UNIVERSITY OF SOUTHAMPTON

FACULTY OF HUMANITIES

Archaeology

Assessing the origins of Levallois through Lower Palaeolithic core variation: A comparative study of Simple Prepared Cores in northwest Europe

by

Lucie Bolton

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ABSTRACT

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ASSESSING THE ORIGINS OF LEVALLOIS THROUGH LOWER PALAEOLITHIC CORE VARIATION: A COMPARATIVE STUDY OF SIMPLE PREPARED CORES IN NORTHWEST EUROPE

Lucie Susan Bolton

The widespread appearance of Levallois technology approximately 300,000 years ago in Europe and Africa is associated with significant behavioural and cognitive changes. The origins of this technique, however, are still highly debated. Fully developed Levallois reduction sequences seem to have their roots in a lesser-understood technique referred to as either 'proto', or 'reduced' Levallois, and more recently as Simple Prepared Core (SPC) technology.

This thesis examines the technological relationship between SPCs and the Levallois technique in eight British and two Belgian assemblages. Whilst exploring the significance of the presence of SPC technology in the Lower Palaeolithic archaeological record of northwest Europe, this research also assesses the implications for hominin behaviour and cognition.

Results demonstrate identical reduction techniques at nine of the ten sites studied, allowing for the construction of a new overarching technological definition of SPC technology, which is now accepted to be present on a significantly wider scale both temporally and geographically. A clear conceptual link between SPC technology and the Levallois technique is apparent regarding the approach to the volume of the core and the targeted end product. However the lack of shaping of the preferential flaking surface prevents the SPC end products from being considered predetermined. As it is the predetermination of the final product that is linked with the cognitive complexity required to implement the Levallois technique, the hominins responsible for SPCs cannot be considered to demonstrate the same level of cognition as those with Levallois technology.

The implications of these results suggest hominins using the SPC technique were conceptually on the path towards the Levallois technique but cannot be considered to demonstrate the same behavioural and cognitive capacity.

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DECLARATION OF AUTHORSHIP

I, Lucie Susan Bolton, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

Assessing the origins of Levallois through Lower Palaeolithic core variation: A comparative study of Simple Prepared Cores in northwest Europe.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signed: ....

Date:..

Acknowledgements

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Definitions and Abbreviations

Kya – Thousand years ago

Mya – Million years ago

SPC – Simple prepared core

PCT – Prepared core technology

Chapter 1: Introduction

1.1 Introduction

The appearance of Levallois or Prepared Core Technology (PCT) is thought to be associated with early Neanderthals or late *H. heidelbergensis* in Europe (Hublin 2009; Stringer 2011) with the earliest dates approximately 350kya (Adler *et al.* 2014). In Africa it is associated with the earliest *H. sapiens* with the earliest appearances of the technique in the Kapthurin Formation between 284-509kya (Tryon *et al.* 2005). In the context of hominin evolution, this method of stone tool production presages game-changing shifts in hominin behaviour such as hunting practices, landscape use and group dynamics (Geneste 1989; White and Pettitt 1995; Féblot-Augustins 1999; Gaudzinski 1999a; 2006; Scott 2011; Julien *et al.* In press) with implications for cognitive abilities (Bordes 1968; Boëda 1995; Schlanger 1996; Wynn and Coolidge 2004; 2010; Tryon *et al.* 2005; White *et al.* 2011; Eren and Lycett 2012; Picin *et al.* 2013; Wiśniewski 2014). The changes associated with this new technology are considered so significant, that the appearance of Levallois is used as the boundary between the Lower and Middle Palaeolithic in Europe and Early and Middle Stone Age in Africa (Richter 2011).

Unsurprisingly, the Levallois reduction strategy has long been of interest to researchers, yet the origins of this technique are still highly debated. Most research continues to focus on the earliest appearance of the Levallois technique itself (Adler *et al.* 2014; Wiśniewski 2014).

It is not the aim of this thesis to find the earliest example of Levallois technology, there will always be an earlier site and an early isolated event will not help to explain how or why this technique became so successful.

Instead, this thesis looks at the origins of Levallois through the lesser studied technique referred to as either ‘proto’ Levallois, ‘reduced’ Levallois, or more recently as Simple Prepared Core (SPC) technology (Wymer 1968; Roe 1981; White and Ashton 2003; McNabb 2007; Van Baelen *et al.* 2008). To the best of my knowledge, this is the first large-scale, comprehensive study comparing these techniques using a uniform methodology. By analysing core working techniques before the appearance of Levallois technology, this research provides a clearer understanding of Lower Palaeolithic core variation.

Previous research (Bolton 2010; Scott 2011) demonstrates recent work on the origins of Levallois has been solely focused on the fully developed technique. Whilst various descriptions of SPCs can be found, a clear technological definition does not yet exist. Furthermore, there has never been a study which embedded SPCs within the broader context of other techniques of core working found on late Lower/ early Middle Palaeolithic sites. One of the objectives of this research has therefore been to establish how prevalent SPCs are within the archaeological record.

1.2 Research Problem

The Levallois technique *seems* to appear throughout Europe and Africa (Dibble and Bar-Yosef 1995; Tryon *et al.* 2005; Richter 2011; Shimelmitz and Kuhn 2013; Adler *et al.* 2014) in a short period of time (see page 41). There are two main arguments for how this technique appeared in Europe. The first suggests the technique was brought into Europe by a new species of hominin dispersing out of Africa (Foley and Lahr 1997). The opposing argument proposes the Levallois technique developed from the already widespread Acheulean (White and Ashton 2003; White *et al.* 2011). The latter interpretation is now widely supported but does not explain why the technique appeared when it did or why there appears to be such a sudden change.

Attempts to study Lower Palaeolithic core working techniques are few in number (White and Ashton 2003; McNabb 2007; Sharon 2009) with most research focusing on handaxe variation (Roe 1968; Wynn and Tierson 1990; Ashton and McNabb 1994; McPherron 1995; White 1998; Wenban-Smith 2004; McNabb 2013). This research will not only contribute towards our understanding of the origins of Levallois but will build upon our knowledge of a vast, and undervalued, body of lithic data.

1.3 Research Question

The main research question is as follows:

What is the precise technological relationship between SPCs and the Levallois technique, and what will this tell us about the behaviour of the hominins associated with these new ways of making stone tools?

This Research Question will be answered through the following sub-questions.

Research sub-question 1

How prevalent are SPCs within Lower Palaeolithic assemblages in northwest Europe?

An answer to this question will create a clearer understanding of Lower Palaeolithic core working variation before the widespread appearance of Levallois technology. This question will also establish if cores referred to using different terminology are technologically the same or if there is different chronological or geographical variation.

Research sub-question 2

What is the relationship between SPCs and other Lower Palaeolithic core working techniques?

In order to understand the relationship between SPCs and the Levallois technique, it must first be established in what ways SPCs are technologically and conceptually different from existing core working techniques.

Research sub-question 3

What are the behavioural and cognitive implications of the identification and presence of SPCs from Lower Palaeolithic assemblages in Britain, and across Europe?

This question addresses the second part of the main Research Question looking at the implications of Lower Palaeolithic core variation in relation to Middle Pleistocene hominin behaviour.

1.4 Thesis outline

Chapter 1 – The *Introduction* presents the research questions and the overall premise of this thesis. It provides an overview of the research and identifies the themes which run throughout.

Chapter 2 – *The Research Framework* develops the ideas presented in Chapter 1 providing an in-depth assessment of the current and previous research carried out in this field. The literature formulating the various opinions on the origins of Levallois technology is discussed along with current thoughts on SPC technique. The problems identified within current thinking are presented and suggestions on how this research will contribute to a wider understanding in changes in lithic technology are discussed.

Chapter 3 – The *Methodology* used to collect the data and analyse the material is described in this chapter. The details of a new methodological framework for analysing core variation combined with existing methodologies for the analysis of Lower and Middle Palaeolithic stone tool assemblages will be presented.

Chapter 4 – A review of the past research and excavation history is present in the chapter on the *Site Backgrounds*. This discusses why each site was selected for the investigation and the current thoughts on material in the assemblages.

Chapter 5 – The *Data Presentation* displays the results of the lithic analysis. The data for each site is presented individually within the chapter.

Chapter 6 – The *Data Interpretation* discusses the results and the implications of the data both technologically and theoretically.

Chapter 7 – The *Conclusion* and area for future work are discussed in the final chapter. This research emphasises the need to analyse core working techniques at the end of the Lower Palaeolithic. Further investigation, specifically into the African record, would help to give a greater understanding of the behavioural changes associated with this transition.

1.5 Limitations

One way of further developing this research would have been to include two well-known assemblages from France; Cagny la Garenne and Orgnac 3 as these sites are often referred to when discussing early Levallois in Europe. Orgnac 3 was of particular interest due to the presence of handaxes with unusual flaking which has been suggested to demonstrate the origins of Levallois in handaxe reduction. Unfortunately, although permission to study these assemblages was requested, access was not granted. Photos of the Cagny la Garenne material were supplied by Dr Agnes Lamotte and will be discussed along with the published material form Orgnac 3 in Chapter 6.

1.6 Summary

This research will present the first comprehensive study comparing variation in core working techniques using a single methodology, linking data from different sites in Britain and continental Europe. Detailed attribute-based technological analysis demonstrates identical reduction techniques at all but one of the British sites and both Belgian sites allowing for the construction of a new overarching technological definition of SPC technology. Results would suggest an *in situ* development for SPC technology and the origins of Levallois from pre-existing core working techniques in the Acheulean. This in turn potentially indicates independent complex hominin behavioural innovations rather than a single contiguous “tradition” as previously thought.

Chapter 2: Research Framework

2.1 Introduction

This chapter will begin by presenting the chronological and environmental framework within which this research is set, before providing an in depth overview of the current and past research surrounding the origins of the Levallois reduction technique. Finally the current research on SPCs is discussed including how this thesis will contribute to our greater understanding of stone tool production in the Lower and early Middle Palaeolithic.

2.2 Chronology and the palaeoenvironmental background

The Middle Pleistocene is the geochronological term given to the time period spanning c. 781 to 127 thousand years ago (kya) (Head and Gibbard 2005). The archaeological subdivisions this expanse of time includes are the Lower Palaeolithic and the early Middle Palaeolithic (see Figure 2.1). The demarcation between the two is distinguished by the appearance of the Levallois technique, a sub-division within Prepared Core Technology - PCT.

Our understanding of the climate and the palaeoenvironment during the Middle Pleistocene in northwest Europe has advanced greatly due to ice core data as well as terrestrial records and deep sea cores (Candy *et al.* 2014). It is through these records we now know that the character of the palaeoenvironment during the Later Middle Pleistocene (450 to 127 kya) was very different to that which preceded it in the Early Middle Pleistocene (781 to 450 kya) (Head and Gibbard 2005). The Later Middle Pleistocene is characterised by climatic oscillations of interglacial and glacial conditions driven by the 100 thousand year (ka) Milankovitch cycle. These extreme fluctuations would have resulted in large ice sheets covering Northern Europe affecting hominin dispersal as well as regional climates and ecosystems.

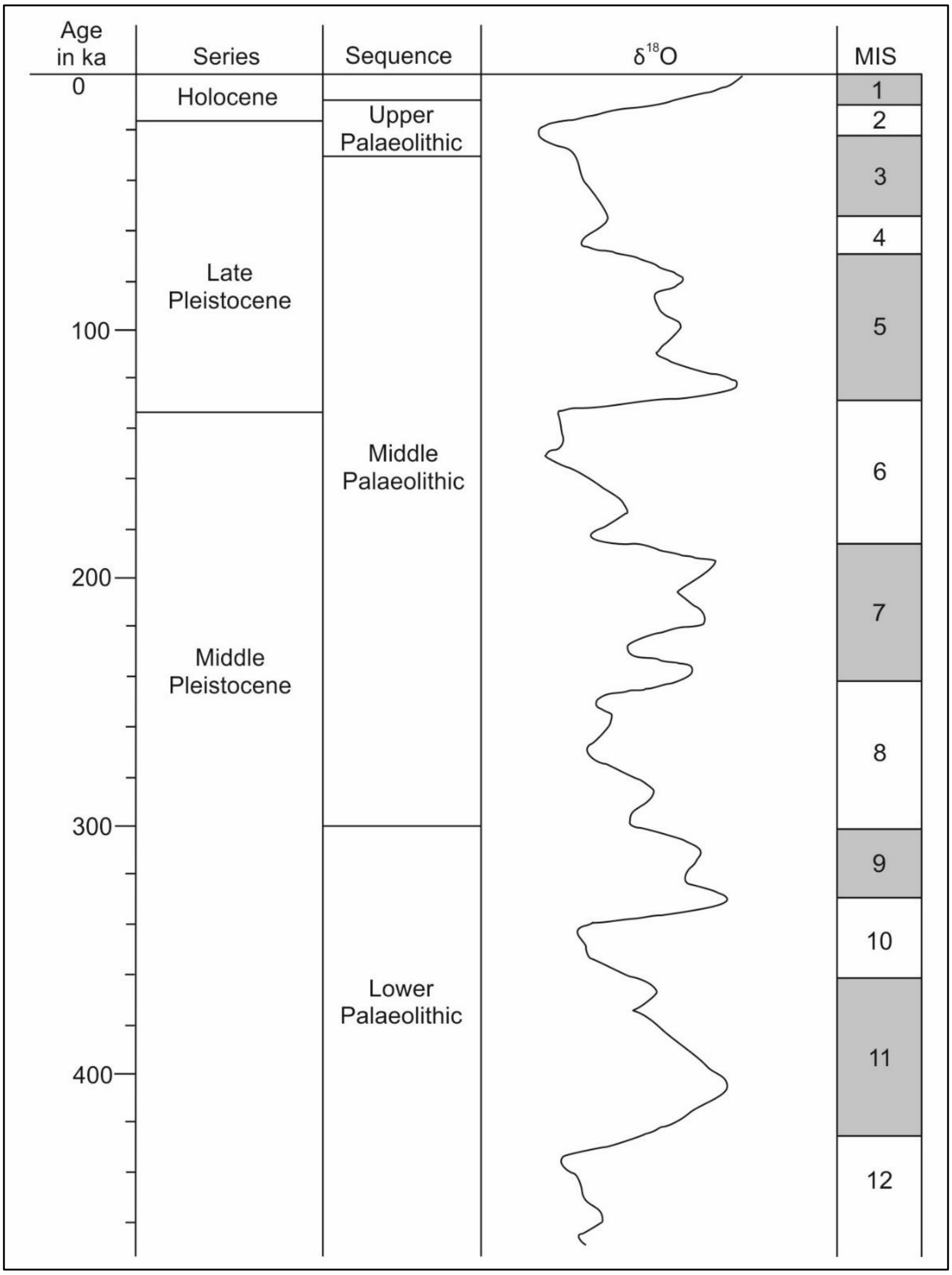


Figure 2.1 The archaeological and geological subdivisions of the Pleistocene in Britain (After Head and Gibbard 2005)

The Middle Pleistocene comprises of 9 cold glacial periods and 10 warm interglacials. Advances in the deep sea core record have resulted in the identification of further sub-stages knows as stadials (cold conditions) within an interglacial and interstadials (warm conditions) within a glaciation (Candy *et al.* 2014).

Proxies such as pollen records, mammalian and molluscan biostratigraphy, and lithostratigraphy all contribute to the reconstruction of Quaternary palaeoenvironments. Mammalian and molluscan biostratigraphy can identify when different species appear and disappear in different geographical areas as well as the first and last appearance dates of different species (Preece 2001; Schreve 2001; Schreve *et al.* 2002). This information can then be used to differentiate between interglacials.

This research is interested in hominin behaviour during the Middle Pleistocene. The Marine Isotope Stages (MIS) relevant to this study are MIS 11 through to the beginning of MIS 8. The resolution of environmental proxies is much finer than those of the archaeology in this period, so it is hard to reconcile the two, however the following brief outline summarises the current state of knowledge for this timeframe.

MIS 11

This interglacial marks the onset of warm conditions after the Anglian glaciation (MIS 12). Sometimes referred to in Britain as the Swanscombe Interglacial, this period spans from approximately 425kya to 364kya, thus making it a relatively long interglacial with two warm, interstadial peaks, MIS11c and MIS11a (Candy *et al.* 2014).

MIS 11 is initially characterised by a long, slow warming. The palaeoenvironmental evidence shows the vegetation of this interglacial is characterised by widespread grassland followed by pine-birch coniferous forest (Ashton *et al.* 2008). At the most temperate phase of the interglacial deciduous oak replaced the coniferous forest before conditions cooled and the boreal forest once again dominated (*ibid*). Finally, the conditions became cooler and drier with the vegetation reverting once again to open grassland. This cyclical progression is sometimes referred to as the 'classic interglacial vegetation succession' (Pettitt and White 2012:73).

The faunal assemblage from the site of Hoxne has demonstrated species which were previously associated with fully interglacial conditions also occur in interstadial periods (Ashton *et al.* 2008). Hoxne is also particularly important as it challenged the pre-existing notion that northwest Europe was only occupied during fully temperate conditions. The environmental reconstructions from Hoxne have shown humans were living in much cooler conditions during the interstadial which, as Ashton and colleagues note, prompts questions about technologies associated with clothing and more adaptive behaviour suitable for varied habitats (2008:666).

The only hominin remains to be discovered, in Britain, in the MIS 11 – 8 timeframe are from the MIS 11 interglacial at Swanscombe, Kent. The three conjoining cranial fragments were originally assigned to the *H. heidelbergensis* lineage but recent work by Stringer now reassigns it to early Neanderthal (Stringer 2012). The hominin remains from Sima de los Huersos, Atapuerca, Spain have recently been re-dated and now have a minimum age of 430,000BP placing them at the end of MIS 12 (Arsuaga *et al.* 2014). Remains from Bilzingsleben, Germany, have been dated to MIS 11 – 9 (Ashton and Lewis 2012).

The archaeology associated with this period is Acheulean (handaxe) and Clactonian (effectively non-handaxe).

MIS 10

Spanning approximately 36,000 years from 364kya – 328kya, this glaciation is characterised by slow cooling at the beginning which was staggered with warm oscillations before onset of the more extreme cold conditions. There is no evidence of ice sheets advancing onto the British mainland (Pettitt and White 2012:60).

MIS 9

The majority of sites in this investigation are dated to this MI stage. This interglacial is significantly shorter than MIS 11, ranging from approximately 328kya – 301kya. This stage had three warm peaks, MIS9e, MIS9c and MIS9a. During the temperate phases the climate is likely to have been more seasonally extreme with warmer summers than present day conditions (Bridgland *et al.* 2013:53). The warmest sub-stage, MIS9e, was no more than 3,600 years in length (Tzedakis *et al.* 2004:2234) and as a whole the interglacial is believed to have become progressively cooler.

Both MIS 11 and MIS 9 are considered to be temperate climate interglacials with very similar pollen sequences. Until relatively recently MIS 9 was not palynologically recognised as a separate interglacial. Developments in lithostratigraphy and mammalian biostratigraphic have enabled the recognition and environmental reconstruction of this interglacial and now a clearer distinction between the two can be identified (Schreve 2001; Schreve *et al.* 2002; Roe *et al.* 2009; Bridgland *et al.* 2013).

There are no hominin fossil remains dated to this interglacial in Britain. Remains from Steinheim, Germany, are likely to be from this interglacial (Hublin 2009) but they have been dated to 350ka and could also be assigned to the MIS 11 interglacial (Gamble 1999).

The first appearance of SPCs and the apparent first occurrences of the Levallois technique are dated to this interglacial (Bridgland *et al.* 2013) though the Acheulean technology remains dominant (Gamble 1999; Ashton *et al.* 2011a). As a consequence of this shift in technology, MIS 9 is seen as the transitional interglacial between the Lower and the early Middle Palaeolithic (Scott and Ashton 2011; Pettitt and White 2012).

MIS 8

Glacial conditions onset at approximately 300kya and lasted around 50,000 years. This is considered to be a long, yet less severe, glaciation with an ice sheet covering part of northern Britain (White *et al.* 2010). Evidence for human occupation during MIS 8 has been identified at numerous sites in northwest Europe at the beginning and towards the end of this interglacial (See papers in Ashton *et al.* 2011b). In Britain, sites such as Baker's Hole, Creffield Road and Lion Pit Tramway Cutting are dated to late MIS 8/ early MIS 7. These sites are considered to be the earliest Middle Palaeolithic examples due to their high Levallois presence (Scott 2011).

2.3 Levallois

2.3.1 History of Levallois

Levallois is the term used to describe what is probably the most renowned variant of PCT. The traditional and widely accepted definition of PCT is the preparation of a core through flaking for the removal of a target end product of predetermined shape and size (Bordes 1950). There are several different variations of PCT found throughout Africa, Europe and Asia (see Figure 2.2) and yet by the time Neanderthals are present in Europe, the Levallois technique is the dominant method of core reduction (Scott 2011; White *et al.* 2011). How and why this technique became so widespread, whilst other PCT techniques did not, has been the focus of much attention over the past twenty years (Rolland 1995; Tuffreau 1995; Schlanger 1996; White and Ashton 2003; White *et al.* 2006; White *et al.* 2011; Eren and Lycett 2012).

Very little research has been carried out on PCT variability on a large scale. Individually the different techniques have been analysed; Sharon (2009) recently looked at the Giant-core phenomenon from a worldwide perspective. This investigation included the different PCT variants providing they had produced flakes of over 10cm in length. Sharon's research highlighted the technological variability and complexity within those PCT techniques which produce large flakes and in particular noting how many had elements which were later to be seen in the Levallois technique but how each PCT was fundamentally different in approach. These similarities and differences link directly to this study of SPC technology which is also aiming to understand the technological relationship between this form of PCT and the Levallois technique. There is a need for further research looking at all of the different PCT techniques, including those producing flakes smaller than 10cm, from a technological perspective. It is not within the scope of this PhD thesis to analyse and compare all of these different flaking technologies; instead a brief overview is presented in Figure 2.2. The attribute analysis developed for this thesis could have the potential to then be applied on a wider scale to give a better insight into core variability in the future.

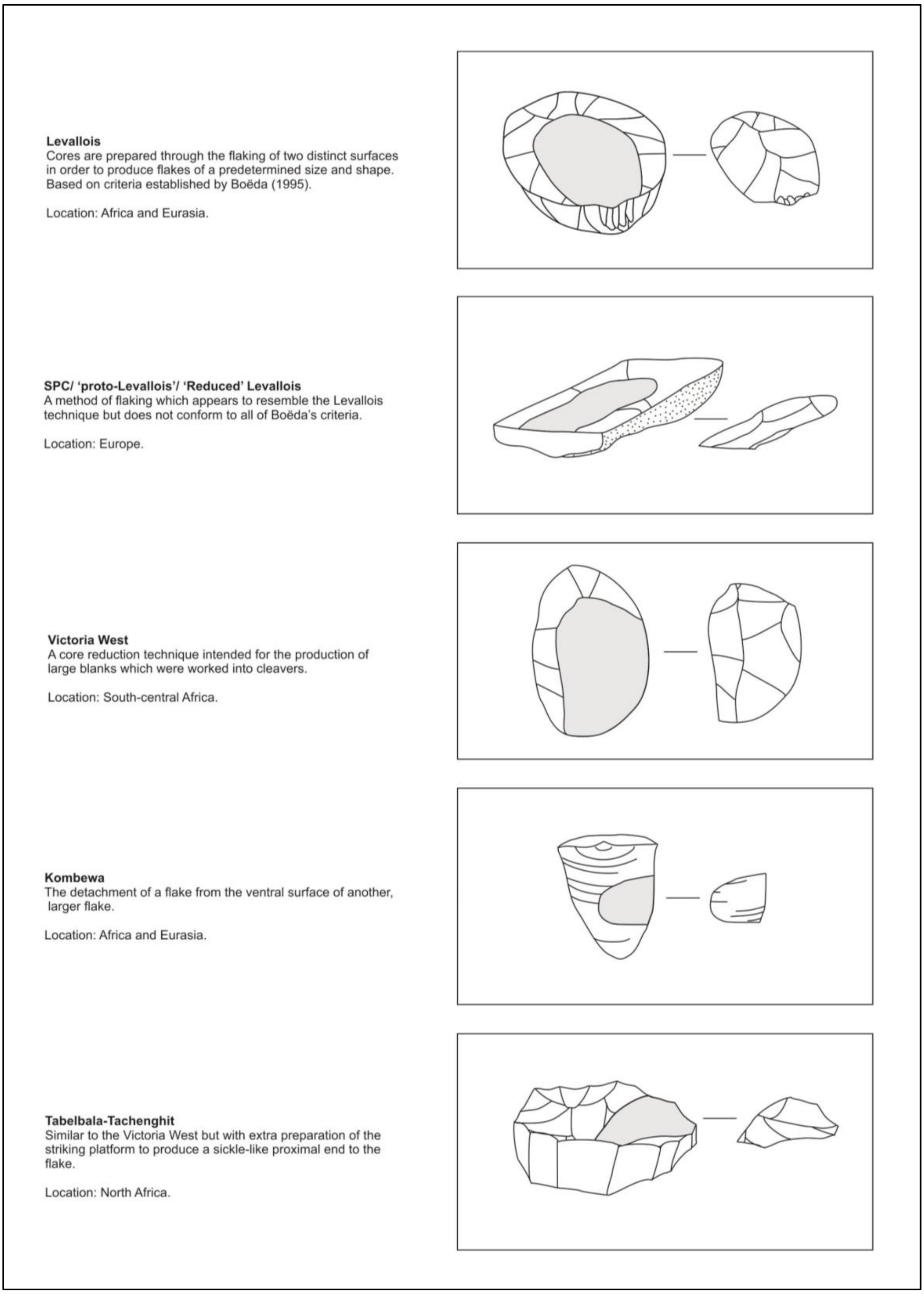


Figure 2.2 Different PCT variants (Bordes 1950; Boëda 1995; White and Ashton 2003; Sharon and Beaumont 2006; Lycett 2009; Sharon 2009; White *et al.* 2011)

Chapter 2: Research Framework

Levallois technology has been present in the literature since the later part of the 19th Century (de Mortillet 1883; Commont 1909; Ranov 1995; Schlanger 1996; Chazan 1997). The term was first used to describe artefacts from an assemblage recovered from Levallois-Perret, a Parisian suburb (de Mortillet 1883:256). De Mortillet (*ibid*) described the flakes as long, wide and oval in shape. Further description and definition came from Victor Commont (1909:122) who identified the bifacial preparation of the core and the preparation of the striking platforms along with the flake butts. Commont looked at the Levallois technique technologically and described how the knapper would prepare the core before removing a large flake from the face (*ibid.*). Commont also identified the Levallois technique as Mousterian and believed Levallois flakes replaced bifaces (1909:154).

Present day understanding was greatly enhanced by the work of French scholars François Bordes in the 1950s and 1960s and Eric Boëda in the 1990s. Bordes described the Levallois technique as 'predetermination through special preparation' (Bordes 1950:21) on the basis of his own flint knapping experience. Bordes included Levallois in his typological list of deliberately made tool types of the Lower and Middle Palaeolithic (Bordes 1961). This framework was designed as an analytical tool to enable archaeologists to define assemblages through the presence, absence and proportion of all the deliberately made 'tools' in an assemblage. The preceding type-fossil approach had focused on culturally diagnostic tools in their final form. Contrary to Commont, Bordes claimed the faceted butt was not always present in Levallois (1950). He did however allow for variation in the preparation of the core as well as noting that more than one predetermined flake could be removed from the Levallois core (Bordes 1961).

By the 1980s the typology created by Bordes was thought to be too restrictive by a growing body of archaeologists (Copeland 1983; Van Peer 1992; 1995; Boëda 1995). The problem related to the identification of Levallois products based on a purely typological method instead of looking at the process of manufacture – i.e. the technology. Many argued that a flake or point that appeared to be a Levallois product could have been produced through alternative core reduction techniques (Copeland 1983; Van Peer 1992; Boëda 1995). The issues surrounding the identification of Levallois products and the lack of a coherent definition of the technique became known as the '*Levallois Problem'* (see Text Box 1) and possible ways to resolve this matter became the focus for many researchers and is still an ongoing area of research today (Boëda *et al.* 1990; Boëda 1995; Van Peer 1992; 1995).

Text Box 1

The Levallois Problem

Issues surrounding the concept of the Levallois reduction strategy.

- What constitutes predetermination and planning?
- Is this a unified concept but with varied application?

How can the 'intended' products of the reduction sequence be identified?

- Blanks which may appear typologically similar can be produced from different methods, e.g. fortuitously pointed flakes as opposed to Levallois points.
- The identification of Levallois products varies between analysts resulting in differently classified flakes within the same assemblage.

Essentially researchers cannot agree on a clear way to recognise the Levallois technique and Levallois products.

2.3.2 What are the current thoughts on SPC technology?

The SPC cores from Purfleet were described by White and Ashton as a 'relatively simple and unrefined form of prepared-core technology' (2003:599). This description is very similar to that which Wymer gave to the cores he called 'proto-tortoise' (1968:73) and 'proto-Levalloisian' (1968:318; 1999:83) and those described as 'Reduced Levallois' by Roe (1981:191) almost all of which came from the same assemblages. White and Ashton initially decided to use the term SPCs as they considered it to be 'less loaded' than 'proto' or 'reduced' which they felt 'carried implications for the origins of Levallois and the origins of Neanderthals' (White and Ashton 2003:599). It is for the same reason that the term SPC is used in this thesis, though it must be noted the term 'proto-Levallois' is still in use (Harding *et al.* 2012; Pettitt and White 2012; Bridgland *et al.* 2013). It is possible the variety of terminology associated with these cores may have contributed towards their under-representation in the literature and misidentification within assemblages.

White and Ashton's (2003) investigation into the cores from Purfleet is the only in-depth analysis of SPCs from British assemblages to date. The authors were presenting their observations on the assemblage and the implications they felt the material had on the origins of Levallois technology. They concluded the assemblage was representative of a 'proto-Levallois' stage which conformed to all but one of Boëda's criteria. They did not feel the SPCs demonstrated sufficient control or maintenance of the distal or lateral convexities to be considered developed Levallois (White and Ashton 2003:603).

Scott's research into early Middle Palaeolithic sites in Britain included the site of Purfleet and analysis of the SPCs. Scott agrees with White and Ashton's opinions on SPCs noting the minimal working and lack of preparation of the distal and lateral convexities (Scott 2011:31), arguing the organisation of the flaking surface and creation of a striking platform is evidence of shaping. Scott proposes *large flakes* were the desired end products of this exploitation and that the surfaces of such cores were minimally controlled through preparatory removals in order to achieve the desired end product (*ibid.*).

Both Scott, and White and Ashton try to address why the SPC technique was implemented at Purfleet. Scott (2011:31) suggests the quality of the raw material would have directly affected the choice in reduction technique whereas White and Ashton note there was no reason for this reduction strategy to be used due to the abundant raw material which had been used for all core reduction techniques (White and Ashton 2003:603). Neither of these options provides a satisfactory explanation for why this technique was implemented at Purfleet. It is anticipated, through the comparison of the Purfleet SPCs with similar material form other assemblages, a better technological understanding will be created along with greater potential to understand the advantages to this technique.

Prior to the White and Ashton investigation into the Purfleet material, Wymer had described the same cores as crude but also noted the striking platforms which had been prepared with some care (Wymer 1968:73). He labelled these cores as uncommon and felt there needed to be a distinction between the crude forms and the 'neat' Levalloisian work (*ibid*). The term crude is quite misleading and still has potential repercussions today. Much of the confusion surrounding Levallois and SPC technology could be connected to people associating Levallois with the preferential centripetal examples like that of the well-known Baker's Hole material when in reality Levallois material is much more varied and less standardised as shown by Scott in her recent assessment of the British early Middle Palaeolithic (2006). Interestingly Wymer suggested the rarity of these cores may be due to collector bias as they were not easily recognisable and may have been discarded by collectors or gravel-diggers (Wymer 1968:73). The collector bias is pertinent to this investigation and will be discussed in the following chapter. Later Wymer (1999:86) noted 'proto-Levalloisian' cores had not been found elsewhere in the Thames. Wymer had previously used the terms 'proto-Levalloisian' and 'proto-tortoise' to describe cores from sites such as South Acre and Morton-on-the-Hill in Norfolk, Elveden and Barnham in Suffolk and Furze Hill in Cambridgeshire (Wymer 1985). A full list of all sites with mentions of 'proto-Levallois', 'reduced' Levallois or 'proto-tortoise' cores is presented in Appendix A. If this technology is as widespread as Wymer's observations suggest, SPCs could be a significant component of the Lower Palaeolithic core working repertoire.

Roe described what are believed to be the same cores as the 'reduced Levalloisian technique', by which he went on to explain was a core which had undergone rudimentary preparation of the flaking surface with a simple striking platform at one end (1981:191). This is the most simplistic description of the technique but still draws upon the same characteristics noted by Wymer (1968; 1985), and later by White and Ashton (2003). Roe also observed the recurrent removals on a small number of the cores as well as the more common single removals. He thought of the cores as Levallois in its formative stage and in the process of becoming the fully developed technique (1981). Roe looked at the material from Caddington in Bedfordshire. He noted some similarities between the cores at Purfleet and described them as a reduced version on Levallois rather than a prototypic version of the full technique, noting a simplification of the preparatory stages with a preferential end product (*ibid*).

In terms of the behavioural implications of this material, Roe saw the makers of these cores as 'highly competent knappers' who were carrying out the 'bare essentials' (*ibid*:191). The term 'reduced' in this context creates confusion as it is unclear if Roe believed the workers were capable of the full technique. For example, had the knappers chosen to implement the 'reduced' version as it was all that was required or had they used that method because they had yet to develop the full technique? The term 'reduced' is therefore another example of unclear terminology which could be considered to lead the reader to make assumptions about the technology and the abilities of those implementing the technique.

Harding and colleagues (2012) have published the most recent description of SPCs from the British record in their paper on the material from Dunbridge. They refer to the cores as 'Proto-Levallois', noting the small size of the flint nodules along with the limited number of removals. Harding and colleagues describe the cores in a very similar way to those from Purfleet, noting a prepared flaking face and a prepared striking platform (Harding *et al.* 2012:12). The material from the Dunbridge assemblage will be analysed for this investigation.

Cores which sound remarkably similar to SPCs have been identified as a part of the Acheulo-Yabrudian complex of the Tabun Cave, Mount Carmel, Israel, in the Levant which has been dated to ca. 415-320 kyr (Shimelmitz *et al.* 2014). It is argued the cores demonstrate organisation for the predetermined production of scraper blanks but do not demonstrate the same complexity and elaboration as Levallois technology (*ibid*.). With the exception of the control of the distal and lateral convexities, Shimelmitz and colleagues (2014) suggest the cores from Tabun conform to Boëda's criteria in every other way. This description is almost identical to the descriptions of the cores from Purfleet. It would therefore seem that cores which appear to be technologically the same as SPCs, though not recognised as such, are now beginning to be accepted as a part of the Lower Palaeolithic core working repertoire in some areas.

A single, widely accepted definition of SPCs has not been found in the literature on the subject although all authors do tend to agree in their descriptions of the cores. The most comprehensive description of the British material is that of White and Ashton (2003) after their work on the SPCs from Purfleet, Essex. As mentioned in Chapter 1, one of the aims of this investigation is to see if SPCs can be defined technologically and if that definition can be applied to other sites where there has been a mention of 'Reduced' or 'proto-Levallois'.

2.3.3 Chaîne opératoire

Boëda elaborated on the work of Bordes and tried to address the 'Levallois Problem' by approaching the technique through a technological perspective (Boeda 1986; 1995). Instead of focusing on the end products alone, Boëda used experimental knapping and created a series of models to try to understand the procedures involved in Levallois reduction. Boëda popularised the term *chaîne opératoire.* This term was first used by André Leroi-Gourhan who believed that looking at how objects were produced was a way to reflect the 'mental structure of the maker' (Leroi-Gourhan 1952:82). The concept of *chaîne opératoire*, when applied in this context, is to study the artefact's life history from raw material procurement to discard of the end product rather than just the morphology of that product. Boëda went on to develop the 'volumetric concept' which consisted of six criteria. This is still the widely accepted Levallois framework in use today.

Levallois technology, or the 'Levallois concept' as defined by Boëda (1995:46-52), looks at the volume of the bifacially flaked core and sees two distinct surfaces that provide different functions. One surface is the preferential flaking surface, from which the large preferential removal(s) are made and the other is the striking platform surface which provides platforms for the removal of flakes on the flaking surface (See Figure 2.3). These two surfaces are separated by a plane of intersection and their roles are non-interchangeable during the reduction sequence. Flakes removed from the distal and lateral convexities of the flaking surface control the morphology of the end product by directing the force of the blow for the preferential removal (see Figure 2.4). Boëda views this criterion, the preparation of the surface as *the* element required to claim predetermination (Boëda 1995:48). The final elements necessary to identify a Levallois core are removals on the flaking surface which are parallel to the plane of intersection and evidence that all flaking was carried out using hard hammer percussion with the axis of percussion perpendicular to the hinge (see Figure 2.5). Boëda claims these last two requirements were necessary to control the force of the removal (1995:52). By combining these requirements, Boëda explains how predetermination can be seen in a reduction sequence thereby addressing one of the major issues in the *Levallois Problem*.

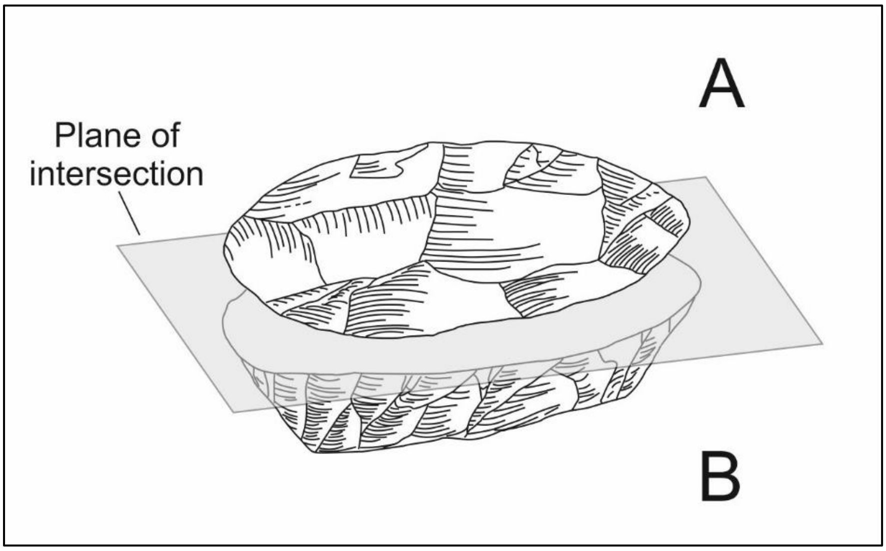


Figure 2.3 Criterion 1 and 2: The flaking surface (A) and striking platform surface (B) are separated by a plane of intersection. (Redrawn after Boëda 1995:51-52)

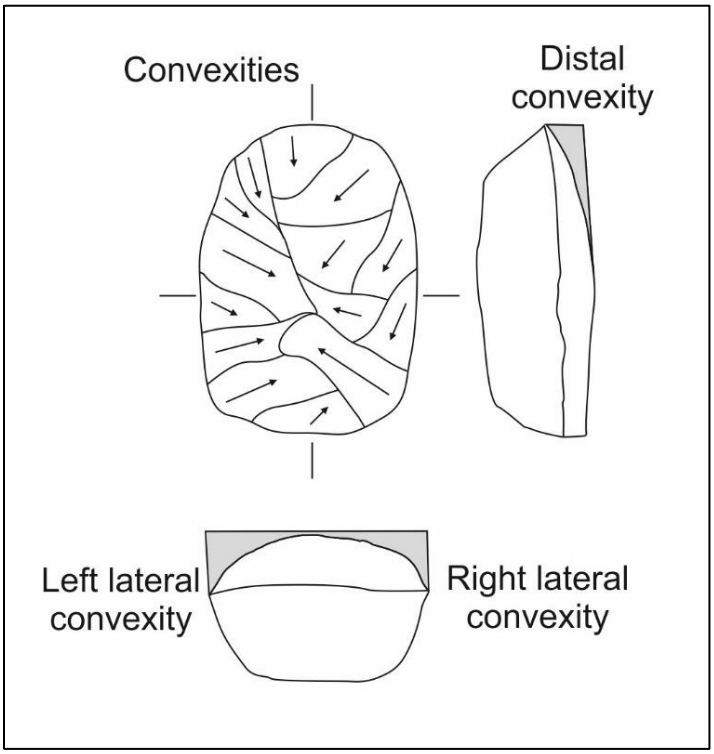


Figure 2.4 Criterion 3: Control of the distal and lateral convexities. (Redrawn after Boëda 1995:52)

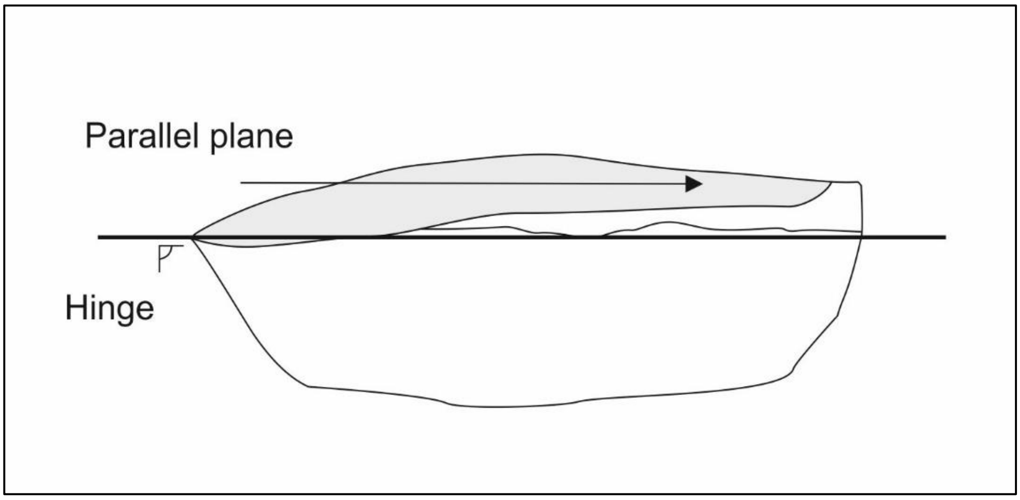


Figure 2.5 Criterion 4 and 5: The fracture plane of the removal is parallel to the plane of intersection of the core. The axis of percussion is perpendicular to the hinge. (Redrawn after Boëda 1995:52-53)

This widely accepted technological approach enables the identification of Levallois end products and allows for variability within the reduction sequence. Multiple approaches to preparation and exploitation are identified within the concept and can be seen in Figure 2.6

and Figure 2.7. These different exploitation techniques fall into two categories; the *linear* preferential method, and the *recurrent* preferential method (Boëda 1995:56). Whilst these different methods of preparation and exploitation work in theory, I feel some of the methods would be hard to identify in practice. For example, how easy is it to distinguish between a core with a single preferential removal from a unipolar surface and a recurrent core from a surface with unipolar preparation? Or how similar would a unipolar distal core with recurrent removals look compared with a bipolar core with no removals? I am also not convinced a core which has been prepared centripetally and then exploited using a centripetal recurrent method would be identifiable in an archaeological example. There may be a similar difficulty differentiating between a centripetally prepared, centripetally exploited core and one which had been centripetally prepared but not exploited (see Figure 2.7). Would the difference between the preparatory flakes and the preferential products be the angle of removal in relation to the plane of intersection? In theory the faceted striking platform should identify the point from which the preferential removal has been struck, however recurrent cores may have multiple areas of faceting, there may be faceting from previous sequences of removal still visible or there may be very little to no faceting visible at all. There are no obvious answers to these problems but they need to be considered when analysing the SPCs. Issues relating to identification within the widely researched Levallois technique will no doubt also be present when trying to identify and define the lesser studied SPCs. Once the material in this investigation has been analysed, a further discussion relating to these issues will take place in Chapter 6.

It is Boëda's change of focus away from final product and concentration on the reduction sequence as a whole that pushed forward our understanding of Levallois and yet this approach is not without its critics. Several researchers have found the six criteria restrictive and are wary of using this approach to analyse assemblages (Van Peer 1992; Chazan 1997; White and Ashton 2003; Scott 2006, 2011). The issue seems to be the use of the criteria as a check-list rather than a guide. Boëda himself follows the check-list approach and defines cores as non-Levallois when one criterion is absent (Boeda 1986:104). Current research seems to be moving away from this check list method and instead we can see the adoption a more holistic approach, using the criteria as a guide (White and Ashton 2003; Scott 2006). This relaxing of the criteria is a positive step for understanding the variety within the archaeological record however it may create further confusion when attempting to draw the boundary between Levallois cores and SPCs. This flexibility could result in those not overly familiar with the variation apparent within the Levallois technique classifying all non-classic, Baker's Hole-like Levallois cores as SPCs. This would not help with our understanding of these technologies, hence why one of the aims of this research is to better understand the relationship between the two methods of reduction.

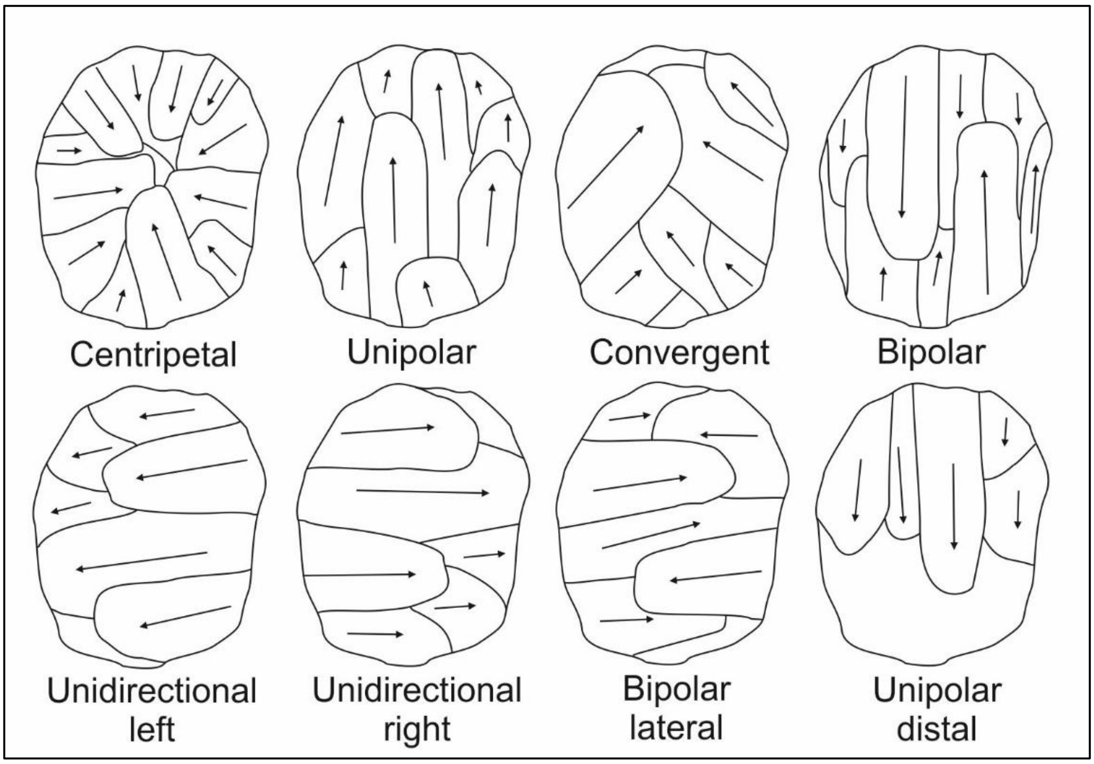


Figure 2.6 Methods of Levallois core preparation based on preparatory/shaping flake scars (Redrawn after Scott 2011:214)

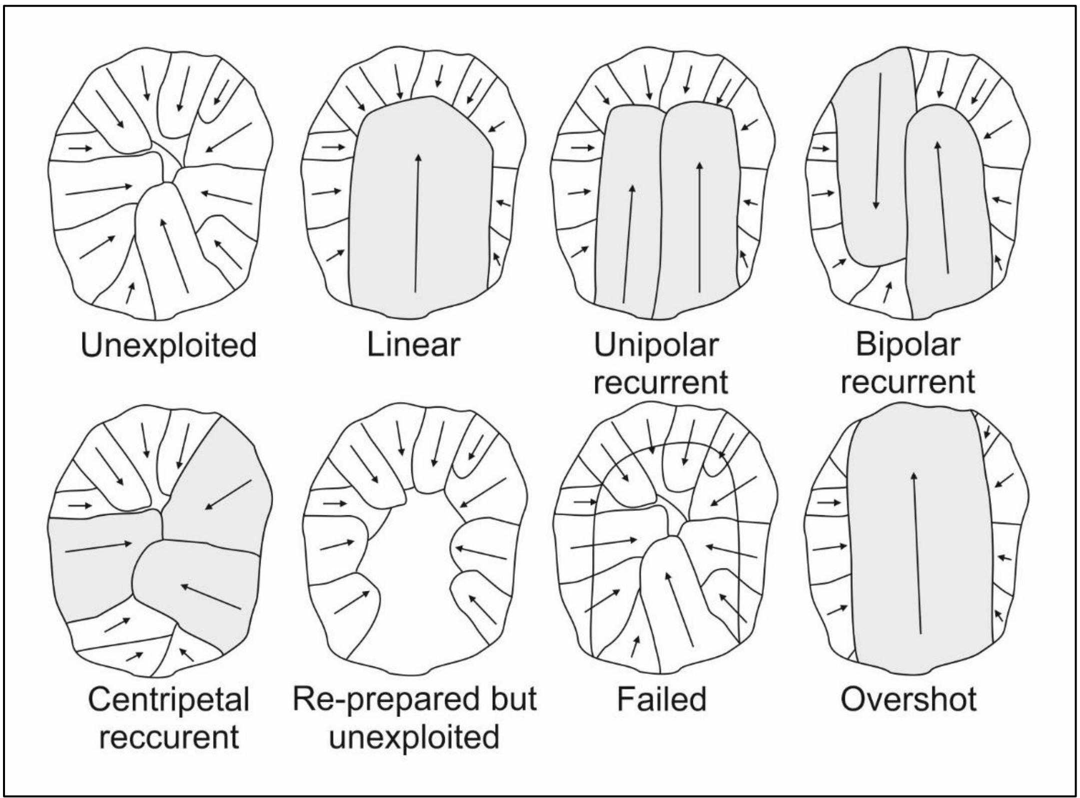


Figure 2.7 Methods of Levallois exploitation highlighting the preferential removals (Redrawn after Scott 2011:215)

Scott's recent study of Levallois assemblages in Britain (Scott 2006, 2011) has provided a more detailed analysis of the available material and offered a different interpretation of the technology, greatly advancing our understanding. Scott's research focused on technological variation in early Middle Palaeolithic sites in Britain. By analysing what stages of lithic reduction are represented at different locales, Scott has identified what preparatory and exploitation strategies have been applied. Scott's findings demonstrate the enormous variability in both preparation and exploitation implemented in the early Middle Palaeolithic and proposes this variability results from both a combination of immediate raw material constraints and specific technological preferences (Scott 2011:179).

Scott views the Levallois technique as a mobile technology which enabled Neanderthals to exploit the landscape in a way earlier hominins could not because they were constrained by the need to stay close to sources of raw material (Scott 2011:186). White and Pettitt made a similar argument when they discussed the problems surrounding the study of lithic technologies in the Lower to Middle Palaeolithic (1995). White and Pettitt looked at the situational variability between handaxe production and the Levallois technique. They suggested handaxes were manufactured as an immediate response to a demand with a short use-life in both time and space (White and Pettitt 1995:28). The curated nature of Levallois technology enabled more varied responses to different situations, allowing for greater mobility (*ibid.*). This level of organisation within the landscape is seen as a key characteristic of Neanderthal behaviour in the Middle Palaeolithic and Scott has demonstrated this behaviour has been widely adopted by late MIS 8/early MIS 7 arguing in favour of the close association of this behavioural characteristic and the Levallois technique (Scott 2011).

2.3.4 Preparation and Predetermination

Much of the discussion above has centred on the relationship between preparation and predetermination and the level to which we can see the application of such in both the Levallois and the SPC techniques. All mentions of SPCs have referred to a prepared flaking surface (Wymer 1968; Roe 1981; White and Ashton 2003; Scott 2011; White *et al.* 2011; Harding *et al.* 2012) and yet the overwhelming difference between SPCs and Levallois cores is argued to be the difference in the degree of preparation (White and Ashton 2003; Scott 2011; White *et al*. 2011). In an attempt to understand how something can be considered to be prepared and yet not prepared enough, a discussion on preparation and predetermination must take place.

Preparation, as defined in the Oxford English Dictionary, is to make something ready in advance. This is slightly different to the definition of predetermine which is to establish the outcome in advance. Palaeolithic scholars have argued for the presence of predetermination and planning in Levallois technology since the technique was first acknowledged and the concepts are very much linked to Boëda's accepted definition. Flint fractures conchodially, meaning the force from a blow will travel through the material in a cone shape until it can escape from the material (Whittaker 2010). Through the convex shaping of the flaking surface, the knapper of a Levallois core is directing where the force of the blow will end, thereby predetermining the width and length of the removal as seen in Figure 2.8.

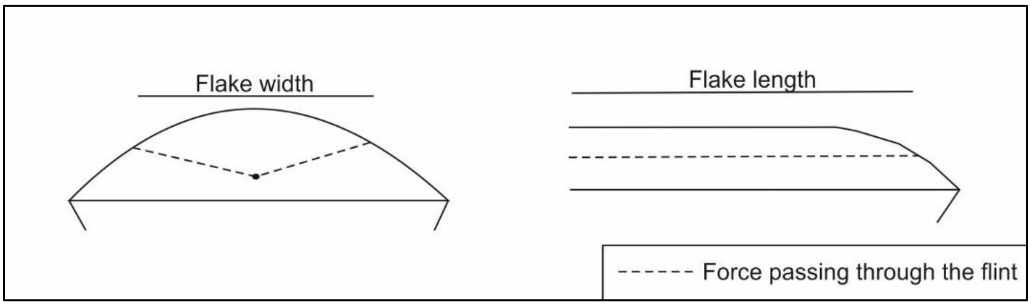


Figure 2.8. Controlling the length and width of Levallois end products through the deliberate shaping of the convexities of the preferential flaking surface.

If the removals from the flaking surface prior to the 'preferential removal' have not shaped the distal and lateral convexities in the way shown in Figure 2.8, the size of the 'preferential removal' cannot be considered to be predetermined. This does not however preclude the removal from being considered 'preferential' and the flaking surface not prepared. In the case of SPCs, there appears to be a clear hierarchy between the two surfaces of the core and the purpose of one of those surfaces is to produce flakes. The removals prior to the 'preferential removal' are still preparing the surface by keeping the surface flat, removing the cortex and generally continuing to maintain that surface. Shimelmitz and colleagues (2014) see the maintenance of the flat flaking surface as preparation for the production of large flakes as it maximises the area available for flaking.

The faceted striking platform on a Levallois core is one of Boëda's criteria and plays a key role in the preparation and predetermination of the core. During the process of faceting, removals are made from the striking platform to create a sharper platform angle (Whittaker 2010). Faceting also creates a specific area or point for the final blow to strike the core thereby giving more precision when removing the preferential removal.

Figure 2.9 is an illustration of two Levallois flakes with faceted butts. The faceted butt is the part of the faceted striking platform which remains on the flake once it has been detached from the core. The faceting on the right is a particular type of faceting known as a *chapeau de gendarme* platform. Van Peer and colleagues (2010: 46) have argued the *chapeau de gendarme* butt produces thinner flakes and enables greater precision. Inizan and colleagues support this argument and describe this particular type of striking platform preparation as the 'preferential impact point' (Inizan *et al.* 1999:80).

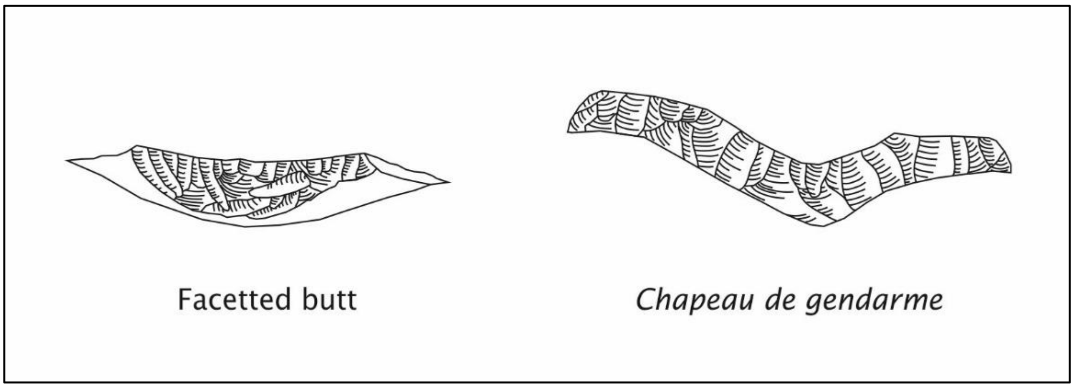


Figure 2.9. Faceted Levallois butt and a *chapeau de gendarme* butt

Very few flakes from SPCs have been identified, but the few which have from Frindsbury do not display faceted striking platforms. An example of a group of refitting flakes from a Frindsbury SPC were illustrated by White and Ashton (2003) and the plain butt of one of these flakes can be seen in Figure 2.10.

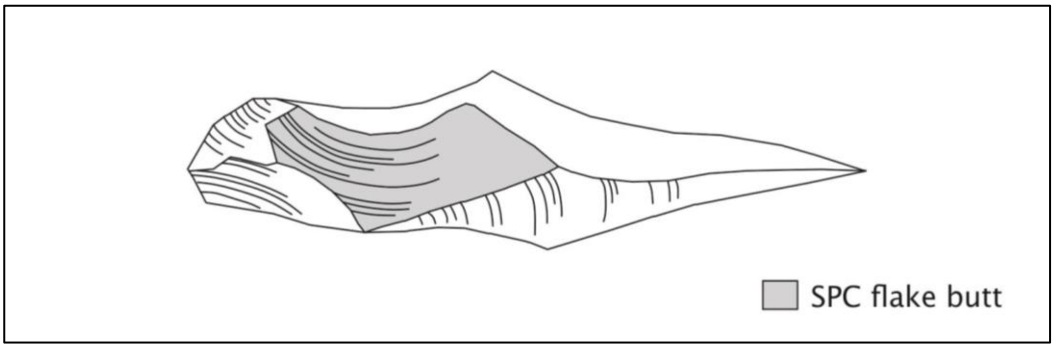


Figure 2.10. An example of a non-faceted SPC flake butt

Mentions of SPCs and potential SPCs seem to refer to a simple striking platform which appears to be perpendicular to the plane of intersection between the two surfaces. If present, this striking platform is a clear example of preparation and although it cannot provide enough accuracy to predetermine the shape of the preferential removal, it does validate the use of the term preferential as the other 'preparatory' removals which have flattened the flaking surface do not have prepared striking platforms. It is entirely conceivable that the striking platform may have been a fortuitous part of an earlier knapping sequence which could then be used to argue against preparation. This highlights the importance of the order of removals in relation to each other and will be explained fully in Chapter 3. The role of the striking platform will also be discussed further once it has been established if this is an attribute present on all SPCs.

The difference between preparing a flaking surface and predetermining the end product is arguably conceptual. In both cases, the knapper is removing flakes from a surface but in the case of predetermination, it is the mind-set of the knapper which shifts, not the process of reduction. There is no predetermination in preparing a flaking surface, just a desire to create or accentuate an already flat surface. One of the problems when identifying different forms of Levallois preparation and exploitation mentioned above was distinguishing between a centripetally prepared, recurrent Levallois core and a centripetally prepared, unexploited Levallois core. This is because the process of reduction does not change physically but a change has taken place in the mind-set of the knapper that the preparation is complete and now is the time to removal the preferential removals. This same shift in mind-set must take place with SPCs and the preferential removals on the flaking surface.

2.4 Why is the Levallois technique important?

The appearance of Levallois technology is often used as a marker for the beginning of the Middle Palaeolithic in Europe and the Middle Stone Age in Africa (White *et al.* 2006; McNabb 2007; White *et al.* 2011; Eren and Lycett 2012; Wadley 2015). Not only is this approach to stone tool production very different to methods previously used, but with the arrival of Levallois we see a major shift in hominin behaviour (White *et al.* 2006; Scott 2011). It is this change in behaviour that makes the origins of the Levallois technique and the relationship between this technology and any earlier manifestations a subject worthy of investigation.

As mentioned in Chapter 1, the widespread appearance of Levallois technology in Europe and Africa c.300,000BP is argued to be the first significant technological change since the appearance of handaxes 1.7 million years ago (mya) (Gamble 1999; White *et al.* 2006; McNabb 2007; Roche *et al.* 2009; White *et al.* 2011; Eren and Lycett 2012; Wadley 2015). It has been suggested Levallois products perform similar as well as additional functions to the handaxes. For example, handaxes are widely accepted as butchery tools with use-wear analysis to support such claims (Mitchell 1995; Ollé *et al.* 2005; Ollé *et al.* 2013; Solodenko *et al.* 2015). Levallois tools show similar use-wear patterns but additional products such as points are used in projectiles (Shea 1993; Boëda *et al.* 1999; Goval *et al.* 2015). The flexibility in tool production facilitated by the Levallois technique arguably resulted in the potential for greater mobility and is a possible explanation for the pattern of the disappearing number of handaxes sites with the increasing dominance of Levallois technology (White and Ashton 2003; Scott 2011; Pettitt and

White 2012). A declining population in Britain from MIS 9 onwards is also argued to be a factor in the change of site densities and will be discussed further in Section 2.7 (Ashton and Lewis 2002; Ashton and Hosfield 2010; Ashton *et al.* 2011a).

A suite of behavioural changes, sometimes referred to as the 'Middle Palaeolithic package' (Scott 2011), can be linked to the appearance of Levallois technology. This 'package' includes changes in landscape use, hunting practices, subsistence strategies, and group dynamics as well as the changes in conception and production of stone tools. White and Ashton (2003) suggests the changes in behaviour are indicators of the increasing 'Neanderthalisation' of hominin society. They argue the conceptual change in stone tools is but one indicator of a complex social transformation which presages Neanderthal behaviour. SPCs are, without question, a significant part of this transformation.

The changes in landscape use are demonstrated by the increase in raw material transport distances during the European Middle Palaeolithic (Geneste 1989; White and Pettitt 1995; Féblot-Augustins 1999; Fernandes *et al.* 2008). There appears to be a shift from local procurement in the Lower Palaeolithic, regardless of raw material quality, towards longer distance transfer of higher quality raw materials in the Middle Palaeolithic (Féblot-Augustins 1999). The high proportion of heavily curated Levallois material made on non-local flint has been argued to demonstrate the preferential transport of Levallois cores and products within the landscape (Scott 2011). Scott also suggests the use of Levallois technology is connected to changes in the organisation of sites within the wider landscape (*ibid*). With specific reference to British Early Middle Palaeolithic sites, Scott argues those sites close to sources of raw material, such as Baker's Hole, were areas of provisioning. These sites tend to be large in size and display all stages of tool production with an apparent primary objective to produce large flake blanks (Turq 1989; Scott 2011). The site of Crayford appears to show a different example of landscape use. In this location hominins appear to have been re-preparing Levallois cores but not abandoning them (Scott 2011). The lack of exhausted cores and a high proportion of elements from the mid-stages of tool production suggest the hominins were taking the cores as well as the products away with them (Scott *et al.* 2011). It is this core transfer, also seen at Creffied Road (Scott 2011), which defines the Levallois technique as mobile.

Changes in hunting practices and a more highly flexible subsistence strategy can be seen through selective hunting at sites such as Salzgitter-Lebenstedt and Schöningen in Germany (Thieme 1997; Gaudzinski 1999a; 2006; Patou-Mathis 2000; Julien *et al.* In press; Rivals *et al.* In press). Through analysis of the faunal assemblage at Salzgitter-Lebenstedt, Gaudzinski (2006) identified a pattern of species specific exploitation which she attributes to targeted hunting. The faunal assemblage, which is dated to between OIS 5-3, is dominated by reindeer which appear to have died within a short space of time. This potential mass-hunting event demonstrates Neanderthal hunting practises not previously seen in the Lower Palaeolithic archaeological record. Gaudzinski (1999a; 2006) argues evidence for hunting prior to MIS 7 is rare and monospecific exploitation seen in the archaeological record is anecdotal with most faunal assemblages the result of scavenging. However, the Lower Palaeolithic site of Schöningen also demonstrates one of the earliest examples of targeted hunting and organisation. Recent work by Julien and colleagues (In press) and Rivals and colleagues (In press) has revealed the large assemblage of horse remains was not a product of single hunting event, like at Salzgitter-Lebenstedt, but multiple events targeting horses potentially at different times of the year. Both of these examples not only demonstrate evidence of hunting but are indicative of the level of social organisation required to carry out such activities.

