.0	33526	retouch	1		
33807	retouch	0	8	0.0	33807	retouch	1	29.3	8.7	2.5	0.4	3.9	33807	retouch		1	
28023	retouch	7	17	41.2	28023	retouch	13	39.5	37.3	14.7	0.9	8.8	28023	retouch		1	
36908	retouch	8	38	21.1	36908	retouch	20	49.2	47.7	23.5	0.9	8.5	36908	retouch		1	

n				Mean	n							Mean	n				
60				35.5%	60							6.6	60		29	31	0
														Percentage of sample	48.3	51.7	0.0

Table 13: Experimental Oldowan quartzite raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; vf – very fine grained; f – fine grained; m – medium grained; c – coarse grained; vc – very coarse grained; g – granules; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**vf**	**f**	**m**	**c**	**vc**	**g**	**Sn**	**Tt**	**N**	**S**	**E**
s36e1	chopper / core cent	3	19	15.8	s36e1	chopper / core cent			1				s36e1	chopper / core cent			1
11d4	chunk	0	4	0.0	14f5	chopper core		1					14f5	chopper core		1	
12a3	chunk	0	11	0.0	32b10	chopper core		1					32b10	chopper core	1		
12a4	chunk	0	6	0.0	14p1	chunk				1			14p1	chunk			1
14h6	chunk	0	5	0.0	14p2	chunk				1			14p2	chunk			1
21b1	chunk	0	5	0.0	21g9	chunk		1					21g9	chunk		1	
2a4	chunk	0	8	0.0	10c7	chunk			1				10c7	chunk	1		
32b13	chunk	0	4	0.0	10f2	chunk		1					10f2	chunk		1	
5idug4	chunk	0	4	0.0	10u1	chunk			1				10u1	chunk		1	
8L2	chunk	0	9	0.0	11d3	chunk				1			11d3	chunk			1
s46e4	chunk	0	3	0.0	11d4	chunk				1			11d4	chunk			1
S8,O8	chunk	0	6	0.0	12a3	chunk					1		12a3	chunk			1
12a1	chunk	0	7	0.0	12a4	chunk					1		12a4	chunk			1
2a2	chunk	0	6	0.0	14,O2	chunk		1					14,O2	chunk		1	
2a5	chunk	0	5	0.0	14c2	chunk		1					14c2	chunk			1

14h10	core casual	0	9	0.0	14d7	chunk		1					14d7	chunk		1	
14h9	core, cent	0	20	0.0	14f1	chunk		1					14f1	chunk		1	
s46e2	core, cent	0	20	0.0	14h11	chunk		1					14h11	chunk			1
14w3	core, pi	0	11	0.0	14h6	chunk		1					14h6	chunk			1
21g8	denticulate	0	12	0.0	14n1	chunk			1				14n1	chunk			1
21c8	denticulate	0	10	0	14n4	chunk			1				14n4	chunk			1
34c2	denticulate	0	9	0.0	14q3	chunk		1					14q3	chunk		1	
s46e7	denticulate	0	17	0.0	14s2	chunk		1					14s2	chunk			1
S8.O6	denticulate	0	16	0.0	14s3	chunk		1					14s3	chunk			1
10c6	flake	0	1	0.0	14t1	chunk			1				14t1	chunk			1
12a5	flake	0	5	0.0	14u3	chunk			1				14u3	chunk			1
14f3	flake	0	7	0.0	14u5	chunk			1				14u5	chunk			1
14h1	flake	0	3	0.0	20aj4	chunk		1					20aj4	chunk		1	
14h4	flake	0	3	0.0	20ak1	chunk			1				20ak1	chunk		1	
14v2	flake	0	1	0.0	20t2	chunk				1			20t2	chunk		1	
21c4	flake	0	2	0.0	21b1	chunk				1			21b1	chunk			1
21L9	flake	0	4	0.0	21c7	chunk		1					21c7	chunk		1	
2a1	flake	0	3	0.0	21h2	chunk		1					21h2	chunk		1	
32b2	flake	0	7	0.0	21L11	chunk		1					21L11	chunk		1	
32c1	flake	0	3	0.0	2a4	chunk				1			2a4	chunk			1
33a3	flake	0	5	0.0	2a7	chunk				1			2a7	chunk			1
36a2	flake	0	7	0.0	31a2	chunk		1					31a2	chunk		1	
36d2	flake	0	2	0.0	32b12	chunk		1					32b12	chunk	1		
46c2	flake	0	5	0.0	32b13	chunk		1					32b13	chunk	1		
5asurf2	flake	0	10	0.0	32c4	chunk						1	32c4	chunk			1
5bsurf1	flake	0	8	0.0	32c6	chunk						1	32c6	chunk			1
5bsurf8	flake	0	18	0.0	34c3	chunk		1					34c3	chunk		1	
5r2	flake	0	9	0.0	36a3	chunk			1				36a3	chunk	1		
8L1	flake	0	4	0.0	36d3	chunk			1				36d3	chunk			1

8L6	flake	0	9	0.0	37a5	chunk			1				37a5	chunk		1	
8m1	flake	0	4	0.0	37d2	chunk					1		37d2	chunk			1
s46e3	flake	0	7	0.0	46a3	chunk		1					46a3	chunk		1	
S8,O1	flake	0	8	0.0	46b4	chunk		1					46b4	chunk		1	
11d2	flake	0	6	0.0	46d1	chunk		1					46d1	chunk			1
11d5	flake	0	4	0.0	5asurf12	chunk			1				5asurf12	chunk		1	
12a7	flake	0	4	0.0	5asurf8	chunk			1				5asurf8	chunk		1	
14h2	flake	0	4	0.0	5bsurf13	chunk		1					5bsurf13	chunk	1		
14h5	flake	0	3	0.0	5bsurf6	chunk		1					5bsurf6	chunk	1		
14u1	flake	0	1	0.0	5ddug2	chunk				1			5ddug2	chunk			1
14w2	flake	0	3	0.0	5ddug3	chunk				1			5ddug3	chunk			1
21c1	flake	0	5	0.0	5gsurf6	chunk		1					5gsurf6	chunk		1	
21L1	flake	0	8	0.0	5idug1	chunk		1					5idug1	chunk		1	
21L2	flake	0	3	0.0	5idug4	chunk		1					5idug4	chunk		1	
21L4	flake	0	1	0.0	5mdug1	chunk			1				5mdug1	chunk		1	
21L5	flake	0	7	0.0	5Odug4	chunk			1				5Odug4	chunk			1
2a3	flake	0	6	0.0	5Odug5	chunk			1				5Odug5	chunk			1
32c3	flake	0	3	0.0	5qdug7	chunk			1				5qdug7	chunk		1	
33a1	flake	0	6	0.0	6a4	chunk		1					6a4	chunk		1	
5asurf4	flake	0	10	0.0	6d6	chunk			1				6d6	chunk		1	
5bsurf2	flake	0	8	0.0	8i6	chunk			1				8i6	chunk		1	
11d12	retouch	0	8	0.0	8L2	chunk			1				8L2	chunk		1	
14h7	retouch	0	9	0.0	8L8	chunk			1				8L8	chunk		1	
14h8	retouch	0	9	0.0	8m6	chunk			1				8m6	chunk		1	
21L6	retouch	0	14	0.0	8n7	chunk			1				8n7	chunk		1	
2a8	retouch	0	10	0.0	8v2	chunk		1					8v2	chunk		1	
32b4	retouch	0	22	0.0	S10,O12	chunk		1					S10,O12	chunk		1	
36d1	retouch	0	10	0.0	S10,O2	chunk		1					S10,O2	chunk		1	
5asurf6	retouch	0	27	0.0	14c1	chunk		1					14c1	chunk		1	

5bsurf7	retouch	0	14	0.0	14c7	chunk		1					14c7	chunk		1	
s46e5	retouch	0	15	0.0	s37e3	chunk			1				s37e3	chunk			1
12a6	scraper	0	5	0.0	s46e4	chunk		1					s46e4	chunk		1	
32b6	scraper	0	9	0.0	S8,O8	chunk			1				S8,O8	chunk	1		
36a4	scraper	0	17	0.0	12a1	chunk					1		12a1	chunk			1
5asurf1	scraper	0	20	0.0	2a2	chunk				1			2a2	chunk			1
5jsurf1	scraper	0	13	0.0	2a5	chunk				1			2a5	chunk			1
5Ldug4	scraper	0	14	0.0	2a6	chunk				1			2a6	chunk			1
5mdug3	scraper	0	20	0.0	5ddug1	chunk				1			5ddug1	chunk			1
8L3	scraper	0	7	0.0	7a1	chunk		1					7a1	chunk		1	
s46e6	scraper	0	22	0.0	14j3	cleaver / chopper			1				14j3	cleaver / chopper			1
S8,O2	scraper	0	37	0.0	14h10	core casual		1					14h10	core casual			1
10f6	scraper	1	36	2.8	14c10	core chunk		1					14c10	core chunk		1	
S10e4	core, cent / handaxe	1	31	3.2	14c9	core chunk		1					14c9	core chunk		1	
S8,O4	core, flat	1	27	3.7	10u3	core, cent			1				10u3	core, cent		1	
21L8	scraper	1	25	4.0	14h9	core, cent		1					14h9	core, cent			1
5Ldug2	core, pi	1	24	4.2	20ak5	core, cent			1				20ak5	core, cent		1	
14f6	denticulate	1	18	5.6	21c9	core, cent		1					21c9	core, cent		1	
21c5	scraper	1	18	5.6	21L10	core, cent		1					21L10	core, cent	1		
5gsurf1	scraper	1	17	5.9	32b11	core, cent		1					32b11	core, cent	1		
12a10	core, pi	1	16	6.3	33a4	core, cent			1				33a4	core, cent		1	
21c6	retouch	1	16	6.3	37d4	core, cent					1		37d4	core, cent			1
33a2	retouch	1	16	6.3	46a1	core, cent		1					46a1	core, cent		1	
8L9	core, pi	1	15	6.7	5gsurf3	core, cent		1					5gsurf3	core, cent	1		
32b10	chopper core	1	14	7.1	5Odug6	core, cent			1				5Odug6	core, cent			1
5bsurf5	core, flat	2	27	7.4	5pdug4	core, cent			1				5pdug4	core, cent			1
12a9	core, frag	1	13	7.7	5pdug8	core, cent		1					5pdug8	core, cent			1
11d11	scraper	1	13	7.7	6d4	core, cent			1				6d4	core, cent		1	

14n11	scraper	1	13	7.7	s46e2	core, cent		1					s46e2	core, cent	1		
5Ldug1	retouch	1	12	8.3	20au3	core, cent			1				20au3	core, cent			1
5asurf7	scraper	1	12	8.3	14t3	core, cent / chopper			1				14t3	core, cent / chopper			1
5pdug2	scraper	1	12	8.3	S10e4	core, cent / handaxe				1			S10e4	core, cent / handaxe		1	
10c2	retouch	2	22	9.1	10a1	core, disc/prep			1				10a1	core, disc/prep	1		
10c3	retouch	2	22	9.1	21h5	core, flat		1					21h5	core, flat		1	
14q2	retouch	1	11	9.1	32d2	core, flat		1					32d2	core, flat			1
5dsurf2	retouch	1	11	9.1	46b2	core, flat		1					46b2	core, flat		1	
7a4	retouch	1	11	9.1	46c1	core, flat		1					46c1	core, flat		1	
46b6	scraper	2	21	9.5	5bsurf5	core, flat		1					5bsurf5	core, flat	1		
21f2	flake	1	10	10.0	s37e5	core, flat			1				s37e5	core, flat			1
5bsurf4	scraper	2	20	10.0	S8,O4	core, flat			1				S8,O4	core, flat		1	
5pdug7	retouch	2	19	10.5	10f5	core, flat/p		1					10f5	core, flat/p		1	
14n7	retouch	1	9	11.1	31a3	core, flat/prep		1					31a3	core, flat/prep		1	
14v3	retouch	1	9	11.1	12a9	core, frag			1				12a9	core, frag			1
5r1	scraper	1	9	11.1	20au2	core, frag			1				20au2	core, frag			1
21f1	scraper	1	9	11.1	5ddug4	core, frag				1			5ddug4	core, frag			1
10a2	scraper	5	44	11.4	5mdug4	core, frag			1				5mdug4	core, frag		1	
36c3	retouch	5	41	12.2	8i3	core, frag			1				8i3	core, frag		1	
14s2	chunk	1	8	12.5	11d10	core, p				1			11d10	core, p			1
2a7	chunk	1	8	12.5	11d9	core, p				1			11d9	core, p			1
2a6	chunk	1	8	12.5	20aj2	core, p		1					20aj2	core, p		1	
21L7	denticulate	1	8	12.5	21b10	core, p				1			21b10	core, p		1	
33a4	denticulate	3	24	12.5	32c10	core, p						1	32c10	core, p			1
12a8	flake	1	8	12.5	5asurf13	core, p			1				5asurf13	core, p		1	
14v1	flake	1	8	12.5	5asurf9	core, p			1				5asurf9	core, p		1	
32c7	flake	1	8	12.5	5dsurf4	core, p				1			5dsurf4	core, p			1

S10,O8	retouch	2	16	12.5	5esurf3	core, p				1			5esurf3	core, p			1
s36e2	scraper	1	8	12.5	5fsurf2	core, p		1					5fsurf2	core, p		1	
37a4	retouch	2	15	13.3	5Odug8	core, p			1				5Odug8	core, p			1
5qdug1	scraper	3	22	13.6	5qdug3	core, p			1				5qdug3	core, p		1	
32c6	chunk	1	7	14.3	8L10	core, p			1				8L10	core, p		1	
14d6	denticulate	2	14	14.3	8n2	core, p			1				8n2	core, p		1	
32c2	flake	1	7	14.3	8n5	core, p			1				8n5	core, p		1	
S10e2	flake	1	7	14.3	8v4	core, p		1					8v4	core, p		1	
32c5	flake	1	7	14.3	6a3	core, p		1					6a3	core, p		1	
5fsurf5	retouch	2	14	14.3	21g10	core, pi		1					21g10	core, pi		1	
8L11	retouch	4	27	14.8	10c4	core, pi				1			10c4	core, pi		1	
5qdug3	core, p	5	33	15.2	12a10	core, pi				1			12a10	core, pi			1
46a5	scraper	2	13	15.4	14n10	core, pi			1				14n10	core, pi			1
5gsurf3	core, cent	5	32	15.6	14w3	core, pi			1				14w3	core, pi			1
11d9	core, p	3	19	15.8	37a7	core, pi			1				37a7	core, pi		1	
32c10	core, p	3	19	15.8	5ddug5	core, pi				1			5ddug5	core, pi			1
5pdug1	retouch	3	19	15.8	5Ldug2	core, pi			1				5Ldug2	core, pi			1
6a3	retouch	3	19	15.8	5r3	core, pi		1					5r3	core, pi			1
11d3	chunk	1	6	16.7	7a3	core, pi		1					7a3	core, pi		1	
14n1	chunk	1	6	16.7	8i5	core, pi			1				8i5	core, pi		1	
21h2	chunk	1	6	16.7	8L9	core, pi			1				8L9	core, pi		1	
21L10	core, cent	4	24	16.7	S10,O10	core, pi		1					S10,O10	core, pi		1	
32b5	flake	1	6	16.7	14,O3	core, pi		1					14,O3	core, pi		1	
34c4	retouch	3	18	16.7	21g8	denticulate		1					21g8	denticulate		1	
21f3	scraper	2	12	16.7	10d1	denticulate			1				10d1	denticulate		1	
5asurf9	core, p	7	41	17.1	14,O1	denticulate		1					14,O1	denticulate		1	
37a2	scraper	5	29	17.2	14d6	denticulate		1					14d6	denticulate		1	
20au3	core, cent	3	17	17.6	14f6	denticulate		1					14f6	denticulate		1	
46a6	denticulate	3	17	17.6	20ak7	denticulate			1				20ak7	denticulate		1	

21c9	core, cent	5	28	17.9	21c8	denticulate		1					21c8	denticulate		1	
5bsurf9	denticulate	2	11	18.2	21L7	denticulate		1					21L7	denticulate		1	
14j2	retouch	2	11	18.2	33a4	denticulate		1					33a4	denticulate		1	
32d4	retouch	4	22	18.2	34c2	denticulate		1					34c2	denticulate		1	
37a3	retouch	4	22	18.2	36a1	denticulate			1				36a1	denticulate	1		
8L5	scraper	2	11	18.2	37a1	denticulate			1				37a1	denticulate	1		
14f7	retouch	3	16	18.8	46a6	denticulate		1					46a6	denticulate		1	
S14e11	retouch	3	16	18.8	46b7	denticulate		1					46b7	denticulate		1	
10a5	retouch	4	21	19.0	46c4	denticulate		1					46c4	denticulate			1
14f4	scraper	4	21	19.0	5asurf5	denticulate			1				5asurf5	denticulate		1	
14h11	chunk	1	5	20.0	5bsurf11	denticulate		1					5bsurf11	denticulate	1		
36d3	chunk	1	5	20.0	5bsurf9	denticulate		1					5bsurf9	denticulate	1		
46b4	chunk	1	5	20.0	5dsurf5	denticulate				1			5dsurf5	denticulate			1
37a1	denticulate	3	15	20.0	5gsurf5	denticulate		1					5gsurf5	denticulate		1	
5bsurf11	denticulate	2	10	20.0	5idug11	denticulate		1					5idug11	denticulate		1	
S10,O6	denticulate	3	15	20.0	5qdug6	denticulate			1				5qdug6	denticulate		1	
11d6	flake	1	5	20.0	8m4	denticulate			1				8m4	denticulate		1	
5idug3	flake	1	5	20.0	S10,O3	denticulate		1					S10,O3	denticulate		1	
8i1	flake	2	10	20.0	S10,O6	denticulate		1					S10,O6	denticulate	1		
14h3	flake	1	5	20.0	S10e3	denticulate			1				S10e3	denticulate		1	
46d2	retouch	3	15	20.0	s37e1	denticulate			1				s37e1	denticulate		1	
21g5	scraper	3	15	20.0	s46e7	denticulate		1					s46e7	denticulate		1	
14n9	scraper	4	20	20.0	S8.O6	denticulate			1				S8.O6	denticulate	1		
32b9	scraper	3	15	20.0	5jsurf3	denticulate			1				5jsurf3	denticulate		1	
5bsurf12	scraper	5	25	20.0	21g7	flake		1					21g7	flake	1		
21h3	scraper	1	5	20.0	10a3	flake			1				10a3	flake	1		
5qdug2	scraper	6	29	20.7	10c6	flake			1				10c6	flake		1	
5gsurf5	denticulate	5	24	20.8	10d4	flake			1				10d4	flake		1	
31a4	retouch	5	24	20.8	10f1	flake		1					10f1	flake		1	

S10e3	denticulate	4	19	21.1	11d1	flake				1			11d1	flake			1
21h4	retouch	3	14	21.4	11d6	flake				1			11d6	flake			1
32d1	retouch	3	14	21.4	12a2	flake					1		12a2	flake			1
8n1	retouch	3	14	21.4	12a5	flake			1				12a5	flake			1
14p3	scraper	3	14	21.4	14c1	flake		1					14c1	flake			1
11d7	scraper	3	14	21.4	14c3	flake		1					14c3	flake			1
20ak6	retouch	2	9	22.2	14d1	flake		1					14d1	flake		1	
5idug8	retouch	2	9	22.2	14d3	flake		1					14d3	flake		1	
20ak4	scraper	4	18	22.2	14f3	flake		1					14f3	flake		1	
7a2	scraper	4	18	22.2	14h1	flake		1					14h1	flake			1
10u3	core, cent	5	22	22.7	14h4	flake		1					14h4	flake			1
11d10	core, p	5	22	22.7	14j1	flake			1				14j1	flake			1
10c4	core, pi	5	22	22.7	14n2	flake			1				14n2	flake			1
8L10	core, p	6	26	23.1	14n3	flake			1				14n3	flake			1
S10,O3	denticulate	3	13	23.1	14u4	flake			1				14u4	flake			1
14n6	retouch	3	13	23.1	14v2	flake			1				14v2	flake		1	
8n2	core, p	5	21	23.8	14v4	flake			1				14v4	flake		1	
14n4	chunk	1	4	25.0	20ak3	flake			1				20ak3	flake		1	
5ddug1	chunk	1	4	25.0	21b5	flake				1			21b5	flake		1	
33a4	core, cent	7	28	25.0	21c4	flake		1					21c4	flake		1	
46b7	denticulate	3	12	25.0	21f2	flake			1				21f2	flake		1	
5dsurf5	denticulate	4	16	25.0	21L9	flake		1					21L9	flake	1		
11d1	flake	1	4	25.0	2a1	flake				1			2a1	flake			1
12a2	flake	1	4	25.0	2a9	flake				1			2a9	flake			1
14c1	flake	1	4	25.0	31a4	flake		1					31a4	flake		1	
14n2	flake	1	4	25.0	32b2	flake		1					32b2	flake	1		
2a9	flake	1	4	25.0	32b5	flake		1					32b5	flake	1		
5asurf3	flake	2	8	25.0	32c1	flake						1	32c1	flake			1
5mdug2	flake	1	4	25.0	32c2	flake						1	32c2	flake			1

21g1	flake	1	4	25.0	33a3	flake			1				33a3	flake		1	
14n5	flake	1	4	25.0	34c1	flake		1					34c1	flake		1	
14s1	flake	1	4	25.0	36a2	flake			1				36a2	flake	1		
14w1	flake	1	4	25.0	36d2	flake			1				36d2	flake			1
21b7	retouch	6	24	25.0	37a6	flake			1				37a6	flake		1	
5bsurf14	retouch	4	16	25.0	37d3	flake					1		37d3	flake			1
5qdug8	retouch	3	12	25.0	46a2	flake		1					46a2	flake		1	
21c3	retouch	1	4	25	46b3	flake		1					46b3	flake		1	
20aj1	scraper	7	28	25.0	46c2	flake		1					46c2	flake		1	
5r3	core, pi	4	15	26.7	5asurf2	flake			1				5asurf2	flake		1	
21g6	retouch	4	15	26.7	5asurf3	flake			1				5asurf3	flake	1		
5idug9	retouch	4	15	26.7	5bsurf1	flake		1					5bsurf1	flake	1		
5idug12	scraper	4	15	26.7	5bsurf8	flake		1					5bsurf8	flake	1		
8i3	core, frag	3	11	27.3	5esurf1	flake				1			5esurf1	flake			1
5idug11	denticulate	3	11	27.3	5esurf2	flake				1			5esurf2	flake			1
46b5	retouch	3	11	27.3	5fsurf4	flake		1					5fsurf4	flake		1	
46c4	denticulate	4	14	28.6	5idug3	flake		1					5idug3	flake		1	
20t4	retouch	4	14	28.6	5idug7	flake		1					5idug7	flake		1	
32b8	retouch	6	21	28.6	5mdug2	flake			1				5mdug2	flake		1	
6d7	retouch	8	28	28.6	5Odug10	flake			1				5Odug10	flake			1
8L7	retouch	4	14	28.6	5Odug9	flake			1				5Odug9	flake			1
31a1	scraper	6	21	28.6	5r2	flake		1					5r2	flake			1
46c1	core, flat	7	24	29.2	6d2	flake			1				6d2	flake		1	
20aj2	core, p	10	34	29.4	8i1	flake			1				8i1	flake		1	
46a4	retouch	5	17	29.4	8L1	flake			1				8L1	flake		1	
10u2	scraper	5	17	29.4	8L6	flake			1				8L6	flake		1	
S14e4	retouch	3	10	30.0	8m1	flake			1				8m1	flake		1	
14f2	retouch	4	13	30.8	8m5	flake			1				8m5	flake		1	
20t3	scraper	4	13	30.8	8v1	flake		1					8v1	flake		1	

32b11	core, cent	5	16	31.3	S10,O5	flake		1					S10,O5	flake		1	
11d8	retouch	5	16	31.3	S10,O7	flake		1					S10,O7	flake		1	
5dsurf4	core, p	7	22	31.8	S10e1	flake			1				S10e1	flake		1	
5asurf5	denticulate	4	12	33.3	S10e2	flake				1			S10e2	flake		1	
8m4	denticulate	6	18	33.3	14c2	flake		1					14c2	flake		1	
10a3	flake	3	9	33.3	14c5	flake		1					14c5	flake		1	
14j1	flake	3	9	33.3	s37e4	flake			1				s37e4	flake			1
S10e1	flake	1	3	33.3	s46e3	flake		1					s46e3	flake	1		
14q1	flake	2	6	33.3	S8,O1	flake			1				S8,O1	flake	1		
21L3	flake	1	3	33.3	21g1	flake		1					21g1	flake		1	
8m3	retouch	6	18	33.3	21g2	flake		1					21g2	flake	1		
s37e2	retouch	5	15	33.3	21g3	flake		1					21g3	flake		1	
5pdug6	scraper	8	24	33.3	11d2	flake				1			11d2	flake			1
36a1	denticulate	7.0	20	35.0	11d5	flake				1			11d5	flake			1
5asurf11	retouch	7	20	35.0	12a7	flake					1		12a7	flake			1
5gsurf6	chunk	4	11	36.4	12a8	flake					1		12a8	flake			1
14,O1	denticulate	4	11	36.4	14c3	flake		1					14c3	flake		1	
8n3	scraper	8	22	36.4	14h2	flake		1					14h2	flake			1
14t1	chunk	3	8	37.5	14h3	flake		1					14h3	flake			1
5asurf8	chunk	3	8	37.5	14h5	flake		1					14h5	flake			1
s37e1	denticulate	6	16	37.5	14n5	flake			1				14n5	flake			1
46b3	flake	3	8	37.5	14q1	flake		1					14q1	flake		1	
34c	retouch	3	8	37.5	14s1	flake		1					14s1	flake			1
32d3	scraper	6	16	37.5	14t2	flake			1				14t2	flake			1
6d3	scraper	6	16	37.5	14u1	flake			1				14u1	flake			1
14d2	scraper	3	8	37.5	14u2	flake			1				14u2	flake			1
14f5	chopper core	9	23	39.1	14v1	flake			1				14v1	flake		1	
S10,O9	scraper	11	28	39.3	14w1	flake			1				14w1	flake			1
10c7	chunk	2	5	40.0	14w2	flake			1				14w2	flake			1

14q3	chunk	2	5	40.0	20ak2	flake			1				20ak2	flake		1	
5idug1	chunk	2	5	40.0	20au1	flake			1				20au1	flake			1
S14e1	chunk	2	5	40.0	20t1	flake				1			20t1	flake		1	
8i5	core, pi	6	15	40.0	21b3	flake				1			21b3	flake			1
20ak7	denticulate	8	20	40.0	21b6	flake				1			21b6	flake		1	
5esurf1	flake	2	5	40.0	21b8	flake				1			21b8	flake		1	
21c2	flake	2	5	40.0	21c1	flake		1					21c1	flake		1	
5dsurf1	flake	2	5	40.0	21c2	flake		1					21c2	flake		1	
S8,O3	flake	2	5	40.0	21f4	flake			1				21f4	flake		1	
10u4	retouch	6	15	40.0	21L1	flake		1					21L1	flake	1		
10a1	core, disc/prep	9	22	40.9	21L2	flake		1					21L2	flake	1		
8n5	core, p	9	22	40.9	21L3	flake		1					21L3	flake	1		
5mdug4	core, frag	5	12	41.7	21L4	flake		1					21L4	flake		1	
5qdug4	scraper	10	24	41.7	21L5	flake		1					21L5	flake	1		
10f3	scraper	8	19	42.1	2a3	flake				1			2a3	flake			1
46c3	scraper	8	19	42.1	32b1	flake		1					32b1	flake	1		
5bsurf6	chunk	3	7	42.9	32c3	flake						1	32c3	flake			1
21b3	flake	3	7	42.9	32c5	flake						1	32c5	flake			1
21g10	core, pi	14	32	43.8	32c7	flake						1	32c7	flake			1
8v3	scraper	7	16	43.8	32c8	flake						1	32c8	flake			1
14f1	chunk	4	9	44.4	33a1	flake			1				33a1	flake		1	
5asurf12	chunk	4	9	44.4	5asurf4	flake			1				5asurf4	flake		1	
8i6	chunk	4	9	44.4	5bsurf2	flake		1					5bsurf2	flake	1		
8i4	scraper	8	18	44.4	5bsurf3	flake		1					5bsurf3	flake	1		
5qdug6	denticulate	9	20	45.0	5dsurf1	flake				1			5dsurf1	flake			1
5qdug9	retouch	9	20	45.0	5idug2	flake		1					5idug2	flake		1	
6d6	chunk	5	11	45.5	5idug6	flake		1					5idug6	flake		1	
10f2	chunk	3	6	50.0	5jsurf2	flake			1				5jsurf2	flake		1	

s37e3	chunk	2	4	50.0	5Odug1	flake			1				5Odug1	flake			1
32d2	core, flat	3	6	50.0	5Odug2	flake			1				5Odug2	flake			1
20au2	core, frag	6	12	50.0	5Odug3	flake			1				5Odug3	flake			1
21b10	core, p	14	28	50.0	5Odug7	flake			1				5Odug7	flake			1
14n10	core, pi	9	18	50.0	6d1	flake			1				6d1	flake		1	
S10,O10	core, pi	12	24	50.0	8i2	flake			1				8i2	flake		1	
14c3	flake	1	2	50.0	S10,O1	flake		1					S10,O1	flake		1	
14n3	flake	1	2	50.0	S8,O3	flake			1				S8,O3	flake		1	
34c1	flake	1	2	50.0	21g6	retouch		1					21g6	retouch	1		
S14e2	flake	1	2	50.0	10a5	retouch		1					10a5	retouch	1		
14u2	flake	1	2	50.0	10c2	retouch				1			10c2	retouch	1		
20au1	flake	2	4	50.0	10c3	retouch				1			10c3	retouch	1		
S10,O1	flake	2	4	50.0	10u4	retouch			1				10u4	retouch		1	
S10,O4	retouch	7	14	50.0	11d12	retouch				1			11d12	retouch			1
32c9	scraper	5	10	50.0	11d8	retouch				1			11d8	retouch			1
6a3	core, p	17	33	51.5	14f2	retouch		1					14f2	retouch		1	
10f5	core, flat/p	12	23	52.2	14f7	retouch		1					14f7	retouch		1	
5fsurf2	core, p	12	23	52.2	14h7	retouch		1					14h7	retouch			1
7a3	core, pi	8	15	53.3	14h8	retouch		1					14h8	retouch			1
10d1	denticulate	15	28	53.6	14j2	retouch			1				14j2	retouch			1
5esurf3	core, p	7	13	53.8	14n6	retouch			1				14n6	retouch			1
S10,O11	scraper	7	13	53.8	14n7	retouch			1				14n7	retouch			1
5fsurf1	scraper	12	22	54.5	14q2	retouch		1					14q2	retouch		1	
5idug5	scraper	6	11	54.5	14v3	retouch			1				14v3	retouch		1	
31a3	core, flat/prep	11	20	55.0	20ak6	retouch			1				20ak6	retouch		1	
46a3	chunk	5	9	55.6	20t4	retouch				1			20t4	retouch		1	
S10,O2	chunk	5	9	55.6	21b7	retouch				1			21b7	retouch		1	
20ak5	core, cent	15	27	55.6	21c6	retouch		1					21c6	retouch		1	

46b2	core, flat	10	18	55.6	21h4	retouch		1					21h4	retouch		1	
36a3	chunk	4	7	57.1	21L6	retouch		1					21L6	retouch	1		
5ddug3	chunk	4	7	57.1	2a8	retouch				1			2a8	retouch			1
5pdug8	core, cent	12	21	57.1	31a4	retouch		1					31a4	retouch		1	
5bsurf3	flake	4	7	57.1	32b4	retouch		1					32b4	retouch	1		
5asurf13	core, p	15	26	57.7	32b8	retouch		1					32b8	retouch	1		
10c1	scraper	11	19	57.9	32d1	retouch		1					32d1	retouch			1
14j3	cleaver / chopper	10	17	58.8	32d4	retouch		1					32d4	retouch			1
14p1	chunk	3	5	60.0	33a2	retouch			1				33a2	retouch		1	
14s3	chunk	3	5	60.0	34c	retouch		1					34c	retouch		1	
20ak1	chunk	3	5	60.0	34c4	retouch		1					34c4	retouch		1	
5pdug4	core, cent	9	15	60.0	36c3	retouch			1				36c3	retouch	1		
31a4	flake	3	5	60.0	36d1	retouch			1				36d1	retouch			1
20ak2	flake	6	10	60.0	37a3	retouch			1				37a3	retouch		1	
32c8	flake	3	5	60.0	37a4	retouch			1				37a4	retouch	1		
8m2	scraper	16	26	61.5	46a4	retouch		1					46a4	retouch		1	
8L8	chunk	5	8	62.5	46b5	retouch			1				46b5	retouch		1	
6d4	core, cent	15	24	62.5	46d2	retouch		1					46d2	retouch		1	
14d1	flake	5	8	62.5	5asurf11	retouch			1				5asurf11	retouch		1	
46a1	core, cent	11	17	64.7	5asurf6	retouch			1				5asurf6	retouch	1		
37a7	core, pi	13	20	65.0	5bsurf14	retouch		1					5bsurf14	retouch	1		
10u1	chunk	2	3	66.7	5bsurf7	retouch		1					5bsurf7	retouch	1		
20t2	chunk	6	9	66.7	5dsurf2	retouch				1			5dsurf2	retouch			1
21L11	chunk	4	6	66.7	5fsurf5	retouch		1					5fsurf5	retouch		1	
37a5	chunk	2	3	66.7	5idug8	retouch		1					5idug8	retouch		1	
7a1	chunk	2	3	66.7	5idug9	retouch		1					5idug9	retouch		1	
21h5	core, flat	10	15	66.7	5Ldug1	retouch			1				5Ldug1	retouch			1
37a6	flake	4	6	66.7	5pdug1	retouch		1					5pdug1	retouch			1

5idug2	flake	6	9	66.7	5pdug7	retouch		1					5pdug7	retouch			1
5jsurf2	flake	2	3	66.7	5qdug8	retouch			1				5qdug8	retouch		1	
6d1	flake	2	3	66.7	5qdug9	retouch			1				5qdug9	retouch		1	
21b4	scraper	2	3	66.7	6a3	retouch		1					6a3	retouch		1	
S14e6	scraper	6	9	66.7	6d7	retouch			1				6d7	retouch		1	
8n7	chunk	5	7	71.4	7a4	retouch		1					7a4	retouch			1
21g7	flake	5	7	71.4	8L11	retouch			1				8L11	retouch		1	
5Odug6	core, cent	8	11	72.7	8L7	retouch			1				8L7	retouch		1	
5jsurf3	denticulate	8	11	72.7	8m3	retouch			1				8m3	retouch		1	
8v5	retouch	14	19	73.7	8n1	retouch				1			8n1	retouch		1	
32c4	chunk	3	4	75.0	8v5	retouch		1					8v5	retouch		1	
5mdug1	chunk	3	4	75.0	S10,O4	retouch		1					S10,O4	retouch		1	
S14e7	chunk	3	4	75.0	S10,O8	retouch		1					S10,O8	retouch		1	
5idug7	flake	3	4	75.0	S14e11	retouch		1					S14e11	retouch		1	
8m5	flake	3	4	75.0	14c4	retouch		1					14c4	retouch		1	
20t1	flake	3	4	75.0	s37e2	retouch			1				s37e2	retouch			1
5esurf5	scraper	15	20	75.0	s46e5	retouch		1					s46e5	retouch		1	
14u5	chunk	10	13	76.9	21c3	retouch		1					21c3	retouch		1	
21b5	flake	7	9	77.8	14p3	scraper				1			14p3	scraper			1
21g9	chunk	4	5	80.0	21g5	scraper		1					21g5	scraper		1	
14d3	flake	4	5	80.0	10a2	scraper			1				10a2	scraper	1		
20ak3	flake	4	5	80.0	10c1	scraper				1			10c1	scraper		1	
5esurf2	flake	4	5	80.0	10f3	scraper		1					10f3	scraper		1	
5fsurf4	flake	4	5	80.0	10f6	scraper		1					10f6	scraper		1	
21g2	flake	4	5	80.0	10u2	scraper			1				10u2	scraper		1	
32b1	flake	4	5	80.0	11d11	scraper				1			11d11	scraper			1
5idug6	flake	4	5	80.0	11d7	scraper				1			11d7	scraper			1
S14e10	core chunk	13	16	81.3	12a6	scraper					1		12a6	scraper			1
8v4	core, p	20	24	83.3	14f4	scraper		1					14f4	scraper		1	

S10,O5	flake	5	6	83.3	14n11	scraper			1				14n11	scraper			1
5Odug12	scraper	10	12	83.3	14n9	scraper			1				14n9	scraper			1
s37e5	core, flat	12	14	85.7	14t5	scraper			1				14t5	scraper			1
14,O3	core, pi	6	7	85.7	20aj1	scraper		1					20aj1	scraper		1	
10d4	flake	6	7	85.7	20ak4	scraper			1				20ak4	scraper		1	
8v1	flake	6	7	85.7	20t3	scraper				1			20t3	scraper		1	
S14e5	flake	6	7	85.7	21b4	scraper				1			21b4	scraper		1	
14t5	scraper	12	14	85.7	21c5	scraper		1					21c5	scraper		1	
46a2	flake	7	8	87.5	21f3	scraper			1				21f3	scraper		1	
5Odug9	flake	9	10	90.0	21L8	scraper		1					21L8	scraper	1		
21b6	flake	9	10	90.0	32b6	scraper		1					32b6	scraper	1		
5Odug8	core, p	15	16	93.8	32b9	scraper		1					32b9	scraper	1		
14p2	chunk	1	1	100.0	32c9	scraper						1	32c9	scraper			1
14,O2	chunk	4	4	100.0	32d3	scraper		1					32d3	scraper			1
14c2	chunk	4	4	100.0	36a4	scraper			1				36a4	scraper	1		
14d7	chunk	5	5	100.0	37a2	scraper			1				37a2	scraper		1	
14u3	chunk	4	4	100.0	37d1	scraper					1		37d1	scraper			1
20aj4	chunk	3	3	100.0	46a5	scraper		1					46a5	scraper		1	
21c7	chunk	3	3	100.0	46b6	scraper			1				46b6	scraper		1	
31a2	chunk	5	5	100.0	46c3	scraper		1					46c3	scraper			1
32b12	chunk	3	3	100.0	5asurf1	scraper			1				5asurf1	scraper	1		
34c3	chunk	1	1	100.0	5asurf7	scraper			1				5asurf7	scraper		1	
37d2	chunk	4	4	100.0	5bsurf12	scraper		1					5bsurf12	scraper	1		
46d1	chunk	5	5	100.0	5bsurf4	scraper		1					5bsurf4	scraper	1		
5bsurf13	chunk	4	4	100.0	5esurf5	scraper				1			5esurf5	scraper			1
5ddug2	chunk	3	3	100.0	5fsurf1	scraper		1					5fsurf1	scraper		1	
5Odug4	chunk	7	7	100.0	5gsurf1	scraper		1					5gsurf1	scraper	1		
5Odug5	chunk	4	4	100.0	5idug12	scraper		1					5idug12	scraper		1	
5qdug7	chunk	4	4	100.0	5idug5	scraper		1					5idug5	scraper		1	

6a4	chunk	2	2	100.0	5jsurf1	scraper			1				5jsurf1	scraper		1	
8m6	chunk	3	3	100.0	5Ldug4	scraper		1					5Ldug4	scraper			1
8v2	chunk	2	2	100.0	5mdug3	scraper			1				5mdug3	scraper		1	
S10,O12	chunk	2	2	100.0	5Odug11	scraper			1				5Odug11	scraper			1
S14e9	core chunk	8	8	100.0	5Odug12	scraper			1				5Odug12	scraper			1
37d4	core, cent	19	19	100.0	5pdug2	scraper			1				5pdug2	scraper			1
14t3	core, cent / chopper	9	9	100.0	5pdug6	scraper		1					5pdug6	scraper			1
5ddug4	core, frag	4	4	100.0	5qdug1	scraper			1				5qdug1	scraper		1	
5ddug5	core, pi	8	8	100.0	5qdug2	scraper			1				5qdug2	scraper		1	
10f1	flake	4	4	100.0	5r1	scraper		1					5r1	scraper			1
14u4	flake	2	2	100.0	6d3	scraper			1				6d3	scraper		1	
14v4	flake	1	1	100.0	7a2	scraper		1					7a2	scraper		1	
37d3	flake	1	1	100.0	8i4	scraper			1				8i4	scraper		1	
5Odug10	flake	1	1	100.0	8L3	scraper			1				8L3	scraper		1	
6d2	flake	3	3	100.0	8L5	scraper			1				8L5	scraper		1	
S10,O7	flake	2	2	100.0	8m2	scraper			1				8m2	scraper		1	
s37e4	flake	3	3	100.0	8n3	scraper			1				8n3	scraper		1	
21g3	flake	2	2	100.0	8v3	scraper		1					8v3	scraper		1	
14c3	flake	6	6	100.0	S10,O11	scraper		1					S10,O11	scraper		1	
14t2	flake	1	1	100.0	S10,O9	scraper		1					S10,O9	scraper		1	
21b8	flake	1	1	100.0	14c6	scraper		1					14c6	scraper		1	
21f4	flake	1	1	100.0	14c8	scraper		1					14c8	scraper		1	
5Odug1	flake	6	6	100.0	s36e2	scraper			1				s36e2	scraper			1
5Odug2	flake	2	2	100.0	s46e6	scraper		1					s46e6	scraper	1		
5Odug3	flake	4	4	100.0	S8,O2	scraper			1				S8,O2	scraper	1		
5Odug7	flake	3	3	100.0	14d2	scraper		1					14d2	scraper		1	
8i2	flake	1	1	100.0	21f1	scraper			1				21f1	scraper			1
37d1	scraper	21	21	100.0	21h3	scraper		1					21h3	scraper		1	

5Odug11	scraper	16	16	100.0	31a1	scraper		1					31a1	scraper		1	
S14e8	scraper	12	12	100.0	5qdug4	scraper			1				5qdug4	scraper		1	
n				**Mean**	**n**								**n**				
445				36.4%	**445**		0	200	167	57	11	10	**445**		62	233	150
						Percentage of sample	0.0	44.9	37.5	12.8	2.5	2.2		Percentage of sample	13.9	52.4	33.7

Table 14: Experimental Oldowan quartz raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**f**	**L, mm**	**w, mm**	**a cm2**	**f/cm2**	**f/10 cm2**	**Sn**	**Tt**	**N**	**S**	**E**
10q3	chunk	6	6	100.0	10q3	chunk	15	18.3	11.3	2.1	7.3	72.5	10q3	chunk			1
10w11	chunk	3	3	100.0	10w11	chunk	16	17.1	12.4	2.1	7.5	75.5	10w11	chunk		1	
10w5	chunk	4	4	100.0	10w5	chunk	9	18.6	10.5	2.0	4.6	46.1	10w5	chunk		1	
13b6	chunk	0	4	0.0	13b6	chunk	5	15.3	10.3	1.6	3.2	31.7	13b6	chunk	1		
14a4	chunk	4	5	80.0	14a4	chunk	5	18.6	16.5	3.1	1.6	16.3	14a4	chunk		1	
15f4	chunk	8	8	100.0	15f4	chunk	18	28	23.8	6.7	2.7	27.0	15f4	chunk			1
15L1	chunk	1	3	33.3	15L1	chunk	3	15	11.6	1.7	1.7	17.2	15L1	chunk	1		
15L12	chunk	1	5	20.0	15L12	chunk	3	16.9	11.8	2.0	1.5	15.0	15L12	chunk	1		
15p1	chunk	1	3	33.3	15p1	chunk	1	18	8.3	1.5	0.7	6.7	15p1	chunk	1		
15s2	chunk	3	6	50.0	15s2	chunk	3	18	16.5	3.0	1.0	10.1	15s2	chunk		1	
15s3	chunk	2	2	100.0	15s3	chunk	3	24	10.4	2.5	1.2	12.0	15s3	chunk		1	
1k3	chunk	3	5	60.0	1k3	chunk	8	13.3	11.2	1.5	5.4	53.7	1k3	chunk		1	
20aq6	chunk	4	4	100.0	20aq6	chunk	20	24.6	15.5	3.8	5.2	52.5	20aq6	chunk	1		

21i5	chunk	3	4	75.0	21i5	chunk	12	18.7	12	2.2	5.3	53.5	21i5	chunk			1
21q5	chunk	0	5	0.0	21q5	chunk	1	32.7	14.3	4.7	0.2	2.1	21q5	chunk	1		
23g1	chunk	1	2	50.0	23g1	chunk	0	25.3	13.0	3.3	0.0	0.0	23g1	chunk		1	
27c11	chunk	5	5	100.0	27c11	chunk	5	13.0	12.0	1.6	3.2	32.1	27c11	chunk		1	
32f2	chunk	4	5	80.0	32f2	chunk	5	33.2	17.6	5.8	0.9	8.6	32f2	chunk			1
32f6	chunk	3	3	100.0	32f6	chunk	4	18.7	13.6	2.5	1.6	15.7	32f6	chunk			1
32g1	chunk	2	2	100.0	32g1	chunk	2	38	10.6	4.0	0.5	5.0	32g1	chunk		1	
32g4	chunk	1	2	50.0	32g4	chunk	2	23.8	7.8	1.9	1.1	10.8	32g4	chunk		1	
35a4	chunk	3	5	60.0	35a4	chunk	14	19.8	18.4	3.6	3.8	38.4	35a4	chunk		1	
35b3	chunk	2	3	66.7	35b3	chunk	1	19.7	18.4	3.6	0.3	2.8	35b3	chunk	1		
36b3	chunk	3	3	100.0	36b3	chunk	6	27.7	19.6	5.4	1.1	11.1	36b3	chunk	1		
36f3	chunk	0	7	0.0	36f3	chunk	9	16.8	14.2	2.4	3.8	37.7	36f3	chunk	1		
37f2	chunk	4	7	57.1	37f2	chunk	10	27.4	16.5	4.5	2.2	22.1	37f2	chunk		1	
40b2	chunk	4	4	100.0	40b2	chunk	12	30.4	16.6	5.0	2.4	23.8	40b2	chunk			1
43a6	chunk	3	6	50.0	43a6	chunk	5	18.5	15.6	2.9	1.7	17.3	43a6	chunk		1	
46f3	chunk	2	3	66.7	46f3	chunk	8	15.7	8.8	1.4	5.8	57.9	46f3	chunk			1
46h2	chunk	4	4	100.0	46h2	chunk	17	13.0	9.0	1.2	14.5	145.3	46h2	chunk			1
46i4	chunk	1	4	25.0	46i3	chunk	11	18.0	12.6	2.3	4.9	48.5	46i3	chunk	1		
46j3	chunk	3	3	100.0	46j3	chunk	7	9.6	8.5	0.8	8.6	85.8	46j3	chunk		1	
50f	chunk	5	6	83.3	50f	chunk	14	21.5	20.3	4.4	3.2	32.1	50f	chunk			1
50g	chunk	4	8	50.0	50g	chunk	7	23.0	12.8	2.9	2.4	23.8	50g	chunk		1	
50j	chunk	1	4	25.0	50j	chunk	1	23.0	16.4	3.8	0.3	2.7	50j	chunk		1	
54a,c2	chunk	6	7	85.7	54a,c2	chunk	15	29.7	24.6	7.3	2.1	20.5	54a,c2	chunk		1	
56b2	chunk	3	3	100.0	56b2	chunk	7	19.0	12.5	2.4	2.9	29.5	56b2	chunk			1
56c2	chunk	1	2	50.0	56c2	chunk	5	18.6	11.1	2.1	2.4	24.2	56c2	chunk	1		
5nsurf5	chunk	7	18	38.9	5nsurf5	chunk	18	18.1	9.7	1.8	10.3	102.5	5nsurf5	chunk			1
5Osurf3	chunk	5	7	71.4	5Osurf3	chunk	12	34.6	17.7	6.1	2.0	19.6	5Osurf3	chunk			1
5rsurf1	chunk	0	4	0.0	5rsurf1	chunk	7	17.6	14.2	2.5	2.8	28.0	5rsurf1	chunk	1		
5stsurf4	chunk	3	5	60.0	5stsurf4	chunk	3	15.8	12.8	2.0	1.5	14.8	5stsurf4	chunk	1		

5usurf6	chunk	5	5	100.0	5usurf6	chunk	3	19	15.9	3.0	1.0	9.9	5usurf6	chunk		1	
8a4	chunk	0	6	0.0	8a4	chunk	3	20.2	8.5	1.7	1.7	17.5	8a4	chunk	1		
8b2	chunk	5	6	83.3	8b2	chunk	19	15.3	15.3	2.3	8.1	81.2	8b2	chunk			1
8c6	chunk	4	6	66.7	8c6	chunk	7	24.6	19.9	4.9	1.4	14.3	8c6	chunk		1	
8d4	chunk	2	2	100.0	8d4	chunk	8	15.9	14	2.2	3.6	35.9	8d4	chunk			1
8g6	chunk	0	7	0.0	8g6	chunk	3	19.4	14.5	2.8	1.1	10.7	8g6	chunk	1		
S15e1	chunk	4	5	80.0	S15e1	chunk	2	27.5	19	5.2	0.4	3.8	S15e1	chunk		1	
s38e3	chunk	2	2	100.0	s38e3	chunk	2	17.7	15.3	2.7	0.7	7.4	s38e3	chunk	1		
S6e11	chunk	4	6	66.7	S6e11	chunk	5	25.5	21.7	5.5	0.9	9.0	S6e11	chunk		1	
S6e2	chunk	9	11	81.8	S6e2	chunk	9	39.8	25.6	10.2	0.9	8.8	S6e2	chunk		1	
10p1	chunk	2	8	25.0	10p1	chunk	21	46.7	24.2	11.3	1.9	18.6	10p1	chunk		1	
5hsurf3	chunk	7	10	70.0	5hsurf3	chunk	3	33.7	19.2	6.5	0.5	4.6	5hsurf3	chunk		1	
14g3	chunk	4	10	40.0	14g3	chunk	10	24.7	24.7	6.1	1.6	16.4	14g3	chunk	1		
6k3	chunk	4	4	100.0	6k3	chunk	3	23.6	19.3	4.6	0.7	6.6	6k3	chunk		1	
10aa2	core, bip	6	16	37.5	10aa2	core, bip	11	15	15	2.3	4.9	48.9	10aa2	core, bip		1	
10ac2	core, bip	1	6	16.7	10ac2	core, bip	3	30	24	7.2	0.4	4.2	10ac2	core, bip	1		
5v3	core, bip	5	12	41.7	5v3	core, bip	4	32.5	17.5	5.7	0.7	7.0	5v3	core, bip	1		
15f1	core, c	8	16	50.0	15f1	core, c	3	19.6	10.4	2.0	1.5	14.7	15f1	core, c		1	
10w10	core, casual	4	7	57.1	10w10	core, casual	6	8.5	7.8	0.7	9.0	90.5	10w10	core, casual		1	
35b1	core, cent	4	21	19.0	35b1	core, cent	5	33.1	32.6	10.8	0.5	4.6	35b1	core, cent	1		
40b1	core, cent	8	8	100.0	40b1	core, cent	13	29.0	19.2	5.6	2.3	23.3	40b1	core, cent			1
43a1	core, cent	10	21	47.6	43a1	core, cent	6	27.8	25.7	7.1	0.8	8.4	43a1	core, cent	1		
46j6	core, cent	8	17	47.1	46j6	core, cent	8	6.5	7.8	0.5	15.8	157.8	46j6	core, cent		1	
53b	core, cent	8	15	53.3	53b	core, cent	6	28.4	18.0	5.1	1.2	11.7	53b	core, cent		1	
54a,c5	core, cent	13	20	65.0	54a,c5	core, cent	13	16.0	13.1	2.1	6.2	62.0	54a,c5	core, cent	1		
56b5	core, cent	16	19	84.2	56b5	core, cent	13	20.8	12.0	2.5	5.2	52.1	56b5	core, cent			1
56c5	core, cent	8	23	34.8	56c5	core, cent	8	17.2	15.7	2.7	3.0	29.6	56c5	core, cent		1	
5nsurf3	core, cent	10	20	50.0	5nsurf3	core, cent	18	22.2	17.8	4.0	4.6	45.6	5nsurf3	core, cent		1	

8g5	core, cent	5	21	23.8	8g5	core, cent	11	16.7	13.8	2.3	4.8	47.7	8g5	core, cent		1	
s38e1	core, cent	7	14	50.0	s38e1	core, cent	4	18.4	23.0	4.2	0.9	9.5	s38e1	core, cent	1		
6L2	core, cent	2	15	13.3	6L2	core, cent	3	26.9	26.6	7.2	0.4	4.2	6L2	core, cent		1	
6k2	core, cent	16	25	64.0	6k2	core, cent	4	24	20.4	4.9	0.8	8.2	6k2	core, cent		1	
8f3	core, cent	10	14	71.4	8f3	core, cent	6	21.6	20	4.3	1.4	13.9	8f3	core, cent		1	
10w9	core, flat	6	13	46.2	10w9	core, flat	12	16.7	9.1	1.5	7.9	79.0	10w9	core, flat		1	
21i8	core, flat	8	14	57.1	21i8	core, flat	15	27.5	23.7	6.5	2.3	23.0	21i8	core, flat		1	
6j3	core, flat	5	19	26.3	6j3	core, flat	14	38.7	36.5	14.1	1.0	9.9	6j3	core, flat		1	
23g10	core, frag	12	17	70.6	23g10	core, frag	3	62.0	41.2	25.5	0.1	1.2	23g10	core, frag		1	
21i10	core, frag	14	21	66.7	21i10	core, frag	7	17.4	12	2.1	3.4	33.5	21i10	core, frag		1	
10b4	core, p	30	36	83.3	10b4	core, p	18	42	20.4	8.6	2.1	21.0	10b4	core, p		1	
10q2	core, p	8	14	57.1	10q2	core, p	16	23.7	9.2	2.2	7.3	73.4	10q2	core, p			1
13b5	core, p	10	16	62.5	13b5	core, p	10	13.8	10.7	1.5	6.8	67.7	13b5	core, p	1		
15f5	core, p	24	29	82.8	15f5	core, p	10	62.8	60.7	38.1	0.3	2.6	15f5	core, p		1	
15s10	core, p	10	14	71.4	15s10	core, p	10	27.6	23.4	6.5	1.5	15.5	15s10	core, p		1	
15s6	core, p	5	12	41.7	15s6	core, p	7	28.5	24	6.8	1.0	10.2	15s6	core, p	1		
20ap3	core, p	8	22	36.4	20ap3	core, p	6	45.6	24	10.9	0.5	5.5	20ap3	core, p		1	
20aq5	core, p	5	34	14.7	20aq5	core, p	15	12.4	9.2	1.1	13.1	131.5	20aq5	core, p		1	
33c3	core, p	6	22	27.3	33c3	core, p	1	30.3	22.6	6.8	0.1	1.5	33c3	core, p	1		
35a1	core, p	13	18	72.2	35a1	core, p	51	46.0	27.9	12.8	4.0	39.7	35a1	core, p		1	
37f3	core, p	7	11	63.6	37f3	core, p	10	17.0	15.1	2.6	3.9	39.0	37f3	core, p		1	
46f5	core, p	21	28	75.0	46f5	core, p	24	11.1	8.5	0.9	25.4	254.4	46f5	core, p		1	
46i6	core, p	8	16	50.0	46i6	core, p	5	22.0	9.5	2.1	2.4	23.9	46i6	core, p		1	
8d3	core, p	8	16	50.0	8d3	core, p	22	19.6	19.6	3.8	5.7	57.3	8d3	core, p		1	
10x3	core, p	7	31	22.6	10x3	core, p	6	28.2	23	6.5	0.9	9.3	10x3	core, p	1		
14g2	core, pi	7	15	46.7	14g2	core, pi	4	35.5	20.8	7.4	0.5	5.4	14g2	core, pi		1	
15p11	core, pi	5	12	41.7	15p11	core, pi	2	21.5	23.4	5.0	0.4	4.0	15p11	core, pi	1		
1k2	core, pi	8	14	57.1	1k2	core, pi	8	16.0	11.3	1.8	4.4	44.2	1k2	core, pi		1	
27c9	core, pi	12	17	70.6	27c9	core, pi	4	35.4	33.6	11.9	0.3	3.4	27c9	core, pi		1	

32f6	core, pi	7	7	100.0	32f6	core, pi	6	12.6	9.7	1.2	4.9	49.1	32f6	core, pi			1
36b1	core, pi	20	25	80.0	36b1	core, pi	12	28.7	23.2	6.7	1.8	18.0	36b1	core, pi		1	
36f1	core, pi	6	24	25.0	36f1	core, pi	7	15.8	15.3	2.4	2.9	29.0	36f1	core, pi	1		
46g3	core, pi	6	6	100.0	46g3	core, pi	10	16.4	6.5	1.1	9.4	93.8	46g3	core, pi			1
50g	core, pi	6	18	33.3	50g	core, pi	7	28.9	26.5	7.7	0.9	9.1	50g	core, pi		1	
8b4	core, pi	7	9	77.8	8b4	core, pi	42	28.3	28.3	8.0	5.2	52.4	8b4	core, pi		1	
S32e5	core, pi	6	6	100.0	S32e5	core, pi	17	22.4	14.8	3.3	5.1	51.3	S32e5	core, pi			1
S6e13	core, pi	15	19	78.9	S6e13	core, pi	14	29.7	23.3	6.9	2.0	20.2	S6e13	core, pi		1	
S6e9	core, pi	19	29	65.5	S6e9	core, pi	13	24.2	18.3	4.4	2.9	29.4	S6e9	core, pi		1	
6m3	core, pi	1	13	7.7	6m3	core, pi	6	30	24.6	7.4	0.8	8.1	6m3	core, pi		1	
6i3	core, pi	8	23	34.8	6i3	core, pi	4	36	19.6	7.1	0.6	5.7	6i3	core, pi		1	
5qsurf3	core, pi	6	9	66.7	5qsurf3	core, pi	14	16.4	16.4	2.7	5.2	52.1	5qsurf3	core, pi		1	
14i3	core, pi	8	13	61.5	14i3	core, pi	20	17.3	15.7	2.7	7.4	73.6	14i3	core, pi			1
10aa1	denticulate	2	7	28.6	10aa1	denticulate	14	28	18.5	5.2	2.7	27.0	10aa1	denticulate		1	
10p3	denticulate	4	19	21.1	10p3	denticulate	9	26.5	21.4	5.7	1.6	15.9	10p3	denticulate		1	
13b3	denticulate	1	17	5.9	13b3	denticulate	15	28.2	10.7	3.0	5.0	49.7	13b3	denticulate	1		
14x2	denticulate	3	17	17.6	14x2	denticulate	1	33.6	24.7	8.3	0.1	1.2	14x2	denticulate	1		
15f6	denticulate	2	7	28.6	15f6	denticulate	1	23	14.7	3.4	0.3	3.0	15f6	denticulate	1		
15L5	denticulate	1	7	14.3	15L5	denticulate	2	21.2	19	4.0	0.5	5.0	15L5	denticulate	1		
15L6	denticulate	3	10	30.0	15L6	denticulate	3	25	23.4	5.9	0.5	5.1	15L6	denticulate	1		
21q9	denticulate	3	13	23.1	21q9	denticulate	2	33.5	31.6	10.6	0.2	1.9	21q9	denticulate	1		
23g9	denticulate	7	8	87.5	23g9	denticulate	3	61.0	27.0	16.5	0.2	1.8	23g9	denticulate		1	
27c10	denticulate	8	16	50.0	27c10	denticulate	4	54.4	22.6	12.3	0.3	3.3	27c10	denticulate		1	
32f4	denticulate	4	15	26.7	32f4	denticulate	7	42.4	36	15.3	0.5	4.6	32f4	denticulate			1
35a2	denticulate	3	15	20.0	35a2	denticulate	10	15.3	15.2	2.3	4.3	43.0	35a2	denticulate		1	
36b6	denticulate	8	26	30.8	36b6	denticulate	12	21.8	18.1	3.9	3.0	30.4	36b6	denticulate		1	
36f6	denticulate	3	14	21.4	36f6	denticulate	4	21.4	7.5	1.6	2.5	24.9	36f6	denticulate	1		
43a3	denticulate	2	12	16.7	43a3	denticulate	3	26.9	16.0	4.3	0.7	7.0	43a3	denticulate	1		
46i1	denticulate	3	14	21.4	46i1	denticulate	8	32.8	17.3	5.7	1.4	14.1	46i1	denticulate	1		

5w6	denticulate	7	17	41.2	5w6	denticulate	7	28.2	18.3	5.2	1.4	13.6	5w6	denticulate	1		
6j1	denticulate	0	9	0.0	6j1	denticulate	7	33.5	26.5	8.9	0.8	7.9	6j1	denticulate		1	
8a3	denticulate	3	14	21.4	8a3	denticulate	2	38.8	22	8.5	0.2	2.3	8a3	denticulate	1		
S15e7	denticulate	3	11	27.3	S15e7	denticulate	5	27.7	18.6	5.2	1.0	9.7	S15e7	denticulate	1		
32g2	flake	1	1	100.0	32g2	bip flake	7	34.4	18.8	6.5	1.1	10.8	32g2	bip flake		1	
5v1	flake	3	6	50.0	5v1	bip flake	4	30.8	15.5	4.8	0.8	8.4	5v1	bip flake	1		
5v2	flake	1	4	25.0	5v2	bip flake	3	37.5	12	4.5	0.7	6.7	5v2	bip flake	1		
10ac1	flake	0	2	0.0	10ac1	bip flake	0	19.5	19.4	3.8	0.0	0.0	10ac1	bip flake	1		
14x1	flake	0	3	0.0	14x1	bip flake	1	55.6	12.6	7.0	0.1	1.4	14x1	bip flake	1		
10q1	flake	3	4	75.0	10q1	flake	15	16	6.8	1.1	13.8	137.9	10q1	flake			1
10w4	flake	4	5	80.0	10w4	flake	9	9.7	10.8	1.0	8.6	85.9	10w4	flake		1	
10w6	flake	2	3	66.7	10w6	flake	14	23.8	9.6	2.3	6.1	61.3	10w6	flake		1	
13b1	flake	3	9	33.3	13b1	flake	30	32	17	5.4	5.5	55.1	13b1	flake		1	
13b2	flake	4	8	50.0	13b2	flake	31	29	15.7	4.6	6.8	68.1	13b2	flake		1	
14i1	flake	2	3	66.7	14i1	flake	7	8.7	8.1	0.7	9.9	99.3	14i1	flake		1	
15f2	flake	5	8	62.5	15f2	flake	5	34.7	22	7.6	0.7	6.5	15f2	flake		1	
15L4	flake	2	4	50.0	15L4	flake	2	22.2	12.2	2.7	0.7	7.4	15L4	flake	1		
15L9	flake	6	13	46.2	15L9	flake	5	43.5	31.7	13.8	0.4	3.6	15L9	flake	1		
15p6	flake	2	2	100.0	15p6	flake	3	24.7	17	4.2	0.7	7.1	15p6	flake	1		
15s1	flake	0	1	0.0	15s1	flake	3	18.3	13.3	2.4	1.2	12.3	15s1	flake	1		
15s4	flake	3	7	42.9	15s4	flake	3	19.2	18.5	3.6	0.8	8.4	15s4	flake	1		
1k5	flake	2	2	100.0	1k5	flake	12	9.7	17.1	1.7	7.2	72.3	1k5	flake		1	
20aq1	flake	0	3	0.0	20aq1	flake	20	16.2	14.3	2.3	8.6	86.3	20aq1	flake		1	
20aq3	flake	1	1	100.0	20aq3	flake	7	20.5	19.4	4.0	1.8	17.6	20aq3	flake			1
21i2	flake	7	10	70.0	21i2	flake	10	22.1	20.3	4.5	2.2	22.3	21i2	flake		1	
21q4	flake	0	1	0.0	21q4	flake	1	28.2	20.2	5.7	0.2	1.8	21q4	flake	1		
23g6	flake	1	1	100.0	23g6	flake	2	40.0	29.4	11.8	0.2	1.7	23g6	flake			1
27c3	flake	3	4	75.0	27c3	flake	3	24.0	19.5	4.7	0.6	6.4	27c3	flake		1	
32f1	flake	7	7	100.0	32f1	flake	4	19	17	3.2	1.2	12.4	32f1	flake			1

33c2	flake	0	3	0.0	33c2	flake	1	47.2	22.2	10.5	0.1	1.0	33c2	flake	1		
35a3	flake	3	4	75.0	35a3	flake	11	22.2	13.3	3.0	3.7	37.3	35a3	flake		1	
35b2	flake	1	3	33.3	35b2	flake	7	30.6	26.1	8.0	0.9	8.8	35b2	flake	1		
36b2	flake	3	3	100.0	36b2	flake	18	30.1	29.2	8.8	2.0	20.5	36b2	flake		1	
36f2	flake	0	2	0.0	36f2	flake	19	20.3	16.5	3.3	5.7	56.7	36f2	flake	1		
37f1	flake	1	1	100.0	37f1	flake	8	17.0	16.2	2.8	2.9	29.0	37f1	flake		1	
40b4	flake	3	3	100.0	40b4	flake	7	24.0	18.9	4.5	1.5	15.4	40b4	flake			1
43a4	flake	2	3	66.7	43a4	flake	10	29.8	29.5	8.8	1.1	11.4	43a4	flake	1		
46f4	flake	3	5	60.0	46f4	flake	11	12.4	9.0	1.1	9.9	98.6	46f4	flake		1	
46g2	flake	4	4	100.0	46g2	flake	29	22.6	18.0	4.1	7.1	71.3	46g2	flake			1
46i5	flake	1	1	100.0	46i5	flake	14	21.5	9.5	2.0	6.9	68.5	46i5	flake		1	
46j4	flake	3	4	75.0	46j4	flake	15	8.1	8.0	0.6	23.1	231.5	46j4	flake		1	
50g1	flake	0	4	0.0	50g	flake	2	18.4	9.2	1.7	1.2	11.8	50g	flake	1		
50i	flake	1	1	100.0	50i	flake	15	14.8	10.7	1.6	9.5	94.7	50i	flake			1
53b	flake	0	6	0.0	53b	flake	1	18.0	14.0	2.5	0.4	4.0	53b	flake	1		
53f1	flake	1	5	20.0	53f1	flake	3	20.4	17.0	3.5	0.9	8.7	53f1	flake	1		
54a,c1	flake	6	6	100.0	54a,c1	flake	16	25.0	20.0	5.0	3.2	32.0	54a,c1	flake	1		
56b1	flake	2	7	28.6	56b1	flake	16	23.0	10.2	2.3	6.8	68.2	56b1	flake		1	
56c1	flake	1	1	100.0	56c1	flake	18	24.8	18.0	4.5	4.0	40.3	56c1	flake		1	
5qsurf1	flake	4	14	28.6	5qsurf1	flake	24	27.6	13.2	3.6	6.6	65.9	5qsurf1	flake		1	
5stsurf3	flake	2	6	33.3	5stsurf3	flake	3	36.3	20	7.3	0.4	4.1	5stsurf3	flake	1		
6b,c3	flake	6	6	100.0	6b,c3	flake	17	20	12.3	2.5	6.9	69.1	6b,c3	flake		1	
6i1	flake	2	5	40.0	6i1	flake	6	24.5	24.5	6.0	1.0	10.0	6i1	flake		1	
6m1	flake	2	5	40.0	6m1	flake	3	30	21.5	6.5	0.5	4.7	6m1	flake	1		
8c1	flake	2	7	28.6	8c1	flake	4	34.8	24	8.4	0.5	4.8	8c1	flake	1		
8d1	flake	1	2	50.0	8d1	flake	12	13	11.2	1.5	8.2	82.4	8d1	flake		1	
8f2	flake	1	5	20.0	8f2	flake	5	28	18	5.0	1.0	9.9	8f2	flake	1		
S15e2	flake	2	9	22.2	S15e2	flake	1	35	30.7	10.7	0.1	0.9	S15e2	flake	1		
s38e2	flake	0	3	0.0	s38e2	flake	2	14.8	10.6	1.6	1.3	12.7	s38e2	flake	1		

S6e3	flake	7	11	63.6	S6e3	flake	13	43	31.8	13.7	1.0	9.5	S6e3	flake		1	
S6e7	flake	10	11	90.9	S6e7	flake	18	63	29	18.3	1.0	9.9	S6e7	flake		1	
S8e1	flake	2	5	40.0	S8e1	flake	6	20.3	12.6	2.6	2.3	23.5	S8e1	flake		1	
15L3	flake	0	8	0.0	15L3	flake	7	23.6	12.6	3.0	2.4	23.5	15L3	flake	1		
15p2	flake	0	2	0.0	15p2	flake	0	1	1	0.0	0.0	0.0	15p2	flake	1		
15p3	flake	3	6	50.0	15p3	flake	0	1	1	0.0	0.0	0.0	15p3	flake	1		
15p4	flake	1	1	100.0	15p4	flake	0	1	1	0.0	0.0	0.0	15p4	flake	1		
15p5	flake	2	4	50.0	15p5	flake	3	21	16	3.4	0.9	8.9	15p5	flake	1		
15p10	flake	3	5	60.0	15p10	flake	2	33.5	22.2	7.4	0.3	2.7	15p10	flake	1		
21i1	flake	0	9	0.0	21i1	flake	4	20.1	14.1	2.8	1.4	14.1	21i1	flake	1		
21i3	flake	1	1	100.0	21i3	flake	22	12	11.4	1.4	16.1	160.8	21i3	flake			1
21i4	flake	1	1	100.0	21i4	flake	5	25.3	9.6	2.4	2.1	20.6	21i4	flake			1
21i6	flake	3	3	100.0	21i6	flake	6	29.7	28.8	8.6	0.7	7.0	21i6	flake		1	
21q1	flake	0	1	0.0	21q1	flake	0	17.7	17.7	3.1	0.0	0.0	21q1	flake	1		
21q3	flake	0	6	0.0	21q3	flake	0	23.5	19.8	4.7	0.0	0.0	21q3	flake	1		
21q7	flake	2	5	40.0	21q7	flake	1	29	23.2	6.7	0.1	1.5	21q7	flake	1		
21q8	flake	4	8	50.0	21q8	flake	2	29	26.3	7.6	0.3	2.6	21q8	flake	1		
14a3	flake	4	6	66.7	14a3	flake	15	40.8	26.5	10.8	1.4	13.9	14a3	flake		1	
20ap2	flake	1	1	100.0	20ap2	flake	7	41.6	14.5	6.0	1.2	11.6	20ap2	flake		1	
5rsurf2	flake	1	4	25.0	5rsurf2	flake	9	27.7	17	4.7	1.9	19.1	5rsurf2	flake		1	
5rsurf3	flake	1	2	50.0	5rsurf3	flake	7	28	24.6	6.9	1.0	10.2	5rsurf3	flake		1	
S8e2	flake	1	8	12.5	S8e2	flake	1	23	21	4.8	0.2	2.1	S8e2	flake		1	
S8e3	flake	0	2	0.0	S8e3	flake	14	42.3	25.3	10.7	1.3	13.1	S8e3	flake	1		
6j2	flake	2	6	33.3	6j2	flake	12	43.7	11.5	5.0	2.4	23.9	6j2	flake	1		
6L1	flake	4	7	57.1	6L1	flake	5	27	22.5	6.1	0.8	8.2	6L1	flake		1	
S11e2	flake	1	1	100.0	S11e2	flake	8	32	24	7.7	1.0	10.4	S11e2	flake		1	
5nsurf1	flake	2	6	33.3	5nsurf1	flake	10	10.5	8.8	0.9	10.8	108.2	5nsurf1	flake		1	
S6e6	flake	6	6	100.0	S6e6	flake	11	34	17	5.8	1.9	19.0	S6e6	flake		1	
8g2	flake	0	1	0.0	8g2	flake	16	32	17	5.4	2.9	29.4	8g2	flake	1		

8b1	flake	1	1	100.0	8b1	flake	12	19.6	13.6	2.7	4.5	45.0	8b1	flake		1	
5w3	flake	3	11	27.3	5w3	flake	10	26.7	24.4	6.5	1.5	15.3	5w3	flake	1		
5w1	flake	1	2	50.0	5w1	flake	3	23	16.6	3.8	0.8	7.9	5w1	flake	1		
8f1	flake	0	2	0.0	8f1	flake	4	20.4	16.3	3.3	1.2	12.0	8f1	flake	1		
5Osurf1	flake	1	1	100.0	5Osurf1	flake	8	22.6	13	2.9	2.7	27.2	5Osurf1	flake			1
5stsurf2	flake	0	4	0.0	5stsurf2	flake	1	28.7	19	5.5	0.2	1.8	5stsurf2	flake	1		
8a1	flake	0	1	0.0	8a1	flake	2	21	21	4.4	0.5	4.5	8a1	flake	1		
10w1	flake	1	1	100.0	10w1	flake	5	18.3	14.5	2.7	1.9	18.8	10w1	flake		1	
S32e1	flake	2	3	66.7	S32e1	flake	15	15.5	15.5	2.4	6.2	62.4	S32e1	flake			1
S32e2	flake	2	2	100.0	S32e2	flake	20	19	19	3.6	5.5	55.4	S32e2	flake			1
10b1	retouch	6	20	30.0	10b1	retouch	5	32.4	32.3	10.5	0.5	4.8	10b1	retouch	1		
10b2	retouch	4	17	23.5	10b2	retouch	6	36.2	28	10.1	0.6	5.9	10b2	retouch		1	
10w2	retouch	0	11	0.0	10w2	retouch	4	25.2	16.6	4.2	1.0	9.6	10w2	retouch		1	
10w3	retouch	7	13	53.8	10w3	retouch	14	9	16	1.4	9.7	97.2	10w3	retouch		1	
14i2	retouch	2	12	16.7	14i2	retouch	10	19.5	8	1.6	6.4	64.1	14i2	retouch		1	
14i3	retouch	10	10	100.0	14i3	retouch	15	10.7	8.5	0.9	16.5	164.9	14i3	retouch			1
15f7	retouch	3	22	13.6	15f7	retouch	1	35.2	24.8	8.7	0.1	1.1	15f7	retouch	1		
15L2	retouch	1	8	12.5	15L2	retouch	2	21.5	10	2.2	0.9	9.3	15L2	retouch	1		
15L8	retouch	0	19	0.0	15L8	retouch	6	39.5	24.2	9.6	0.6	6.3	15L8	retouch	1		
15p8	retouch	2	16	12.5	15p8	retouch	0	1	1	0.0	0.0	0.0	15p8	retouch	1		
15s5	retouch	4	14	28.6	15s5	retouch	4	22	16.8	3.7	1.1	10.8	15s5	retouch		1	
15s7	retouch	5	21	23.8	15s7	retouch	2	20.7	14.4	3.0	0.7	6.7	15s7	retouch		1	
1k4	retouch	0	9	0.0	1k4	retouch	5	14.1	11.4	1.6	3.1	31.1	1k4	retouch	1		
20aq4	retouch	2	9	22.2	20aq4	retouch	22	23	12.6	2.9	7.6	75.9	20aq4	retouch		1	
21i9	retouch	2	13	15.4	21i9	retouch	12	40.4	18	7.3	1.7	16.5	21i9	retouch		1	
21q2	retouch	0	20	0.0	21q2	retouch	0	24	20.5	4.9	0.0	0.0	21q2	retouch	1		
23g3	retouch	2	5	40.0	23g3	retouch	2	27.1	25.0	6.8	0.3	3.0	23g3	retouch		1	
27c1	retouch	0	17	0.0	27c1	retouch	2	18.1	12.5	2.3	0.9	8.8	27c1	retouch	1		
32f3	retouch	4	8	50.0	32f3	retouch	10	38	34.2	13.0	0.8	7.7	32f3	retouch			1

32f5	retouch	3	6	50.0	32f5	retouch	6	44	28.6	12.6	0.5	4.8	32f5	retouch			1
35a6	retouch	2	7	28.6	35a6	retouch	3	27.3	17.6	4.8	0.6	6.2	35a6	retouch		1	
35b4	retouch	2	12	16.7	35b4	retouch	6	25.4	23.6	6.0	1.0	10.0	35b4	retouch		1	
36b4	retouch	5	19	26.3	36b4	retouch	13	46.2	19.4	9.0	1.5	14.5	36b4	retouch	1		
36f4	retouch	4	17	23.5	36f4	retouch	8	14.6	14.0	2.0	3.9	39.1	36f4	retouch	1		
37f4	retouch	8	29	27.6	37f4	retouch	6	12.5	10.2	1.3	4.7	47.1	37f4	retouch		1	
40b3	retouch	15	20	75.0	40b3	retouch	18	30.6	11.8	3.6	5.0	49.9	40b3	retouch			1
43a5	retouch	7	25	28.0	43a5	retouch	9	30.0	26.1	7.8	1.1	11.5	43a5	retouch	1		
46f2	retouch	2	13	15.4	46f2	retouch	8	5.0	5.0	0.3	32.0	320.0	46f2	retouch			1
46g1	retouch	1	8	12.5	46g1	retouch	10	7.2	6.5	0.5	21.4	213.7	46g1	retouch			1
46i3	retouch	3	16	18.8	46i3	retouch	6	24.4	23.8	5.8	1.0	10.3	46i3	retouch		1	
46j2	retouch	7	13	53.8	46j2	retouch	13	11.1	10.6	1.2	11.0	110.5	46j2	retouch		1	
50g	retouch	5	12	41.7	50g	retouch	2	22.2	14.8	3.3	0.6	6.1	50g	retouch		1	
53b	retouch	6	18	33.3	53b	retouch	6	32.6	14.3	4.7	1.3	12.9	53b	retouch		1	
53f	retouch	0	27	0.0	53f	retouch	3	27.6	19.6	5.4	0.6	5.5	53f	retouch	1		
54a,c4	retouch	3	21	14.3	54a,c4	retouch	24	16.0	16.0	2.6	9.4	93.8	54a,c4	retouch		1	
56b4	retouch	6	18	33.3	56b4	retouch	12	22.5	19.4	4.4	2.7	27.5	56b4	retouch		1	
56c4	retouch	2	27	7.4	56c4	retouch	9	21.1	16.4	3.5	2.6	26.0	56c4	retouch	1		
5hsurf2	retouch	5	15	33.3	5hsurf2	retouch	8	37.4	26	9.7	0.8	8.2	5hsurf2	retouch		1	
5msurf3	retouch	3	21	14.3	5msurf3	retouch	1	42.5	32.2	13.7	0.1	0.7	5msurf3	retouch	1		
5nsurf6	retouch	2	11	18.2	5nsurf6	retouch	11	26.6	17.5	4.7	2.4	23.6	5nsurf6	retouch	1		
5usurf1	retouch	2	12	16.7	5usurf1	retouch	18	27.5	22	6.1	3.0	29.8	5usurf1	retouch		1	
5usurf2	retouch	3	18	16.7	5usurf2	retouch	15	31.6	21.7	6.9	2.2	21.9	5usurf2	retouch	1		
6n1	retouch	0	15	0.0	6n1	retouch	1	22	20	4.4	0.2	2.3	6n1	retouch	1		
8b5	retouch	1	11	9.1	8b5	retouch	7	20.7	15.7	3.2	2.2	21.5	8b5	retouch			1
8d2	retouch	1	16	6.3	8d2	retouch	15	16.5	11	1.8	8.3	82.6	8d2	retouch		1	
8g1	retouch	2	7	28.6	8g1	retouch	21	27	15.8	4.3	4.9	49.2	8g1	retouch		1	
8g3	retouch	3	13	23.1	8g3	retouch	11	32.8	17	5.6	2.0	19.7	8g3	retouch		1	
S11e1	retouch	2	17	11.8	S11e1	retouch	1	18.4	12	2.2	0.5	4.5	S11e1	retouch	1		