The wooden spears found in association with the horse remains at Schöningen, are probably the best known and earliest direct evidence for hunting (Thieme 1997). Dated to MIS 9 at an age of approximately 300kya, these spears are associated with the large faunal assemblage described above and are thought to have been used as thrusting weapons (Rivals *et al.* In press). Earlier evidence of hunting is arguably present at Boxgrove where a perforated horse scapula is suggested to be indicative of spear hunting and the butchery of a near complete rhinoceros skeleton has been suggested to demonstrate hominins were hunting by a waterhole or at least had primary access to the carcass (Roberts and Parfitt 1999). It is not until the Middle Palaeolithic and MSA that we see the development of projectile tools for hunting (Shea 1988, 1993; Milo 1998; Boëda *et al.* 1999; Hardy *et al.* 2001; Mazza *et al.* 2006; Villa *et al.* 2009; Rots 2013; Wragg Sykes 2015). This increase in complexity is attributed to the use of Levallois tools and hafting.

The process of hafting and producing composite tools has been suggested to require an increased level of cognitive ability as the complex technology requires the planning and preparation of multiple components such as the haft and binding agent to create the tool. This behaviour was previously considered to be unique to modern humans but work by Barham has demonstrated the use of composite technology at 300ka in central Africa (Barham 2002) approximately the same time as the widespread appearance of Levallois technology. Levallois points produced through convergent flaking are the lithic component of the hafted tools and as the organic component of these tools often is not preserved, the Levallois points are considered to be evidence of hafted technology. These arguments are supported by residue analysis and experimental work replicating broken points (Boëda *et al.* 1999; Shea *et al.* 2001; Villa *et al.* 2009; Wilkins *et al.* 2012; Rots 2013; Iovita *et al.* 2014).

The behavioural changes discussed above would have direct consequences for group dynamics and social organisation. Though not directly visible in the archaeological record, such changes would have required greater group cohesion and possible organisation in the landscape (Gamble 1998; Gamble 1999; Roebroeks 2001; Scott 2011; Ashton 2015; White 2015).

The changes in landscape use, hunting practices and group dynamics are all inherently linked to the Levallois technique as a mobile technology and it is this mobility which is the single most significant advantage over previous lithic technologies (McNabb 2007; Scott 2011; Eren and Lycett 2012; Pettitt and White 2012). Through the preparation and reworking of the flaking surface, rather than creating a single handaxe or multiple flakes, Levallois technology allows for the production of a range of tools from a single core (Boëda 1995; Scott 2011). In addition to producing multiple blanks from one core, Levallois products could also be retouched to form different tools on multiple occasions. Levallois tools identified at both Baker's Hole and Ebbsfleet demonstrate reworking which transformed the edges of individual tools in multiple ways (Scott 2011: 95). It is this versatility of core exploitation and tool production which enabled hominins greater mobility within the landscape, as seen with the raw material transport distances, as one nodule served to produce any number of tools. Levallois cores, blanks and flakes were transported around the landscape as a way of anticipating and producing tools depending on future need (Scott 2011).

Arguably the most important behavioural change is the conceptual and operational shift in the way hominins approached this tool technology as opposed to the tool technology which preceded it. Levallois technology is characterised as the fusion of *débitage* and *façonnage* (White and Ashton 2003). *Débitage* is the reduction and fragmentation of volume through the removal of smaller pieces (flakes) whereas *façonnage* is the shaping of the volume to create the required shape, for example the shaping of a handaxe (White and Ashton 2003; McNabb 2007). Whilst the systems of *débitage* and *façonnage* can both be seen, albeit separately, in Lower Palaeolithic stone tool technologies, it is not until the appearance of the Levallois technique that the fusion of both systems becomes the common place method for producing flake tools (White and Ashton 2003). It could be argued that we see early, occasional appearances of this during the Early Stone Age in Africa with the production of large flakes from Victoria West cores for handaxes and cleavers. However work by Lycett (2009) has suggested that whilst Victoria West cores demonstrate morphological similarities with the Levallois technique, it is still a method for producing Mode 2 technologies (handaxes) and the conceptual difference is Levallois flaking results in the preshaped tool. An identical conclusion to that also noted by McNabb and Beaumont (2012) with their work on the Victoria West material from Canteen Koppie.

With the manufacture of handaxes we see the initial reduction of the volume of material and the shaping of that material through *façonnage* to create the final bifacial product. This is a sequential, non-interchangeable process. The Clactonian is a purely *débitage* process with the mind-set of the knapper focused on the production of flakes; hence the shape of the core is irrelevant and ultimately random. However, Levallois reduction requires the knapper to alternate between *débitage, façonnage* and then *débitage* again. This conceptual breakthrough is also linked with the idea of predetermination and preparation, previously unseen in Lower Palaeolithic core working. Whilst planning and the concept of a preconceived tool form is present in handaxe manufacture, Lower Palaeolithic core working techniques did not demonstrate planning or organisation. Flakes were removed from the core either in a migrating platform fashion or through the discoidal technique. Migrating platform core is the umbrella term for cores where removals have been made from the volume of material in a non-organised fashion (McNabb 2007:324). The flakes are removed cutting into the volume of the material, rather than across the surface. Discoidal flaking is the removal of flakes from a plane of intersection which divides the core. It is argued the plane of intersection is not intended but rather a fortuitous result of flakes being removed in an alternating fashion (White and Ashton 2003; McNabb 2007). The cognitive implications of these ideas will be discussed in greater depth in Section 2.5. However the underlying premise is that products of the Levallois reduction technique were predetermined in their form by the knapper through the preparation of the core, a process that some argue requires greater cognitive ability than the makers of the previous stone tool technology (Schlanger 1996).

The production of flakes of a predetermined shape and form is linked to a fundamental change in stone tool use. The Acheulean is characterised by handheld tools such as handaxes, cleavers and flake tools (e.g. scrapers) whereas with the arrival of the Levallois technique we see the appearance of tools with multiple components, known as composite tools (Ambrose 2001:1751). As mentioned above, this change in tool production requires the maker to use both a reductive and an additive process to produce the tool, as opposed to the Acheulean method which was solely reductive (Barham 2010). The creation of composite tools arguably requires a greater cognitive ability and will be addressed along with other cognitive claims in the following section.

Foley and Lahr (1997) argue the change in hominin morphology and behaviour which they associated with the appearance of Levallois could be considered more important than the changes associated with the Middle to Upper Palaeolithic transition. They argue the Lower to Middle Palaeolithic changes could represent the cognitive and biological shift associated with the earliest emergence of modern humans in Africa and that later developments, in the Upper Palaeolithic, were a further development of this change (Foley and Lahr 1997:27-28). The early examples of Levallois technology outside Africa prior to the earliest modern humans do not support this argument. It seems more plausible that the cognitive and behavioural changes associated with the appearance of Levallois technology are linked to *H. heidelbergensis* or a common ancestor to both modern humans and Neanderthals. In terms of the behavioural shift between the Lower – Middle and Middle – Upper Palaeolithic, the latter change built upon the first however that is not to say the first is more significant as both represent major changes in cognitive evolution as seen in material remains.

It is clear the underlying importance of the arrival of Levallois technology is the change in hominin behaviour which can be associated with it. Not only is this technology representative of a conceptual change in the way stone tools were produced, there is also the change in landscape use, raw material procurement, hunting and provisioning strategies and movement around the landscape. This stone tool technology represents a major technological and behavioural change which marks a conceptual change in hominins in the Middle Pleistocene.

The research in this thesis will build upon our understanding of how and why this technology appeared when it did and will contribute to our broader understanding of this technique. The presence of previously overlooked SPCs in the archaeological record would have implications for this major change in hominin behaviour. The increased presence of this core working technique in assemblages prior to the adoption of the Levallois technique could support the argument that this is a technique which developed from the Acheulean rather than one that was introduced fully formed.

2.5 What are the cognitive implications for Levallois?

In 1950 Bordes noted that Levallois knapping required predetermination (Bordes 1950). Through the identification of predetermination, Bordes started the debate regarding the cognitive implications for hominins using the Levallois technique, a debate which has continued to the present day (Bordes 1968; Boëda 1995; Schlanger 1996; Wynn and Coolidge 2004; 2010; Tryon *et al.* 2005; White *et al.* 2011; Eren and Lycett 2012; Picin *et al.* 2013; Wiśniewski 2014).

The level of expertise required from modern day knappers along with the conceptual complexity of Levallois reduction have led many to argue for the increased cognitive ability of the knappers who used this technique (Wynn and Coolidge 2004; White *et al.* 2011; Eren and Lycett 2012). The seemingly sudden replacement of the long established and geographically widespread Acheulean tool technology has also encouraged researchers to favour significant cognitive advancement as an explanation for the success of the Levallois technique (McBrearty and Tryon 2006).

One of the most in-depth studies on the cognitive implications of Levallois was carried out by Nathan Schlanger in the mid-1990s. Schlanger argued that Levallois has long been used as an indicator for ‘conceptualization, abstraction, intelligence, language etc.’ by many different researchers so much so, that many people take the association between cognitive advancement and Levallois for granted (Schlanger 1996:231). Schlanger highlighted the difficulties of the cognitive claims. The main problem with these claims was the ‘implication of a separation between thought and action in flint knapping’ meaning the knapper is aware of the process and the final outcome before carrying out the action (Schlanger 1996:232).

Schlanger identified two opposing cognitive claims regarding Levallois. The first is what he referred to as a ‘standard’ claim where the Levallois knapper has a ‘clear mental image’ of the procedure and what will be produced. The Levallois definition put forward by Bordes in the 1950s and 1960s would fall into this category. The second is the ‘reactionary’ claim where the knapper is responding to changing circumstances and constraints on a core by core basis, rather than planning ahead, thereby undermining the claims for cognitive advancement (*ibid*). This argument is also championed by Iain Davidson and William Noble (1993) who argue that it is not until the Upper Palaeolithic that we see a ‘capacity for consciousness’. Meaning the hominins implementing the Levallois technique in the Middle Palaeolithic were reacting rather than preplanning when knapping and did not envisage the final form before they started reducing the core. The authors present what they consider to be a simpler explanation for the Levallois technique whereby the aim was to produce multiple, unprepared flakes from a single core. In their proposal, the large removal, which others would call the preferential removal, was supposed to extend to the edges of the surface and thereby rejuvenate the edge. It is argued, in this scenario, that the 'classic' Levallois cores are in fact failed attempts at core rejuvenation which have consequently been abandoned (Davidson and Noble 1993:376). This interpretation has also been put forward more recently by Dennis Sandgathe (2004) who also challenges the reliability of inferring the intentions of early hominins. The problem with this interpretation is the focus on 'classic' Levallois cores and the disregard for the huge volume of varied material which does not conform to this particular method.

The question of predetermination was a persistent issue for Schlanger when looking at the cognitive claims for Levallois (1996). He highlighted that all knapping products have characteristics which have been predetermined by previous removals. The important question therefore is whether or not the predetermination is controlled by the knapper (*ibid.*). Through the refitting of a Levallois core known as 'Marjorie's core' found during excavations at Maastricht-Belvédère, Schlanger rejected the argument put forward by Davidson and Noble (1993) which suggested the 'classic' Levallois cores were abandoned failures and that the desired product of the core was a high number of the flakes which are now referred to as preparatory flakes. Schlanger argues the knapper removed flakes, which he refers to as 'lateral convexity preparation flakes', knowing how they would shape the surface or the core and with an envisaged idea of where the final Levallois flake would be located on the surface, thereby making that final removal predetermined (Schlanger 1996:246). By 'lateral convexity preparation flakes', I believe Schlanger is not referring to éclat debordant removals, which rejuvenate a previously exploited flaking surface, but simply the preparatory removals on the flaking surface. Schlanger concludes the cognitive capabilities required of planning and predetermination should not be restricted to the 'modern' humans of the Upper Palaeolithic but can be applied to the hominins responsible for the knapping of Marjorie's core. Schlanger concluded the reduction sequence seen in this refitting core was neither completely pre-planned nor completely unplanned but lies somewhere in the middle with the knapper taking into consideration the material and the desired product (Schlanger 1996:286). It should therefore be argued that the knapper's decision to apply the Levallois technique, a technique which demonstrates surface preparation, maintenance and control and requires the final product to be envisioned in order to create those surfaces, implies predetermination.

The conclusion reached by Schlanger (1996) supports the idea of conceptual standardisation proposed by McNabb and colleagues (2004). The knapper has a clear idea of what they need to make and the process by which they do that. However the final form of the product is determined by the interplay between raw material and how well the knapping went. In this scenario the routine is standardised but the end product is not. Again this relates to conceptual as opposed to physical predetermination. The Acheulean, Clactonian and Levallois technologies all demonstrate conceptual templates whether it be handaxes (*débitage*), flakes (*façonnage*) or flake tools, elongated pieces or points (*débitage* and *façonnage*). Other forms of PCT such as the Victoria West and the Kombewa methods also follow a conceptual standardisation. They were routinely employed methods for creating blanks in which each reduction sequence followed the same format with the same aim but would not produce identical products (McNabb *et al.* 2004).

Recent work by Eren and Lycett (2012) supports that of Schlanger. Eren and Lycett looked at standardisation in preferential Levallois flakes to see if these flakes can be considered to be predetermined (*ibid*). Their results also highlighted other ways in which the Levallois flake may be the desired product of the reduction sequence. Not only are Levallois flakes usually larger than flakes produced through other reduction techniques (Eren and Lycett 2012:5), the thickness of Levallois flakes is more evenly distributed in cross-section, thereby providing more support and a greater potential for resharpening (Turq 1992; Eren and Lycett 2012; 2015). Figure 2.11 shows a flake with a steeper cross-section has fewer potential phases of retouch or resharpening when compared with the flake with an even cross-section. Eren and Lycett's research supports the argument that the Levallois flakes are predetermined and the preferred product of the reduction sequence. They use this evidence to support the theory that Levallois reduction would have required the cognitive capacity of long-term working memory (Eren and Lycett 2012:9). They also suggest the cognitive capabilities of the hominins using this technique in the Middle Palaeolithic were not all that different from those in the Upper Palaeolithic implying cognition was not the leading factor in behavioural change (*ibid.*).

Whilst this research into width and cross sectional depth has contributed a possible explanation for the Levallois technique, it must be noted that this investigation only included 'classic' Levallois flakes, meaning centripetally prepared and linear exploitation. Levallois flakes produced from a different preparation technique or the second or third Levallois flake removed in a recurrent sequence would not have the symmetrical cross section depicted in Figure 2.11 and would, I imagine, produce different results. The flake scar of a previous preferential removal would leave a different dorsal scar pattern to the preparatory removal scars, creating a potentially uneven cross section. The findings of this research are also limited as the authors were comparing the edge angles of the preferential Levallois flakes with the preparatory flakes from the same cores (Eren and Lycett 2015). It would have been useful to compare the preferential Levallois flakes with flakes produced from other core working techniques. This would have created a comparison of desired end products as opposed to a comparison between end product and waste product.

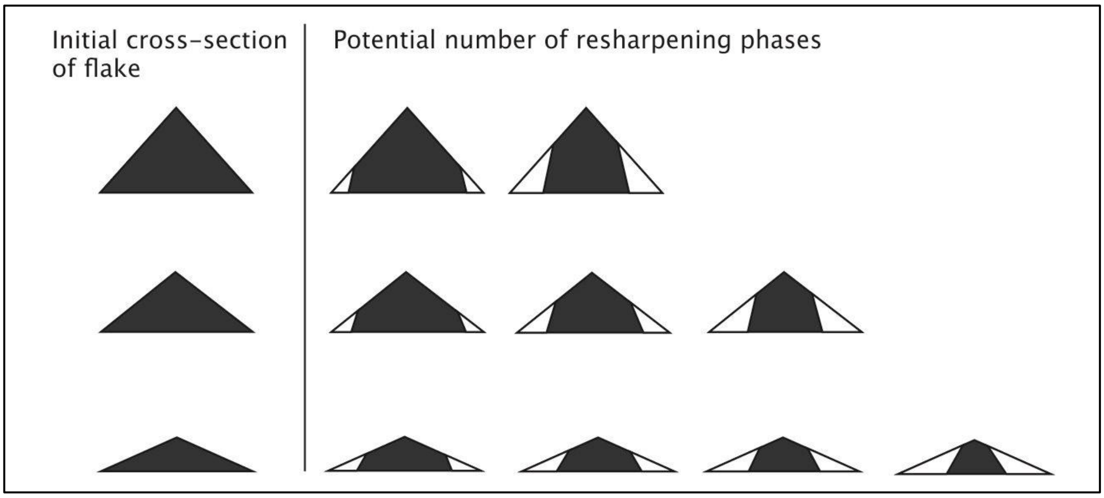


Figure 2.11 Relationship between cross-section of a flake and the potential for instances of resharpening (redrawn after Eren and Lycett 2012:8)

Contrary to the arguments in favour of the Levallois technique representing cognitive advancement, White and colleagues state Levallois does not represent a significant cognitive leap, rather that it combines existing technological schemes already visible in the Acheulean (2011:62). They argue Levallois technology cannot have a single point of origin and must have been invented on multiple occasions throughout the Lower Palaeolithic. White and colleagues used the presence of SPCs at Purfleet and Kesselt- Op de Schans in Belgium along with other forms of PCT to support their argument (White *et al.* 2011). This is not a new theory; indeed multiple origins from within the Acheulean have been discussed by a number of authors (Wymer 1968; Tuffreau and Antoine 1995; White and Ashton 2003; Adler *et al.* 2014). White and colleagues argue the appearance of Levallois does not represent a new cognitive ability. Instead they propose changes had begun in the time preceding the appearance of the Levallois technique, such as increasing brain size and longer childhoods, which came together to allow this technology to take hold (White *et al.* 2011:62).

Our ability to understand the cognitive capabilities of extinct hominin species is limited. The arguments presented thus far have inferred behaviour from the archaeological record and tried to establish what level of cognition the hominins producing these tools must have reached. Alternatively, the social brain hypothesis (Dunbar 1998; 2003, 2009; Dunbar and Shultz 2007; Gamble *et al.* 2011; Gowlett *et al.* 2012; Shultz *et al.* 2012; Dunbar *et al.* 2014) approaches hominin cognition in relation to expanding brain size, suggesting the evolution of larger brains was in response to the pressures of living in complex social groups (Dunbar 1998; 2003). Recent research into brain evolution and increasing brain size demonstrated this was not a gradual process but was characterised by step changes at approximately 100kya, 1Mya and 1.8Mya (Shultz *et al.* 2012). These dates do not coincide with the first appearance of the Levallois technique or any major change in stone tool technology. The disparity between the biological changes and the cultural response seen in the archaeological record has been observed throughout the Lower Palaeolithic (Cole 2012, 2015; Gowlett *et al.* 2012; McNabb and Cole 2015).

Gowlett and colleagues (2012) demonstrate this disparity by using archaeological examples to highlight some of the problems which occur when associating cognitive ability with technological visibility. They challenge the notion that the cognitive demands of tool making are what drove cognitive evolution. Instead suggesting such capabilities may have been present much earlier, requiring specific circumstances for use (*ibid.*). The authors use several archaeological examples including the discussion on early fire use to support their theory. Evidence of fire within the archaeological record is extremely limited due to the combination of factors required to preserve such evidence. Yet we know fire must have existed at many sites where evidence is not present (*ibid.*). Gowlett and colleagues make the very valid observation that we, as archaeologists, are happy to assume more recent control of fire, even when there is no evidence, but we are less inclined to apply the same leniency back in time even when there are several earlier examples of fire, concentrated burning, charred seeds and wood, and burnt bones (Gowlett *et al.* 1981; Brain and Sillent 1988; Harris *et al.* 1997; Goren-Inbar *et al.* 2004). The same argument could be made about the Levallois technique and indeed Gowlett and colleagues do draw some interesting comparisons. They suggest the cognitive requirements needed for the Levallois technique must have been present up to 200ka years earlier than the widespread appearance of Levallois as they see global dispersal between approximately 1.0 ma – 125 ka not as a consequence of an evolved capacity of tool use, instead they see the cognitive complexity present prior to the dispersal.

The argument for the presence of inherent cognitive ability long before widespread technological manifestation is supported by the occasional appearance of early PCT including SPCs. As with fire, we will never find the 'earliest' example of Levallois technology but, that should not matter. The question we should be asking is not when do we first see evidence of this technique, but when were hominins cognitively capable of this level of technology? I would argue isolated occurrences may occur fortuitously but we would be incredibly lucky to identify such incidences in the archaeological record. SPCs and other early PCTs could be like the examples of burnt wood and charred seeds, previously overlooked but still indicative of cognitive ability.

Gowlett and colleagues also highlight the dangers of associating technological manifestation with cognitive ability. Using the example of technological Modes associated with colonisation, they point out the colonisers of Australia were using a Mode 3 technology which would suggest they were cognitively less advanced than the Mode 4 using colonisers of North America (Gowlett *et al.* 2012). However we know that the colonisers of both of these regions had the same levels of cognition as they were all anatomically modern humans.

Cole's (2012, 2015) work on handaxe symmetry is another example of the archaeological evidence not correlating with the biological changes as predicted by the social brain hypothesis. Cole challenged the long standing view that handaxes become more symmetrical and standardised over time reflecting changes in hominin behaviour and cognitive ability. Instead Cole suggests there is no evidence for increased symmetry and that it was not a significant factor for handaxe producing hominins. Arguing it is not until the appearance of PCT, specifically composite tools, that we can start to see an increase in cognitive ability at a species wide level (*ibid*.).

Regardless of the lack of a biological explanation for the change in stone tool technology, the Levallois technique remains a significant development in the approach to stone tool production. Both of the arguments for a cognitive leap or a gradual shift support the notion that this is a change in concept. Field argues this change should be consider a transformation as opposed to a transition (2005). A transformation in this context reflects the ongoing process of change whereas a transition would imply an abrupt change from one technology to the next. SPCs are direct evidence of the transformation from Acheulean to Levallois technologies.

There seems to be two questions which need to be addressed. The first, does a change in conception equal a cognitive leap? As White and colleagues (2011) have stated, the blending of *débitage* and *façonnage* techniques can be seen in the Lower Palaeolithic, but this does not fully take hold until approximately 300,000 years ago with the developed Levallois technique. So, this could represent a gradual cognitive change rather than a leap. Alternatively, following Eren and Lycett's (2012) argument, the advance in cognition is linked with the development of the Levallois technique and the cognitive jump between the Middle/Upper Palaeolithic is actually not as pronounced. By scaling down the Middle/ Upper Palaeolithic transition and increasing the cognitive significance of early PCTs, the cognitive trajectory becomes a gradient rather than a step process.

The other question this debate has raised forms the basis for this thesis and has been presented as the main Research Question:

What is the precise technological relationship between SPCs and the Levallois technique, and what will this tell us about the behaviour of the hominins associated with these new ways of making stone tools?

If it is accepted that the fully developed Levallois technique represents cognitive change, SPC technology must also represent a shift in kind. To what extent this change might be, will be dependent upon how predetermined the SPCs are seen to be. These questions will be addressed once the analysis of the SPC material has been carried out.

The two arguments presented above are both viable options for the cognitive implications of the presence of the Levallois technique. However, a third proposal could combine these two schools of thought. The Levallois reduction technique is, as has already been discussed, an incredibly widespread technique which appears to rapidly change the way in which tools are produced (Wiśniewski 2014). The presence of earlier examples of PCT, such as SPCs demonstrates hominins might have been cognitively capable of such an activity. However, the widespread success of the Levallois technique required a significant change in hominin behaviour in order for the technology to survive. Rather than a sudden cognitive change, the research carried out for this thesis supports a gradual cognitive shift which accelerated towards the end of the Lower Palaeolithic.

Figure 2.12 presents the early occurrences of PCT and some of the earliest appearances of the Levallois technique. There appears to be less variation, and generally less manifestations, of early PCT in Eurasia when compared with the African record. This could be used to support Foley and Lahr's mode 3 hypotheses, a new technology introduced by a new hominin and yet the lack of SPCs or any cores which resemble the description in Africa is also notable and could reflect true differences in technology or alternative origins for the technique in different location. The current arguments surrounding the origins of Levallois technology will be presented in the following section.

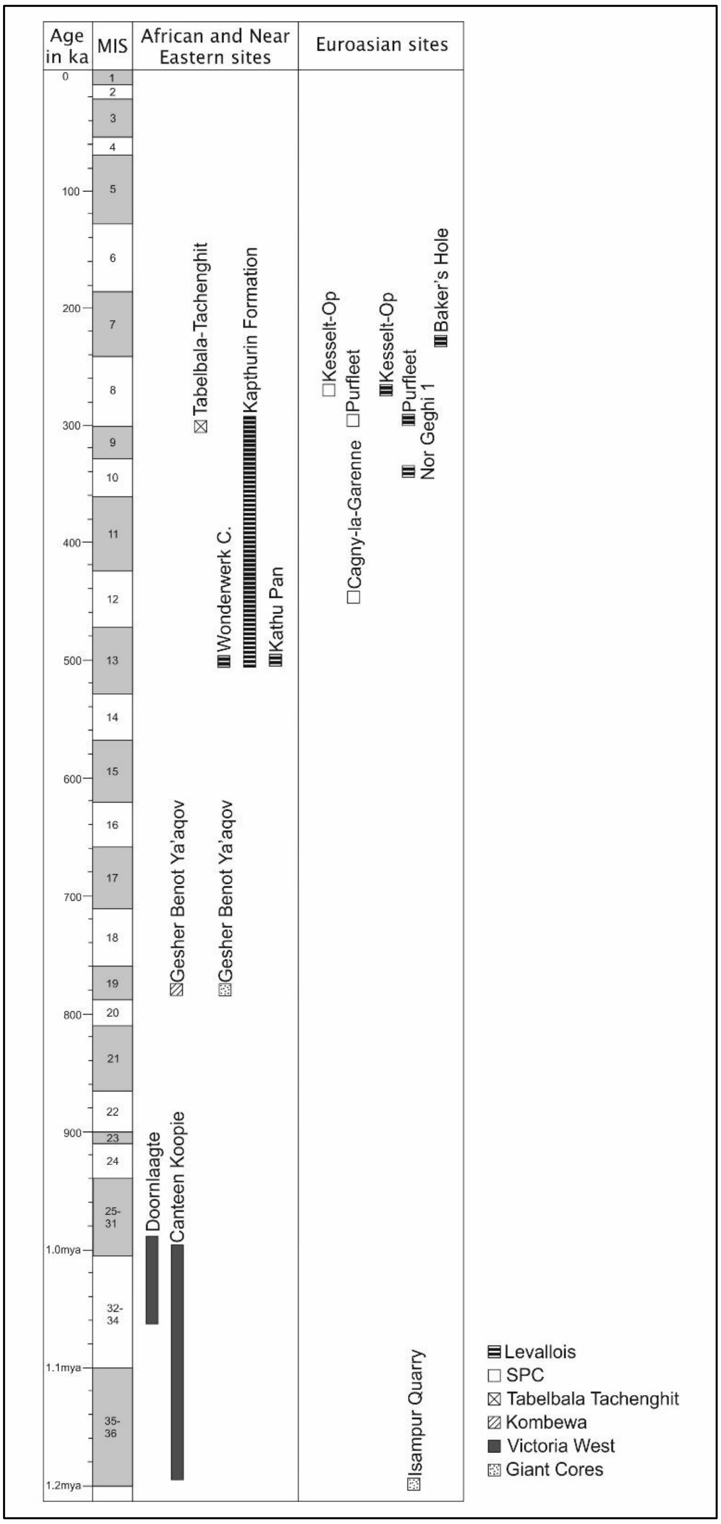


Figure 2.12 Early examples of PCT including the earliest sites with Levallois technology (Sahnouni 1972; Tuffreau and Antoine 1995; Goren-Inbar *et al.* 2000; Paddayya *et al.* 2002; White and Ashton 2003; Tryon *et al.* 2005; Beaumont and Vogel 2006; White *et al.* 2011; Wilkins *et al.* 2012; Adler *et al.* 2014)

2.6 Looking for the origins of Levallois

Due to the cognitive and behavioural implications associated with the Levallois technique, it is unsurprising that the emergence of this technology has captured the imagination of many researchers leading to two opposing theories on the matter; the monocentric model and the polycentric model. Researchers supporting the monocentric model argue for an African origin of the Levallois technique which then spread into Europe with a new hominin species. The polycentric model supports an *in situ* development of the Levallois technique from the Acheulean possibly on multiple occasions and in multiple locations over a vast period of time.

The Mode 3 hypothesis proposed by Foley and Lahr (1997) argues the Levallois technique originated solely in Africa. They suggest the technique was developed by small and sparse populations as a result of adaption and diversification which resulted in the appearance of proto-Levallois techniques such as the Victoria West in Kenya (*ibid*). They claim a rapid dispersal of the fully formed Mode 3 technology took place between 250 – 200kyr with *H. helmei* populations moving into Europe and replacing the existing *H. heidelbergensis* (Foley and Lahr 1997:27). In this model *H. helmei* was the more recent common ancestor to *H. sapiens* and *H. neanderthalensis.* Foley and Lahr's hypothesis suggests the rapid appearance of Levallois in Europe demonstrates the competitive advantage this technology gave the dispersing population in the form of a flexible and more efficient way of producing tools. They suggest it is this competitive edge that resulted in the technique becoming so widespread. There is no doubt that the Levallois technique replaced the existing Acheulean tool kit, however that is not evidence in itself that the dispersal of a new hominin species was responsible. I believe there is a stronger argument to suggest this was not the case.

The palaeoanthropological evidence does not support the monocentric model. Neanderthal-derived features are present in Europe at MIS 11 in the Swanscombe and Sima de los Huesos fossils (Stringer 2002, 2012). This suggests the divergence from the last common ancestor is perhaps beginning around this time and is therefore earlier than the date proposed by Foley and Lahr (Hublin 2009:16025). The archaeological evidence also conflicts with the monocentric model. SPCs and other early examples of Levallois or early PCT exist in Europe before the proposed *H. helmei* dispersal (Tuffreau 1995; White and Ashton 2003; White *et al.* 2011). By analysing the presence of SPCs in the northwest European archaeological record, this thesis will add to this evidence and support the argument for already established core working techniques present within the Acheulean thereby suggesting an *in situ* origin for Levallois rather than one that was brought to Europe already fully developed by hominins moving out of Africa.

The argument for the *in situ* development of Levallois from the Acheulean is now the hypothesis favoured by most researchers investigating this topic (White and Ashton 2003; Scott 2011; White *et al.* 2011; Adler *et al.* 2014; Wiśniewski 2014). White and colleagues (White *et al.* 2011) came to the conclusion that PCT had a long history in both Africa and Eurasia. Looking at examples of early PCT (see Figure 2.12) such as the Victoria West cores from Canteen Koppie, South Africa present at 1.1 mya (McNabb 2001; Sharon and Beaumont 2006); the Tachengit-Tabelbala technique found in the north-west Sahara (Sahnouni 1972); the Kombewa technique found in Ethiopia and Gesher Benot Ya'aqov, Israel (Goren-Inbar *et al.* 2000); the giant cores from Isampur Quarry, India (Paddayya *et al.* 2002); and the SPC technologies at Wallendorf, Germany; Orgnac 3, France, and Purfleet, England (White *et al.* 2011). White and colleagues strongly support the *in situ* development of Levallois, from the flaking concepts already present in the Acheulean, arguing for instances of Levallois-like working as early as 1.5 mya (White *et al.* 2011:58).

The site of Orgnac 3 in southern France is often cited as an example of the gradual development of Levallois *in situ* (White and Ashton 2003; Moncel *et al.* 2005; Villa 2009; Moncel *et al.* 2011; Scott 2011; White *et al.* 2011; Eren and Lycett 2012; Moncel *et al.* 2012; Adler *et al.* 2014; Wiśniewski 2014). The site contains a sequence of 10 stratigraphic layers which were deposited over a relatively short period of time. Levels 8-3 have been dated to MIS 9 and Levels 2-1 have been dated to MIS 8 (Moncel *et al.* 2005). Levels 6 and 5 were dated by electron spin resonance (ESR) and Uranium-thorium (U/Th) to 309,000 ± 34,000BP and Level 2 was assigned to the beginning of MIS 8 due to the volcanic minerals which are dates to 298,000± 55,000BP (Moncel *et al.* 2011). Products from Levallois knapping arguably appear in the middle of this long sequence, which Moncel and colleagues (*ibid.*) correlate with approximately MIS 9, developing further towards the top of the sequence. Before the appearance of Levallois, flaking is dominated by discoidal working and cores which are knapped in relation to the natural shape of the material with multiple flaking surfaces (Moncel *et al.* 2012). This is seen in the lower of three technological divisions of the sequence. The earliest evidence of Levallois flaking is seen in Levels 4b – 4a which is the middle of the three groups. These early examples are found alongside 'unifaced discoid cores' which Moncel and colleagues (*ibid.*) argue are not Levallois as they do not demonstrate the maintenance of the convexities as seen in the technique but they do display preparation of the striking platform.

These cores seem incredibly similar to those from Purfleet which are of a similar age. The Levallois cores found alongside these unifaced cores are characterised by unipolar flaking which is then replaced by centripetal flaking in the upper levels. This topmost group, Levels 3-1 is characterised by fully developed Levallois flaking.

The sequence at Orgnac 3 is particularly relevant to this discussion about SPCs as not only does it appear to represent the *in situ* development of Levallois technology, but it seems to be comparable with the sequence at Purfleet. Whilst the publications on Orgnac 3 contain many illustrations of the bifaces, Levallois cores and tools and discoidal cores, there are none of the 'unifaced' discoidal cores. In addition, access to the material from Orgnac 3 was not granted for analysis in this investigation. However comparisons with this sequence and the material will be discussed in Chapter 6.

The *in situ* development of PCT from the Acheulean is also supported by Rolland (1995) who suggested the manufacture of finely made handaxes would have ultimately led to the 'accidental' discovery of PCT. Early examples of Levallois are often broken handaxes with "long axial thinning flakes" which often look like Levallois (White *et al.* 2006:526). The site of Cagny-la Garenne in northern France has been argued to demonstrate the presence of early Levallois produced through handaxe manufacture (Tuffreau and Antoine 1995). The assemblage from Cagny-la Garenne is clearly Acheulean and has been dated to MIS 12 – MIS 11. Tuffreau and Antoine (*ibid*) propose several pieces show a clear conceptual link between the method of producing handaxes and that of Levallois flake production.

There were two phases of excavation at Cagny-la Garenne and both are believed to have produced material which illustrates this conceptual link (Tuffreau 1995). Analysis of the material from the most recent excavations, Cagny-la Garenne II, identified a small core assemblage with multiple techniques present (Lamotte and Tuffreau 2001). One core is a broken handaxe with additional removals and another is arguably a centripetally prepared Levallois core. The cores of particular interest are those described as unipolar with flaking management of a flaking surface with varying degrees of striking platform preparation (Tuffreau 1995). The striking platform preparation is of particular interest as many other descriptions of early PCT/ Levallois mention a simple striking platform. Figure 2.13 is an illustration of one of the cores in question from Cagny-la Garenne after photos provided by A. Lamotte. The striking platform surface along with the striking platform itself have not been illustrated due to lack of images however this core is strikingly similar to those from Purfleet with the large central removal and smaller peripheral removals.

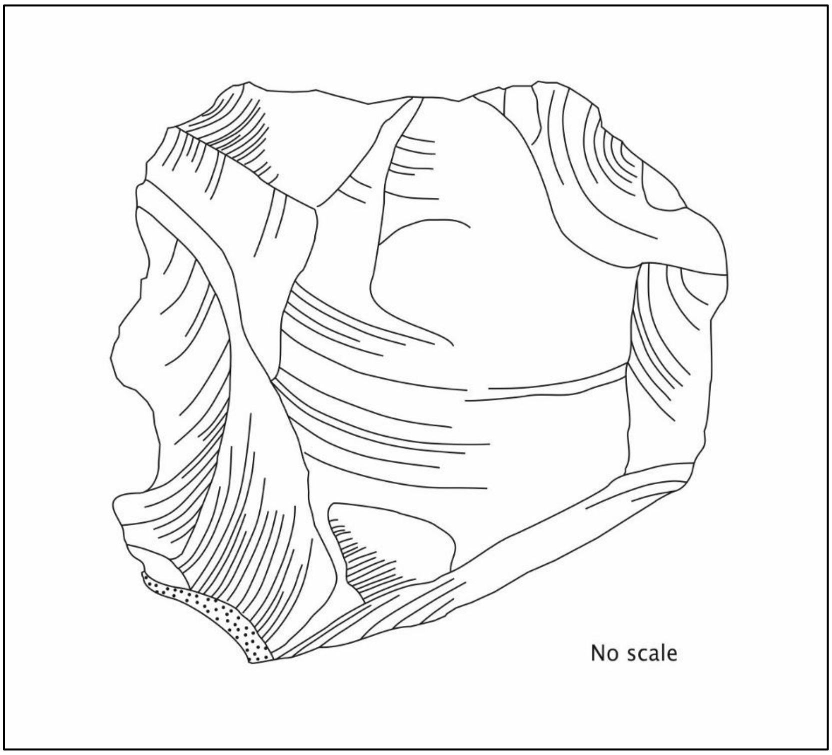


Figure 2.13 An early Levallois core from Cagny-la Garenne. Author’s own illustration after photos provided by A. Lamotte.

Access to the Cagny material is unfortunately restricted and the assemblages has not been analysed as a part of this research. A discussion regarding the material and any similarities or differences with the material from the assemblages which are included in this research will be presented in Chapter 6.

This section has presented the arguments for and against the *in situ* origin of Levallois from within the Acheulean. One suggesting the technique developed from a fusion of techniques present in the Acheulean, and the other arguing the technique developed directly from handaxe manufacture. Both theories agree this was a technology which independently developed on multiple occasions in multiple locations and at various times (Bordes 1968; Bordes 1971; Otte 1995; Rolland 1995; White and Ashton 2003; White *et al.* 2011; Wymer 1968).

2.7 Innovation

A key theme emerging from the discussion regarding cognition centres around how and why the Levallois technique became so successful when previous examples of PCT did not. If the cognitive ability to create and use this method of reduction was already inherent, what other factors may have influenced the success of this technique? In order to address this issue it seems necessary to explore the idea of cultural change and innovation. This area of research and its application to the Palaeolithic has been explored in great depth and with increasing frequency (White and Pettitt 1995; White and Ashton 2003; McBrearty and Tryon 2006; Gamble 2007; Nowell and White 2010; Coward and Grove 2011; Hopkinson 2011; 2012; Davies 2012; Elias 2012; Hovers 2012; Kuhn 2012; Wadley 2013). The low level of technological change in the Acheulean has led researchers to describe the Levallois technique itself as an innovation (Shennan 2001; Wiśniewski 2014). This is not to say the Acheulean lacked variation; there are a plethora of papers on handaxe variability (Gowlett and Crompton 1994; Clark 2001; Lycett and Gowlett 2008; Shipton and Petraglia 2011; Stout 2011; McNabb 2013; Cole 2015). However variation in handaxe shape and manufacture cannot be considered to be a technological innovation like the Levallois technique which changed the way in which stone tools were produced. The presence of SPCs in the Lower Palaeolithic archaeological record will challenge the argument for stasis in the Acheulean, particularly if this technology is seen to appear earlier than MIS 9. This argument will be addressed in greater depth in Chapter 6 once the data has been discussed in Chapter 5.

Cognitive, social, physiological, and demographic factors, alone or combined, can lead to technological innovation (Shennan 2001; Henshilwood and d'Errico 2005; Hosfield 2005; Nowell and White 2010; Coward and Grove 2011). As cognitive and physiological changes associated with Levallois have already been mentioned, this discussion will examine the relevant social and demographic factors.

The link between innovation and population demography, specifically population size, is commonly noted with present day technological development (Boserup 1981; Kremer 1993; Coccia 2014). Estimating population densities for the Palaeolithic is problematic but nevertheless several attempts have been made (Ashton and Lewis 2002; Gamble 2002; Hosfield 2005; Ashton *et al.* 2011a; Dennell *et al.* 2011). In the early 2000's, Stephen Shennan investigated the relationship between demography and cultural innovation in the Palaeolithic by using computer simulation to model the effect of cultural innovation in different population sizes (Shennan 2001). Results show the consequences of innovation are far more successful in larger populations leading Shennan to propose the multiple technological innovations of the Upper Palaeolithic correlated with increased population sizes and densities (Shennan 2001:15).

Hosfield (2005) applied Shennan's theory to Middle Pleistocene deposits in Southern Britain in an attempt to explore the relationship between hominin demography and technological innovation further. Using a methodology first proposed by Ashton and Lewis (2002) for their work in the Middle Thames region, Hosfield used artefact numbers as a proxy for artefact discard rates and created a population density index for three terraces of the Solent River (Hosfield 2005). By contrasting the densities between these terraces, Hosfield suggested populations were relatively small during MIS 13 and 11 with a significant increase in MIS 9 (2005:229). The first occurrence of the Levallois technique also appears in the MIS 9 terrace in the Taddiford Farm gravels suggesting the data from the Solent supports Shennan's model. Hosfield stressed his data does not explain the cause of the population increase, only that the larger populations may have provided the social conditions needed for the technological innovation to survive (2005:232). Thereby arguing the Levallois technique survived when other PCT techniques failed due to larger populations and the social frameworks they provide. More recently however, Hosfield (Ashton and Hosfield 2010) has reversed his stance on population demography in Britain at this time, suggesting regional differences in population size are reflected in the regional differences in artefact density between the Solent and the Thames river valleys resulting in an overall drop in populations from MIS 9 onwards. This would directly contradict the argument that the Levallois technique became widespread after MIS 9 due to the increase in population size and could support the suggestion that small, isolated populations promote innovation.

How we measure the success of an innovation in the Palaeolithic is not easy and many innovations are most likely to be invisible within the archaeological record. However technological change on a larger scale is visible, with the appearance of the Levallois technique as a prime example. Indeed the earlier forms of PCT presented in Figure 2.2 are considered by Nowell and White (2010) to be technological innovations which were short lived or restricted geographically possibly due to a number of factors including social limitations. In order for an innovation to be adopted by others, there must be a social framework whereby such ideas can be shared. Social networks in the Palaeolithic are often discussed with regards to population sizes and the spread of novel behaviours, particularly with the Middle to Upper Palaeolithic transition (Gamble 1999, 2007). Mithen has looked at the implications of social learning, for large and small groups, with regards to hominin tool technology and the transition of ideas (Mithen 1994, 1996). Mithen argues that within large groups of hominins there is likely to be less innovation as factors such as social harassment and predation would be higher, meaning juveniles would stay closer to their kin and opportunities and possibilities for experiment would therefore be reduced (Mithen 1994:8). Smaller groups of hominins would also be more likely to innovate because the restrictive 'cultural traditions' associated with large groups would not be present. However, the rate at which these new ideas are shared would be low as the level of social learning would be lower (*ibid*.).

Group size is clearly an important determinant for the spread of ideas and innovative technology and Mithen uses environment as a driver for group size using data from southern Britain to support his argument (Mithen 1994). Palaeoenvironmental data can be used to recreate the habitats inhabited by hominins in terms of vegetation cover. Mithen argues that environments which were open would have created a need for larger groups due to an increased predator risk and an increased scarcity of resources. Smaller groups are more likely to be found in wooded or closed environments where resources would have been more evenly distributed and trees could be climbed to provide protection from predators (*ibid.*). Mithen based his observations on primate group sizes in the savannah and in forests. With relation to innovation, if small groups are more likely to be innovative, we would expect to see greater variation in the wooded or closed environments of the interglacials. Mithen argued Acheulean assemblages were restricted to glacial stages with open environments whilst the Clactonian assemblages, which Mithen argues demonstrate less social learning, were produced during closed environments in interglacial periods (1994:12), thereby supporting his model. McNabb and Ashton rejected this argument though the presence of Acheulean sites in temperate, interglacial stages such as Boxgrove, Beeches Pit and Barnham (1995).

Mithen's theory on innovation, group sizes and open versus closed environments supports that of Ashton and Hosfield (2010). The MIS 9 interglacial, with a decreasing population and a warm, closed environment would be exactly when we would expect to see greater variation in flaking techniques. The question then becomes, do we see any evidence for this variation in earlier, warmer periods? If so, does this suggest populations never grew to the size requires for innovations to take hold and spread? It may be that smaller groups are the best environment for the development of new ideas however in order for these ideas to become as widespread as the Levallois technique became, the population must have been large enough for the technique to take hold.

Extensive work by Hoppitt, Laland and colleagues has examined the relationship between social learning and innovation further (Rendell *et al.* 2010; Rendell *et al.* 2011; Hoppitt and Laland 2013; Hobaiter *et al.* 2014). Through their work with non-human primates, Hoppitt and Laland note those species which are the most innovative are also those which are most reliant on social learning (2013:50). They also note innovation is a survival strategy for populations in poorer environments or under threat. Hoppitt and Laland present the results of a number of experiments which investigated how people conform in social situations. Results demonstrate that people are more likely to follow the majority in larger groups (2013:219). This information conflicts with Mithen's research as it suggests small groups would be a better environment for the spread of new ideas where as Mithen argues small groups are good for innovation but not social transmission.

The debate about innovation, specifically regarding SPCs and the implications for the Levallois technique will be elaborated upon in Chapter 6 once the results of the analysis have been discussed. The increased presence of SPCs will have a direct impact on how 'successful' this innovation is deemed to be.

2.8 Summary

This chapter has presented the past and current research frameworks for the study of the Levallois reduction technique. The technique, and how it originated, has interested researchers for many decades and yet there are still significant areas of ambiguity. The change from looking at the technique from a technological perspective rather than a typological one has greatly advanced our understanding as has the recent research looking into the origins of the technique. This research will contribute to our understanding by increasing our understanding of the core working techniques in use at the end of the Lower Palaeolithic, before the widespread adoption of the Levallois technique.

Chapter 3: Methodology

3.1 Introduction

Through the research questions posed in Chapter 1 my research aims to examine the relationship between SPCs and other core reduction techniques employed in the British Lower and Early Middle Palaeolithic and the behavioural implications this relationship may demonstrate. This has been done by identifying SPCs in the archaeological record and comparing the reduction strategies at both an inter- and intra-site level. Once the material had been recoded, the reduction strategies of the SPCs were compared through a detailed attribute analysis to determine similarities and differences behind the knapping strategies of SPC technology and non-SPC technology.

This chapter will present the methodological approach for this research. The site selection criteria will be addressed as will the procedure followed to collect the data and analyse the material. The background information for each individual site analysed will be presented in Chapter 4.

3.2 Site Selection Criteria

In order to select sites where SPCs may be present an extensive review of the literature on Lower – Middle Palaeolithic transitions and the origins of Levallois technology was carried out. As mentioned in Chapter 2, confusing and often misleading terminology has long been used to describe SPCs. In order to establish if the different terminology is required, all mentions of these core working techniques have been investigated and where possible the collections analysed. A study of late Lower and Early Middle Palaeolithic site reports was also made to review illustrations of cores which appear to be SPCs. These sites have been included in this investigation.

The examination of the literature followed by the comparison of the cores through detailed attribute analysis will address the first of the Research Sub-questions which aims to establish how prevalent SPCs are given their misidentification in the past?

A table documenting every mention of ‘proto’ Levallois, ‘reduced Levallois’, Levallois-like and other terms from sites within the UK, France and Belgium can be seen in Appendix A. This table also provides the references for each site and the current locations of the material. The ten sites analysed in this investigation are thought to demonstrate the greatest potential to test the methodology and address the research aims and objectives of this project. A brief explanation of why these sites were selected is presented in Table 3.1 along with the terminology used to describe the cores.

3.3 Lithic Analysis

Stone tools are often the only, and certainly the most common, resource available to researchers trying to understand hominin behaviour in the Lower and Early Middle Palaeolithic. Through the analysis of stone tools we are able to see behaviour on an individual level through refitting of reduction sequences which show the production of a specific tool, as well as general trends and patterns in hominin tool use within the wider landscape.

Most of the assemblages discussed in this thesis are mixture of collections amassed in the late 19th and early 20th century, material excavated in the mid-20th century and more recently excavated material. As a consequence, it is expected there will be a heavy bias towards handaxes in the collections from the late 19th and early 20th centuries as they were more easily recognisable to collectors and quarry workers as being made by early man. None of the sites analysed consists solely of material from early collections and it is therefore believed a more balanced interpretation can be made by looking at all available material. It is also possible that SPCs would have been overlooked and misidentified in the past, possibly classified as handaxes, it is therefore important to look at all of the material first hand rather than relying on another researcher's classification. This method of lithic analysis will also contribute to the answering of Sub-research Question 1 by establishing to what extend this material has been misidentified in the past.

Site	*Terminology*	*Reason for selection*
Biddenham, Bedfordshire	Proto-Levallois	A recent review of the Palaeolithic material at the Pitt Rivers Museum suggested there may be 'proto-Levallois' cores in the Biddenham assemblage (Roberts 2013). Roe (1981) and McNabb (2007) also comment on the presence of possible proto-Levallois cores but neither undertook any further examination or interpretation.
Caddington, Bedfordshire	Proto-Levallois, Reduced Levallois	This site has apparently produced a number of cores which have been flaked in a manner described by Roe (1981:191) as a 'reduced Levalloisian technique'. McNabb (2007) also identifies some cores which he likens to the SPCs from Purfleet.
Cuxton, Kent	SPC	McNabb (2007) and White and colleagues (2006) have described a small number of cores in the Cuxton assemblage as SPCs, proto-Levallois and similar to those from Purfleet. Research carried out as part of my Master's thesis has shown these cores are SPCs and further analysis of the assemblage as a whole is required to place these cores within the broader context (Bolton 2010).
Dunbridge, Hampshire	Proto-Levallois	Very little Levallois material has been recorded southern Britain but a recent watching brief carried out by Harding and colleagues (2012) has produced both Levallois cores and cores which they describe as proto-Levallois.
Feltwell, Norfolk	Proto-Levallois	MacRae identified a proto-Levallois core in the Feltwell assemblage. The illustration of this core is almost identical to examples from Frindsbury. Due to the lack of recent investigation into this site, it was thought this could potentially be one of the oldest examples of SPC technology in Britain.
Frindsbury, Kent	Proto-Levallois	Frindsbury is known to have a high number of cores which closely resemble those from Purfleet but detailed attribute analysis has not been undertaken (McNabb 1992; 2007; White and Ashton 2003).
Purfleet, Essex	SPC, Proto-Levallois	An investigation into SPC technology in Britain must include the Botany Pit assemblage from Purfleet as this is the material to which all other cores are compared and it has long been accepted that these cores are not Levallois but a simplified, reduced or early form of the technology (Roe 1981; Wymer 1985; White and Ashton 2003; McNabb 2007).
Red Barns, Hampshire	Almost Levallois	Unlike many of the sites mentioned in this research, the material from Red Barns has been recovered through controlled excavation. Wenban-Smith and colleagues (2000) describe one of the cores from the recent excavations as almost Levallois this warrants examination and comparison with other SPCs. Material from early excavations is thought to be contemporary to that of the Wenban-Smith excavations and yet has received considerably less attention. It was therefore decided an examination of this material may uncover more potential SPCs.
Kesselt- Op de Schans, Belgium	SPC	Material found during the 2006 excavations is often used as a good example of SPC technology comparable to Purfleet from the continent (Van Baelen *et al.* 2007, 2008; Van Baelen and Ryssaert 2011; White *et al.* 2011; Van Baelen 2014). There are also a large number of refits from Kesselt-Op which will enable a greater understanding of the removal sequence.
Mesvin IV, Belgium	Proto-Levallois, SPC, Levallois and Reduced Levallois	Many of the cores from Mesvin IV have been referred to as proto-Levallois, 'reduced' or as 'simple prepared cores' (Cahen and Michel 1986; Van Asperen 2008; Scott and Ashton 2011; Van Baelen and Ryssaert 2011). It is believed the Levallois and SPCs are contemporary which makes this assemblage an idea example for comparisons of SPC found alongside the fully developed Levallois technique and those found alongside handaxes.

Table 3.1 Sites analysed in this investigation with terminology used to describe the cores in question along with the museum location

3.4 Data Collection Procedure

Each artefact has been recorded by the identification number or accession number given by the respective museums. Some items did not have registration numbers in which case the box identification number has been recorded and the items have been recorded in a consistent manner from left to right. This order is unlikely to change as in the museums' 'cut-outs' have been made from polystyrene to prevent the items from moving within the boxes.

Due to the extremely large size of two of the assemblages, Purfleet and Mesvin IV, sampling was required. At Purfleet, the total assemblage numbered 3,967 artefacts. The presence of each item was recorded but detailed attribute analysis was not carried out for every flake. Instead, one in every four flakes was randomly selected and recorded. At Mesvin, the total assemblage numbered 7,889 artefacts. Due to time restrains, attribute analysis was only carried out for one in every 10 flakes. In both cases attribute analyses was carried out for all other artefacts.

All data were recorded in *IBM SPSS Statistics 22* a statistical analysis program and all tables and graphs were subsequently created using this package.

All measurements were made using Moore and Wright plastic digital callipers, 6"/ 150mm.

3.5 Raw Material

The raw material for each artefact has been recorded based on visual inspection. As discussed in Chapter 2, Levallois technology is connected to increased mobility within the landscape with increased raw material transport distances and changes in organisation within the landscape with large reprovisioning sites close to sources of raw material (Scott 2011). By analysing the raw material of the assemblages in this investigation, it will establish if there are patterns between tool technology and raw material exploitation at sites with SPCs. The aim is to establish if tools are made on local raw material or if the makers imported the material from elsewhere thereby giving an insight into the behaviour of the hominins creating these tools and thereby contributing towards an answer for the main Research Question and Sub-research Question 3 which look at the behavioural implications of the presence of SPCs. The broad categories for raw material classification are flint, chert, quartz, quartzite and other.

3.6 Variables relating to condition

The following observations have been made for each artefact to establish if all components of the individual assemblages have undergone the same taphonomic processes, specifically if the SPCs have undergone the same taphonomic processes as the other core reduction techniques within each individual assemblage. These processes will be identified through the assessment of patination, staining and edge damage. These proxies cannot identify the exact taphonomic process each artefact has undergone but they help to create a better overall understanding of the processes.

The condition of the material is particularly important for the sites which are formed of early collections and those with poor dating. It must be stressed that taphonomic processes are not reliable indicators for dating and two items which undergo similar processes may appear very different to one another just as artefacts that appear similar may have undergone different processes (Burroni *et al.* 2002:1282). We cannot say for certain if, for example, the handaxes and SPCs are contemporary but if the conditions were very different we would be more likely to say they are not. However if all of the SPCs at a particular site are distinctly patinated and the remainder of the assemblage is not, this would indicate a problem with the assemblage integrity which will be address for each assemblage in Chapter 6. Overall the condition of the material will contribute towards an answer for the second Sub-research Question which examines the relationship between SPCs and other core working techniques.

3.6.1 Patination and Staining

Chemical alteration to the artefact surface has been recorded in the form of patination and staining. Patination occurs when flint is exposed to the atmosphere or moisture causing the build-up of a bluish milky white layer on the surface of the flint (Wymer 1968). The degree to which the patination will occur depends a variety of factors including the pH of the moisture and the soil, the range of temperatures the material is exposed to, and the length of time such exposures are made (Burroni *et al.* 2002:1281). These alterations cannot indicate the age of an artefact as the speed with which artefacts patinate can vary (*ibid*.). Variation in the patination of the surface of an item can indicate reworking, different phases of working or a recent break as differences in the surface alteration indicate different lengths of time exposed to the patina causing chemicals. Figure 3.1 is an example of a core which is heavily patinated, hence the white coloration, with a more recent, and considerably less patinated removal/ break.

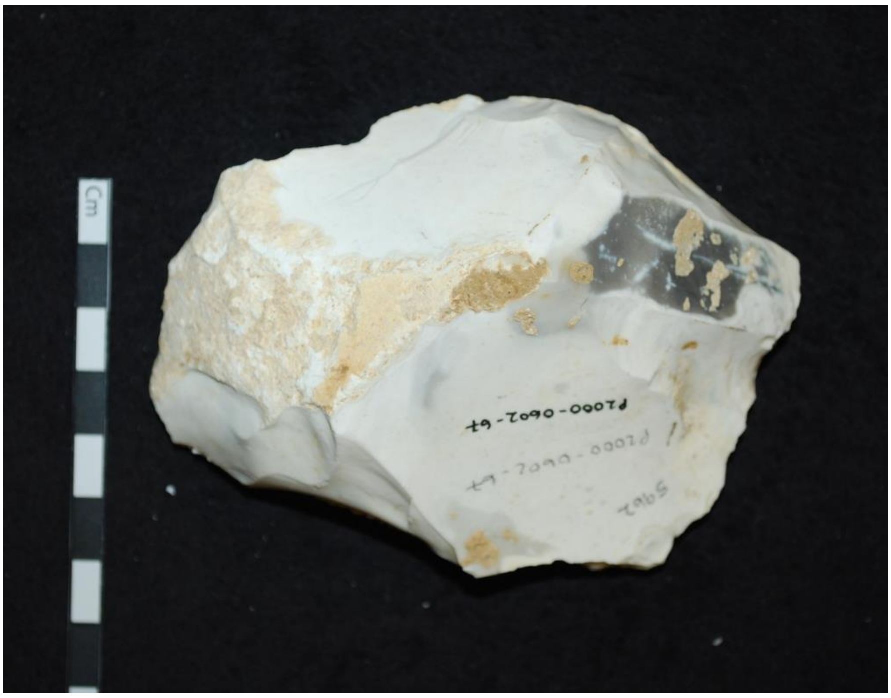


Figure 3.1 Variation in patination displaying recent break on a core from Red Barns

The patination of the material from this investigation has been recorded in the following way; examples of each category can be seen in Figure 3.2:

1. No Patination – The surface has not been chemically altered and remains the same natural colour
2. Light Patination – Some areas of the surface may appear be a mottled milky blue colour with a dull white film.
3. Heavy Patination – Most of the surface is a dull white colour.

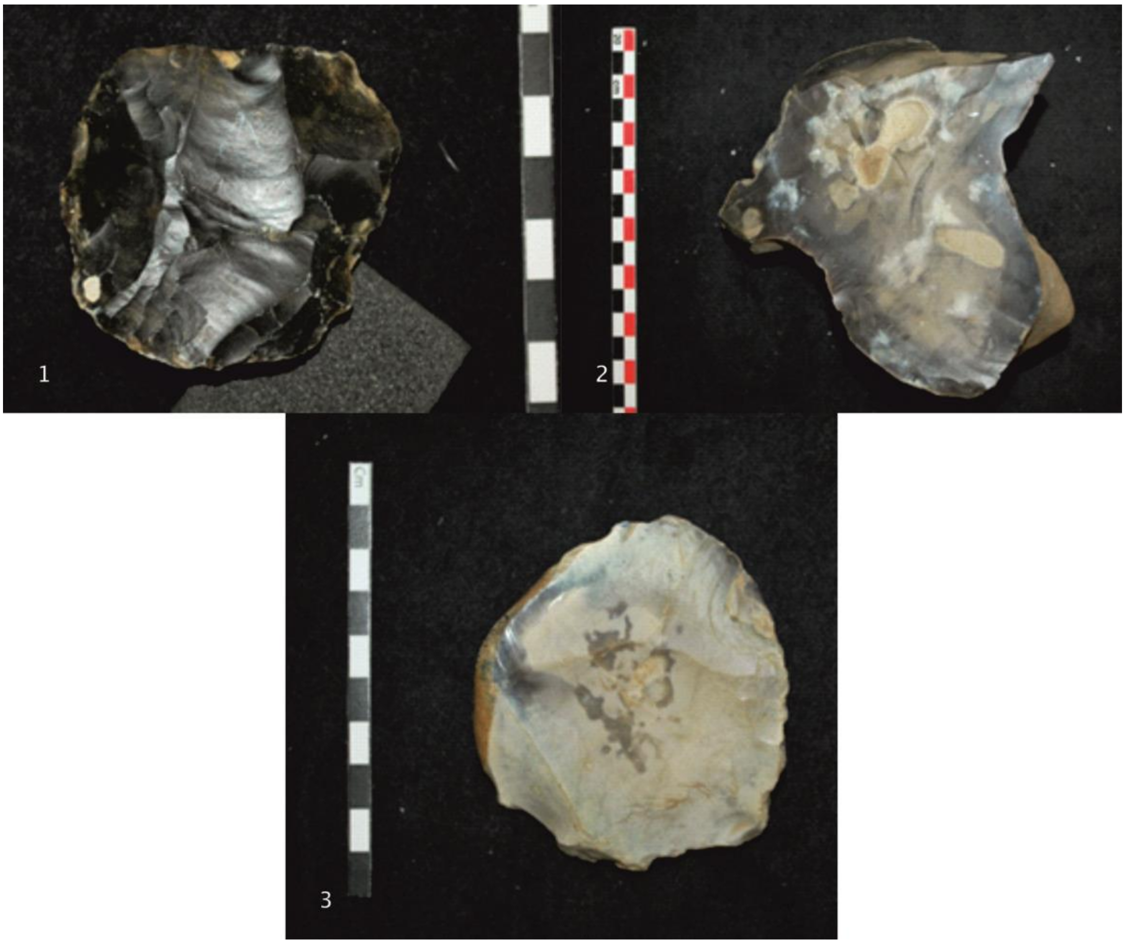


Figure 3.2 The three categories of patination as used in this thesis

Staining is the chemical alteration of the surface of the flint caused by the presence of iron oxides in the groundwater of the deposit. These oxides alter the surface of the flint, causing it to turn a yellow-brown colour (Wymer 1968). As with patination, staining can vary depending on the conditions to which the material is exposed (Burroni *et al.* 2002:1285) but in order to give a general overview of the condition of the material, all artefacts have been categorised into the following groups, examples of which can be seen in Figure 3.3:

1. No Staining – The flint shows no signs of discoloration and remains a natural dark colour.
2. Light Staining - The natural colour of the flint is still visible in places but there is some yellow – light orange discoloration.
3. Heavy Staining - The natural colour of the flint is barely visible and most of the surface has been chemically altered and is now a dark orange – brown colour.