S15e3	retouch	2	21	9.5	S15e3	retouch	4	54.3	41	22.3	0.2	1.8	S15e3	retouch	1		
s38e4	retouch	1	10	10.0	s38e4	retouch	5	16.3	16.2	2.6	1.9	18.9	s38e4	retouch	1		
S6e12	retouch	7	21	33.3	S6e12	retouch	17	25.7	21.7	5.6	3.0	30.5	S6e12	retouch		1	
S6e5	retouch	3	18	16.7	S6e5	retouch	17	44	33	14.5	1.2	11.7	S6e5	retouch		1	
S6e1	retouch	7	12	58.3	S6e1	retouch	15	45.2	21.8	9.9	1.5	15.2	S6e1	retouch		1	
10p2	scraper	5	20	25.0	10p2	scraper	16	43	27.4	11.8	1.4	13.6	10p2	scraper		1	
10q4	scraper	1	10	10.0	10q4	scraper	6	19	15.5	2.9	2.0	20.4	10q4	scraper			1
10w7	scraper	7	15	46.7	10w7	scraper	7	11.9	6.2	0.7	9.5	94.9	10w7	scraper		1	
10w8	scraper	5	12	41.7	10w8	scraper	10	25.4	9.3	2.4	4.2	42.3	10w8	scraper		1	
10x1	scraper	1	16	6.3	10x1	scraper	0	18	18	3.2	0.0	0.0	10x1	scraper	1		
13b4	scraper	4	9	44.4	13b4	scraper	14	11.5	8.1	0.9	15.0	150.3	13b4	scraper	1		
15f3	scraper	15	17	88.2	15f3	scraper	4	31	19.6	6.1	0.7	6.6	15f3	scraper		1	
15L11	scraper	5	11	45.5	15L11	scraper	3	15.2	14.6	2.2	1.4	13.5	15L11	scraper	1		
15L7	scraper	4	10	40.0	15L7	scraper	3	31.2	26.7	8.3	0.4	3.6	15L7	scraper	1		
15p7	scraper	0	10	0.0	15p7	scraper	1	22	15	3.3	0.3	3.0	15p7	scraper	1		
15s8	scraper	8	20	40.0	15s8	scraper	7	37.4	27.8	10.4	0.7	6.7	15s8	scraper		1	
15s9	scraper	9	19	47.4	15s9	scraper	7	26	20	5.2	1.3	13.5	15s9	scraper		1	
1k1	scraper	6	17	35.3	1k1	scraper	7	19.7	12.4	2.4	2.9	28.7	1k1	scraper		1	
20aq2	scraper	1	15	6.7	20aq2	scraper	10	15	7	1.1	9.5	95.2	20aq2	scraper		1	
21i7	scraper	13	25	52.0	21i7	scraper	6	15.2	14	2.1	2.8	28.2	21i7	scraper		1	
21q6	scraper	0	13	0.0	21q6	scraper	1	33.8	16	5.4	0.2	1.8	21q6	scraper	1		
23g2	scraper	11	18	61.1	23g2	scraper	2	27.1	23.0	6.2	0.3	3.2	23g2	scraper		1	
27c7	scraper	5	20	25.0	27c7	scraper	4	34.0	24.6	8.4	0.5	4.8	27c7	scraper		1	
35a5	scraper	5	15	33.3	35a5	scraper	11	32.3	18.5	6.0	1.8	18.4	35a5	scraper		1	
35b5	scraper	5	30	16.7	35b5	scraper	9	33.6	24.7	8.3	1.1	10.8	35b5	scraper	1		
36b5	scraper	2	15	13.3	36b5	scraper	15	22.2	14.0	3.1	4.8	48.3	36b5	scraper		1	
36f5	scraper	4	22	18.2	36f5	scraper	6	17.0	9.8	1.7	3.6	36.0	36f5	scraper	1		
37f5	scraper	2	14	14.3	37f5	scraper	7	25.0	21.1	5.3	1.3	13.3	37f5	scraper	1		
40b5	scraper	6	15	40.0	40b5	scraper	9	29.1	10.2	3.0	3.0	30.3	40b5	scraper			1

43a2	scraper	5	27	18.5	43a2	scraper	9	31.7	26.9	8.5	1.1	10.6	43a2	scraper		1	
46f1	scraper	8	15	53.3	46f1	scraper	7	17.0	13.0	2.2	3.2	31.7	46f1	scraper			1
46h1	scraper	4	9	44.4	46k1	scraper	12	20.6	15.0	3.1	3.9	38.8	46k1	scraper			1
46i2	scraper	0	22	0.0	46i2	scraper	7	17.8	11.3	2.0	3.5	34.8	46i2	scraper	1		
46j1	scraper	10	17	58.8	46j1	scraper	13	10.6	9.5	1.0	12.9	129.1	46j1	scraper		1	
50f	scraper	5	10	50.0	50f	scraper	5	40.0	26.7	10.7	0.5	4.7	50f	scraper		1	
53b	scraper	11	28	39.3	53b	scraper	9	38.7	32.2	12.5	0.7	7.2	53b	scraper		1	
53f2	scraper	1	11	9.1	53f2	scraper	1	22.2	18.1	4.0	0.2	2.5	53f2	scraper	1		
54a,c3	scraper	18	30	60.0	54a,c3	scraper	13	24.0	16.4	3.9	3.3	33.0	54a,c3	scraper		1	
56b3	scraper	3	12	25.0	56b3	scraper	14	29.3	8.4	2.5	5.7	56.9	56b3	scraper			1
56c3	scraper	11	23	47.8	56c3	scraper	6	22.0	13.7	3.0	2.0	19.9	56c3	scraper	1		
5msurf1	scraper	7	23	30.4	5msurf1	scraper	1	37.7	34.5	13.0	0.1	0.8	5msurf1	scraper	1		
5nsurf2	scraper	1	20	5.0	5nsurf2	scraper	16	18.7	14.5	2.7	5.9	59.0	5nsurf2	scraper		1	
5Osurf2	scraper	10	17	58.8	5Osurf2	scraper	26	12.5	12.5	1.6	16.6	166.4	5Osurf2	scraper			1
5qsurf2	scraper	6	18	33.3	5qsurf2	scraper	19	24.7	12.3	3.0	6.3	62.5	5qsurf2	scraper		1	
5usurf3	scraper	4	26	15.4	5usurf3	scraper	4	31.7	24	7.6	0.5	5.3	5usurf3	scraper	1		
6b,c2	scraper	7	21	33.3	6b,c2	scraper	5	25.8	24.2	6.2	0.8	8.0	6b,c2	scraper	1		
6k1	scraper	4	17	23.5	6k1	scraper	11	31.2	26.5	8.3	1.3	13.3	6k1	scraper	1		
6L3	scraper	3	16	18.8	6L3	scraper	3	34	22	7.5	0.4	4.0	6L3	scraper		1	
6n2	scraper	1	24	4.2	6n2	scraper	1	50	28.6	14.3	0.1	0.7	6n2	scraper	1		
8b3	scraper	13	13	100.0	8b3	scraper	11	21.4	12	2.6	4.3	42.8	8b3	scraper			1
8g4	scraper	6	13	46.2	8g4	scraper	32	35.5	26.8	9.5	3.4	33.6	8g4	scraper		1	
S15e4	scraper	21	38	55.3	S15e4	scraper	4	58.8	34	20.0	0.2	2.0	S15e4	scraper		1	
S32e3	scraper	6	10	60.0	S32e3	scraper	17	11.5	11.3	1.3	13.1	130.8	S32e3	scraper			1
S32e4	scraper	13	17	76.5	S32e4	scraper	12	17.3	14	2.4	5.0	49.5	S32e4	scraper			1
s38e5	scraper	0	22	0.0	s38e5	scraper	2	22.8	11.8	2.7	0.7	7.4	s38e5	scraper	1		
S6e10	scraper	11	21	52.4	S6e10	scraper	13	51.4	39.5	20.3	0.6	6.4	S6e10	scraper		1	
S6e4	scraper	2	25	8.0	S6e4	scraper	13	46.5	26.3	12.2	1.1	10.6	S6e4	scraper		1	
14a2	scraper	4	15	26.7	14a2	scraper	21	28	19.5	5.5	3.8	38.5	14a2	scraper	1		

20ap1	scraper	4	20	20.0	20ap1	scraper	5	36.3	23.5	8.5	0.6	5.9	20ap1	scraper	1		
5hsurf1	scraper	1	21	4.8	5hsurf1	scraper	0	24.4	16.6	4.1	0.0	0.0	5hsurf1	scraper	1		
6m2	scraper	1	14	7.1	6m2	scraper	3	27	24.5	6.6	0.5	4.5	6m2	scraper	1		
S11e3	scraper	2	19	10.5	S11e3	scraper	4	28.4	14.3	4.1	1.0	9.8	S11e3	scraper		1	
10b3	scraper	16	22	72.7	10b3	scraper	4	17	16	2.7	1.5	14.7	10b3	scraper		1	
14g1	scraper	6	16	37.5	14g1	scraper	4	40.5	16.6	6.7	0.6	5.9	14g1	scraper		1	
32g3	scraper	3	10	30.0	32g3	scraper	12	35.3	32.3	11.4	1.1	10.5	32g3	scraper		1	
6i2	scraper	7	25	28.0	6i2	scraper	4	23	11.5	2.6	1.5	15.1	6i2	scraper		1	
5nsurf4	scraper	5	23	21.7	5nsurf4	scraper	18	29.2	15	4.4	4.1	41.1	5nsurf4	scraper		1	
S6e8	scraper	12	23	52.2	S6e8	scraper	11	47.2	12.8	6.0	1.8	18.2	S6e8	scraper		1	
5w2	scraper	6	19	31.6	5w2	scraper	4	27.5	27	7.4	0.5	5.4	5w2	scraper	1		
10x2	scraper	3	16	18.8	10x2	scraper	5	30	26.6	8.0	0.6	6.3	10x2	scraper	1		
8c2	scraper	11	18	61.1	8c2	scraper	10	38.8	34	13.2	0.8	7.6	8c2	scraper		1	
20, O1	scraper	3	21	14.3	20, O1	scraper	1	35.7	33.3	11.9	0.1	0.8	20, O1	scraper	1		
5stsurf1	scraper	0	16	0.0	5stsurf1	scraper	2	25	14	3.5	0.6	5.7	5stsurf1	scraper	1		
8a2	scraper	8	17	47.1	8a2	scraper	2	29.2	26.3	7.7	0.3	2.6	8a2	scraper	1		
n				**Mean**	**n**							**Mean**	**n**				
347				45.0%	**347**							30.2	**347**		131	166	50
														Percentage of sample	37.8	47.8	14.4

Table 15: Experimental Oldowan chert raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	f	L, mm	w, mm	a cm2	f/cm2	f/10 cm2	Sn	Tt	N	S	E
10h11	chunk	3	3	100.0	10h11	chunk	11	21.3	16.3	3.5	3.2	31.7	10h11	chunk		1	
10h12	chunk	5	5	100.0	10h12	chunk	8	21.7	18.5	4.0	2.0	19.9	10h12	chunk		1	
10m11	chunk	3	6	50.0	10m11	chunk	3	13.9	12.5	1.7	1.7	17.3	10m11	chunk		1	
10m5	chunk	3	3	100.0	10m5	chunk	3	27.7	16.3	4.5	0.7	6.6	10m5	chunk		1	
10r6	chunk	3	12	25.0	10r6	chunk	8	38.3	30.0	11.5	0.7	7.0	10r6	chunk		1	
10s11	chunk	1	3	33.3	10s11	chunk	5	27.2	17.3	4.7	1.1	10.6	10s11	chunk			1
10s12	chunk	3	3	100.0	10s12	chunk	4	17.8	13.5	2.4	1.7	16.6	10s12	chunk			1
11a11	chunk	6	6	100.0	11a11	chunk	10	27.2	16.7	4.5	2.2	22.0	11a11	chunk		1	
11a4	chunk	6	9	66.7	11a4	chunk	5	28.9	26.8	7.7	0.6	6.5	11a4	chunk			1
11b6	chunk	2	6	33.3	11b6	chunk	1	31.2	21.3	6.6	0.2	1.5	11b6	chunk			1
14k6	chunk	7	9	77.8	14k6	chunk	5	32.0	25.2	8.1	0.6	6.2	14k6	chunk			1
14L3	chunk	0	6	0.0	14L3	chunk	2	17.7	14.2	2.5	0.8	8.0	14L3	chunk			1
14m2	chunk	4	12	33.3	14m2	chunk	3	56.8	27.8	15.8	0.2	1.9	14m2	chunk		1	
15a13	chunk	3	3	100.0	15a13	chunk	2	23.3	18.8	4.4	0.5	4.6	15a13	chunk		1	
15a14	chunk	1	1	100.0	15a14	chunk	4	55.7	32.0	17.8	0.2	2.2	15a14	chunk		1	
15b2	chunk	10	10	100.0	15b2	chunk	4	17.7	15.6	2.8	1.4	14.5	15b2	chunk		1	
15b9	chunk	9	9	100.0	15b9	chunk	9	19.5	19.5	3.8	2.4	23.7	15b9	chunk		1	
15g5	chunk	6	6	100.0	15g5	chunk	1	41.4	31.4	13.0	0.1	0.8	15g5	chunk			1
15i4	chunk	2	6	33.3	15i4	chunk	4	18.0	11.4	2.1	1.9	19.5	15i4	chunk		1	
15i9	chunk	4	4	100.0	15i9	chunk	14	60.0	23.6	14.2	1.0	9.9	15i9	chunk		1	
15k1	chunk	1	2	50.0	15k1	chunk	0	1.0	1.0	0.0	0.0	0.0	15k1	chunk		1	

15k6	chunk	4	8	50.0	15k6	chunk	1	21.1	19.7	4.2	0.2	2.4	15k6	chunk		1	
16a2	chunk	5	6	83.3	16a2	chunk	1	20.6	16.0	3.3	0.3	3.0	16a2	chunk		1	
16a8	chunk	11	11	100.0	16a8	chunk	5	26.0	20.0	5.2	1.0	9.6	16a8	chunk		1	
16c12	chunk	6	6	100.0	16c12	chunk	1	21.1	18.4	3.9	0.3	2.6	16c12	chunk	1		
16f11	chunk	1	4	25.0	16f11	chunk	2	21.0	19.3	4.1	0.5	4.9	16f11	chunk		1	
16f2	chunk	2	7	28.6	16f2	chunk	5	22.2	16.6	3.7	1.4	13.6	16f2	chunk		1	
16g1	chunk	2	6	33.3	16g1	chunk	3	27.2	25.5	6.9	0.4	4.3	16g1	chunk		1	
17a,b,c2	chunk	2	7	28.6	17a,b,c2	chunk	2	21.2	12.4	2.6	0.8	7.6	17a,b,c2	chunk		1	
17a,b,c5	chunk	10	11	90.9	17a,b,c5	chunk	4	49.4	22.7	11.2	0.4	3.6	17a,b,c5	chunk			1
18a4	chunk	9	14	64.3	18a4	chunk	14	23.5	18.7	4.4	3.2	31.9	18a4	chunk		1	
18b1	chunk	0	7	0.0	18b1	chunk	4	14.3	14.3	2.0	2.0	19.6	18b1	chunk		1	
18b11	chunk	6	9	66.7	18b11	chunk	7	25.7	16.4	4.2	1.7	16.6	18b11	chunk		1	
18c12	chunk	3	5	60.0	18c12	chunk	7	17.3	13.6	2.4	3.0	29.8	18c12	chunk		1	
18c9	chunk	9	15	60.0	18c9	chunk	16	46.3	33.4	15.5	1.0	10.3	18c9	chunk		1	
19d13	chunk	1	6	16.7	19d13	chunk	4	16.6	13.5	2.2	1.8	17.8	19d13	chunk		1	
19d14	chunk	2	5	40.0	19d14	chunk	3	18.6	15.9	3.0	1.0	10.1	19d14	chunk		1	
19f/g5	chunk	1	6	16.7	19f/g5	chunk	5	26.0	14.7	3.8	1.3	13.1	19f/g5	chunk	1		
1a7	chunk	4	5	80.0	1a7	chunk	3	20.9	19.3	4.0	0.7	7.4	1a7	chunk		1	
1c4	chunk	2	2	100.0	1c4	chunk	4	22.1	14.0	3.1	1.3	12.9	1c4	chunk	1		
1d1	chunk	2	4	50.0	1d1	chunk	0	29.5	17.6	5.2	0.0	0.0	1d1	chunk		1	
1i/j2	chunk	5	5	100.0	1i/j2	chunk	2	25.0	22.2	5.6	0.4	3.6	1i/j2	chunk	1		
20af3	chunk	6	8	75.0	20af3	chunk	7	28.9	22.2	6.4	1.1	10.9	20af3	chunk			1
21a7	chunk	6	6	100.0	21a7	chunk	5	40.0	27.8	11.1	0.4	4.5	21a7	chunk		1	
21k3	chunk	1	1	100.0	21k3	chunk	2	28.2	24.7	7.0	0.3	2.9	21k3	chunk		1	
21r3	chunk	4	5	80.0	21r3	chunk	1	36.6	15.2	5.6	0.2	1.8	21r3	chunk			1
23b2	chunk	4	6	66.7	23b2	chunk	5	48.0	45.0	21.6	0.2	2.3	23b2	chunk			1
23j1	chunk	4	4	100.0	23j1	chunk	1	27.5	14.0	3.9	0.3	2.6	23j1	chunk		1	
27a1	chunk	4	4	100.0	27a1	chunk	7	38.6	37.2	14.4	0.5	4.9	27a1	chunk			1
28a2	chunk	2	2	100.0	28a2	chunk	4	70.8	48.2	34.1	0.1	1.2	28a2	chunk			1

28b1	chunk	3	3	100.0	28b1	chunk	4	49.0	42.9	21.0	0.2	1.9	28b1	chunk			1
28g	chunk	3	8	37.5	28g	chunk	1	25.8	15.1	3.9	0.3	2.6	28g	chunk	1		
28i	chunk	5	5	100.0	28i	chunk	6	30.7	15.0	4.6	1.3	13.0	28i	chunk	1		
29c1	chunk	0	8	0.0	29c1	chunk	0	29.4	35.2	10.3	0.0	0.0	29c1	chunk			1
29f	chunk	1	1	100.0	29f	chunk	1	29.0	14.5	4.2	0.2	2.4	29f	chunk		1	
30a1	chunk	1	8	12.5	30a1	chunk	0	32.6	17.0	5.5	0.0	0.0	30a1	chunk		1	
30b2	chunk	7	10	70.0	30b2	chunk	2	38.0	33.0	12.5	0.2	1.6	30b2	chunk		1	
30c2	chunk	5	5	100.0	30c2	chunk	9	41.1	41.1	16.9	0.5	5.3	30c2	chunk		1	
30h11	chunk	3	3	100.0	30h11	chunk	8	25.0	20.0	5.0	1.6	16.0	30h11	chunk			1
30j4	chunk	5	7	71.4	30j4	chunk	1	29.5	23.3	6.9	0.1	1.5	30j4	chunk		1	
32a6	chunk	6	8	75.0	32a6	chunk	5	28.4	19.4	5.5	0.9	9.1	32a6	chunk			1
33b13	chunk	7	7	100.0	33b13	chunk	9	27.6	19.4	5.4	1.7	16.8	33b13	chunk		1	
33b14	chunk	6	6	100.0	33b14	chunk	7	19.5	16.7	3.3	2.1	21.5	33b14	chunk		1	
34b1	chunk	2	7	28.6	34b1	chunk	2	22.4	15.8	3.5	0.6	5.7	34b1	chunk		1	
38a2	chunk	5	9	55.6	38a2	chunk	18	48.5	18.2	8.8	2.0	20.4	38a2	chunk		1	
38b4	chunk	4	6	66.7	38b4	chunk	2	33.6	18.5	6.2	0.3	3.2	38b4	chunk			1
38c2	chunk	1	3	33.3	38c2	chunk	5	26.0	14.8	3.8	1.3	13.0	38c2	chunk	1		
39a2	chunk	4	4	100.0	39a2	chunk	4	23.8	22.4	5.3	0.8	7.5	39a2	chunk		1	
39b2	chunk	3	8	37.5	39b2	chunk	2	20.1	12.2	2.5	0.8	8.2	39b2	chunk	1		
39c2	chunk	3	5	60.0	39c2	chunk	0	20.4	13.3	2.7	0.0	0.0	39c2	chunk	1		
40a3	chunk	4	4	100.0	40a3	chunk	6	19.0	18.6	3.5	1.7	17.0	40a3	chunk	1		
40c2	chunk	5	5	100.0	40c2	chunk	11	25.1	21.5	5.4	2.0	20.4	40c2	chunk		1	
40d2	chunk	5	5	100.0	40d2	chunk	13	17.7	17.0	3.0	4.3	43.2	40d2	chunk		1	
41a3	chunk	0	7	0.0	41a3	chunk	0	23.7	11.7	2.8	0.0	0.0	41a3	chunk	1		
41b1	chunk	6	7	85.7	41b1	chunk	3	25.7	11.4	2.9	1.0	10.2	41b1	chunk		1	
42b4	chunk	4	6	66.7	42b4	chunk	4	21.5	14.9	3.2	1.2	12.5	42b4	chunk		1	
42c4	chunk	0	9	0.0	42c4	chunk	3	26.2	10.5	2.8	1.1	10.9	42c4	chunk	1		
43b3	chunk	0	3	0.0	43b3	chunk	1	22.8	15.7	3.6	0.3	2.8	43b3	chunk		1	
43c3	chunk	5	5	100.0	43c3	chunk	7	27.8	20.0	5.6	1.3	12.6	43c3	chunk		1	

44a2	chunk	7	7	100.0	44a2	chunk	5	29.3	25.2	7.4	0.7	6.8	44a2	chunk		1	
44b4	chunk	2	2	100.0	44b4	chunk	3	23.8	12.6	3.0	1.0	10.0	44b4	chunk		1	
44c3	chunk	1	2	50.0	44c3	chunk	1	23.0	18.5	4.3	0.2	2.4	44c3	chunk			1
45a3	chunk	7	7	100.0	45a3	chunk	4	27.8	19.0	5.3	0.8	7.6	45a3	chunk		1	
45b1	chunk	3	7	42.9	45b1	chunk	4	21.0	21.0	4.4	0.9	9.1	45b1	chunk		1	
47a	chunk	9	12	75.0	47a	chunk	11	57.7	37.6	21.7	0.5	5.1	47a	chunk		1	
47b	chunk	2	8	25.0	47b	chunk	3	22.6	17.0	3.8	0.8	7.8	47b	chunk	1		
47d	chunk	6	8	75.0	47d	chunk	3	34.5	27.1	9.3	0.3	3.2	47d	chunk		1	
47f	chunk	2	4	50.0	47f	chunk	8	26.1	16.3	4.3	1.9	18.8	47f	chunk		1	
47g	chunk	5	14	35.7	47g	chunk	2	46.3	36.5	16.9	0.1	1.2	47g	chunk		1	
47h	chunk	3	4	75.0	47h	chunk	3	26.6	26.0	6.9	0.4	4.3	47h	chunk		1	
47i	chunk	4	9	44.4	47i	chunk	4	29.2	16.3	4.8	0.8	8.4	47i	chunk	1		
47j	chunk	3	6	50.0	47j	chunk	4	41.0	31.5	12.9	0.3	3.1	47j	chunk		1	
50d	chunk	5	12	41.7	50d	chunk	1	42.8	22.3	9.5	0.1	1.0	50d	chunk		1	
50e	chunk	6	7	85.7	50e	chunk	14	36.4	33.4	12.2	1.2	11.5	50e	chunk			1
50f	chunk	4	6	66.7	50f	chunk	2	35.0	18.5	6.5	0.3	3.1	50f	chunk		1	
50h	chunk	6	6	100.0	50h	chunk	1	26.8	15.1	4.0	0.2	2.5	50h	chunk		1	
51a	chunk	3	5	60.0	51a	chunk	2	32.8	23.6	7.7	0.3	2.6	51a	chunk			1
51b	chunk	2	2	100.0	51b	chunk	11	33.0	17.3	5.7	1.9	19.3	51b	chunk		1	
51d	chunk	5	8	62.5	51d	chunk	2	29.8	28.6	8.5	0.2	2.3	51d	chunk		1	
51e	chunk	4	4	100.0	51e	chunk	4	27.3	15.5	4.2	0.9	9.5	51e	chunk			1
51f	chunk	0	8	0.0	51f	chunk	2	20.8	9.1	1.9	1.1	10.6	51f	chunk		1	
51h	chunk	5	5	100.0	51h	chunk	11	32.8	25.7	8.4	1.3	13.0	51h	chunk		1	
51j	chunk	2	4	50.0	51j	chunk	0	27.5	22.7	6.2	0.0	0.0	51j	chunk		1	
52e	chunk	7	9	77.8	52e	chunk	1	37.7	23.1	8.7	0.1	1.1	52e	chunk		1	
53d	chunk	3	4	75.0	53d	chunk	1	40.0	18.1	7.2	0.1	1.4	53d	chunk	1		
54b2	chunk	11	13	84.6	54b2	chunk	6	27.7	22.0	6.1	1.0	9.8	54b2	chunk		1	
55a,b2	chunk	1	5	20.0	55a,b2	chunk	4	22.8	20.9	4.8	0.8	8.4	55a,b2	chunk		1	
56a2	chunk	7	8	87.5	56a2	chunk	9	50.6	27.8	14.1	0.6	6.4	56a2	chunk		1	

57a2	chunk	7	8	87.5	57a2	chunk	6	33.6	23.5	7.9	0.8	7.6	57a2	chunk		1	
57b2	chunk	7	9	77.8	57b2	chunk	3	26.2	13.7	3.6	0.8	8.4	57b2	chunk		1	
5bdug12	chunk	4	4	100.0	5bdug12	chunk	4	13.9	7.8	1.1	3.7	36.9	5bdug12	chunk			1
5bdug5	chunk	6	7	85.7	5bdug5	chunk	3	25.0	15.8	4.0	0.8	7.6	5bdug5	chunk			1
5csurf5	chunk	4	6	66.7	5csurf5	chunk	4	53.0	44.4	23.5	0.2	1.7	5csurf5	chunk			1
5csurf6	chunk	5	5	100.0	5csurf6	chunk	3	38.2	29.6	11.3	0.3	2.7	5csurf6	chunk			1
5kdug5	chunk	0	1	0.0	5kdug5	chunk	1	14.6	12.4	1.8	0.6	5.5	5kdug5	chunk		1	
6h7	chunk	1	5	20.0	6h7	chunk	2	15.6	15.3	2.4	0.8	8.4	6h7	chunk		1	
8p4	chunk	4	7	57.1	8p4	chunk	5	37.3	23.0	8.6	0.6	5.8	8p4	chunk		1	
8r5	chunk	2	3	66.7	8r5	chunk	1	29.4	22.7	6.7	0.1	1.5	8r5	chunk		1	
8t3	chunk	4	5	80.0	8t3	chunk	4	34.8	10.0	3.5	1.1	11.5	8t3	chunk		1	
8w11	chunk	4	9	44.4	8w11	chunk	4	23.6	11.1	2.6	1.5	15.3	8w11	chunk		1	
8w12	chunk	2	4	50.0	8w12	chunk	1	17.8	13.6	2.4	0.4	4.1	8w12	chunk		1	
8x5	chunk	5	6	83.3	8x5	chunk	3	38.4	25.9	9.9	0.3	3.0	8x5	chunk		1	
8x8	chunk	5	9	55.6	8x8	chunk	2	47.8	28.0	13.4	0.1	1.5	8x8	chunk			1
9c8	chunk	4	4	100.0	9c8	chunk	11	22.7	22.7	5.2	2.1	21.3	9c8	chunk		1	
9c9	chunk	5	5	100.0	9c9	chunk	10	18.3	13.2	2.4	4.1	41.4	9c9	chunk		1	
9d17	chunk	4	4	100.0	9d17	chunk	7	30.0	18.2	5.5	1.3	12.8	9d17	chunk		1	
9g15	chunk	4	7	57.1	9g15	chunk	3	20.0	15.1	3.0	1.0	9.9	9g15	chunk		1	
9h12	chunk	1	2	50.0	9h12	chunk	2	49.0	27.4	13.4	0.1	1.5	9h12	chunk		1	
9i14	chunk	3	3	100.0	9i14	chunk	4	36.0	36.0	13.0	0.3	3.1	9i14	chunk		1	
9L13	chunk	2	2	100.0	9L13	chunk	2	23.3	22.2	5.2	0.4	3.9	9L13	chunk		1	
9L19	chunk	2	2	100.0	9L19	chunk	4	37.9	27.6	10.5	0.4	3.8	9L19	chunk		1	
9m12	chunk	2	15	13.3	9m12	chunk	5	31.0	28.7	8.9	0.6	5.6	9m12	chunk		1	
9n10	chunk	5	5	100.0	9n10	chunk	4	20.1	17.3	3.5	1.2	11.5	9n10	chunk		1	
9n12	chunk	5	5	100.0	9n12	chunk	2	22.0	16.5	3.6	0.6	5.5	9n12	chunk		1	
9p12	chunk	1	7	14.3	9p12	chunk	1	36.0	17.6	6.3	0.2	1.6	9p12	chunk	1		
9q9	chunk	3	5	60.0	9q9	chunk	1	23.7	7.0	1.7	0.6	6.0	9q9	chunk			1
9r12	chunk	1	10	10.0	9r12	chunk	1	18.3	18.3	3.3	0.3	3.0	9r12	chunk		1	

a2	chunk	3	3	100.0	**a2**	chunk	0	23.3	16.0	3.7	0.0	0.0	**a2**	chunk			1
s16e2	chunk	4	4	100.0	s16e2	chunk	6	39.5	23.0	9.1	0.7	6.6	s16e2	chunk		1	
S18e3	chunk	4	7	57.1	S18e3	chunk	4	25.0	18.0	4.5	0.9	8.9	S18e3	chunk			1
S18e4	chunk	4	7	57.1	S18e4	chunk	6	29.3	11.4	3.3	1.8	18.0	S18e4	chunk			1
S19e11	chunk	2	6	33.3	S19e11	chunk	1	23.4	20	4.7	0.2	2.1	S19e11	chunk	1		
s1e2	chunk	2	4	50.0	s1e2	chunk	1	26.6	20.6	5.5	0.2	1.8	s1e2	chunk		1	
S23e1	chunk	5	6	83.3	S23e1	chunk	7	46.1	27.6	12.7	0.6	5.5	S23e1	chunk	1		
S29e1	chunk	5	5	100.0	S29e1	chunk	4	35.7	26.4	9.4	0.4	4.2	S29e1	chunk			1
S30e5	chunk	7	9	77.8	S30e5	chunk	1	43.8	30.5	13.4	0.1	0.7	S30e5	chunk		1	
S5edug2	chunk	2	4	50.0	S5edug2	chunk	1	32.0	32.0	10.2	0.1	1.0	S5edug2	chunk		1	
s9e7	chunk	3	3	100.0	s9e7	chunk	5	24.2	10.8	2.6	1.9	19.1	s9e7	chunk		1	
9j5	chunk	7	9	77.8	9j5	chunk	6	21.8	20.0	4.4	1.4	13.8	9j5	chunk		1	
9k7	chunk	0	8	0.0	9k7	chunk	4	25.3	16.2	4.1	1.0	9.8	9k7	chunk		1	
9d8	chunk	2	3	66.7	9d8	chunk	10	46.6	19.6	9.1	1.1	10.9	9d8	chunk		1	
15i1	chunk	4	4	100.0	15i1	chunk	2	15.7	10.2	1.6	1.2	12.5	15i1	chunk		1	
15i10	chunk	1	1	100.0	15i10	chunk	10	44.8	31.0	13.9	0.7	7.2	15i10	chunk		1	
15i2	chunk	2	2	100.0	15i2	chunk	2	15.3	13.3	2.0	1.0	9.8	15i2	chunk		1	
15i6	chunk	1	1	100.0	15i6	chunk	2	25.0	19.7	4.9	0.4	4.1	15i6	chunk		1	
15i7	chunk	3	3	100.0	15i7	chunk	5	52.8	27.4	14.5	0.3	3.5	15i7	chunk		1	
15g4	chunk	4	4	100.0	15g4	chunk	0	1.0	1.0	0.0	0.0	0.0	15g4	chunk			1
21a2	chunk	4	4	100.0	21a2	chunk	1	34.4	24.4	8.4	0.1	1.2	21a2	chunk		1	
38c3	core	12	21	57.1	38c3	core	6	28.2	25.2	7.1	0.8	8.4	38c3	core	1		
54b3	core	9	20	45.0	54b3	core	12	48.8	28.2	13.8	0.9	8.7	54b3	core		1	
56a3	core	21	23	91.3	56a3	core	5	30.1	16.1	4.8	1.0	10.3	56a3	core		1	
57a3	core	8	16	50.0	57a3	core	8	41.3	29.7	12.3	0.7	6.5	57a3	core		1	
57b3	core	5	26	19.2	57b3	core	10	46.0	22.6	10.4	1.0	9.6	57b3	core		1	
21k10	core cent, Chopper	9	26	34.6	21k10	chopper/ cent core	1	45.0	27.6	12.4	0.1	0.8	21k10	chopper/ cent core		1	
9a2	core, b/f	15	19	78.9	9a2	core, b/f	10	55.3	35.6	19.7	0.5	5.1	9a2	core, b/f		1	

9j16	core, c	8	12	66.7	9j16	core, c	12	32.0	32.0	10.2	1.2	11.7	9j16	core, c		1	
19b4	core, c	14	23	60.9	19b4	core, c	16	48.0	45.0	21.6	0.7	7.4	19b4	core, c		1	
9m15	core, c	3	23	13.0	9m15	core, c	7	29.5	25.8	7.6	0.9	9.2	9m15	core, c		1	
9L16	core, c/p	24	37	64.9	9L16	core, c/p	1	43.8	35.7	15.6	0.1	0.6	9L16	core, c/p		1	
14r3	core, casual	5	5	100.0	14r3	core, casual	3	48.5	31.0	15.0	0.2	2.0	14r3	core, casual		1	
5bdug10	core, casual	4	8	50.0	5bdug10	core, casual	7	40.5	38.8	15.7	0.4	4.5	5bdug10	core, casual			1
8x7	core, casual	11	14	78.6	8x7	core, casual	4	40.0	30.0	12.0	0.3	3.3	8x7	core, casual		1	
11b4	core, cent	9	19	47.4	11b4	core, cent	2	56.4	44.2	24.9	0.1	0.8	11b4	core, cent		1	
14L2	core, cent	12	23	52.2	14L2	core, cent	19	68.0	51.0	34.7	0.5	5.5	14L2	core, cent		1	
15k9	core, cent	4	10	40.0	15k9	core, cent	7	55.0	21.7	11.9	0.6	5.9	15k9	core, cent		1	
16a10	core, cent	28	35	80.0	16a10	core, cent	6	53.6	38.2	20.5	0.3	2.9	16a10	core, cent		1	
16c4	core, cent	23	49	46.9	16c4	core, cent	1	79	60	47.4	0.0	0.2	16c4	core, cent	1		
18b8	core, cent	8	17	47.1	18b8	core, cent	22	51.0	27.2	13.9	1.6	15.9	18b8	core, cent		1	
18d5	core, cent	10	20	50.0	18d5	core, cent	15	53.0	36.7	19.5	0.8	7.7	18d5	core, cent			1
19d10	core, cent	20	38	52.6	19d10	core, cent	9	63.0	38.4	24.2	0.4	3.7	19d10	core, cent		1	
1b2	core, cent	7	30	23.3	1b2	core, cent	2	56.0	42.7	23.9	0.1	0.8	1b2	core, cent		1	
1b4	core, cent	20	30	66.7	1b4	core, cent	3	52.7	34.8	18.3	0.2	1.6	1b4	core, cent	1		
1f1	core, cent	7	23	30.4	1f1	core, cent	14	56.1	45.1	25.3	0.6	5.5	1f1	core, cent	1		
1g4	core, cent	7	17	41.2	1g4	core, cent	11	39.5	35.6	14.1	0.8	7.8	1g4	core, cent		1	
22b	core, cent	14	21	66.7	22b	core, cent	10	33.9	31.7	10.7	0.9	9.3	22b	core, cent		1	
30j5	core, cent	5	10	50.0	30j5	core, cent	1	27.0	23.0	6.2	0.2	1.6	30j5	core, cent		1	
39a6	core, cent	14	16	87.5	39a6	core, cent	11	29.8	26.3	7.8	1.4	14.0	39a6	core, cent		1	
39b6	core, cent	8	18	44.4	39b6	core, cent	3	24.7	21.8	5.4	0.6	5.6	39b6	core, cent		1	
39c6	core, cent	7	13	53.8	39c6	core, cent	2	36.0	23.0	8.3	0.2	2.4	39c6	core, cent	1		
40c4	core, cent	17	26	65.4	40c4	core, cent	12	22.3	21.7	4.8	2.5	24.8	40c4	core, cent		1	
40d4	core, cent	19	19	100.0	40d4	core, cent	17	19.9	17.4	3.5	4.9	49.1	40d4	core, cent		1	
41d1	core, cent	8	25	32.0	41d1	core, cent	2	30.2	23.5	7.1	0.3	2.8	41d1	core, cent	1		

42b7	core, cent	15	16	93.8	42b7	core, cent	15	53.4	40.0	21.4	0.7	7.0	42b7	core, cent		1	
42c7	core, cent	12	21	57.1	42c7	core, cent	13	45.7	39.5	18.1	0.7	7.2	42c7	core, cent	1		
43b6	core, cent	8	11	72.7	43b6	core, cent	9	41.6	23.0	9.6	0.9	9.4	43b6	core, cent		1	
43c6	core, cent	12	18	66.7	43c6	core, cent	10	38.2	31.5	12.0	0.8	8.3	43c6	core, cent		1	
44c6	core, cent	11	21	52.4	44c6	core, cent	12	57.8	47.3	27.3	0.4	4.4	44c6	core, cent			1
45a6	core, cent	16	20	80.0	45a6	core, cent	11	60.4	53.5	32.3	0.3	3.4	45a6	core, cent		1	
47d	core, cent	16	19	84.2	47d	core, cent	11	37.7	29.9	11.3	1.0	9.8	47d	core, cent		1	
47h	core, cent	10	18	55.6	47h	core, cent	1	43.2	41.7	18.0	0.1	0.6	47h	core, cent		1	
51d	core, cent	11	23	47.8	51d	core, cent	8	58.5	28.3	16.6	0.5	4.8	51d	core, cent		1	
51g	core, cent	4	12	33.3	51g	core, cent	8	47.5	39.4	18.7	0.4	4.3	51g	core, cent		1	
52b	core, cent	16	19	84.2	52b	core, cent	11	74.2	65.4	48.5	0.2	2.3	52b	core, cent	1		
52f	core, cent	8	18	44.4	52f	core, cent	6	53.2	44.1	23.5	0.3	2.6	52f	core, cent		1	
52h	core, cent	4	18	22.2	52h	core, cent	2	47.3	39.8	18.8	0.1	1.1	52h	core, cent	1		
53d	core, cent	16	24	66.7	53d	core, cent	3	32.1	31.2	10.0	0.3	3.0	53d	core, cent	1		
8w10	core, cent	12	28	42.9	8w10	core, cent	3	68.6	64.7	44.4	0.1	0.7	8w10	core, cent		1	
9g13	core, cent	12	17	70.6	9g13	core, cent	4	25.2	17.8	4.5	0.9	8.9	9g13	core, cent		1	
S19e3	core, cent	8	25	32.0	S19e3	core, cent	1	40	27.3	10.9	0.1	0.9	S19e3	core, cent	1		
S30e10	core, cent	17	19	89.5	S30e10	core, cent	1	45.5	45.5	20.7	0.0	0.5	S30e10	core, cent		1	
6h4	core, cent	10	27	37.0	6h4	core, cent	5	62.8	39.7	24.9	0.2	2.0	6h4	core, cent		1	
55a,b3	core, cent / cleaver	20	27	74.1	55a,b3	core, cent / cleaver	14	36.4	33.4	12.2	1.2	11.5	55a,b3	core, cent / cleaver		1	
S18e5	core, chunk	6	11	54.5	S18e5	core, chunk	17	42.3	35.5	15.0	1.1	11.3	S18e5	core, chunk			1
11a9	core, flat	20	20	100.0	11a9	core, flat	8	38.6	19.2	7.4	1.1	10.8	11a9	core, flat		1	
19d8	core, flat	5	15	33.3	19d8	core, flat	4	37.2	31.3	11.6	0.3	3.4	19d8	core, flat		1	
25a	core, flat	4	7	57.1	25a	core, flat	1	22.4	21.1	4.7	0.2	2.1	25a	core, flat		1	
33b10	core, flat	23	26	88.5	33b10	core, flat	7	33.5	29.2	9.8	0.7	7.2	33b10	core, flat		1	
33b9	core, flat	11	16	68.8	33b9	core, flat	5	31.8	28.0	8.9	0.6	5.6	33b9	core, flat		1	
38b6	core, flat	9	10	90.0	38b6	core, flat	5	40.3	33.7	13.6	0.4	3.7	38b6	core, flat			1
45b4	core, flat	8	16	50.0	45b4	core, flat	15	34.7	26.5	9.2	1.6	16.3	45b4	core, flat		1	

47b	core, flat	15	21	71.4	47b	core, flat	8	59.8	40.4	24.2	0.3	3.3	47b	core, flat	1		
53e	core, flat	10	14	71.4	53e	core, flat	2	36.8	29.0	10.7	0.2	1.9	53e	core, flat		1	
9p15	core, flat	1	15	6.7	9p15	core, flat	5	33.0	32.6	10.8	0.5	4.6	9p15	core, flat	1		
47f	core, flat, prep	7	16	43.8	47f	core, flat, prep	10	49.7	31.2	15.5	0.6	6.4	47f	core, flat, prep		1	
14b3	core, flat/p	14	26	53.8	14b3	core, flat/p	2	57.0	49.7	28.3	0.1	0.7	14b3	core, flat/p		1	
10h10	core, p	11	23	47.8	10h10	core, p	22	39.8	33.2	13.2	1.7	16.6	10h10	core, p		1	
10h9	core, p	9	27	33.3	10h9	core, p	19	28.2	27.8	7.8	2.4	24.2	10h9	core, p		1	
10m10	core, p	14	23	60.9	10m10	core, p	5	42.3	31.7	13.4	0.4	3.7	10m10	core, p		1	
14k5	core, p	14	15	93.3	14k5	core, p	5	66.8	51.6	34.5	0.1	1.5	14k5	core, p			1
15b10	core, p	26	26	100.0	15b10	core, p	11	32.4	17.7	5.7	1.9	19.2	15b10	core, p		1	
16f10	core, p	5	29	17.2	16f10	core, p	5	45.0	37.0	16.7	0.3	3.0	16f10	core, p		1	
17a,b,c10	core, p	14	19	73.7	17a,b,c10	core, p	2	57.5	38.8	22.3	0.1	0.9	17a,b,c10	core, p			1
18a3	core, p	25	27	92.6	18a3	core, p	22	26.0	28.7	7.5	2.9	29.5	18a3	core, p		1	
19a3	core, p	28	32	87.5	19a3	core, p	10	70.6	37.6	26.5	0.4	3.8	19a3	core, p		1	
28h	core, p	15	15	100.0	28h	core, p	6	27.4	25.3	6.9	0.9	8.7	28h	core, p		1	
29c	core, p	3	23	13.0	29c	core, p	1	32.6	29.3	9.6	0.1	1.0	29c	core, p			1
30a	core, p	14	28	50.0	30a	core, p	2	81.2	61.1	49.6	0.0	0.4	30a	core, p		1	
30g	core, p	11	16	68.8	30g	core, p	6	40.0	31.3	12.5	0.5	4.8	30g	core, p		1	
32a5	core, p	25	29	86.2	32a5	core, p	20	37.5	36.8	13.8	1.4	14.5	32a5	core, p			1
34a3	core, p	3	16	18.8	34a3	core, p	1	37.0	33.6	12.4	0.1	0.8	34a3	core, p		1	
34b3	core, p	7	13	53.8	34b3	core, p	3	44.7	41.5	18.6	0.2	1.6	34b3	core, p		1	
50c	core, p	12	12	100.0	50c	core, p	3	31.7	27.6	8.7	0.3	3.4	50c	core, p		1	
50d	core, p	7	19	36.8	50d	core, p	1	31.3	31.1	9.7	0.1	1.0	50d	core, p		1	
51e	core, p	11	11	100.0	51e	core, p	7	24.7	24.6	6.1	1.2	11.5	51e	core, p		1	
51i	core, p	8	10	80.0	51i	core, p	2	31.2	23.8	7.4	0.3	2.7	51i	core, p		1	
51j	core, p	5	15	33.3	51j	core, p	1	33.7	27.4	9.2	0.1	1.1	51j	core, p		1	
5csurf3	core, p	9	16	56.3	5csurf3	core, p	5	47.0	41.7	19.6	0.3	2.6	5csurf3	core, p			1
5csurf7	core, p	14	25	56.0	5csurf7	core, p	5	31.6	32.1	10.1	0.5	4.9	5csurf7	core, p			1

6h5	core, p	4	30	13.3	6h5	core, p	1	49.8	39.3	19.6	0.1	0.5	6h5	core, p		1	
9c15	core, p	6	13	46.2	9c15	core, p	10	32.6	32.5	10.6	0.9	9.4	9c15	core, p		1	
9d16	core, p	13	18	72.2	9d16	core, p	30	50.0	46.3	23.2	1.3	13.0	9d16	core, p		1	
9f16	core, p	18	22	81.8	9f16	core, p	7	29.0	22.2	6.4	1.1	10.9	9f16	core, p		1	
9h16	core, p	2	48	4.2	9h16	core, p	3	47.5	26.5	12.6	0.2	2.4	9h16	core, p	1		
9i16	core, p	14	27	51.9	9i16	core, p	1	83.3	76.0	63.3	0.0	0.2	9i16	core, p		1	
S21e5	core, p	10	29	34.5	S21e5	core, p	2	69.0	39.0	26.9	0.1	0.7	S21e5	core, p		1	
6g1	core, p	6	11	54.5	6g1	core, p	1	30.3	21.3	6.5	0.2	1.5	6g1	core, p		1	
10s10	core, pi	4	15	26.7	10s10	core, pi	11	33.4	32.6	10.9	1.0	10.1	10s10	core, pi		1	
10s9	core, pi	5	13	38.5	10s9	core, pi	9	22.0	19.8	4.4	2.1	20.7	10s9	core, pi		1	
10v2	core, pi	12	28	42.9	10v2	core, pi	3	40.5	36.0	14.6	0.2	2.1	10v2	core, pi		1	
11a8	core, pi	23	24	95.8	11a8	core, pi	10	22.7	20.7	4.7	2.1	21.3	11a8	core, pi		1	
15b12	core, pi	9	9	100.0	15b12	core, pi	12	18.5	9.2	1.7	7.1	70.5	15b12	core, pi		1	
15g	core, pi	10	10	100.0	15g	core, pi	9	31.9	17.3	5.5	1.6	16.3	15g	core, pi			1
17a,b,c7	core, pi	12	16	75.0	17a,b,c7	core, pi	1	46.2	35.5	16.4	0.1	0.6	17a,b,c7	core, pi			1
18c11	core, pi	10	15	66.7	18c11	core, pi	24	49.0	35.8	17.5	1.4	13.7	18c11	core, pi		1	
21a8	core, pi	9	12	75.0	21a8	core, pi	2	25.0	25.0	6.3	0.3	3.2	21a8	core, pi		1	
22a	core, pi	12	15	80.0	22a	core, pi	3	76.5	61.1	46.7	0.1	0.6	22a	core, pi			1
23b	core, pi	8	14	57.1	23b	core, pi	6	26.7	25.9	6.9	0.9	8.7	23b	core, pi		1	
23j	core, pi	7	15	46.7	23j	core, pi	4	39.4	18.2	7.2	0.6	5.6	23j	core, pi		1	
28b	core, pi	9	10	90.0	28b	core, pi	4	49.0	36.4	17.8	0.2	2.2	28b	core, pi		1	
28g	core, pi	9	11	81.8	28g	core, pi	6	35.4	30.2	10.7	0.6	5.6	28g	core, pi		1	
29b	core, pi	7	14	50.0	29b	core, pi	1	51.7	33.8	17.5	0.1	0.6	29b	core, pi			1
30b	core, pi	10	17	58.8	30b	core, pi	5	56.6	38.7	21.9	0.2	2.3	30b	core, pi		1	
41a5	core, pi	6	17	35.3	41a5	core, pi	2	36.4	28.3	10.3	0.2	1.9	41a5	core, pi		1	
44a5	core, pi	17	17	100.0	44a5	core, pi	6	24.3	20.9	5.1	1.2	11.8	44a5	core, pi		1	
44b7	core, pi	11	12	91.7	44b7	core, flat	10	52.4	32.0	16.8	0.6	6.0	44b7	core, pi		1	
47g	core, pi	5	9	55.6	47g	core, pi	3	44.0	32.1	14.1	0.2	2.1	47g	core, pi	1		
50e	core, pi	7	12	58.3	50e	core, pi	6	37.7	25.7	9.7	0.6	6.2	50e	core, pi		1	

50f	core, pi	7	17	41.2	50f	core, pi	4	43.8	32.2	14.1	0.3	2.8	50f	core, pi		1	
51f	core, pi	2	8	25.0	51f	core, pi	2	30.9	26.7	8.3	0.2	2.4	51f	core, pi		1	
52e	core, pi	3	12	25.0	52e	core, pi	4	44.0	35.5	15.6	0.3	2.6	52e	core, pi		1	
53c	core, pi	9	15	60.0	53c	core, pi	7	38.8	29.6	11.5	0.6	6.1	53c	core, pi		1	
8p5	core, pi	4	14	28.6	8p5	core, pi	3	42.2	25.4	10.7	0.3	2.8	8p5	core, pi		1	
8u2	core, pi	15	18	83.3	8u2	core, pi	18	72.4	39.4	28.5	0.6	6.3	8u2	core, pi		1	
8x10	core, pi	19	19	100.0	8x10	core, pi	4	68.0	39.2	26.7	0.2	1.5	8x10	core, pi		1	
9c16	core, pi	10	10	100.0	9c16	core, pi	21	41.7	41.5	17.3	1.2	12.1	9c16	core, pi		1	
9n15	core, pi	11	11	100.0	9n15	core, pi	0	1.0	1.0	0.0	0.0	0.0	9n15	core, pi		1	
9n16	core, pi	18	23	78.3	9n16	core, pi	2	46.0	24.0	11.0	0.2	1.8	9n16	core, pi		1	
9p16	core, pi	5	15	33.3	9p16	core, pi	6	38.4	34.8	13.4	0.4	4.5	9p16	core, pi	1		
9q12	core, pi	6	13	46.2	9q12	core, pi	1	42.0	37.3	15.7	0.1	0.6	9q12	core, pi			1
s16e3	core, pi	11	17	64.7	s16e3	core, pi	4	37.5	16.3	6.1	0.7	6.5	s16e3	core, pi		1	
19f/g3	core, pi	19	21	90.5	19f/g3	core, pi	9	36.7	35.5	13.0	0.7	6.9	19f/g3	core, pi		1	
10L2	core, pi	16	20	80.0	10L2	core, pi	11	38.0	31.5	12.0	0.9	9.2	10L2	core, pi		1	
10r3	core, pi	4	13	30.8	10r3	core, pi	2	40.0	29.5	11.8	0.2	1.7	10r3	core, pi		1	
1i/j6	denticulate	3	12	25.0	1i/j1	denticulate	1	32.3	12.6	4.1	0.2	2.5	1i/j6	denticulate	1		
10h6	denticulate	4	8	50.0	10h6	denticulate	12	40.7	26.0	10.6	1.1	11.3	10h6	denticulate		1	
15a11	denticulate	6	23	26.1	15a11	denticulate	14	58.0	50.0	29.0	0.5	4.8	15a11	denticulate		1	
15a8	denticulate	9	24	37.5	15a8	denticulate	4	65.6	58.2	38.2	0.1	1.0	15a8	denticulate		1	
15b11	denticulate	6	8	75.0	15b11	denticulate	8	31.2	22.5	7.0	1.1	11.4	15b11	denticulate		1	
15k11	denticulate	2	14	14.3	15k11	denticulate	3	21.6	20.9	4.5	0.7	6.6	15k11	denticulate		1	
16a11	denticulate	2	10	20.0	16a11	denticulate	8	35.0	24.0	8.4	1.0	9.5	16a11	denticulate		1	
16a12	denticulate	8	32	25.0	16a12	denticulate	19	56.4	49.6	28.0	0.7	6.8	16a12	denticulate	1		
16d1	denticulate	1	6	16.7	16d1	denticulate	4	48.0	22.0	10.6	0.4	3.8	16d1	denticulate		1	
16f12	denticulate	0	13	0.0	16f12	denticulate	2	32.3	21.5	6.9	0.3	2.9	16f12	denticulate		1	
16f13	denticulate	0	15	0.0	16f13	denticulate	1	24.2	20.9	5.1	0.2	2.0	16f13	denticulate		1	
17a,b,c11	denticulate	6	17	35.3	17a,b,c11	denticulate	5	40.0	32.7	13.1	0.4	3.8	17a,b,c11	denticulate		1	
18b12	denticulate	2	11	18.2	18b12	denticulate	10	35.5	22.5	8.0	1.3	12.5	18b12	denticulate		1	

18b13	denticulate	2	11	18.2	18b13	denticulate	13	43.8	14.8	6.5	2.0	20.1	18b13	denticulate		1	
18d6	denticulate	6	14	42.9	18d6	denticulate	14	38.3	31.6	12.1	1.2	11.6	18d6	denticulate			1
19b2	denticulate	5	15	33.3	19b2	denticulate	10	45.0	44.3	19.9	0.5	5.0	19b2	denticulate		1	
19c1	denticulate	4	17	23.5	19c1	denticulate	7	58	28.5	16.5	0.4	4.2	19c1	denticulate		1	
19d11	denticulate	5	14	35.7	19d11	denticulate	8	24.1	14.1	3.4	2.4	23.5	19d11	denticulate		1	
19f/g4	denticulate	4	10	40.0	19f/g4	denticulate	9	23.8	33.6	8.0	1.1	11.3	19f/g4	denticulate	1		
1a5	denticulate	7	17	41.2	1a5	denticulate	8	33.4	31.3	10.5	0.8	7.7	1a5	denticulate		1	
1b5	denticulate	4	18	22.2	1b5	denticulate	4	32.6	20.1	6.6	0.6	6.1	1b5	denticulate		1	
1f2	denticulate	3	16	18.8	1f2	denticulate	1	28.8	20.7	6.0	0.2	1.7	1f2	denticulate	1		
1g5	denticulate	4	14	28.6	1g5	denticulate	9	44.0	17.7	7.8	1.2	11.6	1g5	denticulate		1	
22c2	denticulate	10	14	71.4	22c2	denticulate	1	29.7	14.0	4.2	0.2	2.4	22c2	denticulate		1	
23b2	denticulate	1	21	4.8	23b2	denticulate	1	29.0	25.0	7.3	0.1	1.4	23b2	denticulate		1	
23d2	denticulate	2	14	14.3	23d2	denticulate	2	42.6	28.4	12.1	0.2	1.7	23d2	denticulate		1	
23j2	denticulate	4	15	26.7	23j2	denticulate	0	23.2	17.6	4.1	0.0	0.0	23j2	denticulate	1		
25a	denticulate	7	9	77.8	25a1	denticulate	6	25.4	25.4	6.5	0.9	9.3	25a1	denticulate		1	
27a2	denticulate	8	10	80.0	27a2	denticulate	4	48.4	33.2	16.1	0.2	2.5	27a2	denticulate			1
28b2	denticulate	4	10	40.0	28b2	denticulate	2	32.0	22.4	7.2	0.3	2.8	28b2	denticulate		1	
29c2	denticulate	2	14	14.3	29c2	denticulate	1	28.5	23.5	6.7	0.1	1.5	29c2	denticulate			1
30a2	denticulate	5	41	12.2	30a2	denticulate	3	58.4	34.1	19.9	0.2	1.5	30a2	denticulate		1	
30b	denticulate	1	12	8.3	30b2	denticulate	1	35.2	18.0	6.3	0.2	1.6	30b2	denticulate		1	
30c2	denticulate	16	21	76.2	30c2	denticulate	17	84.0	42.4	35.6	0.5	4.8	30c2	denticulate		1	
30i11	denticulate	5	10	50.0	30i11	denticulate	4	22.0	22.0	4.8	0.8	8.3	30i11	denticulate		1	
34a2	denticulate	3	14	21.4	34a2	denticulate	3	30.0	20.0	6.0	0.5	5.0	34a2	denticulate		1	
38b1	denticulate	5	10	50.0	38b1	denticulate	6	35.3	19.0	6.7	0.9	8.9	38b1	denticulate			1
38c6	denticulate	3	23	13.0	38c6	denticulate	2	31.4	15.2	4.8	0.4	4.2	38c6	denticulate	1		
38d1	denticulate	5	10	50.0	38d1	denticulate	10	25.5	14.2	3.6	2.8	27.6	38d1	denticulate			1
39a1	denticulate	6	15	40.0	39a1	denticulate	10	33.3	14.0	4.7	2.1	21.5	39a1	denticulate	1		
39b1	denticulate	2	9	22.2	39b1	denticulate	2	19.0	18.7	3.6	0.6	5.6	39b1	denticulate	1		
39c1	denticulate	4	15	26.7	39c1	denticulate	3	25.5	17.4	4.4	0.7	6.8	39c1	denticulate	1		

40a4	denticulate	3	19	15.8	40a4	denticulate	15	30.3	18.4	5.6	2.7	26.9	40a4	denticulate		1	
40c3	denticulate	1	6	16.7	40c3	denticulate	8	31.7	21.7	6.9	1.2	11.6	40c3	denticulate		1	
40d3	denticulate	12	15	80.0	40d3	denticulate	23	23.5	21.4	5.0	4.6	45.7	40d3	denticulate		1	
41a4	denticulate	4	15	26.7	41a4	denticulate	5	45.7	29.3	13.4	0.4	3.7	41a4	denticulate		1	
42b1	denticulate	9	20	45.0	42b1	denticulate	14	38.3	35.5	13.6	1.0	10.3	42b1	denticulate		1	
42c1	denticulate	2	10	20.0	42c1	denticulate	6	39.0	17.7	6.9	0.9	8.7	42c1	denticulate	1		
43b1	denticulate	6	22	27.3	43b1	denticulate	8	36.3	20.2	7.3	1.1	10.9	43b1	denticulate		1	
43c1	denticulate	8	16	50.0	43c1	denticulate	7	37.1	24.2	9.0	0.8	7.8	43c1	denticulate	1		
44b1	denticulate	4	11	36.4	44b1	denticulate	9	31.8	27.2	8.6	1.0	10.4	44b1	denticulate		1	
45c1	denticulate	6	22	27.3	45c1	denticulate	10	50.7	32.0	16.2	0.6	6.2	45c1	denticulate		1	
47a	denticulate	7	17	41.2	47a	denticulate	8	27.9	20.2	5.6	1.4	14.2	47a	denticulate		1	
47b	denticulate	2	13	15.4	47b	denticulate	6	40.0	26.8	10.7	0.6	5.6	47b	denticulate	1		
47f	denticulate	5	13	38.5	47f	denticulate	0	26.1	23.8	6.2	0.0	0.0	47f	denticulate		1	
47j	denticulate	1	7	14.3	47j	denticulate	2	29.8	17.5	5.2	0.4	3.8	47j	denticulate		1	
50d	denticulate	9	25	36.0	50d	denticulate	4	48.9	36.7	17.9	0.2	2.2	50d	denticulate		1	
51b	denticulate	1	14	7.1	51b	denticulate	3	29.3	17.7	5.2	0.6	5.8	51b	denticulate		1	
51g	denticulate	2	20	10.0	51g	denticulate	5	34.2	25.7	8.8	0.6	5.7	51g	denticulate		1	
52h	denticulate	4	15	26.7	52h	denticulate	2	30.2	20.7	6.3	0.3	3.2	52h	denticulate	1		
53d	denticulate	4	23	17.4	53d	denticulate	3	39.0	20.9	8.2	0.4	3.7	53d	denticulate	1		
55a,b6	denticulate	13	18	72.2	55a,b6	denticulate	7	27.6	24.8	6.8	1.0	10.2	55a,b6	denticulate		1	
5csurf2	denticulate	4	11	36.4	5csurf2	denticulate	3	33.5	27.0	9.0	0.3	3.3	5csurf2	denticulate			1
8u3	denticulate	9	13	69.2	8u3	denticulate	13	61.0	31.6	19.3	0.7	6.7	8u3	denticulate		1	
8w7	denticulate	7	27	25.9	8w7	denticulate	3	51.5	41.7	21.5	0.1	1.4	8w7	denticulate		1	
9a11	denticulate	7	20	35.0	9a11	denticulate	14	32.2	19.4	6.2	2.2	22.4	9a11	denticulate		1	
9b14	denticulate	0	6	0.0	9b14	denticulate	0	33.6	29.5	9.9	0.0	0.0	9b14	denticulate	1		
9d14	denticulate	2	7	28.6	9d14	denticulate	20	47.0	34.4	16.2	1.2	12.4	9d14	denticulate		1	
9i11	denticulate	3	12	25.0	9i11	denticulate	4	45.4	22.0	10.0	0.4	4.0	9i11	denticulate	1		
a3	denticulate	10	15	66.7	**a3**	denticulate	3	48.6	36.0	17.5	0.2	1.7	**a3**	denticulate	1		
a4	denticulate	12	13	92.3	**a4**	denticulate	1	31.2	27.5	8.6	0.1	1.2	**a4**	denticulate		1	

S30e3	denticulate	1	12	8.3	S30e3	denticulate	1	35.0	26.8	9.4	0.1	1.1	S30e3	denticulate		1	
s41e1	denticulate	2	15	13.3	s41e1	denticulate	6	36.5	20.0	7.3	0.8	8.2	s41e1	denticulate		1	
s50e	denticulate	11	11	100.0	s50e	denticulate	9	22.2	20.8	4.6	1.9	19.5	s50e	denticulate		1	
s53e	denticulate	3	13	23.1	s53e	denticulate	1	30.3	16.6	5.0	0.2	2.0	s53e	denticulate		1	
s9e13	denticulate	7	9	77.8	s9e13	denticulate	9	32.2	32.2	10.4	0.9	8.7	s9e13	denticulate		1	
21r1	flake	2	3	66.7	21r1	bip flake	1	22.6	7.8	1.8	0.6	5.7	21r1	bip flake			1
21r2	flake	3	3	100.0	21r2	bip flake	2	24.3	15.3	3.7	0.5	5.4	21r2	bip flake			1
21r5	flake	2	4	50.0	21r5	bip flake	4	43.7	19.6	8.6	0.5	4.7	21r5	bip flake			1
10h1	flake	3	8	37.5	10h1	flake	1	25.3	19.2	4.9	0.2	2.1	10h1	flake		1	
10h4	flake	3	9	33.3	10h4	flake	9	28.0	21.3	6.0	1.5	15.1	10h4	flake		1	
10L2	flake	2	2	100.0	10L2	flake	3	16.5	14.2	2.3	1.3	12.8	10L2	flake		1	
10m6	flake	5	5	100.0	10m6	flake	2	27.0	22.5	6.1	0.3	3.3	10m6	flake		1	
10m8	flake	6	6	100.0	10m8	flake	1	44.0	18.4	8.1	0.1	1.2	10m8	flake		1	
10r4	flake	0	2	0.0	10r4	flake	1	22.3	14.7	3.3	0.3	3.1	10r4	flake		1	
10s4	flake	5	6	83.3	10s4	flake	10	25.0	17.6	4.4	2.3	22.7	10s4	flake		1	
10s8	flake	2	2	100.0	10s8	flake	14	41.7	29.0	12.1	1.2	11.6	10s8	flake		1	
11a2	flake	1	1	100.0	11a2	flake	5	29.7	20.7	6.1	0.8	8.1	11a2	flake		1	
11a6	flake	11	11	100.0	11a6	flake	11	24.0	15.2	3.6	3.0	30.2	11a6	flake		1	
11b2	flake	7	13	53.8	11b2	flake	1	48.0	35.0	16.8	0.1	0.6	11b2	flake			1
13a3	flake	4	4	100.0	13a3	flake	2	31.8	28.0	8.9	0.2	2.2	13a3	flake			1
13a5	flake	1	1	100.0	13a5	flake	3	41.6	25.5	10.6	0.3	2.8	13a5	flake			1
14L1	flake	2	2	100.0	14L1	flake	4	57.0	28.2	16.1	0.2	2.5	14L1	flake		1	
14m1	flake	3	4	75.0	14m1	flake	3	37.3	25.2	9.4	0.3	3.2	14m1	flake		1	
15a5	flake	4	6	66.7	15a5	flake	3	48.0	44.0	21.1	0.1	1.4	15a5	flake		1	
15a7	flake	6	17	35.3	15a7	flake	3	75.0	43.4	32.6	0.1	0.9	15a7	flake		1	
15b6	flake	6	7	85.7	15b6	flake	7	31.0	22.6	7.0	1.0	10.0	15b6	flake		1	
15b8	flake	3	3	100.0	15b8	flake	21	46.4	36.4	16.9	1.2	12.4	15b8	flake		1	
15c2	flake	4	9	44.4	15c2	flake	20	54	32.5	17.6	1.1	11.4	15c2	flake		1	
15d3	flake	7	8	87.5	15d3	flake	7	51.0	28.0	14.3	0.5	4.9	15d3	flake	1		

15g2	flake	1	1	100.0	15g2	flake	0	1.0	1.0	0.0	0.0	0.0	15g2	flake			1
15i3	flake	1	3	33.3	15i3	flake	4	22.6	8.0	1.8	2.2	22.1	15i3	flake		1	
15i8	flake	4	4	100.0	15i8	flake	8	53.0	21.3	11.3	0.7	7.1	15i8	flake		1	
15k2	flake	0	4	0.0	15k2	flake	2	16.0	14.5	2.3	0.9	8.6	15k2	flake		1	
15k7	flake	2	8	25.0	15k7	flake	1	34.3	23.7	8.1	0.1	1.2	15k7	flake		1	
16a3	flake	5	5	100.0	16a3	flake	2	22.6	21.8	4.9	0.4	4.1	16a3	flake		1	
16a5	flake	5	6	83.3	16a5	flake	3	27.0	26.0	7.0	0.4	4.3	16a5	flake		1	
16c2	flake	2	10	20.0	16c2	flake	0	1	1	0.0	0.0	0.0	16c2	flake	1		
16f5	flake	1	6	16.7	16f5	flake	2	33.0	21.3	7.0	0.3	2.8	16f5	flake		1	
16f6	flake	0	5	0.0	16f6	flake	4	33.0	30.0	9.9	0.4	4.0	16f6	flake		1	
16h1	flake	3	3	100.0	16h1	flake	4	23.4	17.0	4.0	1.0	10.1	16h1	flake	1		
17a,b,c3	flake	0	1	0.0	17a,b,c3	flake	2	23.4	19.7	4.6	0.4	4.3	17a,b,c3	flake			1
17a,b,c4	flake	2	2	100.0	17a,b,c4	flake	2	39.4	18.2	7.2	0.3	2.8	17a,b,c4	flake			1
18a2	flake	5	8	62.5	18a2	flake	24	24.5	24.5	6.0	4.0	40.0	18a2	flake		1	
18b6	flake	0	4	0.0	18b6	flake	20	48.5	32.3	15.7	1.3	12.8	18b6	flake		1	
18b7	flake	5	6	83.3	18b7	flake	23	52.2	28.0	14.6	1.6	15.7	18b7	flake		1	
18c14	flake	4	4	100.0	18c14	flake	25	44.8	21.2	9.5	2.6	26.3	18c14	flake		1	
18c7	flake	3	3	100.0	18c7	flake	21	57.0	29.2	16.6	1.3	12.6	18c7	flake		1	
18d4	flake	5	16	31.3	18d4	flake	11	39.0	30.0	11.7	0.9	9.4	18d4	flake			1
19a2	flake	8	11	72.7	19a2	flake	9	42	40	16.8	0.5	5.4	19a2	flake		1	
19d7	flake	4	4	100.0	19d7	flake	12	42.3	36.3	15.4	0.8	7.8	19d7	flake		1	
19d9	flake	2	2	100.0	19d9	flake	9	47.4	38.6	18.3	0.5	4.9	19d9	flake		1	
19f/g2	flake	2	5	40.0	19f/g2	flake	5	37.0	34.4	12.7	0.4	3.9	19f/g2	flake		1	
1a6	flake	6	10	60.0	1a6	flake	13	56.8	28.5	16.2	0.8	8.0	1a6	flake		1	
1c3	flake	3	6	50.0	1c3	flake	3	36.0	23.6	8.5	0.4	3.5	1c3	flake	1		
1g6	flake	3	6	50.0	1g6	flake	13	56.2	33.2	18.7	0.7	7.0	1g6	flake		1	
1i/j1	flake	7	7	100.0	1i/j1	flake	2	46.7	28.0	13.1	0.2	1.5	1i/j1	flake	1		
20af1	flake	3	5	60.0	20af1	flake	2	20.0	16.2	3.2	0.6	6.2	20af1	flake		1	
21a10	flake	2	2	100.0	21a10	flake	15	61.3	59.0	36.2	0.4	4.1	21a10	flake		1	

21k7	flake	1	1	100.0	21k7	flake	1	43.3	27.8	12.0	0.1	0.8	21k7	flake		1	
22a1	flake	3	3	100.0	22a1	flake	3	60.0	35.0	21.0	0.1	1.4	22a1	flake			1
22b1	flake	1	2	50.0	22b1	flake	12	45.0	32.0	14.4	0.8	8.3	22b1	flake		1	
23b1	flake	3	3	100.0	23b1	flake	2	50.0	40.0	20.0	0.1	1.0	23b1	flake			1
23j2	flake	3	4	75.0	23j2	flake	2	35.0	22.0	7.7	0.3	2.6	23j2	flake	1		
23k1	flake	0	5	0.0	23k1	flake	1	15.0	12.0	1.8	0.6	5.6	23k1	flake	1		
27a1	flake	2	2	100.0	27a1	flake	3	35.0	35.0	12.3	0.2	2.4	27a1	flake			1
28a1	flake	3	4	75.0	28a1	flake	1	38.0	20.0	7.6	0.1	1.3	28a1	flake			1
28b1	flake	4	4	100.0	28b1	flake	9	45.0	45.0	20.3	0.4	4.4	28b1	flake		1	
29c1	flake	0	6	0.0	29c1	flake	1	20.0	15.0	3.0	0.3	3.3	29c1	flake		1	
29d1	flake	1	1	100.0	29d1	flake	0	30.0	25.0	7.5	0.0	0.0	29d1	flake		1	
30a2	flake	3	9	33.3	30a2	flake	1	73.0	50.0	36.5	0.0	0.3	30a2	flake	1		
30b1	flake	1	9	11.1	30b1	flake	1	55.0	43.0	23.7	0.0	0.4	30b1	flake		1	
30c1	flake	2	3	66.7	30c1	flake	2	30.0	30.0	9.0	0.2	2.2	30c1	flake		1	
30d2	flake	5	10	50.0	30d2	flake	1	40.0	40.0	16.0	0.1	0.6	30d2	flake	1		
30h2	flake	1	1	100.0	30h2	flake	1	45.3	34.6	15.7	0.1	0.6	30h2	flake		1	
30i1	flake	3	5	60.0	30i1	flake	3	25.0	9.8	2.5	1.2	12.2	30i1	flake		1	
32a1	flake	3	3	100.0	32a1	flake	4	21.5	18.5	4.0	1.0	10.1	32a1	flake			1
32a2	flake	1	1	100.0	32a2	flake	7	30.5	23.3	7.1	1.0	9.9	32a2	flake			1
33b4	flake	4	5	80.0	33b4	flake	5	38.3	9.4	3.6	1.4	13.9	33b4	flake		1	
33b5	flake	1	1	100.0	33b5	flake	7	37.7	36.0	13.6	0.5	5.2	33b5	flake		1	
38a3	flake	1	1	100.0	38a3	flake	24	22.7	23.8	5.4	4.4	44.4	38a3	flake		1	
38b5	flake	1	2	50.0	38b5	flake	1	27.2	15.8	4.3	0.2	2.3	38b5	flake			1
38c1	flake	3	6	50.0	38c1	flake	1	20.3	15.2	3.1	0.3	3.2	38c1	flake	1		
39a3	flake	4	4	100.0	39a3	flake	13	36.8	31.2	11.5	1.1	11.3	39a3	flake		1	
39b3	flake	2	3	66.7	39b3	flake	1	36.0	17.2	6.2	0.2	1.6	39b3	flake	1		
39c3	flake	0	2	0.0	39c3	flake	1	27.4	18.0	4.9	0.2	2.0	39c3	flake	1		
40a2	flake	6	6	100.0	40a2	flake	12	27.5	16.4	4.5	2.7	26.6	40a2	flake		1	
40c1	flake	3	5	60.0	40c1	flake	9	41.7	20.7	8.6	1.0	10.4	40c1	flake		1	

40d1	flake	3	3	100.0	40d1	flake	18	25.2	24.0	6.0	3.0	29.8	40d1	flake		1	
41a2	flake	3	6	50.0	41a2	flake	3	35.2	28.0	9.9	0.3	3.0	41a2	flake		1	
41c2	flake	8	8	100.0	41c2	flake	0	34.7	21.4	7.4	0.0	0.0	41c2	flake	1		
42b2	flake	5	7	71.4	42b2	flake	11	41.3	34.6	14.3	0.8	7.7	42b2	flake		1	
42c2	flake	5	7	71.4	42c2	flake	1	39.3	18.1	7.1	0.1	1.4	42c2	flake	1		
43b2	flake	3	3	100.0	43b2	flake	11	45.3	25.5	11.6	1.0	9.5	43b2	flake		1	
43c2	flake	5	8	62.5	43c2	flake	5	32.3	22.1	7.1	0.7	7.0	43c2	flake		1	
44a1	flake	6	6	100.0	44a1	flake	4	40.9	27.2	11.1	0.4	3.6	44a1	flake		1	
44b2	flake	3	3	100.0	44b2	flake	4	27.7	26.0	7.2	0.6	5.6	44b2	flake		1	
44c1	flake	2	5	40.0	44c1	flake	1	27.7	21.3	5.9	0.2	1.7	44c1	flake			1
45a1	flake	2	5	40.0	45a1	flake	5	44.0	26.0	11.4	0.4	4.4	45a1	flake		1	
45c2	flake	3	5	60.0	45c2	flake	2	19.0	13.9	2.6	0.8	7.6	45c2	flake		1	
47b	flake	5	17	29.4	47b	flake	12	65.6	32.0	21.0	0.6	5.7	47b	flake		1	
47d	flake	1	4	25.0	47d	flake	7	21.9	18.3	4.0	1.7	17.5	47d	flake		1	
47f	flake	5	5	100.0	47f	flake	22	39.6	19.7	7.8	2.8	28.2	47f	flake		1	
47g	flake	2	4	50.0	47g	flake	1	44.8	31.6	14.2	0.1	0.7	47g	flake		1	
47h	flake	2	5	40.0	47h	flake	0	34.2	23.7	8.1	0.0	0.0	47h	flake		1	
50c	flake	4	8	50.0	50c	flake	6	22.4	20.3	4.5	1.3	13.2	50c	flake			1
50d	flake	2	2	100.0	50d	flake	3	32.0	30.1	9.6	0.3	3.1	50d	flake		1	
50e	flake	4	4	100.0	50e	flake	2	28.9	19.7	5.7	0.4	3.5	50e	flake		1	
50f	flake	1	5	20.0	50f	flake	1	17.4	12.5	2.2	0.5	4.6	50f	flake		1	
51b	flake	3	5	60.0	51b	flake	1	23.2	17.9	4.2	0.2	2.4	51b	flake		1	
51d	flake	3	4	75.0	51d	flake	1	27.9	14.6	4.1	0.2	2.5	51d	flake		1	
51e	flake	1	1	100.0	51e	flake	6	24.5	15.4	3.8	1.6	15.9	51e	flake		1	
51f	flake	1	2	50.0	51f	flake	1	20.7	15.3	3.2	0.3	3.2	51f	flake		1	
51g	flake	2	5	40.0	51g	flake	6	23.0	18.3	4.2	1.4	14.3	51g	flake		1	
51j	flake	0	2	0.0	51j	flake	3	23.0	17.9	4.1	0.7	7.3	51j	flake		1	
52a	flake	2	3	66.7	52a	flake	3	34.7	26.6	9.2	0.3	3.3	52a	flake	1		
52d	flake	5	8	62.5	52d	flake	4	35.1	33.6	11.8	0.3	3.4	52d	flake		1	

52e	flake	2	5	40.0	52e	flake	2	41.4	34.2	14.2	0.1	1.4	52e	flake		1	
52f	flake	2	3	66.7	52f	flake	6	31.8	25.1	8.0	0.8	7.5	52f	flake		1	
53d	flake	0	7	0.0	53d	flake	1	25.6	16.9	4.3	0.2	2.3	53d	flake	1		
54b1	flake	3	4	75.0	54b1	flake	4	32.2	23.3	7.5	0.5	5.3	54b1	flake		1	
54i	flake	4	4	100.0	54i	flake	1	31.7	24.2	7.7	0.1	1.3	54i	flake			1
55a,b1	flake	0	5	0.0	55a,b1	flake	6	30.2	24.7	7.5	0.8	8.0	55a,b1	flake		1	
56a1	flake	4	4	100.0	56a1	flake	7	32.1	27.0	8.7	0.8	8.1	56a1	flake		1	
57a1	flake	3	3	100.0	57a1	flake	8	25.0	22.2	5.6	1.4	14.4	57a1	flake		1	
57b1	flake	1	4	25.0	57b1	flake	4	24.2	14.1	3.4	1.2	11.7	57b1	flake		1	
5bdug4	flake	2	2	100.0	5bdug4	flake	3	25.2	11.1	2.8	1.1	10.7	5bdug4	flake			1
5bdug6	flake	3	3	100.0	5bdug6	flake	7	19.3	19.2	3.7	1.9	18.9	5bdug6	flake			1
5csurf4	flake	2	3	66.7	5csurf4	flake	3	65.3	28.0	18.3	0.2	1.6	5csurf4	flake			1
5kdug3	flake	2	2	100.0	5kdug3	flake	4	45.3	26.0	11.8	0.3	3.4	5kdug3	flake		1	
6h1	flake	1	8	12.5	6h1	flake	0	40.5	30.0	12.2	0.0	0.0	6h1	flake		1	
8p2	flake	2	3	66.7	8p2	flake	2	34.3	23.3	8.0	0.3	2.5	8p2	flake		1	
8q2	flake	2	2	100.0	8q2	flake	5	28.7	28.6	8.2	0.6	6.1	8q2	flake		1	
8s2	flake	5	11	45.5	8s2	flake	4	29.0	26.0	7.5	0.5	5.3	8s2	flake		1	
8w3	flake	3	5	60.0	8w3	flake	4	45.4	23.0	10.4	0.4	3.8	8w3	flake		1	
8w8	flake	1	8	12.5	8w8	flake	1	43.0	37.0	15.9	0.1	0.6	8w8	flake		1	
8x1	flake	4	4	100.0	8x1	flake	2	18.0	11.7	2.1	0.9	9.5	8x1	flake		1	
8x3	flake	4	4	100.0	8x3	flake	3	29.0	20.8	6.0	0.5	5.0	8x3	flake		1	
9a6	flake	4	4	100.0	9a6	flake	10	53.2	44.0	23.4	0.4	4.3	9a6	flake		1	
9b11	flake	4	5	80.0	9b11	flake	9	68.3	33.0	22.5	0.4	4.0	9b11	flake		1	
9c12	flake	1	1	100.0	9c12	flake	24	46.0	31.0	14.3	1.7	16.8	9c12	flake		1	
9c6	flake	5	5	100.0	9c6	flake	1	17.1	11.4	1.9	0.5	5.1	9c6	flake		1	
9f10	flake	3	3	100.0	9f10	flake	20	51.0	35.0	17.9	1.1	11.2	9f10	flake		1	
9h2	flake	0	3	0.0	9h2	flake	0	12.4	12.4	1.5	0.0	0.0	9h2	flake	1		
9i7	flake	0	4	0.0	9i7	flake	0	1.0	1.0	0.0	0.0	0.0	9i7	flake		1	
9L12	flake	5	5	100.0	9L12	flake	0	1.0	1.0	0.0	0.0	0.0	9L12	flake		1	

9L14	flake	6	8	75.0	9L14	flake	1	47.5	29.0	13.8	0.1	0.7	9L14	flake		1	
9L8	flake	5	6	83.3	9L8	flake	2	22.3	17.8	4.0	0.5	5.0	9L8	flake		1	
9n4	flake	1	4	25.0	9n4	flake	2	19.4	16.2	3.1	0.6	6.4	9n4	flake		1	
9n6	flake	1	6	16.7	9n6	flake	1	23.2	17.8	4.1	0.2	2.4	9n6	flake		1	
9o14	flake	1	3	33.3	9o14	flake	4	41.8	21.7	9.1	0.4	4.4	9o14	flake		1	
9q11	flake	5	7	71.4	9q11	flake	2	33.0	27.0	8.9	0.2	2.2	9q11	flake			1
a1	flake	1	1	100.0	**a1**	flake	2	40.0	30.0	12.0	0.2	1.7	**a1**	flake		1	
S18e1	flake	2	3	66.7	S18e1	flake	4	18.4	9.0	1.7	2.4	24.2	S18e1	flake			1
s1e1	flake	0	5	0.0	s1e1	flake	0	21.2	11.7	2.5	0.0	0.0	s1e1	flake		1	
S21e2	flake	2	3	66.7	S21e2	flake	2	46.7	28.0	13.1	0.2	1.5	S21e2	flake		1	
S23e1	flake	2	3	66.7	S23e1	flake	6	37.0	37.0	13.7	0.4	4.4	S23e1	flake		1	
S30e8	flake	10	14	71.4	S30e8	flake	1	45.6	42.2	19.2	0.1	0.5	S30e8	flake		1	
S5edug1	flake	1	1	100.0	S5edug1	flake	1	21.4	19.5	4.2	0.2	2.4	S5edug1	flake			1
s9e12	flake	6	6	100.0	s9e12	flake	19	48.2	45.0	21.7	0.9	8.8	s9e12	flake		1	
18b2	flake	0	4	0.0	18b2	flake	11	22.7	16.2	3.7	3.0	29.9	18b2	flake		1	
9r11	flake	1	12	8.3	9r11	flake	2	25.8	21.0	5.4	0.4	3.7	9r11	flake		1	
16g3	flake	4	12	33.3	16g3	flake	6	43	29.3	12.6	0.5	4.8	16g3	flake		1	
19d1	flake	0	5	0.0	19d1	flake	1	15.0	12.0	1.8	0.6	5.6	19d1	flake		1	
19d2	flake	3	3	100.0	19d2	flake	5	19.0	16.4	3.1	1.6	16.0	19d2	flake		1	
19d3	flake	2	6	33.3	19d3	flake	8	23.3	22.8	5.3	1.5	15.1	19d3	flake		1	
18c1	flake	2	6	33.3	18c1	flake	6	17.7	9.2	1.6	3.7	36.8	18c1	flake		1	
18c2	flake	1	7	14.3	18c2	flake	6	19.0	14.7	2.8	2.1	21.5	18c2	flake		1	
18c4	flake	1	3	33.3	18c4	flake	3	26.7	13.5	3.6	0.8	8.3	18c4	flake		1	
18c5	flake	2	2	100.0	18c5	flake	16	35.6	13.0	4.6	3.5	34.6	18c5	flake		1	
9k8	flake	0	4	0.0	9k8	flake	2	24.8	22.3	5.5	0.4	3.6	9k8	flake		1	
9m10	flake	4	9	44.4	9m10	flake	7	27.5	25.2	6.9	1.0	10.1	9m10	flake		1	
s16e1	flake	7	11	63.6	s16e1	flake	6	47.2	22	10.4	0.6	5.8	s16e1	flake		1	
9L1	flake	0	7	0.0	9L1	flake	2	23.4	7.5	1.8	1.1	11.4	9L1	flake	1		
9L2	flake	3	7	42.9	9L2	flake	0	1.0	1.0	0.0	0.0	0.0	9L2	flake	1		