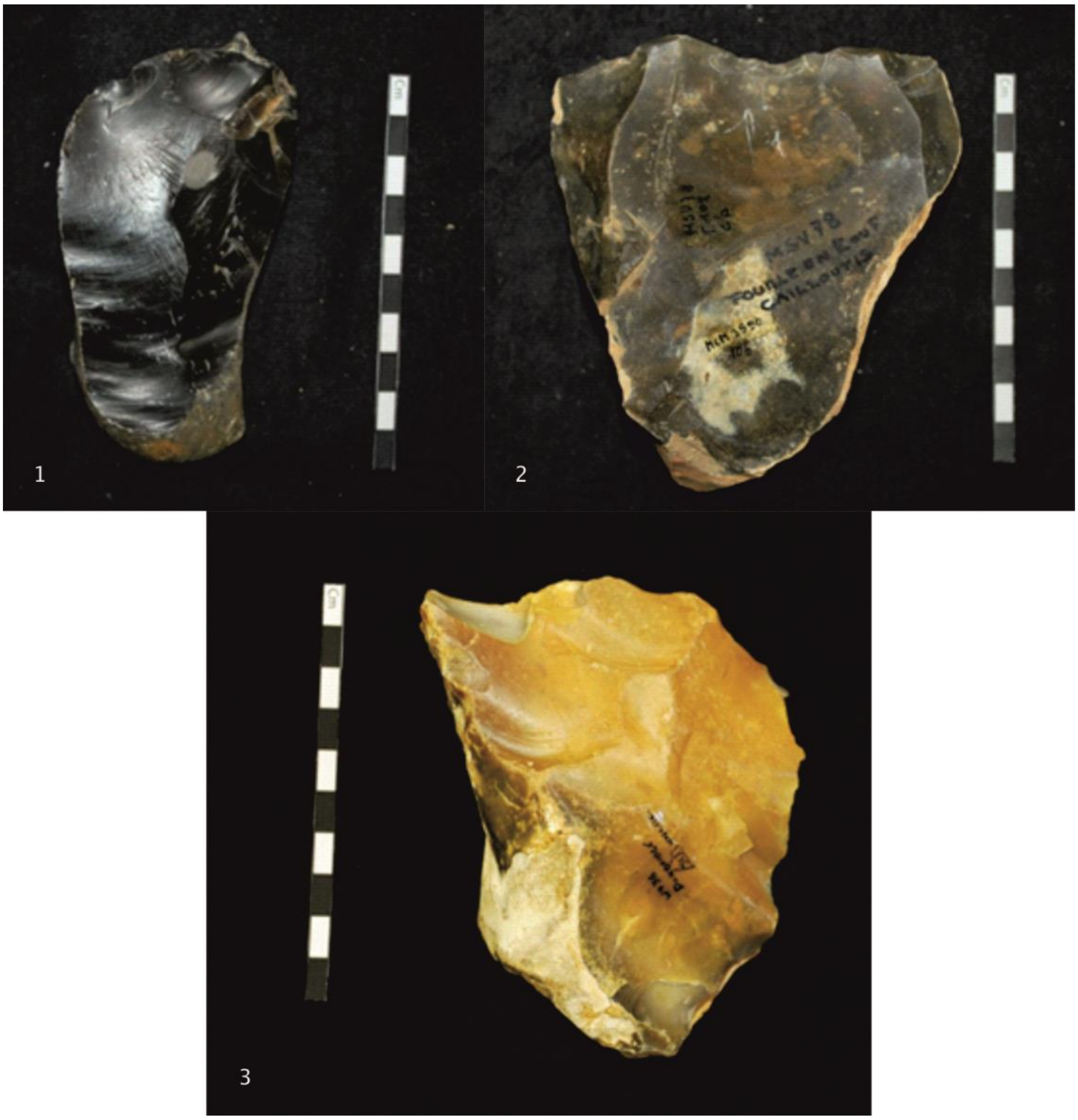


Figure 3.3 The three categories of staining as used in this thesis

3.6.2 Condition

The physical damage to the artefacts has been recorded. This is used as a proxy to indicate how much the items were subjected to movement after deposition (Wymer 1968). Extensive abrasion or rolling is considered to be a partial indicator of long transport distance (Hosfield 2011b). Paul Bingham's recent investigation into recording variability highlighted the taxonomic assessment of rolling as a particular point of ambiguity among Palaeolithic researchers (Bingham 2012). Bingham used Ashton's (1998) four categories for the identification of rolling in combination with a method proposed by Chambers (2003) which looked at arête rounding. Bingham found participants gave varied responses with regards to the extent of rolling using this methodology. As a way to avoid ambiguity, Bingham suggests reference material should be used when assessing condition (2012:75). However for this research assessing if SPCs are in the same condition as the remaining material from each site is sufficient as most of the assemblages are from secondary deposits. For this reason the three categories below will be used as demonstrated in Figure 3.4:

1. Fresh – no arête damage
2. Slightly rolled – arête is no longer sharp but still physically and visually distinct
3. Heavily Rolled – arête is rounded and may be physically and/or visually difficult to distinguish

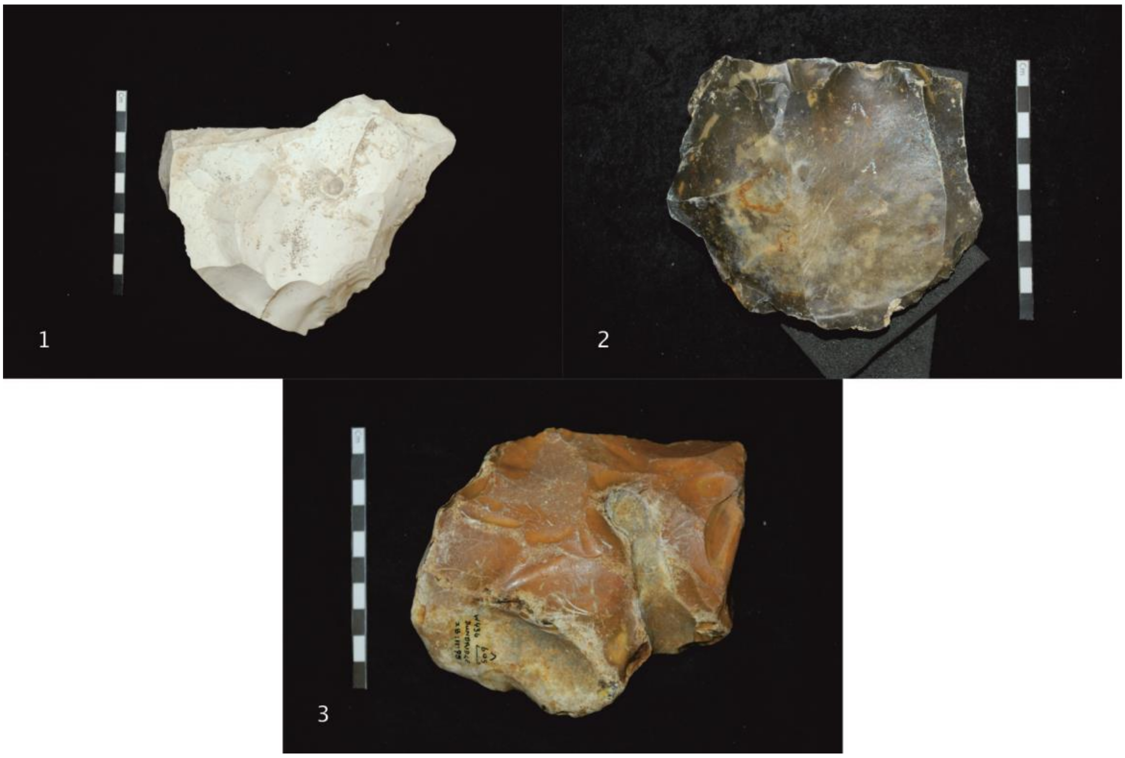


Figure 3.4 The three categories of condition as used in this thesis

3.6.3 Cortex

Percentage of cortex remaining on the artefact was recorded to estimate at what stage of the reduction process each flake was from, or at what stage the core was abandoned (Dibble *et al.* 2005). The amount of cortex remaining on a core can also be used to indicate the original nodule size which can reveal information about raw material transport (Dibble *et al.* 2005; Lin *et al.* 2010). For example if 75% of the core is covered in cortex, we can probably say the core has not been extensively reduced and 75% of the surface is the same as when the core was just a nodule.

The cortex observations will be used to establish if SPCs have been more heavily reduced when compared with other core reduction techniques within the assemblage. This relates to the research questions which are examining the relationship between SPCs and other core working techniques in both handaxe and non-handaxe assemblages. The estimated percentage of cortex coverage remaining on the dorsal surface of flakes, and the whole surface of cores and handaxes was recorded and grouped into the following categories:

- 0% Cortex
- < 25% Cortex
- 25 - 50% Cortex
- 50 - 75% Cortex
- >75% Cortex

3.7 Variables relating to technology

All artefacts were identified and categorised by technology using a combination of McNabb's (2007) framework, for stone tool assemblages from the British Lower and Earlier Middle Palaeolithic, in conjunction with the framework devised by Scott (2006) for the analysis of Levallois cores and their products. SPCs were recorded using a new methodology which I developed for this research and which is described in detail below.

Though the detailed attribute analysis of all artefacts, the main Research Question, along with Sub-question 1 and 2 will be addressed. The technological relationship between SPCs and the Levallois technique as well as the relationship between SPCs and other Lower Palaeolithic core working techniques will be investigated. The investigation into the variation in core technology will also help to establish if cores have been incorrectly identified in the past.

McNabb's (2007) framework is divided into two sections, flaked pieces and detached pieces. Each section is then divided into two again. Cores and bifacially shaped pieces fall within the flaked pieces category and unretouched and retouched pieces come under the detached category.

3.7.1 Core reduction technique

There are three approaches to flaking: *single, parallel and alternate removals.* The application of one of these approaches to flaking is described as an episode. Cores are considered to be an amalgamation of episodes of one or more of the different flaking types. Figure 3.5 presents the different possible core episode types and Table 3.2 describes these types in more detail.

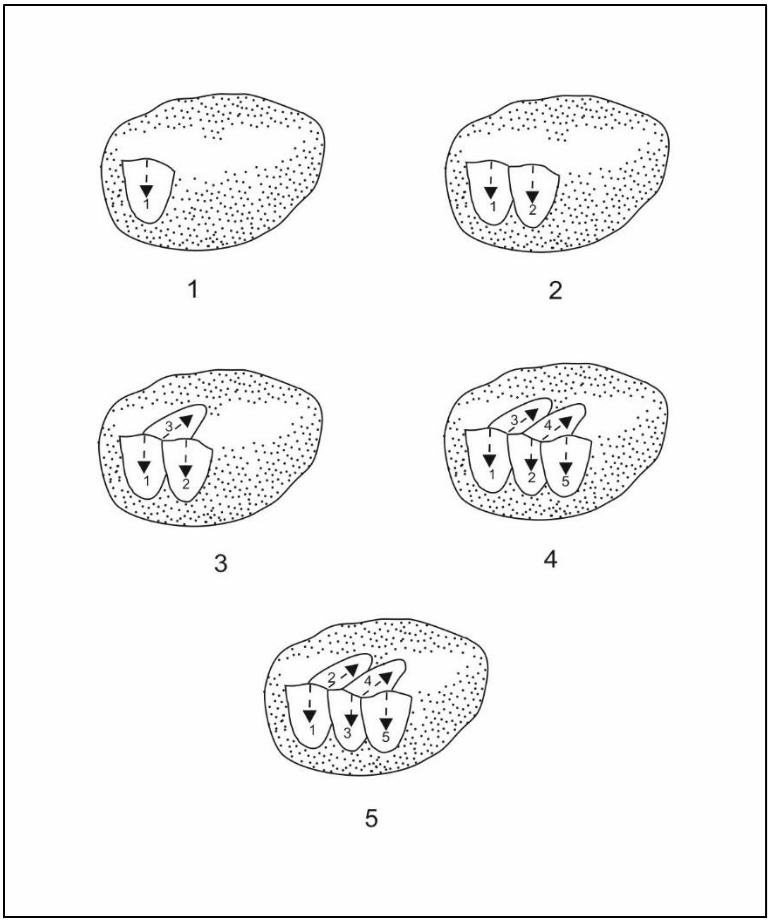


Figure 3.5 Core episodes. Numbers 1 – 5 refer to Table 3.2, redrawn after Ashton and McNabb (1996:245)

McNabb's (2007) framework brings together these core episodes in Table 3.2 and groups them into four different approaches to flaking which can be seen in Table 3.3. These groups were used to classify the cores studied in this research. Instead of using the term *Generic non-PCT* cores, this research uses the term *Migrating Platform core.* Scott (2011:25) uses this term to describe cores which do not have a specific volumetric approach to flaking but instead an *ad hoc* exploitation of platforms as they become available. This term is used when describing these cores as a group, however the individual core episodes have also be recorded according to McNabb's (2007) framework.

Core episode type	***Description***
Single removal (1)	This consists of a single flake removal from a natural surface or from flake scars that are part of a different core episode.
Parallel flaking (2)	Two or more flakes removed in a parallel direction from the same or adjacent platform.
Alternate flaking (3)	One or more flakes removed in parallel from the platform or platforms at their proximal ends for the next or more removals. They in turn may form the platform or platforms at their proximal ends for further removals in the same direction as the original set of removals.
Simple alternate flaking (3)	The core is turned once, with one or more removals forming the platform for the second set of removals.
Complex alternate flaking (4)	The core is turned at least twice and consists of at least three sets of removals.
Classic alternate flaking (5)	A single flake forms the platform for the second flake which in turn forms the platform for the third flake. Several more flakes may be removed in this way.
Simple alternate flaking with parallel episode	A simple alternate episode that includes an episode of parallel flaking.
Complex alternate flaking with parallel episode	A complex alternate episode that includes an episode of parallel flaking.

Table 3.2 Types of core episode, after Ashton and McNabb (1996: 244-245)

Cores with fewer than three removals have been described as *cores with few removals*; cores tools were also recorded separately. SPCs are included in McNabb's framework but have not been included in this table as they require greater attention. The framework used to identify and analyse SPCs will be presented in greater detail following the discussion on Levallois cores in the next section.

Category	*Definition*

A.	Generic non- PCT cores. No maintained flaking face and no fixed perimeter.
	- Alternate
	- Mixture of episodes of alternate and parallel
	- Parallel either from
	    - one platform
	    - Multiple platforms
	- Single / Multiple episodes of single removals
	- Mixture of above
	- Other generic non-PCT

B.	Non- PCT cores, a fixed perimeter only. - Centripetal alternate - Biconical - Centripetal alternate - Discoidal
C.	Cores knapped by PCT. A fixed perimeter related to a single maintained flaking face. Detachments parallel to the fixed perimeter. - Radial - Convergent - Parallel / Laminar
D.	Cores knapped from a fixed platform. The flaking face is not pre-prepared to the same extent as in C, or maintained. Successive removals create the flaking face. - Laminar. Prismatic or conical, unipolar or bipolar.

Table 3.3 Core Framework, after McNabb (2007:320)

3.7.2 Levallois Cores

Levallois cores were identified using Boëda's six criteria (1995) (see Chapter 2) and fall into category C of McNabb's Framework (2007). Like the other methods of core reduction within McNabb's Framework, Levallois cores are a product of alternate, parallel and single removals; however these methods are applied in a very specific way. Cores which have been prepared and follow Boëda's criteria but do not have a Levallois removal have been included within this category but are recorded as unstruck. Analysis applied to SPCs has also be applied to Levallois cores so direct comparisons can be made.

Method of preparation and organisation of preparation scars: This was recorded using a combination of Boëda's (1995) and Scott's (2011) method's which look at the location and orientation of flake scars which precede that of the preferential removal. Illustrations of the different methods of preparation can be seen in Figure 2.3 (see page 19). The method of preparation is recorded for unstruck Levallois cores as well as cores with preferential removal scars. In the case of the latter, only the preparatory scars which have not been obliterated by the preferential removal can be recorded.

Method of exploitation: Only the final phase of exploitation can be recorded. For this Boëda's (1995) and Scott's (2011) methods were used (Figure 2.4, page 20). This is based on the location and orientation of the preferential removal on the flaking surface. By following Boëda's criteria this must be parallel to the plane of intersection and the morphology of the flake must have been determined by the shaping of the distal and lateral convexities of the flaking surface (Boëda 1995:48). In order to negate the issue of misidentifying cores which have been, for example, prepared centripetally and then exploited in a recurrent, centripetal manor, the identification of the remains of the faceted striking platform will also be required in order to classify the preferential removal. The size of the preferential removal in relation to the preparatory removals will also be taken into account.

Levallois flake scar: The dimensions of all preferential flake scars were recorded to see if a specific size or shape of removal is favoured.

3.7.3 Simple Prepared Cores

A range of attributes were identified, analysed and recorded for each core where elements of preparation could be observed and so could potentially be consider to be a SPC. These attributes were studied on an intra- and inter-site level to see if an overarching definition for SPCs could be applied. Prior to this no universally adopted definition of what constitutes an SPC exists. The definition presented in Text Box 2 has been created for this thesis as a result of the application of my methodology.

Text Box 2.

Simple Prepared Core Definition

Preferential flaking is focused around a single surface of the core which has been selected for preferential exploitation over any other area on the core. This flaking surface is flat and does not cut deeply into the volume of the material. A simple prepared core has the three following elements:

Preferential flaking surface. A preferential removal is larger in comparison to other removals on the flaking surface. Unlike Levallois preparation, these smaller removals do not create or maintain the distal and lateral convexities as seen in Boëda's third criterion. The pre-preferential removals are still referred to as preparatory as they prepare the preferential surface by flattening it but they do not shape it (convex/domed surface, lateral and distal convexities) in the same way as we see with the Levallois technique.

Striking platform surface. Removals on the striking platform surface may vary. Some cores have no removals on this surface with the exception of a simple striking platform for the preferential removal (simple prepared core group A - see below). Other SPCs have a small number of removals which act as platforms for the preparatory removals on the flaking surface (simple prepared cores groups B and C – see below). The different function of each surface is therefore hierarchically conceived and like Levallois technology, non-interchangeable within the reduction sequence.

Striking platform. The scar which the hammer stone strikes to detach the preferential flake.

Preferential flaking surface: The selection of a clear preferential flaking surface is one of the most important features of an SPC; it is what distinguishes this core reduction technique from all other techniques. In order for a surface to be described as preferential, there must be evidence that this surface has been selected for preferential exploitation over all other surfaces. The sequence of removals on this surface is therefore a vitally important attribute to study when trying to establish if there has indeed been preparation of the flaking surface.

Attributes on the flaking surface have been recorded in the following way:

- Identification of presence of preferential removal based on size in comparison to the other removals on the preferential flaking surface.
- Dimensions of preferential removal – Maximum length along the direction of the removal and width at the widest point perpendicular to the length
- Method of exploitation – Linear or Recurrent following Scott's (2006) framework (see Figure 2.7 page 23), the lack of a faceted striking platform will make recurrent SPCs harder to identify than recurrent Levallois cores, however SPCs which have more than one removal from a clear striking platform(s), which conform in all other ways to the SPC preferential removals, will be categorised as recurrent.

- Number of removals on the flaking surface which have prepared the surface through flattening prior to the preferential removal – further referred to as preparatory removals.
- Direction of preparatory removals following Scott's (2006) framework (see Figure 2.6 page 22) - centripetal, unidirectional, bipolar or convergent.
- When possible the order of preparatory removals will be recorded by looking at which removals truncate which.

Striking platform surface: Maintenance of the distal and lateral convexities is the third of Boëda's (1995) criteria for Levallois cores. This is done through the preparation of the striking platform surface and predetermines the shape of the preferential removal. This is the criteria White and Ashton (2003:603) state is missing from the SPCs at Purfleet and is the attribute which prevents the classification of SPCs as Levallois. It is therefore crucial to investigate the presence or absence of this key attribute on all of the material.

During analysis of the Purfleet assemblage for my Master's dissertation in 2010 it was noted that the cores from this site showed varying degrees of preparation on the striking platform surface which was not covered in either Scott or Boëda's frameworks (Bolton 2010). For this reason I have developed a new scheme to record the amount of preparation on the striking platform surface. With the Levallois technique, removals on the striking platform surface create striking platforms for the removals which shape the convexities of the flaking surface. The variation of the removals on the SPC striking platform surface may indicate the development of this attribute. The three categories in Text Box 3 refer to the removals on the striking platform surface of SPCs only.

Recording SPC preparation and exploitation in this way helps to address Sub-research Question 2 as presented in Chapter 1, allowing for comparison of the different core working techniques between sites. In Chapter 6 the relationship between these groups and the development of the reduction technique will be addressed.

Text Box 3.

SPC categories

Group A - SPCs with a striking platform - but no further removals on the striking platform surface (see Figure 3.6)

Group B - SPCs with a striking platform and preparation of part/whole of one lateral or the distal edge of the striking platform surface (see Figure 3.6)

Group C - SPCs with a striking platform and an attempt to prepare more than one lateral and/or distal edge of the striking platform surface (see Figure 3.6).

The cores in Group C may, by definition, appear similar to Levallois cores in many respects however the preferential flaking face is still not convex and whilst the preparatory removals will have flattened it, they will not have shaped the surface in a way which can be said to predetermine the shape of the preferential removal.

Overall the following attributes will be recorded for the striking platform surface:

- Number of removals
- Order of removals
- What SPC group does a core fall within?
- Lateral striking platform surface removals (one or both sides) – yes/no
- Distal striking platform surface removals – yes/no
- What are the locations of the removals on the striking platform surface?

Striking platform:

- Is there a clear striking platform?
- Is the striking platform faceted?
- How many removals have gone into preparing the striking platform?

Preferential removal: In order for a removal to be considered *preferential* it must be the intended product of the reduction sequence. The issues relating to predetermination have been discussed in Chapter 2. For identification purposes in this thesis, a preferential removal has been identified as a removal which appears to be the targeted end-product of the flaking sequence. This has been established through a number of attributes:

- Size of the preferential removal in comparison to the other removals on the core.

- Organisation of the preparatory removals in relation to the preferential removal following the methodology applied for the Levallois preparation as seen in Figure 2.3 (see page 19).

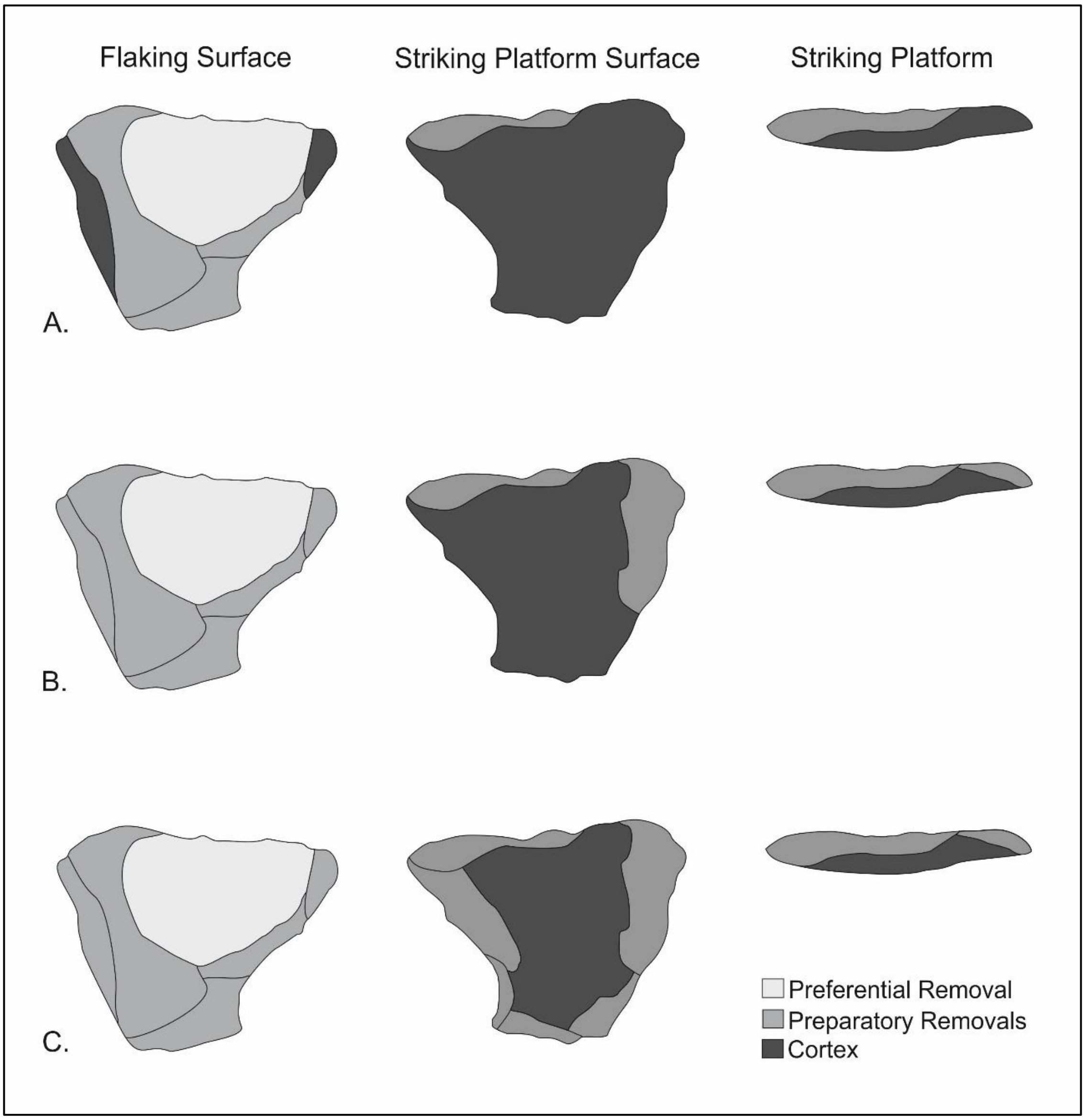


Figure 3.6 SPC Groups A - C

3.7.4 All cores

The dimensions of all cores have been recoded and compared to see if SPCs are the most/least heavily reduced. This will address Sub-research Questions 2 and 3 which are trying to establish in what ways SPCs are different to other Lower Palaeolithic core working techniques and what this means in terms of hominin behaviour. SPCs and Levallois cores will be measured using the method already established. Reduction techniques which lack a preferential removal, such as a migrating platform core, see below, have no such axis to follow. In these cases, the longest core measurement was recoded as the length and the measurement perpendicular to that, the breadth.

The total number of removals on each core has been recorded to determine which core reduction techniques are the most intensively worked. The fewer the total number of flake scars, the less intensely worked the core. As many of the migrating platform cores consisted of multiple reduction sequences, it was not often possible to identify which was the final removal. As a consequence, none of the flake scars on the migrating platforms were recorded as none would be comparable to the preferential removals on SPCs and Levallois cores. For this reason the final removals on the other core working techniques were also not recorded. The comparisons looking at preferential flake size will only include SPCs and Levallois cores.

In summary, the core reduction techniques identified in this research were classified into the following categories:

- Migrating Platform – any number and/or combination of episodes of reduction
- Discoidal or Biconical – alternate flaking around a fixed perimeter
- Levallois – following Boëda’s criteria as a framework, not a strict checklist as described in Chapter 2.
- SPC – following the definition presented in Text Box 2
- Core with few removals - less than three removals on the entire volume of the core

3.7.5 SPC products

Preferential flakes produced through the SPC technique were not recorded for this investigation because it is not possible to recognise them without refitting- it is believed the flakes would appear no different to flakes produced from other reduction techniques. White and Ashton (2003:600) also came to the same conclusion when looking at the Purfleet material.

3.7.6 Levallois products

Levallois flakes were identified by demonstrating characteristics as evidence of being removed form a Levallois core. For example they will display:

- Complex dorsal scar patterning as a result of core preparation (see Figure 3.7). This method of preparation will be recorded.

- Signs they have been removed from the preferential flaking face of the core rather than the volume, i.e. they will be relatively flat.
- May display signs of striking platform preparation in the form of faceting.
- Formed with a hard hammer.

For each flake the length, breadth and thickness has been recorded using axial measurements. This was then used to see if the Levallois flakes were relatively flat when compared with flakes produced by other reduction techniques. The width and length of the Levallois flakes were then used to see if they were elongated and if any similarities existed between the Levallois flakes and SPC preferential removal scars. Such similarities or differences will contribute towards an answer to the main research question by building a better technological understanding of the SPC preferential removals.

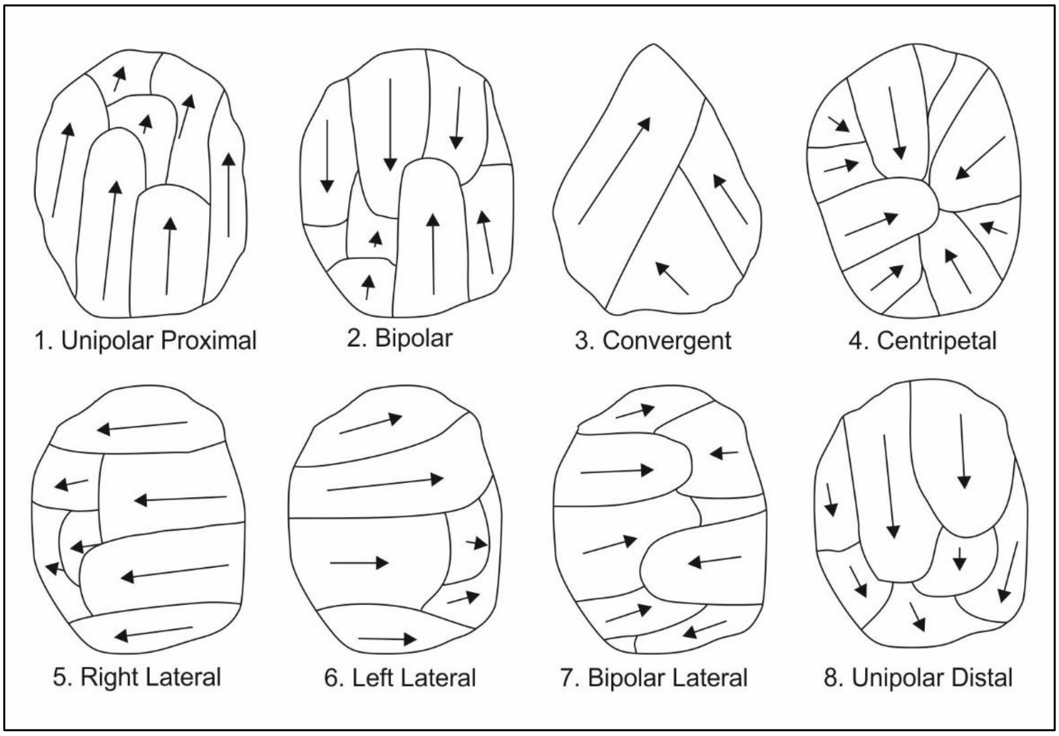


Figure 3.7 Levallois flake dorsal scar patterns (Redrawn after Scott 2011: 220)

3.7.7 Flakes and flake tools

When discussing SPCs, and their products, several authors suggest this core reduction technique was employed to produce flakes which were large and flat (White and Ashton 2003:599). However, no analysis has ever been carried out to confirm this. In order to establish if the flakes produced using the SPC method are indeed larger than the flakes produced from alternative techniques, the length, breadth and thickness of the flakes and flake tools from assemblages were recorded and analysed to see if flake size trends correlated with SPC preferential flake removal sizes. By their very nature, flake tools will be smaller than their original flake size due to the retouch which transformed them into tools. However they have been included in this analysis to give the widest range of core products in each assemblage. SPC preferential scar size on cores has been used as a proxy for SPC flakes as I believe in the absence of butt faceting, and without refitting, it would be extremely difficult to reliably identify SPC products from within the assemblage. With recurrent SPCs, measurements for all preferential removals will be recorded. The dimensions will be recorded in the manner presented in Figure 3.8 following axial length and width instead of natural dimensions. Flakes with an axial length of less than 10mm will not be recorded.

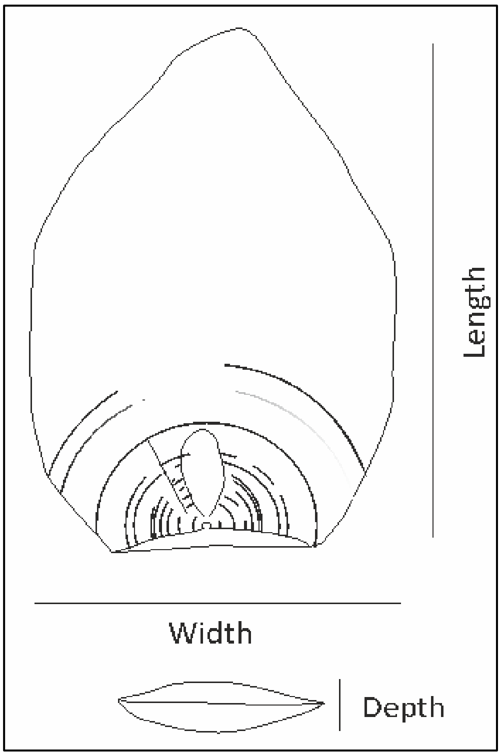


Figure 3.8 Method for measuring flakes and flake tools, and scars on cores

One of Boëda's criteria for Levallois is the use of hard hammer percussion. The mode of percussion for every flake was therefore recorded in the following way to see if the same characteristic could be applied to SPCs. Flakes produced through hard hammer percussion are identified by a clear cone of percussion, pronounced conchodial fracture marks and a pronounced bulb with an unlipped butt (Ohnuma and Bergman 1982:169). Flakes produced through soft hammer percussion do not have a defined cone of percussion and the bulb is diffused (*ibid*).

- Hard hammer
- Soft hammer
- Indeterminate

Flakes with evidence of retouch have been classified as flake tools using McNabb's (2007:336-341) framework. Flake tool classification is based on the location of the retouch on the flake.

3.7.8 Bifacially shaped pieces

In order to establish if an assemblage is an Acheulean assemblage or a non-handaxe assemblage, the presence of bifacially shaped material was recoded. Inferences about hominin behaviour can be made if there are any patterns relating to SPC presence alongside handaxes or in non-handaxe assemblages. Bifacially worked material has been identified using McNabb's (2007:329-330) framework which relies on the identification of LCTs showing bifacial thinning and shaping, or the presence of diagnostic débitage from that process.

3.7.9 Photos

All material was photographed for analysis and future reference. Special attention was taken with the cores with photos taken from multiple angles highlighting any preferential exploitation of a single surface (see Figure 3.9). These photos clearly show the preferential flaking surface, the striking platform surface, the striking platform and the plane of intersection. Handaxes, flakes and flake tools were only photographed from two sides to record the two distinct surfaces. In the case of handaxes this was the two faces and for flakes and flake tools, the dorsal and ventral surfaces.

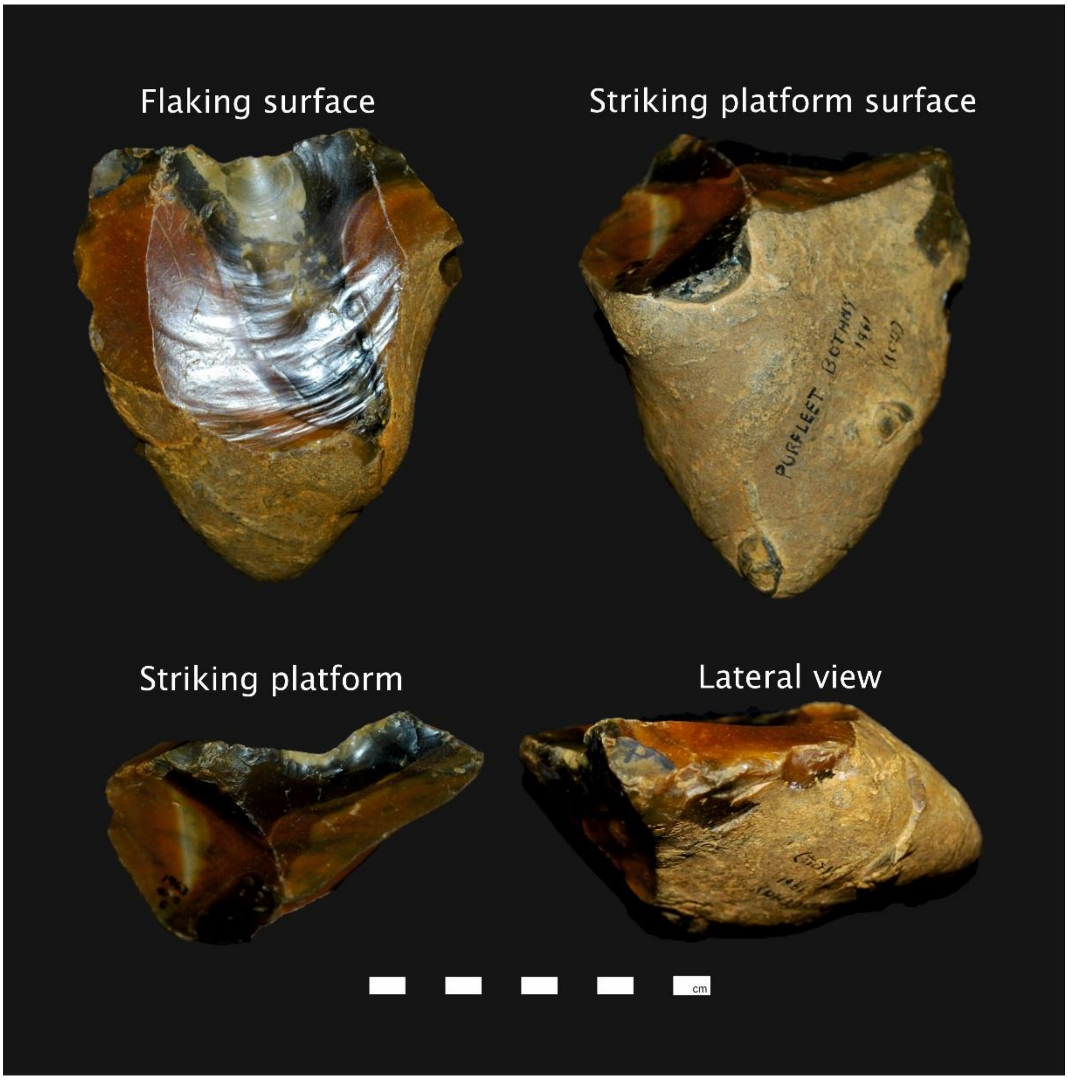


Figure 3.9 Photos to demonstrate how the cores will be recorded

3.7.10 Use of iPad

As mentioned in above, recording the order of removals is of particular importance with regard to the SPCs. Instead of sketching the artefacts, an iPad and a program called Skitch was used to record the reduction sequence. This program takes photos of the cores which can immediately be drawn upon. This allows for more precise recording as the order of removals can often be hard to establish from a photograph, even one of high quality. Quick hand drawn sketches can also be inaccurate depending on the accuracy of the illustrator. Figure 3.10 is an example of a photograph taken and edited with this program. Four photographs were again taken for each core, thereby recording each surface. These will be the flaking surface, the striking platform surface, the striking platform and a lateral view of the core to show the hierarchal relationship between the flaking surface and the striking platform surface. The Skitch diagrams of each core analysed in this investigation can be seen in Appendix B.

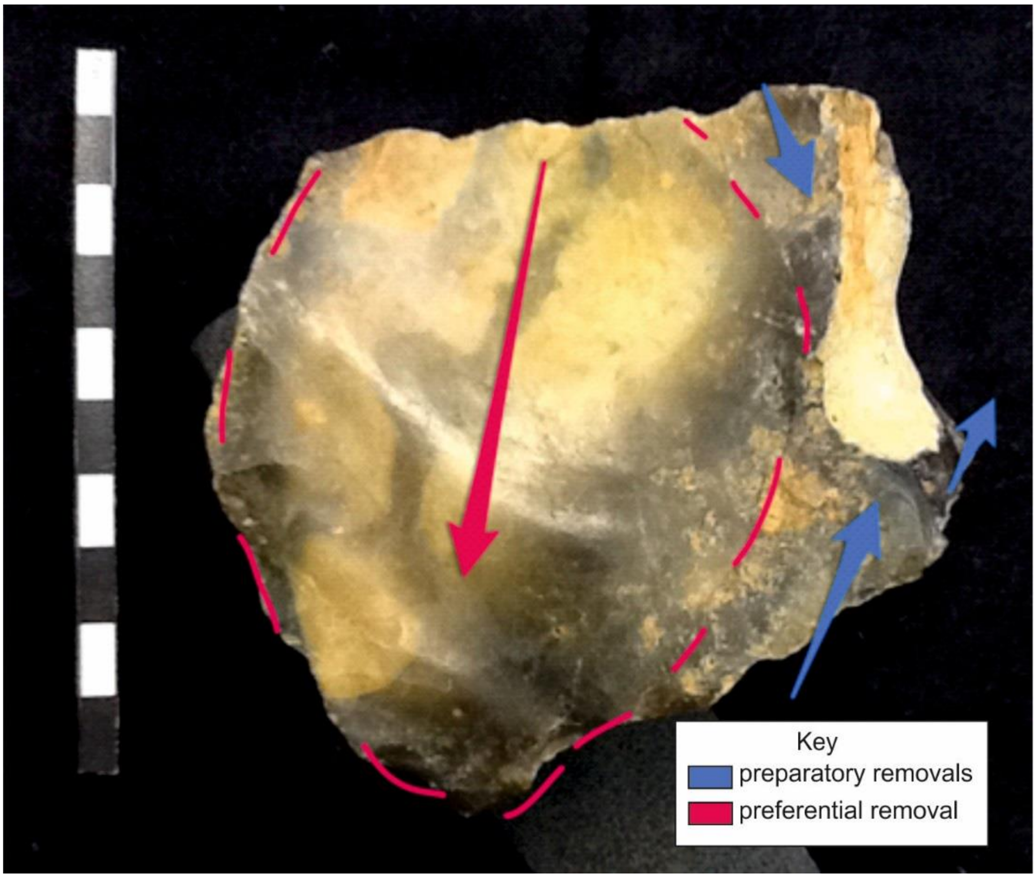


Figure 3.10 Example of recording flaking surface removals using Skitch

3.8 Summary

As noted above, the methodology present in this chapter has been used to analyse the assemblages selected with the aim of addressing the research questions presented in Chapter 1. For each assemblage, all available material was studied to see if SPCs have been previously overlooked or misidentified in the past. Analysis also included those cores which had been identified by other researchers but had not been analysed using a single methodology, like the one developed specifically for this research. The reduction sequences of all cores have been analysed and used to differentiate between the different techniques. A number of attributes of both SPCs and other reduction techniques have also been analysed to help define SPCs technologically. Inter-site comparisons were made to see if this definition can be applied to all SPCs.

Chapter 4: Site background

4.1 Introduction

Artefacts from ten sites have been examined for this investigation. Eight of the sites are in Britain and two are in Belgium. The location of the sites can be seen in Figure 4.1. This chapter presents the relevant background information for each site including excavation history, dating, current interpretations, and thoughts regarding the core working techniques.

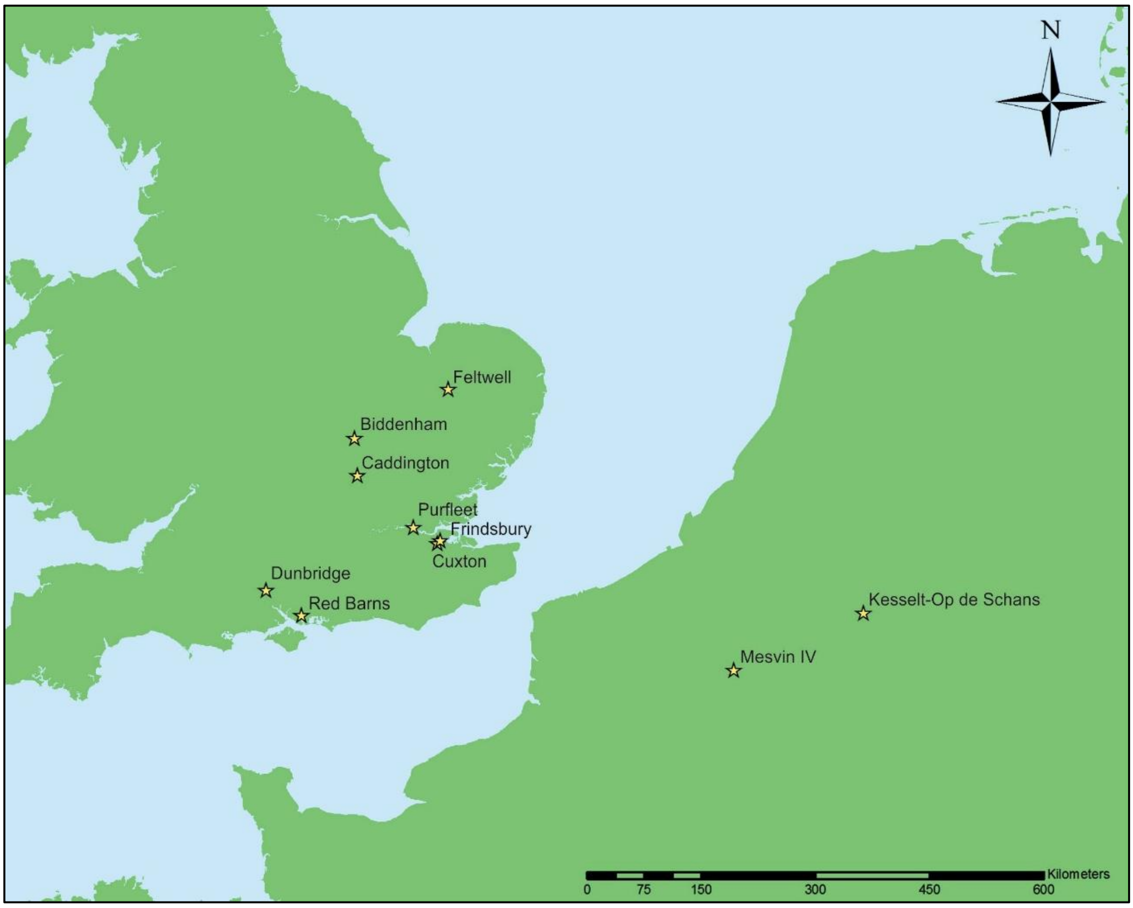


Figure 4.1 Map showing sites discussed in this chapter

4.2 Biddenham, Bedfordshire

4.2.1 Introduction

The prolific site of Biddenham was one of the first handaxe sites to be discovered in Britain. Material has been collected from the site since the early 1860's (Wyatt 1862) with finds including a particularly large handaxe (Evans 1897:533). Historically, previous research has focused on the Wyatt collections at the British Museum, whilst little attention has been paid to the Knowles collection at the Pitt Rivers Museum. A recent review of the Palaeolithic material at the Pitt Rivers, carried out by Alison Roberts (2013) suggested there may be 'proto-Levallois' cores in the Biddenham assemblage.

Location

52.138890 (lat.) -0.511016 (long.) Grid reference TL 020500

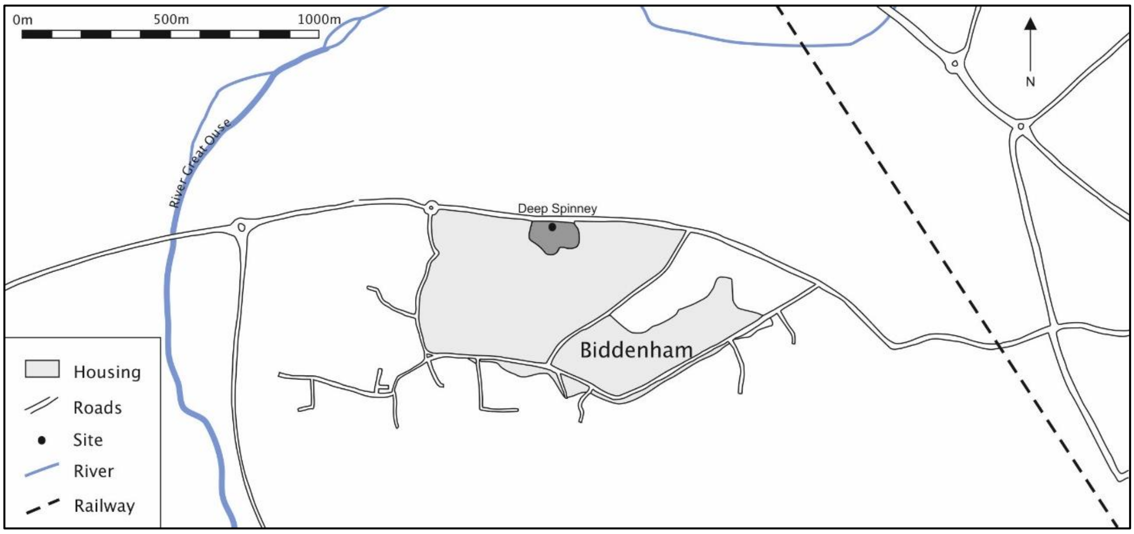


Figure 4.2 Biddenham site map

4.2.2 Excavation history

The site of Biddenham, a gravel pit situated on a terrace of the River Ouse, was originally noted by Prestwich (1861), Wyatt (1862, 1864) and Evans (1897) in the mid-19th Century. Wyatt, in particular, was keenly aware of the palaeoenvironmental and archaeological significance of the site, visiting the pit regularly and collecting a large quantity of palaeoliths along with mammalian and molluscan remains (Wyatt 1862, 1864). Wyatt's assemblage predominantly consists of handaxes and can now be found in the British Museum, Wyatt Collection. Personal examination revealed no cores are present in this collection and further study was not therefore required.

Material was also collected by Francis Knowles and donated to the Pitt Rivers Museum. Knowles regularly visited Biddenham and donated material between 1904 and 1911. Unlike many collectors of the time, Knowles made an effort to collect not only handaxes but all worked material (Knowles 1953:15). This resulted in the donation of over 1,000 artefacts, most of which have not been analysed until this thesis. Roe (1981:191) was aware of the collection and commented on the presence of 'proto-Levallois' material but made no further study. Roberts recently reviewed the Palaeolithic material in the Pitt Rivers Museum, also noting the Biddenham assemblage had not undergone modern analysis (Roberts 2013:185). Roberts similarly drew attention to the potential ‘proto-Levallois’ cores Roe had previously identified, suggesting further work to characterise the assemblage would be valuable. It was under this recommendation the Pitt Rivers collection was included in this investigation.

The recent excavations by Harding and colleagues produced very little archaeology, a total of five flakes and one core (Harding *et al.* 1992). This core, (see Figure 4.3) shows no sign of preparation and the authors state it can neither support nor contradict Roe’s observations of the presents of ‘proto-Levallois’ technology (*ibid*:90).

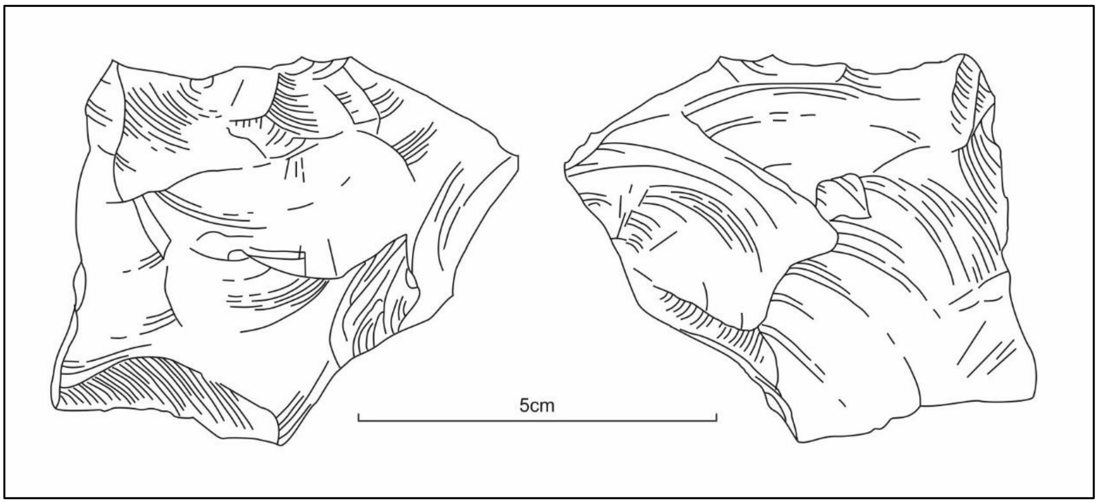


Figure 4.3 Migrating platform core from Biddenham (Re-drawn after Harding *et al.* 1992)

4.2.3 Dating

Sections of the River Ouse terrace deposits were excavated as part of the reinvestigation by Harding and colleagues (1992). A site appraisal programme confirmed the presence of archaeological and faunal remains at the base of the deposit (*ibid.*). Harding and colleagues attribute the Biddenham deposits to the highest terrace of the River Ouse with a Middle Pleistocene date, possibly MIS 11 but most likely MIS 9 (Harding *et al.* 1992; Pettitt and White 2012). An MIS 9 date is also supported by Wymer who described the Biddenham deposits as post-Anglian, and yet considerably older than MIS 7 date assigned to the interglacial deposits at Stoke Goldington (Wymer 1999:123).

4.2.4 Stratigraphy

During their reinvestigation, Harding and colleagues (1992) recorded two stratigraphic sections in the Deep Spinney pit. Figure 4.4 is a schematic reconstruction of Section A. The Palaeolithic artefacts came from the base of the deposits, just above the Oxford Clay. This correlates with the stratigraphy recorded by Wyatt and presented to the Geological Society by Prestwich (1861).

Molluscan evidence from the reinvestigation suggests the assemblage was deposited during temperate conditions, again supporting the work of Wyatt who concluded part of the area must have been a small freshwater lake or stream (Wyatt 1862, 1864).

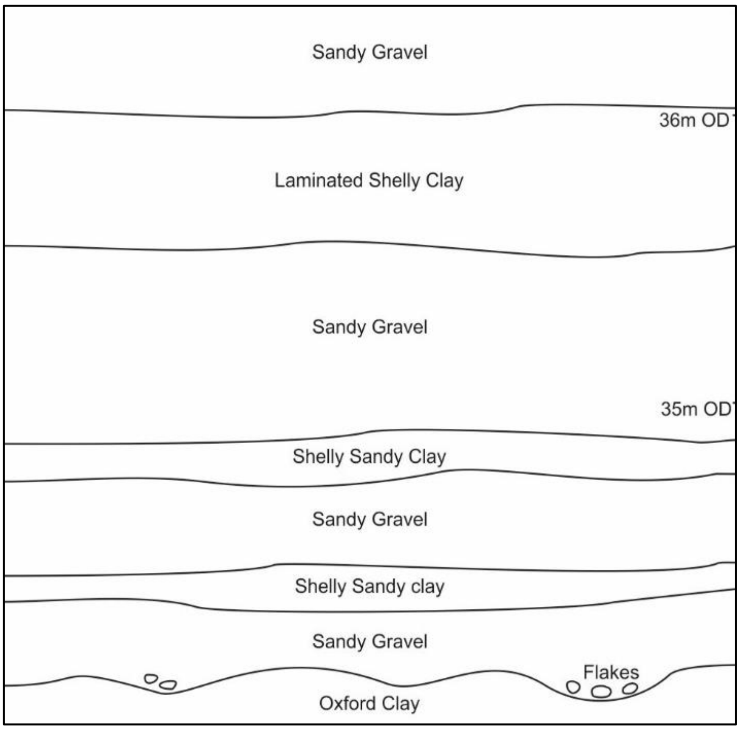


Figure 4.4 Schematic stratigraphic section from Biddenham after Harding *et al*. (1992)

4.2.5 Summary

The Knowles Collection from the Pitt Rivers Museum will be included in this investigation to try and establish whether the 'proto-Levallois' cores identified by Roe and Roberts are SPCs. As much of this assemblage has not been studied and any previous investigation has focused solely on the handaxes, a detailed investigation into all available material using modern attribute analysis techniques will further our understanding of SPC technology. Though poorly dated, Biddenham is clearly a handaxe assemblage and the presence of SPCs will contribute towards answering Research Questions 2 and 3 which ask how prevalent SPC technology is and examines the relationship between SPCs and other Lower Palaeolithic core working techniques.

4.3 Caddington, Bedfordshire

4.3.1 Introduction

Caddington was discovered by Worthington G. Smith in the late 1880's (Smith 1894). Located on the then county boundary between Bedfordshire and Hertfordshire, in the Chilterns, the site has produced a number of cores which have been flaked in a manner described by Roe (1981:191) as a 'reduced Levalloisian technique'. McNabb also mentions these cores, likening them to the SPCs from Purfleet (2007:207).

Location

51.863926 (lat.) -0.454757 (long.) Grid reference TL 065195

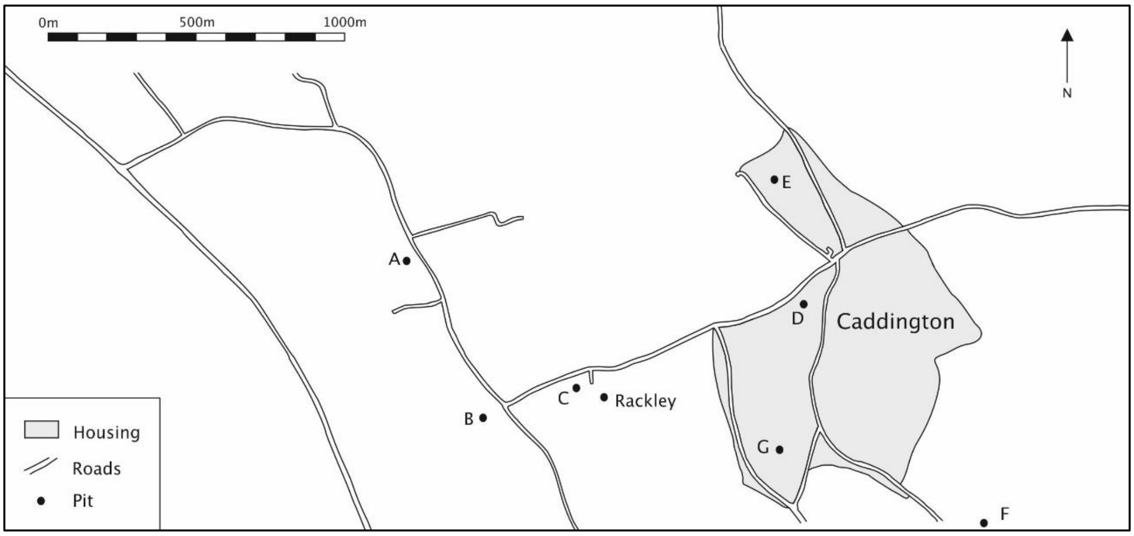


Figure 4.5 Caddington site map

4.3.2 Excavation history

The site itself was a collection of seven localities used for clay extraction for brickmaking (Sampson 1978). Smith found the first *in situ* Palaeolithic implement at Caddington in 1889 (Smith 1894). In the following six years Smith made regular visits to the site and even trained the workmen to recognise worked flint (Sampson 1978). The best known of the Caddington pits is the Cottages Site or Pit C. Here, Smith had uncovered a primary context knapping horizon where bifaces were produced (Smith, 1894; Sampson, 1978; McNabb, 2007). Evidence of the *in situ* manufacture of these implements is seen through refits, of which Smith was able to identify over 500 (Smith 1894:77).

In the 1970s, a reinvestigation was carried out by C. Garth Sampson and colleagues. Sampson tried to locate the Palaeolithic floor but the only undisturbed section of the Pit C deposit was inaccessible and so the investigation moved to a smaller pit nearby (Sampson, 1987). This location became known as the Rackley Site and was excavated in 1971 (*ibid*). Figure 4.5 presents the seven different pits and the Rackley Site in relation so each other. This reinvestigation did not locate the Palaeolithic floor but palynological evidence revealed the environmental sequence (White 1997:917). The Rackley deposits demonstrate an environment which was becoming more open with standing bodies of water such as marsh or ponds (Campbell and Hubbard 1978; White 1997; McNabb 2007).

Quarrying at the Cottages Site is thought to have passed over a Levallois floor eight years after the Cottages Site was exhausted (Catt *et al.* 1978; McNabb 2007). The exact location of the Levallois site is unknown, although the date of discovery suggests the material was 100 meters away from the Acheulean floor in Pit C (McNabb 2007:207). This Levallois floor contained no handaxes and as a result Smith did not record these as meticulously (Catt *et al.* 1978). Future work has been proposed by Catt and colleagues to determine the exact location of this Levallois floor and such work may provide useful insight to the Lower to Middle Palaeolithic transition (1978). The Levallois floor is considered separately to the two Levallois specimens which had been discovered by 1893 (Sampson 1978) along with the Levallois cores and flakes discovered by quarrymen between December 1903 and January 1906 (McNabb 2007). Bradley and Sampson (1978) attribute the Levallois flakes at the Cottages Site to by-products of handaxe manufacture, stating that no Levallois cores or clear Levallois flakes were found at the Cottages Site (Catt *et al.* 1978). Roe (1981:191), however describes Caddington as 'an Acheulean industry of Levallois facies' identifying classic Levallois cores and flakes. It is Roe who first mentions the presence of SPCs, as 'reduced Levalloisian' (Roe 1981:191). Though there is no mention of the quantity of these cores, Roe goes on to describe the reduction of these cores as:

'…rudimentary preparation of its upper surface and a simple striking platform was fashioned at one end, before a single large flake, or in a few cases a couple of sizable flakes, were removed from it' (Roe 1981:191)

This depiction is very similar to that of Ashton and White's (2003) description of the cores from Purfleet, thus making Caddington a valuable site for this investigation.

Recent work carried out by Fredrick Foulds, as part of his PhD research, has emphasised that the material from the different pits at Caddington, particularly Pits E and F, cannot be considered to be a single assemblage (Foulds 2014). Instead Foulds sees this as a point in the landscape repeatedly visited by hominins manufacturing handaxes, arguing variation in handaxe production strategies implies multiple groups were responsible for the material. However Foulds goes on to state that problems separating the material from the contorted drift and the Palaeolithic floor make it difficult to determine if the groups were separated solely in terms of location or also temporally (*ibid*).

For the purposes of this investigation of SPC technology, the material from Caddington pits will be analysed and attention will be paid to the specific pit from which any SPCs originate. As many of the assemblages in this investigation are from secondary contexts, I do not feel this site with potentially multiple occupations and a mix of *in situ* and derived material should be excluded from further analysis. The mere presence or absence can address Research Questions 2 and 3 whilst any SPCs which are identified will help contribute to a wider understanding of this technology.

4.3.3 Dating

Caddington has never been reliably dated. Catt *et al.* (1978) correlate the Acheulean floor at the Cottages Site with the upper brickearths at Rackley through pollen data and stratigraphic correlations. Palynological analysis was carried out on pollen samples taken from the brickearth preserved on a cluster of refitting flakes in the Smith collection. This analysis attributes the Acheulean floor to the Ipswichian Interglacial though these results remain tentative as the sample was very small (Catt *et al.* 1978). The loess in the brickearth is believed to be Anglian or Wolstonian which gives a lower age limit of MIS 12 and a lack of Devensian loess provides an upped age limit of MIS 5 (*ibid.*). McNabb (2007) suggests a late MIS 9 date like that of Purfleet but also admits the site could well be situated in the Averley/West Thurrock Interglacial of MIS 7.

4.3.4 Stratigraphy

The investigations at the Rackley Site demonstrated a considerable variation in stratigraphy over a relatively short distance however attempts were made to correlate the sequence with Smith's notes for the Cottages Site. Figure 4.6 is a schematic representation of Section 1. Palaeolithic implements are believed to have come from the Contorted Red Brown Gravel as well as the Palaeolithic 'floors'.

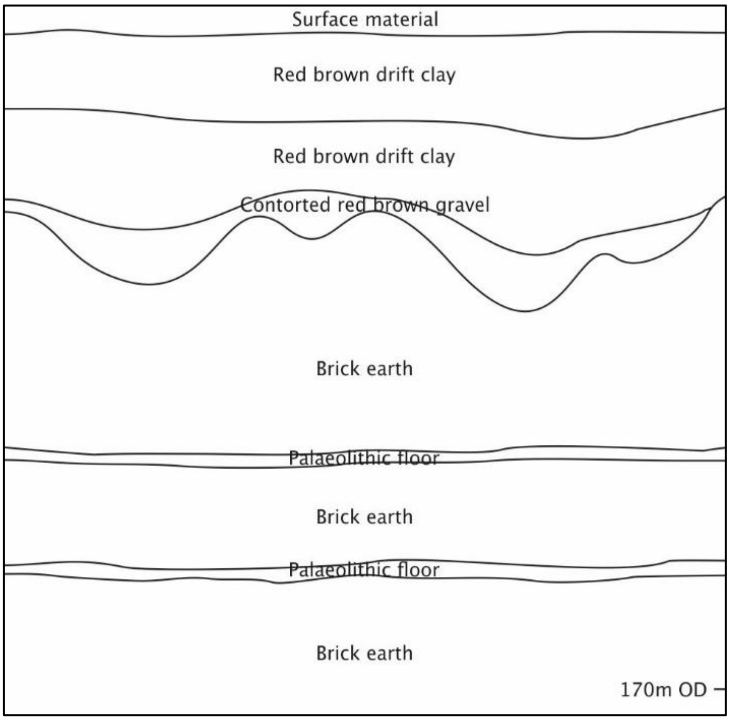


Figure 4.6 Schematic stratigraphy for the Cottages site/ Pit C, Section 1. Redrawn after Smith (1894)

4.3.5 Summary

The debate surrounding the possible presence of Levallois or 'reduced' Levallois at Caddington make this an important site to include here. The confusion highlights the need for a clearer understanding of what is considered to be Levallois technology or not.

4.4 Cuxton, Kent

4.4.1 Introduction

The site of Cuxton in Kent has been excavated on three occasions since the early 1960s and is probably best known for the exceptionally large ficron handaxes found in 2004 (Wenban-Smith 2004). Cuxton is on the west bank of the River Medway and is associated with the Medway Gap which cuts through the North Downs (Pettitt and White 2012). A small number of cores have been described as 'proto-Levalloisian, making the material from Cuxton of interest to this investigation.

Location

51.371840 (lat.) 0.453909 (long.) Grid reference TQ 709665

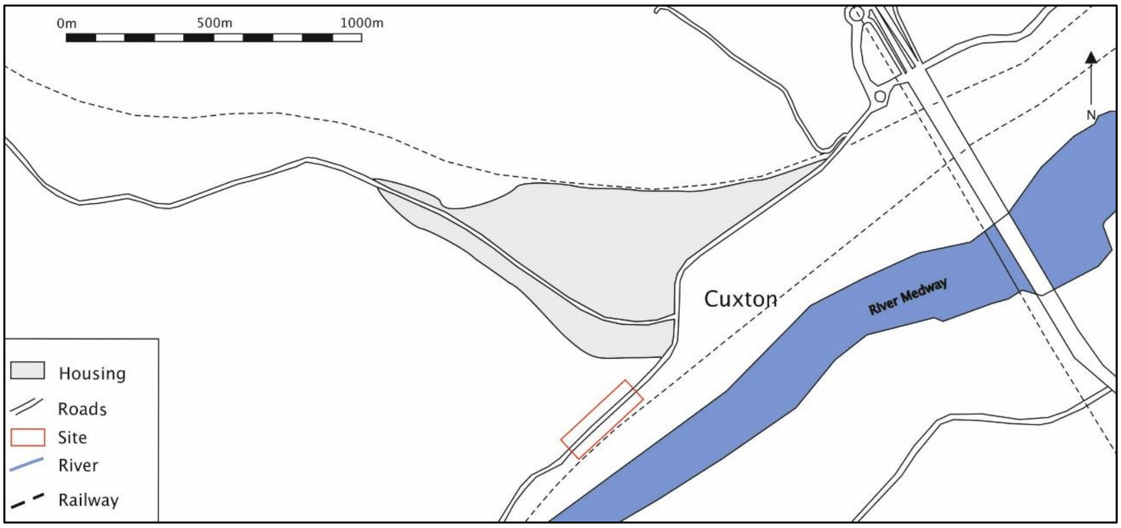


Figure 4.7 Cuxton site location map

4.4.2 Excavation history

The first excavations were carried out by Tester in 1962-3 at the Rectory site and can be seen in Figure 4.8. This investigation produced over 600 flint artefacts, 20 of which were described as cores, a few of which showed signs of preparation before flake removal (Tester 1965:40). Tester described these tools as 'proto-Levalloisian' and suggests they support the theory that the origins of Levallois lies in the Acheulean (Tester 1965:60). Roe (1981) also noted that elements of the Levalloisian technique were present in the Cuxton assemblage though sparingly used.