18d1	flake	0	8	0.0	18d1	flake	3	27.4	11.5	3.2	1.0	9.5	18d1	flake			1
9n1	flake	0	2	0.0	9n1	flake	0	1.0	1.0	0.0	0.0	0.0	9n1	flake		1	
9n5	flake	4	4	100.0	9n5	flake	1	25.5	17.0	4.3	0.2	2.3	9n5	flake		1	
15b1	flake	3	7	42.9	15b1	flake	6	21.0	12.0	2.5	2.4	23.8	15b1	flake		1	
9i1	flake	0	2	0.0	9i1	flake	0	1.0	1.0	0.0	0.0	0.0	9i1	flake		1	
15a1	flake	5	5	100.0	15a1	flake	2	22.8	17.0	3.9	0.5	5.2	15a1	flake		1	
16f1	flake	0	3	0.0	16f1	flake	2	16.7	12.5	2.1	1.0	9.6	16f1	flake		1	
16f3	flake	1	4	25.0	16f3	flake	6	25.4	19.0	4.8	1.2	12.4	16f3	flake		1	
16a1	flake	0	4	0.0	16a1	flake	2	22.0	11.3	2.5	0.8	8.0	16a1	flake		1	
9c2	flake	0	1	0.0	9c2	flake	0	28.4	10.1	2.9	0.0	0.0	9c2	flake		1	
9c4	flake	2	2	100.0	9c4	flake	7	25.3	16.0	4.0	1.7	17.3	9c4	flake		1	
9q3	flake	1	5	20.0	9q3	flake	0	1.0	1.0	0.0	0.0	0.0	9q3	flake			1
9q5	flake	2	3	66.7	9q5	flake	2	22.3	15.3	3.4	0.6	5.9	9q5	flake			1
15g1	flake	3	3	100.0	15g1	flake	0	1.0	1.0	0.0	0.0	0.0	15g1	flake			1
S21e1	flake	1	2	50.0	S21e1	flake	1	26.5	17.8	4.7	0.2	2.1	S21e1	flake			1
S21e4	flake	3	4	75.0	S21e4	flake	4	55.5	39.4	21.9	0.2	1.8	S21e4	flake		1	
21a4	flake	1	1	100.0	21a4	flake	1	42.8	16.0	6.8	0.1	1.5	21a4	flake		1	
21a6	flake	1	2	50.0	21a6	flake	4	45.6	34.8	15.9	0.3	2.5	21a6	flake		1	
21k2	flake	1	3	33.3	21k2	flake	0	31.2	17.0	5.3	0.0	0.0	21k2	flake		1	
21k4	flake	4	6	66.7	21k4	flake	1	29.7	27.5	8.2	0.1	1.2	21k4	flake		1	
21k5	flake	4	8	50.0	21k5	flake	1	38.7	22.5	8.7	0.1	1.1	21k5	flake		1	
21k6	flake	3	3	100.0	21k6	flake	1	36.4	24.5	8.9	0.1	1.1	21k6	flake		1	
5bdug1	flake	3	4	75.0	5bdug1	flake	0	22.0	8.3	1.8	0.0	0.0	5bdug1	flake			1
5bdug2	flake	1	1	100.0	5bdug2	flake	6	17.3	13.7	2.4	2.5	25.3	5bdug2	flake			1
8q1	flake	5	6	83.3	8q1	flake	3	26.0	18.0	4.7	0.6	6.4	8q1	flake		1	
33b1	flake	5	6	83.3	33b1	flake	3	20.0	16.4	3.3	0.9	9.1	33b1	flake		1	
33b3	flake	4	4	100.0	33b3	flake	5	30.0	27.2	8.2	0.6	6.1	33b3	flake		1	
33b7	flake	3	4	75.0	33b7	flake	7	28.8	24.6	7.1	1.0	9.9	33b7	flake		1	
11a3	flake	3	3	100.0	11a3	flake	4	31.0	27.7	8.6	0.5	4.7	11a3	flake			1

11b1	flake	8	11	72.7	11b1	flake	3	41.8	36.6	15.3	0.2	2.0	11b1	flake			1
8r2	flake	3	5	60.0	8r2	flake	1	29.2	19.0	5.5	0.2	1.8	8r2	flake		1	
10h3	flake	3	8	37.5	10h3	flake	7	25.8	23.6	6.1	1.1	11.5	10h3	flake		1	
34a1	flake	2	2	100.0	34a1	flake	7	31.8	17.0	5.4	1.3	12.9	34a1	flake		1	
10s1	flake	2	2	100.0	10s1	flake	1	18.0	16.6	3.0	0.3	3.3	10s1	flake		1	
8p3	flake	1	2	50.0	8p3	flake	7	38.7	35.6	13.8	0.5	5.1	8p3	flake		1	
10m1	flake	1	5	20.0	10m1	flake	0	17.7	13.8	2.4	0.0	0.0	10m1	flake		1	
10m2	flake	1	5	20.0	10m2	flake	1	24.7	10.5	2.6	0.4	3.9	10m2	flake		1	
8x2	flake	4	4	100.0	8x2	flake	1	19.8	10.7	2.1	0.5	4.7	8x2	flake		1	
8x6	flake	5	5	100.0	8x6	flake	2	40.6	31.0	12.6	0.2	1.6	8x6	flake			1
14r2	flake	3	4	75.0	14r2	flake	4	29.0	21.8	6.3	0.6	6.3	14r2	flake			1
14k1	flake	5	5	100.0	14k1	flake	4	25.7	21.0	5.4	0.7	7.4	14k1	flake			1
14k2	flake	3	3	100.0	14k2	flake	4	26.0	19.8	5.1	0.8	7.8	14k2	flake			1
10h2	retouch	5	12	41.7	10h2	retouch	5	31.0	19.6	6.1	0.8	8.2	10h2	retouch		1	
10h5	retouch	5	14	35.7	10h5	retouch	12	34.3	26.3	9.0	1.3	13.3	10h5	retouch		1	
10L1	retouch	2	7	28.6	10L1	retouch	5	27.4	24.0	6.6	0.8	7.6	10L1	retouch		1	
10m3	retouch	4	6	66.7	10m3	retouch	0	29.5	15.0	4.4	0.0	0.0	10m3	retouch		1	
10m9	retouch	6	10	60.0	10m9	retouch	4	43.2	27.6	11.9	0.3	3.4	10m9	retouch		1	
10r5	retouch	3	16	18.8	10r5	retouch	5	23.3	19.4	4.5	1.1	11.1	10r5	retouch		1	
10s2	retouch	1	2	50.0	10s2	retouch	9	25.8	19.5	5.0	1.8	17.9	10s2	retouch		1	
10s3	retouch	1	8	12.5	10s3	retouch	6	23.0	22.4	5.2	1.2	11.6	10s3	retouch		1	
11a1	retouch	10	20	50.0	11a1	retouch	4	26.2	18.0	4.7	0.8	8.5	11a1	retouch		1	
11a12	retouch	9	12	75.0	11a12	retouch	10	32.5	23.8	7.7	1.3	12.9	11a12	retouch		1	
11b5	retouch	1	13	7.7	11b5	retouch	4	37.0	21.8	8.1	0.5	5.0	11b5	retouch			1
13a1	retouch	3	6	50.0	13a1	retouch	3	32.0	18.0	5.8	0.5	5.2	13a1	retouch			1
14b4	retouch	0	19	0.0	14b4	retouch	0	32.9	19.4	6.4	0.0	0.0	14b4	retouch		1	
14k3	retouch	3	10	30.0	14k3	retouch	8	35.3	23.6	8.3	1.0	9.6	14k3	retouch			1
15a2	retouch	0	16	0.0	15a2	retouch	3	28.8	25.0	7.2	0.4	4.2	15a2	retouch		1	
15a4	retouch	0	12	0.0	15a4	retouch	2	56.7	27.0	15.3	0.1	1.3	15a4	retouch		1	

15b3	retouch	11	15	73.3	15b3	retouch	6	29.0	20.5	5.9	1.0	10.1	15b3	retouch		1	
15b5	retouch	8	28	28.6	15b5	retouch	10	32.3	31.5	10.2	1.0	9.8	15b5	retouch		1	
15c1	retouch	12	23	52.2	15c1	retouch	14	46.0	35.7	16.4	0.9	8.5	15c1	retouch		1	
15g14	retouch	14	18	77.8	15g14	retouch	8	27.9	21.3	5.9	1.3	13.5	15g14	retouch			1
15i11	retouch	5	13	38.5	15i11	retouch	12	43.0	22.5	9.7	1.2	12.4	15i11	retouch		1	
15i12	retouch	5	8	62.5	15i12	retouch	21	42.7	30.5	13.0	1.6	16.1	15i12	retouch		1	
15k3	retouch	0	13	0.0	15k3	retouch	3	20.8	16.0	3.3	0.9	9.0	15k3	retouch		1	
15k4	retouch	2	12	16.7	15k4	retouch	0	25.5	16.3	4.2	0.0	0.0	15k4	retouch		1	
16a4	retouch	0	10	0.0	16a4	retouch	3	27.6	20.0	5.5	0.5	5.4	16a4	retouch		1	
16a6	retouch	4	6	66.7	16a6	retouch	5	45.5	17.0	7.7	0.6	6.5	16a6	retouch		1	
16c3	retouch	4	22	18.2	16c3	retouch	10	66.0	46.0	30.4	0.3	3.3	16c3	retouch	1		
16d3	retouch	24	30	80.0	16d3	retouch	6	55.0	18.0	9.9	0.6	6.1	16d3	retouch		1	
16f4	retouch	0	16	0.0	16f4	retouch	5	37.0	14.7	5.4	0.9	9.2	16f4	retouch		1	
16f8	retouch	2	16	12.5	16f8	retouch	8	46.3	32.0	14.8	0.5	5.4	16f8	retouch		1	
17a,b,c1	retouch	3	15	20.0	17a,b,c1	retouch	1	18.0	15.6	2.8	0.4	3.6	17a,b,c1	retouch			1
17a,b,c6	retouch	5	23	21.7	17a,b,c6	retouch	3	43.7	22.8	10.0	0.3	3.0	17a,b,c6	retouch		1	
18b3	retouch	0	18	0.0	18b3	retouch	14	28.0	19.2	5.4	2.6	26.0	18b3	retouch		1	
18b4	retouch	0	15	0.0	18b4	retouch	14	35.8	17.8	6.4	2.2	22.0	18b4	retouch		1	
18c13	retouch	7	16	43.8	18c13	retouch	12	30.0	14.3	4.3	2.8	28.0	18c13	retouch		1	
18c8	retouch	3	14	21.4	18c8	retouch	11	44.5	18.0	8.0	1.4	13.7	18c8	retouch		1	
18d2	retouch	0	13	0.0	18d2	retouch	10	33.6	24.0	8.1	1.2	12.4	18d2	retouch			1
19c2	retouch	6	21	28.6	19c2	retouch	6	44.4	33.0	14.7	0.4	4.1	19c2	retouch		1	
19d12	retouch	4	19	21.1	19d12	retouch	4	37.2	24.4	9.1	0.4	4.4	19d12	retouch		1	
19d6	retouch	3	14	21.4	19d6	retouch	15	43.0	25.0	10.8	1.4	14.0	19d6	retouch		1	
19f/g1	retouch	4	19	21.1	19f/g1	retouch	6	20	20	4.0	1.5	15.0	19f/g1	retouch	1		
1a1	retouch	8	28	28.6	1a1	retouch	5	33.1	26.6	8.8	0.6	5.7	1a1	retouch		1	
1f3	retouch	2	19	10.5	1f3	retouch	2	33.1	18.8	6.2	0.3	3.2	1f3	retouch	1		
1g1	retouch	5	12	41.7	1g1	retouch	13	48.0	28.1	13.5	1.0	9.6	1g1	retouch		1	
1g7	retouch	0	9	0.0	1g7	retouch	10	37.6	15.5	5.8	1.7	17.2	1g7	retouch		1	

1i/j3	retouch	8	21	38.1	1i/j3	retouch	3	37.9	16.6	6.3	0.5	4.8	1i/j3	retouch	1		
21a5	retouch	9	13	69.2	21a5	retouch	4	33.0	31.0	10.2	0.4	3.9	21a5	retouch		1	
21k8	retouch	5	11	45.5	21k8	retouch	2	29.0	22.0	6.4	0.3	3.1	21k8	retouch		1	
21r4	retouch	2	20	10.0	21r4	retouch	3	41.4	19.5	8.1	0.4	3.7	21r4	retouch			1
23b	retouch	4	16	25.0	23b	retouch	1	40.5	20.3	8.2	0.1	1.2	23b	retouch		1	
23j	retouch	4	10	40.0	23j	retouch	3	37.3	24.3	9.1	0.3	3.3	23j	retouch	1		
23k2	retouch	5	15	33.3	23k2	retouch	1	35.2	21.4	7.5	0.1	1.3	23k2	retouch	1		
28a	retouch	12	17	70.6	28a	retouch	3	54.6	44.5	24.3	0.1	1.2	28a	retouch		1	
28b	retouch	3	13	23.1	28b	retouch	4	28.2	20.3	5.7	0.7	7.0	28b	retouch		1	
29b	retouch	9	12	75.0	29b	retouch	1	32.4	26.6	8.6	0.1	1.2	29b	retouch			1
29c	retouch	3	21	14.3	29c	retouch	0	31.1	28.6	8.9	0.0	0.0	29c	retouch		1	
29d2	retouch	5	15	33.3	29d2	retouch	5	32.0	25.2	8.1	0.6	6.2	29d2	retouch		1	
29e	retouch	10	25	40.0	29e	retouch	1	67.7	32.8	22.2	0.0	0.5	29e	retouch		1	
30a	retouch	4	19	21.1	30a	retouch	5	51.7	32.3	16.7	0.3	3.0	30a	retouch	1		
30b	retouch	10	36	27.8	30b	retouch	5	52.5	47.4	24.9	0.2	2.0	30b	retouch		1	
30c	retouch	1	15	6.7	30c	retouch	1	28.4	27.0	7.7	0.1	1.3	30c	retouch		1	
30d	retouch	8	35	22.9	30d	retouch	2	46.8	33.3	15.6	0.1	1.3	30d	retouch	1		
30f	retouch	5	15	33.3	30f	retouch	12	24.8	21.4	5.3	2.3	22.6	30f	retouch		1	
30h1	retouch	0	22	0.0	30h1	retouch	0	40.0	22.6	9.0	0.0	0.0	30h1	retouch		1	
30i3	retouch	3	8	37.5	30i3	retouch	0	29.0	15.6	4.5	0.0	0.0	30i3	retouch		1	
32a3	retouch	5	13	38.5	32a3	retouch	3	30.4	22.7	6.9	0.4	4.3	32a3	retouch			1
33b12	retouch	5	9	55.6	33b12	retouch	7	20.6	17.4	3.6	2.0	19.5	33b12	retouch		1	
33b6	retouch	11	23	47.8	33b6	retouch	4	46.3	25.4	11.8	0.3	3.4	33b6	retouch		1	
38a1	retouch	7	19	36.8	38a1	retouch	51	42.3	35.1	14.8	3.4	34.3	38a1	retouch		1	
38b3	retouch	6	17	35.3	38b3	retouch	13	43.2	28.0	12.1	1.1	10.7	38b3	retouch			1
38c4	retouch	6	24	25.0	38c4	retouch	3	28.2	26.3	7.4	0.4	4.0	38c4	retouch	1		
39a5	retouch	7	19	36.8	39a5	retouch	21	42.0	30.0	12.6	1.7	16.7	39a5	retouch	1		
39b5	retouch	7	25	28.0	39b5	retouch	3	37.0	19.0	7.0	0.4	4.3	39b5	retouch		1	
39c5	retouch	5	16	31.3	39c5	retouch	3	33.4	19.3	6.4	0.5	4.7	39c5	retouch	1		

40c5	retouch	4	14	28.6	40c5	retouch	7	23.1	18.0	4.2	1.7	16.8	40c5	retouch		1	
40d5	retouch	3	20	15.0	40d5	retouch	6	33.2	18.6	6.2	1.0	9.7	40d5	retouch		1	
41a6	retouch	6	19	31.6	41a6	retouch	13	35.0	21.6	7.6	1.7	17.2	41a6	retouch		1	
41a7	retouch	13	23	56.5	41a7	retouch	1	39.8	18.7	7.4	0.1	1.3	41a7	retouch		1	
41b2	retouch	10	25	40.0	41b2	retouch	1	36.2	23.2	8.4	0.1	1.2	41b2	retouch		1	
42b6	retouch	7	12	58.3	42b6	retouch	9	28.8	27.5	7.9	1.1	11.4	42b6	retouch		1	
42c6	retouch	3	20	15.0	42c6	retouch	6	33.4	26.0	8.7	0.7	6.9	42c6	retouch	1		
43b5	retouch	5	14	35.7	43b5	retouch	11	24.9	21.5	5.4	2.1	20.5	43b5	retouch		1	
43c5	retouch	5	18	27.8	43c5	retouch	7	40.5	27.1	11.0	0.6	6.4	43c5	retouch		1	
44a4	retouch	6	16	37.5	44a4	retouch	7	39.6	36.0	14.3	0.5	4.9	44a4	retouch		1	
44b6	retouch	3	24	12.5	44b6	retouch	7	31.4	23.8	7.5	0.9	9.4	44b6	retouch		1	
44c5	retouch	10	17	58.8	44c5	retouch	4	42.0	25.0	10.5	0.4	3.8	44c5	retouch		1	
45a5	retouch	4	19	21.1	45a5	retouch	10	39.1	24.9	9.7	1.0	10.3	45a5	retouch		1	
45b3	retouch	2	16	12.5	45b3	retouch	1	19.8	15.1	3.0	0.3	3.3	45b3	retouch		1	
47b	retouch	5	28	17.9	47b	retouch	11	57.2	33.7	19.3	0.6	5.7	47b	retouch		1	
47d	retouch	6	16	37.5	47d	retouch	5	32.6	19.7	6.4	0.8	7.8	47d	retouch		1	
47e	retouch	0	17	0.0	47e	retouch	1	29.5	19.6	5.8	0.2	1.7	47e	retouch	1		
47f	retouch	1	14	7.1	47f	retouch	2	28.6	18.2	5.2	0.4	3.8	47f	retouch		1	
47g	retouch	0	19	0.0	47g	retouch	1	25.1	19.0	4.8	0.2	2.1	47g	retouch	1		
47h	retouch	3	15	20.0	47h	retouch	1	24.5	14.6	3.6	0.3	2.8	47h	retouch		1	
50c	retouch	6	15	40.0	50c	retouch	1	36.8	27.1	10.0	0.1	1.0	50c	retouch			1
50d	retouch	2	9	22.2	50d	retouch	1	27.0	20.5	5.5	0.2	1.8	50d	retouch		1	
50e	retouch	4	9	44.4	50e	retouch	3	28.8	6.5	1.9	1.6	16.0	50e	retouch		1	
50f	retouch	8	15	53.3	50f	retouch	2	30.0	24.2	7.3	0.3	2.8	50f	retouch		1	
51b	retouch	2	8	25.0	51b	retouch	3	27.7	15.3	4.2	0.7	7.1	51b	retouch		1	
51d	retouch	2	10	20.0	51d	retouch	4	35.8	18.2	6.5	0.6	6.1	51d	retouch		1	
51e	retouch	4	12	33.3	51e	retouch	4	17.7	13.4	2.4	1.7	16.9	51e	retouch		1	
51f	retouch	3	9	33.3	51f	retouch	1	22.7	11.0	2.5	0.4	4.0	51f	retouch		1	
51i	retouch	14	14	100.0	51i	retouch	1	31.6	26.0	8.2	0.1	1.2	51i	retouch		1	

51j	retouch	2	12	16.7	51j	retouch	0	21.9	21.3	4.7	0.0	0.0	51j	retouch		1	
52d	retouch	8	28	28.6	52d	retouch	10	58.0	43.2	25.1	0.4	4.0	52d	retouch		1	
52e	retouch	4	15	26.7	52e	retouch	1	45.8	25.8	11.8	0.1	0.8	52e	retouch		1	
52f	retouch	2	17	11.8	52f	retouch	5	47.8	24.8	11.9	0.4	4.2	52f	retouch		1	
53c	retouch	2	10	20.0	53c	retouch	4	29.0	17.5	5.1	0.8	7.9	53c	retouch		1	
53d	retouch	5	16	31.3	53d	retouch	3	33.8	28.3	9.6	0.3	3.1	53d	retouch	1		
54b4	retouch	6	18	33.3	54b4	retouch	10	51.0	21.9	11.2	0.9	9.0	54b4	retouch		1	
55a,b4	retouch	8	23	34.8	55a,b4	retouch	9	46.5	27.8	12.9	0.7	7.0	55a,b4	retouch		1	
56a4	retouch	7	26	26.9	56a4	retouch	5	33.0	25.8	8.5	0.6	5.9	56a4	retouch		1	
57a4	retouch	3	12	25.0	57a4	retouch	4	18.7	11.0	2.1	1.9	19.4	57a4	retouch		1	
57b4	retouch	4	17	23.5	57b4	retouch	2	21.8	12.8	2.8	0.7	7.2	57b4	retouch		1	
5bdug11	retouch	4	7	57.1	5bdug11	retouch	6	18.1	16.1	2.9	2.1	20.6	5bdug11	retouch			1
5bdug8	retouch	5	14	35.7	5bdug8	retouch	8	29.7	20.0	5.9	1.3	13.5	5bdug8	retouch			1
5csurf1	retouch	4	11	36.4	5csurf1	retouch	0	30.8	17.7	5.5	0.0	0.0	5csurf1	retouch			1
5kdug1	retouch	2	13	15.4	5kdug1	retouch	10	40.0	25.8	10.3	1.0	9.7	5kdug1	retouch		1	
5kdug6	retouch	4	19	21.1	5kdug6	retouch	2	19.0	18.1	3.4	0.6	5.8	5kdug6	retouch		1	
6g3	retouch	0	14	0.0	6g3	retouch	4	26.3	25.8	6.8	0.6	5.9	6g3	retouch		1	
6h2	retouch	3	25	12.0	6h2	retouch	2	48.4	38.0	18.4	0.1	1.1	6h2	retouch		1	
6h6	retouch	4	16	25.0	6h6	retouch	3	27.9	23.2	6.5	0.5	4.6	6h6	retouch		1	
8r1	retouch	2	10	20.0	8r1	retouch	1	23.0	17.8	4.1	0.2	2.4	8r1	retouch		1	
8t1	retouch	3	10	30.0	8t1	retouch	3	33.0	22.8	7.5	0.4	4.0	8t1	retouch		1	
8w1	retouch	0	15	0.0	8w1	retouch	0	28.2	26.8	7.6	0.0	0.0	8w1	retouch	1		
8w5	retouch	2	27	7.4	8w5	retouch	4	40.5	39.3	15.9	0.3	2.5	8w5	retouch		1	
8x11	retouch	4	12	33.3	8x11	retouch	4	24.0	20.1	4.8	0.8	8.3	8x11	retouch			1
8x4	retouch	6	17	35.3	8x4	retouch	3	34.1	28.5	9.7	0.3	3.1	8x4	retouch		1	
9b13	retouch	5	11	45.5	9b13	retouch	4	39.7	39.7	15.8	0.3	2.5	9b13	retouch		1	
9c17	retouch	6	23	26.1	9c17	retouch	10	43.4	40.3	17.5	0.6	5.7	9c17	retouch		1	
9c7	retouch	7	9	77.8	9c7	retouch	7	28.2	20.5	5.8	1.2	12.1	9c7	retouch		1	
9d18	retouch	6	18	33.3	9d18	retouch	8	33.0	28.8	9.5	0.8	8.4	9d18	retouch		1	

9g11	retouch	7	27	25.9	9g11	retouch	22	76.7	28.0	21.5	1.0	10.2	9g11	retouch		1	
9g8	retouch	4	11	36.4	9g8	retouch	14	48.0	31.7	15.2	0.9	9.2	9g8	retouch		1	
9h10	retouch	2	18	11.1	9h10	retouch	0	38.0	32.6	12.4	0.0	0.0	9h10	retouch	1		
9i12	retouch	5	23	21.7	9i12	retouch	0	1.0	1.0	0.0	0.0	0.0	9i12	retouch		1	
9L10	retouch	2	10	20.0	9L10	retouch	0	1.0	1.0	0.0	0.0	0.0	9L10	retouch	1		
9L18	retouch	3	13	23.1	9L18	retouch	3	31.5	15.8	5.0	0.6	6.0	9L18	retouch		1	
9n7	retouch	8	15	53.3	9n7	retouch	1	26.0	26.0	6.8	0.1	1.5	9n7	retouch		1	
9n9	retouch	3	11	27.3	9n9	retouch	0	1.0	1.0	0.0	0.0	0.0	9n9	retouch		1	
9o17	retouch	10	37	27.0	9o17	retouch	3	48.6	44.0	21.4	0.1	1.4	9o17	retouch		1	
9p3	retouch	2	12	16.7	9p3	retouch	4	18.2	17.5	3.2	1.3	12.6	9p3	retouch		1	
a5	retouch	5	13	38.5	**a5**	retouch	3	31.2	28.5	8.9	0.3	3.4	**a5**	retouch		1	
S18e6	retouch	4	12	33.3	S18e6	retouch	16	41.3	26.0	10.7	1.5	14.9	S18e6	retouch			1
S19e1	retouch	0	24	0.0	S19e1	retouch	0	1	1	0.0	0.0	0.0	S19e1	retouch	1		
S30e6	retouch	4	15	26.7	S30e6	retouch	1	42.0	33.5	14.1	0.1	0.7	S30e6	retouch		1	
10s6	retouch	4	9	44.4	10s6	retouch	12	37.2	28.0	10.4	1.2	11.5	10s6	retouch		1	
10h7	scraper	11	15	73.3	10h7	scraper	22	46.8	29.0	13.6	1.6	16.2	10h7	scraper		1	
10h8	scraper	9	18	50.0	10h8	scraper	13	40.0	41.7	16.7	0.8	7.8	10h8	scraper		1	
10m4	scraper	3	9	33.3	10m4	scraper	2	27.0	18.5	5.0	0.4	4.0	10m4	scraper		1	
10m7	scraper	6	9	66.7	10m7	scraper	1	38.0	22.5	8.6	0.1	1.2	10m7	scraper		1	
10s5	scraper	12	18	66.7	10s5	scraper	15	27.0	25.6	6.9	2.2	21.7	10s5	scraper		1	
10s7	scraper	5	22	22.7	10s7	scraper	12	36.5	26.7	9.7	1.2	12.3	10s7	scraper		1	
10v1	scraper	6	25	24.0	10v1	scraper	2	43.6	27.5	12.0	0.2	1.7	10v1	scraper		1	
11a5	scraper	15	21	71.4	11a5	scraper	16	46.8	45.0	21.1	0.8	7.6	11a5	scraper		1	
11a7	scraper	14	19	73.7	11a7	scraper	7	41.4	12.0	5.0	1.4	14.1	11a7	scraper		1	
13a2	scraper	3	7	42.9	13a2	scraper	2	31.0	27.5	8.5	0.2	2.3	13a2	scraper			1
13a4	scraper	6	7	85.7	13a4	scraper	0	26.6	26.4	7.0	0.0	0.0	13a4	scraper			1
14b1	scraper	5	15	33.3	14b1	scraper	1	44.7	42.2	18.9	0.1	0.5	14b1	scraper		1	
14k4	scraper	5	11	45.5	14k4	scraper	2	38.7	34.4	13.3	0.2	1.5	14k4	scraper			1
14m3	scraper	3	23	13.0	14m3	scraper	3	44.4	36.7	16.3	0.2	1.8	14m3	scraper		1	

15a12	scraper	10	24	41.7	15a12	scraper	4	37.3	24.4	9.1	0.4	4.4	15a12	scraper		1	
15a6	scraper	10	16	62.5	15a6	scraper	3	54.5	44.0	24.0	0.1	1.3	15a6	scraper		1	
15b4	scraper	6	10	60.0	15b4	scraper	11	31.3	29.0	9.1	1.2	12.1	15b4	scraper		1	
15b7	scraper	12	17	70.6	15b7	scraper	13	48.2	34.8	16.8	0.8	7.8	15b7	scraper		1	
15d2	scraper	4	21	19.0	15d2	scraper	1	46.2	31.7	14.6	0.1	0.7	15d2	scraper	1		
15g13	scraper	15	15	100.0	15g13	scraper	10	30.2	19.9	6.0	1.7	16.6	15g13	scraper			1
15g3	scraper	20	20	100.0	15g3	scraper	2	38.8	15.2	5.9	0.3	3.4	15g3	scraper			1
15i10	scraper	3	18	16.7	15i10	scraper	5	34.6	23.0	8.0	0.6	6.3	15i10	scraper		1	
15i5	scraper	2	9	22.2	15i5	scraper	2	22.6	21.0	4.7	0.4	4.2	15i5	scraper		1	
15k12	scraper	5	21	23.8	15k12	scraper	7	26.6	25.0	6.7	1.1	10.5	15k12	scraper		1	
15k13	scraper	3	22	13.6	15k13	scraper	2	25.2	24.6	6.2	0.3	3.2	15k13	scraper		1	
16a11	scraper	3	21	14.3	16a11	scraper	9	41.4	32.4	13.4	0.7	6.7	16a11	scraper	1		
16a7	scraper	1	22	4.5	16a7	scraper	1	35.7	30.5	10.9	0.1	0.9	16a7	scraper	1		
16c11	scraper	1	29	3.4	16c11	scraper	0	30	25.6	7.7	0.0	0.0	16c11	scraper	1		
16d2	scraper	16	20	80.0	16d2	scraper	4	55	19.2	10.6	0.4	3.8	16d2	scraper		1	
16f7	scraper	2	13	15.4	16f7	scraper	2	34.5	27.5	9.5	0.2	2.1	16f7	scraper		1	
16f9	scraper	5	16	31.3	16f9	scraper	10	52.0	42.7	22.2	0.5	4.5	16f9	scraper		1	
16g2	scraper	6	19	31.6	16g2	scraper	4	37.7	33.4	12.6	0.3	3.2	16g2	scraper		1	
16h2	scraper	13	13	100.0	16h2	scraper	8	27.5	19	5.2	1.5	15.3	16h2	scraper	1		
16h3	scraper	11	26	42.3	16h3	scraper	4	41.0	15.3	6.3	0.6	6.4	16h3	scraper	1		
17a,b,c8	scraper	3	16	18.8	17a,b,c8	scraper	3	46.8	43.9	20.5	0.1	1.5	17a,b,c8	scraper		1	
17a,b,c9	scraper	15	15	100.0	17a,b,c9	scraper	2	48.0	28.2	13.5	0.1	1.5	17a,b,c9	scraper		1	
18a1	scraper	8	14	57.1	18a1	scraper	28	46.0	28.0	12.9	2.2	21.7	18a1	scraper		1	
18b14	scraper	6	18	33.3	18b14	scraper	15	35.1	29.2	10.2	1.5	14.6	18b14	scraper		1	
18b5	scraper	8	17	47.1	18b5	scraper	13	35.6	24.2	8.6	1.5	15.1	18b5	scraper		1	
18c10	scraper	19	25	76.0	18c10	scraper	15	40.0	34.8	13.9	1.1	10.8	18c10	scraper		1	
18c6	scraper	8	16	50.0	18c6	scraper	18	43.8	35.0	15.3	1.2	11.7	18c6	scraper		1	
18d3	scraper	0	6	0.0	18d3	scraper	9	36.2	28.4	10.3	0.9	8.8	18d3	scraper			1
19a1	scraper	0	13	0.0	19a1	scraper	0	35.0	18.6	6.5	0.0	0.0	19a1	scraper		1	

19b1	scraper	11	27	40.7	19b1	scraper	10	43	39	16.8	0.6	6.0	19b1	scraper		1	
19d4	scraper	5	8	62.5	19d4	scraper	5	33.0	23.2	7.7	0.7	6.5	19d4	scraper		1	
19d5	scraper	2	15	13.3	19d5	scraper	12	32.0	32.0	10.2	1.2	11.7	19d5	scraper		1	
1a3	scraper	5	20	25.0	1a3	scraper	8	43.7	25.4	11.1	0.7	7.2	1a3	scraper		1	
1b1	scraper	6	18	33.3	1b1	scraper	5	42.8	29.3	12.5	0.4	4.0	1b1	scraper		1	
1c1	scraper	1	14	7.1	1c1	scraper	1	18.2	21.2	3.9	0.3	2.6	1c1	scraper	1		
1g2	scraper	1	36	2.8	1g2	scraper	3	56.3	34.1	19.2	0.2	1.6	1g2	scraper		1	
1i/j5	scraper	8	24	33.3	1i/j5	scraper	3	41.4	35.3	14.6	0.2	2.1	1i/j5	scraper	1		
20af2	scraper	9	12	75.0	20af2	scraper	4	28.2	23.0	6.5	0.6	6.2	20af2	scraper		1	
21a9	scraper	8	14	57.1	21a9	scraper	15	69.2	53.0	36.7	0.4	4.1	21a9	scraper		1	
21k9	scraper	3	11	27.3	21k9	scraper	1	43.0	29.0	12.5	0.1	0.8	21k9	scraper		1	
22a	scraper	5	16	31.3	22a	scraper	2	34.8	33.4	11.6	0.2	1.7	22a	scraper		1	
23b	scraper	6	11	54.5	23b	scraper	4	35.4	27.7	9.8	0.4	4.1	23b	scraper		1	
23b	scraper	14	19	73.7	23b	scraper	10	43.8	28.0	12.3	0.8	8.2	23b	scraper		1	
23j	scraper	7	15	46.7	23j	scraper	1	28.9	25.7	7.4	0.1	1.3	23j	scraper	1		
23k	scraper	1	12	8.3	23k	scraper	0	33.6	26.5	8.9	0.0	0.0	23k	scraper	1		
28a	scraper	8	15	53.3	28a	scraper	2	33.3	30.3	10.1	0.2	2.0	28a	scraper		1	
28b	scraper	4	11	36.4	28b	scraper	4	39.7	32.0	12.7	0.3	3.1	28b	scraper		1	
28g	scraper	0	19	0.0	28g	scraper	1	48.2	23.3	11.2	0.1	0.9	28g	scraper		1	
29a	scraper	15	15	100.0	29a	scraper	6	35.8	34.5	12.4	0.5	4.9	29a	scraper			1
29c	scraper	1	11	9.1	29c	scraper	1	27.6	21.7	6.0	0.2	1.7	29c	scraper			1
30a	scraper	2	20	10.0	30a	scraper	0	46.0	29.8	13.7	0.0	0.0	30a	scraper		1	
30b	scraper	3	17	17.6	30b	scraper	1	31.4	23.5	7.4	0.1	1.4	30b	scraper			1
30c	scraper	9	17	52.9	30c	scraper	5	38.6	36.7	14.2	0.4	3.5	30c	scraper		1	
30f	scraper	3	11	27.3	30f	scraper	5	25.7	23.3	6.0	0.8	8.3	30f	scraper		1	
30g	scraper	4	15	26.7	30g	scraper	2	24.8	25.9	6.4	0.3	3.1	30g	scraper		1	
30i2	scraper	6	15	40.0	30i2	scraper	2	22.4	16.0	3.6	0.6	5.6	30i2	scraper		1	
30k3	scraper	11	24	45.8	30k3	scraper	1	46.2	43.0	19.9	0.1	0.5	30k3	scraper		1	
32a4	scraper	16	20	80.0	32a4	scraper	10	40.0	16.0	6.4	1.6	15.6	32a4	scraper			1

33b11	scraper	5	19	26.3	33b11	scraper	6	32.9	24.4	8.0	0.7	7.5	33b11	scraper		1	
33b8	scraper	8	19	42.1	33b8	scraper	12	51.0	33.6	17.1	0.7	7.0	33b8	scraper		1	
34b2	scraper	5	17	29.4	34b2	scraper	2	27.6	22.0	6.1	0.3	3.3	34b2	scraper		1	
38b2	scraper	16	34	47.1	38b2	scraper	22	44.2	32.0	14.1	1.6	15.6	38b2	scraper		1	
38c5	scraper	6	21	28.6	38c5	scraper	3	28.7	25.8	7.4	0.4	4.1	38c5	scraper	1		
38d2	scraper	2	15	13.3	38d2	scraper	4	40.5	21.7	8.8	0.5	4.6	38d2	scraper			1
39a4	scraper	14	20	70.0	39a4	scraper	23	50.0	36.0	18.0	1.3	12.8	39a4	scraper	1		
39b4	scraper	2	18	11.1	39b4	scraper	5	43.0	18.0	7.7	0.6	6.5	39b4	scraper		1	
39c4	scraper	1	8	12.5	39c4	scraper	0	38.0	22.4	8.5	0.0	0.0	39c4	scraper	1		
40a6	scraper	9	20	45.0	40a6	scraper	13	30.0	22.8	6.8	1.9	19.0	40a6	scraper	1		
40c6	scraper	3	13	23.1	40c6	scraper	13	28.7	16.0	4.6	2.8	28.3	40c6	scraper		1	
40d6	scraper	14	18	77.8	40d6	scraper	8	40.3	7.2	2.9	2.8	27.6	40d6	scraper		1	
41a8	scraper	7	16	43.8	41a8	scraper	1	46.5	19.6	9.1	0.1	1.1	41a8	scraper		1	
42b5	scraper	5	18	27.8	42b5	scraper	13	52.6	28.6	15.0	0.9	8.6	42b5	scraper		1	
42c5	scraper	3	21	14.3	42c5	scraper	4	40.2	20.5	8.2	0.5	4.9	42c5	scraper	1		
43b4	scraper	5	14	35.7	43b4	scraper	4	32.3	21.9	7.1	0.6	5.7	43b4	scraper		1	
43c4	scraper	7	18	38.9	43c4	scraper	5	35.5	27.9	9.9	0.5	5.0	43c4	scraper		1	
44a3	scraper	15	20	75.0	44a3	scraper	8	32.6	28.9	9.4	0.8	8.5	44a3	scraper		1	
44b5	scraper	7	12	58.3	44b5	scraper	1	28.2	18.8	5.3	0.2	1.9	44b5	scraper		1	
44c4	scraper	5	19	26.3	44c4	scraper	2	43.6	21.5	9.4	0.2	2.1	44c4	scraper		1	
45a4	scraper	3	18	16.7	45a4	scraper	7	47.7	26.8	12.8	0.5	5.5	45a4	scraper		1	
45b2	scraper	12	16	75.0	45b2	scraper	9	22.5	21.8	4.9	1.8	18.3	45b2	scraper		1	
47a	scraper	2	20	10.0	47a	scraper	4	42.5	26.7	11.3	0.4	3.5	47a	scraper	1		
47b	scraper	3	17	17.6	47b	scraper	11	49.2	44.1	21.7	0.5	5.1	47b	scraper		1	
47d	scraper	6	15	40.0	47d	scraper	3	39.2	22.6	8.9	0.3	3.4	47d	scraper		1	
47f	scraper	4	12	33.3	47f	scraper	10	24.7	20.8	5.1	1.9	19.5	47f	scraper		1	
47g	scraper	4	8	50.0	47g	scraper	1	37.7	25.2	9.5	0.1	1.1	47g	scraper		1	
47h	scraper	4	11	36.4	47h	scraper	2	38.9	27.9	10.9	0.2	1.8	47h	scraper	1		
47i	scraper	3	18	16.7	47i	scraper	3	36.4	24.7	9.0	0.3	3.3	47i	scraper	1		