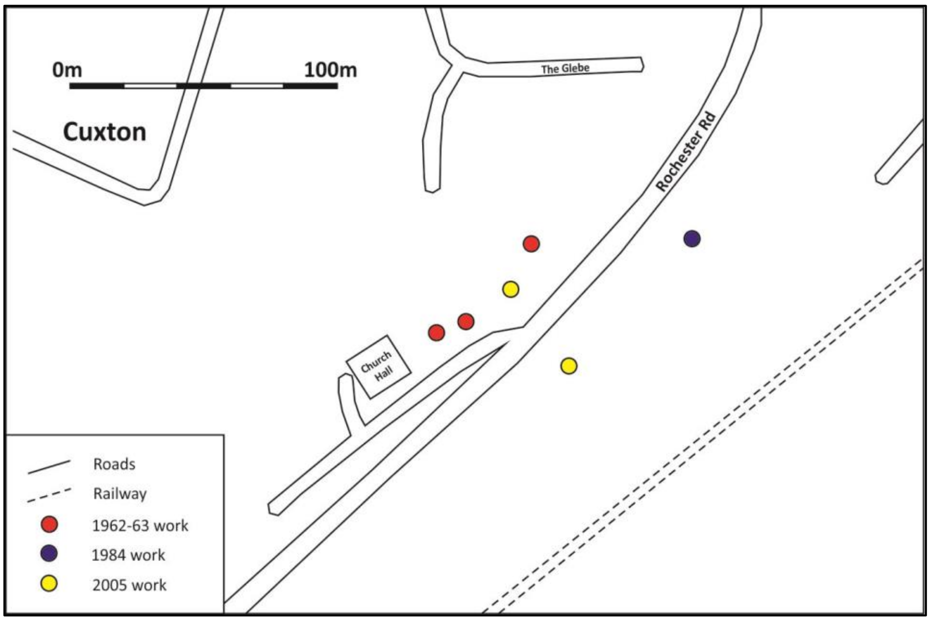


Figure 4.8 Cuxton plan of investigations

There are two published illustrations of the cores Tester identifies as 'proto-Levallois' from Cuxton (Tester 1965: 56). An example of one of these cores can be seen in Figure 4.9. Unfortunately, only one surface, the flaking surface, has been illustrated for each core and the degree of working on the non-visible surfaces is unknown. This is not surprising as much of the attention Cuxton has received is as a result of the extremely large handaxes. Whilst the handaxes are unusual they are not the only interesting technological component at this site. By studying the cores, I believe we can expand our knowledge of hominin behaviour at this site.

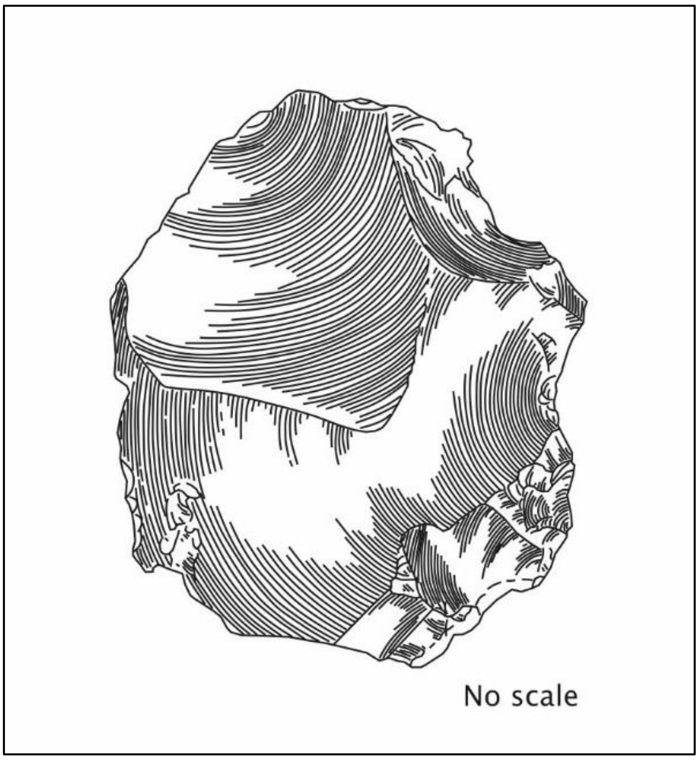


Figure 4.9 Potential SPC from Cuxton (after Tester1965: 56)

The 1984 excavation carried out at 15 Rochester Road by Cruse produced fewer artefacts. Only eight cores were recorded and only one of these has the potential to be considered prepared (Cruse *et al.* 1987; McNabb 2007). Cruse states that none of the cores display 'evidence of care in preparation of the platform' (Cruse *et al.* 1987:58) whilst McNabb (2007:177) describes one of the cores as a SPC with a striking similarity to those from Purfleet.

The most recent excavations at Cuxton were carried out in 2005 as part of the Aggregates Levy *Medway Valley Palaeolithic Project* (MVPP). One of the aims of this project was to date the site using OSL and to build a clearer picture of the stratigraphy of the terrace outcrop (Wenban-Smith *et al.* 2007). Two phases of excavation were carried out at 21 Rochester Road. Combined, the excavations produced 27 handaxes, including pointed ficrons and a particularly large cleaver. A total of three cores were also found during this investigation (Wenban-Smith *et al.* 2007, Table 10).

4.4.3 Dating

Recent work by the Medway Valley Palaeolithic Project has produced two dates for Cuxton using OSL. These dates are 197.540 ± 17.09 and 232.640 ± 13.75 BP (Wenban-Smith *et al.* 2007:31). This places Cuxton at the beginning of MIS 7, making it the youngest handaxe site in Britain (*ibid.*). This date has provided some contention as some argue that according to terrace correlation with the Thames, Cuxton is somewhat older and more likely to be around MIS 9 and therefore broadly contemporary with Purfleet and the Lynch Hill/Corbets Tey terrace (Bridgland 2003; Shaw and White 2003:306).

4.4.4 Stratigraphy

Each of the three investigations at Cuxton produced detailed section drawings which correlate reasonably well. A schematic interpretation of Tester's section from Trench 2 is presented in Figure 4.10. Tester states the artefacts were located in the gravels with a small number in the overlying loam (1965:32). The archaeological material from Cruse's excavation was also located in the gravels which were likely deposited in a fluvial environment during a periglacial episode (1987). The most recent excavations produced a similar stratigraphic sequence with the giant handaxes recovered from the gravel layer below the cross-bedded sands (Wenban-Smith 2004) however the depth of this stratigraphic sequence was considerably less than expected.

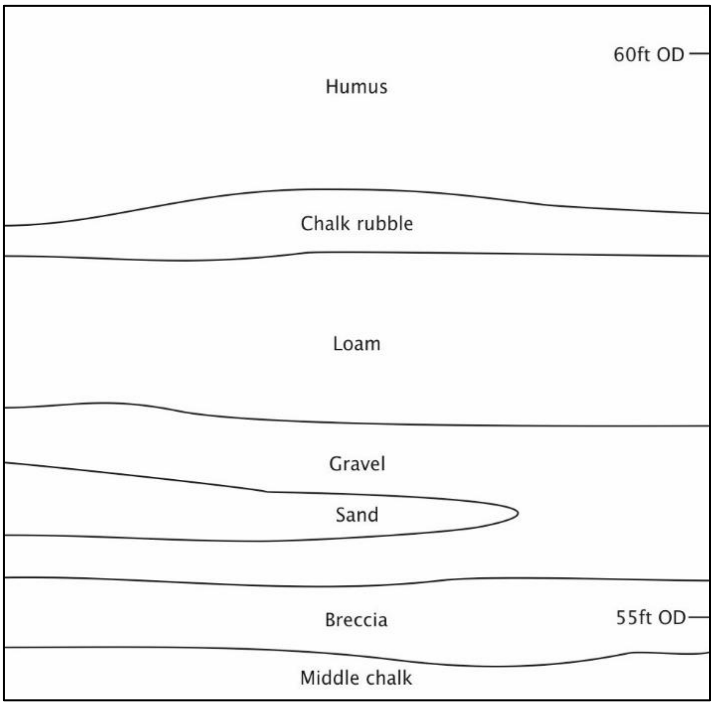


Figure 4.10 Schematic stratigraphy of Trench 2 from the 1962-63 excavations after Tester (1965)

4.4.5 Summary

If the dating of Cuxton is robust, this is the youngest site in this investigation. Not only is Cuxton of interest due to the late date, the site has also produced some of the most well-known handaxes in the British Palaeolithic and the significance of those finds may have overshadowed the presence of SPC technology. Previous work described a small number of cores in the Cuxton assemblage as 'proto-Levallois' and similar to those from Purfleet. Recent research has shown these cores are SPCs and further analysis of the assemblage as a whole is required (Bolton 2010).

4.5 Dunbridge, Hampshire

4.5.1 Introduction

The site of Dunbridge is located in Hampshire, to the west of the River Test at its confluence with the River Dun (see Figure 4.11). The site is known for the extensive handaxe assemblage collected in the late 19th century along with examples of the Levallois technique (Dale 1912, 1918; White 1912; Roe 1968). Recent work by Harding and colleagues has produce further handaxes along with potential SPCs which have been described as 'proto-Levallois' (Harding *et al.* 2012).

Location

51.034365 (lat.) -1.547209 (long.) Grid reference SU 31846 26209

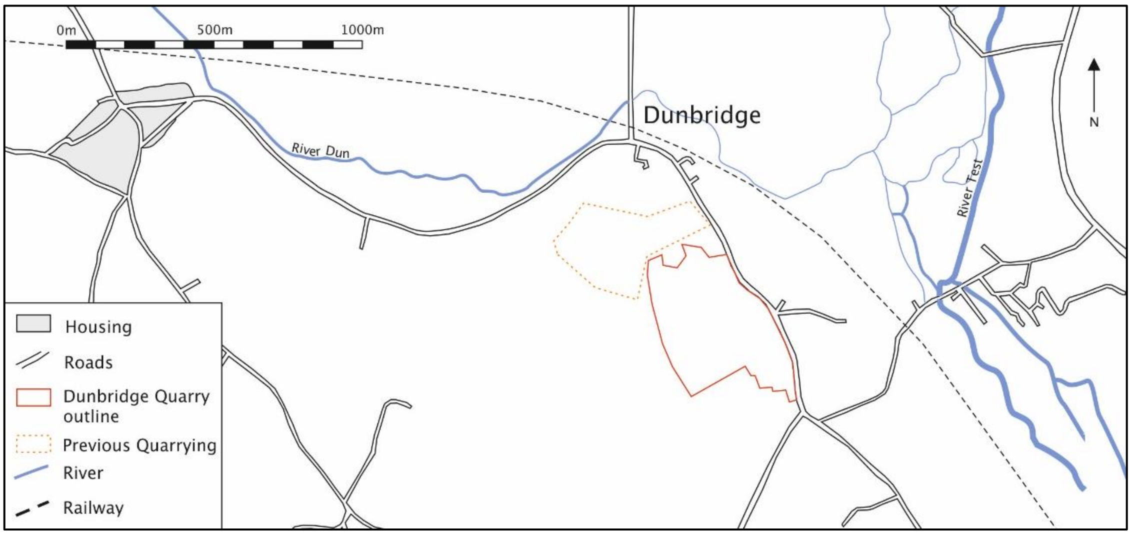


Figure 4.11 Dunbridge location with watching brief and SSSI outlined (After Harding *et al.* 2012:2)

4.5.2 Excavation history

Extraction of gravel at Dunbridge began in the late 19th century. During this time two local geologists, H.J.O. White and W. Dale, collected a large number of Palaeolithic implements, the vast majority of which are handaxes (Dale 1912, 1918; White 1912). Roe (1981:206) described Dunbridge as the most prolific Palaeolithic find spot in Hampshire, noting almost 1,000 handaxes along with three cores, 16 retouched flakes, 24 unretouched flakes and three Levallois flakes (Roe 1968:96).

White (1912) suggested there were two terrace levels or stages at Dunbridge; an upper 'Belbin Stage' above a lower 'Mottisfont Stage' with the implements originating in the former, higher terrace. This has been supported by more recent work by Harding and colleagues (2012). The Belbin Stage is also known to have produced many other palaeoliths when found elsewhere (White 1912; Roe 1968; Harding *et al.* 2012).

A watching brief was in place at Dunbridge from 1991 to 2007 during gravel extraction in Kimbridge Farm Quarry, Hampshire (Harding *et al.* 2012). Figure 4.11 shows the location of the Kimbridge Farm Quarry, marked in red as the Dunbridge Quarry outline, in relation to previous quarrying where the large handaxe assemblage was recovered. The aim of the watching brief was to establish the geological context for the material collected over the last century at Dunbridge. Sections were recorded and sampled along with the collection of a further 198 Palaeolithic artefacts (*ibid*).

The results of the recent watching brief are of particular interest to this study as the presence of handaxes, 'proto-Levallois' cores and fully developed Levallois cores are noted, though it is mentioned that the Levallois material is likely to be younger than the proto-Levallois and handaxes which are believed to be a similar age (Harding *et al.* 2012).

Three 'proto'-Levallois cores were identified during the watching brief. Two of which can be seen in Figure 4.12. These cores are described as 'embryonic' Levallois and comparisons were made with the Purfleet cores and sequence (Harding *et al.* 2012:21).

The terminology in this paper is noteworthy. It is unclear if the use of the term 'proto-Levallois' after the establishment of the term 'Simple Prepared Cores', put forward nine years earlier, is intentional. This varying use of terminology could suggest the cores from Dunbridge more closely resemble the Levallois technique as opposed to cores which have been termed SPCs. Alternatively this could be a case of multiple terminology for the same technology. This investigation into the material at Dunbridge will clarify any ambiguity.

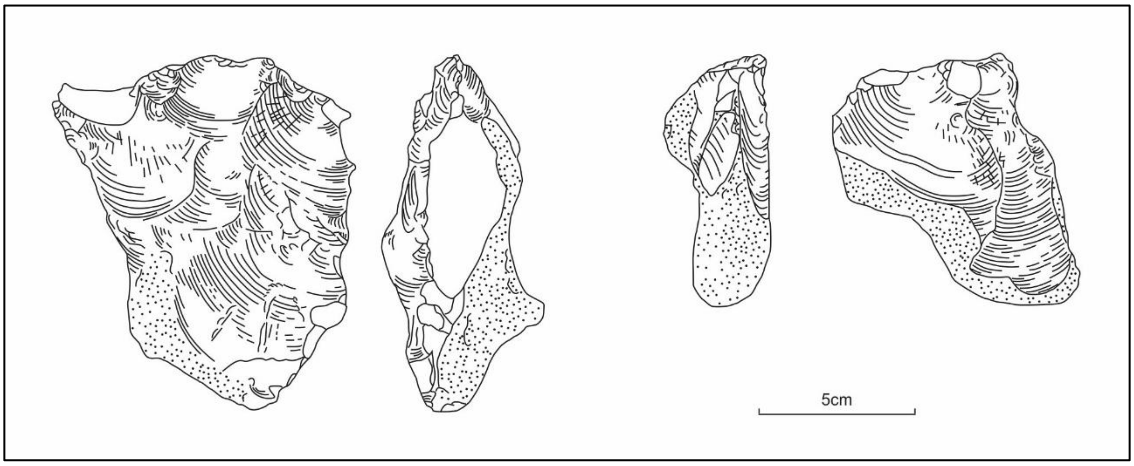


Figure 4.12 'Proto-Levallois' cores form Dunbridge (Re-drawn after Harding *et al.* 2012:15)

The presence of 'proto'-Levallois flakes was also mentioned but no illustrations were included in the publication nor were there any labels to identify these flakes in the collection (Harding *et al.* 2012). These flakes are described as having unidirectional flake scars and controlled flaking angles (Harding *et al.* 2012:14). No further details of how this control was identified have been made and without this I do not believe it is possible to identify a flake from a SPC. Unidirectional flake scars could be present on a flake removed from a SPC but equally these scars would be present on a flake removed from a core which had been reduced using a parallel method. In White and Ashton's (2003:600) paper on Purfleet, the authors described the difficulty of identifying flakes produced through the SPC method noting it would be hard to distinguish the SPC flakes from the products of alternative reduction techniques.

4.5.3 Dating

All of the material recovered during the watching brief originated from the Belbin Gravel Formation, but Harding and colleagues argue the condition of the artefacts varies with the Levallois material being in a fresher condition whilst the handaxes and 'proto'-Levallois were described as rolled and heavily stained (Harding *et al.* 2012). The authors use this to suggest the Levallois material came from higher in the deposit and is therefore more recent in date (Harding *et al.* 2012:21). Figure 4.13 shows the proposed location of the artefacts in relation to the terraces based on the description given by Harding (pers. comm.). OSL dating carried out as part of the watching brief dates the Belbin Gravel to MIS 9b and the overlaying Mottisfont terrace to MIS 8 (Schwenninger *et al.* 2011). OSL samples were only taken from the Mottisfont Gravel and gave an age of 267±30ka (*ibid.*).

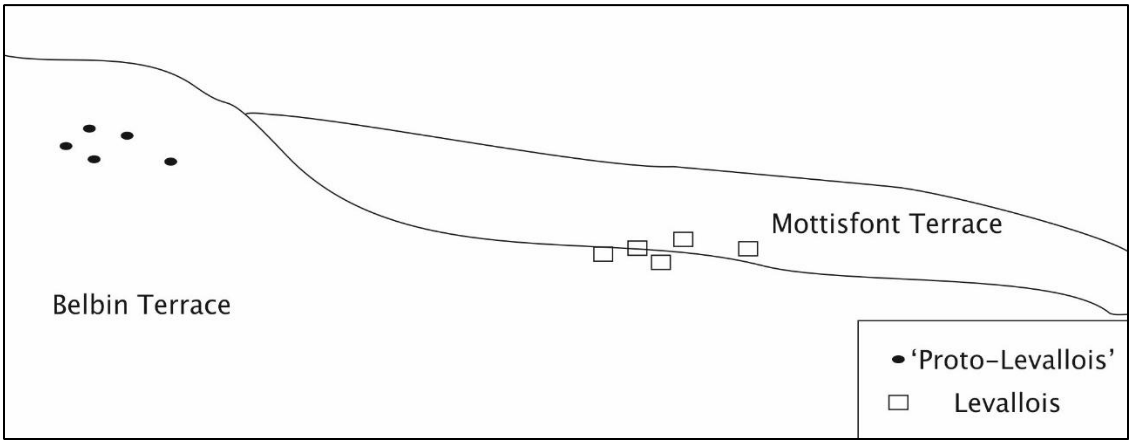


Figure 4.13 Hypothesised location of Levallois and 'Proto-Levallois' material within the terraces

4.5.4 Stratigraphy

The sections produced during the watching brief show a complicated stratigraphic sequence at Dunbridge. Section 4a and 4b from the Harding and colleagues report appears to be closest section taken in relation to the location of the possible SPCs and has been reproduced in Figure 4.14. The red box highlights the approximate section from which the implements originated based on flakes in the section, but the exact location of much of material remains unknown as it was identified in the processing room after removal. Harding and colleagues have been able to establish an approximate location within the quarry based on when the material was recovered (2012).

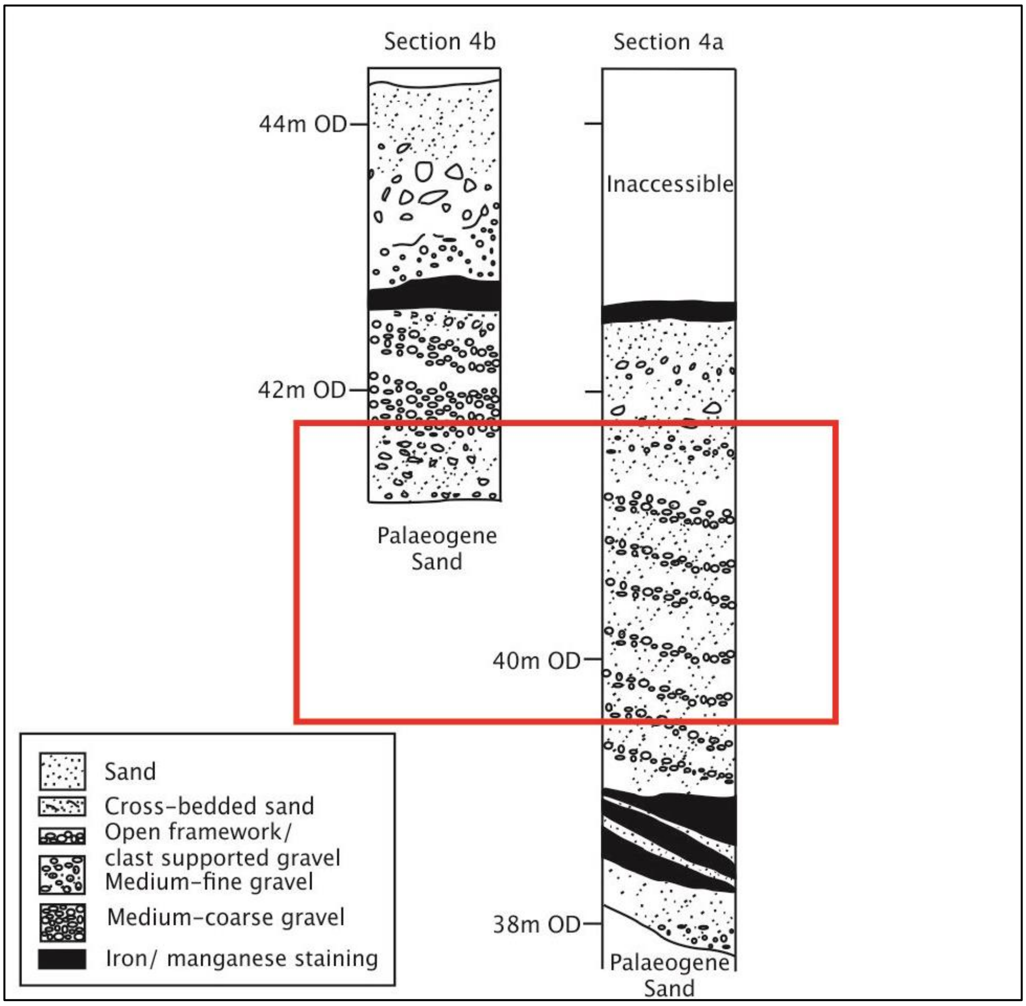


Figure 4.14 Dunbridge stratigraphy (After Harding *et al* 2012)

4.5.5 Summary

The recent publication on the finds from Dunbridge specifically discussed the presence of 'proto-Levallois' technology. This identification of this material requires the inclusion of Dunbridge in this investigation. This is the youngest identification of this technology outside of Purfleet in British research.

4.6 Feltwell, Norfolk

4.6.1 Introduction

The site of Feltwell in Norfolk has not undergone controlled excavation however over 350 palaeolithis were 'rescued' from the Frimstone's Pit in Feltwell by R. I. MacRae and T. Hardaker between 1996 and 1999 (MacRae 1999; Hardaker and MacRae 2000). One of the cores in the MacRae collection appears to be remarkably similar to those from Frindsbury.

Location

52.501768 (lat.) 0.560576 (long.) Grid reference TL 739924

Figure 4.15 Feltwell site location

4.6.2 Excavation history

The Frimstone's Pit is approximately 2km from the prolific Shrub Hill pit where over 230 handaxes had been found in the mid-19th century (Wymer 1985; MacRae 1999). Prior to MacRae and Hardaker's interest in the site, local enthusiast Eric Secker had been collecting handaxes from the pit for about 12 years (MacRae 1999). MacRae and Hardaker recovered their assemblage from the reject heaps at the quarry over a period of three years (*ibid*).

Located in deposits of the now extinct Bytham River, very little is known about this site. The Bytham River flowed eastwards from the West Midlands, through East Anglia and into the North Sea (Rose *et al.* 2000). The river is associated with many prolific Palaeolithic assemblages but was obliterated by the Anglian Glaciation (Parfitt *et al.* 2005).

A possible 'proto-Levallois' core was identified by MacRae (1999). As seen in Figure 4.16, this core appeared to have a large preferential removal and minimal preparation. The similarities between this core and previously identified SPCs naturally led to the inclusion of Feltwell in this research.

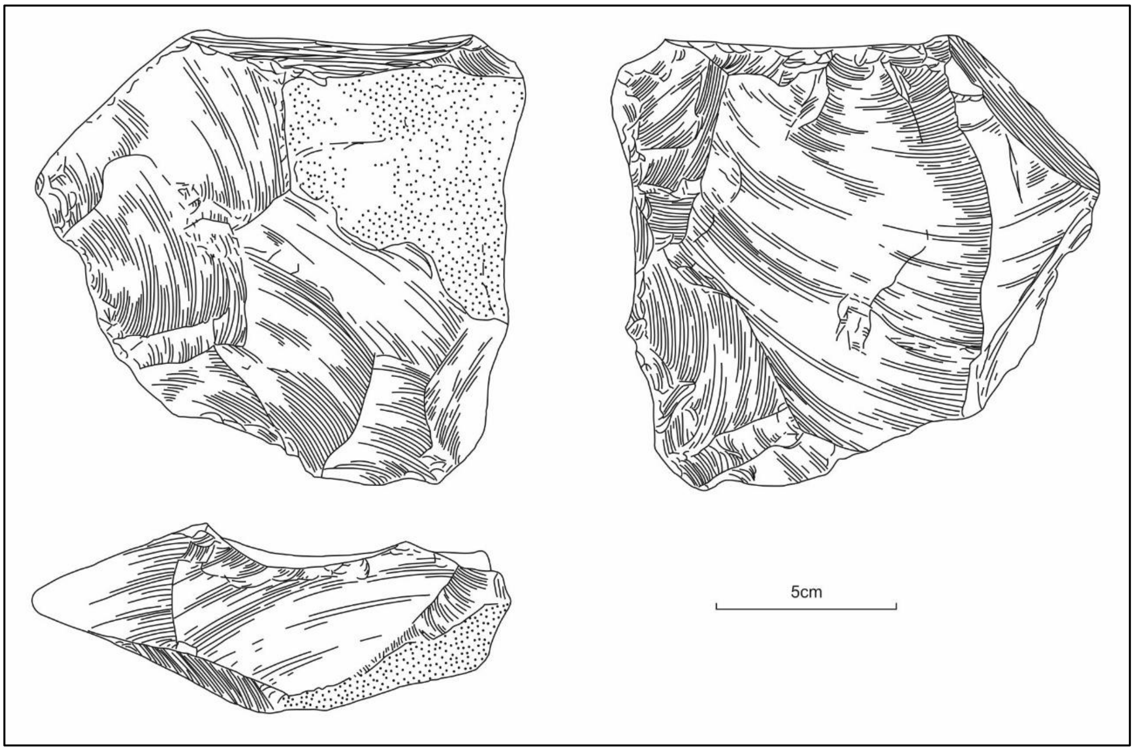


Figure 4.16 Possible 'proto-Levallois core (Re-drawn after MacRae 1999:6)

4.6.3 Dating

Controversy still remains regarding the sequencing of the terraces of the Bytham River (Lee *et al.* 2004; Westaway 2009; Hosfield 2011a; Pettitt and White 2012). Current thinking places Feltwell in the Warren Hill terrace at MIS 14 (Rose *et al.* 1999; Rose *et al.* 2000; Hosfield 2011a; Pettitt and White 2012) thus making Feltwell the oldest assemblage included in this investigation. However the fragmentary nature of the Bytham River terrace deposits has resulted in uncertainty surrounding the correct correlation between sites and terraces (Hosfield 2011a). Hamblin and colleagues attempted to map the pre-Devensian stratigraphy of Norfolk with their 'new glacial stratigraphy' model which proposes glaciations during MIS 16, 12, 10 and 6. This model suggests the formation of the Bytham terraces was like that of the Thames where there is evidence for a link between climate forcing every 100ka and terrace formation (Lee *et al.* 2004; Bridgland *et al.* 2006). The biostratigraphical evidence from sites such as Sidestrand and West Runton in Norfolk do not support this stratigraphic framework (Preece and Parfitt 2008; Preece *et al.* 2009; Preece and Parfitt 2012). Instead Preece and colleagues' 'biostratigraphic age model' suggests deposits assigned to MIS 16 by the 'new glacial stratigraphy' model are in fact significantly younger, possibly as young as MIS 12 (Preece *et al.* 2009). In terms of what this means for Feltwell, the proposed MIS 14 date should be treated with caution. However, as the site is not securely assigned to any terrace, a pre-MIS 12 date is probably the safest conclusion. This still makes Feltwell the oldest assemblage in this investigation.

4.6.4 Stratigraphy

It has not been possible to reconstruct the chronostratigraphic sequence at Feltwell due to the lack of controlled excavation.

4.6.5 Summary

Feltwell has been included in this investigation based on the similarities between the core illustrated in Figure 4.16 and the SPCs from other assemblages. This appears to be particularly similar to those from Frindsbury. Caution must be taken as the provenance of the material is not secure and the dating of the site is only a rough estimate. However, the assemblage will be included with the intention of attempting to understand more about the material and the site itself.

4.7 Frindsbury, Kent

4.7.1 Introduction

First discovered in 1923, Frindsbury was excavated in 1924 by W.H. Cook and J.R. Killick. The site was located on the top of a chalk cliff spur alongside the River Medway (Cook and Killick 1922-1924; McNabb 1992). Very little is known about the site and much of the material has since been lost (McNabb pers. comm.). However, the majority of the remaining cores have been reduced in a manner comparable to those from Purfleet (White and Ashton 2003) thus making Frindsbury a valuable inclusion in this investigation.

Location

51.399523 (lat.) 0.505713 (long.) Grid reference TQ 744697

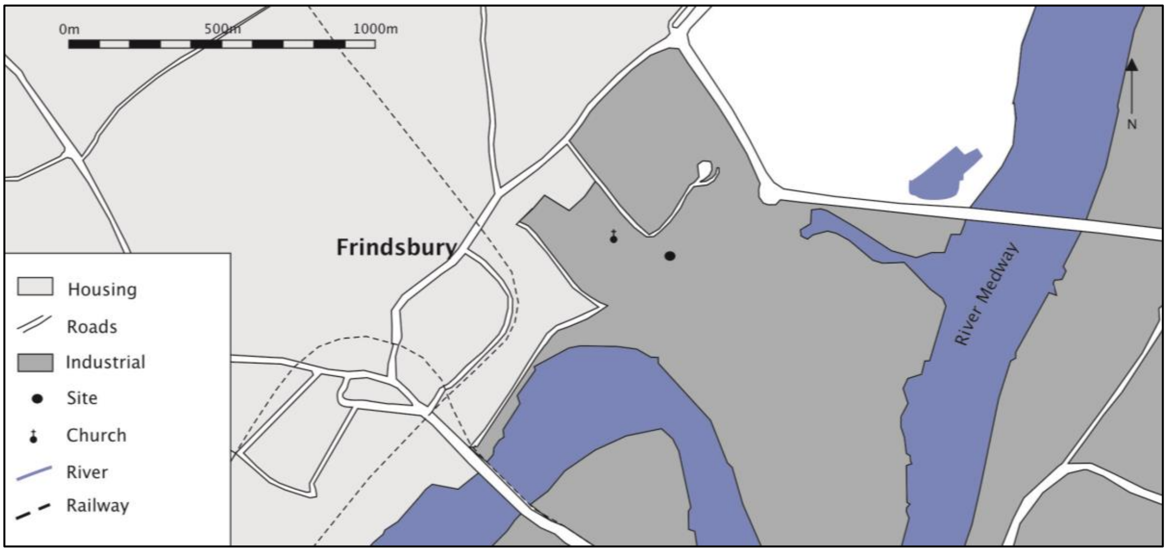


Figure 4.17 Frindsbury location map

4.7.2 Excavation history

Over 4,000 implements were originally recorded from Frindsbury and now only 13.2% still remains (McNabb 1992). McNabb was able to reconstruct the site to some extent using newspaper articles and photographs (*ibid.*). The site was located between a disused chalk pit and a road leading to the cement works. Figure 4.18 shows McNabb's (*ibid*) interpretation of the site layout in relation to the nearby All Saints church.

In their only published paper on the site, Cook and Killick (1922-24) describe some of the finds. The site consisted of a 'working floor' with 17 flint heaps. These heaps appeared to contain unretouched flakes, hammerstones, débitage, handaxes and cores (Cook and Killick 1922-1924:135). It was specifically noted that none of the cores were 'tortoise-backed type', taken to mean there was no Levallois cores found.

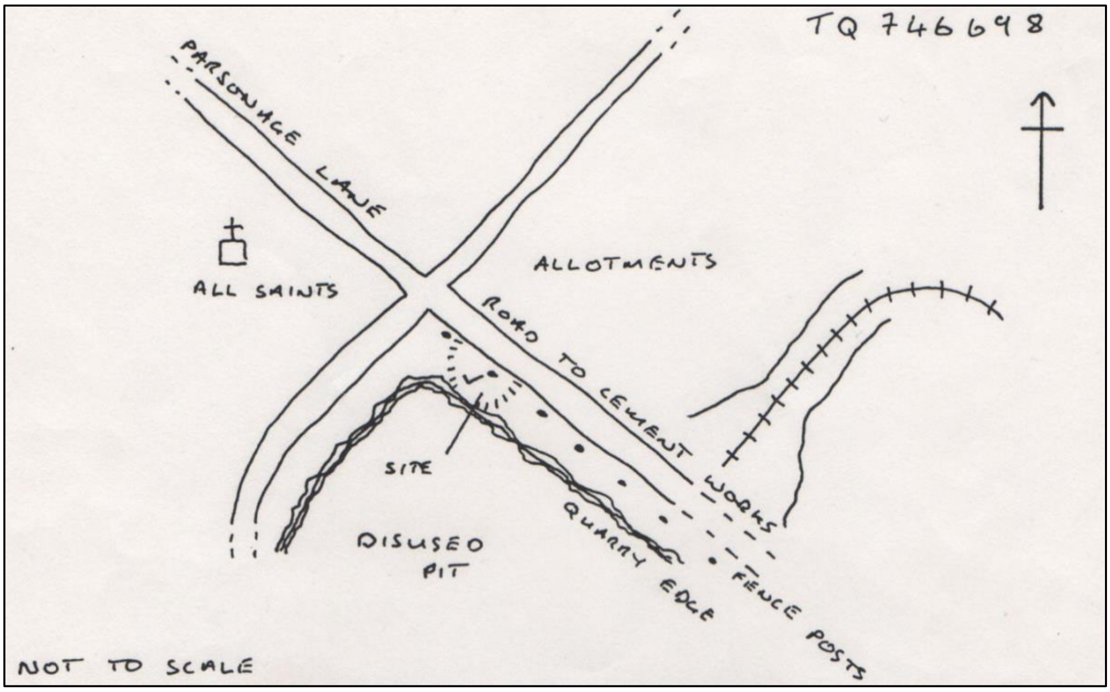


Figure 4.18 The site of Frindsbury located between the disused chalk pit and the road to the cement works which have since been built upon (McNabb 1992:171)

White and Ashton (2003:601) describe 14 of the 16 cores from Frindsbury as being 'identical' to those of Purfleet with 'clear intention of flaking across surfaces'. Indeed the only illustration of one of the cores does appear to show some preparation of the flaking surface and a preferential flake scar removal (see Figure 4.19). Unfortunately only one flaking surface has been illustrated and there is not a scale so the size of this core is unknown.

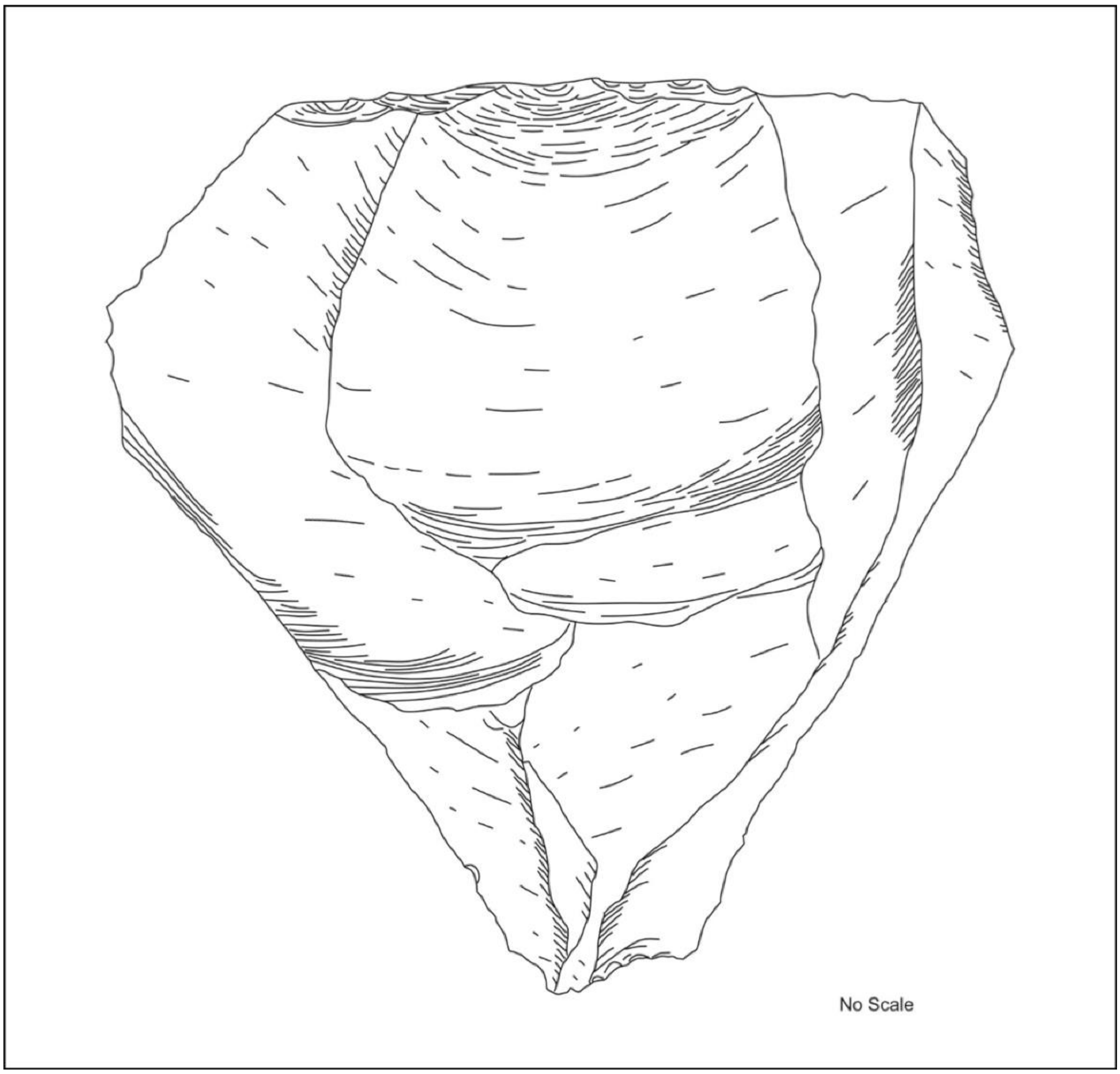


Figure 4.19 Potential SPC from Frindsbury (Re-drawn after Cook and Killick 1922-24: 145)

4.7.3 Dating

Frindsbury has never been dated convincingly. Newspaper reports at the time incorrectly estimated an age of 50,000yr BP (Anon 1925). Technologically the assemblage cannot be dated with any certainty; however the colluvial nature of the site, along with its position well above the River Medway terraces, could place the occupation in the Middle Pleistocene. This is due to the elevation of the site in relation to the River Medway, as 'no river is likely to have flowed at this elevation since this time' (McNabb 1992:182).

4.7.4 Stratigraphy

Cook and Killick recorded the stratigraphy of the site and nearby exposed sections. Figure 4.20 is a schematic interpretation of their sections. The implements were grouped in heaps, which Cook and Killick interpreted as working locations within the same floor. A total of 17 heaps were identified and although their stratigraphic position within the section drawing (redrawn in Figure 4.20) suggests they were deposited in the mid-lower levels of the gravel, Cook and Killick then go on to say the heaps were on the 'furrowed surface of the chalk' (1922-1924:140) meaning they should not be scattered throughout the layer as shown in the illustration but should be situated somewhere near the bottom of the gravel in small clusters as marked on Figure 4.20 in red.

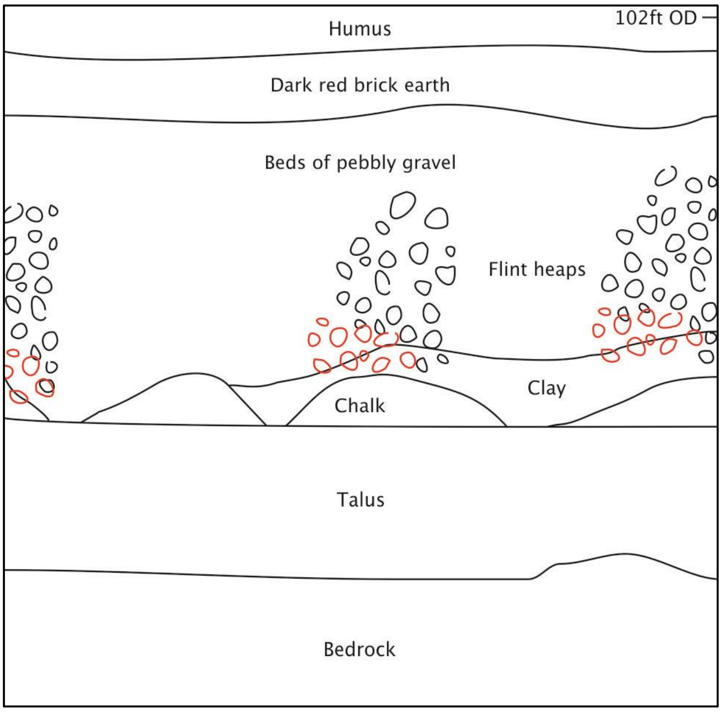


Figure 4.20 Schematic stratigraphy from Frindsbury (after Cook and Killick 1922-1924)

4.7.5 Summary

Although much of the material from Frindsbury has been lost, it is still a valuable contribution to this investigation and the total size of the remaining assemblage is still large enough to see a profile of the technology present.

4.8 Purfleet, Essex

4.8.1 Introduction

Purfleet is located in the Lower Thames Valley and arguably represents the earliest evidence of Levallois in Europe (White and Ashton 2003; McNabb 2007; Scott 2011; Bridgland *et al.* 2013). The site is associated with the Lynch Hill/Corbets Tey Formation (MIS 10-9-8) (Bridgland 1994; Schreve *et al.* 2002; Bridgland *et al.* 2013) and belongs to a now abandoned meander loop of the Thames

(White and Ashton 2003; Scott 2011). There are four chalk pits at Purfleet from which Middle Pleistocene deposits have been recorded. Bluelands, Greenlands, Esso and Botany Pit (Bridgland 1994) (see Figure 4.21). These four sites are particularly significant to the study of the Lower Thames terraces as they provide archaeological, lithostratigraphical and biostratigraphical evidence of the development of the Lynch Hill/Corbets Tey terrace (Schreve *et al.* 2002).

Location

51.485006 (lat.) 0.236718 (long.) Grid reference TQ 554786 A

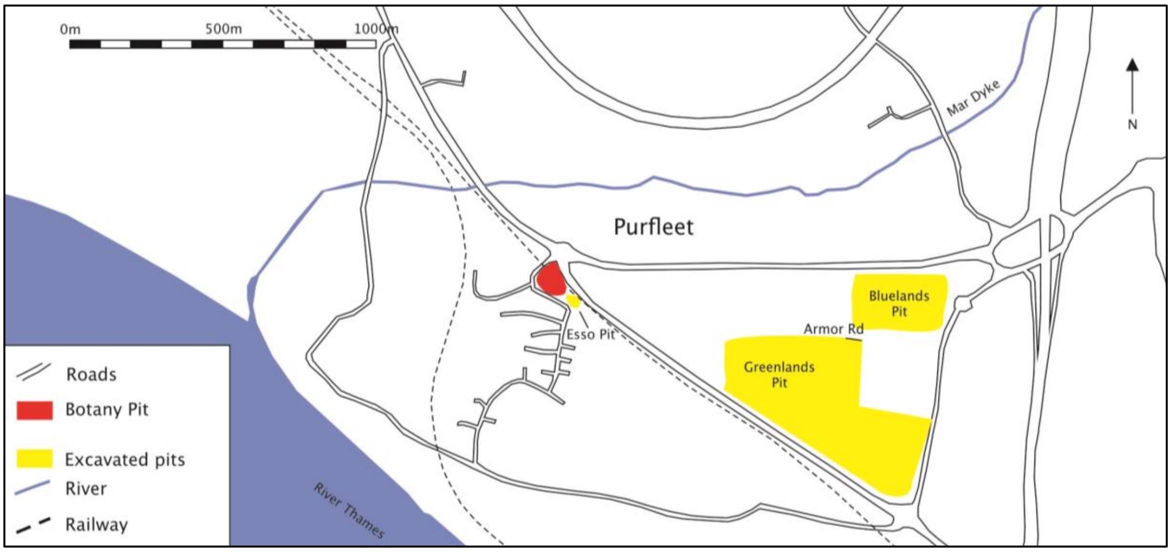


Figure 4.21 Purfleet location map

4.8.2 Excavation history

Of the four sites at Purfleet, only Botany Pit is of particular interest with reference to SPCs and therefore the focus of this investigation (Bridgland 1994; White and Ashton 2003; Scott 2011). Discovered by Andrew Snelling during quarrying for sand and gravel in the early 1960s, Botany Pit has produced a large core and flake assemblage with a few handaxes (Wymer 1968; Roe 1981; Schreve *et al.* 2002). Snelling recovered the material through both controlled excavation and by searching the pit floor (Wymer 1968). Wymer (1981:73) described 23 of the cores as ‘proto tortoise’ or ‘proto-Levalloisian’ whilst Roe (1981:191) noticed a higher level of controlled flaking in some of the cores and made comparisons with the ‘reduced’ Levalloisian cores from Caddington, Bedfordshire. Figure 4.22 is an example of one of the SPCs from Purfleet. This illustration demonstrates the flat flaking surface and the simple striking platform.

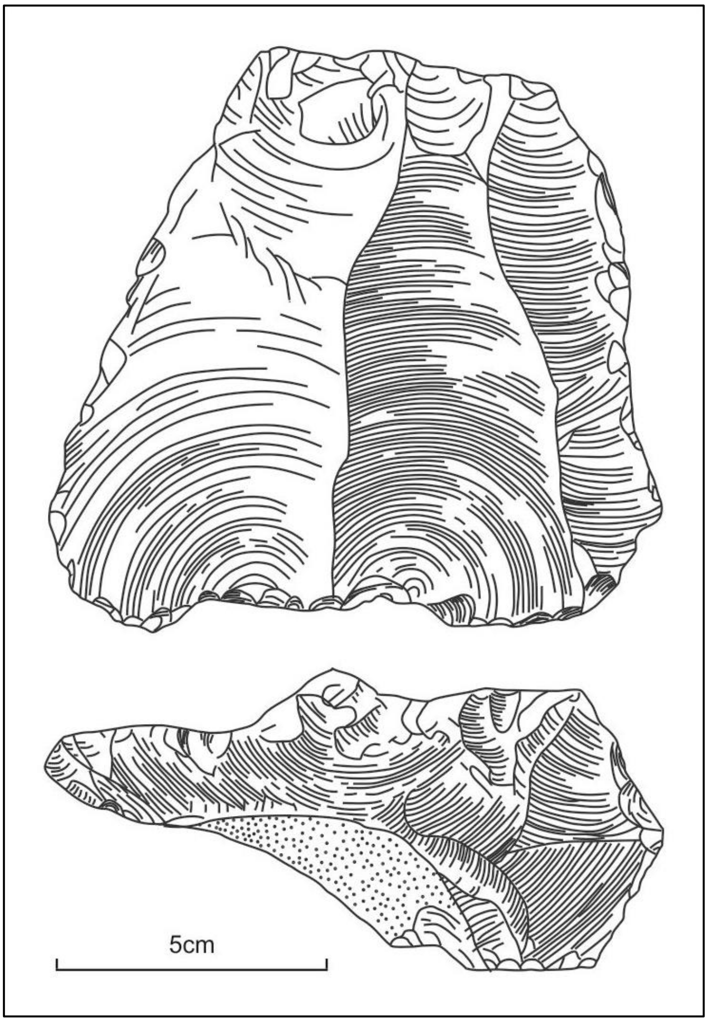


Figure 4.22 SPC from Purfleet (Re-drawn after: White and Ashton 2003:601)

The assemblage size at Botany Pit suggests this was an area of prolonged exploitation (Schreve *et al.* 2002; Scott 2011) and the different methods of core reduction seen at Purfleet are thought to represent a change in hominid technological behaviour (Scott 2011). The overriding interpretation of Botany Pit is that this was an area of tool manufacturing where new technological concepts are seen for the first time in Britain (Schreve *et al.* 2002; White and Ashton 2003; White *et al.* 2006; Scott 2011). My research will show Purfleet is not the isolated occurrence previous research has led us to believe. The other sites studied in this project demonstrate this change in technology was more widely spread than previously thought. However, the assemblage at Purfleet is considerably larger than any of the other assemblages and this likely contributed to the dominance of the site in the literature.

The relationship between the SPCs at Purfleet and fully developed Levallois is addressed in White and Ashton's (2003) paper. Here they conclude the SPCs represent a 'proto-Levallois' technology indicative of a conceptual leap with the fusion of the *débitage* and *façonnage* operational systems (White and Ashton 2003:605). As discussed in Chapter 2, the authors stressed this leap was probably part of a continuity of change rather than an abrupt transformation. Scott (2011) also comments on the differences between the Botany Pit assemblage and other typical Lower Palaeolithic assemblages suggesting the variation is reflective of the hominins active choice to exploit the volume of a core or the surface. Both papers did note the SPCs were not the most common method of core reduction at Botany Pit. White and Ashton (2003:599) calculated 49% of the cores were migrating platform cores whilst Scott (2011:23) calculated 56.1% were reduced through this method. The difference in percentages highlights just how subjective lithic analysis can be although in this example the difference could be attributed to the slight difference in assemblage size studied by the authors. Scott (2011:23) analysed a total of 303 cores whilst White and Ashton (2003:599) analysed 268.

Purfleet is particularly unusual due to the tripartite technological sequence of Clactonian, Acheulean and Levalloisian industries with the latter regarded as the earliest known occurrence in Britain (Schreve *et al.* 2002; White *et al.* 2006). However, as Bates and colleagues (2014) highlighted in their recent paper on Harnham, the presentation of Levallois material at Purfleet has often been confusing. The articles most often referenced when arguing for the presence of Levallois at Purfleet are Susan Palmer's original report on the excavations at the Greenlands and Bluelands Quarries (Palmer 1975) along with Wymer (1968). Neither of these authors argues for the presence of fully developed Levallois material at Purfleet. Palmer identifies one 'proto-Levallois' core (1975:5) and three retouched 'proto-Levallois' flakes (1975:7) from the Bluelands Quarry material. Palmer goes on to describe the industry as 'Middle Acheilian' with 'some evidence of a Levalloisian technique' which is 'not as pronounced as at Botany Pit' (1975:12). As there is no mention of Levallois material in Palmer's list of finds from each quarry, I believe the Levalloisian technique to which she is referring at the end of her report is the material she previously described as 'proto-Levallois'.

Having analysed the Snelling collection for my Masters' dissertation (Bolton 2010) I agree Levallois material is present within the Botany Pit assemblage. However, like Bates and colleagues (2014), I remain unconvinced as to the exact provenance of this material. The terminology used by both Palmer and Wymer is misleading and may have been misinterpreted. The stratigraphic sequence of Botany Pit and its correlation to the more recently excavated Blueland and Greenlands Pits is also unclear and will be discussed in the following section. In brief, the gravel in Botany Pit is one stratigraphic layer whereas the gravels in Bluelands Pit, Greenlands Pit and Armor Road are separated by a layer of silt, sand and clay. In Greenlands Pit, SPCs have been identified in the underlying Bluelands Gravels and, in Armor Road, Levallois material has been identified in the Botany Gravel. Theoretically I do not see a problem with Levallois and SPC material occurring within the same context and the implications of this will be addressed in Chapter 6. However, having reviewed the available information, to say the two techniques are of a contemporary age within Botany Pit at Purfleet is premature.

The work by Scott (2011) and White and Ashton (2003) differ in opinions of why hominids were creating the SPCs. While all authors agree that the desired flakes from this core reduction method are large and flat (White and Ashton 2003; Scott 2011), Scott argues the choice in reduction was probably based on the quality of raw material whereas White and Ashton note there was no reason for the reduced Levallois to be used due to the abundant raw material. These conflicting arguments illustrate the ambiguity surrounding SPCs.

4.8.3 Dating

Purfleet has recently been dated using two geochronological techniques. OSL results estimate a date of 329±30ka whilst amino acid dating positions the site later than MIS 11 but earlier than MIS 7 (Bridgland *et al.* 2013). These dates support the previous biostratigraphical analysis which placed the Purfleet deposits in the MIS 9 interglacial (Bridgland 1994; Schreve *et al.* 2002). There have been tentative suggestions which refine this date further and which will be discussed along with the stratigraphy in the following section. The lithological and palaeontological analysis carried out by Schreve and colleagues (2002) suggests the deposits were laid down by a large river, a short distance from the present-day estuary and the biological evidence suggests temperate conditions with mixed woodland, grassland and marshland.

4.8.4 Stratigraphy

An understanding of the stratigraphy at Purfleet is essential for the claims of earliest Levallois and the relationship with SPC technology. However the Botany Pit stratigraphic sections as recorded by Snelling are not detailed by today's standards. Figure 4.23 is a schematic representation of the stratigraphy of a section from each investigation at Purfleet. The section from Botany Pit has been taken from Snelling's field notes (reproduced with his permission) and no further accuracy can be given to the location of the material within the gravels from the Botany Pit excavations.

Reinvestigations at Bluelands and Greenlands Quarries in the 1990s and prior to the construction of the high-speed railway (HS 1) have produced highly detailed stratigraphic sections of several test pits (Schreve *et al.* 2002, see Figures 6 and 7; Bridgland *et al.* 2013, see Figures 4 - 15) but the stratigraphic resolution in relation to the archaeology at Purfleet is still not ideal. The confusion is thanks to the inability to distinguish between the Botany Gravel and the Bluelands Gravel in the HS 1 sections due to the lack of the decalcified clay silt deposit which separates the two in Greenlands Quarry, Blueland Quarry and in the Armor Road section (see Figure 4.23) (Schreve *et* *al.* 2002). Bridgland and colleagues (2013) associate the base of the Botany/Bluelands Gravels with the SPCs and Acheulean material but 1km away in the Armor Road test pit there are fully developed Levallois cores in the Botany Gravel. Bridgland and colleagues (*ibid.*) tentatively suggest the decalcified clay silt deposit between the Botany and Bluelands Gravels at Armor Road could be a marine interglacial highstand within MIS 9 possibly dating to MIS 9c and/or MIS 9a which would then make the Bluelands Gravels MIS 9d or MIS 9e. Consequently the entire upper part of the Purfleet sequence would then be attributed to MIS 9 and not MIS 9/8. If this distinction is supported, it would argue for Acheulean technology alongside SPCs in the early stages of MIS 9 and fully developed Levallois alongside SPCs during the later stages as SPCs appear to be present in both Gravels (Schreve *et al.* 2002).

As shown in Figure 4.23, SPCs are located in the Bluelands Gravel at Greenlands Pit whereas the Levallois material is located in the Botany Gravel in the Armor Road section. The only instances where Levallois material and SPCs are found alongside each other is when the Botany and Bluelands Gravels are indistinguishable in the HS 1 sections and although the detail in the Botany Pit section is not as detailed, it seems plausible that the same inability to distinguish between the gravels was present there.

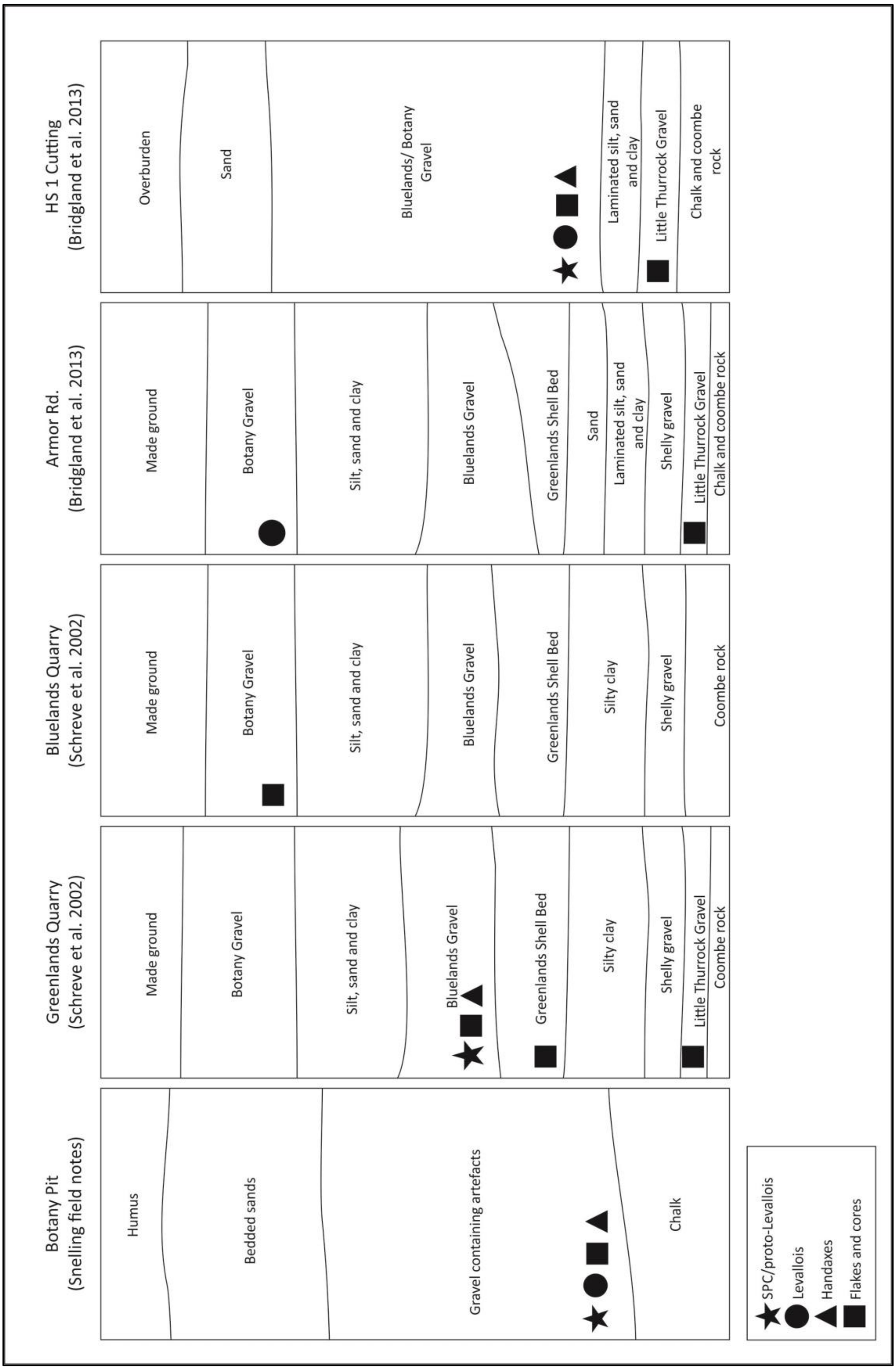


Figure 4.23 Schematic stratigraphic sections for the Purfleet pits

4.8.5 Summary

In summary, it is widely accepted that the SPCs at Botany Pit do not represent the majority of the assemblage. It is also agreed that these cores do represent a 'proto-stage' in the development of Levallois, however interpretations as to why this method of core reduction was employed are still varied and uncertain. This research will address the question of why this technique was implemented and compare the relatively well studied cores from Purfleet with the considerably lesser studied material from the following sites.

4.9 Red Barns, Hampshire

4.9.1 Introduction

The site of Red Barns is located on the outskirts of Portsmouth, on Ports Down Hill, and has undergone three separate investigations since 1973, producing over 6,000 artefacts (Gamble and ApSimon 1986; Wenban-Smith *et al.* 2000).

Location

50.853029 (lat.) -1.137641 (long.) Grid reference SU 608 063

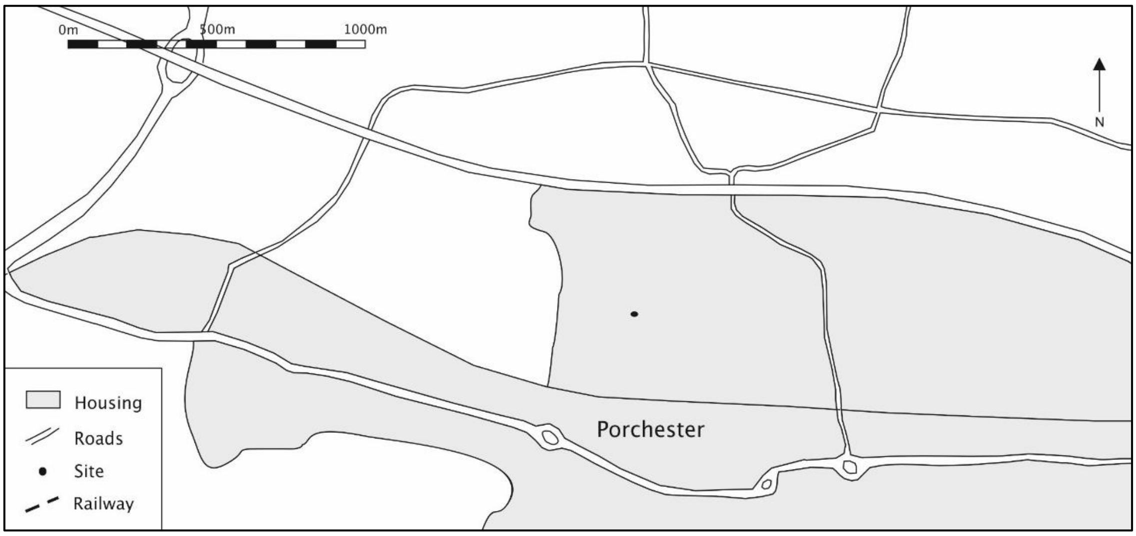


Figure 4.24 Red Barns location map

4.9.2 Excavation history

Chris Draper first noticed Palaeolithic implements at Red Barns when surveying sections of contractor's trenches in advance of the building of a new housing development (Gamble and ApSimon 1986). In December 1973, Draper identified three findspots A, B and C (see Figure 4.25).

Findspot A produced over 350 artefacts and was located 185 meters to the west of findspots B and C which were grouped together and produced smaller numbers of finds (*ibid.*). Draper returned to Red Barns in 1974 and, together with Woodcock, excavated a small trench 12 meters to the west of Findspot A, known as D (Woodcock n.d.; Gamble and ApSimon 1986). At each site, the lithic artefacts came from a layer of grey loam situated under a cemented breccia. Geological section drawings confirm similar stratigraphy at each location (Woodcock n.d.). The stratigraphy from findspots A and D were considered by Wenban-Smith and colleagues (2000) to be 'directly comparable' to that of Findspot A.