50e	scraper	10	14	71.4	50e	scraper	4	41.6	21.5	8.9	0.4	4.5	50e	scraper		1	
50f	scraper	4	16	25.0	50f	scraper	1	30.2	21.9	6.6	0.2	1.5	50f	scraper		1	
50h	scraper	11	13	84.6	50h	scraper	2	39.7	30.5	12.1	0.2	1.7	50h	scraper		1	
51a	scraper	7	13	53.8	51a	scraper	1	58.0	35.9	20.8	0.0	0.5	51a	scraper			1
51b	scraper	1	12	8.3	51b	scraper	1	23.7	22.7	5.4	0.2	1.9	51b	scraper		1	
51d	scraper	2	25	8.0	51d	scraper	2	37.3	26.5	9.9	0.2	2.0	51d	scraper		1	
51e	scraper	15	17	88.2	51e	scraper	11	38.6	29.2	11.3	1.0	9.8	51e	scraper		1	
51f	scraper	4	22	18.2	51f	scraper	19	36.0	23.7	8.5	2.2	22.3	51f	scraper		1	
51j	scraper	1	18	5.6	51j	scraper	1	27.6	21.5	5.9	0.2	1.7	51j	scraper		1	
52b	scraper	8	14	57.1	52b	scraper	4	37.3	36.0	13.4	0.3	3.0	52b	scraper		1	
52c	scraper	4	21	19.0	52c	scraper	3	38.2	23.9	9.1	0.3	3.3	52c	scraper		1	
52g	scraper	2	24	8.3	52g	scraper	2	40.0	35.4	14.2	0.1	1.4	52g	scraper		1	
53c	scraper	8	22	36.4	53c	scraper	5	43.6	35.8	15.6	0.3	3.2	53c	scraper		1	
53d	scraper	4	24	16.7	53d	scraper	2	39.0	25.2	9.8	0.2	2.0	53d	scraper	1		
54b5	scraper	10	23	43.5	54b5	scraper	14	37.8	26.9	10.2	1.4	13.8	54b5	scraper		1	
55a,b5	scraper	9	39	23.1	55a,b5	scraper	12	55.0	42.4	23.3	0.5	5.1	55a,b5	scraper		1	
56a5	scraper	10	18	55.6	56a5	scraper	7	30.8	24.2	7.5	0.9	9.4	56a5	scraper			1
57a5	scraper	9	13	69.2	57a5	scraper	12	35.8	19.5	7.0	1.7	17.2	57a5	scraper		1	
57b5	scraper	7	32	21.9	57b5	scraper	10	33.0	29.8	9.8	1.0	10.2	57b5	scraper		1	
5bdug7	scraper	8	9	88.9	5bdug7	scraper	11	27.0	21.3	5.8	1.9	19.1	5bdug7	scraper			1
5bdug9	scraper	16	25	64.0	5bdug9	scraper	8	25.0	25.0	6.3	1.3	12.8	5bdug9	scraper			1
5kdug2	scraper	2	18	11.1	5kdug2	scraper	2	29.0	23.0	6.7	0.3	3.0	5kdug2	scraper		1	
6g2	scraper	4	19	21.1	6g2	scraper	0	39.6	37.6	14.9	0.0	0.0	6g2	scraper		1	
6h3	scraper	0	16	0.0	6h3	scraper	2	53.6	37.3	20.0	0.1	1.0	6h3	scraper		1	
8p1	scraper	2	10	20.0	8p1	scraper	4	28.5	23.7	6.8	0.6	5.9	8p1	scraper		1	
8r3	scraper	5	17	29.4	8r3	scraper	2	41.4	21.8	9.0	0.2	2.2	8r3	scraper		1	
8s1	scraper	0	18	0.0	8s1	scraper	0	32.3	31.8	10.3	0.0	0.0	8s1	scraper		1	
8t2	scraper	3	23	13.0	8t2	scraper	8	45.0	36.0	16.2	0.5	4.9	8t2	scraper		1	
8w2	scraper	1	21	4.8	8w2	scraper	3	36.4	31.0	11.3	0.3	2.7	8w2	scraper		1	

8w4	scraper	5	23	21.7	8w4	scraper	3	42.2	31.0	13.1	0.2	2.3	8w4	scraper		1	
8x12	scraper	10	14	71.4	8x12	scraper	18	41.3	23.0	9.5	1.9	18.9	8x12	scraper		1	
8x9	scraper	8	10	80.0	8x9	scraper	3	51.0	37.3	19.0	0.2	1.6	8x9	scraper		1	
9a5	scraper	12	17	70.6	9a5	scraper	14	37.0	27.3	10.1	1.4	13.9	9a5	scraper		1	
9c14	scraper	5	10	50.0	9c14	scraper	2	18.4	12.4	2.3	0.9	8.8	9c14	scraper		1	
9g14	scraper	4	12	33.3	9g14	scraper	13	18.9	15.5	2.9	4.4	44.4	9g14	scraper		1	
9h15	scraper	0	7	0.0	9h15	scraper	0	20.0	20.0	4.0	0.0	0.0	9h15	scraper	1		
9i14	scraper	2	14	14.3	9i14	scraper	4	27.0	26.7	7.2	0.6	5.5	9i14	scraper		1	
9L17	scraper	5	14	35.7	9L17	scraper	0	21.3	17.0	3.6	0.0	0.0	9L17	scraper	1		
9L6	scraper	2	13	15.4	9L6	scraper	0	16.0	14.7	2.4	0.0	0.0	9L6	scraper	1		
9n14	scraper	3	13	23.1	9n14	scraper	1	28.6	28.0	8.0	0.1	1.2	9n14	scraper		1	
9n17	scraper	7	8	87.5	9n17	scraper	6	22.3	19.6	4.3708	1.3727	13.7	9n17	scraper		1	
9o15	scraper	5	16	31.3	9o15	scraper	2	35.7	25.4	9.1	0.2	2.2	9o15	scraper		1	
S18e2	scraper	3	14	21.4	S18e2	scraper	10	21.7	19.2	4.2	2.4	24.0	S18e2	scraper			1
S21e3	scraper	5	14	35.7	S21e3	scraper	2	53.2	38.8	20.6	0.1	1.0	S21e3	scraper			1
S23e1	scraper	7	12	58.3	S23e1	scraper	7	36.3	34.5	12.5	0.6	5.6	S23e1	scraper		1	
S30e4	scraper	6	14	42.9	S30e4	scraper	0	36.0	30.0	10.8	0.0	0.0	S30e4	scraper		1	
s41e2	scraper	2	17	11.8	s41e2	scraper	0	34.0	23.9	8.1	0.0	0.0	s41e2	scraper		1	
21a1	scraper	4	9	44.4	21a1	scraper	7	29.7	27.0	8.0	0.9	8.7	21a1	scraper		1	
8w6	scraper	3	10	30.0	8w6	scraper	7	47.2	28.8	13.6	0.5	5.1	8w6	scraper		1	
8u1	scraper	8	10	80.0	8u1	scraper	6	60.0	31.5	18.9	0.3	3.2	8u1	scraper		1	
10r1	scraper	2	9	22.2	10r1	scraper	2	23.0	19.3	4.4	0.5	4.5	10r1	scraper		1	
10r2	scraper	2	11	18.2	10r2	scraper	1	30.7	26.3	8.1	0.1	1.2	10r2	scraper		1	
11b3	scraper	7	21	33.3	11b3	scraper	2	61.4	45.0	27.6	0.1	0.7	11b3	scraper			1
14r1	scraper	2	2	100.0	14r1	flake	1	21.8	16.7	3.6	0.3	2.7	14r1	flake			1
n				**Mean**	**n**							**Mean**	**n**				
882				51.6%	**882**							7.2	**882**		111	642	129
														Percentage	12.6	72.8	14.6

Table 16: Experimental Acheulean quartzite raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; vf – very fine grained; f – fine grained; m – medium grained; c – coarse grained; vc – very coarse grained; g – granules; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	**Tt**	**Iscar**	**Dscar**	**% F**	**Sn**	**Tt**	**vf**	**f**	**m**	**c**	**vc**	**g**	**Sn**	**Tt**	**N**	**S**	**E**
10a3	ach flake ret	3	9	33.3	10a3	ach flake ret			1				21b1	chunk			1
14h10	casual core	0	9	0.0	14h10	casual core		1					21b3	flake			1
21L10	cent core	4	24	16.7	21L10	cent core		1					21b5	flake		1	
21c10	chopper	10	25	40.0	21c10	chopper		1					21b6	flake		1	
21f5	chopper	0	16	0.0	21f5	chopper			1				21b7	flake		1	
5idug10	chopper	11	24	45.8	5idug10	chopper		1					21b8	flake		1	
5Ldug3	chopper	2	11	18.2	5Ldug3	chopper			1				21b9	handaxe		1	
2a10	chopper	3	9	33.3	2a10	chopper				1			21b10	core, p		1	
14v5	chopper	1	7	14.3	14v5	chopper			1				21c1	flake		1	
10c5	chopper	9	30	30.0	10c5	chopper				1			21c2	flake		1	
14d5	chopper	5	19	26.3	14d5	chopper		1					21c3	retouch		1	
34c5	chopper	7	19	36.8	34c5	chopper		1					21c4	flake		1	
14f5	chopper core	9	23	39.1	14f5	chopper core		1					21c5	chunk		1	
32b10	chopper core	1	14	7.1	32b10	chopper core		1					21c6	flake		1	
21b1	chunk	0	5	0.0	21b1	chunk				1			21c7	chunk		1	
21c5	chunk	1	2	50.0	21c5	chunk		1					21c8	flake		1	
21c7	chunk	3	3	100.0	21c7	chunk		1					21c10	chopper		1	
21h2	chunk	1	6	16.7	21h2	chunk		1					21f2	flake		1	
14f1	chunk	4	9	44.4	14f1	chunk		1					21f4	flake		1	
32c4	chunk	3	4	75.0	32c4	chunk						1	21f5	chopper		1	
12a1	chunk	0	7	0.0	12a1	chunk					1		21h1	flake		1	
12a3	chunk	0	11	0.0	12a3	chunk					1		21h2	chunk		1	
12a4	chunk	0	6	0.0	12a4	chunk					1		21h4	flake		1	

5idug1	chunk	2	5	40.0	5idug1	chunk		1					21h5	core, p		1	
14s2	chunk	1	8	12.5	14s2	chunk		1					21g1	flake		1	
14s3	chunk	3	5	60.0	14s3	chunk		1					21g2	flake	1		
14j1	chunk	3	9	33.3	14j1	chunk			1				21g3	flake		1	
8L8	chunk	5	8	62.5	8L8	chunk			1				21g4	flake	1		
2a2	chunk	0	6	0.0	2a2	chunk				1			21g6	flake	1		
2a4	chunk	0	8	0.0	2a4	chunk				1			21g8	flake		1	
2a5	chunk	0	5	0.0	2a5	chunk				1			21g9	flake		1	
2a6	chunk	1	8	12.5	2a6	chunk				1			21g10	core, pi		1	
2a7	chunk	1	8	12.5	2a7	chunk				1			21L1	flake	1		
5ddug1	chunk	1	4	25.0	5ddug1	chunk				1			21L2	flake	1		
5ddug2	chunk	3	3	100.0	5ddug2	chunk				1			21L3	flake	1		
14c1	chunk	2	5	40.0	14c1	chunk		1					21L4	flake		1	
14c4	chunk	3	4	75.0	14c4	chunk		1					21L5	flake	1		
14c7	chunk	3	4	75.0	14c7	chunk		1					21L6	flake	1		
14n4	chunk	1	4	25.0	14n4	chunk			1				21L7	flake		1	
14n6	chunk	3	5	60.0	14n6	chunk			1				21L9	flake	1		
7a1	chunk	2	3	66.7	7a1	chunk		1					21L10	cent core	1		
14,O1	chunk	4	11	36.4	14,O1	chunk		1					5bsurf1	flake	1		
14,O2	chunk	4	4	100.0	14,O2	chunk		1					5bsurf2	flake	1		
8v2	chunk	2	2	100.0	8v2	chunk		1					5bsurf3	flake	1		
5mdug1	chunk	3	4	75.0	5mdug1	chunk			1				5bsurf4	flake	1		
14u3	chunk	4	4	100.0	14u3	chunk			1				5bsurf7	retouch	1		
10f2	chunk	3	6	50.0	10f2	chunk		1					5bsurf8	flake	1		
34c3	chunk	1	1	100.0	34c3	chunk		1					5bsurf9	flake	1		
5Odug5	chunk	4	4	100.0	5Odug5	chunk			1				5bsurf10	handaxe	1		
14c2	chunk	4	4	100.0	14c2	chunk		1					8i1	flake		1	
14t1	chunk	3	8	37.5	14t1	chunk			1				8i2	flake		1	
20t2	chunk	6	9	66.7	20t2	chunk				1			8i3	core, frag		1	

10u1	chunk	2	3	66.7	10u1	chunk			1				8i5	core, pi		1	
20ak1	chunk	3	5	60.0	20ak1	chunk			1				14f1	chunk		1	
6a1	cleaver	11	59	18.6	6a1	cleaver		1					14f2	flake		1	
5gsurf4	cleaver	2	37	5.4	5gsurf4	cleaver		1					14f3	retouch		1	
14j3	cleaver / chopper	10	17	58.8	14j3	cleaver / chopper			1				14f5	chopper core		1	
14c9	core chunk	8	8	100.0	14c9	core chunk		1					32c1	flake		1	
14c10	core chunk	13	16	81.3	14c10	core chunk		1					32c2	flake			1
14h9	core, cent	0	20	0.0	14h9	core, cent		1					32c3	flake			1
5gsurf3	core, cent	5	32	15.6	5gsurf3	core, cent		1					32c4	chunk			1
33a4	core, cent	7	28	25.0	33a4	core, cent			1				32c5	flake			1
20au3	core, cent	3	17	17.6	20au3	core, cent			1				32c7	flake			1
10u3	core, cent	5	22	22.7	10u3	core, cent			1				32c8	flake			1
6d4	core, cent	15	24	62.5	6d4	core, cent			1				32c10	core, p			1
20ak5	core, cent	15	27	55.6	20ak5	core, cent			1				12a1	chunk			1
14t3	core, cent / chopper	9	9	100.0	14t3	core, cent / chopper			1				12a2	flake			1
S10e4	core, cent / handaxe	1	31	3.2	S10e4	core, cent / handaxe				1			12a3	chunk			1
10a1	core, disc/prep	9	22	40.9	10a1	core, disc/prep			1				12a4	chunk			1
S8,O4	core, flat	1	27	3.7	S8,O4	core, flat			1				12a5	flake			1
32d2	core, flat	3	6	50.0	32d2	core, flat		1					12a7	flake			1
10f5	core, flat/p	12	23	52.2	10f5	core, flat/p		1					12a8	flake			1
31a3	core, flat/prep	11	20	55.0	31a3	core, flat/prep		1					12a9	core, frag			1
8i3	core, frag	3	11	27.3	8i3	core, frag			1				12a10	core, pi			1
12a9	core, frag	1	13	7.7	12a9	core, frag			1				32b1	flake	1		
5ddug4	core, frag	4	4	100.0	5ddug4	core, frag				1			32b2	flake	1		
5mdug4	core, frag	5	12	41.7	5mdug4	core, frag			1				32b4	flake	1		
20au2	core, frag	6	12	50.0	20au2	core, frag			1				32b5	flake	1		

5pdug4	core, frag	9	15	60.0	5pdug4	core, frag			1				32b8	flake	1		
10f4	core, frag	6	12	50.0	10f4	core, frag		1					32b9	flake	1		
21b10	core, p	14	28	50.0	21b10	core, p				1			32b10	chopper core	1		
21h5	core, p	10	15	66.7	21h5	core, p		1					5idug1	chunk		1	
32c10	core, p	3	19	15.8	32c10	core, p						1	5idug2	flake		1	
11d9	core, p	3	19	15.8	11d9	core, p				1			5idug3	flake		1	
11d10	core, p	5	22	22.7	11d10	core, p				1			5idug4	flake		1	
8L10	core, p	6	26	23.1	8L10	core, p			1				5idug6	flake		1	
6a3	core, p	17	33	51.5	6a3	core, p		1					5idug7	flake		1	
5fsurf2	core, p	12	23	52.2	5fsurf2	core, p		1					5idug8	flake		1	
20aj2	core, p	10	34	29.4	20aj2	core, p		1					5idug9	flake		1	
8v4	core, p	20	24	83.3	8v4	core, p		1					5idug10	chopper		1	
8n2	core, p	5	21	23.8	8n2	core, p			1				11d1	flake			1
8n5	core, p	9	22	40.9	8n5	core, p			1				11d2	flake			1
5asurf9	core, p	7	41	17.1	5asurf9	core, p			1				11d3	flake			1
5esurf3	core, p	7	13	53.8	5esurf3	core, p				1			11d4	flake			1
5dsurf4	core, p	7	22	31.8	5dsurf4	core, p				1			11d5	flake			1
5qdug3	core, p	5	33	15.2	5qdug3	core, p			1				11d6	flake			1
5Odug8	core, p	15	16	93.8	5Odug8	core, p			1				11d8	flake			1
21g10	core, pi	14	32	43.8	21g10	core, pi		1					11d9	core, p			1
8i5	core, pi	6	15	40.0	8i5	core, pi			1				11d10	core, p			1
12a10	core, pi	1	16	6.3	12a10	core, pi				1			5r2	flake			1
5r3	core, pi	4	15	26.7	5r3	core, pi		1					5r3	core, pi			1
5Ldug2	core, pi	1	24	4.2	5Ldug2	core, pi			1				14s1	flake			1
8L9	core, pi	1	15	6.7	8L9	core, pi			1				14s2	chunk			1
5ddug5	core, pi	8	8	100.0	5ddug5	core, pi				1			14s3	chunk			1
S10,O10	core, pi	12	24	50.0	S10,O10	core, pi		1					14j1	chunk			1
14n10	core, pi	9	18	50.0	14n10	core, pi			1				14j2	flake			1

7a3	core, pi	8	15	53.3	7a3	core, pi		1					14j3	cleaver / chopper			1
14,O3	core, pi	6	7	85.7	14,O3	core, pi		1					5Ldug1	flake			1
14w3	core, pi	0	11	0.0	14w3	core, pi			1				5Ldug2	core, pi			1
14q3	core, pi	2	5	40.0	14q3	core, pi		1					5Ldug3	chopper			1
10c4	core, pi	5	22	22.7	10c4	core, pi				1			8L1	flake		1	
14u5	core, pi	10	13	76.9	14u5	core, pi			1				8L2	flake		1	
5jsurf3	denticulate	8	11	72.7	5jsurf3	denticulate			1				8L6	flake		1	
8m3	denticulate	6	12	50.0	8m3	denticulate			1				8L7	flake		1	
10c2	denticulate	2	21	9.5	10c2	denticulate				1			8L8	chunk		1	
21b3	flake	3	7	42.9	21b3	flake				1			8L9	core, pi		1	
21b5	flake	7	9	77.8	21b5	flake				1			8L10	core, p		1	
21b6	flake	9	10	90.0	21b6	flake				1			2a1	flake			1
21b7	flake	5	8	62.5	21b7	flake				1			2a2	chunk			1
21b8	flake	1	1	100.0	21b8	flake				1			2a3	flake			1
21c1	flake	0	5	0.0	21c1	flake		1					2a4	chunk			1
21c2	flake	2	5	40.0	21c2	flake		1					2a5	chunk			1
21c4	flake	0	2	0.0	21c4	flake		1					2a6	chunk			1
21c6	flake	1	1	100.0	21c6	flake		1					2a7	chunk			1
21c8	flake	0	1	0	21c8	flake		1					2a8	flake			1
21f2	flake	1	10	10.0	21f2	flake			1				2a9	flake			1
21f4	flake	1	1	100.0	21f4	flake			1				2a10	chopper			1
21h1	flake	2	5	40	21h1	flake		1					14h1	flake			1
21h4	flake	4	6	66.7	21h4	flake		1					14h2	flake			1
21g1	flake	1	4	25.0	21g1	flake		1					14h3	flake			1
21g2	flake	4	5	80.0	21g2	flake		1					14h4	flake			1
21g3	flake	2	2	100.0	21g3	flake		1					14h5	flake			1
21g4	flake	1	2	50.0	21g4	flake		1					14h6	flake			1
21g6	flake	3	8	37.5	21g6	flake		1					14h7	flake			1

21g8	flake	0	2	0.0	21g8	flake		1					14h8	retouch			1
21g9	flake	4	5	80.0	21g9	flake		1					14h9	core, cent			1
21L1	flake	0	8	0.0	21L1	flake		1					14h10	casual core			1
21L2	flake	0	3	0.0	21L2	flake		1					5ddug1	chunk			1
21L3	flake	1	3	33.3	21L3	flake		1					5ddug2	chunk			1
21L4	flake	0	1	0.0	21L4	flake		1					5ddug4	core, frag			1
21L5	flake	0	7	0.0	21L5	flake		1					5ddug5	core, pi			1
21L6	flake	0	6	0.0	21L6	flake		1					14v1	flake		1	
21L7	flake	0	1	0.0	21L7	flake		1					14v2	flake		1	
21L9	flake	0	4	0.0	21L9	flake		1					14v3	flake		1	
5bsurf1	flake	0	8	0.0	5bsurf1	flake		1					14v4	flake		1	
5bsurf2	flake	0	8	0.0	5bsurf2	flake		1					14v5	chopper		1	
5bsurf3	flake	4	7	57.1	5bsurf3	flake		1					6a1	cleaver		1	
5bsurf4	flake	2	10	20.0	5bsurf4	flake		1					6a2	handaxe		1	
5bsurf8	flake	0	18	0.0	5bsurf8	flake		1					6a3	core, p		1	
5bsurf9	flake	4	18	22.2	5bsurf9	flake		1					5fsurf2	core, p		1	
8i1	flake	2	10	20.0	8i1	flake			1				5fsurf3	pick		1	
8i2	flake	1	1	100.0	8i2	flake			1				20aj2	core, p		1	
14f2	flake	4	4	100.0	14f2	flake		1					10d2	handaxe		1	
32c1	flake	0	3	0.0	32c1	flake						1	S10,O1	flake		1	
32c2	flake	1	7	14.3	32c2	flake						1	S10,O2	flake		1	
32c3	flake	0	3	0.0	32c3	flake						1	S10,O3	flake		1	
32c5	flake	1	7	14.3	32c5	flake						1	S10,O4	flake		1	
32c7	flake	1	8	12.5	32c7	flake						1	S10,O5	flake		1	
32c8	flake	3	5	60.0	32c8	flake						1	S10,O6	flake	1		
12a2	flake	1	4	25.0	12a2	flake					1		S10,O7	flake		1	
12a5	flake	0	5	0.0	12a5	flake			1				S10,O8	flake		1	
12a7	flake	0	4	0.0	12a7	flake					1		S10,O10	core, pi		1	

12a8	flake	1	8	12.5	12a8	flake					1		14c1	chunk		1	
32b1	flake	4	5	80.0	32b1	flake		1					14c2	flake		1	
32b2	flake	0	7	0.0	32b2	flake		1					14c3	flake		1	
32b4	flake	0	3	0.0	32b4	flake		1					14c4	chunk		1	
32b5	flake	1	6	16.7	32b5	flake		1					14c5	flake		1	
32b8	flake	6	8	75.0	32b8	flake		1					14c7	chunk		1	
32b9	flake	3	5	60.0	32b9	flake		1					14c9	core chunk		1	
5idug2	flake	6	9	66.7	5idug2	flake		1					14c10	core chunk		1	
5idug3	flake	1	5	20.0	5idug3	flake		1					5gsurf3	core, cent	1		
5idug4	flake	0	4	0.0	5idug4	flake		1					5gsurf4	cleaver		1	
5idug6	flake	4	5	80.0	5idug6	flake		1					31a2	flake		1	
5idug7	flake	3	4	75.0	5idug7	flake		1					31a3	core, flat/prep		1	
5idug8	flake	2	2	100.0	5idug8	flake		1					10a1	core, disc/prep		1	
5idug9	flake	3	3	100.0	5idug9	flake		1					10a3	ach flake ret		1	
11d1	flake	1	4	25.0	11d1	flake				1			10a4	handaxe		1	
11d2	flake	0	6	0.0	11d2	flake				1			14n1	flake			1
11d3	flake	1	6	16.7	11d3	flake				1			14n2	flake			1
11d4	flake	0	4	0.0	11d4	flake				1			14n3	flake			1
11d5	flake	0	4	0.0	11d5	flake				1			14n4	chunk			1
11d6	flake	1	5	20.0	11d6	flake				1			14n5	flake			1
11d8	flake	0	10	0.0	11d8	flake				1			14n6	chunk			1
5r2	flake	0	9	0.0	5r2	flake		1					14n7	flake			1
14s1	flake	1	4	25.0	14s1	flake		1					14n8	flake			1
14j2	flake	1	2	50.0	14j2	flake			1				14n9	flake			1
5Ldug1	flake	1	3	33.3	5Ldug1	flake			1				14n10	core, pi			1
8L1	flake	0	4	0.0	8L1	flake			1				7a1	chunk		1	

8L2	flake	0	9	0.0	8L2	flake			1				7a3	core, pi		1	
8L6	flake	0	9	0.0	8L6	flake			1				14,O1	chunk		1	
8L7	flake	4	10	40.0	8L7	flake			1				14,O2	chunk		1	
2a1	flake	0	3	0.0	2a1	flake				1			14,O3	core, pi		1	
2a3	flake	0	6	0.0	2a3	flake				1			8v1	flake		1	
2a8	flake	0	10	0.0	2a8	flake				1			8v2	chunk		1	
2a9	flake	1	4	25.0	2a9	flake				1			8v4	core, p		1	
14h1	flake	0	3	0.0	14h1	flake		1					33a1	flake		1	
14h2	flake	0	4	0.0	14h2	flake		1					33a3	flake		1	
14h3	flake	1	5	20.0	14h3	flake		1					33a4	core, cent		1	
14h4	flake	0	3	0.0	14h4	flake		1					5mdug1	chunk		1	
14h5	flake	0	3	0.0	14h5	flake		1					5mdug2	flake		1	
14h6	flake	0	5	0.0	14h6	flake		1					5mdug4	core, frag		1	
14h7	flake	0	2	0.0	14h7	flake		1					5jsurf2	flake		1	
14v1	flake	1	8	12.5	14v1	flake			1				5jsurf3	denticulate		1	
14v2	flake	0	1	0.0	14v2	flake			1				20au1	flake			1
14v3	flake	1	8	12.5	14v3	flake			1				20au2	core, frag			1
14v4	flake	1	1	100.0	14v4	flake			1				20au3	core, cent			1
S10,O1	flake	2	4	50.0	S10,O1	flake		1					14w1	flake			1
S10,O2	flake	5	9	55.6	S10,O2	flake		1					14w2	flake			1
S10,O3	flake	4	7	57.1	S10,O3	flake		1					14w3	core, pi			1
S10,O4	flake	1	2	50.0	S10,O4	flake		1					14q1	flake		1	
S10,O5	flake	5	6	83.3	S10,O5	flake		1					14q2	flake		1	
S10,O6	flake	3	7	42.9	S10,O6	flake		1					14q3	core, pi		1	
S10,O7	flake	2	2	100.0	S10,O7	flake		1					8m1	flake		1	
S10,O8	flake	1	1	100.0	S10,O8	flake		1					8m3	denticulate		1	
14c2	flake	1	2	50.0	14c2	flake		1					8m4	flake		1	
14c3	flake	6	6	100.0	14c3	flake		1					8m5	flake		1	
14c5	flake	6	7	85.7	14c5	flake		1					8n2	core, p		1	

31a2	flake	5	5	100.0	31a2	flake		1					8n4	handaxe		1	
14n1	flake	1	6	16.7	14n1	flake			1				8n5	core, p		1	
14n2	flake	1	4	25.0	14n2	flake			1				5asurf2	flake		1	
14n3	flake	1	2	50.0	14n3	flake			1				5asurf3	flake	1		
14n5	flake	1	4	25.0	14n5	flake			1				5asurf4	flake		1	
14n7	flake	2	3	66.7	14n7	flake			1				5asurf5	flake		1	
14n8	flake	3	8	37.5	14n8	flake			1				5asurf6	flake	1		
14n9	flake	5	8	62.5	14n9	flake			1				5asurf8	flake		1	
8v1	flake	6	7	85.7	8v1	flake		1					5asurf9	core, p		1	
33a1	flake	0	6	0.0	33a1	flake			1				5asurf10	handaxe		1	
33a3	flake	0	5	0.0	33a3	flake			1				5esurf1	flake			1
5mdug2	flake	1	4	25.0	5mdug2	flake			1				5esurf2	flake			1
5jsurf2	flake	2	3	66.7	5jsurf2	flake			1				5esurf3	core, p			1
20au1	flake	2	4	50.0	20au1	flake			1				14p1	flake			1
14w1	flake	1	4	25.0	14w1	flake			1				14p2	flake			1
14w2	flake	0	3	0.0	14w2	flake			1				5dsurf1	flake			1
14q1	flake	2	6	33.3	14q1	flake		1					5dsurf3	handaxe			1
14q2	flake	1	5	20.0	14q2	flake		1					5dsurf4	core, p			1
8m1	flake	0	4	0.0	8m1	flake			1				10c2	denticulate	1		
8m4	flake	6	9	66.7	8m4	flake			1				10c3	flake	1		
8m5	flake	3	4	75.0	8m5	flake			1				10c4	core, pi		1	
5asurf2	flake	0	10	0.0	5asurf2	flake			1				10c5	chopper		1	
5asurf3	flake	2	8	25.0	5asurf3	flake			1				S8,O1	flake	1		
5asurf4	flake	0	10	0.0	5asurf4	flake			1				S8,O3	flake		1	
5asurf5	flake	2	7	28.6	5asurf5	flake			1				S8,O4	core, flat		1	
5asurf6	flake	0	12	0.0	5asurf6	flake			1				S8,O5	handaxe		1	
5asurf8	flake	3	8	37.5	5asurf8	flake			1				14u1	flake			1
5esurf1	flake	2	5	40.0	5esurf1	flake				1			14u2	flake			1
5esurf2	flake	4	5	80.0	5esurf2	flake				1			14u3	chunk			1

14p1	flake	3	5	60.0	14p1	flake				1			14u4	flake			1
14p2	flake	1	1	100.0	14p2	flake				1			14u5	core, pi			1
5dsurf1	flake	2	5	40.0	5dsurf1	flake				1			5pdug1	flake			1
10c3	flake	4	13	30.8	10c3	flake				1			5pdug4	core, frag			1
S8,O1	flake	0	8	0.0	S8,O1	flake			1				5pdug5	handaxe			1
S8,O3	flake	2	5	40.0	S8,O3	flake			1				5qdug3	core, p		1	
14u1	flake	0	1	0.0	14u1	flake			1				5qdug5	pick		1	
14u2	flake	1	2	50.0	14u2	flake			1				14d1	flake		1	
14u4	flake	2	2	100.0	14u4	flake			1				14d3	flake		1	
5pdug1	flake	1	4	25.0	5pdug1	flake		1					14d4	handaxe		1	
14d1	flake	5	8	62.5	14d1	flake		1					14d5	chopper		1	
14d3	flake	4	5	80.0	14d3	flake		1					10f1	flake		1	
10f1	flake	4	4	100.0	10f1	flake		1					10f2	chunk		1	
34c1	flake	1	2	50.0	34c1	flake		1					10f4	core, frag		1	
34c2	flake	0	4	0.0	34c2	flake		1					10f5	core, flat/p		1	
5Odug1	flake	6	6	100.0	5Odug1	flake			1				34c1	flake		1	
5Odug2	flake	2	2	100.0	5Odug2	flake			1				34c2	flake		1	
5Odug3	flake	4	4	100.0	5Odug3	flake			1				34c3	chunk		1	
5Odug4	flake	7	7	100.0	5Odug4	flake			1				34c5	chopper		1	
5Odug7	flake	3	3	100.0	5Odug7	flake			1				5Odug1	flake			1
5Odug9	flake	9	10	90.0	5Odug9	flake			1				5Odug2	flake			1
5Odug10	flake	1	1	100.0	5Odug10	flake			1				5Odug3	flake			1
14c1	flake	1	4	25.0	14c1	flake		1					5Odug4	flake			1
14c3	flake	1	2	50.0	14c3	flake		1					5Odug5	chunk			1
32d1	flake	1	2	50.0	32d1	flake		1					5Odug7	flake			1
14t2	flake	1	1	100.0	14t2	flake			1				5Odug8	core, p			1
S10e1	flake	1	3	33.3	S10e1	flake			1				5Odug9	flake			1
S10e2	flake	1	7	14.3	S10e2	flake				1			5Odug10	flake			1
20t1	flake	3	4	75.0	20t1	flake				1			14c1	flake			1

6d1	flake	2	3	66.7	6d1	flake			1				14c2	chunk			1
6d2	flake	3	3	100.0	6d2	flake			1				14c3	flake			1
20ak2	flake	6	10	60.0	20ak2	flake			1				14c4	handaxe			1
20ak3	flake	4	5	80.0	20ak3	flake			1				32d1	flake			1
21b9	handaxe	8	17	47.1	21b9	handaxe				1			32d2	core, flat			1
5bsurf10	handaxe	9	56	16.1	5bsurf10	handaxe		1					14t1	chunk			1
6a2	handaxe	24	66	36.4	6a2	handaxe		1					14t2	flake			1
10d2	handaxe	25	53	47.2	10d2	handaxe			1				14t3	core, cent / chopper			1
10a4	handaxe	20	67	29.9	10a4	handaxe			1				S10e1	flake		1	
5asurf10	handaxe	10	31	32.3	8n4	handaxe			1				S10e2	flake		1	
5dsurf3	handaxe	11	27	40.7	5asurf10	handaxe			1				S10e4	core, cent / handaxe		1	
S8,O5	handaxe	8	37	21.6	5dsurf3	handaxe			1				20t1	flake		1	
5pdug5	handaxe	8	16	50.0	S8,O5	handaxe			1				20t2	chunk		1	
14d4	handaxe	12	33	36.4	5pdug5	handaxe		1					10u1	chunk		1	
14c4	handaxe	9	24	37.5	14d4	handaxe		1					10u3	core, cent		1	
6d5	handaxe	20	26	76.9	14c4	handaxe		1					6d1	flake		1	
8n4	handaxe, tip	7	18	38.9	6d5	handaxe			1				6d2	flake		1	
5fsurf3	pick	25	34	73.5	5fsurf3	pick		1					6d4	core, cent		1	
5qdug5	pick	19	32	59.4	5qdug5	pick			1				6d5	handaxe		1	
21c3	retouch	1	4	25	21c3	retouch		1					20ak1	chunk		1	
5bsurf7	retouch	0	14	0.0	5bsurf7	retouch		1					20ak2	flake		1	
14f3	retouch	0	12	0.0	14f3	retouch		1					20ak3	flake		1	
14h8	retouch	0	9	0.0	14h8	retouch		1					20ak5	core, cent		1	
33a2	retouch	0	14	0.0	33a2	retouch			1				33a2	retouch		1	
5r1	retouch	1	9	11.1	5r1	retouch		1					5r1	retouch			1
8v3	retouch	7	16	43.8	8v3	retouch		1					8v3	retouch		1	
8i4	retouch	8	18	44.4	8i4	retouch			1				8i4	retouch		1	
34c4	retouch	3	18	16.7	34c4	retouch		1					34c4	retouch		1	

n				**Mean**	**n**								**n**				
303				40.2%	**303**		0	134	108	47	6	8	**303**		32	158	113
						Percentage of sample	0.0	44.2	35.6	15.5	2.0	2.6		Percentage of sample	10.6	52.1	37.3

Table 17: Experimental Acheulean quartz raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	f	L, mm	w, mm	a cm2	f/cm2	f/10 cm2	Sn	Tt	N	S	E
S15e1	chunk	4	5	80.0	S15e1	chunk	2	27.5	19	5.2	0.4	3.8	S15e1	chunk		1	
S15e2	flake	2	9	22.2	S15e2	flake	1	35	30.7	10.7	0.1	0.9	S15e2	flake	1		
S15e3	flake	2	3	66.7	S15e3	flake	4	54.3	41	22.3	0.2	1.8	S15e3	flake	1		
15f1	core, c	8	16	50.0	15f1	core, c	3	19.6	10.4	2.0	1.5	14.7	15f1	core, c		1	
15f2	flake	5	8	62.5	15f2	flake	5	34.7	22	7.6	0.7	6.5	15f2	flake		1	
15f4	chunk	8	8	100.0	15f4	chunk	18	28	23.8	6.7	2.7	27.0	15f4	chunk			1
15f5	core, p	24	29	82.8	15f5	core, p	10	62.8	60.7	38.1	0.3	2.6	15f5	core, p		1	
15L1	chunk	1	3	33.3	15L1	chunk	3	15	11.6	1.7	1.7	17.2	15L1	chunk	1		
15L2	flake	1	4	25.0	15L2	flake	2	21.5	10	2.2	0.9	9.3	15L2	flake	1		
15L3	flake	0	8	0.0	15L3	flake	7	23.6	12.6	3.0	2.4	23.5	15L3	flake	1		
15L4	flake	2	4	50.0	15L4	flake	2	22.2	12.2	2.7	0.7	7.4	15L4	flake	1		
15L5	flake	0	4	0.0	15L5	flake	2	21.2	19	4.0	0.5	5.0	15L5	flake	1		
15L6	flake	1	3	33.3	15L6	flake	3	25	23.4	5.9	0.5	5.1	15L6	flake	1		
15L9	flake	6	13	46.2	15L9	flake	5	43.5	31.7	13.8	0.4	3.6	15L9	flake	1		
15p1	chunk	1	3	33.3	15p1	chunk	1	18	8.3	1.5	0.7	6.7	15p1	chunk	1		

15p2	flake	0	2	0.0	15p2	flake	0	1	1	0.0	0.0	0.0	15p2	flake	1		
15p3	flake	3	6	50.0	15p3	flake	0	1	1	0.0	0.0	0.0	15p3	flake	1		
15p4	flake	1	1	100.0	15p4	flake	0	1	1	0.0	0.0	0.0	15p4	flake	1		
15p5	flake	2	4	50.0	15p5	flake	3	21	16	3.4	0.9	8.9	15p5	flake	1		
15p6	flake	2	2	100.0	15p6	flake	3	24.7	17	4.2	0.7	7.1	15p6	flake	1		
15p8	flake	2	4	50.0	15p8	flake	0	1	1	0.0	0.0	0.0	15p8	flake	1		
15p9	flake	3	3	100.0	15p9	flake	4	29	14	4.1	1.0	9.9	15p9	flake	1		
15p10	flake	3	5	60.0	15p10	flake	2	33.5	22.2	7.4	0.3	2.7	15p10	flake	1		
15p11	core, pi	5	12	41.7	15p11	core, pi	2	21.5	23.4	5.0	0.4	4.0	15p11	core, pi	1		
15s1	flake	0	1	0.0	15s1	flake	3	18.3	13.3	2.4	1.2	12.3	15s1	flake	1		
15s2	chunk	3	6	50.0	15s2	chunk	3	18	16.5	3.0	1.0	10.1	15s2	chunk		1	
15s3	flake	2	2	100.0	15s3	flake	3	24	10.4	2.5	1.2	12.0	15s3	flake		1	
15s4	flake	3	7	42.9	15s4	flake	3	19.2	18.5	3.6	0.8	8.4	15s4	flake	1		
15s6	core, p	5	12	41.7	15s6	core, p	7	28.5	24	6.8	1.0	10.2	15s6	core, p	1		
15s7	chunk	2	2	100.0	15s7	chunk	2	20.7	14.4	3.0	0.7	6.7	15s7	chunk		1	
15s10	core, p	10	14	71.4	15s10	core, p	10	27.6	23.4	6.5	1.5	15.5	15s10	core, p		1	
21i1	flake	0	9	0.0	21i1	flake	4	20.1	14.1	2.8	1.4	14.1	21i1	flake	1		
21i2	flake	7	10	70.0	21i2	flake	10	22.1	20.3	4.5	2.2	22.3	21i2	flake		1	
21i3	flake	1	1	100.0	21i3	flake	22	12	11.4	1.4	16.1	160.8	21i3	flake			1
21i4	flake	1	1	100.0	21i4	flake	5	25.3	9.6	2.4	2.1	20.6	21i4	flake			1
21i5	chunk	3	4	75.0	21i5	chunk	12	18.7	12	2.2	5.3	53.5	21i5	chunk			1
21i6	flake	3	3	100.0	21i6	flake	6	29.7	28.8	8.6	0.7	7.0	21i6	flake		1	
21i9	flake	3	3	100.0	21i9	flake	12	40.4	18	7.3	1.7	16.5	21i9	flake		1	
21i10	core, frag	14	21	66.7	21i10	core, frag	7	17.4	12	2.1	3.4	33.5	21i10	core, frag		1	
21q1	flake	0	1	0.0	21q1	flake	0	17.7	17.7	3.1	0.0	0.0	21q1	flake	1		
21q2	flake	0	9	0.0	21q2	flake	0	24	20.5	4.9	0.0	0.0	21q2	flake	1		
21q3	flake	0	6	0.0	21q3	flake	0	23.5	19.8	4.7	0.0	0.0	21q3	flake	1		
21q4	flake	0	1	0.0	21q4	flake	1	28.2	20.2	5.7	0.2	1.8	21q4	flake	1		
21q5	flake	0	5	0.0	21q5	flake	1	32.7	14.3	4.7	0.2	2.1	21q5	flake	1		

21q7	flake	2	5	40.0	21q7	flake	1	29	23.2	6.7	0.1	1.5	21q7	flake	1		
21q8	flake	4	8	50.0	21q8	flake	2	29	26.3	7.6	0.3	2.6	21q8	flake	1		
21q9	flake	1	4	25.0	21q9	flake	2	33.5	31.6	10.6	0.2	1.9	21q9	flake	1		
8b1	flake	1	1	100.0	8b1	flake	12	19.6	13.6	2.7	4.5	45.0	8b1	flake		1	
8b2	core, casual	5	6	83.3	8b2	core, casual	19	15.3	15.3	2.3	8.1	81.2	8b2	core, casual			1
8b3	chunk	13	13	100.0	8b3	chunk	11	21.4	12	2.6	4.3	42.8	8b3	chunk			1
8b4	core, pi	7	9	77.8	8b4	core, pi	42	28.3	28.3	8.0	5.2	52.4	8b4	core, pi		1	
8d1	flake	1	2	50.0	8d1	flake	12	13	11.2	1.5	8.2	82.4	8d1	flake		1	
8d3	core, p	8	16	50.0	8d3	core, p	22	19.6	19.6	3.8	5.7	57.3	8d3	core, p		1	
5qsurf1	chunk	4	14	28.6	5qsurf1	chunk	24	27.6	13.2	3.6	6.6	65.9	5qsurf1	chunk		1	
5qsurf3	core, pi	6	9	66.7	5qsurf3	core, pi	14	16.4	16.4	2.7	5.2	52.1	5qsurf3	core, pi		1	
5msurf3	flake	3	10	30.0	5msurf3	flake	1	42.5	32.2	13.7	0.1	0.7	5msurf3	flake	1		
14x1	bip flake	0	3	0.0	14x1	bip flake	1	55.6	12.6	7.0	0.1	1.4	14x1	bip flake	1		
33c2	flake	0	3	0.0	33c2	flake	1	47.2	22.2	10.5	0.1	1.0	33c2	flake	1		
33c3	core, p	6	22	27.3	33c3	core, p	1	30.3	22.6	6.8	0.1	1.5	33c3	core, p	1		
20, O2	chopper	5	16	31.3	20, O2	chopper	2	31.2	31	9.7	0.2	2.1	20, O2	chopper	1		
6n1	flake	0	5	0.0	6n1	flake	1	22	20	4.4	0.2	2.3	6n1	flake	1		
5stsurf2	flake	0	4	0.0	5stsurf2	flake	1	28.7	19	5.5	0.2	1.8	5stsurf2	flake	1		
5stsurf3	flake	2	6	33.3	5stsurf3	flake	3	36.3	20	7.3	0.4	4.1	5stsurf3	flake	1		
8a1	flake	0	1	0.0	8a1	flake	2	21	21	4.4	0.5	4.5	8a1	flake	1		
8a3	flake	3	11	27.3	8a3	flake	2	38.8	22	8.5	0.2	2.3	8a3	flake	1		
10x3	core, p	7	31	22.6	10x3	core, p	6	28.2	23	6.5	0.9	9.3	10x3	core, p	1		
5w1	flake	1	2	50.0	5w1	flake	3	23	16.6	3.8	0.8	7.9	5w1	flake	1		
5w3	flake	3	11	27.3	5w3	flake	10	26.7	24.4	6.5	1.5	15.3	5w3	flake	1		
10ac1	bip flake	0	2	0.0	10ac1	bip flake	0	19.5	19.4	3.8	0.0	0.0	10ac1	bip flake	1		
10ac2	core, bip	1	6	16.7	10ac2	core, bip	3	30	24	7.2	0.4	4.2	10ac2	core, bip	1		
5v1	bip flake	3	6	50.0	5v1	bip flake	4	30.8	15.5	4.8	0.8	8.4	5v1	bip flake	1		
5v2	bip flake	1	4	25.0	5v2	bip flake	3	37.5	12	4.5	0.7	6.7	5v2	bip flake	1		

5v3	core, bip	5	12	41.7	5v3	core, bip	4	32.5	17.5	5.7	0.7	7.0	5v3	core, bip	1		
5usurf1	flake	2	4	50.0	5usurf1	flake	6	27.5	22	6.1	1.0	9.9	5usurf1	flake		1	
5usurf3	core, cent	4	26	15.4	5usurf3	core, cent	4	31.7	24	7.6	0.5	5.3	5usurf3	core, cent	1		
8f1	flake	0	2	0.0	8f1	flake	4	20.4	16.3	3.3	1.2	12.0	8f1	flake	1		
8f2	flake	1	5	20.0	8f2	flake	5	28	18	5.0	1.0	9.9	8f2	flake	1		
8f3	core, cent	10	14	71.4	8f3	core, cent	6	21.6	20	4.3	1.4	13.9	8f3	core, cent		1	
8c1	flake	2	7	28.6	8c1	flake	4	34.8	24	8.4	0.5	4.8	8c1	flake	1		
32f1	flake	7	7	100.0	32f1	flake	3	19	17	3.2	0.9	9.3	32f1	flake			1
32f2	flake	4	5	80.0	32f2	flake	5	33.2	17.6	5.8	0.9	8.6	32f2	flake			1
32f3	flake	3	3	100.0	32f3	flake	8	38	34.2	13.0	0.6	6.2	32f3	flake			1
32f4	flake	4	5	80.0	32f4	flake	4	42.4	36	15.3	0.3	2.6	32f4	flake			1
32f5	flake	1	3	33.3	32f5	flake	6	44	28.6	12.6	0.5	4.8	32f5	flake			1
S32e1	flake	2	3	66.7	S32e1	flake	15	15.5	15.5	2.4	6.2	62.4	S32e1	flake			1
S32e2	flake	2	2	100.0	S32e2	flake	20	19	19	3.6	5.5	55.4	S32e2	flake			1
S32e3	flake	2	3	66.7	S32e3	flake	17	11.5	11.3	1.3	13.1	130.8	S32e3	flake			1
S32e5	chunk	6	6	100.0	S32e5	chunk	17	22.4	14.8	3.3	5.1	51.3	S32e5	chunk			1
14i1	flake	2	3	66.7	14i1	flake	7	8.7	8.1	0.7	9.9	99.3	14i1	flake		1	
14i2	flake	2	4	50.0	14i2	flake	10	19.5	8	1.6	6.4	64.1	14i2	flake		1	
14i3	core, pi	8	13	61.5	14i3	core, pi	20	17.3	15.7	2.7	7.4	73.6	14i3	core, pi			1
10q1	flake	3	4	75.0	10q1	flake	15	16	6.8	1.1	13.8	137.9	10q1	flake			1
10q2	core, p	8	14	57.1	10q2	core, p	16	23.7	9.2	2.2	7.3	73.4	10q2	core, p		1	
10q3	chunk	6	6	100.0	10q3	chunk	15	18.3	11.3	2.1	7.3	72.5	10q3	chunk			1
10aa1	flake	1	3	33.3	10aa1	flake	14	28	18.5	5.2	2.7	27.0	10aa1	flake		1	
5Osurf1	flake	1	1	100.0	5Osurf1	flake	8	22.6	13	2.9	2.7	27.2	5Osurf1	flake			1
13b1	flake	3	9	33.3	13b1	flake	30	32	17	5.4	5.5	55.1	13b1	flake		1	
13b2	flake	4	8	50.0	13b2	flake	31	29	15.7	4.6	6.8	68.1	13b2	flake		1	
13b3	flake	1	2	50.0	13b3	flake	15	28.2	10.7	3.0	5.0	49.7	13b3	flake	1		
13b5	core, p	10	16	62.5	13b5	core, p	10	13.8	10.7	1.5	6.8	67.7	13b5	core, p	1		
8g2	flake	0	1	0.0	8g2	flake	16	32	17	5.4	2.9	29.4	8g2	flake	1		

8g3	flake	2	6	33.3	8g3	flake	11	32.8	17	5.6	2.0	19.7	8g3	flake		1	
8g4	flake	4	5	80.0	8g4	flake	32	35.5	26.8	9.5	3.4	33.6	8g4	flake		1	
8g5	core, cent	5	21	23.8	8g5	core, cent	11	16.7	13.8	2.3	4.8	47.7	8g5	core, cent		1	
20aq1	flake	0	3	0.0	20aq1	flake	20	16.2	14.3	2.3	8.6	86.3	20aq1	flake		1	
20aq3	flake	1	1	100.0	20aq3	flake	7	20.5	19.4	4.0	1.8	17.6	20aq3	flake			1
20aq4	retouch	2	9	22.2	20aq4	retouch	22	23	12.6	2.9	7.6	75.9	20aq4	retouch		1	
20aq5	core, p	5	34	14.7	20aq5	core, p	15	12.4	9.2	1.1	13.1	131.5	20aq5	core, p		1	
5nsurf1	flake	2	6	33.3	5nsurf1	flake	10	10.5	8.8	0.9	10.8	108.2	5nsurf1	flake		1	
5nsurf3	core, pi	10	20	50.0	5nsurf3	core, pi	18	22.2	17.8	4.0	4.6	45.6	5nsurf3	core, pi		1	
5nsurf5	core, frag	7	18	38.9	5nsurf5	core, frag	18	18.1	9.7	1.8	10.3	102.5	5nsurf5	core, frag			1
S6e1	retouch	7	12	58.3	S6e1	retouch	15	45.2	21.8	9.9	1.5	15.2	S6e1	retouch		1	
S6e2	chunk	9	11	81.8	S6e2	chunk	9	39.8	25.6	10.2	0.9	8.8	S6e2	chunk		1	
S6e3	flake	7	11	63.6	S6e3	flake	13	43	31.8	13.7	1.0	9.5	S6e3	flake		1	
S6e5	flake	5	13	38.5	S6e5	flake	17	44	33	14.5	1.2	11.7	S6e5	flake		1	
S6e6	flake	6	6	100.0	S6e6	flake	11	34	17	5.8	1.9	19.0	S6e6	flake		1	
S6e7	flake	10	11	90.9	S6e7	flake	18	63	29	18.3	1.0	9.9	S6e7	flake		1	
S6e9	core, pi	19	29	65.5	S6e9	core, pi	13	24.2	18.3	4.4	2.9	29.4	S6e9	core, pi		1	
20ap2	flake	1	1	100.0	20ap2	flake	7	41.6	14.5	6.0	1.2	11.6	20ap2	flake		1	
20ap3	core, p	8	22	36.4	20ap3	core, p	6	45.6	24	10.9	0.5	5.5	20ap3	core, p		1	
6j1	flake	0	5	0.0	6j1	flake	7	33.5	26.5	8.9	0.8	7.9	6j1	flake		1	
6j2	flake	2	6	33.3	6j2	flake	12	43.7	11.5	5.0	2.4	23.9	6j2	flake	1		
6j3	core, flat	5	19	26.3	6j3	core, flat	14	38.7	36.5	14.1	1.0	9.9	6j3	core, flat		1	
10p1	chunk	2	8	25.0	10p1	chunk	21	46.7	24.2	11.3	1.9	18.6	10p1	chunk		1	
5hsurf3	chunk	7	10	70.0	5hsurf3	chunk	3	33.7	19.2	6.5	0.5	4.6	5hsurf3	chunk		1	
6m1	flake	2	5	40.0	6m1	flake	3	30	21.5	6.5	0.5	4.7	6m1	flake	1		
6m3	core, pi	1	13	7.7	6m3	core, pi	6	30	24.6	7.4	0.8	8.1	6m3	core, pi		1	
S11e1	retouch	2	17	11.8	S11e1	retouch	1	18.4	12	2.2	0.5	4.5	S11e1	retouch	1		
S11e2	flake	1	1	100.0	S11e2	flake	8	32	24	7.7	1.0	10.4	S11e2	flake		1	
S8e1	flake	2	5	40.0	S8e1	flake	6	20.3	12.6	2.6	2.3	23.5	S8e1	flake		1	

S8e2	flake	1	8	12.5	S8e2	flake	1	23	21	4.8	0.2	2.1	S8e2	flake		1	
S8e3	flake	0	2	0.0	S8e3	flake	14	42.3	25.3	10.7	1.3	13.1	S8e3	flake	1		
5rsurf1	chunk	0	4	0.0	5rsurf1	chunk	7	17.6	14.2	2.5	2.8	28.0	5rsurf1	chunk	1		
5rsurf2	flake	1	4	25.0	5rsurf2	flake	9	27.7	17	4.7	1.9	19.1	5rsurf2	flake		1	
5rsurf3	flake	1	2	50.0	5rsurf3	flake	7	28	24.6	6.9	1.0	10.2	5rsurf3	flake		1	
6L1	flake	4	7	57.1	6L1	flake	5	27	22.5	6.1	0.8	8.2	6L1	flake		1	
6L2	core, cent	2	15	13.3	6L2	core, cent	3	26.9	26.6	7.2	0.4	4.2	6L2	core, cent		1	
14a1	flake	3	7	42.9	14a1	flake	3	29.4	11	3.2	0.9	9.3	14a1	flake	1		
14a3	flake	4	6	66.7	14a3	flake	15	40.8	26.5	10.8	1.4	13.9	14a3	flake		1	
10b2	flake	3	3	100.0	10b2	flake	6	36.2	28	10.1	0.6	5.9	10b2	flake		1	
10b4	core, p	30	36	83.3	10b4	core, p	18	42	20.4	8.6	2.1	21.0	10b4	core, p		1	
32g1	bip flake	2	2	100.0	32g1	bip flake	2	38	10.6	4.0	0.5	5.0	32g1	bip flake		1	
32g2	bip flake	1	1	100.0	32g2	bip flake	7	34.4	18.8	6.5	1.1	10.8	32g2	bip flake		1	
6k2	core, cent	16	25	64.0	6k2	core, cent	4	24	20.4	4.9	0.8	8.2	6k2	core, cent		1	
6k3	chunk	4	4	100.0	6k3	chunk	3	23.6	19.3	4.6	0.7	6.6	6k3	chunk		1	
6b,c3	flake	6	6	100.0	6b,c3	flake	17	20	12.3	2.5	6.9	69.1	6b,c3	flake		1	
6b,c4	pick	17	33	51.5	6b,c4	pick	10	26.6	26.6	7.1	1.4	14.1	6b,c4	pick		1	
6i1	flake	2	5	40.0	6i1	flake	6	24.5	24.5	6.0	1.0	10.0	6i1	flake		1	
6i3	core, pi	8	23	34.8	6i3	core, pi	4	36	19.6	7.1	0.6	5.7	6i3	core, pi		1	
14g2	core, pi	7	15	46.7	14g2	core, pi	4	35.5	20.8	7.4	0.5	5.4	14g2	core, pi		1	
14g3	chunk	4	10	40.0	14g3	chunk	10	24.7	24.7	6.1	1.6	16.4	14g3	chunk	1		
10w1	flake	1	1	100.0	10w1	flake	5	18.3	14.5	2.7	1.9	18.8	10w1	flake		1	
10w2	retouch	2	6	33.3	10w2	retouch	1	20	15	3.0	0.3	3.3	10w2	retouch		1	
10w3	flake	5	6	83.3	10w3	flake	4	25.8	21	5.4	0.7	7.4	10w3	flake		1	
10w4	flake	4	5	80.0	10w4	flake	4	30.6	14.4	4.4	0.9	9.1	10w4	flake		1	
10w5	chunk	4	4	100.0	10w5	chunk	4	26.2	18.2	4.8	0.8	8.4	10w5	chunk		1	
10w6	flake	2	3	66.7	10w6	flake	3	31	18.8	5.8	0.5	5.1	10w6	flake		1	
10w9	core, flat	6	13	46.2	10w9	core, flat	4	32	16	5.1	0.8	7.8	10w9	core, flat		1	
10w10	core,	4	7	57.1	10w10	core,	5	30	29.6	8.9	0.6	5.6	10w10	core, casual		1	

	casual					casual											
27c2	flake	2	2	100.0	27c2	flake	3	18.0	14.5	2.6	1.1	11.5	27c2	flake		1	
27c3	flake	3	4	75.0	27c3	flake	3	24.0	19.5	4.7	0.6	6.4	27c3	flake		1	
27c4	flake	2	2	100.0	27c4	flake	4	24.0	22.0	5.3	0.8	7.6	27c4	flake		1	
27c5	flake	3	6	50.0	27c5	flake	5	27.8	19.0	5.3	0.9	9.5	27c5	flake		1	
27c6	flake	3	10	30.0	27c6	flake	2	22.7	18.6	4.2	0.5	4.7	27c6	flake		1	
27c8	core, casual	8	11	72.7	27c8	core, casual	4	42.8	26.2	11.2	0.4	3.6	27c8	core, casual		1	
27c9	core, pi	12	17	70.6	27c9	core, pi	4	35.4	33.6	11.9	0.3	3.4	27c9	core, pi		1	
23g1	chunk	1	2	50.0	23g1	chunk	0	25.3	13.0	3.3	0.0	0.0	23g1	chunk		1	
23g4	flake	6	7	85.7	23g4	flake	3	34.0	20.4	6.9	0.4	4.3	23g4	flake			1
23g5	chunk	9	9	100.0	23g5	chunk	4	32.4	29.2	9.5	0.4	4.2	23g5	chunk			1
23g6	flake	1	1	100.0	23g6	flake	2	40.0	29.4	11.8	0.2	1.7	23g6	flake			1
23g7	core, flat	7	7	100.0	23g7	core, flat	5	38.2	35.5	13.6	0.4	3.7	23g7	core, flat		1	
23g8	flake	4	4	100.0	23g8	flake	3	49.0	33.2	16.3	0.2	1.8	23g8	flake		1	
23g9	flake	1	1	100.0	23g9	flake	3	61.0	27.0	16.5	0.2	1.8	23g9	flake		1	
23g10	core, frag	12	17	70.6	23g10	core, frag	3	62.0	41.2	25.5	0.1	1.2	23g10	core, frag		1	
n				**Mean**	**n**							**Mean**	**n**				
174				53.1%	**174**							21.2	**174**		63	87	24
														Percentage of sample	36.2	50.0	13.8

Table 19: Experimental Acheulean chert raw data.

Key: Sn – sample number; Tt – tool type; ISCAR – flake scars with impurities; DSCAR – flake scars total on tool; % F – ratio of flaws in percentage; f – no. of fractures; Lmm – length of area sampled, Wmm – width of area sampled; a cm2 – area in centimetres squared; f/cm2 – fractures per centimetre squared; f/10 - cm2 fractures per ten centimetre squared; N - no weathering; S – slight weathering; E – extensive weathering.

Sn	Tt	Iscar	Dscar	% F	Sn	Tt	f	L, mm	w, mm	a cm2	f/cm2	f/10 cm2	Sn	Tt	N	S	E
9a1	cleaver	35	42	83.3	9a1	cleaver	10	37.6	31.7	11.9	0.8	8.4	9a1	cleaver		1	
9a2	core, b/f	15	19	78.9	9a2	core, b/f	10	55.3	35.6	19.7	0.5	5.1	9a2	core, b/f		1	
9a6	flake	4	4	100.0	9a6	flake	10	53.2	44.0	23.4	0.4	4.3	9a6	flake		1	
9b11	flake	4	5	80.0	9b11	flake	9	68.3	33.0	22.5	0.4	4.0	9b11	flake		1	
9c2	flake	0	1	0.0	9c2	flake	0	28.4	10.1	2.9	0.0	0.0	9c2	flake		1	
9c4	flake	2	2	100.0	9c4	flake	7	25.3	16.0	4.0	1.7	17.3	9c4	flake		1	
9c6	flake	5	5	100.0	9c6	flake	1	17.1	11.4	1.9	0.5	5.1	9c6	flake		1	
9c7	chunk	3	3	100.0	9c7	chunk	7	28.2	20.5	5.8	1.2	12.1	9c7	chunk		1	
9c8	chunk	4	4	100.0	9c8	chunk	11	22.7	22.7	5.2	2.1	21.3	9c8	chunk		1	
9c9	chunk	5	5	100.0	9c9	chunk	10	18.3	13.2	2.4	4.1	41.4	9c9	chunk		1	
9c12	flake	1	1	100.0	9c12	flake	24	46.0	31.0	14.3	1.7	16.8	9c12	flake		1	
9c15	core, p	6	13	46.2	9c15	core, p	10	32.6	32.5	10.6	0.9	9.4	9c15	core, p		1	
9c16	core, pi	10	10	100.0	9c16	core, pi	21	41.7	41.5	17.3	1.2	12.1	9c16	core, pi		1	
9d8	chunk	2	3	66.7	9d8	chunk	10	46.6	19.6	9.1	1.1	10.9	9d8	chunk		1	
9d16	core, p	13	18	72.2	9d16	core, p	30	50.0	46.3	23.2	1.3	13.0	9d16	core, p		1	
s9e7	chunk	3	3	100.0	s9e7	chunk	5	24.2	10.8	2.6	1.9	19.1	s9e7	chunk		1	
s9e12	flake	6	6	100.0	s9e12	flake	19	48.2	45.0	21.7	0.9	8.8	s9e12	flake		1	
s9e16	handaxe	50	50	100.0	s9e16	handaxe	24	67.0	43.5	29.1	0.8	8.2	s9e16	handaxe		1	
9f10	flake	3	3	100.0	9f10	flake	20	51.0	35.0	17.9	1.1	11.2	9f10	flake		1	
9f16	core, p	18	22	81.8	9f16	core, p	7	29.0	22.2	6.4	1.1	10.9	9f16	core, p		1	
9g8	flake	4	6	66.7	9g8	flake	14	48.0	31.7	15.2	0.9	9.2	9g8	flake		1	

9g11	flake	7	10	70.0	9g11	flake	22	76.7	28.0	21.5	1.0	10.2	9g11	flake		1	
9h2	flake	0	3	0.0	9h2	flake	0	12.4	12.4	1.5	0.0	0.0	9h2	flake	1		
9h10	flake	0	6	0.0	9h10	flake	0	38.0	32.6	12.4	0.0	0.0	9h10	flake	1		
9h12	chunk	1	2	50.0	9h12	chunk	2	49.0	27.4	13.4	0.1	1.5	9h12	chunk		1	
9h16	core, p	2	48	4.2	9h16	core, p	3	47.5	26.5	12.6	0.2	2.4	9h16	core, p	1		
9i1	flake	0	2	0.0	9i1	flake	0	1.0	1.0	0.0	0.0	0.0	9i1	flake		1	
9i7	flake	0	4	0.0	9i7	flake	0	1.0	1.0	0.0	0.0	0.0	9i7	flake		1	
9i12	flake	6	8	75.0	9i12	flake	0	1.0	1.0	0.0	0.0	0.0	9i12	flake		1	
9i14	chunk	4	4	100.0	9i14	chunk	2	36.0	36.0	13.0	0.2	1.5	9i14	chunk		1	
9i16	core, p	14	27	51.9	9i16	core, p	1	83.3	76.0	63.3	0.0	0.2	9i16	core, p		1	
9j5	chunk	7	9	77.8	9j5	chunk	6	21.8	20.0	4.4	1.4	13.8	9j5	chunk		1	
9j16	core, c	8	12	66.7	9j16	core, c	12	32.0	32.0	10.2	1.2	11.7	9j16	core, c		1	
9k7	chunk	0	8	0.0	9k7	chunk	4	25.3	16.2	4.1	1.0	9.8	9k7	chunk		1	
9k8	flake	0	4	0.0	9k8	flake	2	24.8	22.3	5.5	0.4	3.6	9k8	flake		1	
9L1	flake	0	7	0.0	9L1	flake	2	23.4	7.5	1.8	1.1	11.4	9L1	flake	1		
9L2	flake	3	7	42.9	9L2	flake	0	1.0	1.0	0.0	0.0	0.0	9L2	flake	1		
9L4	flake	2	4	50.0	9L4	flake	1	22.0	11.1	2.4	0.4	4.1	9L4	flake	1		
9L8	flake	5	6	83.3	9L8	flake	2	22.3	17.8	4.0	0.5	5.0	9L8	flake		1	
9L10	flake	2	5	40.0	9L10	flake	0	1.0	1.0	0.0	0.0	0.0	9L10	flake	1		
9L12	flake	5	5	100.0	9L12	flake	0	1.0	1.0	0.0	0.0	0.0	9L12	flake		1	
9L13	chunk	2	2	100.0	9L13	chunk	2	23.3	22.2	5.2	0.4	3.9	9L13	chunk		1	
9L14	flake	6	8	75.0	9L14	flake	1	47.5	29.0	13.8	0.1	0.7	9L14	flake		1	
9L16	core, c/p	24	37	64.9	9L16	core, c/p	1	43.8	35.7	15.6	0.1	0.6	9L16	core, c/p		1	
9m10	flake	4	9	44.4	9m10	flake	7	27.5	25.2	6.9	1.0	10.1	9m10	flake		1	
9m12	chunk	2	15	13.3	9m12	chunk	5	31.0	28.7	8.9	0.6	5.6	9m12	chunk		1	
9m15	core, c	3	23	13.0	9m15	core, c	7	29.5	25.8	7.6	0.9	9.2	9m15	core, c		1	
9n1	flake	0	2	0.0	9n1	flake	0	1.0	1.0	0.0	0.0	0.0	9n1	flake		1	
9n4	flake	1	4	25.0	9n4	flake	2	19.4	16.2	3.1	0.6	6.4	9n4	flake		1	
9n5	flake	4	4	100.0	9n5	flake	1	25.5	17.0	4.3	0.2	2.3	9n5	flake		1	

9n6	flake	1	6	16.7	9n6	flake	1	23.2	17.8	4.1	0.2	2.4	9n6	flake		1	
9n7	flake	5	9	55.6	9n7	flake	1	26.0	26.0	6.8	0.1	1.5	9n7	flake		1	
9n9	flake	4	4	100.0	9n9	flake	0	1.0	1.0	0.0	0.0	0.0	9n9	flake		1	
9n12	chunk	5	5	100.0	9n12	chunk	2	22.0	16.5	3.6	0.6	5.5	9n12	chunk		1	
9n14	chunk	3	4	75.0	9n14	chunk	1	28.6	28.0	8.0	0.1	1.2	9n14	chunk		1	
9n15	chunk	10	12	83.3	9n15	chunk	0	1.0	1.0	0.0	0.0	0.0	9n15	chunk		1	
9n16	core, pi	18	23	78.3	9n16	core, pi	2	46.0	24.0	11.0	0.2	1.8	9n16	core, pi		1	
9o14	flake	1	3	33.3	9o14	flake	4	41.8	21.7	9.1	0.4	4.4	9o14	flake		1	
9o15	flake	5	6	83.3	9o15	flake	2	35.7	25.4	9.1	0.2	2.2	9o15	flake		1	
9o17	handaxe/ point	9	31	29.0	9o17	handaxe/ point	3	48.6	44.0	21.4	0.1	1.4	9o17	handaxe/ point		1	
9p3	flake	0	2	0.0	9p3	flake	4	18.2	17.5	3.2	1.3	12.6	9p3	flake		1	
9p12	chunk	1	7	14.3	9p12	chunk	1	36.0	17.6	6.3	0.2	1.6	9p12	chunk	1		
9p16	core, pi	5	15	33.3	9p16	core, pi	6	38.4	34.8	13.4	0.4	4.5	9p16	core, pi	1		
9q3	flake	1	5	20.0	9q3	flake	0	1.0	1.0	0.0	0.0	0.0	9q3	flake			1
9q5	flake	2	3	66.7	9q5	flake	2	22.3	15.3	3.4	0.6	5.9	9q5	flake			1
9q9	chunk	3	5	60.0	9q9	chunk	1	23.7	7.0	1.7	0.6	6.0	9q9	chunk			1
9q11	chunk	5	7	71.4	9q11	chunk	2	33.0	27.0	8.9	0.2	2.2	9q11	chunk			1
9q12	core, pi	6	13	46.2	9q12	core, pi	1	42.0	37.3	15.7	0.1	0.6	9q12	core, pi			1
9r11	flake	1	12	8.3	9r11	flake	2	25.8	21.0	5.4	0.4	3.7	9r11	flake		1	
9r12	chunk	1	10	10.0	9r12	chunk	1	18.3	18.3	3.3	0.3	3.0	9r12	chunk		1	
15g1	flake	3	3	100.0	15g1	flake	0	1.0	1.0	0.0	0.0	0.0	15g1	flake			1
15g2	flake	1	1	100.0	15g2	flake	0	1.0	1.0	0.0	0.0	0.0	15g2	flake			1
15g4	chunk	4	4	100.0	15g4	chunk	0	1.0	1.0	0.0	0.0	0.0	15g4	chunk			1
15g5	chunk	6	6	100.0	15g5	chunk	1	41.4	31.4	13.0	0.1	0.8	15g5	chunk			1
16h1	flake	3	3	100.0	16h1	flake	4	23.4	17.0	4.0	1.0	10.1	16h1	flake	1		
19f/g2	flake	2	5	40.0	19f/g2	flake	5	37.0	34.4	12.7	0.4	3.9	19f/g2	flake		1	
19f/g3	core, pi	19	21	90.5	19f/g3	core, pi	9	36.7	35.5	13.0	0.7	6.9	19f/g3	core, pi		1	
16d1	flake	3	4	75.0	16d1	flake	4	48.0	22.0	10.6	0.4	3.8	16d1	flake		1	

s16e1	flake	7	11	63.6	s16e1	flake	6	47.2	22	10.4	0.6	5.8	s16e1	flake		1	
s16e2	chunk	4	4	100.0	s16e2	chunk	6	39.5	23.0	9.1	0.7	6.6	s16e2	chunk		1	
s16e3	core, pi	11	17	64.7	s16e3	core, pi	4	37.5	16.3	6.1	0.7	6.5	s16e3	core, pi		1	
19a2	flake	8	11	72.7	19a2	flake	9	42	40	16.8	0.5	5.4	19a2	flake		1	
19a3	core, p	28	32	87.5	19a3	core, p	10	70.6	37.6	26.5	0.4	3.8	19a3	core, p		1	
16g1	chunk	2	6	33.3	16g1	chunk	3	27.2	25.5	6.9	0.4	4.3	16g1	chunk		1	
16g3	flake	4	12	33.3	16g3	flake	6	43	29.3	12.6	0.5	4.8	16g3	flake		1	
15c2	flake	4	9	44.4	15c2	flake	20	54	32.5	17.6	1.1	11.4	15c2	flake		1	
15c3	handaxe	19	33	57.6	15c3	handaxe	31	88.0	36.7	32.3	1.0	9.6	15c3	handaxe		1	
19b2	flake	6	10	60.0	19b2	flake	10	45.0	44.3	19.9	0.5	5.0	19b2	flake		1	
19b4	core, c	14	23	60.9	19b4	core, c	16	48.0	45.0	21.6	0.7	7.4	19b4	core, c		1	
19c1	flake	5	8	62.5	19c1	flake	7	58	28.5	16.5	0.4	4.2	19c1	flake		1	
19c2	flake	3	3	100.0	19c2	flake	6	44.4	33.0	14.7	0.4	4.1	19c2	flake		1	
19c3	handaxe	22	36	61.1	19c3	handaxe	7	54	47.7	25.8	0.3	2.7	19c3	handaxe		1	
18a2	flake	5	8	62.5	18a2	flake	24	24.5	24.5	6.0	4.0	40.0	18a2	flake		1	
18a3	core, p	25	27	92.6	18a3	core, p	22	26.0	28.7	7.5	2.9	29.5	18a3	core, p		1	
18a4	core chunk	9	14	64.3	18a4	core chunk	14	23.5	18.7	4.4	3.2	31.9	18a4	core chunk		1	
16c2	flake	2	10	20.0	16c2	flake	0	1	1	0.0	0.0	0.0	16c2	flake	1		
16c3	flake	4	6	66.7	16c3	flake	10	66.0	46.0	30.4	0.3	3.3	16c3	flake	1		
16c4	core, cent	23	49	46.9	16c4	core, cent	1	79	60	47.4	0.0	0.2	16c4	core, cent	1		
15d3	flake	7	8	87.5	15d3	flake	7	51.0	28.0	14.3	0.5	4.9	15d3	flake	1		
S19e1	flake	0	9	0.0	S19e1	flake	0	1	1	0.0	0.0	0.0	S19e1	flake	1		
S19e2	chopper	7	15	46.7	S19e2	chopper	2	55.0	37.0	20.4	0.1	1.0	S19e2	chopper	1		
S19e3	core, cent	8	25	32.0	S19e3	core, cent	0	1	1	0.0	0.0	0.0	S19e3	core, cent	1		
15b1	flake	3	7	42.9	15b1	flake	6	21.0	12.0	2.5	2.4	23.8	15b1	flake		1	
15b2	chunk	10	10	100.0	15b2	chunk	4	17.7	15.6	2.8	1.4	14.5	15b2	chunk		1	
15b3	flake	11	11	100.0	15b3	flake	6	29.0	20.5	5.9	1.0	10.1	15b3	flake		1	

15b6	chunk	6	7	85.7	15b6	chunk	7	31.0	22.6	7.0	1.0	10.0	15b6	chunk		1	
15b7	flake	12	12	100.0	15b7	flake	13	48.2	34.8	16.8	0.8	7.8	15b7	flake		1	
15b8	flake	3	3	100.0	15b8	flake	21	46.4	36.4	16.9	1.2	12.4	15b8	flake		1	
15b9	chunk	9	9	100.0	15b9	chunk	9	19.5	19.5	3.8	2.4	23.7	15b9	chunk		1	
15b10	core, p	26	26	100.0	15b10	core, p	11	32.4	17.7	5.7	1.9	19.2	15b10	core, p		1	
18c1	flake	2	6	33.3	18c1	flake	6	17.7	9.2	1.6	3.7	36.8	18c1	flake		1	
18c2	flake	1	7	14.3	18c2	flake	6	19.0	14.7	2.8	2.1	21.5	18c2	flake		1	
18c3	flake	0	8	0.0	18c3	flake	9	24.4	13.5	3.3	2.7	27.3	18c3	flake		1	
18c4	flake	1	3	33.3	18c4	flake	3	26.7	13.5	3.6	0.8	8.3	18c4	flake		1	
18c5	flake	2	2	100.0	18c5	flake	16	35.6	13.0	4.6	3.5	34.6	18c5	flake		1	
18c6	flake	3	3	100.0	18c6	flake	18	43.8	35.0	15.3	1.2	11.7	18c6	flake		1	
18c7	flake	3	3	100.0	18c7	flake	21	57.0	29.2	16.6	1.3	12.6	18c7	flake		1	
18c8	flake	2	2	100.0	18c8	flake	11	44.5	18.0	8.0	1.4	13.7	18c8	flake		1	
18c9	chunk	9	15	60.0	18c9	chunk	16	46.3	33.4	15.5	1.0	10.3	18c9	chunk		1	
15k1	flake	1	2	50.0	15k1	flake	0	1.0	1.0	0.0	0.0	0.0	15k1	flake		1	
15k2	flake	0	4	0.0	15k2	flake	2	16.0	14.5	2.3	0.9	8.6	15k2	flake		1	
15k3	flake	0	5	0.0	15k3	flake	3	20.8	16.0	3.3	0.9	9.0	15k3	flake		1	
15k4	flake	0	3	0.0	15k4	flake	0	25.5	16.3	4.2	0.0	0.0	15k4	flake		1	
15k5	flake	0	7	0.0	15k5	flake	0	29.3	10.3	3.0	0.0	0.0	15k5	flake		1	
15k6	chunk	4	8	50.0	15k6	chunk	1	21.1	19.7	4.2	0.2	2.4	15k6	chunk		1	
15k7	flake	2	8	25.0	15k7	flake	1	34.3	23.7	8.1	0.1	1.2	15k7	flake		1	
15k9	flake	4	10	40.0	15k9	flake	7	55.0	21.7	11.9	0.6	5.9	15k9	flake		1	
15k10	core, cent	6	19	31.6	15k10	core, cent	9	53.6	37.0	19.8	0.5	4.5	15k10	core, cent		1	
16f1	flake	0	3	0.0	16f1	flake	2	16.7	12.5	2.1	1.0	9.6	16f1	flake		1	
16f2	flake	2	7	28.6	16f2	flake	5	22.2	16.6	3.7	1.4	13.6	16f2	flake		1	
16f3	flake	1	4	25.0	16f3	flake	6	25.4	19.0	4.8	1.2	12.4	16f3	flake		1	
16f4	flake	0	4	0.0	16f4	flake	5	37.0	14.7	5.4	0.9	9.2	16f4	flake		1	
16f5	flake	1	6	16.7	16f5	flake	2	33.0	21.3	7.0	0.3	2.8	16f5	flake		1	

16f6	flake	0	5	0.0	16f6	flake	4	33.0	30.0	9.9	0.4	4.0	16f6	flake		1	
16f7	flake	2	5	40.0	16f7	flake	2	34.5	27.5	9.5	0.2	2.1	16f7	flake		1	
16f8	flake	2	7	28.6	16f8	flake	8	46.3	32.0	14.8	0.5	5.4	16f8	flake		1	
16f10	core, p	5	29	17.2	16f10	core, p	5	45.0	37.0	16.7	0.3	3.0	16f10	core, p		1	
15i1	chunk	4	4	100.0	15i1	chunk	2	15.7	10.2	1.6	1.2	12.5	15i1	chunk		1	
15i2	chunk	2	2	100.0	15i2	chunk	2	15.3	13.3	2.0	1.0	9.8	15i2	chunk		1	
15i3	flake	1	3	33.3	15i3	flake	4	22.6	8.0	1.8	2.2	22.1	15i3	flake		1	
15i4	chunk	2	6	33.3	15i4	chunk	4	18.0	11.4	2.1	1.9	19.5	15i4	chunk		1	
15i5	chunk	2	2	100.0	15i5	chunk	2	22.6	21.0	4.7	0.4	4.2	15i5	chunk		1	
15i6	chunk	1	1	100.0	15i6	chunk	2	25.0	19.7	4.9	0.4	4.1	15i6	chunk		1	
15i7	chunk	3	3	100.0	15i7	chunk	5	52.8	27.4	14.5	0.3	3.5	15i7	chunk		1	
15i8	chunk	4	4	100.0	15i8	chunk	8	53.0	21.3	11.3	0.7	7.1	15i8	chunk		1	
15i9	chunk	4	4	100.0	15i9	chunk	14	60.0	23.6	14.2	1.0	9.9	15i9	chunk		1	
15i10	chunk	1	1	100.0	15i10	chunk	10	44.8	31.0	13.9	0.7	7.2	15i10	chunk		1	
18d1	flake	0	8	0.0	18d1	flake	3	27.4	11.5	3.2	1.0	9.5	18d1	flake			1
18d2	flake	0	1	0.0	18d2	flake	10	33.6	24.0	8.1	1.2	12.4	18d2	flake			1
18d4	flake	5	16	31.3	18d4	flake	11	39.0	30.0	11.7	0.9	9.4	18d4	flake			1
18d5	core, cent	10	20	50.0	18d5	core, cent	15	53.0	36.7	19.5	0.8	7.7	18d5	core, cent			1
S18e1	flake	2	3	66.7	S18e1	flake	4	18.4	9.0	1.7	2.4	24.2	S18e1	flake			1
S18e3	chunk	4	7	57.1	S18e3	chunk	4	25.0	18.0	4.5	0.9	8.9	S18e3	chunk			1
S18e4	chunk	4	7	57.1	S18e4	chunk	6	29.3	11.4	3.3	1.8	18.0	S18e4	chunk			1
S18e5	core, chunk	6	11	54.5	S18e5	core, chunk	17	42.3	35.5	15.0	1.1	11.3	S18e5	core, chunk			1
19d1	flake	0	5	0.0	19d1	flake	1	15.0	12.0	1.8	0.6	5.6	19d1	flake		1	
19d2	flake	3	3	100.0	19d2	flake	5	19.0	16.4	3.1	1.6	16.0	19d2	flake		1	
19d3	flake	2	6	33.3	19d3	flake	8	23.3	22.8	5.3	1.5	15.1	19d3	flake		1	
19d4	flake	1	1	100.0	19d4	flake	5	33.0	23.2	7.7	0.7	6.5	19d4	flake		1	
19d6	flake	1	3	33.3	19d6	flake	15	43.0	25.0	10.8	1.4	14.0	19d6	flake		1	
19d7	flake	4	4	100.0	19d7	flake	12	42.3	36.3	15.4	0.8	7.8	19d7	flake		1	