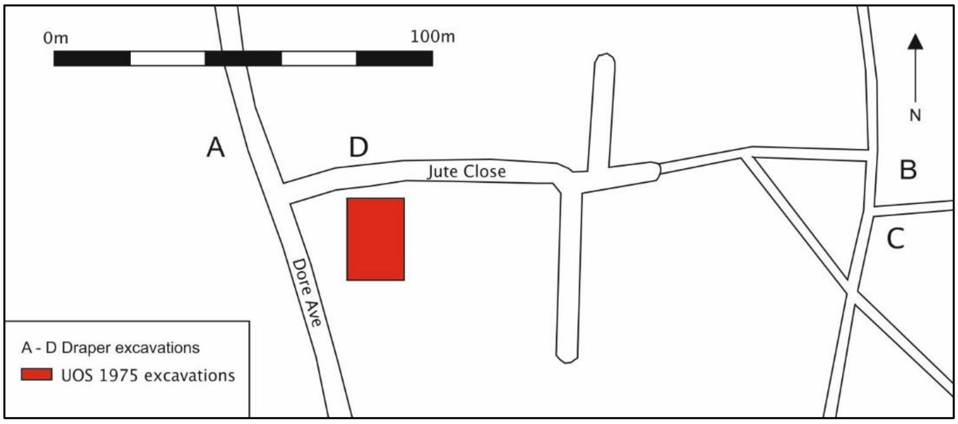


Figure 4.25 Plan of excavations at Red Barns

The Department of Archaeology at the University of Southampton carried out rescue excavations at Red Barns in 1975. An area 40 m^2 was excavated to the South of Draper and Woodcock's site D (Wenban-Smith *et al.* 2000). A lithic assemblage of over 6,000 artefacts was recovered from grey soil beneath a calcrete layer (Gamble and ApSimon 1986; Wenban-Smith *et al.* 2000). Stratigraphically, the sequence correlates with that of the Draper and Woodcocks investigation (Gamble and ApSimon 1986:10). The vast majority of the material were chips, irregular waste and débitage (Wenban-Smith *et al.* 2000) but 19 handaxes were also identified. Wenban-Smith argues the signature of the assemblage is one of handaxe production with a preference for plano-convex sub-cordate shape (*ibid.*). This argument is supported by the large quantity of débitage and the representation of the complete reduction sequence thanks to the thorough excavation and recording techniques which included sieving all spoil though a mesh of 6mm (Wenban-Smith *et al.* 2000:213).

In the initial site report the core reduction technique was described as 'non-Levallois' (Gamble and ApSimon 1986:10). The analysis carried out by Wenban-Smith appears to disagree with this (2000:232). The more recent analysis identifies only four cores in the entire assemblage and suggests one of these demonstrates a 'Levalloisian approach' (Wenban-Smith *et al.* 2000:232). The authors describe a prepared surface with striking platforms, arguing the core meets all of the six criteria identified by Boëda (*ibid.*). The core in question can be seen in Figure 4.26. There seems to be some ambiguity in this paper as to whether the authors wish to call this Levalloisian or not. The original caption to the illustration refers to 'Levalloisian' however the same core is later referred to as 'Levalloisian-looking' (Wenban-Smith *et al.* 2000:242) and again on the same page the site is describes as having 'proto-Levalloisian' elements. This ambiguity in use of descriptive language is a common occurrence in the literature and highlights how essential a thorough study of this technology is.

Wenban-Smith and colleagues (2000) argue the presence of the core in question should not suggest a Levalloisian industry is contemporary with the handaxes at Red Barns. Instead they suggest individual instances of Levalloisian technology may appear before the widespread adoption (2000:242).

The site was investigated once again in 1999. Wenban-Smith opened three new test pits, one of which was situated next to the 1975 trench. This was the only test pit to reach the cemented breccia under which were a small number of flakes, one handaxe and no cores (Wenban-Smith 2000:9).

4.9.3 Dating

Red Barns has been dated to between 200,000 – 425,000 BP using amino acid dating (Wenban-Smith *et al.* 2000:250). It has been suggested that a date within the range OIS 11-9 is most likely (*ibid.*).

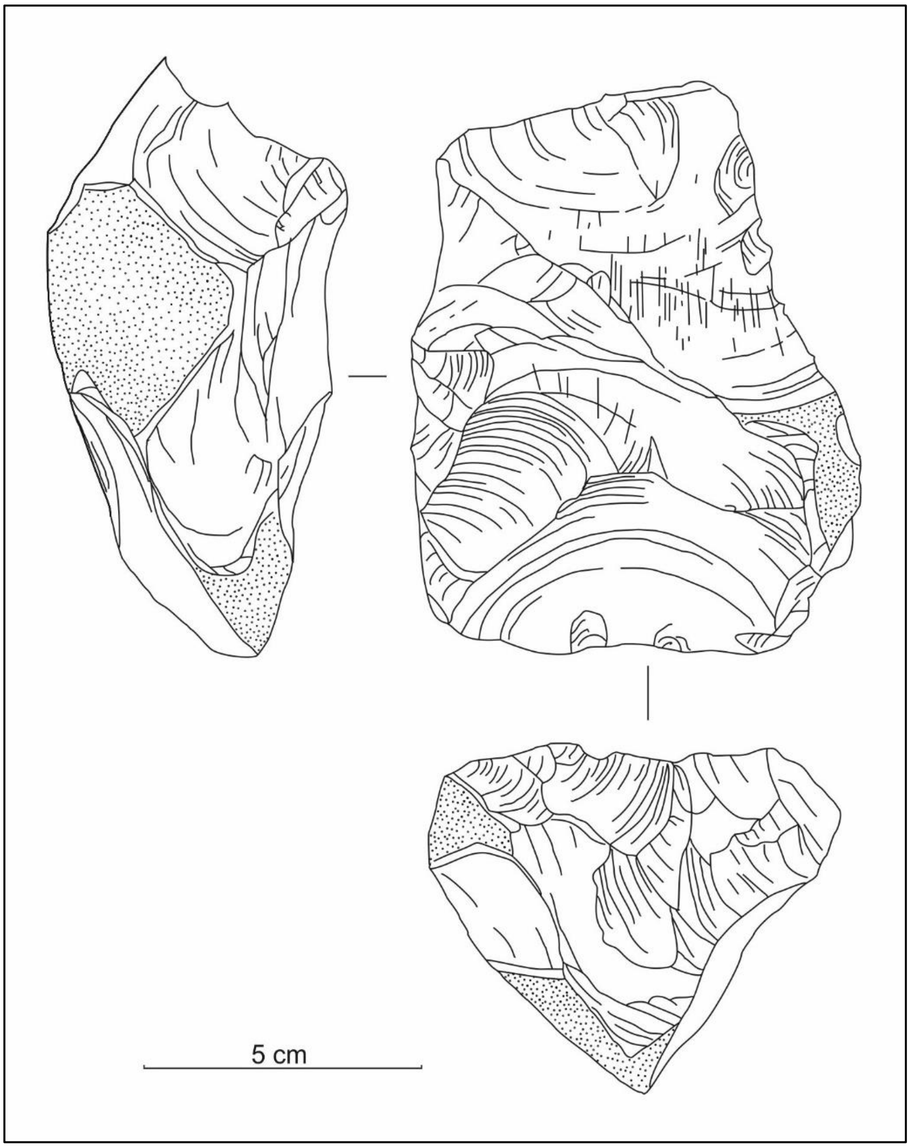


Figure 4.26 ‘Recurrent bipolar Levalloisian core’ from Red Barns (Re-drawn after Wenban-Smith *et al.* 2000:232)

4.9.4 Stratigraphy

The archaeology from Red Barns came from two stratigraphic layers, the cemented breccia and the underlying grey loam. These two layers can be seen at the base of Figure 4.27 which provides a schematic reconstruction of the South section of the 1975 trench. The vast majority of artefacts came from the grey loam with the heaviest concentrations at the base of the loam. The cemented breccia, grey loam and underlying chalk (not shown) correspond to the same stratigraphic layers in the Draper excavations at sites A and D.

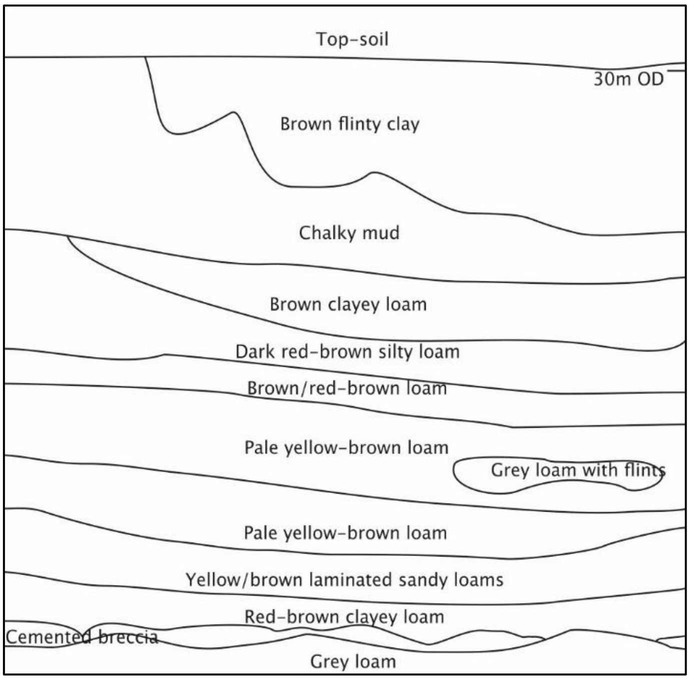


Figure 4.27 Schematic stratigraphy for the South section on the 1975 excavations at Red Barns (after Wenban -Smith *et al*. 2000)

Samples for palaeoenvironmental analysis were taken from both the 1975 trench and the Draper excavations (Wenban-Smith *et al.* 2000). A lack of diatoms suggests the deposits were not formed through fluvial processes. None of the samples contained enough pollen for analysis and no Pleistocene pollen was found in the grey loam sample meaning no deductions can be made about the climate or environment (*ibid.*). Only one sample contained ostracods and poor faunal preservation in the grey loam make interpretations difficult. Finally, although molluscan remains were identified in five of the samples, none were useful in contributing towards estimating an age of the sediments (*ibid.*). Overall the palaeoenvironmental data provides little support by way of dating the sediments.

4.9.5 Summary

For this investigation two collections from Red Barns have been analysed. The first collection is stored at Franks House, British Museum, and consists of the material from the 1975 University of Southampton excavations. The second collection is stored at an outstation of Portsmouth Museum and consists of material loaned by Gamble from the same excavations as well as material donated by Draper after the initial investigation at Red Barns in 1973-74. Due to the low number of cores in the British Museum collection, the decision was made to include the Draper material in this investigation. This will also be the first time the Draper material has undergone modern technological analysis.

4.10 Kesselt-Op de Schans

4.10.1 Introduction

Discovered in 2006, the site of Kesselt-Op de Schans in Belgium is the most recently excavated assemblage in this thesis. Located in a brickyard quarry in Belgian Limburg along the eastern side of the Albert Canal (see Figure 4.28), the site was excavated during the summers of 2007 and 2008 (Van Baelen *et al.* 2007, 2008). The material recovered from Kesselt-Op is regarded by many to demonstrate a core reduction technique similar to that seen at Purfleet (Van Baelen *et al.* 2008; Scott and Ashton 2011; White *et al.* 2011).

Location

50.836700 (lat.) 5.638569 (long.)

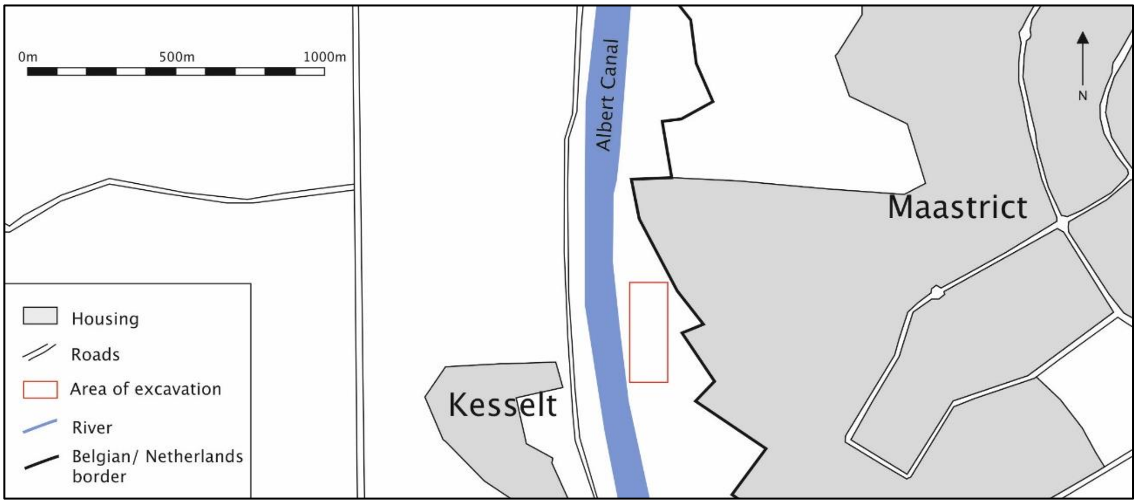


Figure 4.28 Kesselt-Op location map

4.10.2 Excavation history

The Op de Schans pit had produced Late Pleistocene finds since 2001 (Meijs *et al.* 2012). This led to systematic prospecting from 2001 – 2006 when the Middle Pleistocene deposits were discovered containing artefacts in their primary context (*ibid*:138). The Kesselt-Op site consists of four clusters of lithic artefacts (ODS 1- 4). These clusters are believed to be isolated knapping floors within the same palaeolevel (Van Baelen and Ryssaert 2011:202). This pattern of distribution is remarkably similar to the Cook and Killick's description of the Frindsbury assemblage (1922-24). The clusters contain partial and near complete reduction sequences which have been reconstructed through extensive refitting (*ibid.*:203). Baelen and Ryssaert (*ibid.*) note the presence of discoidal, Levallois and 'simple prepared core' strategies. As mentioned in

Chapter 2, the SPCs from Kesselt-Op seem to be widely acknowledged and often compared to the material from Purfleet. White and colleagues describe the SPCs as 'carefully prepared and exploited' (White *et al.* 2011:61), whilst Scott and Ashton describe the reduction sequence as 'volumetrically distinct (2011:94).

Ann Van Baelen analysed the Kesselt-Op material extensively for her PhD thesis (Van Baelen 2014). The four clusters produced a total of almost 3,000 finds. Table 4.1 presents the different core reduction techniques, as identified by Van Baelen. It seems remarkable that a site that is widely cited to be a good example of SPC technology (Van Baelen *et al.* 2007, 2008; White *et al.* 2011; Scott and Ashton 2011; Picin *et al.* 2013; Wiśniewski 2014) only has one SPC though this does validate the inclusion of other assemblages within this research, such as Feltwell, which also have small SPC totals (Van Baelen 2014). The cores from Kesselt are consistently referred to as 'simple prepared cores'. This is the only assemblage in this study where this reduction technique is not referred to as 'proto-Levallois' or any of the other variants. My aim in analysing this assemblage is to clarify whether there is indeed a distinction between the technique seen at Kesselt and the techniques seen in the British assemblages where the method is often still referred to as 'proto-Levallois' (Harding *et al.* 2012; Bridgland *et al.* 2013).

Core Type	*ODS1* *N*	*ODS 2* *N*	*ODS 3* *N*	*ODS 4* *N*	*Total* *N*
SPC				1	1
Discoidal	1	2	1		4
Levallois		1			1
Flaked flake			1		1
Multiple platform			1		1
Core fragment		4			4

Table 4.1 Kesselt-Op de Schans Core reduction techniques (Van Balen 2014)

As seen in Figure 4.29, there does not appear to be a single preferential removal on the SPC from Kesselt. This raises questions as to why this is widely accepted as SPC technology when similar material from the British assemblages is not.

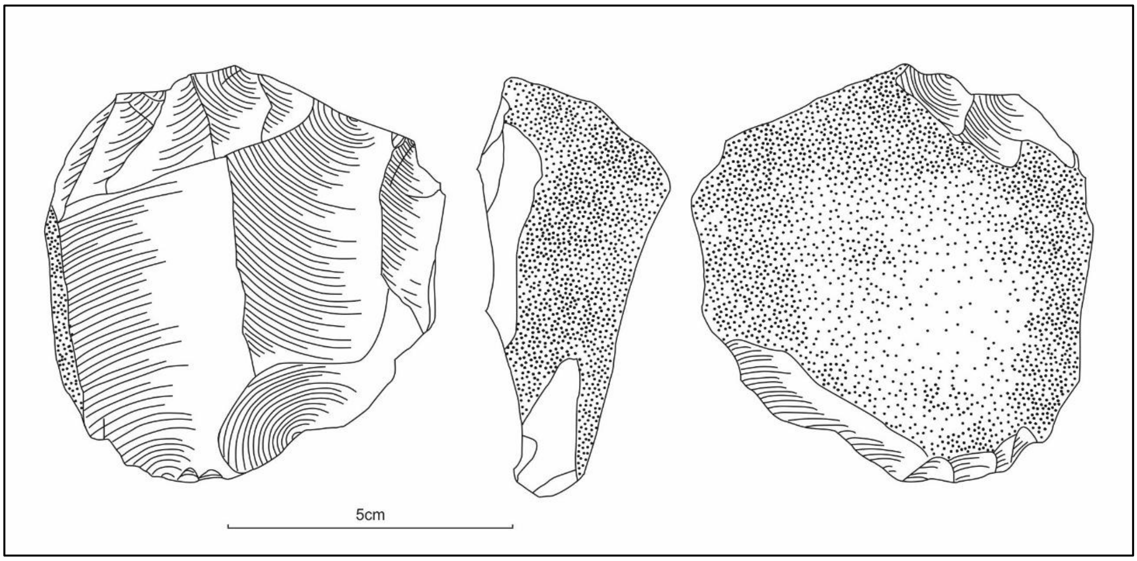


Figure 4.29 SPC from Kesselt-Op (Re-drawn after Van Baelen *et al.* 2008:8)

4.10.3 Dating

The material from Kesselt-Op has been placed within the wider stratigraphic framework of the area surrounding the quarry and assigned to the transition between MIS 9/ MIS 8, around 300ka (Van Baelen *et al.* 2007, 2008; Meijs *et al.* 2012). The palaeosurface within which the material has been recovered is sandwiched between a sandy, rapidly deposited, loess, correlated with the onset of the MIS 8 glaciation and a truncated luvisol (interglacial palaeosol), correlated with MIS 9 (Van Baelen and Ryssaert 2011:202). These correlations have been made using a combination of river terrace sequences, pollen sequences, ice isotope temperature and dust sequences and MI ice-volume sequences (Van Baelen *et al.* 2007:20).

4.10.4 Stratigraphy

The longstanding lithostratigraphical research in the area surrounding Kesselt (Meijs *et al.* 2012) has enabled the stratigraphic layers identified during the Kesselt-Op excavations to be correlated within the wider chronostratigraphic framework. Figure 4.30 is a schematic illustration of a section of the stratigraphy at Kesselt-Op. The ◆ marks the location of the archaeological material within the units.

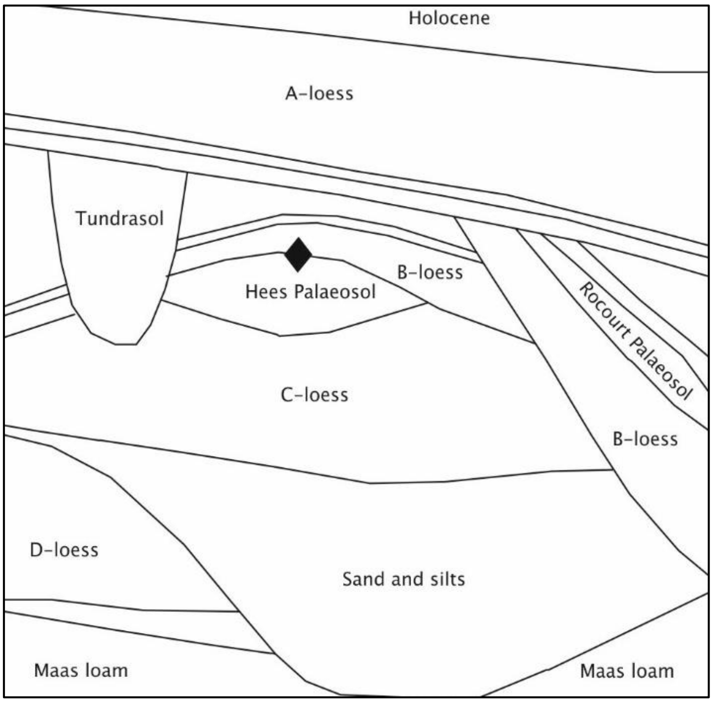


Figure 4.30 Stratigraphic section of Kesselt-Op (after Meijs *et al* 2012)

4.10.5 Summary

The material from Kesselt has been analysed in depth and is widely recognised as SPC technology. It is therefore essential this material is included in this investigation and compared with the reduction techniques present in the British assemblages. This assemblage is also one of the few in this investigation which has been excavated using modern techniques meaning the dating and exact provenance of the material is more reliable. All of the material from the Kesselt excavations will be examined.

4.11 Mesvin IV

4.11.1 Introduction

Mesvin IV is one of the key sites in the Haine basin near Mons, Belgium (see Figure 4.31). Excavations have produced a large assemblage containing 'under developed' Levallois material similar to that from Purfleet (Cahen and Michel 1986; Scott and Ashton 2011).

Location

50.421542 (lat.) 3.970266 (long.)

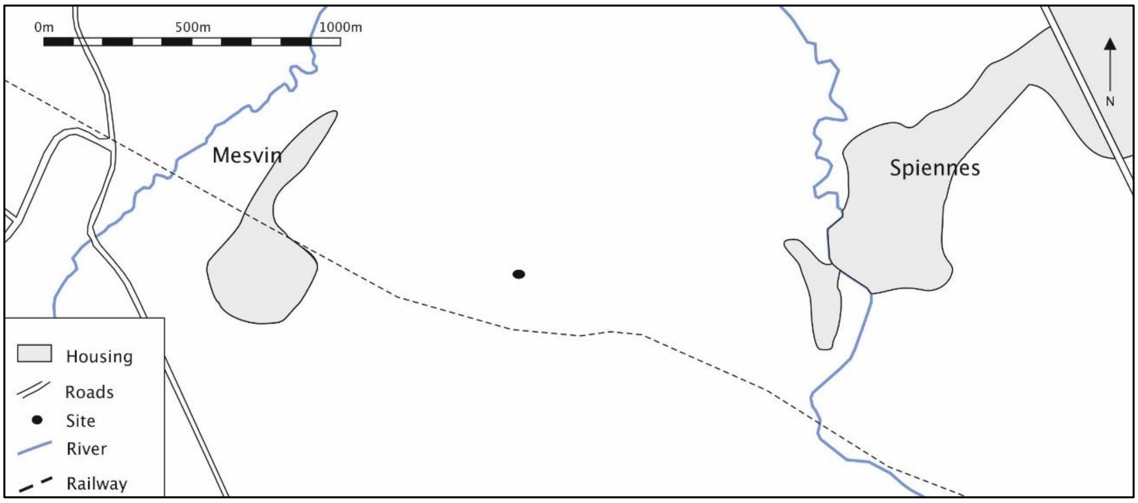


Figure 4.31 Mesvin IV location map

4.11.2 Excavation history

The site of Mesvin IV is located on the edge of the Mesvin terrace of the Haine Valley (Van Baelen and Ryssaert 2011). Four terraces have been recognised in the Haine Valley. Two of the oldest terraces are attributed to the Middle Pleistocene and have been correlated with MIS 12 and MIS 10. The Mesvin terrace is younger and correlates with MIS 8 (*ibid*). Various collections of lithic materials have been found in association with these terraces, for this research the Mesvin IV assemblage is the most relevant and well-known.

The Mesvin terrace was first discovered during the installation of pipelines in 1868. Geologists noticed lithics and faunal remains at about 15 – 18 meters above the present day river valley (Pirson *et al.* 2009:61). In 1966, during earthworks enlarging the Canal du Centre, east of Mons, the Palaeolithic deposits were once again recognised and excavated by P. Haesaerts (1984). Further excavations were carried out between 1977 and 1983 by the Royal Institute of Natural Sciences of Belgium in collaboration with the Society of Prehistoric Research Hainaut. These excavations produced the site known as Mesvin IV (Pirson *et al.* 2009:63). Within the Mesvin IV site there are two channels cut into the Tertiary deposits. Channel 2 cuts into Channel 1 and both channels contained lithics in fresh condition as well as faunal remains (Cahen and Michel 1986:91). Refitting material from the two channels suggests the material from Channel 2 is reworked material from Channel 1 (*ibid*).

The Mesvin IV assemblage is described as a Levallois assemblage but many of the cores have been referred to as ‘reduced’ or as ‘simple prepared cores’ (Cahen and Michel 1986; Van Asperen 2008; Scott and Ashton 2011; Van Baelen and Ryssaert 2011). Scott and Ashton describe the cores as ‘very similar’ to those from Purfleet (2011:94) whilst Cahen and Michel (1986:90) characterised the assemblage as one of abundant, but incompletely developed, Levallois flaking.

4.11.3 Dating

Mesvin IV has been dated to 250-300 ka BP by uranium-series dating of dental and postcranial horse remains found in association with the lithic material (Van Asperen 2008). This MIS 8 date corresponds with the dating of the Haine terraces in general with the oldest terraces Pa d’la l’iau and Petit-Spiennes correlating with MIS 12 and MIS 10 respectively and the lower terrace of Carière Hélin considered to be MIS 6 though AAR dating results suggest an older age for the lowest terrace (Van Baelen and Ryssaert 2011).

4.11.4 Stratigraphy

The two channels at Mesvin IV have slightly differing stratigraphy as illustrated in Figure 4.32. Most of the archaeological material comes from the intersection between the basal gravel units and the Thanetian (Landenian) sands (Van Baelen and Ryssaert 2011).

There is very little palaeoenvironmental data on the terraces of the Haine Basin (Pirson *et al.* 2009). However comparisons with the Somme suggest the four gravel terraces of the Haine correspond to fluvial deposits in a periglacial environment. This is generally supported by the paleontological information from the Mesvin IV excavations which suggests a predominately open and cold environment with faunal remains correlating with the earlier part of the Saalian complex (Van Neer 1986; Van Asperen 2008; Pirson *et al.* 2009).

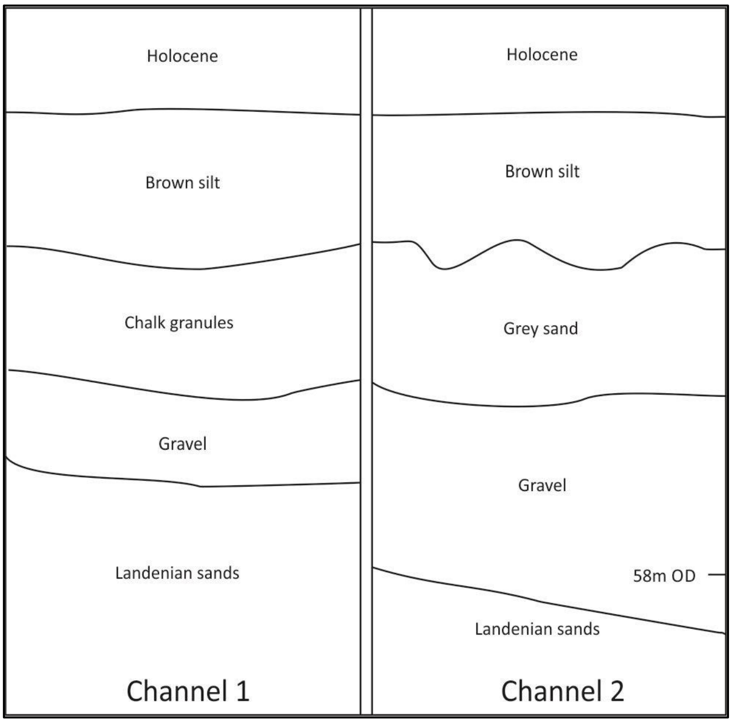


Figure 4.32 Schematic stratigraphic section of both channels form Mesvin IV (after Cahen and Michel 1986)

4.11.5 Summary

The Mesvin IV assemblage has been included in this investigation for two reasons. Firstly, the apparent similarities between the lithic material and that of Purfleet and secondly, the assemblage has a large, fully developed Levallois component. The analysis will help to determine if SPCs found alongside Levallois material and the same as those found alongside handaxes, thereby addressing one of the Research Questions proposed in Chapter 1.

4.12 Site background summary

This chapter has given the background information and excavation histories of each site studied within this research. This background information gives details of discovery, previous analysis and current site interpretations. Where applicable, details of SPCs and potential SPCs have been presented along with any illustrations of these cores. The results of the analysis will be presented in the following chapter.

Chapter 5: Data Presentation

5.1 Introduction

This chapter presents the analysis of the lithic data from the ten sites discussed in Chapter 4 following the methodology presented in Chapter 3. Each site will be discussed individually to establish the presence or absence of SPCs. The assemblage overviews will also highlight the technological components of each site thereby addressing Sub-research Question 1, establishing the frequency of SPCs in the archaeological record given the ambiguity of the technology in the past. This data will also provide the evidence needed to answer Sub-research Question 2 by enabling comparisons between SPCs and other core working techniques.

A thematic discussion of these results will follow in Chapter 6 following the analysis of the data at an inter-site level. This will allow for a better overall understanding of the SPC technique and will establish if this core working technique is the same across all ten sites.

5.2 Biddenham

5.2.1 Lithic assemblage

The material from Biddenham was not recovered through controlled excavation and the exact provenance is therefore unknown. The assemblage consisted of 750 items, 12 of which are natural, unworked, and therefore excluded from further analysis. Table 5.1 presents the material from Biddenham which has been analysed for this thesis. The cores are a small component of this assemblage (4.1%), with flakes (65.2%) and handaxes (23.8%) the more dominant. There are no Levallois cores however there are two Levallois products, one flake and one point. As there is no information about the point of origin of these two artefacts, it is unknown if they are contemporary with the SPCs though Table 5.2 does not identify any notable difference in condition.

The condition of the assemblage overall is mixed indicating the material has undergone a variety of post depositional processes. Biddenham is one of the sites in this investigation where very little is known about the original context of the material. The assemblage is most likely in secondary context as reflected in the slightly rolled condition of 82% of the material and its location on the terraces of the River Ouse. The entire assemblage is produced on good quality flint with chalky cortex.

Artefact	***Count***	***Percentage***
Flake	482	65.2%
Retouched flake	40	5.4%
Soft hammer flake	0	0%
Cores	29	4.1%
Handaxe	176	23.8%
Levallois flake/tools	2	0.3%
Refitted flakes	0	0%
Chopper	5	0.7%
Roughout	4	0.6%
Total	**738**	**100%**

Table 5.1 Biddenham assemblage

Artefact	***Abrasion***			***Staining***			***Patination***		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	75	401	6	81	67	334	246	83	153
Retouched flake	4	35	1	6	3	31	23	7	10
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	6	22	1	6	5	18	12	7	10
Handaxe	17	140	19	10	8	158	113	20	43
Levallois flake/tool	1	1	0	1	0	1	0	1	1
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	0	5	0	2	1	2	2	0	3
Roughout	1	3	0	1	0	3	1	1	2
Total	**104**	**607**	**27**	**107**	**84**	**547**	**397**	**119**	**222**

Table 5.2 Biddenham assemblage condition

5.2.2 Core assemblage

The strategies which result in migrating platform cores are the most common core reduction technique but there are a range of different techniques employed (see Table 5.3). The assemblage contains a high percentage of SPCs and five discoidal cores but no Levallois cores.

Core reduction technique	***Count***	***Percentage***
Migrating platform core	10	34.5%
Levallois core	0	0.0%
SPC	9	31.0%
Discoidal core	5	17.2%
Core with few removals	3	10.3%
Core fragment	2	6.9%
Total	**29**	**100%**

Table 5.3 Biddenham core working techniques

5.2.3 Core condition

Reflecting the assemblage as a whole, the condition of the cores is mixed (see Table 5.4) however the majority of all cores techniques are slightly rolled and lightly stained which could suggest they have undergone the same post depositional process. The degree of patina present is more equally spread amongst all core types. Overall the SPCs are in a similar condition to the migrating platform cores and all of the material will be treated as one assemblage albeit one in a secondary context.

The amount of cortex remaining of the cores indicates no cores were in the early stages of reduction as all have less than 50% cortex remaining (see Table 5.5). However only three of the cores, including one SPC, are heavily reduced with 0% cortex remaining.

Core reduction technique	Biddenham								
	Abrasion			***Staining***			***Patination***		
	Fresh	**Slightly**	**Heavy**	**None**	**Light**	**Heavy**	**None**	**Light**	**Heavy**
Migrating platform core	1	8	1	2	3	5	3	4	3
Levallois core	0	0	0	0	0	0	0	0	0
SPC	2	7	0	0	1	8	3	2	4
Discoidal core	0	5	0	2	1	2	3	0	2
Core with few removals	2	1	0	1	0	2	1	1	1
Core fragment	1	1	0	1	0	1	2	0	0
Total	**6**	**22**	**1**	**6**	**5**	**18**	**12**	**7**	**10**

Table 5.4 Biddenham core condition

Core reduction technique	***Cortex***				
	0%	**<25%**	**25 - 50%**	**50 - 75%**	**>75%**
Migrating platform core	0	7	3	0	0
Levallois core	0	0	0	0	0
SPC	1	3	5	0	0
Discoidal core	1	2	2	0	0
Core with few removals	0	0	3	0	0
Core fragment	1	0	1	0	0
Total	**3**	**12**	**14**	**0**	**0**

Table 5.5 Biddenham core cortex coverage

Overall, the SPCs are in a similar condition to the majority of the core assemblage from Biddenham.

5.2.4 Core technology

The statistics for the length, breadth and thickness of the cores from Biddenham are presented in Appendix D. Figure 5.1 compares the volumes of the cores from Biddenham. With the exception of the one discoidal outlier, there are no particular differences in the core volume between the different core working techniques. A Kruskal-Wallis H test was run to determine if the lack of differences in volume between the four core working techniques: SPCs (n=9), migrating platform (n=10), discoidal (n=5) and cores with few removals (n=3) was statistically significant. Distribution of the volume is similar for all groups, as assessed by visual inspection of a boxplot (see Appendix D). Median volume for SPCs was larger than both the migrating platform and discoidal medians but the differences were not statistically significant between the different techniques, $X^2(3)$ = 3.638, p = .303 meaning there is little difference between these groups.

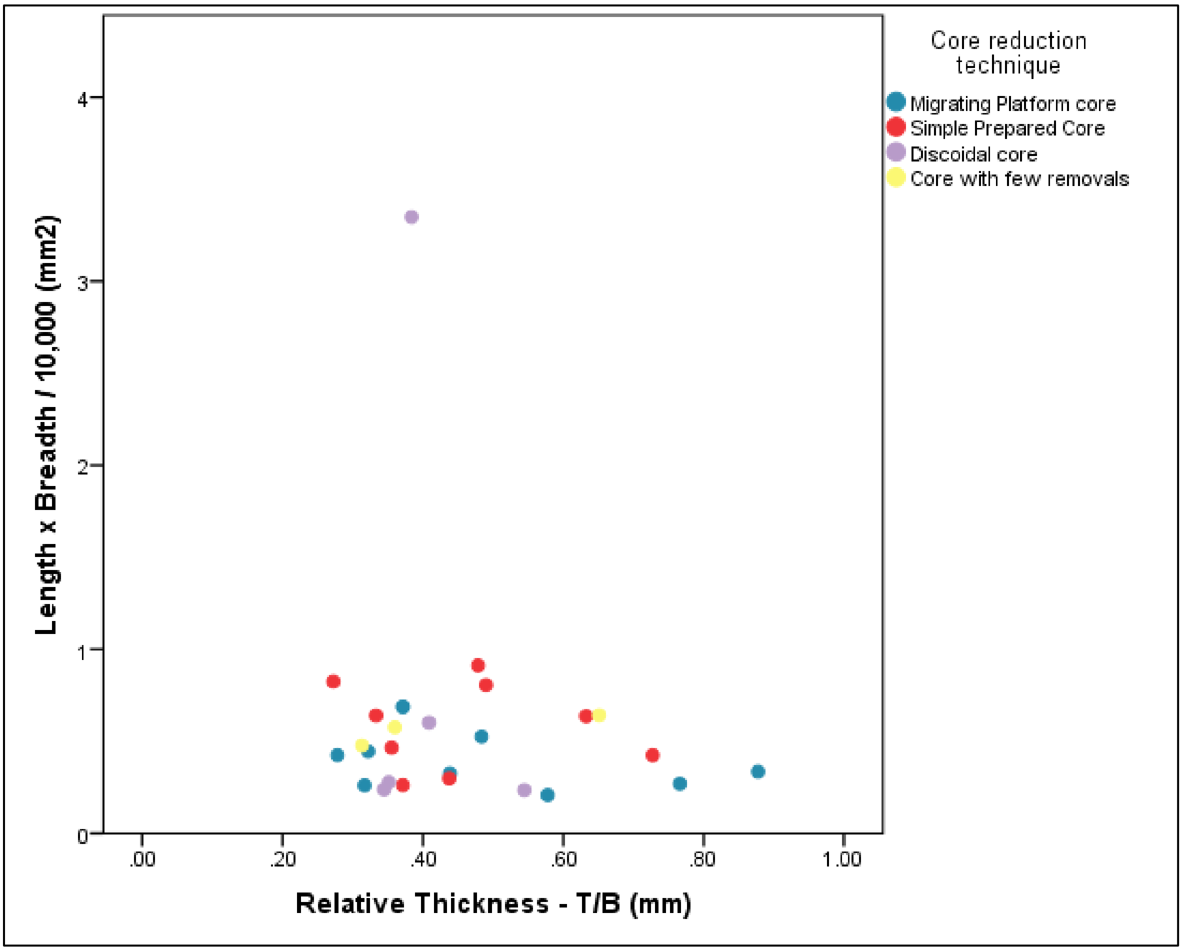


Figure 5.1 Biddenham core volume

The SPCs and discoidal cores have a very similar spread of visible flake scars. The SPCs have a mean of 10.75 scars, not including the outlier which has 20 scars; the discoidal cores have a mean number of 11.8 scars. The number of flake scare for the SPCs and the discoidal cores fall visually within the range of flake scars for the migrating platform cores and the midspreads for all three techniques are very similar.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (9), migrating platform (10), discoidal (5) and cores with few removals (3). Distributions of the number of flake scars were not similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.2 and Appendix D). The mean ranks of the number of flake scars were statistically significant between the different core techniques, $X^2(3) = 9.490$, $p = .023$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and the cores with few removals only, $U = <.0001$, $z = -2.514$, $p = .012$. This means there are no statistically significant differences between the number of flake scars on the SPC, migrating platform or discoidal cores but there is a statistically significant difference between the SPCs and the cores with few removals. This is unsurprising as by definition the cores with few removals will only have 3 flake scars or less.

In terms of core size and extent of reduction, the SPCs are not particularly different to the other core working techniques at Biddenham with the exception of the cores with few removals.

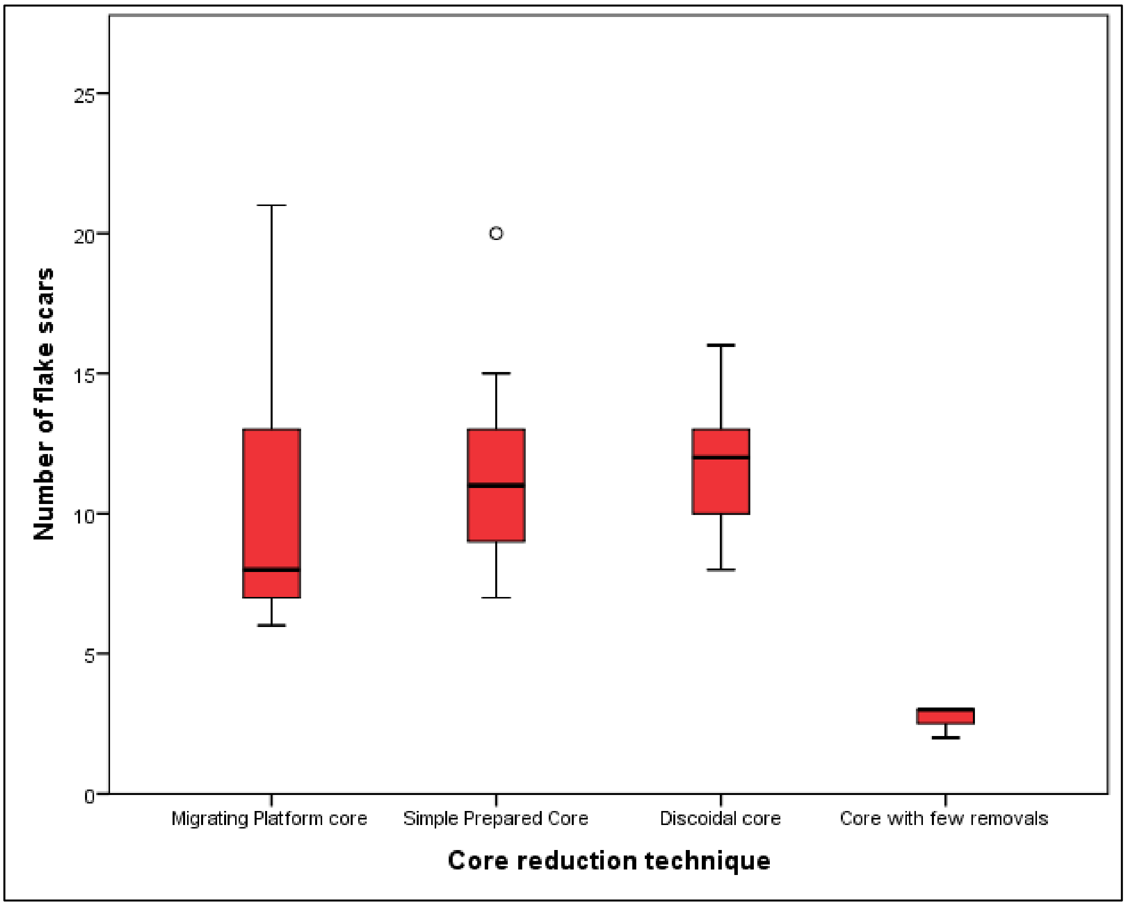


Figure 5.2 Boxplot comparing the number of flake scars on each core from Biddenham

5.2.5 SPCs

Nine SPCs have been identified in the Biddenham assemblage. Table 5.6 presents the technological attributes of the SPCs from Biddenham. All of the SPCs have only a single removal for a striking platform with no evidence for faceting and the most common method of preparation and exploitation is centripetal and linear. The data for each individual SPC is presented in Appendix C.

Biddenham SPC n = 9		
Preparation		
Centripetal	5	55.6%
Unipolar	2	22.2%
Bipolar	2	22.2%
Convergent	0	0%
Exploitation		
Linear	7	77.8%
Recurrent	1	11.1%
Unexploited	1	11.1%
Faceting		
Yes	0	0%
No	9	100%

Table 5.6 Technological attributes of the SPCs from Biddenham

Table 5.7 demonstrates the SPCs from Biddenham have undergone a varying degree of striking platform surface preparation with no single method appearing to be favoured.

SPC Group	*Count*
A	2
B	3
C	4
Total	**9**

Table 5.7 SPC reduction types at Biddenham

5.2.6 Products

Table 5.8 presents the summary of the flake area and SPC preferential scar area statistics. The mean area of the preferential flake scars is over 1000mm^2 smaller than the area of the flakes and flake tools suggesting the SPCs were not producing flakes which were larger than the flakes produced from the other methods of core reduction. Figure 5.3 compares the area of all SPC preferential flake scars with the flake/ flake tool areas. This graph shows there are a number of outliers (◦) and extreme outliers (⋆) within the flake/ flake tool data but visually all of the SPC data falls within the midspreads and lower quartile of the flake data. Meaning the products of the SPCs were not notably different in size to the products of the other core reduction techniques.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=9) and the flakes/ flake tool area (n=431) were statistically significant. Distributions for the area of both groups were similar as assessed by visual inspection (see Figure 5.3). Results determined that the median area for SPC products (3141.8) was statistically significantly different to that for flakes/flake tools (3861.9), U = 1196, z = -1.969, p = .049. Meaning the differences in flake size is ‘real’ and not a consequence of sampling variation.

	Flake area mm^2 (n=431)	SPC pref. scar area mm^2 (n=9)
Mean	4293	2882
Median	3861	3141
Std. Deviation	2342	1082
Range	17467	3107

Table 5.8 Summary statistics for the flake and SPC flake scar areas for Biddenham

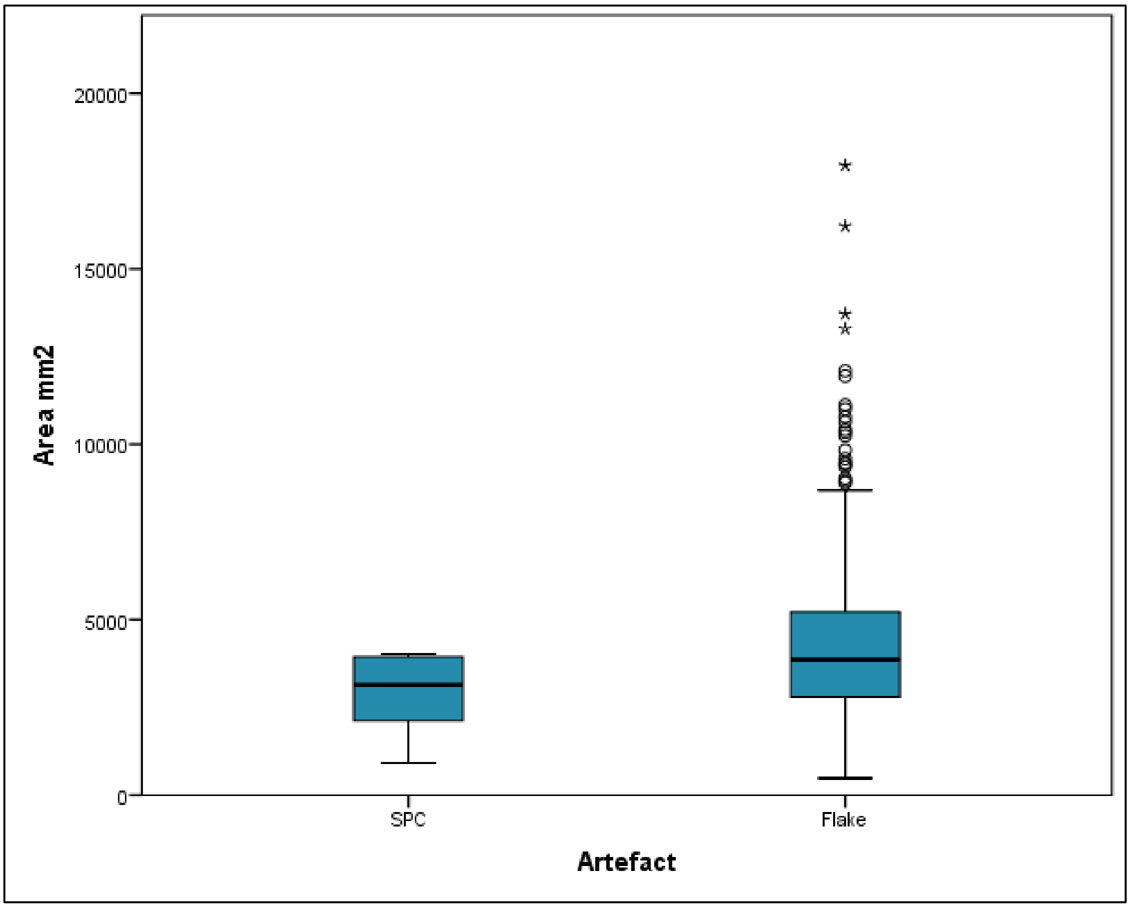


Figure 5.3 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Biddenham

5.2.7 Summary

Biddenham is predominantly a handaxe and flake assemblage with a total of 29 cores (4.1%), nine of which are SPCs. The SPCs are not the most common core working technique as there are 10 migrating platform cores but as this category is an umbrella term for a number of different strategies, SPCs are the most common single method. The assemblage as a whole, including the SPCs, is in a mixed condition reflective of its secondary context.

The SPCs are not noticeably different to the other methods of core reduction in terms of the extent to which they have been reduced both in core volume and the amount of cortex remaining on the cores. In terms of exploitation, there is not a noticeable difference between the SPCs and the other core working techniques.

Of the nine SPCs, the majority have been centripetally prepared with a single preferential removal. The main difference within the SPCs is the extent to which the striking platform surface has been prepared. This is demonstrated in the range of SPC types.

It has not been possible to identify the products of the SPCs but comparisons between the flakes/ flake tools and the preferential removal area of the SPCs demonstrates little difference in size.

5.3 Caddington

5.3.1 Lithic assemblage

The Caddington assemblage is widely distributed among many museums and institutions. For this investigation three different museums, the British Museum, the Ashmolean and the Pitt Rivers Museum, and nine different collections were analysed producing a total of 373 items. 45 items were unworked, natural material and three hammerstones, these items have been excluded from further analysis. The material from Caddington which has been analysed for this thesis is presented in Table 5.9. There were no SPCs identified in the Caddington material but there were three cores which have elements of SPC technology. These will be presented in section 5.3.5 and discussed in depth in Chapter 6.

Table 5.10 presents the condition of the material from Caddington, four broken flakes and two groups of refitting flakes were not included in this analysis. The majority of the assemblage is fresh or slightly rolled and heavily stained. The degree of patination is varied throughout the assemblage. The mixture of fresh and slightly worked material suggests the majority of the material is in primary context but some has probably been reworked from above. The fresh material is that from the ‘Palaeolithic floor’ and contains many refits whilst the rolled material is derived and came from the ‘contorted drift’. One core and three flakes are produced on a local Hertfordshire puddingstone whilst the rest of the assemblage is produced on flint.

Artefact	*Count*	*Percentage*
Flake	132	40.6%
Retouched flake	12	3.7%
Soft hammer flake	0	0.0%
Cores	40	12.3%
Handaxe	89	27.4%
Levallois flake/tools	0	0.0%
Refitted flakes	47	14.5%
Chopper	3	0.9%
Roughout	2	0.6%
Total	**325**	**100%**

Table 5.9 Caddington assemblage

Artefact	*Abrasion*			*Staining*			*Patination*		
	Fresh	*Slightly*	*Heavy*	*None*	*Light*	*Heavy*	*None*	*Light*	*Heavy*
Flake	68	54	6	8	31	89	34	49	45
Retouched flake	5	5	2	1	2	4	4	2	6
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	25	12	3	2	5	33	6	14	20
Handaxe	49	36	4	12	26	51	31	33	25
Levallois flake/tools	0	0	0	0	0	0	0	0	0
Refitted flakes	44	1	0	4	28	13	8	25	12
Chopper	2	0	1	0	2	1	1	2	0
Roughout	2	0	0	0	0	2	1	0	1
Total	**195**	**108**	**16**	**27**	**94**	**193**	**85**	**125**	**109**

Table 5.10 Caddington assemblage condition

5.3.2 Core assemblage

The majority of the cores analysed from Caddington have been reduced by the migrating platform technique (see Table 5.11). There were no SPCS identified but three of the migrating platform cores have attributes similar to SPCs.

Core reduction technique	*Count*	*Percentage*
Migrating platform core	26	65.0%
Levallois core	0	0.0%
SPC	0	0.0%
Discoidal core	8	20.0%
Core with few removals	2	5.0%
Refitting flakes and core	4	10.0%
Total	**40**	**100%**

Table 5.11 Caddington core working techniques

5.3.3 Core condition

The cores from Caddington demonstrate a range of conditions. The majority of the cores are fresh with heavy staining and varying degrees of patination (See Table 5.12).

Core reduction technique	Caddington								
	Abrasion			*Staining*			*Patination*		
	Fresh	Slightly	Heavy	None	Light	Heavy	None	Light	Heavy
Migrating platform core	14	10	2	1	4	21	4	9	13
Levallois core	0	0	0	0	0	0	0	0	0
SPC	0	0	0	0	0	0	0	0	0
Discoidal core	6	2	0	0	1	7	1	3	4
Core with few removals	1	0	1	0	0	2	1	0	1
Refitting flakes and core	4	0	0	1	0	3	0	2	2
Total	**25**	**12**	**3**	**2**	**5**	**33**	**6**	**14**	**20**

Table 5.12 Caddington core condition

Table 5.13 demonstrates 38 of the 42 cores from Caddington have less than 50% cortex remaining and therefore not in the early stages of reduction.

Core reduction technique	*Cortex*				
	0%	<25%	25 - 50%	50 - 75%	>75%
Migrating platform core	1	16	8	1	0
Levallois core	0	0	0	0	0
SPC	0	0	0	0	0
Discoidal core	1	7	0	0	0
Core with few removals	0	0	1	1	0
Refitting flakes and core	0	1	3	0	0
Total	**2**	**24**	**12**	**2**	**0**

Table 5.13 Caddington core cortex coverage

5.3.4 Core technology

A summary of the statistics for the length, breadth and thickness of the cores is presented in Appendix D. The relative thickness of the cores has been plotted against the surface area or length x breadth in Figure 5.4 to compare the volumes of the different core working techniques. Based on the mean dimensions, the cores with few removals are the largest. The volumes of discoidal and migrating platform cores are similar. A Kruskal-Wallis H test was run to determine if the lack of differences in volume between the three core working techniques: migrating platform (n=26), discoidal (n=8) and cores with few removals (n=2) was statistically significant. Distribution of the volume is not similar for all groups, as assessed by visual inspection of boxplots (see Appendix D). The mean volume for cores with few removals (444027.91) was larger than both the migrating platform (241795.41) and discoidal (184963.02) means but the differences were not statistically significant between the different techniques, $X^2(2) = 4.353$, $p = .113$ meaning this difference in volume could be a consequence of sampling.

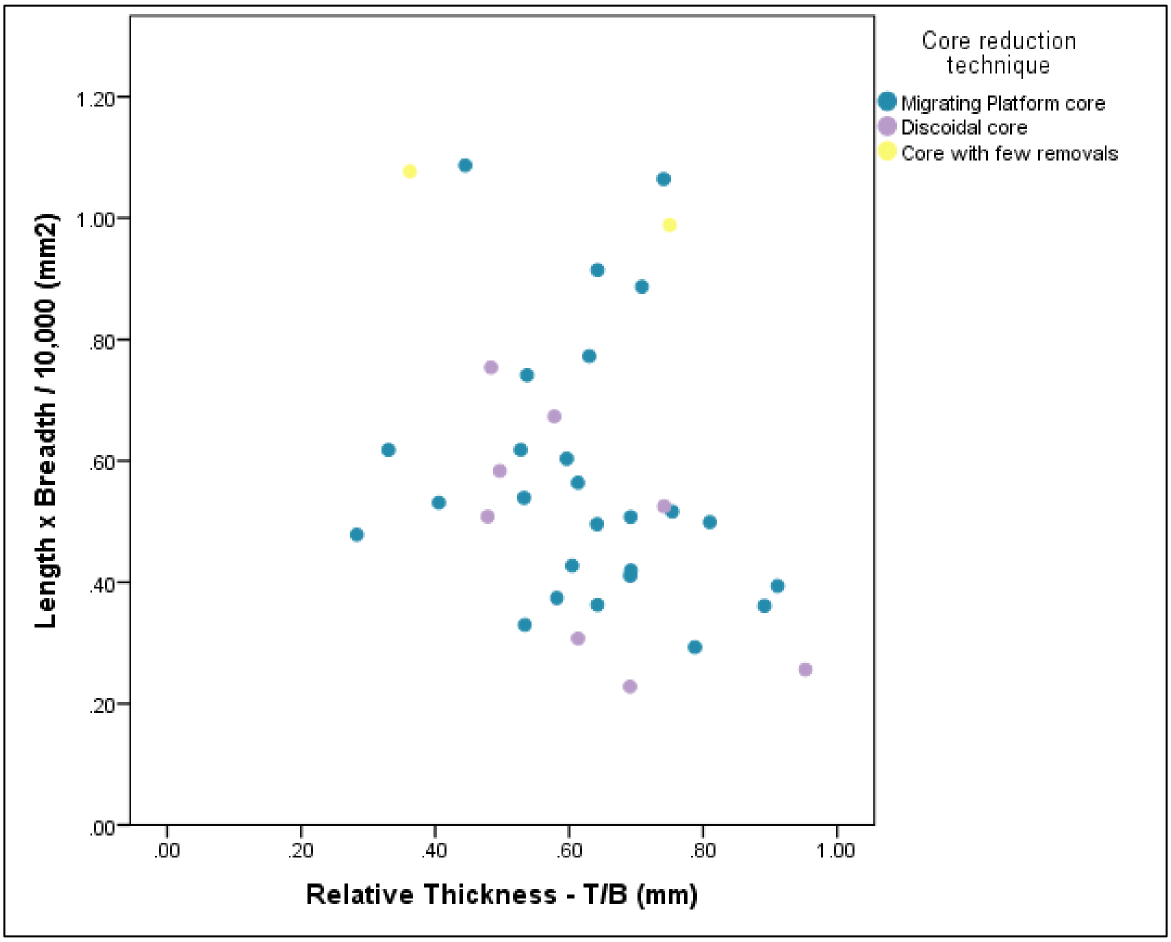


Figure 5.4 Caddington core volume

The discoidal cores from Caddington display more flake scars compared to the migrating platform cores. A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; migrating platform (26), discoidal (8) and cores with few removals (2). Distributions of the number of flake scars were not similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.5). The mean ranks of the number of flake scars were statistically significant between the different core techniques, $X^2(2) = 16.061$, $p < = .0005$. Subsequent post hoc analysis using the Mann-Whitney U test between the different core working techniques individually revealed a statistically significant result between each core group; migrating platform and discoidal, $U = 20$, $z = -3.43$, $p = .001$, migrating platform and cores with few removals, $U = .000$, $z = -2.338$, $p = .019$, discoidal and cores with few removals, $U = .000$, $z = -2.095$, $p = .036$ meaning these differences are genuine between the three groups.

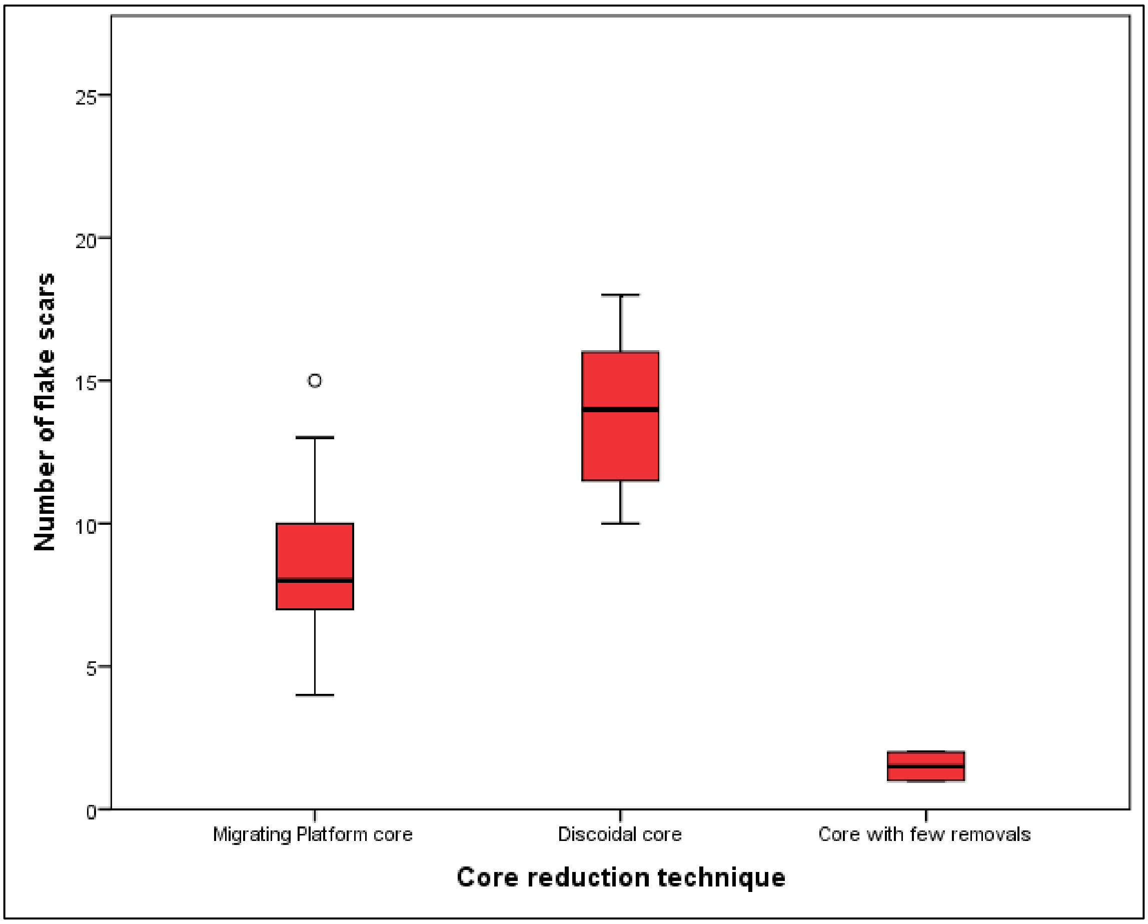


Figure 5.5 Boxplot comparing the number of flake scars on each core from Caddington

5.3.5 SPCs

There are no SPCs in the material analysed from Caddington. There are however, three cores which have elements reminiscent of the SPC technology. These items will be discussed in detail in the following chapter.

5.3.6 Products

As there are no SPCs in the Caddington assemblage there are no preferential removals to compare with the flake dimensions.

5.3.7 Summary

The Caddington material analysed contains 40 cores, none of which are considered to be SPCs. The condition of the material is mixed with the largest groups being the fresh, heavily stained and lightly patinated categories. The fresh material is likely to be from the Palaeolithic floor whilst the rolled material is most likely derived from the contorted drift. These differences in condition clearly imply there are two assemblages within the Caddington material but as the focus of this thesis is on SPC technology, and there were no SPCs identified within the Caddington material, the results have been presented for the entire site.

5.4 Cuxton

5.4.1 Lithic assemblage

Two collections, both stored at the British Museum, were analysed from Cuxton. Of the 1051 items studied, three were non-diagnostic chucks of flint and two were non-worked nodules and have therefore been excluded from further analysis. There are 62 cores in the Cuxton assemblage, four of which are SPCS. A further breakdown of the Cuxton material can be seen Table 5.14. The Cuxton assemblage is relatively homogenous with over 80% of the material in a fresh condition and therefore most likely *in* situ. Table 5.15 displays the variation in staining and patination within the assemblage. The entire assemblage has been produced on good quality flint.

Artefact	***Count***	***Percentage***
Flake	721	68.9%
Retouched flake	23	2.2%
Soft hammer flake	3	0.3%
Cores	62	5.9%
Handaxe	235	22.5%
Levallois flake/tools	0	0%
Refitted flakes	0	0%
Chopper	1	0.1%
Roughout	1	0.1%
Total	**1046**	**100%**

Table 5.14 Cuxton assemblage

Artefact	***Abrasion***			***Staining***			***Patination***		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	592	127	2	222	264	235	425	234	62
Retouched flake	15	8	0	2	6	15	11	10	2
Soft hammer flake	3	0	0	1	2	0	2	0	1
Cores	50	12	0	8	40	14	49	9	4
Handaxe	190	45	0	31	87	117	177	41	17
Levallois flake/tools	0	0	0	0	0	0	0	0	0
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	1	0	0	0	0	1	0	1	0
Roughout	1	0	0	0	0	1	1	0	0
Total	**852**	**192**	**2**	**264**	**399**	**383**	**665**	**295**	**86**

Table 5.15 Cuxton assemblage condition

5.4.2 Core assemblage

There are a range of core working techniques within the Cuxton assemblage as seen Table 5.16. The majority of cores (71%) have been reduced using techniques which fall under the umbrella term migrating platform and four of the cores (6.5%) are SPCs.

Core reduction technique	***Count***	***Percentage***
Migrating platform core	43	69%
Levallois core	0	0%
SPC	4	6.5%
Discoidal core	3	4.8%
Core with few removals	12	19.4%
Total	**62**	**100%**

Table 5.16 Cuxton core working techniques

5.4.3 Core condition

A breakdown of the condition of the cores from Cuxton is presented in Table 5.17. Reflection the condition of the assemblage as a whole, 50 of the cores are in a fresh condition including three of the four SPCs. The SPC which is slightly rolled is also lightly patinated whereas the other three SPCs have no patination. These combined differences in condition suggest this SPC has undergone slightly different post-depositional processes to the remaining SPCs and the majority of the assemblage. As the differences are only slight and there are other cores which also demonstrate the same difference in condition, it is not felt these cores represent an entirely separate assemblage within the Cuxton material.

Core reduction technique	**Cuxton**								
	Abrasion			***Staining***			***Patination***		
	Fresh	**Slightly**	**Heavy**	**None**	**Light**	**Heavy**	**None**	**Light**	**Heavy**
Migrating platform core	35	8	0	5	27	11	34	6	3
Levallois core	0	0	0	0	0	0	0	0	0
SPC	3	1	0	0	4	0	3	1	0
Discoidal core	3	0	0	0	2	1	2	1	0
Core with few removals	9	3	0	3	7	2	10	1	1
Total	**50**	**12**	**0**	**8**	**40**	**14**	**49**	**9**	**4**

Table 5.17 Cuxton core condition

The range of residual cortex coverage on the Cuxton core assemblage is presented in Table 5.18. The SPCs have between 25% and 75% residual cortex which reflects the core assemblage as a whole suggesting they were neither exhausted nor in the early stages of reduction.