19d9	flake	2	2	100.0	19d9	flake	9	47.4	38.6	18.3	0.5	4.9	19d9	flake		1	
19d10	core, cent	20	38	52.6	19d10	core, cent	9	63.0	38.4	24.2	0.4	3.7	19d10	core, cent		1	
17a,b,c1	flake	2	7	28.6	17a,b,c1	flake	1	18.0	15.6	2.8	0.4	3.6	17a,b,c1	flake			1
17a,b,c2	chunk	2	7	28.6	17a,b,c2	chunk	2	21.2	12.4	2.6	0.8	7.6	17a,b,c2	chunk		1	
17a,b,c3	flake	0	1	0.0	17a,b,c3	flake	2	23.4	19.7	4.6	0.4	4.3	17a,b,c3	flake			1
17a,b,c4	flake	2	2	100.0	17a,b,c4	flake	2	39.4	18.2	7.2	0.3	2.8	17a,b,c4	flake			1
17a,b,c5	chunk	10	11	90.9	17a,b,c5	chunk	4	49.4	22.7	11.2	0.4	3.6	17a,b,c5	chunk			1
17a,b,c6	chunk	3	5	60.0	17a,b,c6	chunk	3	43.7	22.8	10.0	0.3	3.0	17a,b,c6	chunk		1	
17a,b,c7	core, pi	12	16	75.0	17a,b,c7	core, pi	1	46.2	35.5	16.4	0.1	0.6	17a,b,c7	core, pi			1
17a,b,c9	core, cent	15	15	100.0	17a,b,c9	core, cent	2	48.0	28.2	13.5	0.1	1.5	17a,b,c9	core, cent		1	
17a,b,c10	core, p	14	19	73.7	17a,b,c10	core, p	2	57.5	38.8	22.3	0.1	0.9	17a,b,c10	core, p			1
16a1	flake	0	4	0.0	16a1	flake	2	22.0	11.3	2.5	0.8	8.0	16a1	flake		1	
16a2	chunk	5	6	83.3	16a2	chunk	1	20.6	16.0	3.3	0.3	3.0	16a2	chunk		1	
16a3	flake	5	5	100.0	16a3	flake	2	22.6	21.8	4.9	0.4	4.1	16a3	flake		1	
16a4	flake	0	4	0.0	16a4	flake	3	27.6	20.0	5.5	0.5	5.4	16a4	flake		1	
16a5	flake	5	6	83.3	16a5	flake	3	27.0	26.0	7.0	0.4	4.3	16a5	flake		1	
16a8	chunk	11	11	100.0	16a8	chunk	5	26.0	20.0	5.2	1.0	9.6	16a8	chunk		1	
16a10	core, cent	28	35	80.0	16a10	core, cent	6	53.6	38.2	20.5	0.3	2.9	16a10	core, cent		1	
18b1	chunk	0	7	0.0	18b1	chunk	4	14.3	14.3	2.0	2.0	19.6	18b1	chunk		1	
18b2	flake	0	4	0.0	18b2	flake	11	22.7	16.2	3.7	3.0	29.9	18b2	flake		1	
18b3	flake	0	6	0.0	18b3	flake	14	28.0	19.2	5.4	2.6	26.0	18b3	flake		1	
18b4	flake	0	3	0.0	18b4	flake	14	35.8	17.8	6.4	2.2	22.0	18b4	flake		1	
18b5	flake	4	7	57.1	18b5	flake	13	35.6	24.2	8.6	1.5	15.1	18b5	flake		1	
18b6	flake	0	4	0.0	18b6	flake	20	48.5	32.3	15.7	1.3	12.8	18b6	flake		1	
18b7	flake	5	6	83.3	18b7	flake	23	52.2	28.0	14.6	1.6	15.7	18b7	flake		1	
18b9	chopper	16	35	45.7	18b9	chopper	14	23.4	33.3	7.8	1.8	18.0	18b9	chopper		1	
18b10	handaxe	22	49	44.9	18b10	handaxe	18	49.0	24.8	12.2	1.5	14.8	18b10	handaxe		1	

15a1	flake	5	5	100.0	15a1	flake	2	22.8	17.0	3.9	0.5	5.2	15a1	flake		1	
15a2	flake	0	7	0.0	15a2	flake	3	28.8	25.0	7.2	0.4	4.2	15a2	flake		1	
15a5	flake	4	6	66.7	15a5	flake	3	48.0	44.0	21.1	0.1	1.4	15a5	flake		1	
15a7	flake	6	17	35.3	15a7	flake	3	75.0	43.4	32.6	0.1	0.9	15a7	flake		1	
15a8	flake	4	18	22.2	15a8	flake	4	65.6	58.2	38.2	0.1	1.0	15a8	flake		1	
15a9	handaxe	1	43	2.3	15a9	handaxe	6	49.4	28.2	13.9	0.4	4.3	15a9	handaxe		1	
15a10	chopper	30	50	60.0	15a10	chopper	3	84.7	38.2	32.4	0.1	0.9	15a10	chopper		1	
21a2	chunk	4	4	100.0	21a2	chunk	1	34.4	24.4	8.4	0.1	1.2	21a2	chunk		1	
21a3	flake	3	3	100.0	21a3	flake	0	36.5	18.4	6.7	0.0	0.0	21a3	flake		1	
21a4	flake	1	1	100.0	21a4	flake	1	42.8	16.0	6.8	0.1	1.5	21a4	flake		1	
21a5	flake	5	5	100.0	21a5	flake	4	33.0	31.0	10.2	0.4	3.9	21a5	flake		1	
21a6	flake	1	2	50.0	21a6	flake	4	45.6	34.8	15.9	0.3	2.5	21a6	flake		1	
21a7	core, frag	6	6	100.0	21a7	core, frag	5	40.0	27.8	11.1	0.4	4.5	21a7	core, frag		1	
21a8	chopper	9	12	75.0	21a8	chopper	2	25.0	25.0	6.3	0.3	3.2	21a8	chopper		1	
21a9	flake	4	4	100.0	21a9	flake	15	69.2	53.0	36.7	0.4	4.1	21a9	flake		1	
21a10	flake	2	2	100.0	21a10	flake	15	61.3	59.0	36.2	0.4	4.1	21a10	flake		1	
S21e1	flake	1	2	50.0	S21e1	flake	1	26.5	17.8	4.7	0.2	2.1	S21e1	flake			1
S21e2	flake	2	3	66.7	S21e2	flake	2	46.7	28.0	13.1	0.2	1.5	S21e2	flake		1	
S21e4	flake	3	4	75.0	S21e4	flake	4	55.5	39.4	21.9	0.2	1.8	S21e4	flake		1	
S21e5	core, p	10	29	34.5	S21e5	core, p	2	69.0	39.0	26.9	0.1	0.7	S21e5	core, p		1	
21r1	bip flake	2	3	66.7	21r1	bip flake	1	22.6	7.8	1.8	0.6	5.7	21r1	bip flake			1
21r2	bip flake	3	3	100.0	21r2	bip flake	2	24.3	15.3	3.7	0.5	5.4	21r2	bip flake			1
21r3	bip flake	4	5	80.0	21r3	bip flake	1	36.6	15.2	5.6	0.2	1.8	21r3	bip flake			1
21r4	bip flake	3	4	75.0	21r4	bip flake	3	41.4	19.5	8.1	0.4	3.7	21r4	bip flake			1
21r5	bip flake	2	4	50.0	21r5	bip flake	4	43.7	19.6	8.6	0.5	4.7	21r5	bip flake			1
21k1	flake	1	5	20.0	21k1	flake	0	22.7	14.8	3.4	0.0	0.0	21k1	flake		1	
21k2	flake	1	3	33.3	21k2	flake	0	31.2	17.0	5.3	0.0	0.0	21k2	flake		1	
21k3	flake	1	1	100.0	21k3	flake	2	28.2	24.7	7.0	0.3	2.9	21k3	flake		1	
21k4	flake	4	6	66.7	21k4	flake	1	29.7	27.5	8.2	0.1	1.2	21k4	flake		1	

21k5	flake	4	8	50.0	21k5	flake	1	38.7	22.5	8.7	0.1	1.1	21k5	flake		1	
21k6	flake	3	3	100.0	21k6	flake	1	36.4	24.5	8.9	0.1	1.1	21k6	flake		1	
21k7	flake	1	1	100.0	21k7	flake	1	43.3	27.8	12.0	0.1	0.8	21k7	flake		1	
21k8	chunk	4	8	50.0	21k8	chunk	2	29.0	22.0	6.4	0.3	3.1	21k8	chunk		1	
21k10	chopper/ cent core	9	26	34.6	21k10	chopper/ cent core	1	45.0	27.6	12.4	0.1	0.8	21k10	chopper/ cent core		1	
6h1	flake	1	8	12.5	6h1	flake	0	40.5	30.0	12.2	0.0	0.0	6h1	flake		1	
6h2	flake	3	3	100.0	6h2	flake	2	48.4	38.0	18.4	0.1	1.1	6h2	flake		1	
6h4	core, cent	10	27	37.0	6h4	core, cent	5	62.8	39.7	24.9	0.2	2.0	6h4	core, cent		1	
6h5	core, p	4	30	13.3	6h5	core, p	1	49.8	39.3	19.6	0.1	0.5	6h5	core, p		1	
8p2	flake	2	3	66.7	8p2	flake	2	34.3	23.3	8.0	0.3	2.5	8p2	flake		1	
8p3	flake	1	2	50.0	8p3	flake	7	38.7	35.6	13.8	0.5	5.1	8p3	flake		1	
8p4	chunk	4	7	57.1	8p4	chunk	5	37.3	23.0	8.6	0.6	5.8	8p4	chunk		1	
8p5	core, pi	4	14	28.6	8p5	core, pi	3	42.2	25.4	10.7	0.3	2.8	8p5	core, pi		1	
10s1	flake	2	2	100.0	10s1	flake	1	18.0	16.6	3.0	0.3	3.3	10s1	flake		1	
10s3	flake	1	2	50.0	10s3	flake	6	23.0	22.4	5.2	1.2	11.6	10s3	flake		1	
10s4	flake	5	6	83.3	10s4	flake	10	25.0	17.6	4.4	2.3	22.7	10s4	flake		1	
10s5	flake	3	4	75.0	10s5	flake	15	27.0	25.6	6.9	2.2	21.7	10s5	flake		1	
10s6	retouch	4	9	44.4	10s6	retouch	12	37.2	28.0	10.4	1.2	11.5	10s6	retouch		1	
10s8	flake	2	2	100.0	10s8	flake	14	41.7	29.0	12.1	1.2	11.6	10s8	flake		1	
10s9	core, pi	5	13	38.5	10s9	core, pi	9	22.0	19.8	4.4	2.1	20.7	10s9	core, pi		1	
10s10	core, pi	4	15	26.7	10s10	core, pi	11	33.4	32.6	10.9	1.0	10.1	10s10	core, pi		1	
14b2	handaxe	8	42	19.0	14b2	handaxe	2	66.7	48.0	32.0	0.1	0.6	14b2	handaxe		1	
14b3	core, flat/p	14	26	53.8	14b3	core, flat/p	2	57.0	49.7	28.3	0.1	0.7	14b3	core, flat/p		1	
14r1	flake	2	2	100.0	14r1	flake	1	21.8	16.7	3.6	0.3	2.7	14r1	flake			1
14r2	flake	3	4	75.0	14r2	flake	4	29.0	21.8	6.3	0.6	6.3	14r2	flake			1
14r3	core, casual	5	5	100.0	14r3	core, casual	3	48.5	31.0	15.0	0.2	2.0	14r3	core, casual		1	
20af1	flake	6	6	100.0	20af1	flake	2	20.0	16.2	3.2	0.6	6.2	20af1	flake		1	

S5edug1	retouch	1	6	16.7	S5edug1	retouch	1	21.4	19.5	4.2	0.2	2.4	S5edug1	retouch			1
S5edug2	core, casual	2	4	50.0	S5edug2	core, casual	1	32.0	32.0	10.2	0.1	1.0	S5edug2	core, casual		1	
34b1	chunk	2	7	28.6	34b1	chunk	2	22.4	15.8	3.5	0.6	5.7	34b1	chunk		1	
34b3	core, p	7	13	53.8	34b3	core, p	3	44.7	41.5	18.6	0.2	1.6	34b3	core, p		1	
10L1	flake	3	3	100.0	10L1	flake	5	27.4	24.0	6.6	0.8	7.6	10L1	flake		1	
10L2	core, pi	16	20	80.0	10L2	core, pi	11	38.0	31.5	12.0	0.9	9.2	10L2	core, pi		1	
10r3	core, pi	4	13	30.8	10r3	core, pi	2	40.0	29.5	11.8	0.2	1.7	10r3	core, pi		1	
10v2	core, pi	12	28	42.9	10v2	core, pi	3	40.5	36.0	14.6	0.2	2.1	10v2	core, pi		1	
5kdug1	flake	3	12	25.0	5kdug1	flake	1	20.0	18.6	3.7	0.3	2.7	5kdug1	flake		1	
5kdug3	flake	2	2	100.0	5kdug3	flake	4	45.3	26.0	11.8	0.3	3.4	5kdug3	flake		1	
14m1	flake	3	4	75.0	14m1	flake	3	37.3	25.2	9.4	0.3	3.2	14m1	flake		1	
14m2	chunk	4	12	33.3	14m2	chunk	3	56.8	27.8	15.8	0.2	1.9	14m2	chunk		1	
34a1	flake	2	2	100.0	34a1	flake	7	31.8	17.0	5.4	1.3	12.9	34a1	flake		1	
34a2	flake	3	10	30.0	34a2	flake	3	30.0	20.0	6.0	0.5	5.0	34a2	flake		1	
34a3	core, p	3	16	18.8	34a3	core, p	1	37.0	33.6	12.4	0.1	0.8	34a3	core, p		1	
10h1	flake	3	8	37.5	10h1	flake	1	25.3	19.2	4.9	0.2	2.1	10h1	flake		1	
10h3	flake	3	8	37.5	10h3	flake	7	25.8	23.6	6.1	1.1	11.5	10h3	flake		1	
10h4	flake	3	9	33.3	10h4	flake	9	28.0	21.3	6.0	1.5	15.1	10h4	flake		1	
10h5	flake	5	5	100.0	10h5	flake	12	34.3	26.3	9.0	1.3	13.3	10h5	flake		1	
10h6	flake	4	6	66.7	10h6	flake	12	40.7	26.0	10.6	1.1	11.3	10h6	flake		1	
10h8	chunk	9	18	50.0	10h8	chunk	13	40.0	41.7	16.7	0.8	7.8	10h8	chunk		1	
10h9	core, p	9	27	33.3	10h9	core, p	19	28.2	27.8	7.8	2.4	24.2	10h9	core, p		1	
10h10	core, p	11	23	47.8	10h10	core, p	22	39.8	33.2	13.2	1.7	16.6	10h10	core, p		1	
14L1	flake	2	2	100.0	14L1	flake	4	57.0	28.2	16.1	0.2	2.5	14L1	flake		1	
14L2	core, cent	12	23	52.2	14L2	core, cent	19	68.0	51.0	34.7	0.5	5.5	14L2	core, cent		1	
8q1	flake	5	6	83.3	8q1	flake	3	26.0	18.0	4.7	0.6	6.4	8q1	flake		1	
8q2	flake	2	2	100.0	8q2	flake	5	28.7	28.6	8.2	0.6	6.1	8q2	flake		1	
8t1	flake	1	7	14.3	8t1	flake	3	33.0	22.8	7.5	0.4	4.0	8t1	flake		1	

6g1	core, p	6	11	54.5	6g1	core, p	1	30.3	21.3	6.5	0.2	1.5	6g1	core, p		1	
8u2	core, pi	15	18	83.3	8u2	core, pi	18	72.4	39.4	28.5	0.6	6.3	8u2	core, pi		1	
8w1	flake	0	10	0.0	8w1	flake	0	28.2	26.8	7.6	0.0	0.0	8w1	flake	1		
8w3	flake	3	5	60.0	8w3	flake	4	45.4	23.0	10.4	0.4	3.8	8w3	flake		1	
8w8	flake	1	8	12.5	8w8	flake	1	43.0	37.0	15.9	0.1	0.6	8w8	flake		1	
8w9	handaxe	7	45	15.6	8w9	handaxe	1	55.0	46.0	25.3	0.0	0.4	8w9	handaxe		1	
8w10	core, cent	12	28	42.9	8w10	core, cent	3	68.6	64.7	44.4	0.1	0.7	8w10	core, cent		1	
11b1	flake	8	11	72.7	11b1	flake	3	41.8	36.6	15.3	0.2	2.0	11b1	flake			1
11b2	flake	7	13	53.8	11b2	flake	1	48.0	35.0	16.8	0.1	0.6	11b2	flake			1
11b4	core, cent	9	19	47.4	11b4	core, cent	2	56.4	44.2	24.9	0.1	0.8	11b4	core, cent		1	
8r1	flake	3	4	75.0	8r1	flake	1	23.0	17.8	4.1	0.2	2.4	8r1	flake		1	
8r2	flake	3	5	60.0	8r2	flake	1	29.2	19.0	5.5	0.2	1.8	8r2	flake		1	
8s2	flake	5	11	45.5	8s2	flake	4	29.0	26.0	7.5	0.5	5.3	8s2	flake		1	
32a1	flake	3	3	100.0	32a1	flake	4	21.5	18.5	4.0	1.0	10.1	32a1	flake			1
32a2	flake	1	1	100.0	32a2	flake	7	30.5	23.3	7.1	1.0	9.9	32a2	flake			1
32a3	flake	5	6	83.3	32a3	flake	3	30.4	22.7	6.9	0.4	4.3	32a3	flake			1
32a5	core, p	25	29	86.2	32a5	core, p	20	37.5	36.8	13.8	1.4	14.5	32a5	core, p			1
14k1	flake	5	5	100.0	14k1	flake	4	25.7	21.0	5.4	0.7	7.4	14k1	flake			1
14k2	flake	3	3	100.0	14k2	flake	4	26.0	19.8	5.1	0.8	7.8	14k2	flake			1
14k3	flake	2	2	100.0	14k3	flake	8	35.3	23.6	8.3	1.0	9.6	14k3	flake			1
14k5	core, p	14	15	93.3	14k5	core, p	5	66.8	51.6	34.5	0.1	1.5	14k5	core, p			1
5bdug1	flake	3	4	75.0	5bdug1	flake	0	22.0	8.3	1.8	0.0	0.0	5bdug1	flake			1
5bdug2	flake	1	1	100.0	5bdug2	flake	6	17.3	13.7	2.4	2.5	25.3	5bdug2	flake			1
5bdug3	flake	0	2	0.0	5bdug3	flake	0	20.8	7.6	1.6	0.0	0.0	5bdug3	flake			1
5bdug4	flake	2	2	100.0	5bdug4	flake	2	25.2	11.1	2.8	0.7	7.2	5bdug4	flake			1
5bdug5	flake	6	7	85.7	5bdug5	flake	2	25.0	15.8	4.0	0.5	5.1	5bdug5	flake			1
5bdug6	flake	3	3	100.0	5bdug6	flake	7	19.3	19.2	3.7	1.9	18.9	5bdug6	flake			1
5bdug10	core,	4	8	50.0	5bdug10	core,	7	40.5	38.8	15.7	0.4	4.5	5bdug10	core,			1

	casual					casual								casual			
5csurf3	core, p	9	16	56.3	5csurf3	core, p	5	47.0	41.7	19.6	0.3	2.6	5csurf3	core, p			1
5csurf4	flake	2	3	66.7	5csurf4	flake	3	65.3	28.0	18.3	0.2	1.6	5csurf4	flake			1
5csurf5	flake	4	6	66.7	5csurf5	flake	4	53.0	44.4	23.5	0.2	1.7	5csurf5	flake			1
13a1	flake	1	1	100.0	13a1	flake	3	32.0	18.0	5.8	0.5	5.2	13a1	flake			1
13a3	flake	4	4	100.0	13a3	flake	2	31.8	28.0	8.9	0.2	2.2	13a3	flake			1
13a5	flake	1	1	100.0	13a5	flake	3	41.6	25.5	10.6	0.3	2.8	13a5	flake			1
10m1	flake	1	5	20.0	10m1	flake	0	17.7	13.8	2.4	0.0	0.0	10m1	flake		1	
10m2	flake	1	5	20.0	10m2	flake	1	24.7	10.5	2.6	0.4	3.9	10m2	flake		1	
10m3	flake	4	6	66.7	10m3	flake	0	29.5	15.0	4.4	0.0	0.0	10m3	flake		1	
10m5	flake	3	3	100.0	10m5	flake	3	27.7	16.3	4.5	0.7	6.6	10m5	flake		1	
10m6	flake	5	5	100.0	10m6	flake	2	27.0	22.5	6.1	0.3	3.3	10m6	flake		1	
10m7	flake	3	6	50.0	10m7	flake	1	38.0	22.5	8.6	0.1	1.2	10m7	flake		1	
10m9	flake	1	1	100.0	10m9	flake	4	43.2	27.6	11.9	0.3	3.4	10m9	flake		1	
10m10	core, p	14	23	60.9	10m10	core, p	5	42.3	31.7	13.4	0.4	3.7	10m10	core, p		1	
11a2	flake	1	1	100.0	11a2	flake	5	29.7	20.7	6.1	0.8	8.1	11a2	flake		1	
11a3	flake	3	3	100.0	11a3	flake	4	31.0	27.7	8.6	0.5	4.7	11a3	flake			1
11a4	flake	6	9	66.7	11a4	flake	5	28.9	26.8	7.7	0.6	6.5	11a4	flake			1
11a6	flake	11	11	100.0	11a6	flake	11	24.0	15.2	3.6	3.0	30.2	11a6	flake		1	
11a8	core, pi	23	24	95.8	11a8	core, pi	10	22.7	20.7	4.7	2.1	21.3	11a8	core, pi		1	
11a9	core, flat	20	20	100.0	11a9	core, flat	8	38.6	19.2	7.4	1.1	10.8	11a9	core, flat		1	
11a10	chopper	19	26	73.1	11a10	chopper	6	18.6	17.1	3.2	1.9	18.9	11a10	chopper		1	
8x1	flake	4	4	100.0	8x1	flake	2	18.0	11.7	2.1	0.9	9.5	8x1	flake		1	
8x2	flake	4	4	100.0	8x2	flake	1	19.8	10.7	2.1	0.5	4.7	8x2	flake		1	
8x3	flake	4	4	100.0	8x3	flake	3	29.0	20.8	6.0	0.5	5.0	8x3	flake		1	
8x4	chunk	5	5	100.0	8x4	chunk	3	34.1	28.5	9.7	0.3	3.1	8x4	chunk		1	
8x5	chunk	5	6	83.3	8x5	chunk	3	38.4	25.9	9.9	0.3	3.0	8x5	chunk		1	
8x6	flake	5	5	100.0	8x6	flake	2	40.6	31.0	12.6	0.2	1.6	8x6	flake			1
8x7	core,	11	14	78.6	8x7	core,	4	40.0	30.0	12.0	0.3	3.3	8x7	core,		1	

	casual					casual								casual			
8x8	core, frag	5	9	55.6	8x8	core, frag	2	47.8	28.0	13.4	0.1	1.5	8x8	core, frag			1
8x10	core, pi	19	19	100.0	8x10	core, pi	4	68.0	39.2	26.7	0.2	1.5	8x10	core, pi		1	
33b1	flake	5	6	83.3	33b1	flake	3	20.0	16.4	3.3	0.9	9.1	33b1	flake		1	
33b3	flake	4	4	100.0	33b3	flake	5	30.0	27.2	8.2	0.6	6.1	33b3	flake		1	
33b4	flake	4	5	80.0	33b4	flake	5	38.3	9.4	3.6	1.4	13.9	33b4	flake		1	
33b5	flake	1	1	100.0	33b5	flake	7	37.7	36.0	13.6	0.5	5.2	33b5	flake		1	
33b7	flake	3	4	75.0	33b7	flake	7	28.8	24.6	7.1	1.0	9.9	33b7	flake		1	
33b9	core, flat	11	16	68.8	33b9	core, flat	5	31.8	28.0	8.9	0.6	5.6	33b9	core, flat		1	
33b10	core, flat	23	26	88.5	33b10	core, flat	7	33.5	29.2	9.8	0.7	7.2	33b10	core, flat		1	
27b1	flake	0	3	0.0	27b1	flake	0	21.0	12.5	2.6	0.0	0.0	27b1	flake	1		
27b2	flake	2	6	33.3	27b2	flake	1	25.4	20.0	5.1	0.2	2.0	27b2	flake	1		
27b3	flake	2	11	18.2	27b3	flake	0	36.8	12.5	4.6	0.0	0.0	27b3	flake	1		
27b4	flake	3	5	60.0	27b4	flake	1	33.0	24.2	8.0	0.1	1.3	27b4	flake	1		
27b5	flake	1	1	100.0	27b5	flake	3	56.0	16.3	9.1	0.3	3.3	27b5	flake	1		
27b6	flake	1	11	9.1	27b6	flake	0	39.0	24.8	9.7	0.0	0.0	27b6	flake	1		
27b8	flake	5	12	41.7	27b8	flake	3	63.5	41.3	26.2	0.1	1.1	27b8	flake	1		
27b10	handaxe	17	41	41.5	27b10	handaxe	1	83.0	55.5	46.1	0.0	0.2	27b10	handaxe	1		
30h1	cutting	0	22	0.0	30h1	cutting	0	40.0	22.6	9.0	0.0	0.0	30h1	cutting		1	
30h2	flake	1	1	100.0	30h2	flake	1	45.3	34.6	15.7	0.1	0.6	30h2	flake		1	
30k1	flake	4	8	50.0	30k1	flake	1	26.7	24.0	6.4	0.2	1.6	30k1	flake		1	
23d2	flake	2	6	33.3	23d2	flake	2	42.6	28.4	12.1	0.2	1.7	23d2	flake		1	
S30e1	flake	3	4	75.0	S30e1	flake	1	22.6	21.5	4.9	0.2	2.1	S30e1	flake		1	
S30e2	flake	7	7	100.0	S30e2	flake	1	28.2	18.0	5.1	0.2	2.0	S30e2	flake		1	
S30e3	flake	1	5	20.0	S30e3	flake	1	35.0	26.8	9.4	0.1	1.1	S30e3	flake		1	
S30e5	flake	7	9	77.8	S30e5	flake	1	43.8	30.5	13.4	0.1	0.7	S30e5	flake		1	
S30e6	flake	4	5	80.0	S30e6	flake	1	42.0	33.5	14.1	0.1	0.7	S30e6	flake		1	
S30e7	core, flat	14	15	93.3	S30e7	core, flat	1	47.2	44.2	20.9	0.0	0.5	S30e7	core, flat		1	
S30e8	flake	10	14	71.4	S30e8	flake	1	45.6	42.2	19.2	0.1	0.5	S30e8	flake		1	

S30e10	core, cent	17	19	89.5	S30e10	core, cent	1	45.5	45.5	20.7	0.0	0.5	S30e10	core, cent		1	
30j1	flake	2	8	25.0	30j1	flake	1	20.0	15.5	3.1	0.3	3.2	30j1	flake		1	
30j2	flake	9	16	56.3	30j2	flake	0	28.2	24.3	6.9	0.0	0.0	30j2	flake		1	
30j3	flake	0	1	0.0	30j3	flake	0	24.8	16.6	4.1	0.0	0.0	30j3	flake		1	
30j4	chunk	5	7	71.4	30j4	chunk	1	29.5	23.3	6.9	0.1	1.5	30j4	chunk		1	
30j5	core, flat	5	10	50.0	30j5	core, flat	1	27.0	23.0	6.2	0.2	1.6	30j5	core, flat		1	
30i1	flake	3	5	60.0	30i1	flake	3	25.0	9.8	2.5	1.2	12.2	30i1	flake		1	
30i3	cutting	3	8	37.5	30i3	cutting	0	29.0	15.6	4.5	0.0	0.0	30i3	cutting		1	
30i4	core, casual	7	14	50.0	30i4	core, casual	1	27.0	19.7	5.3	0.2	1.9	30i4	core, casual		1	
30i5	chunk	6	8	75.0	30i5	chunk	2	38.0	15.0	5.7	0.4	3.5	30i5	chunk		1	
n				**Mean**	**n**							**Mean**	**n**				
366				60.9%	**366**							6.5	**366**		26	281	59
														Percentage of sample	7.1	76.8	16.1

Table 20: Mann-Whitney test results for IERs

SWK vs EXP	Oldowan	quartzite
A (N=445) vs. B(N=43)		
Mean ranks:	226.4	18.09
T=Ub:	7.88E+03	
p(same):	5.50E-02	
Monte Carlo p:	0.055	

SWK vs EXP	Oldowan	quartz
D (N=347) vs. E(N=375)		
Mean ranks:	201.5	160
T=Ub:	4.50E+04	
p(same):	6.34E-13	
Monte Carlo p:	<0.0001	

SWK vs EXP	Oldowan	chert
G (N=882) vs. H(N=274)		
Mean ranks:	472.8	105.7
T=Ub:	8.45E+04	
p(same):	4.26E-14	
Monte Carlo p:	<0.0001	

STK vs EXP	Oldowan	quartzite
A (N=77) vs. B(N=445)		
Mean ranks:	24.11	237.4
T=Ub:	9585	
p(same):	4.93E-10	
Monte Carlo p:	<0.0001	

STK vs EXP	Oldowan	quartz
D (N=347) vs. E(N=157)		
Mean ranks:	199.8	52.7
T=Ub:	1.42E+04	
p(same):	3.30E-18	
Monte Carlo p:	<0.0001	

STK vs EXP	Oldowan	chert
G (N=882) vs. H(N=21)		
Mean ranks:	447.9	4.127
T=Ub:	3496	
p(same):	9.82E-07	
Monte Carlo p:	<0.0001	

STK vs SWK	Oldowan	quartzite
A (N=77) vs. B(N=43)		
Mean ranks:	34.94	25.56
T=Ub:	1190	
p(same):	7.67E-03	
Monte Carlo p:	0.0071	

STK vs SWK	Oldowan	quartz
D (N=157) vs. E(N=375)		
Mean ranks:	66.61	199.9
T=Ub:	2.30E+04	
p(same):	5.60E-05	
Monte Carlo p:	<0.0001	

STK vs SWK	Oldowan	chert
G (N=21) vs. H(N=274)		
Mean ranks:	7.325	140.7
T=Ub:	1930	
p(same):	0.01149	
Monte Carlo p:	0.0088	

SWK vs EXP	Acheulean	quartzite
A (N=34) vs. B(N=303)		
Mean ranks:	9.568	159.4

SWK vs EXP	Acheulean	quartz
D (N=18) vs. E(N=174)		
Mean ranks:	4.576	91.92

SWK vs EXP	Acheulean	chert
G (N=60) vs. H(N=366)		
Mean ranks:	19.58	193.9

T=Ub:	2630	
p(same):	2.45E-06	
Monte Carlo p:	<0.0001	

T=Ub:	707.5	
p(same):	0.000121	
Monte Carlo p:	<0.0001	

T=Ub:	6513	
p(same):	3.32E-07	
Monte Carlo p:	<0.0001	

STK vs EXP	Acheulean	quartzite
J (N=34) vs. K(N=303)		
Mean ranks:	11.92	157.1
T=Ub:	3424	
p(same):	0.001248	
Monte Carlo p:	0.0007	

STK vs EXP	Acheulean	quartz
M (N=33) vs. N(N=174)		
Mean ranks:	7.867	96.13
T=Ub:	1068	
p(same):	8.99E-09	
Monte Carlo p:	<0.0001	

STK vs EXP	Acheulean	chert
n/a STK sample too small		

STK vs SWK	Acheulean	quartzite
A (N=34) vs. B(N=34)		
Mean ranks:	18.4	16.1
T=Ub:	500	
p(same):	0.3295	
Monte Carlo p:	0.3238	

STK vs SWK	Acheulean	quartz
A (N=18) vs. B(N=33)		
Mean ranks:	10.06	15.94
T=Ub:	252	
p(same):	0.3728	
Monte Carlo p:	0.3717	

STK vs SWK	Acheulean	chert
n/a STK sample too small		

Table 21: Mann-Whitney test results for FERs

SWK vs EXP	Oldowan	quartz
A (N=375) vs. B(N=347)		
Mean ranks:	158.9	202.6
T=Ub:	4.42E+04	
p(same):	1.02E-13	
Monte Carlo p:	<0.0001	

SWK vs EXP	Oldowan	chert
D (N=274) vs. E(N=882)		
Mean ranks:	123	455.5
T=Ub:	1.05E+05	
p(same):	7.48E-04	
Monte Carlo p:	0.0005	

STK vs EXP	Oldowan	quartz
G (N=81) vs. H(N=347)		
Mean ranks:	26.08	188.4
T=Ub:	7.84E+03	
p(same):	5.72E-10	
Monte Carlo p:	<0.0001	

STK vs EXP	Oldowan	chert
J (N=20) vs. K(N=882)		
Mean ranks:	5.16	446.3
T=Ub:	4445	
p(same):	1.46E-04	
Monte Carlo p:	0.0001	

STK vs SWK	Oldowan	quartz
M (N=81) vs. N(N=375)		
Mean ranks:	34.75	193.7
T=Ub:	1.25E+04	
p(same):	1.34E-02	
Monte Carlo p:	0.0144	

STK vs SWK	Oldowan	chert
P (N=20) vs. Q(N=274)		
Mean ranks:	6.689	140.8
T=Ub:	1757	
p(same):	0.00727	
Monte Carlo p:	0.0074	

SWK vs EXP	Acheulean	quartz
A (N=18) vs. B(N=174)		

SWK vs EXP	Acheulean	chert
D (N=60) vs. E(N=366)		

Mean ranks:	7.883	88.62
T=Ub:	1343	
p(same):	0.3204	
Monte Carlo p:	0.3244	

STK vs EXP	Acheulean	quartz
G (N=33) vs. H(N=174)		
Mean ranks:	10.18	93.82
T=Ub:	1547	
p(same):	2.72E-05	
Monte Carlo p:	<0.0001	

STK vs SWK	Acheulean	quartz
K (N=18) vs. L(N=33)		
Mean ranks:	11.92	14.08
T=Ub:	157	
p(same):	0.005953	
Monte Carlo p:	0.0046	

Mean ranks:	30.72	182.8
T=Ub:	1.07E+04	
p(same):	7.53E-01	
Monte Carlo p:	0.7566	

STK vs EXP	Acheulean	chert
n/a STK sample too small		

STK vs SWK	Acheulean	chert
n/a STK sample too small		

Table 22: Chi-square test results for weathering distributions

STK vs EXP	Oldowan	quartzite	p
36.4	55.8	7.8	0.000
13.93258	52.35955	33.70787	
SWK vs EXP	Oldowan	quartzite	
65.11628	30.23256	4.651163	0.000
13.93258	52.35955	33.70787	
STK vs SWK	Oldowan	quartzite	
36.36364	55.84416	7.792208	0.000
65.11628	30.23256	4.651163	
SWK vs STK	Oldowan	quartzite	
65.11628	30.23256	4.651163	0.000
36.36364	55.84416	7.792208	

STK vs EXP	Oldowan	quartz	p
88.88889	8.641975	2.469136	0.000
37.75216	47.83862	14.40922	
SWK vs EXP	Oldowan	quartz	
71.73333	28.26667	0	0.000
37.75216	47.83862	14.40922	
STK vs SWK	Oldowan	quartz	
88.88889	8.641975	2.469136	0.000
71.73333	28.26667	0.01	
SWK vs STK	Oldowan	quartz	
71.73333	28.26667	0	0.000
88.88889	8.641975	2.469136	

STK vs EXP	Oldowan	chert	p
30	70	0	0.000
12.58503	72.78912	14.62585	
SWK vs EXP	Oldowan	chert	
24.08759	74.81752	1.094891	0.000
12.58503	72.78912	14.62585	
STK vs SWK	Oldowan	chert	
30.0	70.0	0.0	0.242
24.1	74.8	1.1	
SWK vs STK	Oldowan	chert	
24.1	74.8	1.1	0.000
30.0	70.0	0.0	

Table 23: Chi-square test results for weathering distributions

STK vs EXP	Acheulean	quartzite	
67.6	29.4	2.9	0.000
10.63123	51.82724	37.54153	
SWK vs EXP	Acheulean	quartzite	
61.76471	38.23529	0	0.000
10.6	51.8	37.5	
STK vs SWK	Acheulean	quartzite	
67.6	29.4	2.9	0.000
61.76471	38.23529	0.01	
SWK vs STK	Acheulean	quartzite	
61.76471	38.23529	0.01	0.048
67.6	29.4	2.9	

STK vs EXP	Acheulean	quartz	
90.90909	9.090909	0	0.000
36.2069	50	13.7931	
SWK vs EXP	Acheulean	quartz	
72.22222	27.77778	0	0.000
36.2	50.0	13.8	
STK vs SWK	Acheulean	quartz	
90.90909	9.090909	0.01	0.000
72.22222	27.77778	0.01	
SWK vs STK	Acheulean	quartz	
72.22222	27.77778	0.01	0.000
90.90909	9.090909	0.01	

STK vs EXP	Acheulean	chert	
n/a			
SWK vs EXP	Acheulean	chert	
48.33333	51.66667	0	0.000
7.1	76.8	16.1	
STK vs SWK	Acheulean	chert	
n/a			
SWK vs STK	Acheulean	chert	
n/a			

Table 24: Chi-square test results for weathering distributions materials combined

STK Oldowan vs SWK Oldowan	52.5 59.55056	46.8 35.95506	0.7225 4.4944	0.000
SWK Oldowan vs STK Oldowan	59.55056 52.5	35.95506 46.8	4.4944 0.7225	0.026

STK Acheulean vs SWK Acheulean	79.10448 56.25	19.4 43.75	1.4925 0.01	0.000
SWK Acheulean vs STK Acheulean	56.25 79.10448	43.75 19.4	0.01 1.4925	0.000

Table 25: Chi-square test results for weathering distributions Oldowan vs Acheulean

STK	Oldowan vs Acheulean	quartzite	p
36.36364	55.84416	7.792208	0.000
67.64706	29.41176	2.941176	
STK	Oldowan vs Acheulean	quartz	
88.88889	8.641975	2.469136	0.281
90.90909	9.090909	0	
STK	Oldowan vs Acheulean	all	
63.29114	31.64557	5.063291	0.004
79.10448	19.40299	1.492537	

SWK	Oldowan vs Acheulean	quartzite	p
65.11628	30.23256	4.651	0.031
61.76471	38.23529	0	
SWK	Oldowan vs Acheulean	quarts	
71.73333	28.26667	0.01	0.994
72.22222	27.77778	0.01	
SWK	Oldowan vs Acheulean	chert	
24.08759	74.81752	1.095	0.000
48.33333	51.66667	0	
SWK	Oldowan vs Acheulean	all	
52.45665	46.82081	0.723	0.549
56.25	43.75	0	

Table 26: Chi-square test results for grain size distributions

Grains	Oldowan									
STK	2.597403	57.14286	35.065	3.896	1.298701	0.01	STK vs EXP	0.000	STK Oldowan vs Acheulean	0.000
SWK	2.325581	48.83721	46.512	2.326	0.01	0.01	SWK vs EXP	0.000	SWK Oldowan vs Acheulean	0.000
EXP	0.01	44.94382	37.528	12.81	2.47191	2.247191	STK vs SWK	0.000		
							SWK vs STK	0.229		
Grains	Acheulean									
STK	11.76471	29.41176	50	8.824	0.01	0.01	STK vs EXP	0.000		
SWK	8.823529	41.17647	44.118	2.941	2.941176	0.01	SWK vs EXP	0.000		
EXP	0.01	44.22442	35.644	15.51	1.980198	2.640264	STK vs SWK	0.001		
							SWK vs STK	0.000		