Core reduction technique	Cortex				
	0%	**<25%**	**25 - 50%**	**50 - 75%**	**>75%**
Migrating platform core	0	12	18	13	0
Levallois core	0	0	0	0	0
SPC	0	0	3	1	0
Discoidal core	1	2	0	0	0
Core with few removals	0	3	1	8	0
Total	**1**	**17**	**22**	**22**	**0**

Table 5.18 Cuxton core cortex coverage

5.4.4 Core technology

A summary of the statistics for the length, breadth and thickness of the cores from Cuxton is presented in Appendix D and the relationship between the relative core thickness and the length x breadth measurements can be seen in Figure 5.6. The mean dimensions of the discoidal cores make them the smallest or most heavily reduced of the different core working techniques. The SPCs and the migrating platform cores have similar mean dimensions with the mean SPC breadth approximately 10mm larger.

A Kruskal-Wallis H test was run to determine if there were differences in volume between the four core working techniques: SPCs (n=4), migrating platform (n=43), discoidal (n=3) and cores with few removals (n=12). Distribution of the volume is similar for all groups, as assessed by visual inspection (see Appendix D). Median volume for SPCs was larger than all other core reduction techniques but the differences were not statistically significant, $X^2(3) = 5.033$, $p = .169$. Meaning whilst the SPCs may seem larger, this could be a result of sampling variation and in fact there could be no difference between the volumes.

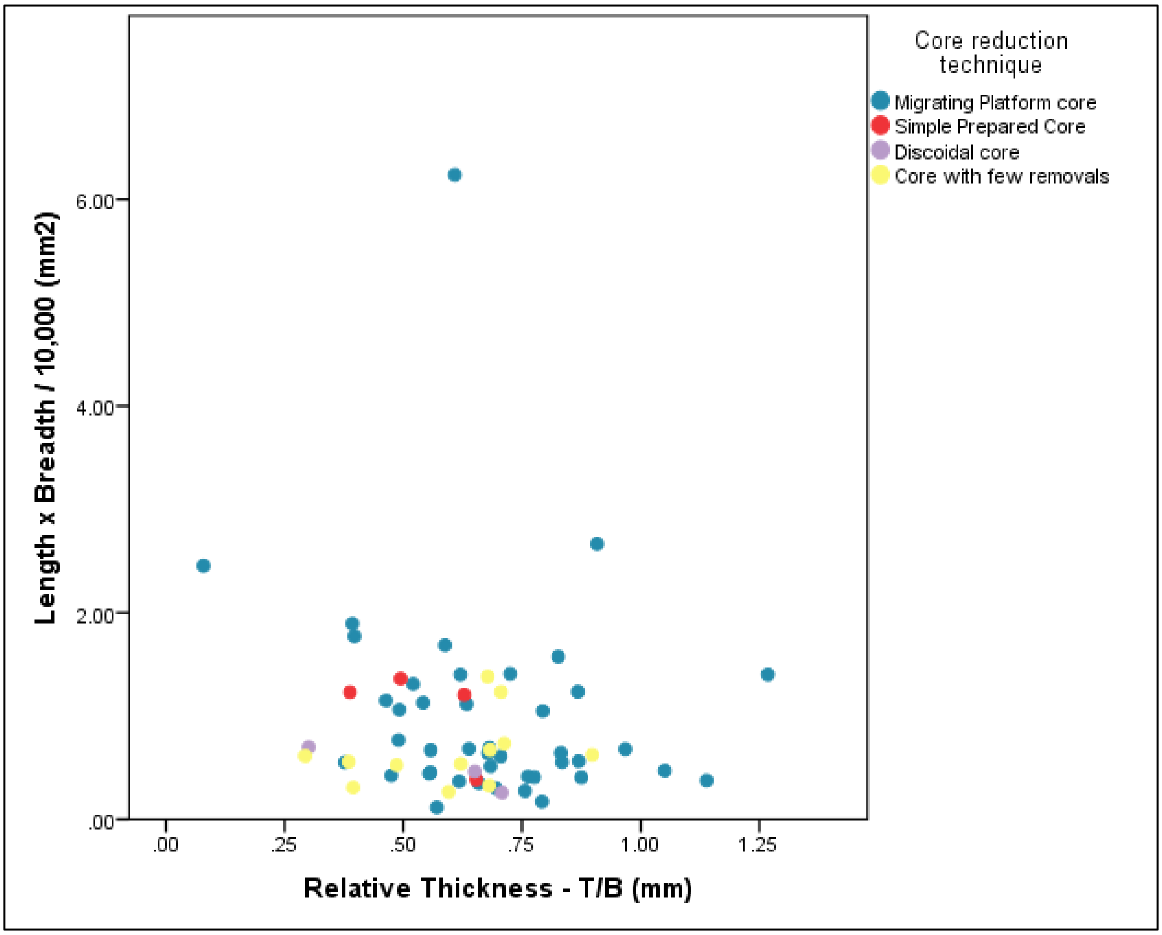


Figure 5.6 Cuxton core volume

The number of visible flake scars on the different core techniques can be seen in Figure 5.7 below. The discoidal cores have the highest mean and range of flake scars whilst all four of the SPCs fall within the range of the migrating platform cores. With the exception of the cores with few removals, the migrating platform cores have the lowest mean number of flake scars with one outlier (◦). This would imply there is no difference between the number of flake scars on SPCs and migrating platform cores.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (4), migrating platform (43), discoidal (3) and cores with few removals (12). Distributions of the number of flake scars were similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.7). The median number of flake scars were statistically significant between the different core techniques, $X^2(3) = 31.749$, $p <= .0005$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and the cores with few removals only, $U = .000$, $z = -3.065$, $p = .002$. This result suggests the core with few removals have fewer flake scars than the SPCs which is unsurprising as they have fewer flake scars by definition but the SPCs and the migrating platforms show a similar number of flake scars.

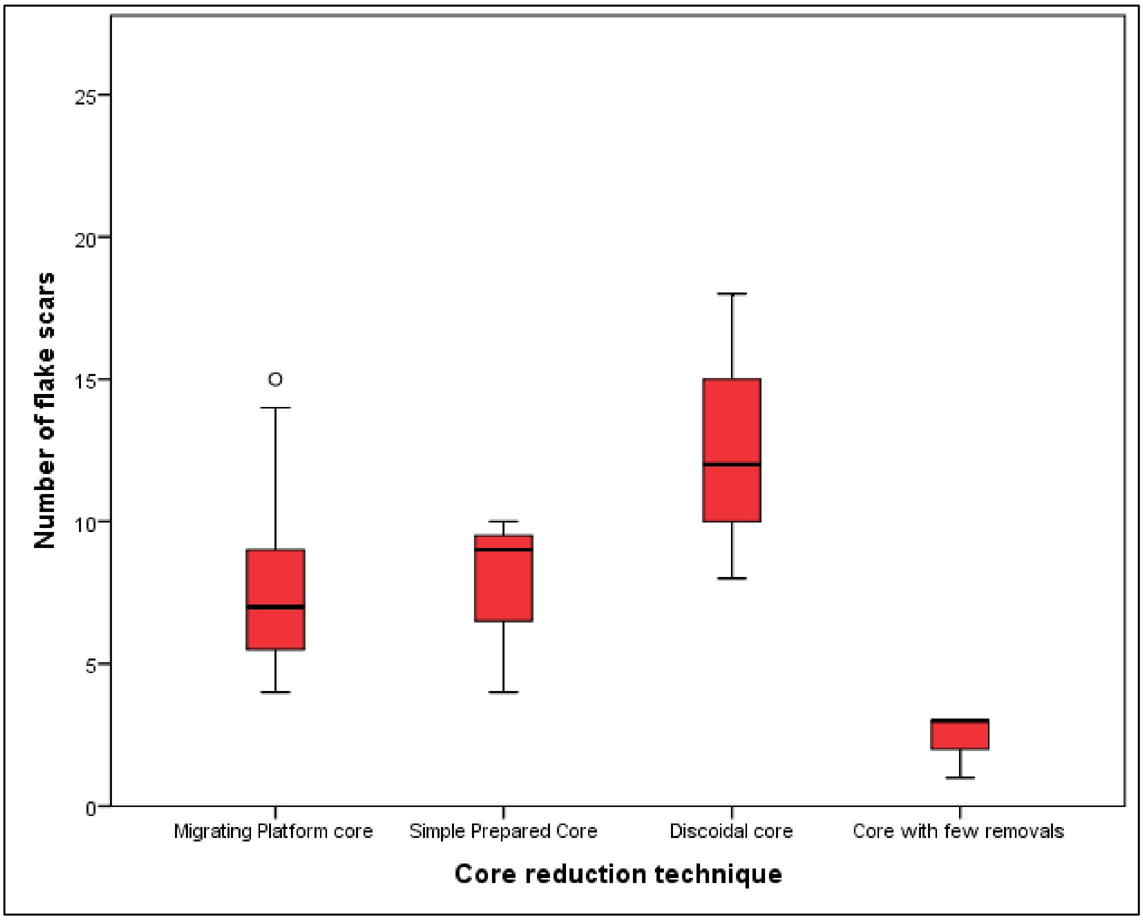


Figure 5.7 Boxplot comparing the number of flake scars on each core from Cuxton

5.4.5 SPCs

Four SPCs have been identified in the Cuxton assemblage. One core is from Layer 3 in Trench 1 of the 1984 investigation. The remaining three were from the 1962-63 investigations. One was from Trench 5, one from Trench 6 and the last from Trench 7. This variation in location and excavations suggests the SPCs are a real component of the Cuxton assemblage.

The technological attributes of the SPCs from Cuxton are similar with a small degree of variation in the method of exploitation (Table 5.19). All four cores have centripetal preparation with no faceting. Two of the cores have been exploited in a linear method whilst the other two cores are recurrent.

Cuxton SPC n = 4		
Preparation		
Centripetal	4	100%
Unipolar	0	0%
Bipolar	0	0%
Convergent	0	0%
Exploitation		
Linear	2	50%
Recurrent	2	50%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	4	100%

Table 5.19 Technological attributes of the SPCs from Cuxton

None of the four SPCs from Cuxton have both lateral and distal edges of the striking platform surface prepared. One core falls into SPC Group A with very minimal preparation of the flaking surface and no working on the striking platform surface expect for the striking platform itself. In Table 5.20 it can be seen that three of the four SPCs were Group B, partially worked on the striking platform surface.

SPC Group	*Count*
A	1
B	3
C	0
Total	**4**

Table 5.20 SPC reduction types at Cuxton

5.4.6 Products

Table 5.21 shows the mean area of the preferential removals is larger than the mean flake size thereby suggesting the SPCs were producing larger flakes when compared with the other core techniques at Cuxton. There are six preferential removal scars included in this analysis as two of the SPC were recurrent.

Figure 5.8 compares the area of all SPC preferential flake scars with the flake/ flake tool areas. This graph shows there are a number of outliers (∘) and extreme outliers (⋆) within the flake/ flake tool data but all of the SPC data falls within the midspreads and upper quartile of the flake data. This suggests that the SPC technique may have been used at Cuxton to produce slightly larger flakes even though there would have been access to many other large flakes as demonstrated by the outliers and extreme outliers in Figure 5.8.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=6) and the flakes/ flake tool area (n=613) were statistically significant. Distributions for the area of both groups were similar as assessed by visual inspection (see Figure 5.8). Results determined the median area for SPC products (4749.65) was statistically significantly different to that for flakes/flake tools (2667), U = 1358, z = -1.103, p = .270 confirming the SPCs were producing flakes which were larger than the average flake in the Cuxton assemblage.

	Flake area mm^2 (n=613)	***SPC pref. scar area mm^2 (n=6)***
Mean	3412	*3933*
Median	2667	4749
Std. Deviation	2677	1645
Range	18482	3630

Table 5.21 Summary statistics for the flake and SPC flake scar areas for Cuxton

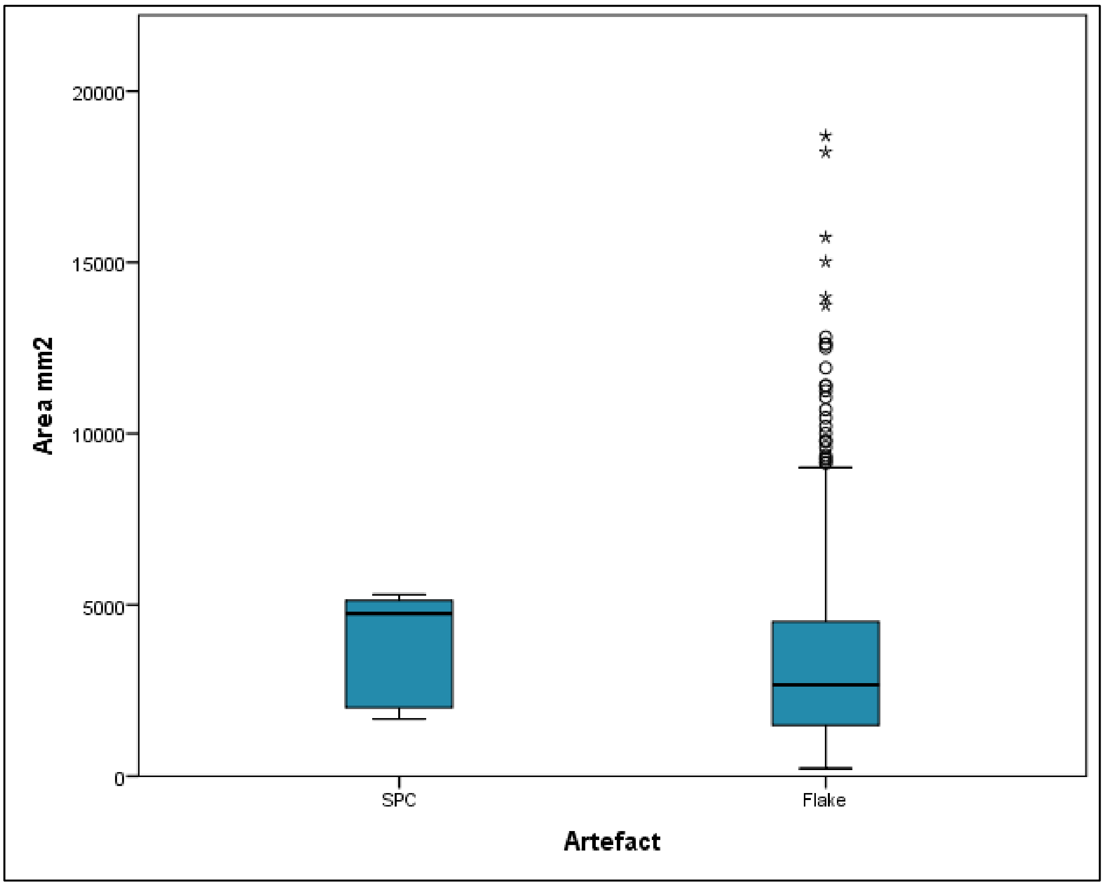


Figure 5.8 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Cuxton

5.4.7 Summary

The Cuxton assemblage mostly consists of flakes and handaxes with 62 cores making up 5.9% of the total assemblage. The material is mostly in a fresh, unrolled condition with a mixture of staining and little to no patination. The condition of the cores reflects that of the assemblage as a whole.

Both the migrating platform cores and the SPCs show a similar number of flake scars, but both are less extensively worked compared to the discoidal cores. The SPCs are a small component of the core assemblage and demonstrate a small amount of variation in terms of preparation and exploitation.

No SPC products were identified but the mean area of the preferential removals is larger than the mean area of the flakes and flake tools suggesting the SPCs would have produced larger flakes.

5.5 Dunbridge

5.5.1 Lithic assemblage

The Dunbridge material was stored in two locations, the British Museum and at Wessex Archaeology, and was spread over nine different collections. The vast majority of the material came from the Wessex collection as a result of the watching brief described in Chapter 4. The assemblage as a whole consisted of 253 objects, one of which was an unworked nodule and another which was considered to be natural. These two objects have been excluded from further analysis. The material from Dunbridge included in this analysis is presented in Table 5.22. This highlights the large quantity (103) of handaxes from Dunbridge along with 21 cores. Table 5.23 presents the condition of the material from Dunbridge.

The condition of the Dunbridge assemblage is mixed reflecting the fluvial deposition of the gravels from within which the material was found. Whilst the condition is mixed, the staining and patination data is relatively similar. It is these three proxies as well as the date of discovery which pushed Harding and colleagues (2012) to separate the Levallois material from the body of the main assemblage temporally and the data collected in this investigation supports their conclusion. The Levallois flake is only included in the discussion about condition and the Levallois cores are included in the core analysis in order to compare the technology with the SPC technology however they are considered to be separate assemblages. All of the Dunbridge material has been made of flint.

Artefact	***Count***	***Percentage***
Flake	117	46.6%
Retouched flake	6	2.4%
Soft hammer flake	0	0.0%
Cores	21	8.4%
Handaxe	103	41.0%
Levallois flake/tools	1	0.4%
Refitted flakes	0	0.0%
Chopper	2	0.8%
Roughout	1	0.4%
Total	**251**	**100%**

Table 5.22 Dunbridge assemblage

Artefact	***Abrasion***			***Staining***			***Patination***		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	5	42	70	8	6	103	93	6	18
Retouched flake	2	3	1	2	0	4	2	2	2
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	7	8	6	1	3	17	13	6	2
Handaxe	5	32	66	0	2	101	100	2	1
Levallois flake/tools	1	0	0	1	0	0	0	1	0
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	0	0	2	0	0	2	2	0	0
Roughout	0	0	1	0	0	1	1	0	0
Total	**20**	**85**	**146**	**12**	**11**	**228**	**211**	**17**	**23**

Table 5.23 Dunbridge assemblage condition

5.5.2 Core assemblage

The most common core working technique at Dunbridge is the migrating platform method with 14 cores (see Table 5.24). The SPCs identified were those already acknowledged by Harding and colleagues (2012) plus one additional core. The only Levallois cores identified were also those mentioned by Harding and colleagues (*ibid*).

Core reduction technique	***Count***	***Percentage***
Migrating platform core	14	66.7%
Levallois core	3	14.3%
SPC	4	19.0%
Discoidal core	0	0.0%
Total	**21**	**100%**

Table 5.24 Dunbridge core working techniques

5.5.3 Core condition

The SPCs from Dunbridge are in a similar condition to the migrating platform cores whilst the Levallois cores demonstrate having undergone different post-depositional processes. The Levallois cores are all in a fresh condition whilst only one SPC and three migrating platform cores are considered to be fresh (see Table 5.25). 13 of the 14 migrating cores are heavily stained, as are all of the SPCs, whereas the Levallois cores are all slightly stained. There is also a difference between the reduction techniques and the degree of patination presence. The SPCs have no patina whilst two of the Levallois cores are lightly patinated. The migrating platform cores show a range of patination with over 50% with no patination but two cores are heavily patinated. With all three of the proxies for condition considered together with the location of the finds, the Levallois material is not contemporary with SPCs.

Core reduction technique	Dunbridge								
	Abrasion			*Staining*			*Patination*		
	Fresh	Slightly	Heavy	None	Light	Heavy	None	Light	Heavy
Migrating platform core	3	6	5	1	0	13	8	4	2
Levallois core	3	0	0	0	3	0	1	2	0
SPC	1	2	1	0	0	4	4	0	0
Discoidal core	0	0	0	0	0	0	0	0	0
Total	**7**	**8**	**6**	**1**	**3**	**17**	**13**	**6**	**2**

Table 5.25 Dunbridge core condition

The amount of residual cortex, displayed in Table 5.26 demonstrates the SPCs were more heavily reduced when compared with the Levallois cores. However, the migrating platform cores show a range of the extent of reduction. The discoidal cores show a similar degree of reduction to the SPCs. No cores from Dunbridge are therefore in the early stages of reduction.

Core reduction technique	*Cortex*				
	0%	<25%	25 - 50%	50 - 75%	>75%
Migrating platform core	1	4	7	2	0
Levallois core	0	0	3	0	0
SPC	1	1	2	0	0
Discoidal core	0	0	0	0	0
Total	**2**	**5**	**12**	**2**	**0**

Table 5.26 Dunbridge core cortex coverage

5.5.4 Core technology

The statistics for the length, breadth and thickness of the cores from Dunbridge are presented in Appendix D. The mean core length for the SPCs is much smaller than the migrating platform and

Levallois mean lengths. With regards to breadth and thickness, the SPCs fall between the other two techniques. This would suggest the SPCs are the smallest cores in terms of volume. The relative thickness has been plotted against the surface area of all the cores from Dunbridge and is presented in Figure 5.9. A Kruskal-Wallis H test was run to determine if there were differences in volume between the three core working techniques: SPCs (n=4), Levallois (n=3) and migrating platform (n=14). Distribution of the volume is similar for all groups, as assessed by visual inspection (see Appendix D). Median volume for SPCs was the smallest of the three core categories but the differences were not statistically significant between the different techniques, $X^2(2) = 2.731$, $p = .255$.

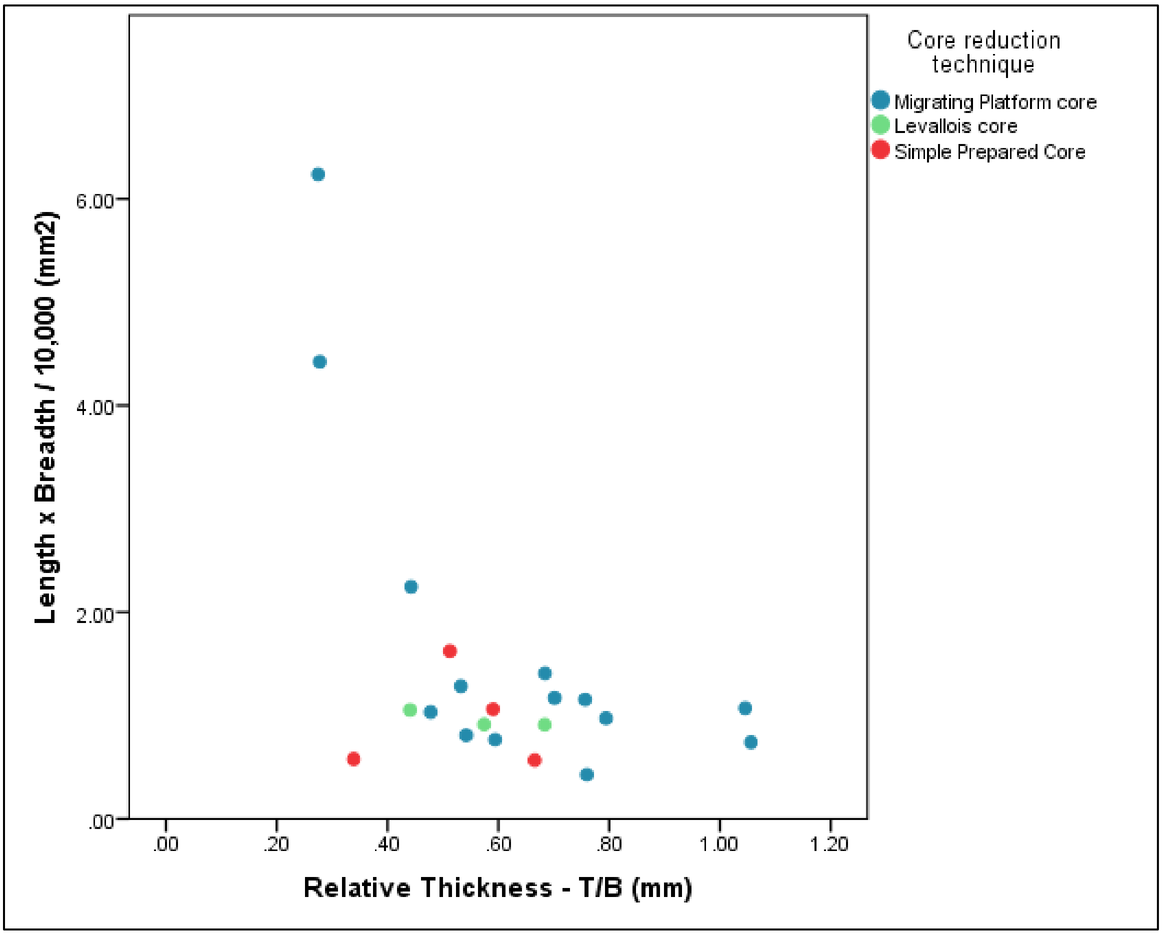


Figure 5.9 Dunbridge core volume

Figure 5.10 compares the number of visible flake scars on each core from Dunbridge. The migrating platform cores and the SPCs demonstrate a similar range of total removals with the SPCs having a slightly higher mean. The Levallois cores have a more limited, but higher, range and mean. There is one outlier (◦), a migrating platform core.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (4), Levallois (3) migrating platform (14). Distributions of the number of flake scars were similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.10). The median the number of flake scars were not statistically significant between any of the different core techniques, $X^2(2) = 4.281$, $p = .118$.

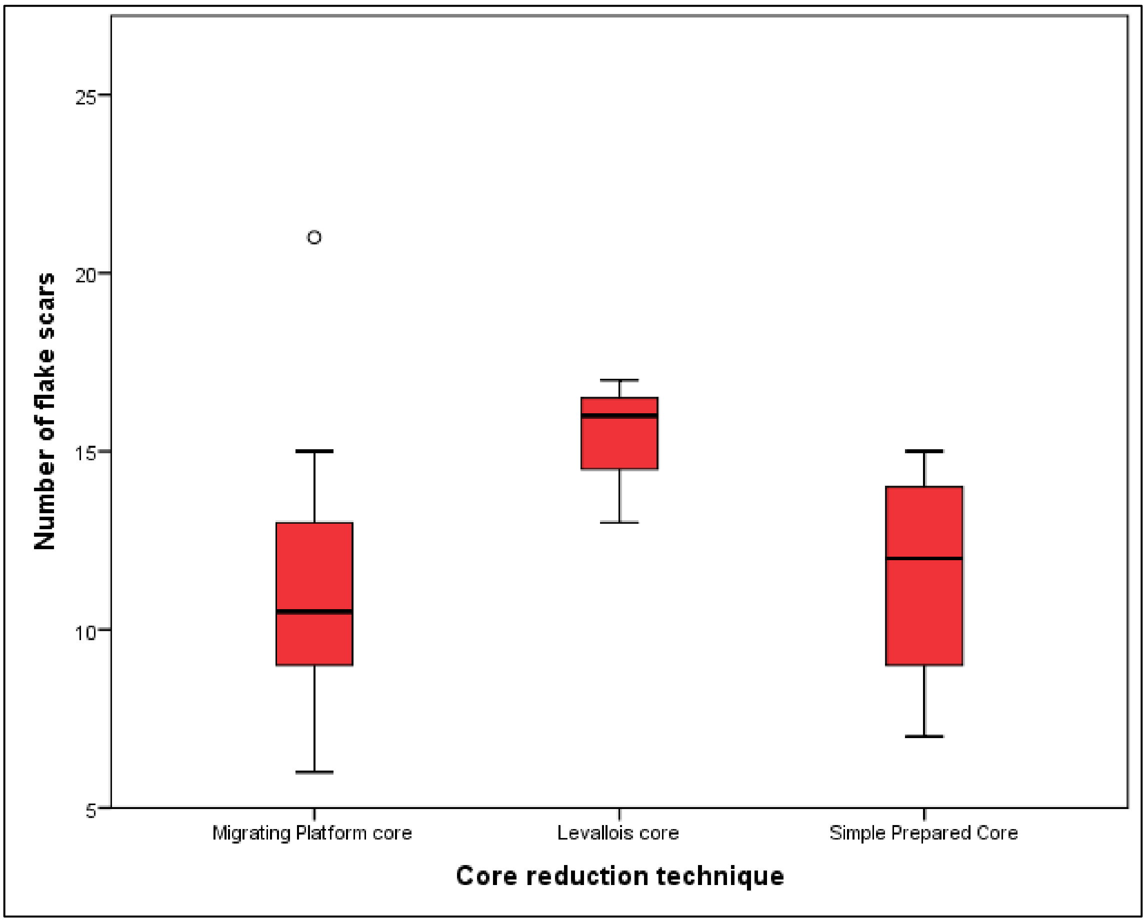


Figure 5.10 Boxplot comparing the number of flake scars on each core from Dunbridge

5.5.5 SPCs

There were four SPCs identified from the Dunbridge assemblage. All were discovered during the watching brief either in the reject heaps or in the processing plant.

The technological attributes presented in Table 5.27 show that all four SPCs are not faceted and have linear exploitation. There is however, a difference in the preparation of the cores. Two SPCs have been prepared centripetally and two have unipolar preparation. The two unipolar SPCs are the same two cores which had between 25%-50% cortex remaining and were SPC Group B, meaning they were less extensively prepared.

Dunbridge SPC n = 4		
Preparation		
Centripetal	2	50%
Unipolar	2	0%
Bipolar	0	50%
Convergent	0	0%
Exploitation		
Linear	4	100%
Recurrent	0	0%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	4	100%

Table 5.27 Technological attributes of the SPCs from Dunbridge

All four SPCs from Dunbridge show some degree of preparation on the striking platform surface as well as the flaking surface. In Table 5.28 it can be seen that two of the cores are more extensively worked placing them within Group C, whereas the other two are Group B.

SPC Group	***Count***
A	0
B	2
C	2
Total	**4**

Table 5.28 SPC reduction types at Dunbridge

5.5.6 Levallois cores

The three Levallois cores from Dunbridge have all been prepared and exploited in the same way (see Table 5.29). The preparation is bipolar with recurrent exploitation and all three have faceted striking platforms.

Dunbridge Levallois n = 3		
Preparation		
Centripetal	0	0%
Unipolar	0	0%
Bipolar	3	100%
Convergent	0	0%
Exploitation		
Linear	0	0%
Recurrent	3	100%
Unexploited	0	0%
Faceting		
Yes	3	100%
No	0	0%

Table 5.29 Technological attributes of the Levallois cores from Dunbridge

5.5.7 Products

Unfortunately the 'proto-Levallois' flakes identified by Harding and colleagues were not identified during this investigation.

Table 5.30 shows the mean area of the SPC preferential removals is over 2000mm^2 smaller than the mean area of the flakes and flake tools from Dunbridge and the SPC preferential removal areas all fall within the range of the flake areas. The Levallois preferential removal scars are similar to the SPC preferential scar area. This suggests the SPCs were producing flakes which were on average smaller than the flakes produced through other techniques but similar to the Levallois products. Figure 5.11 also identifies a number of outliers (◦) in the flake data.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=4), the Levallois preferential scar area (n=2) and the flakes/ flake tool area (n=107) were statistically significant. Distributions for the area of both groups were similar as assessed by visual inspection (see Figure 5.11). Results determined the median area for SPC products (2930.46) was not statistically significantly different to that for Levallois products (3328.61) or flakes/flake tools (5082.48), $X^2(2) = 4.839$, $p = .089$.

	Flake area mm^2 (n=107)	***SPC pref. scar area mm^2 (n=4)***	***Levallois pref. scar area mm^2 (n=2)***
Mean	5368	3673	3328
Median	5082	2930	3328
Std. Deviation	2362	2051	424
Range	11052	4564	600

Table 5.30 Summary statistics for the flakes/ flake tools, SPC and Levallois flake scar areas for Dunbridge

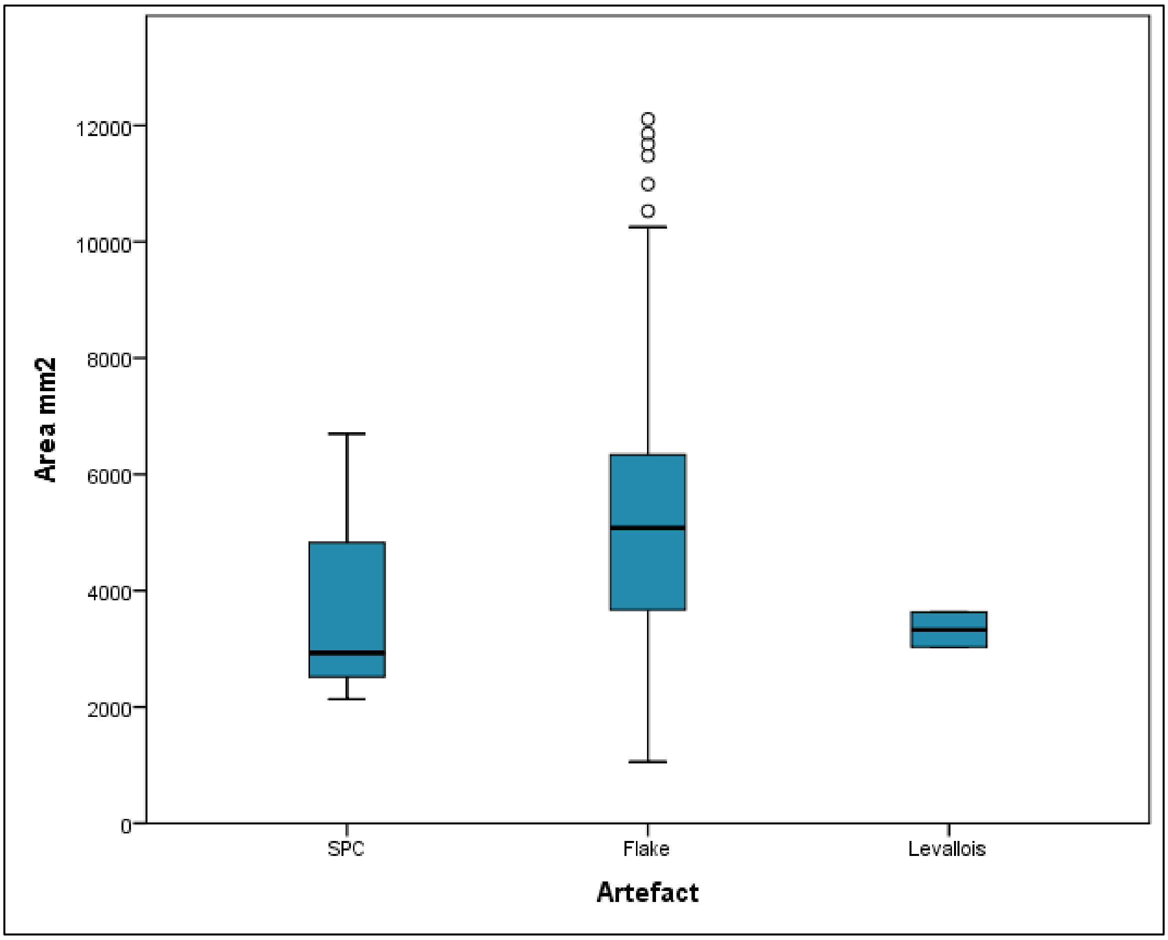


Figure 5.11 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Dunbridge

The thickness of flakes, flake tools and Levallois products were compared to see if there were preferences for tools to be made on thinner flakes and to establish whether Levallois flakes were generally thinner than flakes produced from other techniques. Figure 5.12 demonstrates the median thickness is approximately the same across each category. A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the thickness of each product; the flakes (101), flake tools (5) and Levallois endproducs (1). The median thicknesses were not statistically significant between any of the different products, $X^2(2) = .828$, $p = .661$.

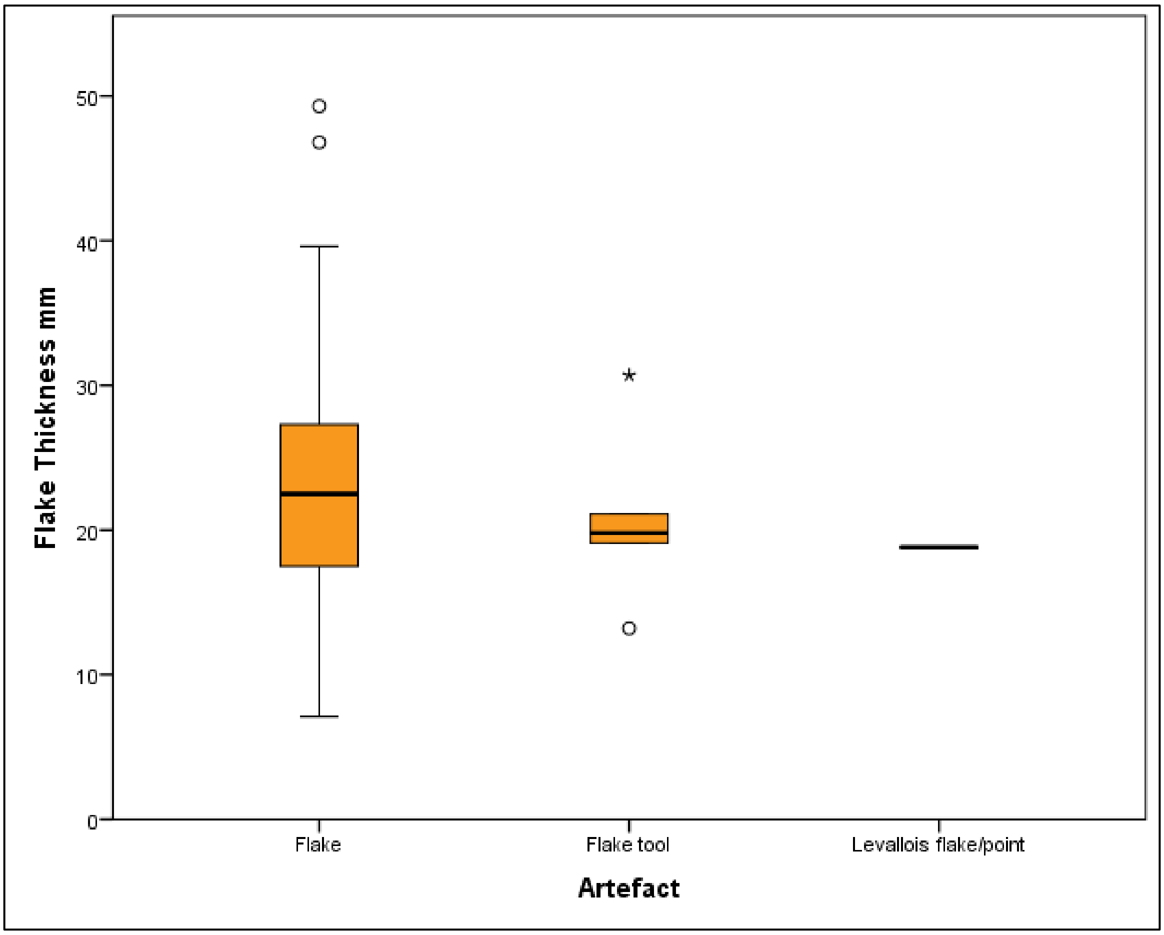


Figure 5.12 Boxplot comparing the thickness of flakes, flake tools and Levallois products from Dunbridge

5.5.8 Summary

The Dunbridge assemblage is small with a high proportion of handaxes, 103 and 21 cores. Most of the material is heavily rolled and stained with no patination. The most common core technique is the migrating platform method with 14 cores. There are four SPCs, three Levallois cores and no discoidal cores.

The Levallois material is not considered to be contemporary with the SPCs and handaxes based on condition but has been included within the analysis as a technological comparison to the SPCs.

The SPCs tend to be smaller, when compared with the other core working techniques, but with a similar number of flake scars. The products of the SPCs are also smaller than the products of the other techniques but similar in size to the Levallois products.

5.6 Feltwell

5.6.1 Lithic assemblage

The material form Feltwell was not recovered through controlled excavation and the exact provenance is unknown. The collection contains of 142 items, one of which is natural and has therefore been excluded. The material which was analysed is presented in Table 5.31. Table 5.32 demonstrates the mixed condition of the assemblage. Most of the material is slightly rolled and heavily patinated but the level of staining varies within the assemblage.

Feltwell is the least reliable assemblage in this investigation. It is clear from the number of artefacts analysed that the entire MacRae collection was not studied and the location of this material is unknown. The assemblage also consists entirely of material collected during quarrying with no excavation. These factors must be taken into consideration when interpreting the material however the assemblage has been included within this analysis as the site location can be assigned broadly to a pre-Anglian terrace. The assemblage is made entirely of good quality flint.

Artefact	***Count***	***Percentage***
Flake	122	86.5%
Retouched flake	6	4.3%
Soft hammer flake	0	0%
Cores	10	7.1%
Handaxe	2	1.4%
Levallois flake/tools	0	0%
Refitted flakes	0	0%
Chopper	1	0.7%
Roughout	0	0%
Total	**141**	**100%**

Table 5.31 Feltwell assemblage

Artefact	Abrasion			Staining			Patination		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	9	110	3	37	27	58	10	22	90
Retouched flake	2	4	0	3	2	1	0	2	4
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	2	8	0	1	1	8	1	1	8
Handaxe	0	2	0	0	1	1	0	0	2
Levallois flake/tools	0	0	0	0	0	0	0	0	0
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	0	1	0	0	1	0	0	0	1
Roughout	0	0	0	0	0	0	0	0	0
Total	**13**	**125**	**3**	**41**	**32**	**68**	**11**	**25**	**105**

Table 5.32 Feltwell assemblage condition

5.6.2 Core assemblage

Of the ten cores from the Feltwell assemblage, only one is a SPC. There is one discoidal core and eight migrating platform cores (see Table 5.33).

Core reduction technique	***Count***	***Percentage***
Migrating platform core	8	80%
Levallois core	0	0%
SPC	1	10%
Discoidal core	1	10%
Total	**10**	**100%**

Table 5.33 Feltwell core working techniques

5.6.3 Core condition

All of the cores from Feltwell are in a similar condition. The SPC and the discoidal core are slightly rolled, heavily stained and heavily patinated, as are six of the migrating platform cores. The two exceptions in each condition category are not the same core in each instance. For example, one of the fresh cores is also heavily stained and lightly patinated.

There is little variation in terms of residual cortex with all 10 of the cores displaying less than 50% cortex remaining. Seven have less than 25% cortex, including the SPC and the discoidal core (see Table 5.35) which implies there were more heavily reduced.

Core reduction technique	Feltwell								
	Abrasion			*Staining*			*Patination*		
	Fresh	Slightly	Heavy	None	Light	Heavy	None	Light	Heavy
Migrating platform core	2	6	0	1	1	6	1	1	6
Levallois core	0	0	0	0	0	0	0	0	0
SPC	0	1	0	0	0	1	0	0	1
Discoidal core	0	1	0	0	0	1	0	0	1
Total	**2**	**8**	**0**	**1**	**1**	**8**	**1**	**1**	**8**

Table 5.34 Feltwell core condition

Core reduction technique	*Cortex*				
	0%	<25%	25 - 50%	50 - 75%	>75%
Migrating platform core	1	4	3	0	0
Levallois core	0	0	0	0	0
SPC	0	1	0	0	0
Discoidal core	0	1	0	0	0
Total	**1**	**6**	**3**	**0**	**0**

Table 5.35 Feltwell core cortex coverage

5.6.4 Core technology

The statistics for the length, breadth and thickness of the cores from Feltwell are presented in Appendix D. The SPC is considerably larger than the discoidal core and the mean of the migrating platform cores. A comparison of the surface area by relative thickness for each core (see Figure 5.13) also illustrates the size of the SPC. A Kruskal-Wallis H test was run to determine if there were differences in volume between the three core working techniques: SPCs (n=1), migrating platform (n=8), discoidal (n=1). Distribution of the volume is not similar for all groups, as assessed by visual inspection of a boxplot (see Appendix D). The mean rank for volume demonstrates the SPC volume (830106.84mm^3) was much larger than both the mean migrating platform (382767.69mm^3) and discoidal (101268.84mm^3) volumes but the differences were not statistically significant between the different techniques, $X^2(2) = 4.418$, $p = .110$.

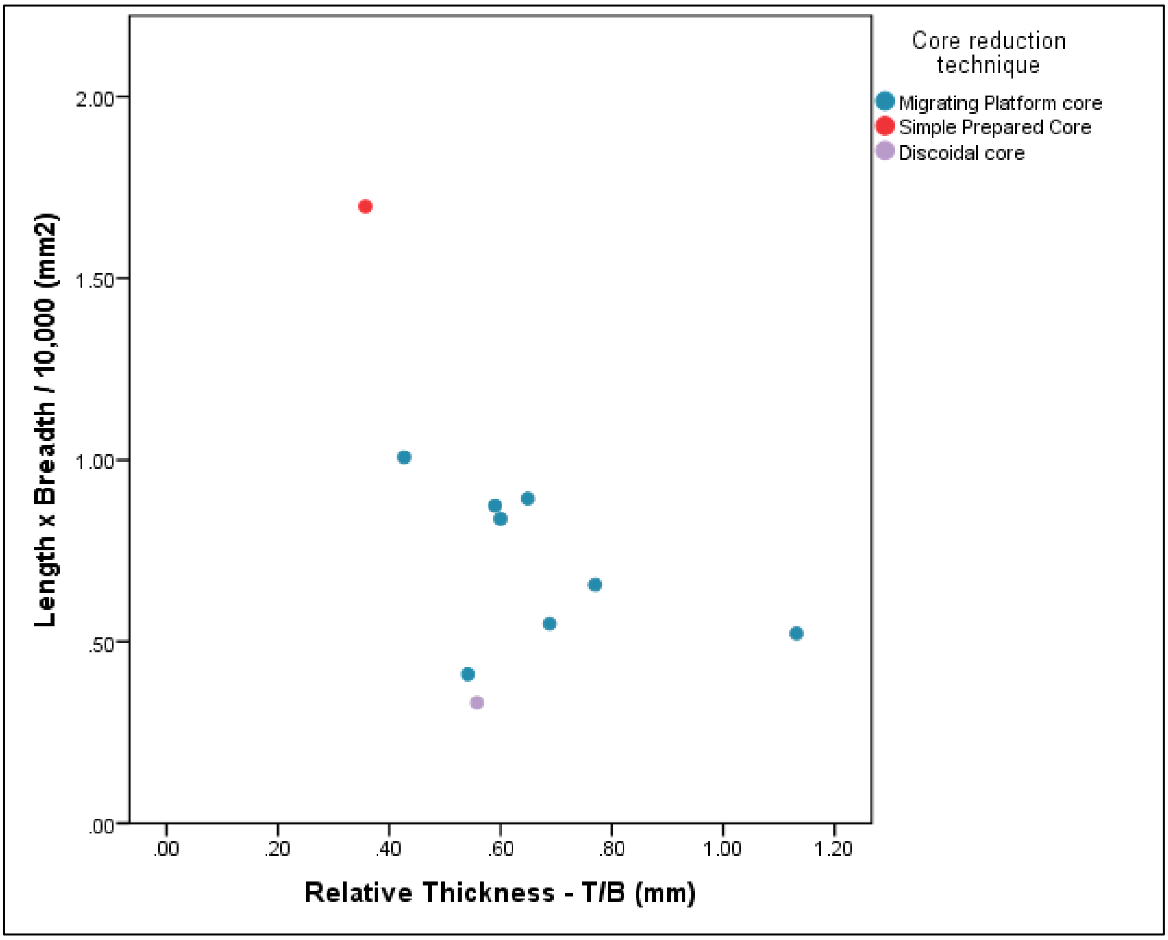


Figure 5.13 Feltwell core volume

There are 12 visible flake scars on the SPC from Feltwell (see Figure 5.14). This is two more removals than the mean number of removals on the migrating platform cores and two more removals than the discoidal core. Both the SPC and the discoidal total number of removals fall within the midspread of the migrating platform data suggesting there is no difference in the number of flake scars between the different techniques.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPC (1), migrating platform (8), discoidal (1). Distributions of the number of flake scars were similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.14 and Appendix D). The median number of flake scars was slightly higher for the SPC but the results were not statistically significant between the different core techniques, $X^2(2) = .295$, $p = .863$.

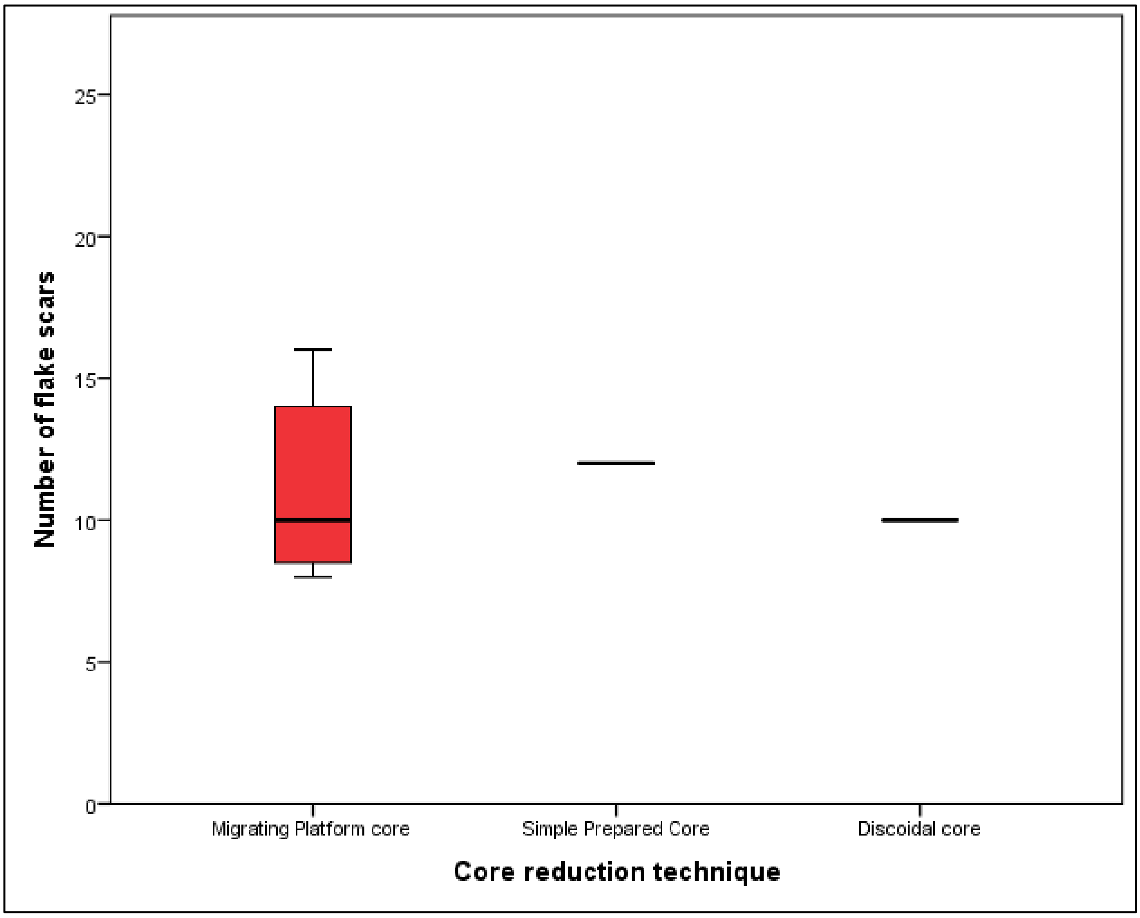


Figure 5.14 Boxplot comparing the number of flake scars on each core from Feltwell

5.6.5 SPCs

The exact provenance of the one SPC in the Feltwell assemblage is not known. The only supporting information is the month in which it was found (February 1999) but this does not narrow down the location within the pit.

The one SPC from Feltwell has been prepared on both the flaking surface and part of the striking platform surface placing it in SPC Group C (see Table 5.37). The preparation is centripetal with linear exploitation and no faceting on the striking platform (see Table 5.36).

Feltwell SPC n = 1		
Preparation		
Centripetal	1	100%
Unipolar	0	0%
Bipolar	0	0%
Convergent	0	0%
Exploitation		
Linear	1	100%
Recurrent	0	0%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	1	100%

Table 5.36 Technological attributes of the SPCs from Feltwell

SPC Group	*Count*
A	0
B	0
C	1
Total	**1**

Table 5.37 SPC reduction types at Feltwell

5.6.6 Products

Table 5.38 presents the summary of the flake area and SPC preferential scar area statistics. The mean area of the preferential flake scar is over 5500 mm^2 larger than the mean area of the flakes and flake tools. Figure 5.15 compares the area of the SPC preferential flake scar with the flake/ flake tool areas. This graph shows there are a number of outliers (◦) and one far outlier (⋆) within the flake/ flake tool data. The SPC scar size falls well outside the range of the flake/ flake tool data demonstrating the SPC produced a flake significantly bigger than the flakes produced from the other core working techniques.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=1) and the flakes/ flake tool area (n=113) were statistically significant. Distributions for the area of both groups were not similar as assessed by visual inspection (see Figure 5.15). Results determined the mean area for SPC products (10012.5) was considerably larger but not statistically significantly different to that for flakes/flake tools (4494.25), $U = 2$, $z = -1.656$, $p = .098$.

	Flake area mm² *(n = 113)*	*SPC pref. scar area mm²* *(n = 1)*
Mean	4494	10012
Median	4037	10012
Std. Deviation	1783	n/a
Range	10262	0

Table 5.38 Summary statistics for the flake and SPC flake scar areas

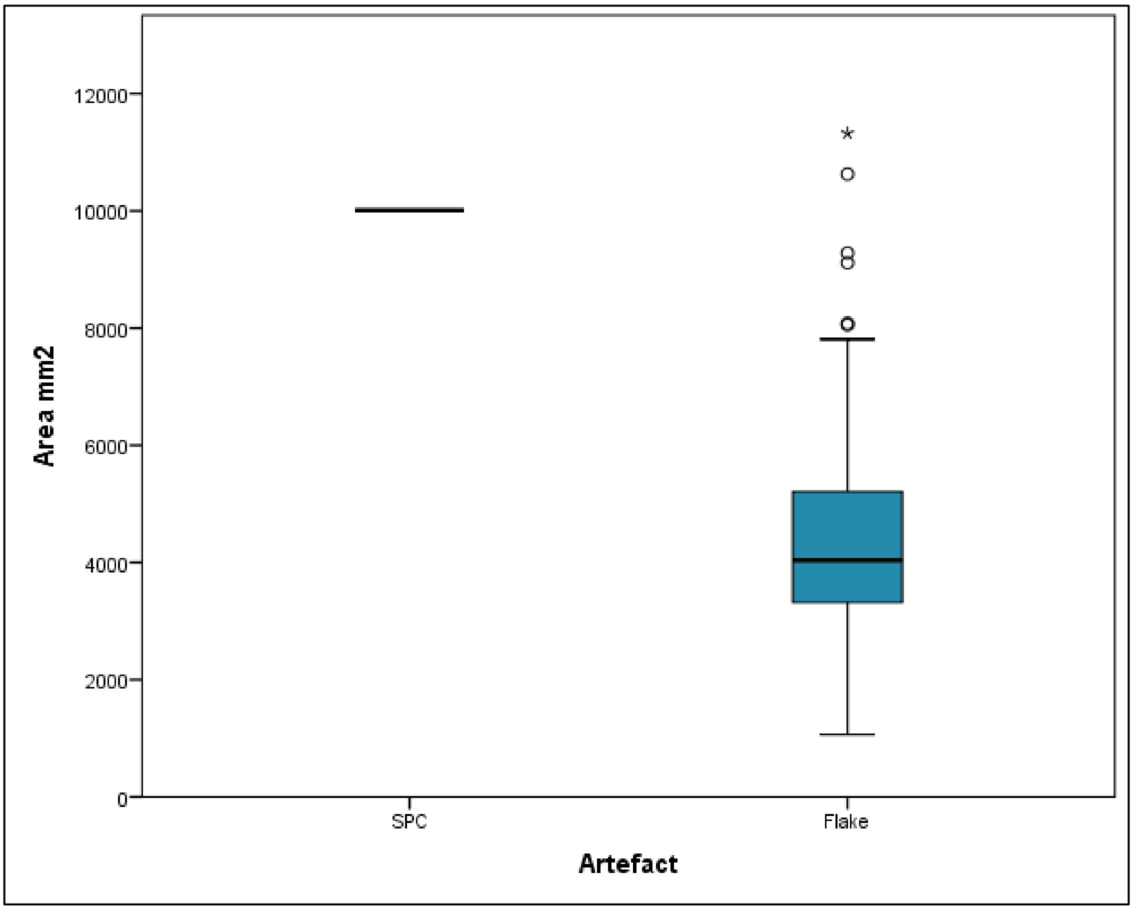


Figure 5.15 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Feltwell

5.6.7 Summary

The Feltwell assemblage is very small with only 141 artefacts analysed. There are only two handaxes and 10 cores, one of which is a SPC. As an assemblage, most of the material is slightly rolled with heavy patination and varying degrees of staining.

The one SPC has a larger volume and has produced a larger preferential product when compared with the other techniques but none of the differences are statistically significant.

5.7 Frindsbury

5.7.1 Lithic assemblage

Two collections, stored at two different museums, the British Museum and the Pitt Rivers Museum, were analysed resulting in 529 items. 27 of these are identified as natural and have been excluded from further analysis along with three hammerstones. Seven broken flakes and one group of the four refitting flakes groups have also been excluded after the Table 5.39. The material is almost exclusively in a fresh condition indicating little post-depositional movement with varying degrees of staining and patination (see Table 5.40). The entire assemblage is made on good quality flint.

Artefact	***Count***	***Percentage***
Flake	472	94.6%
Retouched flake	1	0.2%
Soft hammer flake	0	0%
Cores	20	4.0%
Handaxe	2	0.4%
Levallois flake/tools	0	0%
Refitted flakes	4	0.8%
Chopper	0	0%
Roughout	0	0%
Total	**499**	**100%**

Table 5.39 Frindsbury assemblage

Artefact	***Abrasion***			***Staining***			***Patination***		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	461	4	0	170	261	34	49	211	205
Retouched flake	1	0	0	1	0	0	0	1	0
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	19	1	0	7	12	1	0	13	7
Handaxe	0	2	0	2	0	0	0	0	2
Levallois flake/tools	0	0	0	0	0	0	0	0	0
Refitted flakes	3	0	0	2	1	0	0	3	0
Chopper	0	0	0	0	0	0	0	0	0
Roughout	0	0	0	0	0	0	0	0	0
Total	**484**	**7**	**0**	**182**	**274**	**35**	**49**	**228**	**214**

Table 5.40 Frindsbury assemblage condition

5.7.2 Core assemblage

Of the 20 cores from Frindsbury, 13 have been identified as SPCs, making this reduction technique the most common. There are also six migrating platform cores and one discoidal core (see Table 5.41).

Core reduction technique	***Count***	***Percentage***
Migrating platform core	6	30%
Levallois core	0	0%
SPC	13	65%
Discoidal core	1	5%
Total	**20**	**100%**

Table 5.41 Frindsbury core working techniques

5.7.3 Core condition

With the exception of one slightly rolled SPC, 19 of the 20 cores are in a fresh condition reflecting the condition of the assemblage overall. The degree of staining ranges between there cores. 12 of the cores are lightly staining whilst seven are not stained at all. All of the cores from Frindsbury have patina and seven, including four SPCs are heavily patinated (see Table 5.42).

Core reduction technique	**Frindsbury**								
	Abrasion			***Staining***			***Patination***		
	Fresh	**Slightly**	**Heavy**	**None**	**Light**	**Heavy**	**None**	**Light**	**Heavy**
Migrating platform core	6	0	0	2	3	1	0	3	3
Levallois core	0	0	0	0	0	0	0	0	0
SPC	12	1	0	5	8	0	0	9	4
Discoidal core	1	0	0	0	1	0	0	1	0
Total	**19**	**1**	**0**	**7**	**12**	**1**	**0**	**13**	**7**

Table 5.42 Frindsbury core condition

Table 5.43 demonstrates the variation in the extent of core reduction at Frindsbury. Half of all the cores, including 6 SPCs are considered to be heavily reduced with less than 25% residual cortex. Only two cores, both of which are SPCs have between 50-75% residual cortex and are therefore considered to be in the initial stages of reduction. The SPCs do not therefore stand out as being more heavily worked when compared with the other core reduction techniques.

Core reduction technique	Cortex				
	0%	**<25%**	**25 - 50%**	**50 - 75%**	**>75%**
Migrating platform core	0	3	3	0	0
Levallois core	0	0	0	0	0
SPC	1	5	5	2	0
Discoidal core	1	0	0	0	0
Total	**2**	**8**	**8**	**2**	**0**

Table 5.43 Frindsbury core cortex coverage

5.7.4 Core technology

A summary of the statistics for the length, breadth and thickness of the cores is presented in Appendix D. The SPCs do not particularly differ in size from the other core working techniques. The migrating platform cores have the largest mean core length and thickness but the SPCs have the largest mean core breadth. This data shows the SPCs are on average wider than and not as elongated as the migrating platform cores. Figure 5.16 compares the flaking surface area with the relative thickness and demonstrates the migrating platform cores are generally thicker than the SPCs.

A Kruskal-Wallis H test was run to determine if there were differences in volume between the three core working techniques: SPCs (n=13), migrating platform (n=6), discoidal (n=1). Distribution of the volume is similar for all groups, as assessed by visual inspection (see Appendix D). Median volume for SPCs (683560.64) was smaller than the migrating platform (868285.40 median but larger than the discoidal (630446.19) median however the differences between the techniques are not statistically significant, $X^2(2) = .210$, $p = .900$.

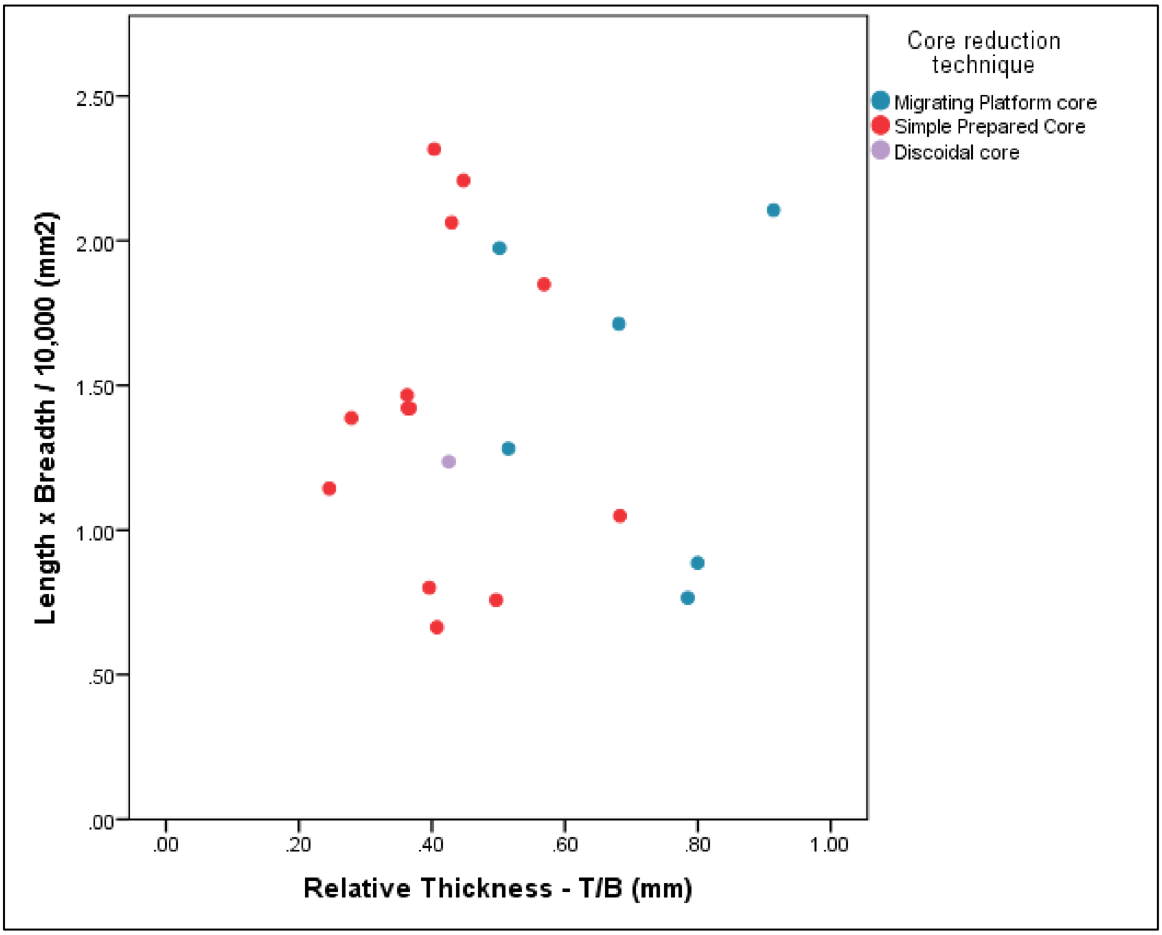


Figure 5.16 Frindsbury core volume

The comparison of the number of flake scars on each core shows the data for migrating platform and discoidal cores falls within the SPCs range and can be seen in Figure 5.17. The mean number of removals from the SPCs is the same as that of the migrating platform cores, however there is one extreme outlier (⋆). The one discoidal core has a high number of removals, 10, but this total is still lower than the highest number of removals from the SPCs.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (13), migrating platform (6) and discoidal (1). Distributions of the number of flake scars were similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.17). The mean ranks of the number of flake scars were not statistically significant between the different core techniques, $X^2(2)$ =1.145, p = .564.

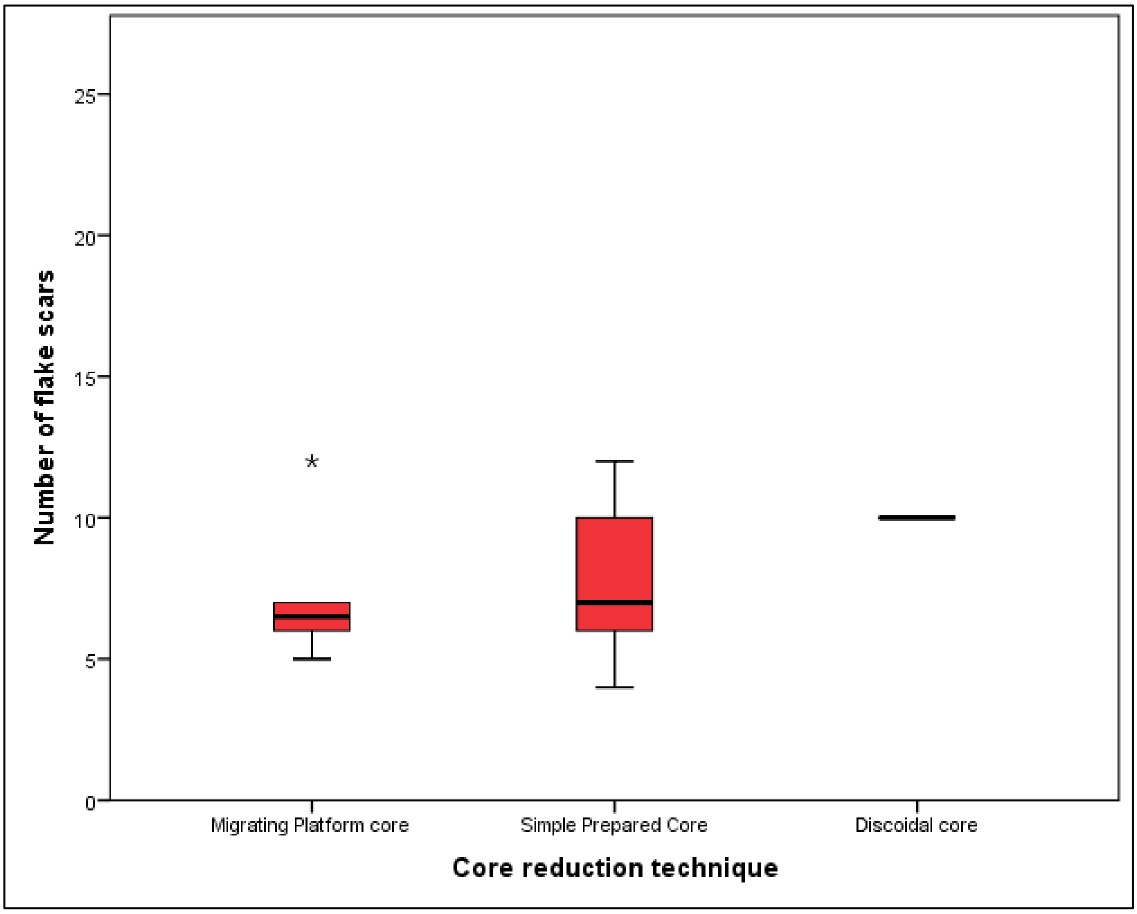


Figure 5.17 Boxplot comparing the number of flake scars on each core from Frindsbury

5.7.5 SPCs

All 13 of the SPCs identified within the Frindsbury assemblages were from the Cook and Killick collection at the British Museum. No further details on the exact location within these excavations are known.

The technological attributes of the SPCs from Frindsbury show two methods of preparation were preferred (see Table 5.44). Six of the cores were prepared centripetally whilst the other seven cores have unipolar preparation. The method of exploitation demonstrates less varied with only one recurrent SPC. All 13 SPCs lack faceted striking platforms.

Frindsbury SPC n = 13		
Preparation		
Centripetal	6	46.2%
Unipolar	7	53.8%
Bipolar	0	0%
Convergent	0	0%
Exploitation		
Linear	12	92.3%
Recurrent	1	7.7%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	13	100%

Table 5.44 Technological attributes of the SPCs from Frindsbury

The SPCs from Frindsbury fall into two categories based on the extent of the working prior to the removal of the preferential flake (see Table 5.45). Six of the SPCs have no working on the striking platform surface with the exception of a single removal for the striking platform itself and are therefore Group A. The remaining seven have more extensive preparation with removals on the striking platform surface as well as a striking platform and are Group C.

SPC Group	***Count***
A	6
B	0
C	7
Total	**13**

Table 5.45 SPC reduction types at Frindsbury

5.7.6 Products

Table 5.46 presents the summary of the flake area and SPC preferential scar area statistics. The mean area of the preferential flake scars is 524.86mm^2 smaller than the area of the flakes and flake tools. Figure 5.18 compares the area of all SPC preferential flake scars with the flake/ flake tool areas. This graph shows there are a number of outliers (∘) within the flake/ flake tool data but all of the SPC data falls within the range of the flake data. Meaning the preferential products of the SPCs were not notably different in size to the products of the other core reduction techniques.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=14) and the flakes/ flake tool area (n=378) were statistically significant. Distributions for the area of both groups were similar as assessed by visual inspection (see Figure 5.18). Results determined the median area for SPC products (5397.98) was not statistically significantly different to that for flakes/flake tools (6068.4), U = 2397, z = -.598, p = .550.

	Flake area mm²* *(n = 378)	***SPC pref. scar area mm²* *(n = 14)***
Mean	6457	5932
Median	6068	5397
Std. Deviation	3122	2755
Range	18391	8524

Table 5.46 Summary statistics for the flake and SPC flake scar areas

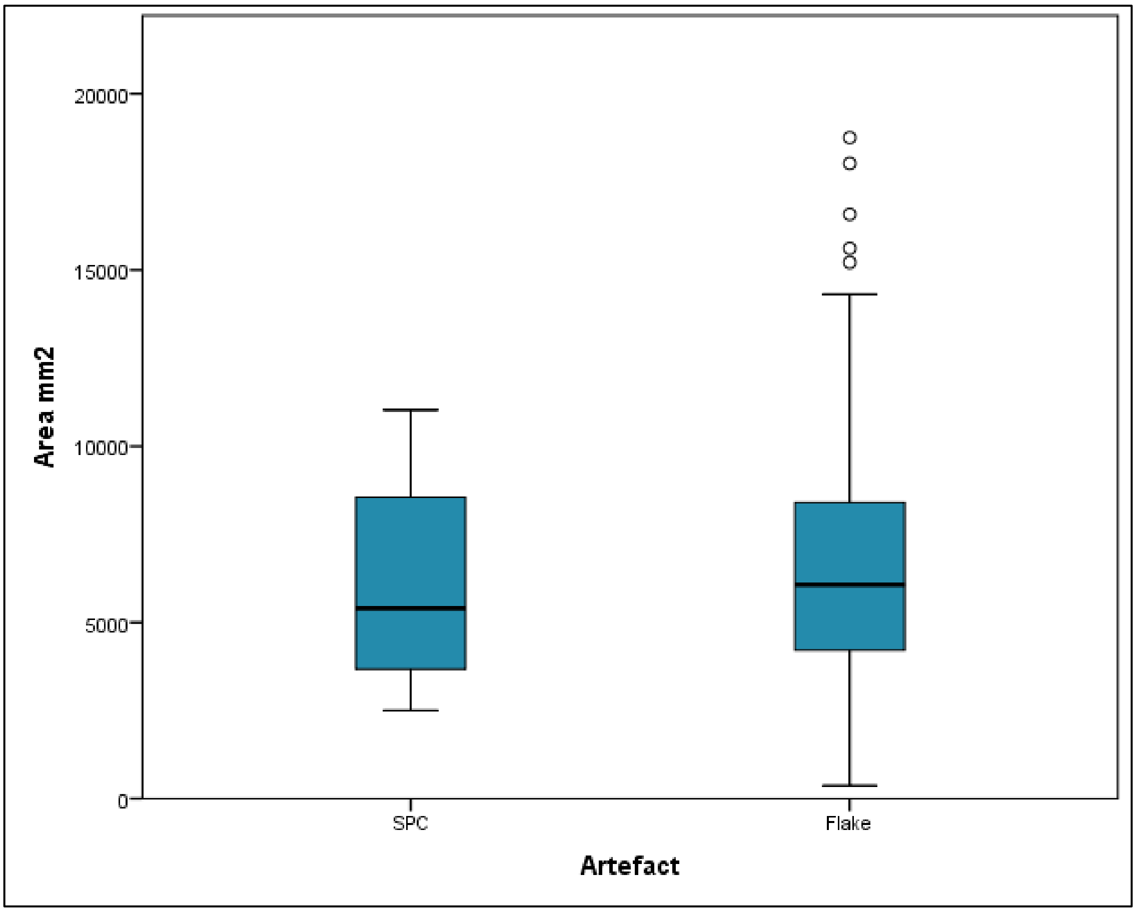


Figure 5.18 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Frindsbury

5.7.7 Summary

Of the 499 artefacts identified from Frindsbury, 20 are cores, 13 of which are SPCs. This is the highest proportion of SPCs to cores for any assemblage. The material is in a fresh condition indicating little post-depositional movement. The loss of the majority of the material from Frindsbury will have affected the overall sample and there is no way of knowing if the material analysed is representative. However many of the assemblages analysed in this thesis are older collections which may not be representative of the entire assemblage and the large number of SPCs make Frindsbury an important site to include in this investigation.

The cores from Frindsbury vary in size and extent to which they have been worked. The SPCs also demonstrate varying preparation of both the flaking and striking platform surfaces but there is little variation in the method of exploitation with only one recurrent core. The products of the SPCs from Frindsbury would have been very similar to the other flakes in terms of size.

5.8 Purfleet

5.8.1 Lithic assemblage

The Botany Pit assemblage from Purfleet is the largest assemblage studied with a total of 3973 objects from two collections at the British Museum. Four items were considered to be natural and were excluded from further analysis along with two hammerstones. Broken flakes were also excluded after initial identification (see Table 5.47) and due to the large number of flakes and flake tools, a sample of 1461 were analysed. Table 5.48 displays the range of staining and patination on the Purfleet material. The assemblage as a whole has undergone little to no rolling as indicated by the degree of abrasion on the artefacts. The entire assemblage has been produced on flint.

Artefact	***Count***	***Percentage***
Flake	3547	89.4%
Retouched flake	76	1.9%
Soft hammer flake	0	0%
Cores	320	8.1%
Handaxe	20	0.5%
Levallois flake/tools	4	0.1%
Refitted flakes	0	0%
Chopper	0	0%
Roughout	0	0%
Total	**3967**	**100%**

Table 5.47 Purfleet assemblage

Artefact	Abrasion			Staining			Patination		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	748	713	0	94	188	1179	789	445	227
Retouched flake	46	18	0	6	4	54	46	13	5
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	2	318	0	1	7	312	311	8	1
Handaxe	16	4	0	0	2	18	11	7	2
Levallois flake/tools	3	0	0	0	0	3	1	1	1
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	0	0	0	0	0	0	0	0	0
Roughout	0	0	0	0	0	0	0	0	0
Total	**815**	**1053**	**0**	**101**	**201**	**1566**	**1158**	**474**	**236**

Table 5.48 Purfleet assemblage condition

5.8.2 Core assemblage

Purfleet has the largest number of cores studied in this thesis. Of the 320 cores, 122 are SPCs. This is not the most common method of reduction at the site as there are 155 cores which fall under the migrating platform umbrella term (see Table 5.49).

Core reduction technique	***Count***	***Percentage***
Migrating platform core	155	48.4%
Levallois core	10	3.1%
SPC	122	38.1%
Discoidal core	18	5.6%
Core with few removals	15	4.7%
Total	**320**	**100%**

Table 5.49 Purfleet core working techniques

5.8.3 Core condition

Table 5.50 demonstrates the vast majority of cores from Purfleet are in the same condition. Only two cores are in a fresh condition, one migrating platform core and one Levallois core. 312 cores are heavily stained and 311 have no patination. Neither the SPCs nor the Levallois cores have undergone any different post-deposition processes when compared to the other cores, based upon their condition.

Core reduction technique	Purfleet								
	Abrasion			*Staining*			*Patination*		
	Fresh	**Slightly**	**Heavy**	**None**	**Light**	**Heavy**	**None**	**Light**	**Heavy**
Migrating platform core	1	154	0	0	3	152	151	3	1
Levallois core	1	9	0	1	1	8	9	1	0
SPC	0	122	0	0	2	120	121	1	0
Discoidal core	0	18	0	0	1	17	16	2	0
Core with few removals	0	15	0	0	0	15	14	1	0
Total	**2**	**318**	**0**	**1**	**7**	**312**	**311**	**8**	**1**

Table 5.50 Purfleet core condition

Core reduction technique	*Cortex*				
	0%	**<25%**	**25 - 50%**	**50 - 75%**	**>75%**
Migrating platform core	19	59	57	20	0
Levallois core	0	7	3	0	0
SPC	2	15	82	23	0
Discoidal core	7	9	2	0	0
Core with few removals	1	2	2	10	0
Total	**29**	**92**	**146**	**53**	**0**

Table 5.51 Purfleet core cortex coverage

The amount of residual cortex on the cores from Purfleet shows no cores were in the earliest stages of reduction and only a relatively small number were heavily reduced. The majority of SPCs have between 25-50% residual cortex whilst the majority of Levallois cores have slightly less.

5.8.4 Core technology

The summary of the statistics for the length, breadth and thickness of the cores is presented in Appendix D. The SPCs are similar in size to the discoidal cores, smaller than the migrating platform but larger than the Levallois cores. A comparison of the relative thickness and the flaking surface area of the cores can be seen in Figure 5.19. This demonstrates the SPCs are relatively thinner when compared with the other core working techniques.

A Kruskal-Wallis H test was run to determine if there were differences in volume between the five core working techniques: SPCs (n=122), Levallois (10) migrating platform (n=155), discoidal (n=18) and cores with few removals (n=15). Distribution of the volume is similar for all groups, as assessed by visual inspection of a boxplot (see Appendix D). The median volumes were statistically significant between the different core techniques, $X^2(4) = 22.333$, $p < = .0005$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and migrating platform cores, U = 7184, z = -3.431, p = .001 and the SPCs and the Levallois cores U = 378, z = -1.995, p = .046. Meaning the SPCs are smaller than the migrating platform cores but larger than the Levallois cores.

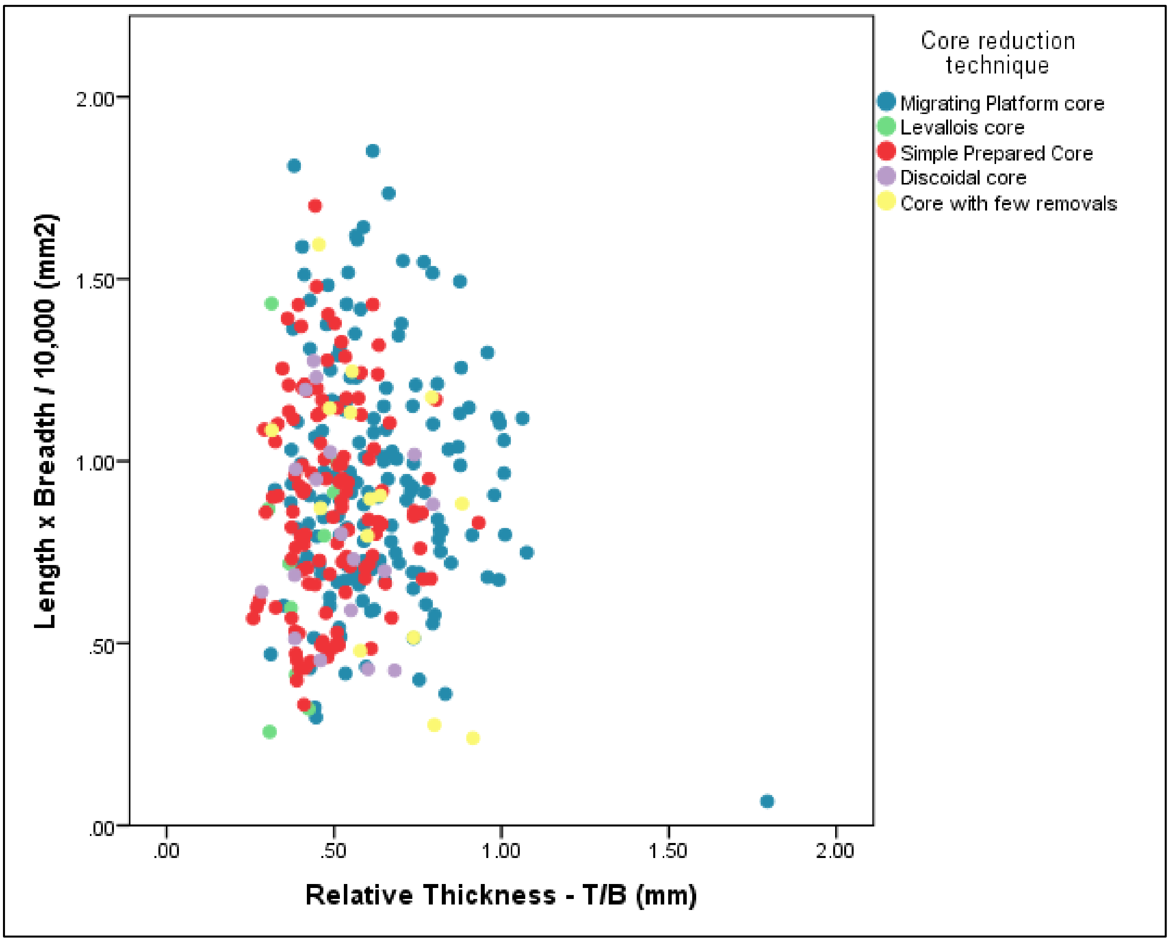


Figure 5.19 Purfleet core volume

Figure 5.20 shows the variation in number of visible flake scars amongst the different core working techniques. The Levallois cores have the highest mean number of scars, 19, whilst the SPC mean is 6, lower than both the migrating platform and discoidal means. This suggests the Levallois cores were the most heavily worked and the SPCs were the least of the main four core reduction techniques. There are a number of outliers (◦) for the migrating platform, discoidal and Levallois cores. The SPCs have no outliers but they do display the largest range in number of removals.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (122), Levallois (10) migrating platform (155), discoidal (18) and cores with few removals (15). Distributions of the number of flake scars were not similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.20 and Appendix D). The mean ranks of the number of flake scars were statistically significant between the different core techniques, $X^2(4) = 127.75$, $p <= .0005$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and Levallois, cores $U = 4.5$, $z = -5.255$, $p <= .0005$, SPCs and migrating platform cores, $U = 5351$, $z = -6.245$, $p <= .0005$, SPCs and discoidal cores $U = 96$, $z = -6.287$, $p <= .0005$ and SPCs and the cores with few removals, $U = <.001$, $z = -6.360$, $p <= .0005$, meaning the SPCs have fewer removals compared with Levallois and discoidal cores but a similar number of removals to migrating platform cores.

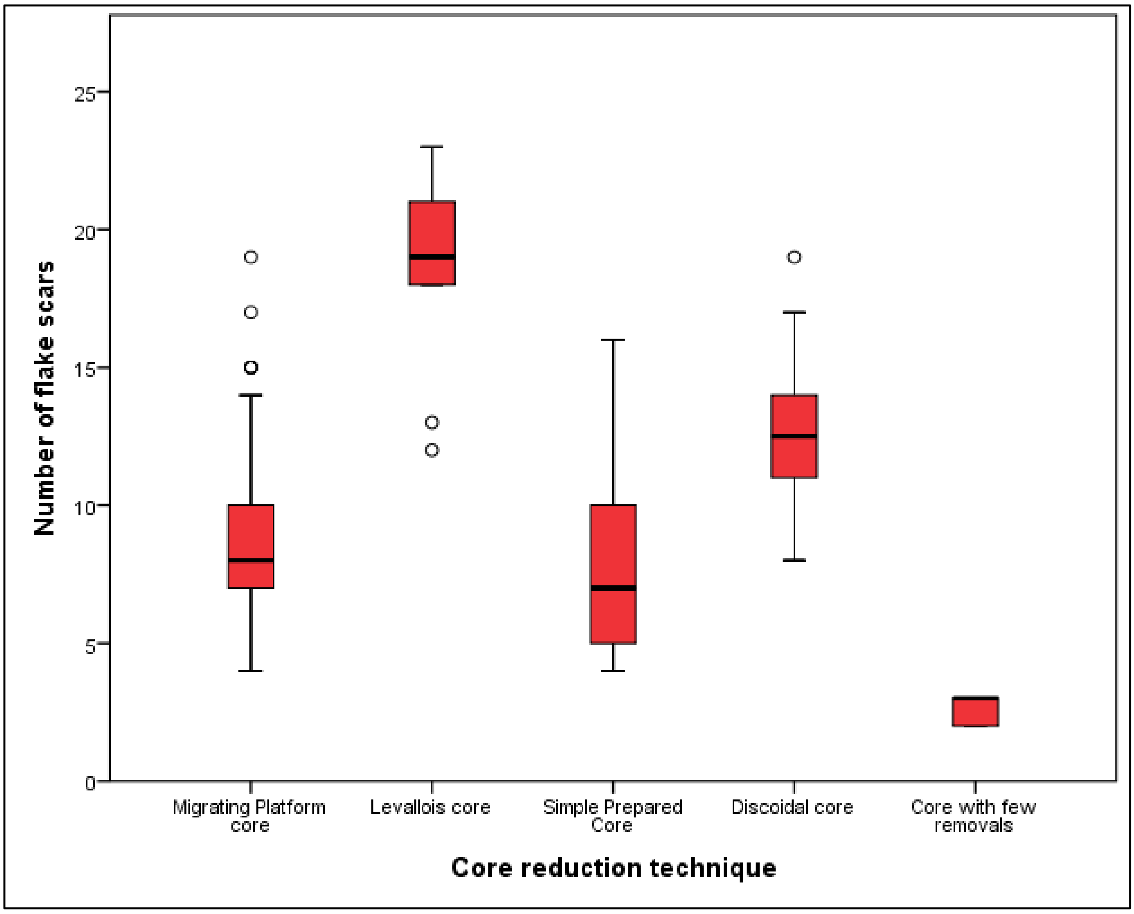


Figure 5.20 Boxplot comparing the number of flake scars on each core from Purfleet

5.8.5 SPCs

The provenance of the 122 SPCs from Purfleet is unknown but all of the cores are from the Snelling excavations at Botany Pit.

The technological attributes of the SPCs presented in Table 5.52 demonstrated the variation in flaking surface preparation with the unipolar method the most frequent. The exploitation of the SPCs is less varied with a single preferential removal dominating the assemblage. The presence of facetted striking platforms on SPCs was unexpected but present in 14 of the cores. The SPCs from

Purfleet also demonstrate a range of preparation of the striking platform surface. Table 5.53 shows the majority of SPCs were Group B meaning they were moderately prepared with one or two edges of the striking platform worked along with the presence of a specific striking platform for the preferential removal(s).

Purfleet SPC n = 122		
Preparation		
Centripetal	50	41%
Unipolar	61	50%
Bipolar	10	8.2%
Convergent	1	0.8%
Exploitation		
Linear	96	78.7%
Recurrent	19	15.6%
Unexploited	7	5.7%
Faceting		
Yes	14	11.5%
No	108	88.5%

Table 5.52 Technological attributes of the SPCs from Purfleet

SPC Group	*Count*
A	30
B	76
C	16
Total	**122**

Table 5.53 SPC reduction types at Purfleet

5.8.6 Levallois cores

All of the Levallois cores from Purfleet have been prepared centripetally with a faceted striking platform. 9 of the Levallois cores have one preferential removal whilst one Levallois core remains unexploited. There is very little variation in the Levallois cores from Purfleet.

Purfleet Levallois n = 10		
Preparation		
Centripetal	10	100%
Unipolar	0	0%
Bipolar	0	0%
Convergent	0	0%
Exploitation		
Linear	9	90%
Recurrent	0	0%
Unexploited	1	10%
Faceting		
Yes	10	100%
No	0	0%

Table 5.54 Technological attributes of the Levallois cores from Purfleet

5.8.7 Products

Figure 5.21 compares the area of all SPC preferential flake scars with the flake/ flake tool areas. This graph shows there are a number of outliers (◦) and extreme outliers (⋆) within the flake/ flake tool data but all of the SPC data falls within the range of the flake data. Figure 5.21 shows just how similar the three data sets are, meaning the products of the SPCs were not notably different in size to the products of the other core reduction techniques.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=137), The Levallois preferential scar area (n=9) and the flakes/ flake tool area (n=1345) were statistically significant. Distributions for the area of both groups were similar as assessed by visual inspection (see Figure 5.21). Results determined the median area for SPC products (4384.64) was not statistically significantly different to that for flakes/flake tools (4409.14) or the Levallois preferential removal scars (4112.5), $X^2(2) = 1.455$, $p = .483$.

	Flake area mm^2 (n = 1344)	***SPC pref. scar area mm^2 (n = 139)***	***Levallois pref. scar area mm^2 (n = 9)***
Mean	4869	4585	3752
Median	4409	4384	4112
Std. Deviation	2662	2032	2026
Range	21279	9537	5427

Table 5.55 Summary statistics for the flake and SPC flake scar areas

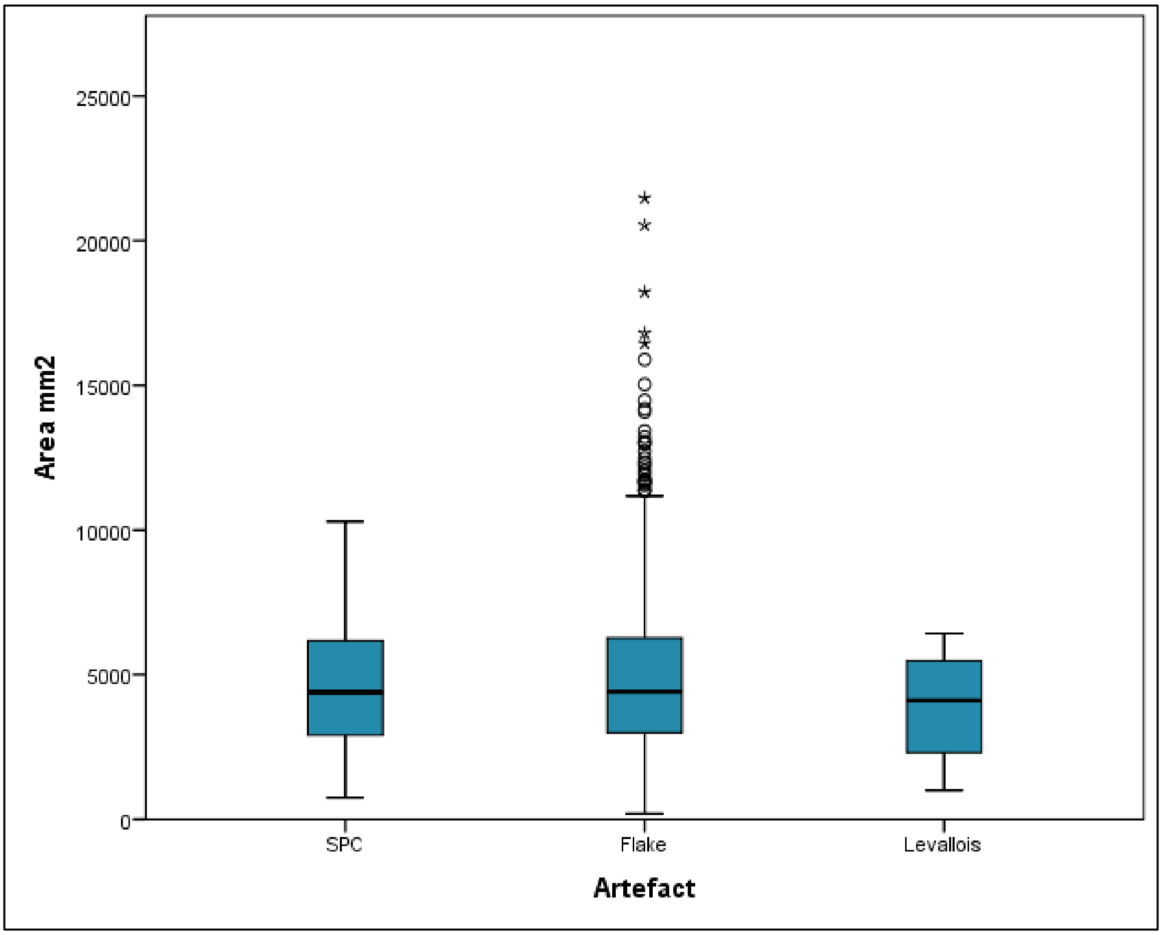


Figure 5.21 Comparison between area of SPC preferential flake scars, Levallois preferential flake scars and area of flakes/flake tools from Purfleet

The thickness of flakes, flake tools and Levallois products were compared to see if there were preferences for tools to be made on thinner flakes and to establish whether Levallois flakes were generally thinner than flakes produced from other techniques. Figure 5.22 demonstrates the median thickness is approximately the same across each category. A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the thickness of each product; the flakes (1,281), flake tools (58) and Levallois endproducs (3). The median thicknesses were not statistically significant between any of the different products, $X^2(2) = 4.150$, $p = .126$.

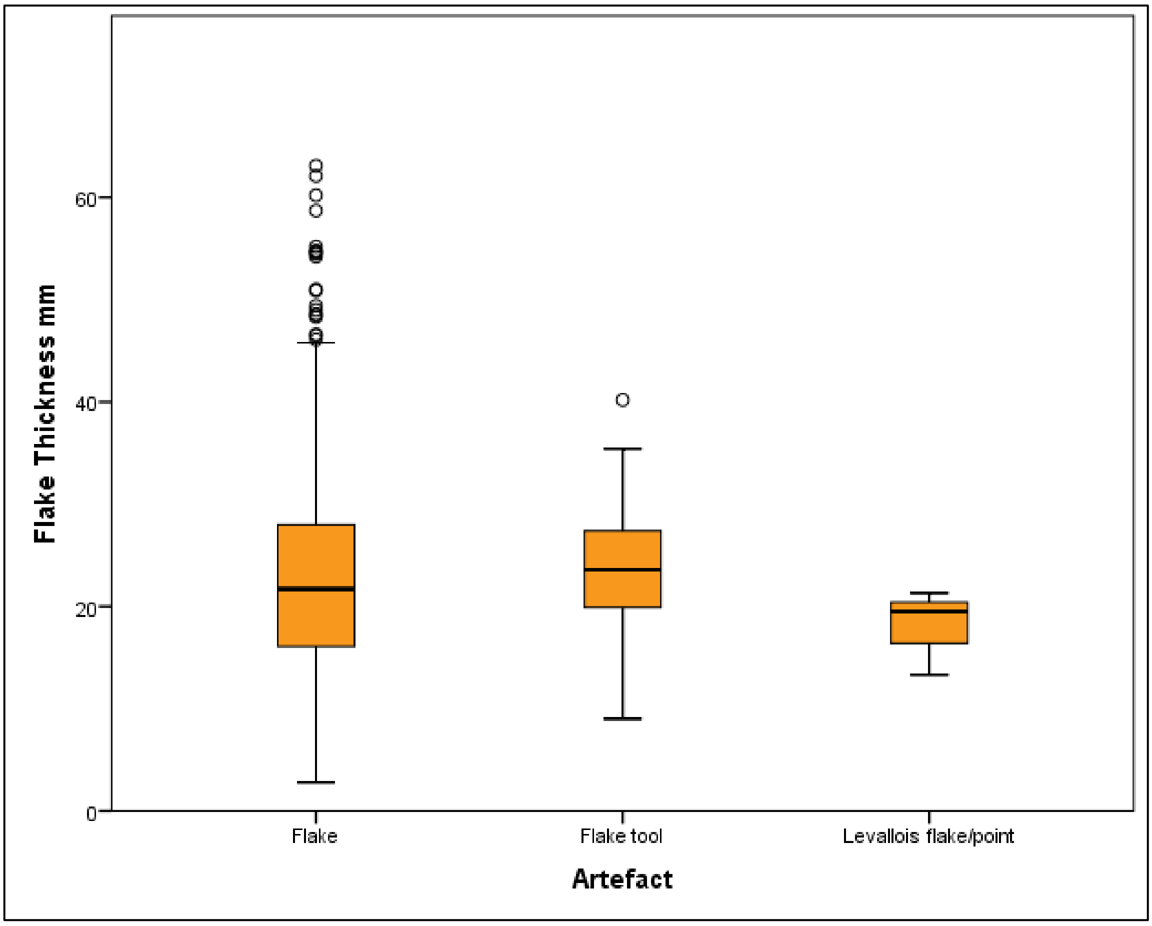


Figure 5.22 Boxplot comparing the thickness of flakes, flake tools and Levallois products from Purfleet

5.8.8 Summary

Purfleet has the largest SPC assemblage. Of the 320 cores, 122 are SPCS. This is not the highest proportion of cores as there are more migrating platform examples. The assemblage as a whole demonstrates little to no rolling with varying extents of staining and patination.

The core technology at Purfleet is varied with five different flake production techniques present. In terms of condition, there is no way to distinguish between the Levallois and SPC material which is consistent with them coming from either the same gravel or two indistinguishable gravels. In terms of size, SPCs fall between migrating platform cores and Levallois cores with the latter being the smaller. SPCs in general also have fewer flake scars compared with the Levallois and discoidal material but more on average compared with the migrating platform cores.

The SPCs themselves demonstrate a great deal of variability in the degree to which they have been prepared on the flaking and striking platform surfaces but they do not demonstrate the same degree of variability with the method of exploitation. The Levallois cores are much less varied in terms of both preparation and exploitation.

Finally, the products of the SPCs are indistinguishable to products of the other flaking methods suggesting there is little difference in terms of the size.

5.9 Red Barns

5.9.1 Lithic assemblage

Two collections from two excavations at Red Barns were studied, one stored at the British Museum and the other at Portsmouth Museum. A total of 2046 items were analysed, 142 of which were natural or non-diagnostic fragments which were then excluded along with one hammerstone. Table 5.56 presents the assemblage breakdown highlighting the large number of flakes but small number of cores (55). Table 5.57 shows the homogeneity of the assemblage condition. The entire assemblage was produced on heavily frost fractured flint. The condition of the material supports the conclusion drawn by Wenban-Smith and colleagues (2000) that the material was from the same deposit.

Artefact	***Count***	***Percentage***
Flake	1555	81.7%
Retouched flake	9	0.5%
Soft hammer flake	251	13%
Cores	55	2.9%
Handaxe	24	1.3%
Levallois flake/tools	0	0%
Refitted flakes	0	0%
Chopper	1	0.1%
Roughout	8	0.4%
Total	**1903**	**100%**

Table 5.56 Red Barns assemblage

Artefact	***Abrasion***			***Staining***			***Patination***		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	1555	0	0	1554	1	0	0	22	1533
Retouched flake	9	0	0	9	0	0	0	0	9
Soft hammer flake	251	0	0	251	0	0	0	6	245
Cores	55	0	0	53	2	0	0	0	55
Handaxe	24	0	0	24	0	0	0	0	24
Levallois flake/tools	0	0	0	0	0	0	0	0	0
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	1	0	0	1	0	0	0	0	1
Roughout	8	0	0	8	0	0	0	0	8
Total	**1903**	**0**	**0**	**1900**	**3**	**0**	**0**	**28**	**1875**

Table 5.57 Red Barns assemblage condition

5.9.2 Core assemblage

There are four different core working techniques at Red Barns, the most common of which is the migrating platform method (see Table 5.58). There are two SPCs and three discoidal cores. Unlike the other assemblages, there are a large number of cores with few removals. Due to the frost fractured nature of the material it is possible these cores are actually tested nodules however as they conform to the methodology for identifying cores, they have been categorised as such.

Core reduction technique	***Count***	***Percentage***
Migrating platform core	41	74.5%
Levallois core	0	0%
SPC	2	3.6%
Discoidal core	3	5.5%
Core with few removals	8	14.6%
Core fragment	1	1.8%
Total	**55**	**100%**

Table 5.58 Red Barns core working techniques

5.9.3 Core condition

The cores are all in a very similar condition which reflects the overall assemblage. They are all fresh with heavy patination and, with the exception of two cores which are lightly stained, have no staining (see Table 5.59).

Core reduction technique	**Red Barns**								
	Abrasion			***Staining***			***Patination***		
	Fresh	**Slightly**	**Heavy**	**None**	**Light**	**Heavy**	**None**	**Light**	**Heavy**
Migrating platform core	41	0	0	39	2	0	0	0	41
Levallois core	0	0	0	0	0	0	0	0	0
SPC	2	0	0	2	0	0	0	0	2
Discoidal core	3	0	0	3	0	0	0	0	3
Core with few removals	8	0	0	8	0	0	0	0	8
Core fragment	1	0	0	1	0	0	0	0	1
Total	**55**	**0**	**0**	**53**	**2**	**0**	**0**	**0**	**55**

Table 5.59 Red Barns core condition

The two SPCs from Red Barns are heavily worked with less than 25% residual cortex however the cores in general demonstrate a range in the extent of reduction (see Table 5.60). A relatively high proportion have over 50% residual cortex whilst four of the cores have none.

Core reduction technique	Cortex				
	0%	<25%	25 - 50%	50 - 75%	>75%
Migrating platform core	3	10	15	13	0
Levallois core	0	0	0	0	0
SPC	0	2	0	0	0
Discoidal core	1	1	1	0	0
Core with few removals	0	1	0	7	0
Core fragment	0	1	0	0	0
Total	**4**	**15**	**16**	**20**	**0**

Table 5.60 Red Barns core cortex coverage

5.9.4 Core technology

A summary of the statistics for core length, breadth and thickness is presented in Appendix D. The data for mean core length is almost identical for the migrating platform and SPCs whilst the discoidal cores have a noticeably shorter mean length. The SPCs are much wider than the other core working techniques with a mean of over 30mm larger. Figure 5.23 plots the flaking surface area against the relative thickness of the cores and demonstrates the range in volume.

A Kruskal-Wallis H test was run to determine if there were differences in volume between the four core working techniques: SPCs (n=2), migrating platform (n=41), discoidal (n=3) and cores with few removals (n=8). Distribution of the volume is similar for all groups, as assessed by visual inspection (see Appendix D). Median volume for SPCs was smaller than all other core working techniques but the differences between the different groups were not statistically significant, $X^2(3) = 6.394$, $p = .094$.

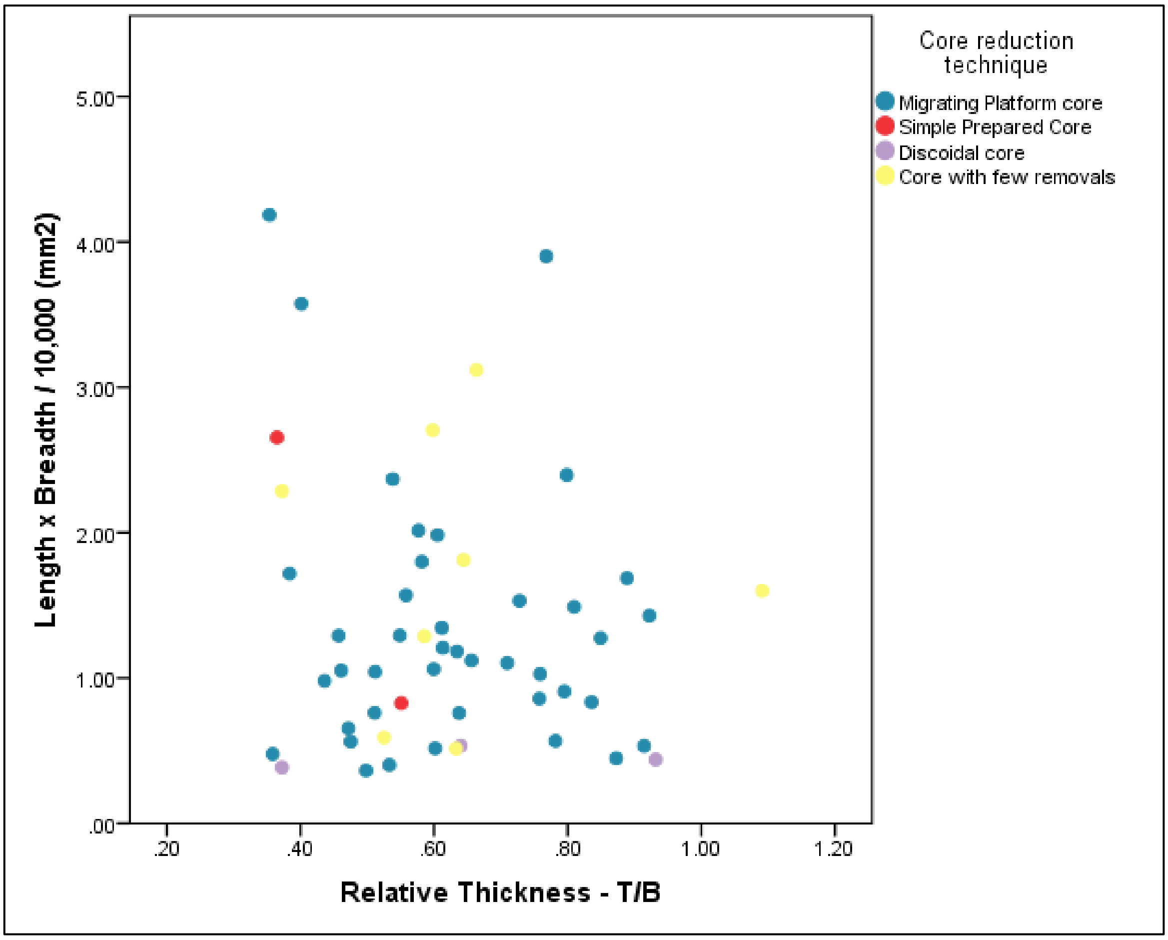


Figure 5.23 Red Barns core volume

Both SPCs from Red Barns have more visible flake scars compared with most of the other core working techniques (see Figure 5.24). The migrating platform cores show a range in the number of visible flake scars with one outlier (∘). The number of flake scars on the SPCs is still within the range of the migrating platform cores.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (2), migrating platform (40), discoidal (3) and cores with few removals (8). Distributions of the number of flake scars were similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.24). The median number of flake scars were statistically significant between the different core techniques, $X^2(3) = 24.872$, $p <= .0005$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and the migrating platform cores, $U = 7.5$, $z = -1.937$, $p = .053$ and the SPCs and the cores with few removals only, $U = .000$, $z = -2.184$, $p = .029$, meaning the SPCs have more flake scars compared with the other techniques.

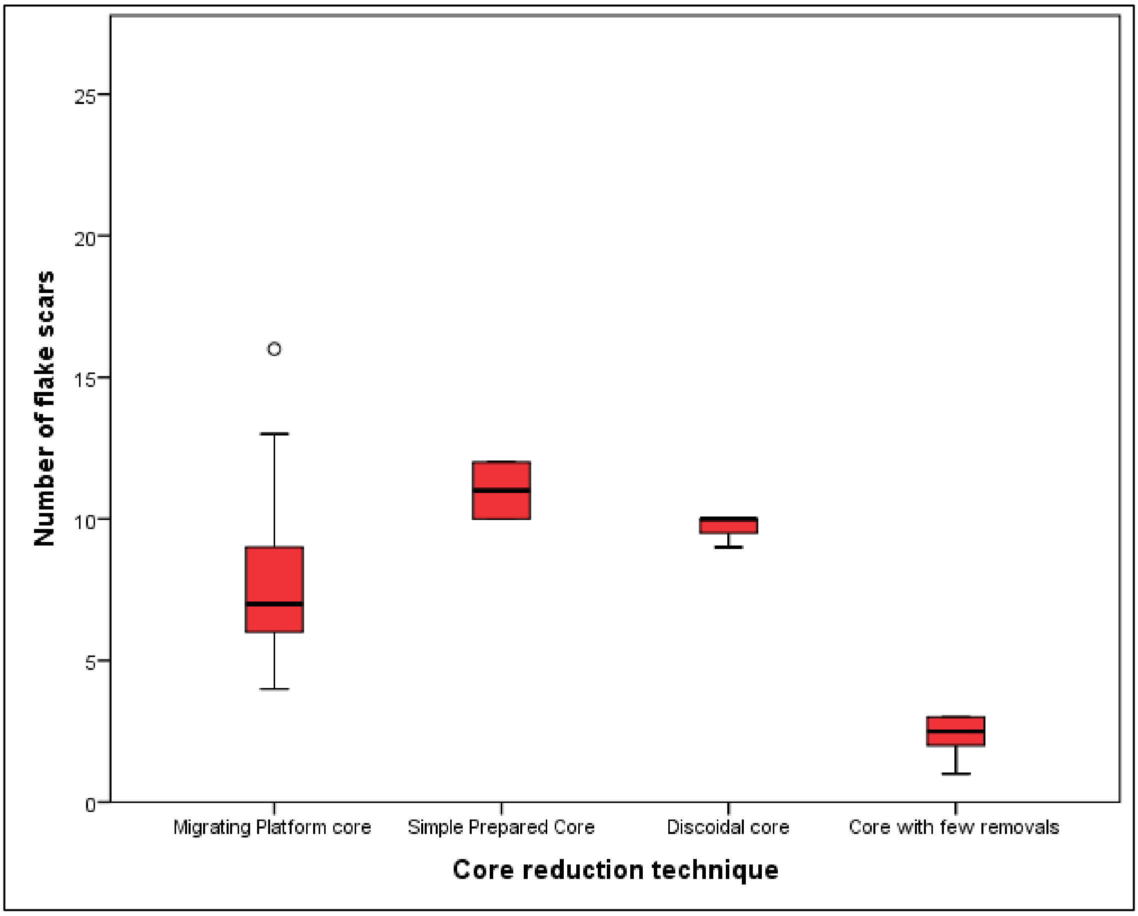


Figure 5.24 Boxplot comparing the number of flake scars on each core from Red Barns

5.9.5 SPCs

There were two SPCs identified in the Red Barns assemblages. One is from the Draper excavations and is recorded to have been found in the spoil heap. The other is from the grey loam in the University of Southampton excavations.

The technological attributes of the two SPCs are also the same. Table 5.61 shows both cores were prepared centripetally with a single, linear, removal and no faceting. Both SPCs from Red Barns fall into category C meaning they have a defined striking platform and preparation on the striking platform in addition to the striking platform (see Table 5.62).

Red Barns SPC n = 2		
Preparation		
Centripetal	2	100%
Unipolar	0	0%
Bipolar	0	0%
Convergent	0	0%
Exploitation		
Linear	2	100%
Recurrent	0	0%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	2	100%

Table 5.61 Technological attributes of the SPCs from Red Barns

SPC Group	***Count***
A	0
B	0
C	2
Total	**2**

Table 5.62 SPC reduction types at Red Barns

5.9.6 Products

Table 5.63 presents the summary of the flake area and SPC preferential scar area statistics. The mean area of the preferential flake scar is over 2,200mm^2 larger than the mean area of the flakes and flake tools. Only one SPC flake scar was recorded due to a more recent removal (as identified by a difference in patination) intersecting the preferential removal. Figure 5.25 compares the area of all SPC preferential flake scars with the flake/ flake tool areas. This graph shows there are a number of outliers (◦) and extreme outliers (⋆) within the flake/ flake tool data, and the SPC data falls outside the range of the flake/ flake tool data. Meaning the products of the SPCs were notably larger in size to the products of the other core reduction techniques.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=1) and the flakes/ flake tool area (n=553) were statistically significant. Distributions for the area of both groups were not similar as assessed by visual inspection (see Figure 5.25). Results determined the median area for SPC products (4953.8) was not statistically significantly different to that for flakes/flake tools (1018.78), U = 40, z = -1.479, p = .139 and therefore likely to be a consequence of sampling variation.

	Flake area mm² (n = 962)	SPC pref. scar area mm² (n = 1)
Mean	2711	4953
Median	1705	4953
Std. Deviation	2840	n/a
Range	20740	0

Table 5.63 Summary statistics for the flake and SPC flake scar areas

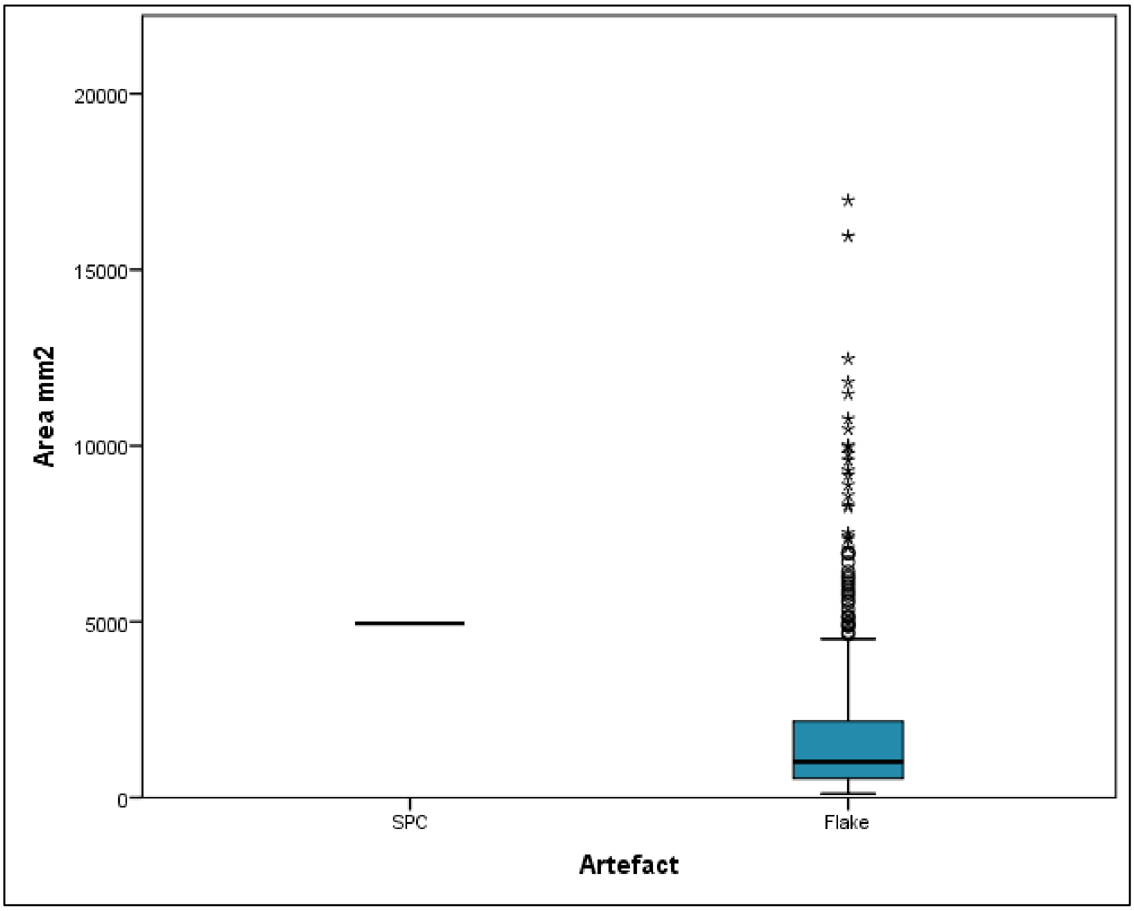


Figure 5.25 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Red Barns

5.9.7 Summary

The Red Barns assemblage is largely flakes with 55 cores, two of which are SPCs. With the exception of a few items, the condition of the material is the same; fresh, no staining and heavy patination reflecting the *in situ* nature of the assemblage.

The cores assemblage consists of four different methods of reduction including SPC technology. The most common cores are those which fall under the migrating platform umbrella category but all methods display a range of residual cortex and therefore a range in the extent of reduction.

The SPCs are generally smaller than the other techniques with a greater number of flake scars but not statistically significantly so.

The SPCs demonstrate little variation in terms of preparation or exploitation and though the products of the SPCs may be larger in area compared with the other methods of flake production, the difference is not statistically significant.

5.10 Kesselt-Op de Schans

5.10.1 Lithic assemblage

Many items in this assemblage were not recorded because they were smaller than 10mm in axial length or because they were flakes which had been refitted and stuck together making it impossible to record dimension and characteristics. The material which was included in the analysis is presented in Table 5.64. The assemblage as a whole is in a fresh, unabraided condition with little to no staining and patination (see Table 5.65). The homogenous condition of the material combined with the presence of many small fragments of débitage and refits suggest no post-depositional movement of the material

With the exception of a small group of refits made on sandstone, all of the assemblage was made on flint.

Artefact	***Count***	***Percentage***
Flake	223	77.7%
Retouched flake	3	1%
Soft hammer flake	0	0%
Cores	6	2.1%
Handaxe	0	0.0%
Levallois flake/tools	6	2.1%
Refitted flakes	48	17%
Blade	1	0.3%
Chopper	0	0%
Roughout	0	0%
Total	**287**	**100%**

Table 5.64 Kesselt-Op assemblage

Artefact	Abrasion			Staining			Patination		
	Fresh	*Slightly*	*Heavy*	*None*	*Light*	*Heavy*	*None*	*Light*	*Heavy*
Flake	218	5	0	204	13	6	210	13	0
Retouched flake	3	0	0	3	0	0	3	0	0
Soft hammer flake	0	0	0	0	0	0	0	0	0
Cores	6	0	0	6	0	0	6	0	0
Handaxe	0	0	0	0	0	0	0	0	0
Levallois flake/tools	6	0	0	6	0	0	6	0	0
Refitted flakes	48	0	0	48	0	0	48	0	0
Blade	1	0	0	1	0	0	1	0	0
Chopper	0	0	0	0	0	0	0	0	0
Roughout	0	0	0	0	0	0	0	0	0
Total	**282**	**5**	**0**	**268**	**13**	**6**	**274**	**13**	**0**

Table 5.65 Kesselt-Op assemblage condition

5.10.2 Core assemblage

There are only six cores in the Kesselt-Op assemblage (see Table 5.66). The most common core working technique is the discoidal method. There is also one SPC, one migrating platform core and one Levallois core.

Core reduction technique	*Count*	*Percentage*
Migrating platform core	1	16.7%
Levallois core	1	16.7%
SPC	1	16.7%
Discoidal core	3	50%
Refitting flakes and core	0 (3)	0%
Total	**6**	**100%**

Table 5.66 Kesselt-Op core working techniques

5.10.3 Core condition

Reflecting the assemblage as a whole, all six cores are in the same condition. They are fresh with no staining and no patination (see Table 5.67). There is some variation with regards to residual cortex and therefore the extent to which the cores have been reduced (see Table 5.68). The SPC has the most cortex remaining potentially making it the least reduced.

Core reduction technique	Kesselt-Op								
	Abrasion			*Staining*			*Patination*		
	Fresh	Slightly	Heavy	None	Light	Heavy	None	Light	Heavy
Migrating platform core	1	0	0	1	0	0	1	0	0
Levallois core	1	0	0	1	0	0	1	0	0
SPC	1	0	0	1	0	0	1	0	0
Discoidal core	3	0	0	3	0	0	3	0	0
Total	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**

Table 5.67 Kesselt-Op core condition

Core reduction technique	*Cortex*				
	0%	<25%	25 - 50%	50 - 75%	>75%
Migrating platform core	0	1	0	0	0
Levallois core	0	0	1	0	0
SPC	0	0	0	1	0
Discoidal core	1	0	2	0	0
Total	**1**	**1**	**3**	**1**	**0**

Table 5.68 Kesselt-Op core cortex coverage

5.10.4 Core technology

A summary of the statistics for the length, breadth and thickness of the cores is presented in Appendix D. The SPC is larger than the Levallois and the discoidal core. The SPC is a similar size to the migrating platform core in terms of length and breadth but the SPC is much thinner though not as thin as the Levallois or the discoidal core. The length and breadth of the cores has been plotted against the relative width in Figure 5.26 and demonstrates the SPC and Levallois cores have similar relative thicknesses but the Levallois core has a smaller flaking surface area.

A Kruskal-Wallis H test was run to determine if there were differences in volume between the four core working techniques: SPCs (n=1), Levallois (1), migrating platform (n=11) and discoidal (n=3). Distribution of the volume is not similar for all groups, as assessed by visual inspection (see Appendix D). Mean volume for SPCs was larger than both the Levallois and discoidal mean but smaller than the migrating platform mean however the differences were not statistically significant between the different techniques, $X^2(3) = 4.429$, $p = .219$.

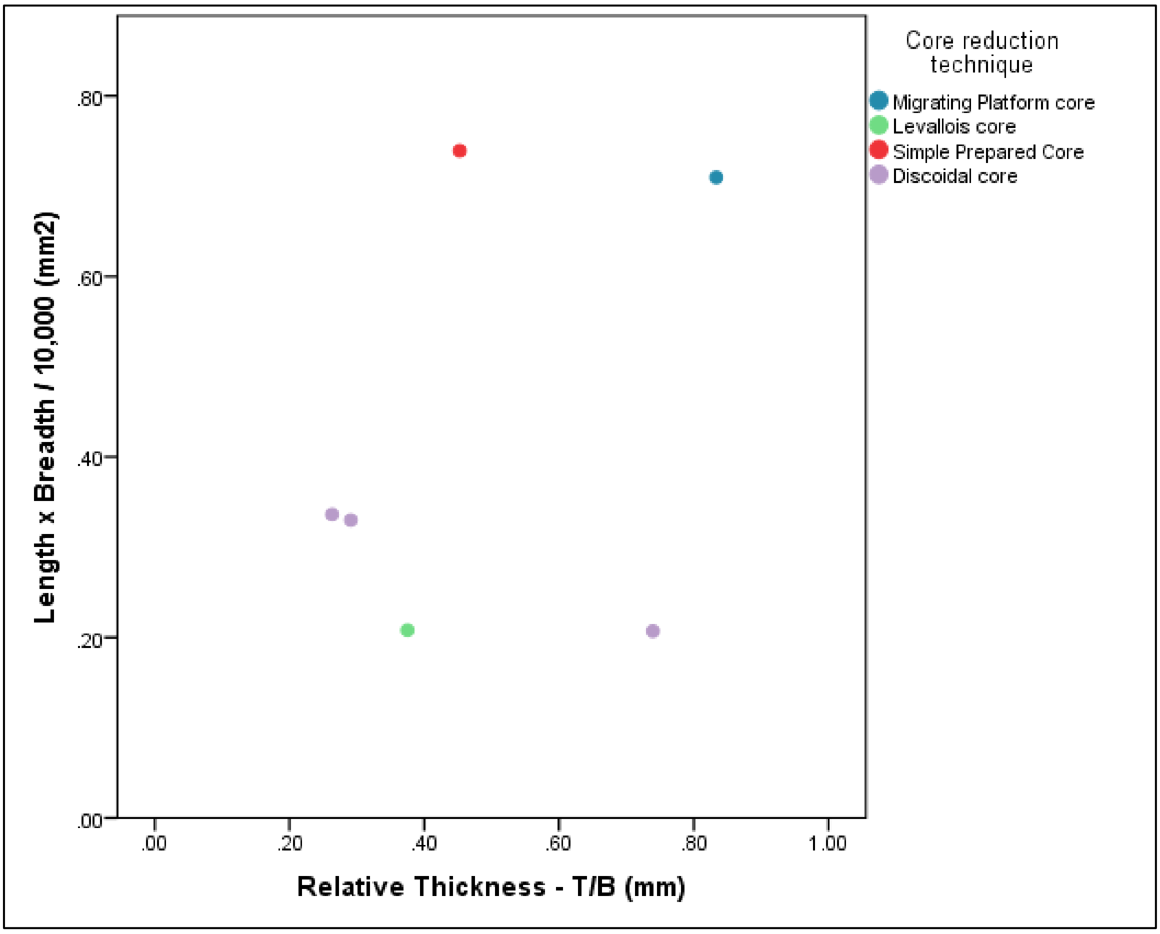


Figure 5.26 Kesselt-Op core volume

The cores from Kesselt-Op all have a high number of visible flake scars. Figure 5.27 demonstrates the differences between the six cores. The discoidal cores have the highest number of removals and the migrating platform core has the fewest.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPC (1), Levallois (1) migrating platform (1) and discoidal (3). Distributions of the number of flake scars were not similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.27). The mean ranks of the number of flake scars were not statistically significant between the different core techniques, $X^2(3) = 4.429$, $p = .219$.

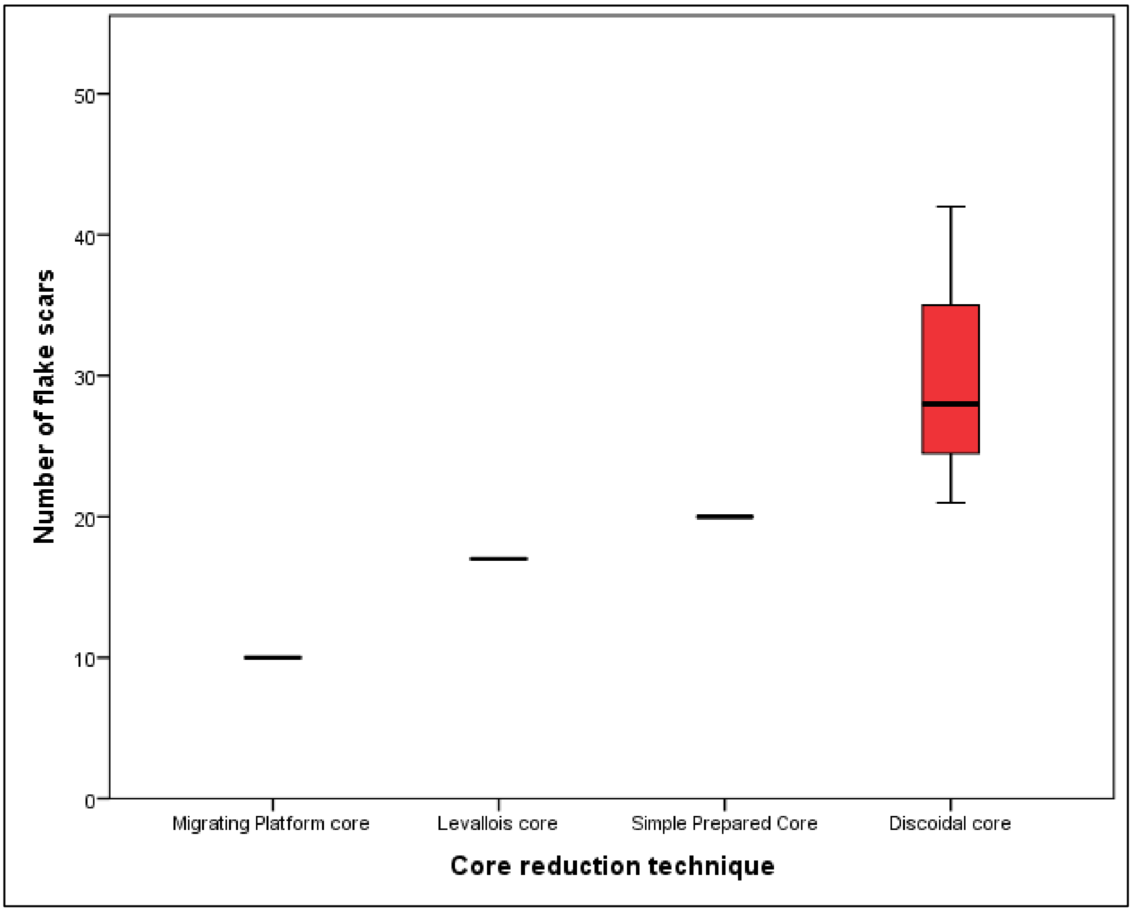


Figure 5.27 Boxplot comparing the number of flake scars on each core from Kesselt-Op

5.10.5 SPCs

There was one SPC identified from the Kesselt-Op assemblage. The exact location of this core has been well recorded within ODS4.

The SPC from Kesselt-Op has been prepared centripetally with recurrent exploitation and no faceting of the striking platform (see Table 5.69). The SPC displays a moderate amount of preparation of the striking platform surface making it SPC Group B (see Table 5.70).

Kesselt-Op SPC n = 1		
Preparation		
Centripetal	0	0%
Unipolar	0	0%
Bipolar	1	100%
Convergent	0	0%
Exploitation		
Linear	0	0%
Recurrent	1	100%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	1	100%

Table 5.69 Technological attributes of the SPCs from Kesselt-Op

SPC Group	*Count*
A	0
B	1
C	0
Total	**1**

Table 5.70 SPC reduction type at Kesselt-Op

5.10.6 Levallois core

Like the SPC from Kesselt-Op, the Levallois core has been prepared through centripetal flaking with recurrent exploitation. Unlike the SPC, this core has a clear faceted butt (see Table 5.71).

Kesselt-Op Levallois n = 1		
Preparation		
Centripetal	1	100%
Unipolar	0	0%
Bipolar	0	0%
Convergent	0	0%
Exploitation		
Linear	0	0%
Recurrent	1	100%
Unexploited	0	0%
Faceting		
Yes	1	100%
No	0	0%

Table 5.71 Technological attributes of the Levallois core from Kesselt-Op

5.10.7 Products

Table 5.72 presents the summary of the flake area and SPC preferential scar area statistics. The size of the Levallois preferential removal scar was obstructed by refits and measurements were not therefore taken. The mean area of the preferential flake scars is over 3300mm^2 larger than the area of the flakes and flake tools. Figure 5.28 compares the area of the SPC preferential flake scar with the flake/ flake tool areas. This graph shows there are a number of outliers (◦) and extreme outliers (⋆) within the flake/ flake tool data but the SPC data falls outside the range of the flake data meaning the product of the SPC were notably larger in size compared to the products of the other core reduction techniques.

A Mann-Whitney U test was run to determine if the differences between the SPC preferential scar area (n=1) and the flakes/ flake tool area (n=174) were statistically significant. Distributions for the area of both groups were not similar as assessed by visual inspection (see Figure 5.28). Results determined the area for the SPC product (4284) was not statistically significantly different to that for flakes/flake tools (979.43), $U = 8$, $z = -1.564$, $p = .118$.

	Flake area mm^2 (n = 174)	***SPC pref. scar area mm^2 (n = 1)***
Mean	979	4284
Median	316	4284
Std. Deviation	1449	n/a
Range	8249	0

Table 5.72 Summary statistics for the flake and SPC flake scar areas

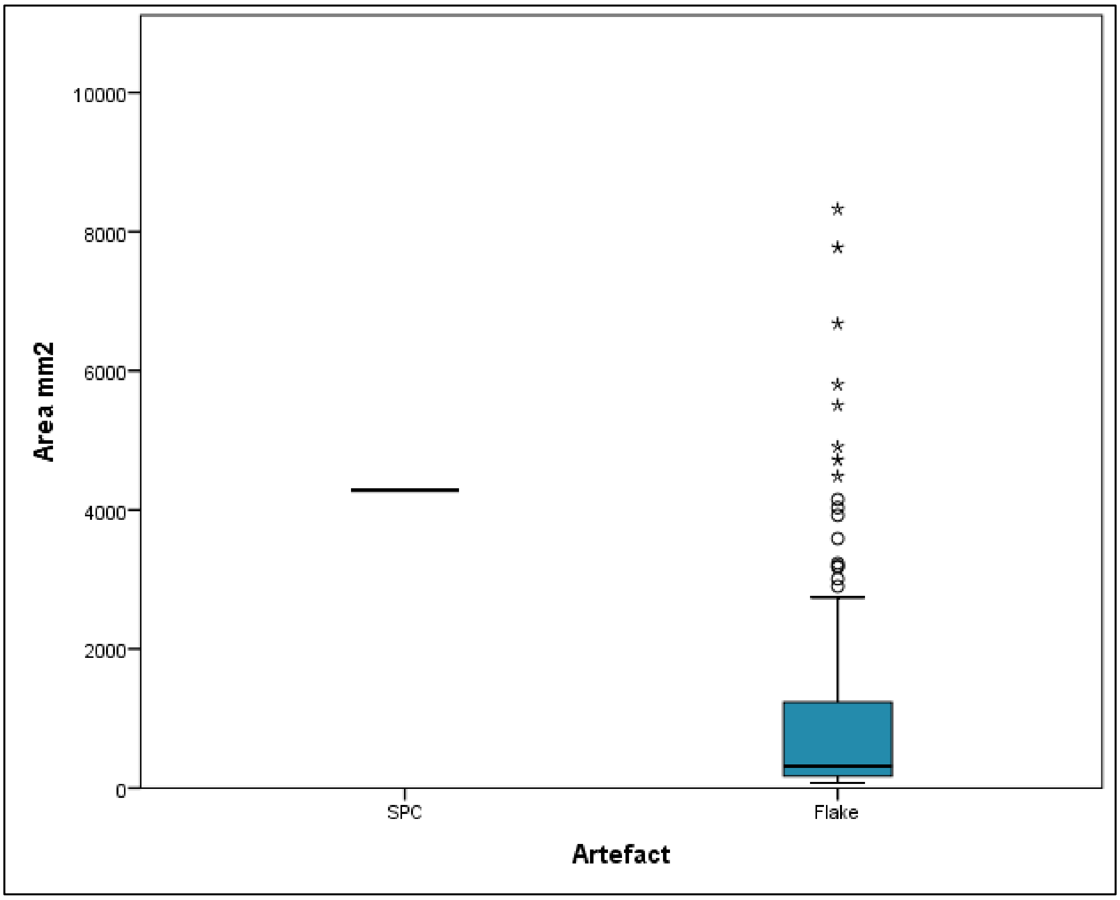


Figure 5.28 Comparison between area of SPC preferential flake scars and area of flakes/flake tools from Kesselt-Op

The thickness of flakes, flake tools and Levallois products were compared to see if there were preferences for tools to be made on thinner flakes and to establish whether Levallois flakes were generally thinner than flakes produced from other techniques. Figure 5.29 demonstrates the median thickness is not visually similar for each category and suggests the flake tools and Levallois products were generally thicker than the flakes. A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the thickness of each product; the flakes (159), flake tools (3) and Levallois endproducs (6). The mean ranks of the number of flake scars were statistically significant between the different core techniques, $X^2(2) = 13.447$, $p = .001$. Subsequent post hoc analysis using the Mann-Whitney U test between the different products revealed a statistically significant result between the flakes and the flake tools $U = 56$, $z = -2.268$, $p = .023$ and between the flakes and the Levallois products $U = 139.5$, $z = -2.938$, $p = .003$ but not between the flake tools and the Levallois products $U = 7$, $z = -.516$, $p = .714$.

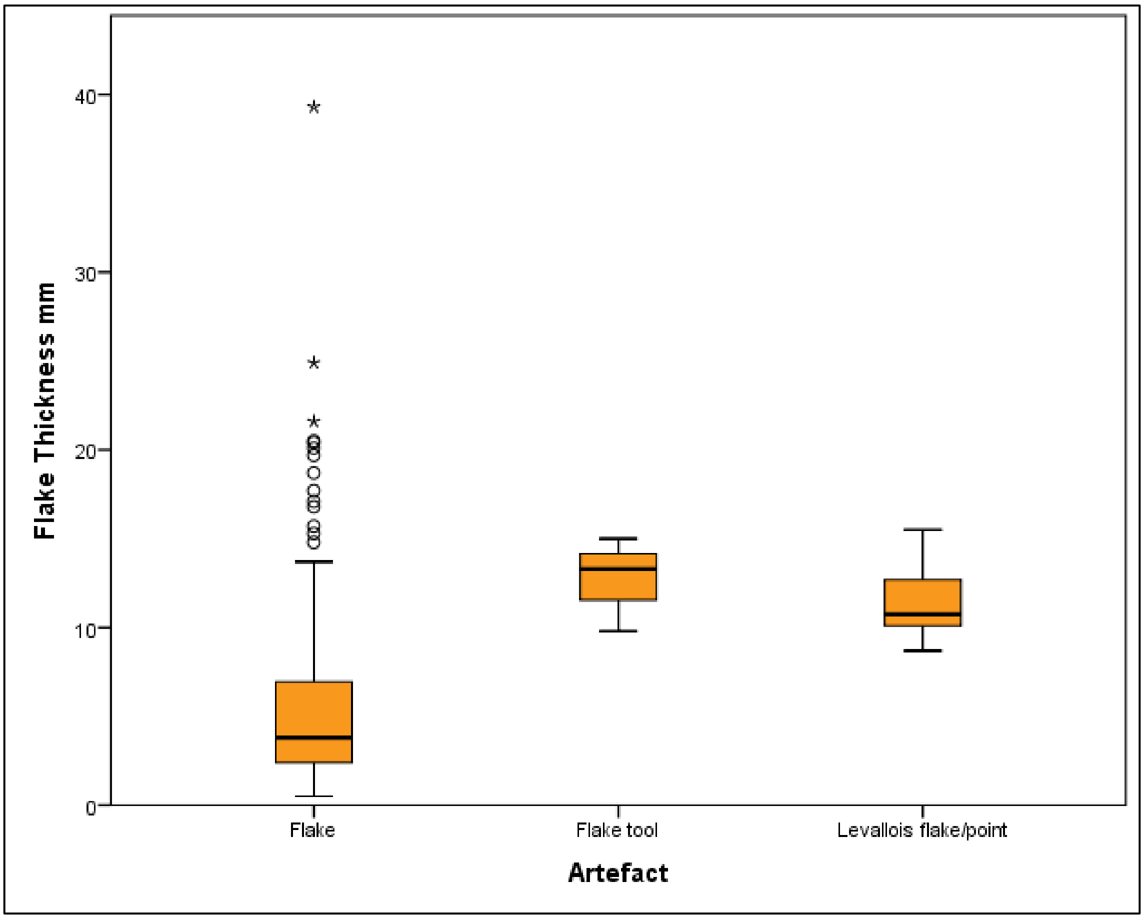


Figure 5.29 Boxplot comparing the thickness of flakes, flake tools and Levallois products from Kesselt-Op

5.10.8 Summary

The Kesselt-Op assemblage is relatively small as chips and fragments smaller than 10mm were not recorded. Of the 287 artefacts, only six are cores and only one of these is a SPC. The assemblage as a whole is fresh with no staining or patination reflecting the *in situ* nature of the material.

The core assemblage is very small with only one SPC and one Levallois core. All six cores are in the same condition as the assemblage in general. The discoidal cores have the most flake scars whilst the Levallois core and the SPC have a similar number of flake scars.

The single SPC falls into group B with bipolar preparation, two preferential removals and no faceting of the striking platform. The Levallois core is centripetally prepared with recurrent exploitation and a faceted striking platform. The area of the one preferential removal which was recordable is larger and outside the range of the area of the flakes and flakes tools however the difference is not statistically significant.

5.11 Mesvin IV

5.11.1 Lithic assemblage

The Mesvin IV assemblage is the largest studied in this investigation. In total there are 7,889 artefacts (Cahen and Michel 1986:96), however not all of these could be analysed in detail and hence the sampling method described in Chapter 3 was followed for the flakes and flake tools. A total of 1,050 items were recorded, 24 of which were non-diagnostic fragments and one hammerstone which were not analysed further (see Table 5.73). Initial observations noted a large number of Levallois flakes, too large to have come from any of the Levallois cores present. It was also noted, a number of 'classic' Levallois flakes were on loan from the collection. The Mesvin IV material is in a mixed condition (see Table 5.76) which reflects the fluvial nature of the deposition. Unlike at Dunbridge there does not seem to be any noticeable difference in condition between the Levallois material, the SPCs and the handaxes. This probably indicates some of the material at least has been re-worked from higher deposits. The entire assemblage is made on flint.

Artefact	***Count***	***Percentage***
Flake	715	69.8%
Retouched flake	106	10.3%
Soft hammer flake	19	2%
Cores	81	7.9%
Handaxe	15	1.5%
Levallois flake/tools	87	8.5%
Refitted flakes	0	0%
Chopper	2	0%
Roughout	0	0%
Total	**1025**	**100%**

Table 5.73 Mesvin assemblage

Artefact	Abrasion			Staining			Patination		
	Fresh	*Slightly*	*Heavy*	*None*	*Light*	*Heavy*	*None*	*Light*	*Heavy*
Flake	481	227	7	196	224	295	332	183	200
Retouched flake	71	31	4	15	16	75	36	37	33
Soft hammer flake	19	0	0	7	3	9	11	4	4
Cores	33	39	9	7	21	53	20	28	33
Handaxe	8	6	1	5	2	8	5	5	5
Levallois flake/tools	75	12	0	14	19	54	44	19	24
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	2	0	0	1	0	1	0	0	2
Roughout	0	0	0	0	0	0	0	0	0
Total	**689**	**315**	**21**	**245**	**285**	**495**	**448**	**276**	**301**

Table 5.74 Mesvin IV assemblage condition

5.11.2 Core assemblage

There are a range of core working techniques implemented at Mesvin IV. The most common method is the migrating platform technique. There are a similar number of Levallois, SPC and discoidal cores (see Table 5.75).

Core reduction technique	*Count*	*Percentage*
Migrating platform core	32	39.5%
Levallois core	15	18.5%
SPC	13	16.0%
Discoidal core	11	13.6%
Refitting flakes and core	2	2.5%
Core with few removals	4	4.9%
Core fragment	4	4.9%
Total	**81**	**100%**

Table 5.75 Mesvin IV core working techniques

5.11.3 Core condition

The cores from Mesvin IV are in a mixed condition reflecting the assemblage as a whole (see Table 5.76). No one core reduction method is in a particularly different condition.

Table 5.77 demonstrates that almost half of the cores from Mesvin IV have less than 25% cortex remaining, suggesting they were not in the early stages of reduction. The cores with the least residual cortex are Levallois whilst the majority of SPCs have between 25-50% cortex remaining.

Core reduction technique	Mesvin IV								
	Abrasion			*Staining*			*Patination*		
	Fresh	Slightly	Heavy	None	Light	Heavy	None	Light	Heavy
Migrating platform core	13	18	1	0	8	24	5	13	14
Levallois core	4	10	1	2	4	9	5	2	8
SPC	5	5	3	2	0	11	3	5	5
Discoidal core	6	2	3	1	5	5	4	5	2
Core with few removals	1	2	1	0	1	3	0	2	2
Refitting flakes and core	2	0	0	0	2	0	1	1	0
Core fragment	2	2	0	2	1	1	2	0	2
Total	**33**	**39**	**9**	**7**	**21**	**53**	**20**	**28**	**33**

Table 5.76 Mesvin IV core condition

Core reduction technique	*Cortex*				
	0%	<25%	25 - 50%	50 - 75%	>75%
Migrating platform core	2	13	12	5	0
Levallois core	6	4	5	0	0
SPC	3	0	9	1	0
Discoidal core	3	7	1	0	0
Core with few removals	0	0	2	2	0
Refitting flakes and core	1	1	0	0	0
Core fragment	0	1	3	0	0
Total	**15**	**26**	**32**	**8**	**0**

Table 5.77 Mesvin IV core cortex coverage

5.11.4 Core technology

One of the discoidal cores is broken and has therefore been excluded from the dimension analysis. A summary of the statistics for the length, breadth and thickness is presented in Appendix D. The migrating platform cores have the largest mean length and thickness dimensions along with the greatest range. The mean SPC dimensions are similar to those of the migrating platform cores but slightly wider and thinner. The Levallois cores have the all-round smallest average dimensions closely followed by the discoidal cores which have a mean breadth similar to the SPC mean breadth. Figure 5.30 plots the relative thickness of the cores against the length x breadth measurements. This data demonstrates the migrating platform cores are relatively thicker whilst the discoidal cores are relatively thinner. The data for the SPCs and Levallois cores falls between the two.

A Kruskal-Wallis H test was run to determine if there were differences in volume between the five core working techniques: SPCs (n=13), Levallois (n=15), migrating platform (n=32), discoidal (n=10) and cores with few removals (n=4). Distribution of the volume is similar for all groups, as assessed by visual inspection (see Appendix D). Median volume for SPCs was larger than both the Levallois and discoidal medians and smaller than the migrating platform and cores with few removals medians. The differences between the reduction techniques were statistically significant, $X^2(5) = 11.98$, $p = .035$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and the Levallois cores only, $U = .47$, $z = -2.326$, $p = .020$ suggesting the SPCs are genuinely larger than the Levallois cores.

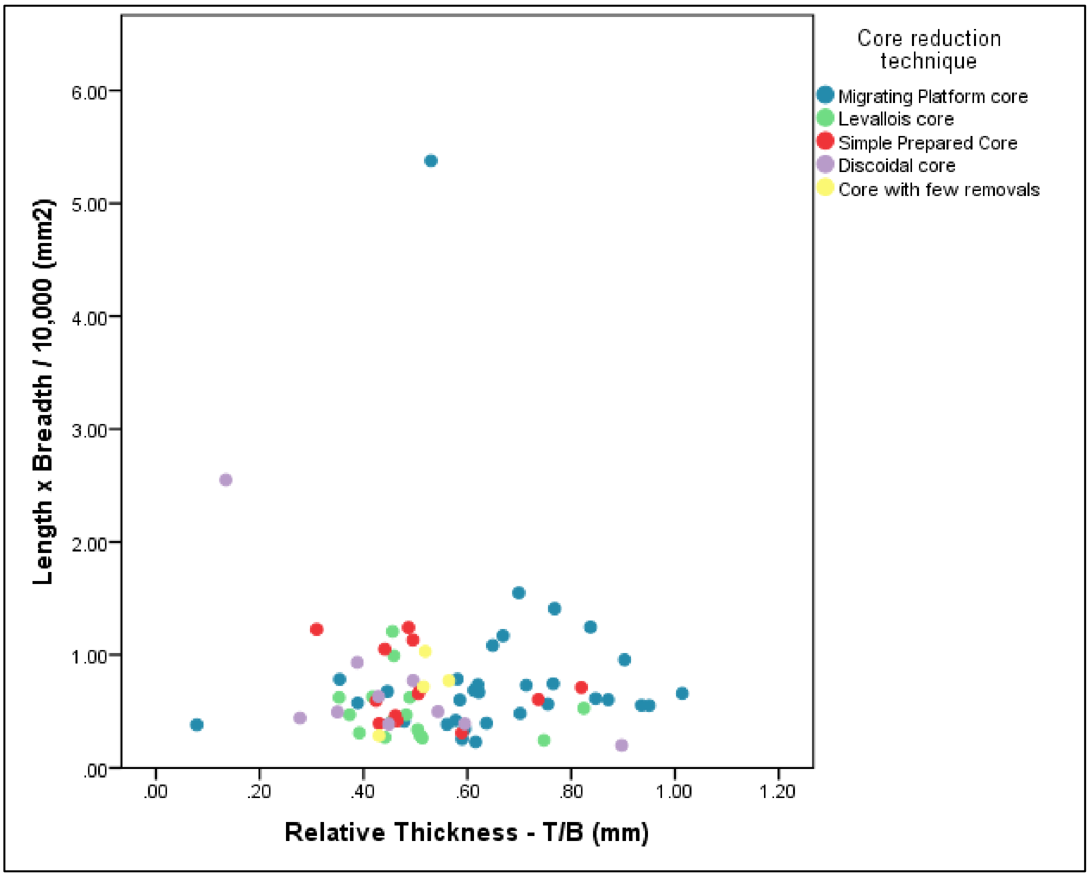


Figure 5.30 Mesvin IV core volume

Figure 5.31 shows the variation in the number of visible flake scars. The Levallois cores have the highest mean number of scars as well as the range. The SPCs have a lower mean compared with the migrating platform, Levallois and discoidal cores. The Levallois range is similar to that of the discoidal cores whilst the migrating platform range is similar to the SPCs. There are three outliers (∘) and one extreme outlier (⋆) in the migrating platform cores. The two core tools have a very different number of remaining scars and the refitting core and flakes has a high number of removals. This is unsurprising as the refitting core and flakes is a Levallois core with a refitting preparatory flake and Levallois flake.

A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the number of flake scars between the different core working techniques; the SPCs (13), Levallois (15) migrating platform (31), discoidal (11) and cores with few removals (4). Distributions of the number of flake scars were not similar for all core groups as assessed by visual inspection of a boxplot (see Figure 5.31). The mean ranks of the number of flake scars were statistically significant between the different core techniques, $X^2(4) = 38.079$, $p = <.001$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the different core working techniques individually revealed a statistically significant result between the SPCs and the Levallois cores $U = 3.000$, $z = -4.365$, $p <= .0005$, The SPCs and the discoidal cores, $U = 12.5$, $z = -3.441$, $p = .001$, and the SPCs and the cores with few removals, $U = .000$, $z = -2.983$, $p = .001$.

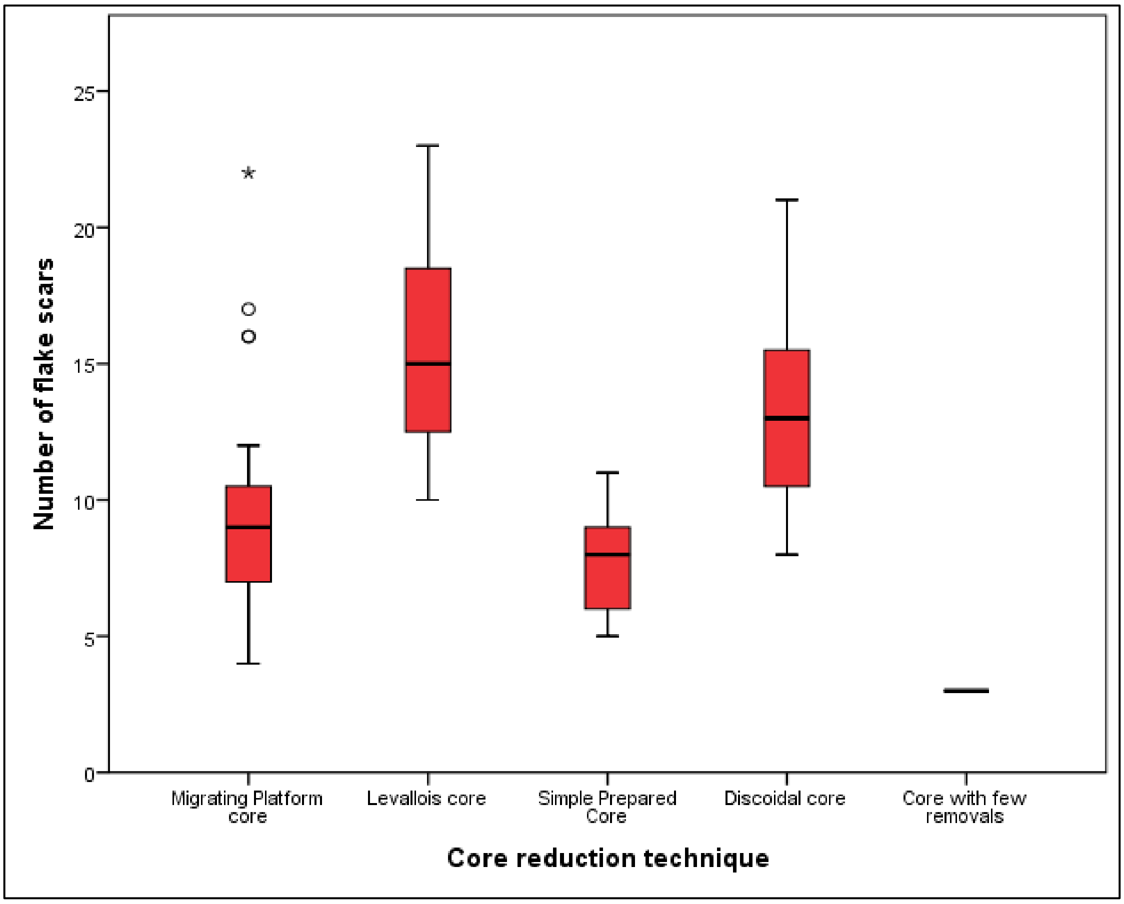


Figure 5.31 Boxplot comparing the number of flake scars on each core from Mesvin IV

5.11.5 SPCs

There were 13 SPCs identified in the Mesvin IV assemblage. It is unknown from which of the two channels the cores originated.

As seen in Table 5.79, the SPCs from Mesvin IV show a varying degree of preparation. Technologically the SPCs are all very similar. Only one SPC is recurrent and all 13 do not have faceted striking platforms. The only technological variation is apparent in the preparation of the cores. Six of the SPCs have been prepared centripetally, six are unipolar, and the final core is convergent (see Table 5.78). Almost 50% of the SPCs have very minimal preparation of the striking platform surface with only a single removal for a striking platform making them group A. One core has preparation of the striking platform surface around the full extent of the plane of intersection whilst the remaining six cores have some preparation of the striking platform surface in addition to the striking platform.

Mesvin IV SPC n = 13		
Preparation		
Centripetal	6	46.2%
Unipolar	6	46.2%
Bipolar	0	0%
Convergent	1	7.7%
Exploitation		
Linear	12	92.3%
Recurrent	1	7.7%
Unexploited	0	0%
Faceting		
Yes	0	0%
No	13	100%

Table 5.78 Technological attributes of the SPCs from Mesvin IV

SPC Group	***Count***
A	6
B	6
C	1
Total	**13**

Table 5.79 SPC reduction types at Mesvin IV

5.11.6 Levallois cores

The Levallois cores from Mesvin IV demonstrate a range of technological attributes. Table 5.80 shows the variation is particularly apparent in the methods of exploitation. The majority of Levallois cores have been prepared centripetally with one unipolar and one convergent core. There are two cores which lack faceted striking platforms. These cores will be discussed in depth in the following chapter.

Mesvin IV Levallois n = 15		
Preparation		
Centripetal	13	86.6%
Unipolar	1	6.7%
Bipolar	0	0%
Convergent	1	6.7%
Exploitation		
Linear	9	60%
Recurrent	2	13.4%
Unexploited	4	26.6%
Faceting		
Yes	13	86.6%
No	2	13.4%

Table 5.80 Technological attributes of the Levallois cores from Mesvin IV

5.11.7 Products

Table 5.81 presents the summary of the flake area and SPC preferential scar area statistics. The mean area of the preferential flake scars is over 1600mm^2 larger than the area of the flakes and flake tools. Figure 5.32 compares the area of all SPC preferential flake scars with the flake/ flake tool areas. This graph shows there are a number of outliers (◦) and extreme outliers (⋆) within the flake/ flake tool data and one outlier in the SPC data. The differences between the two means are clear along with the difference in midspreads. Meaning the products of the SPCs are notably different in size to the products of the other core reduction techniques but that the difference in sample size may have influenced the results.

A Kruskal-Wallis H test was run to determine if the differences between the SPC preferential scar area (n=14), the Levallois preferential scar area (n=10) and the flakes/ flake tool area (n=630) were statistically significant. Distributions for the area of all groups were similar as assessed by visual inspection (see Figure 5.32). Results determined the median area for SPC products (3081.04) was statistically significantly different to that for Levallois products (2097.99) and flakes/flake tools (1669.94), $X^2(2) = 12.693$, $p = .002$. Subsequent post hoc analysis using the Mann-Whitney U test between the SPCs and the other two groups individually revealed statistically significant differences between the SPCs and the flakes, U – 1985, $z = -3.522$, $p <= .0005$ and SPCs and Levallois products U – 27, $z = -2.518$, $p = .012$, meaning the SPCs flakes are generally larger than the flakes from other production techniques.

	Flake area mm^2 (n = 631)	*SPC pref. scar area mm^2 (n = 14)*	*Levallois pref. scar area mm^2 (n = 10)*
Mean	2285	3976	2315
Median	1668	3081	2097
Std. Deviation	2239	2271	1791
Range	17154	8069	6450

Table 5.81 Summary statistics for the flake and SPC flake scar areas

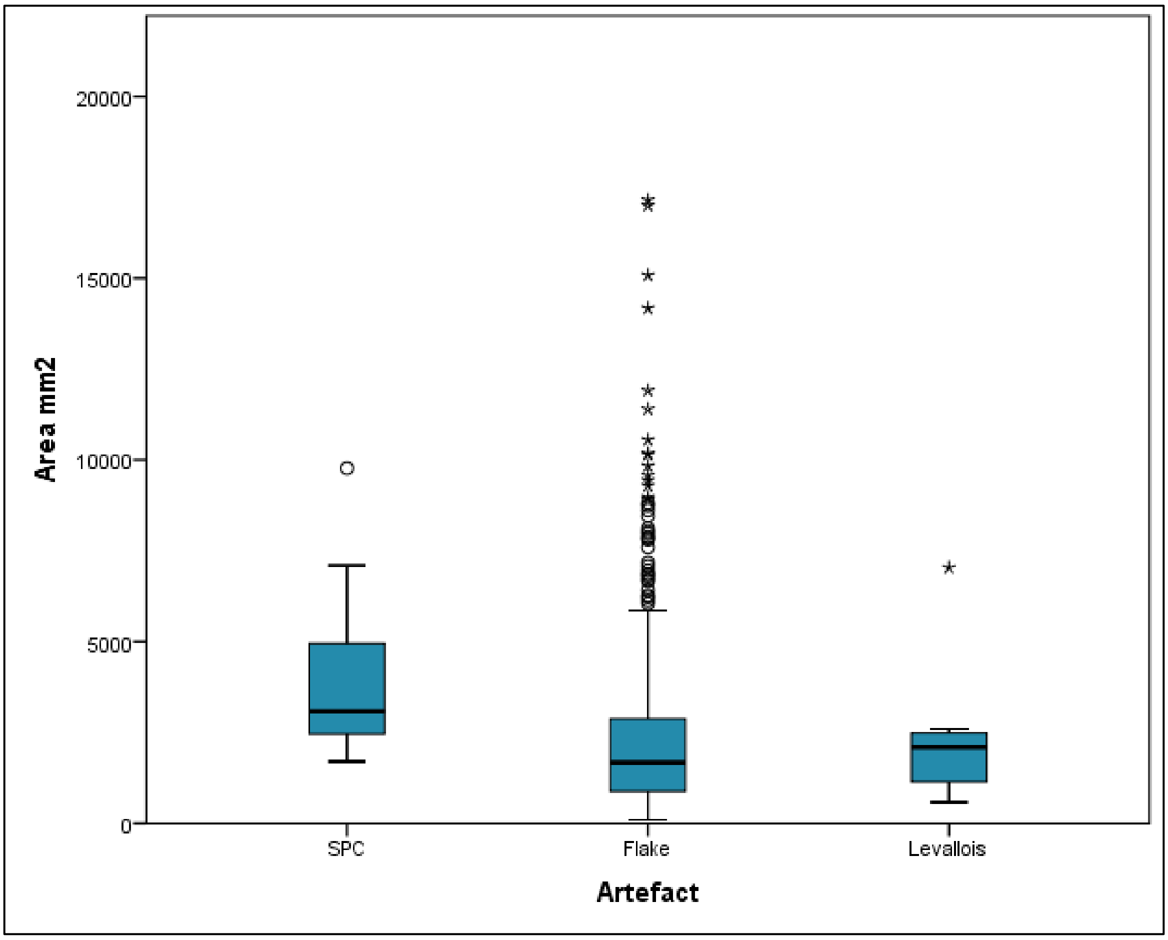


Figure 5.32 Comparison between area of SPC preferential flake scars, Levallois preferential flake scars and area of flakes/flake tools from Mesvin IV

The thickness of flakes, flake tools and Levallois products were compared to see if there were preferences for tools to be made on thinner flakes and to establish whether Levallois flakes were generally thinner than flakes produced from other techniques. Figure 5.33 demonstrates the median thickness is approximately the same across each category. A Kruskal-Wallis H test was conducted to determine if there were statistically significant differences in the thickness of each product; the flakes (455), flake tools (76) and Levallois endproducs (678. The median thicknesses were statistically significant between the different products, $X^2(2) = 85.217$, $p = <.0005$. Subsequent post hoc analysis using the Mann-Whitney U test between the different products revealed a statistically significant result between the flakes and the flake tools $U = 8841$, $z = -$

6.824, $p <= .0005$ and between the flakes and the Levallois products $U = 8781$, $z = -7.133$, $p <= .0005$ but not between the flake tools and the Levallois products $U = 2788$, $z = -.363$, $p = .525$.

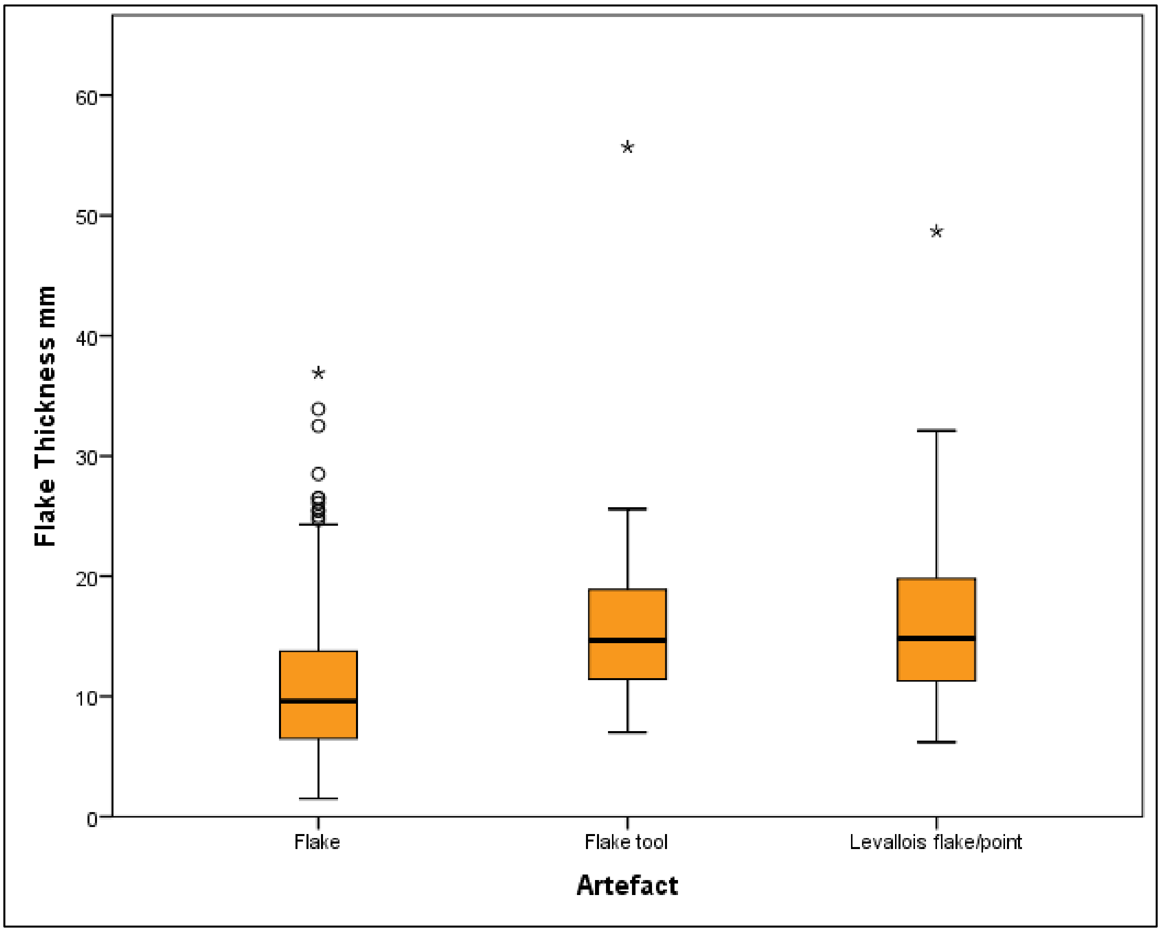


Figure 5.33 Boxplot comparing the thickness of flakes, flake tools and Levallois products from Mesvin IV

5.11.8 Summary

The Mesvin IV assemblage is large but not all the material was recorded for this investigation. Of the 1025 artefacts analysed, 81 are cores. The condition of the assemblage is very mixed in all categories reflecting the fluvial nature of the assemblage.

The core assemblage comprises a full range of reduction techniques. The condition of the core assemblage is mixed as is the condition of the SPCs. Of the four main reduction techniques, the SPCs have the fewest number of flake scars and all of the SPC data falls within the range of the migrating platform data. The Levallois cores have the highest number of scars but the data is very similar to the discoidal data.

The SPCs demonstrate a range of methods for preparation and exploitation. The Levallois cores demonstrate less variation in preparation but display a range of exploitation techniques. The products of the SPCs, based on the area of the preferential removals are statistically significantly larger than the flakes and flake tools and the Levallois preferential flake scars, which implies the SPCs were producing larger flakes.

5.12 Assemblage Integrity

As mentioned in Chapter 4, many of the assemblages analysed in this investigation are formed of collections or are from early excavations where the recording techniques fall short of today's standards. Some of the sites have been reinvestigated and new material has helped to locate the origins of earlier material, but unfortunately for sites like Frindsbury new excavations have not been possible. The condition of the material within the assemblages is therefore an important tool for assessing the integrity of the assemblage.

As seen in Table 5.82, Dunbridge is the only assemblage in this investigation where the majority of the material is heavily abraded suggesting a significant amount of post-depositional movement. The material from Frindsbury, Red Barns and Kesselt-Op is in a fresh condition indicating little to no post-depositional movement and, potentially, material in primary/near context. The remaining six sites are somewhat mixed suggesting the material has been subjected to some movement and is most likely to be in secondary context like most material from fluvial deposition. As this research is not looking to put a precise date on the earliest appearance of SPC technology and is instead aiming to examine technological variation on a wider scale, these assemblages have been included and a broad scale based on MIS stage will be adopted. As noted by Wenban-Smith and colleagues (2007), the study of transported artefacts could be considered to represent a more holistic view of stone technology as it reflects a time and space average rather than a snapshot of activity.

Artefact	***Abrasion***			***Staining***			***Patination***		
	Fresh	***Slightly***	***Heavy***	***None***	***Light***	***Heavy***	***None***	***Light***	***Heavy***
Flake	481	227	7	196	224	295	332	183	200
Retouched flake	71	31	4	15	16	75	36	37	33
Soft hammer flake	19	0	0	7	3	9	11	4	4
Cores	33	39	9	7	21	53	20	28	33
Handaxe	8	6	1	5	2	8	5	5	5
Levallois endproducts	75	12	0	14	19	54	44	19	24
Refitted flakes	0	0	0	0	0	0	0	0	0
Chopper	2	0	0	1	0	1	0	0	2
Roughout	0	0	0	0	0	0	0	0	0
Total	**689**	**315**	**21**	**245**	**285**	**495**	**448**	**276**	**301**

Table 5.82 A summary of the assemblage conditions

5.13 Data Presentation Summary

Sub-research Question 1 asked how frequent SPCs are in the archaeological record. The results presented in this chapter have demonstrated that SPCs are far more prevalent than expected and that Purfleet is not the only assemblage which contains a SPC component. No other site analysed for this research has produced as many SPCs are Purfleet but proportionally, there are several sites with a strong SPC presence. In the following chapter the technological relationship between SPCs, Levallois cores and other Lower Palaeolithic core working techniques will be discussed followed by a discussion in Chapter 7 on the behavioural and cognitive implications for the hominins employing these techniques.

Chapter 6: Data Interpretation

6.1 Introduction

This chapter will discuss the results presented in Chapter 5, from a thematic perspective in relation to the Research Questions presented in Chapter 1. The results of the analysis on an inter-site level will be discussed leading to conclusions about variation in Lower Palaeolithic core working techniques and the technological relationship between SPCs and Levallois technology. The following chapter will discuss the origins of Levallois along with the behavioural and cognitive implications of the appearance of SPC technology.

This chapter will address the main research question:

What is the precise technological relationship between SPCs and the Levallois technique, and what will this tell us about the behaviour of the hominins associated with these new ways of making stone tools?

Along with the following sub-questions:

Research sub-question 1

How prevalent are SPCs within Lower Palaeolithic assemblages in northwest Europe?

Research sub-question 2

What is the relationship between SPCs and other Lower Palaeolithic core working techniques?

The final sub-research question 3 will be addressed in Chapter 7.

6.2 Discussion of Lithic Analysis

6.2.1 Introduction

In this section the implications of the results presented in Chapter 5 will be discussed at an inter-site level and in relation to the Research Questions. Specific focus will be upon the SPC frequency within the assemblages, variation within the core working techniques, SPC variation and a discussion regarding the intended products of SPCs at both an inter and intra-site level.

6.2.2 SPC component of the assemblages

Sub-research Question 1 asks:

How prevalent are SPCs within Lower Palaeolithic assemblages in northwest Europe?

Prior to this research, SPC technology has been identified at Purfleet, Frindsbury and Kesselt-Op de Schans (White and Ashton 2003; Van Baelen 2014). Cores which resemble those from Purfleet have been mentioned in the literature since the 1960s (Wymer 1968; Roe 1981) but no direct comparisons between the cores or the technology had taken place. Potentially confusing and often misleading terminology such as ‘reduced’, ‘proto’, ‘Levallois-like’ and ‘proto-tortoise’ have added to the confusion surrounding the origins of Levallois technology as it is not clear if these cores represent a crude form of the technique or an earlier technology which paved the way for Levallois technology. Scott (2011) has demonstrated the huge variation in Levallois technology which does not conform to the classic centripetal, linear cores. Prior to the research for this thesis, it could be argued the ‘proto’ or ‘reduced’ Levallois cores mentioned at sites such as Biddenham and Cuxton were non-classic Levallois as opposed to a separate technique.

The results presented in Chapter 5 demonstrate SPCs are present at nine of the ten sites analysed. Although the total number of SPCs in each assemblage is relatively low, this reflects the low core densities. Figure 6.1 presents the core data, as a percentage contribution to the total core assemblage from each site with the red segments representing the SPC component. The sites of Cuxton, Feltwell and Red Barns all have a very small proportion of SPCs in relation to the other core working techniques present and Frindsbury is the only site where SPCs are the dominant core technique. Although Frindsbury is the only site with predominantly SPC technology, the technique is also well represented at Purfleet and Biddenham and demonstrates similar or greater numbers to the discoidal cores at most of the sites.

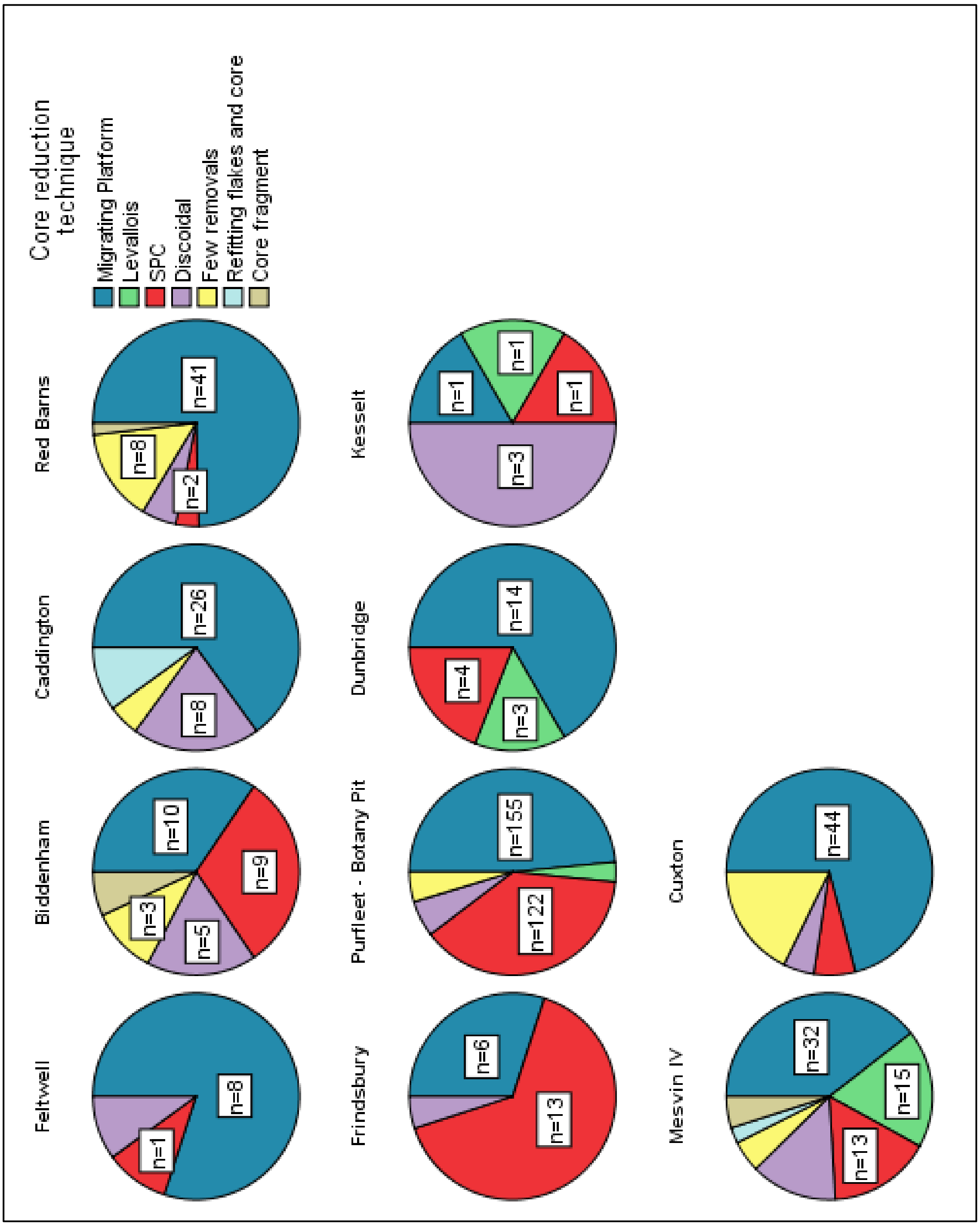


Figure 6.1. A comparison of the percentage of core techniques present at each site. Sites are presented approximately in order of MI Stage.

Regardless of the exact quantities, Figure 6.1 demonstrates SPCs are more prevalent in the archaeological record than previously thought and the detailed attribute analysis confirms the cores which have been described in different ways in the past, including varying terminology, are technologically the same. When considering the sites studied in this investigation, it is clear SPCs are a component of the core working repertoire.

In summary, SPCs are more prevalent within northwest European assemblages than previous research has demonstrated with nine of the ten assemblages analysed for this thesis containing SPC technology.

6.2.3 Core Variation

Sub-research Question 2 is investigating the relationship between SPCs and other Lower Palaeolithic core working techniques. Three different factors will be considered when discussing this relationship; the frequency of the SPCs as opposed to the other techniques, the extent of exploitation and the end products of the different techniques.

Frequency

The analysis which answered Sub-research Question 1 above will also provide part of the answer for Sub-research Question 2 with regards to the frequency of the SPCs in relation to the other flaking methods. Figure 6.1 not only demonstrates SPC presence, it also demonstrates how the SPC technique does not appear to have replaced any of the other methods. With the exception of Dunbridge, all of the assemblages analysed which contain SPC technology also include migrating platform and discoidal cores. The charts have been ordered by their estimated MI Stage which also highlights the SPCs do not replace either of the other techniques over time.

Part of the answer to Sub-research Question 2 must therefore state SPCs are found alongside other Lower Palaeolithic core working techniques.

Extent of exploitation

Addressing the extent to which a core has been reduced is problematic unless the full refitting sequence is available. This is because the original size of the nodule of raw material is unknown and without this it is not possible to say exactly how much the core is smaller than it once was. In an attempt to circumvent this problem, three proxies will be used together to estimate the extent of reduction for the different Lower Palaeolithic core working techniques thus making comparisons between the methods possible. These three proxies are the residual cortex on the core, the total number of visible flake scars and the volume of the core.

<u>Residual cortex</u>

The first proxy used to estimate extent of reduction is the percentage of cortex remaining on the core. A comparison of the data for amount of cortex remaining for each core technique at each site is presented in Table 6.1. This data demonstrates SPCs often have more residual cortex when compared to other core working techniques in the same assemblage.

None of the assemblages contained cores which have over 75% cortex remaining. This may be because nodules with less than 3 removals were not classed as cores but instead were categorised as tested nodules. Unsurprisingly, the majority of cores with few removals were the most cortical at each site. With the exception of Kesselt-Op, the highest proportion of SPCs within each assemblage falls into the 25-50% remaining cortex category. At six of the sites, the highest proportion of migrating platform cores falls into the <25% category whilst the remaining four sites are in the 25-50% category. In most assemblages the discoidal cores have less than 25% cortex remaining. The data for the Levallois cores is slightly mixed. At Purfleet and Mesvin IV, the majority of Levallois cores have between 0% and <25% cortex whilst at Dunbridge and Kesselt-Op, the Levallois cores are in the 25-50% category. The discoidal cores demonstrate a similar pattern of residual cortex to the SPCs but the migrating platform cores, particularly at Cuxton, Purfleet and Red Barns, demonstrate a wider range of cores in each category.

Overall, in each assemblage, using residual cortex as a proxy, SPCs display a similar extent of reduction as discoidal cores which is less than the migrating platform cores.

Site	Core reduction technique	Cortex				
		0%	<25%	25 - 50%	50 - 75%	>75%
Biddenham	Migrating Platform	0	7	3	0	0
	SPC	1	3	5	0	0
	Discoidal	1	2	2	0	0
	Few removals	0	0	3	0	0
Caddington	Migrating Platform	1	16	8	1	0
	Discoidal	1	7	0	0	0
	Few removals	0	0	1	1	0
Cuxton	Migrating Platform	0	13	18	13	0
	SPC	0	0	3	1	0
	Discoidal	1	2	0	0	0
	Few removals	0	2	1	8	0
Dunbridge	Migrating Platform	1	4	7	2	0
	Levallois	0	0	3	0	0
	SPC	1	1	2	0	0
Feltwell	Migrating Platform	1	4	3	0	0
	SPC	0	1	0	0	0
	Discoidal	0	1	0	0	0
Frindsbury	Migrating Platform	0	3	3	0	0
	SPC	1	5	5	2	0
	Discoidal	1	0	0	0	0
Purfleet	Migrating Platform	19	59	57	20	0
	Levallois	0	7	3	0	0
	SPC	2	15	82	23	0
	Discoidal	7	9	2	0	0
	Few removals	1	2	2	10	0
Red Barns	Migrating Platform	3	10	15	13	0
	SPC	0	2	0	0	0
	Discoidal	1	1	1	0	0
	Few removals	0	1	0	7	0
Kesselt-Op	Migrating Platform	0	1	0	0	0
	Levallois	0	0	1	0	0
	SPC	0	0	0	1	0
	Discoidal	1	0	2	0	0
Mesvin IV	Migrating Platform	2	13	12	5	0
	Levallois	6	4	5	0	0
	SPC	3	0	9	1	0
	Discoidal	3	7	1	0	0
	Few removals	0	0	2	2	0

Table 6.1 A comparison of the percentage of cortex remaining on the different core working techniques from each site.

<u>Visible flake scars</u>

In Chapter 5, the number of flake scars on each core was presented for each site. Figure 6.2 presents the mean number of removals for each core working technique for each site to examine if the same patterns can be seen throughout the data. With the exception of Kesselt-Op, which has the smallest sample size, it can be seen that Levallois cores, when present, have the highest number of removals. It could be hypothesised therefore, that if SPCs are a less intensive or reduced form of Levallois, that these cores would have fewer removals anyway but still higher than other techniques as they are becoming more complex. Figure 6.2 demonstrates this is not the case as at all but one site where discoidal cores are present, they have on average more removals than the SPCs. Also somewhat surprisingly, migrating platform cores also have similar or higher means throughout the data. Frindsbury and Cuxton are the only sites at which SPCs have a higher mean number of removals than the migrating platform cores.

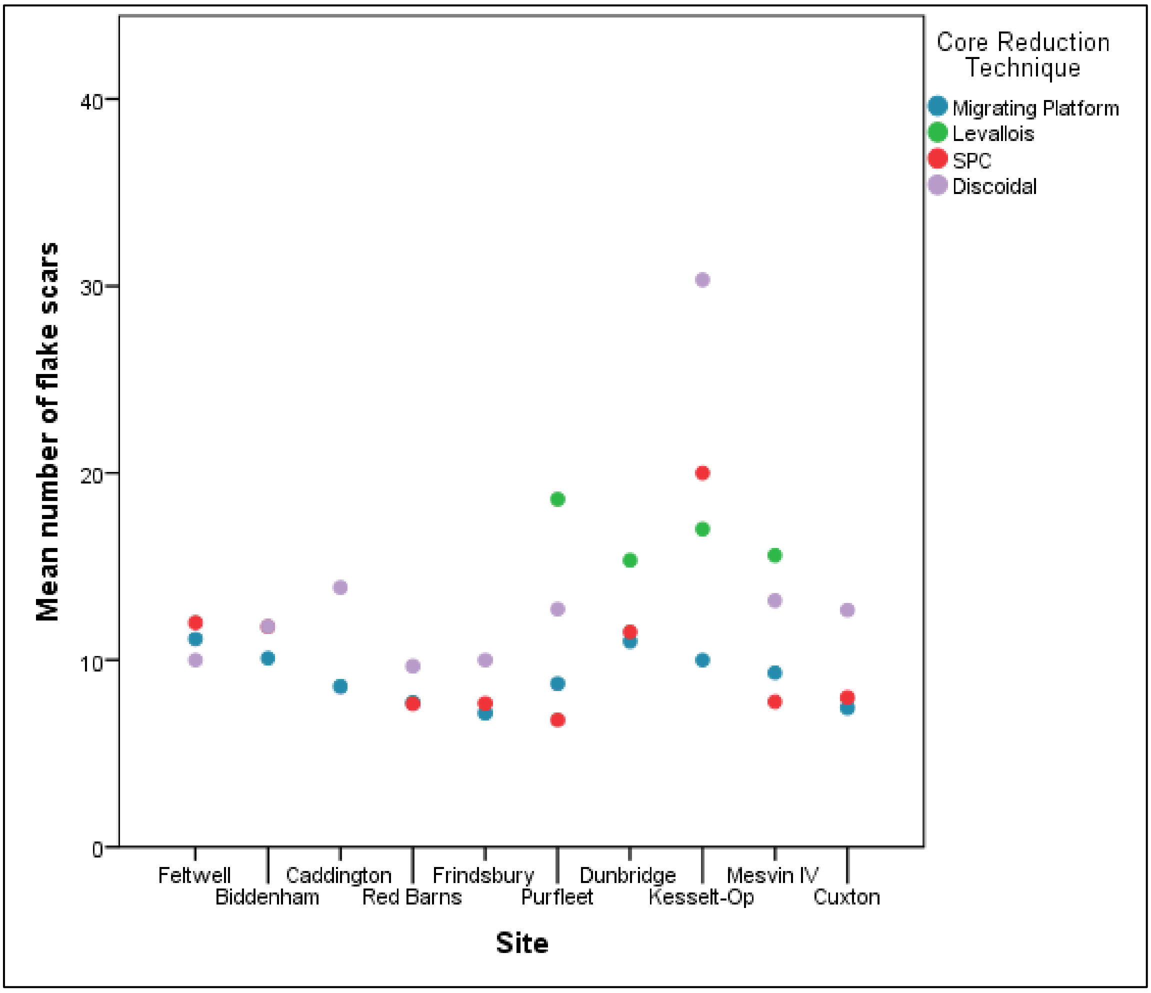


Figure 6.2 A comparison of the mean number of flake scars for the different core working techniques at each site

In further contribution to an answer for Sub-research Question 2, if the number of flake scars is used as a proxy for extent or intensity of exploitation, this would suggest the SPCs were less heavily reduced than other core working techniques.

Core volume

The two proxies discussed above are also connected to the size of the cores. Cores with a greater volume have a larger surface area to exploit and may therefore display more flakes scars. However the reverse could also be true, cores which have been heavily reduced may have a small volume but a large number of flake scars. It is for this reason the size of the cores will now be addressed and provide a contribution towards an answer to Sub-research Question 2.

Figure 6.3 collates the data for the length x breadth measurements plotted against the relative thickness measurements to compare the volume of the different core working techniques in each assemblage.

Physically, the SPCs are not the smallest in terms of length, breadth or thickness in any of the assemblages with the exception of Dunbridge where the mean SPC length is the smallest of the different core techniques. Conversely the SPCs are also, on average, not the largest cores in any assemblage. They do however often demonstrate the largest mean measurements for breadth. This is the case for Cuxton, Feltwell, Frindsbury, Purfleet (this measurement is joint with discoidal), Red Barns and Kesselt-Op. Not only do Cuxton and Feltwell have the largest mean breadth but they also demonstrate the largest mean lengths. The larger core breadths could be a reflection of the organisation of the core. The greater width would have enabled the creation of a larger flaking surface and so support the optimisation of the core.

When comparing the volumes of the different core working techniques, SPCs are only the largest at Cuxton and Feltwell. With the exception of Biddenham, where the migrating platform cores have the smallest mean volume, at all of the sites either discoidal or Levallois cores have the smallest mean core volume. This could suggest the SPCs were not the most heavily reduced when using volume as a proxy. Clearly there is an issue with the contemporaneity of the Levallois material as discussed in section 4.5, page 89. But even if the Levallois material is excluded from the analysis, SPCs are only the smallest and, by proxy, potentially the most heavily reduced cores at Dunbridge. The smallest mean volume after Levallois in the other assemblages is discoidal. It is noted that there are no discoidal cores in the Dunbridge assemblage.

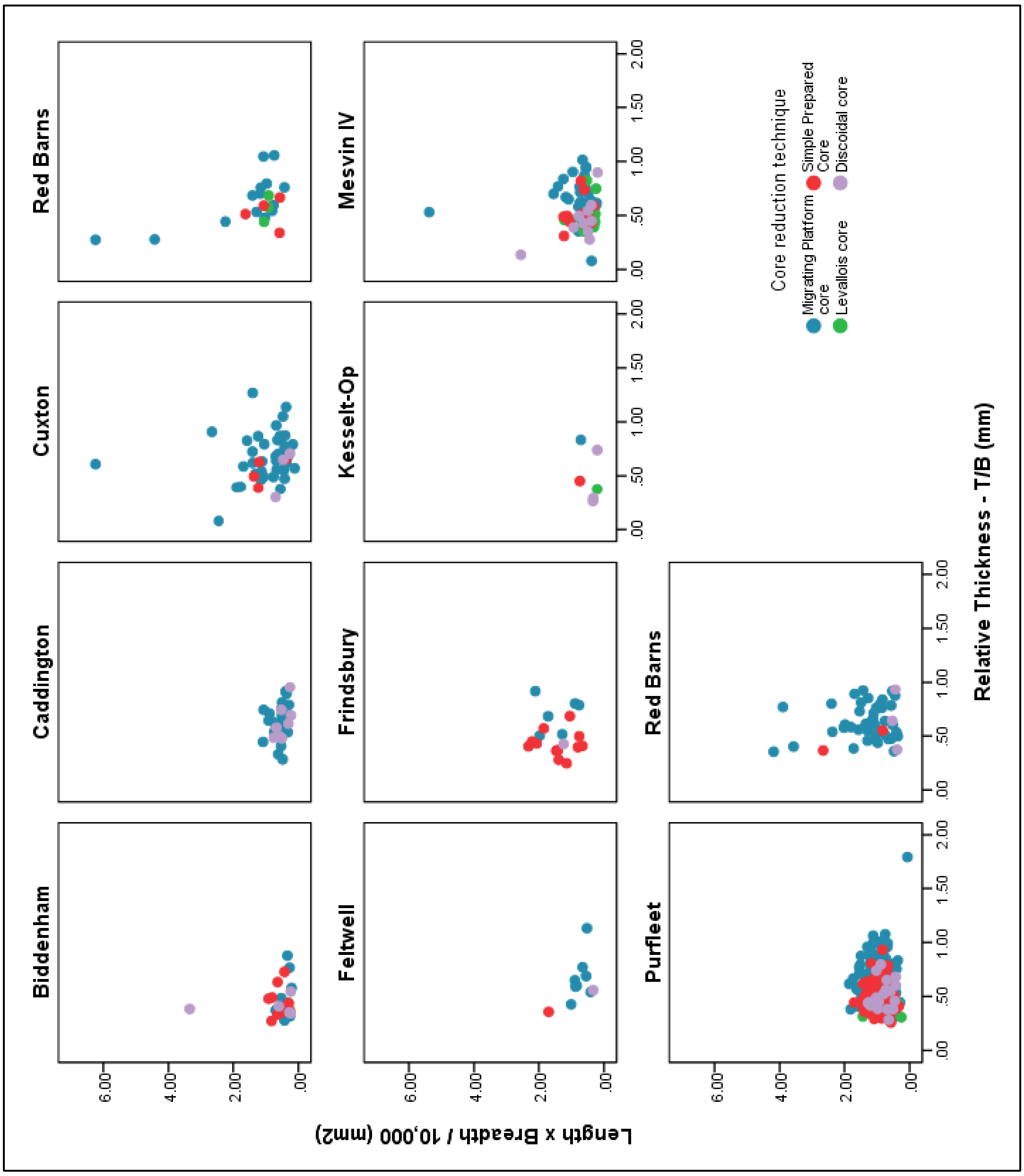


Figure 6.3 Comparison of the variation in volume for the different core techniques in each assemblage

The core metrics suggest the SPCs were not as heavily reduced as the Levallois or discoidal cores. A partial answer to Sub-research Question 2 must be the SPCs are found in the same contexts are other core working techniques but are often not as heavily reduced.

To answer the Sub-research Question 2 fully with regards to exploitation, the three proxies discussed above need to be considered together. Overall the SPCs display a similar amount of residual cortex to the discoidal cores and both techniques display less compared to the migrating platform cores. This would suggest the SPCs demonstrate similar levels of exploitation to the discoidal cores. In terms of the number of visible flake scars, the SPCs generally have fewer flake scars than all other core working techniques. This contradicts the residual cortex interpretation as it suggests the SPCs were not as intensively flaked as the other techniques. Finally, in terms of volume, the SPCs are similar to the migrating platform techniques and larger than the discoidal and Levallois cores. These three proxies demonstrate the importance of multiple proxies for exploitation as they give varying results.

In summary, the SPCs are not noticeably different to the other core working techniques in terms of the extent to which they have been exploited. This supports the hypothesis that SPCs should be considered to be part of the Lower Palaeolithic core working repertoire. This argument will be presented in depth in the following chapter.

Products

The final factor to be considered when analysing the relationship between SPCs and other Lower Palaeolithic core working techniques is the products for which the cores were being reduced to create. As the analysis of the SPC products can also be used to answer the main Research Question by comparing them with the Levallois products, these two questions will be addressed together in a standalone section following the SPC analysis.

The analysis above provides the following answer to Sub-research Question 2. SPCs have a close relationship with other Lower Palaeolithic core working techniques in terms of their frequency within the assemblages and the extent to which they have been exploited. Differences remain in the approach to the volume of the material and these will be discussed in Chapter 7.

6.2.4 SPC Variation

Variation within Levallois technology has been commented upon thought out this thesis. In order to answer the main Research Question which analyses the technological relationship between SPCs and the Levallois technique, it is essential to establish if the same degree of variation is present within SPC technology. To address this, the following four attributes of SPC technology will be discussed to assess the variation: the preparation of the flaking surface; preparation of the striking platform surface; preparation of the striking platform; and the preferential removals.

Preparation of the preferential flaking surface

The method of SPC flaking surface preparation for each assemblage can be seen in Table 6.2. In each assemblage, with the exception of Kesselt-Op the most frequent methods of preparation are centripetal and unipolar. The one SPC from Kesselt-Op is bipolar but with a sample size of one it is impossible to interpret this further. As the bipolar method is also only represented at Biddenham and Purfleet in small quantities, I believe this technique should be considered a method which was rarely employed.

The high proportion of SPCs with unipolar preparation of the flaking surface is not unexpected as the sequence at Orgnac 3 demonstrated flaking of a single surface began with similar cores (Moncel *et al.* 2012). Unipolar preparation is also similar to parallel flaking which could suggest the origin of this technique may lie in the parallel flaking of a fortuitously flat core. This hypothesis will be discussed further in Section 7.3. An almost equal proportion of centripetal cores could suggest a greater degree of preparation compared to the early examples from Orgnac 3. There do not appear to be any distinctions between the method of preparation and the age of the sites. Regardless of the dating issues, Biddenham and Feltwell are most likely to be the oldest sites and although Biddenham contains a high proportion of centripetally prepared cores, it is impossible to characterise Feltwell with a sample size of one. Altogether, this would make it hard to suggest there was a gradual development of more complex flaking surfaces.

Convergent cores are the smallest contribution to the data and are only present at Purfleet and Mesvin IV. The Mesvin IV example can be seen in Figure 6.4. Neither of the convergent cores display the same extent of preparation as a convergent Levallois core and this combined with the small number of instances suggests these cores are most likely a fortuitous consequence of unipolar flaking and not intended for making convergent points.

Preparation method	***Site***				
	***Feltwell* (n=1)**	***Biddenham* (n=9)**	***Red Barns* (n=2)**	***Frindsbury* (n=13)**	***Purfleet* (n=122)**
Centripetal	100%	55.6%	100%	46.2%	41.0%
Unipolar	0%	22.2%	0%	53.8%	50.0%
Bipolar	0%	22.2%	0%	0.0%	8.2%
Convergent	0%	0%	0%	0%	0.8%

Preparation method	***Site***				***Total***
	***Dunbridge* (n=4)**	***Kesselt-Op* (n=1)**	***Mesvin IV* (n=13)**	***Cuxton* (n=4)**	
Centripetal	50%	0%	46.2%	100%	**45%**
Unipolar	50%	0%	46.2%	0%	**46.2%**
Bipolar	0%	100%	0.0%	0%	**7.7%**
Convergent	0%	0%	7.7%	0%	**1.2%**

Table 6.2 Summary statistics for SPC flaking surface preparation. Sites are orderd by approximate MI stage

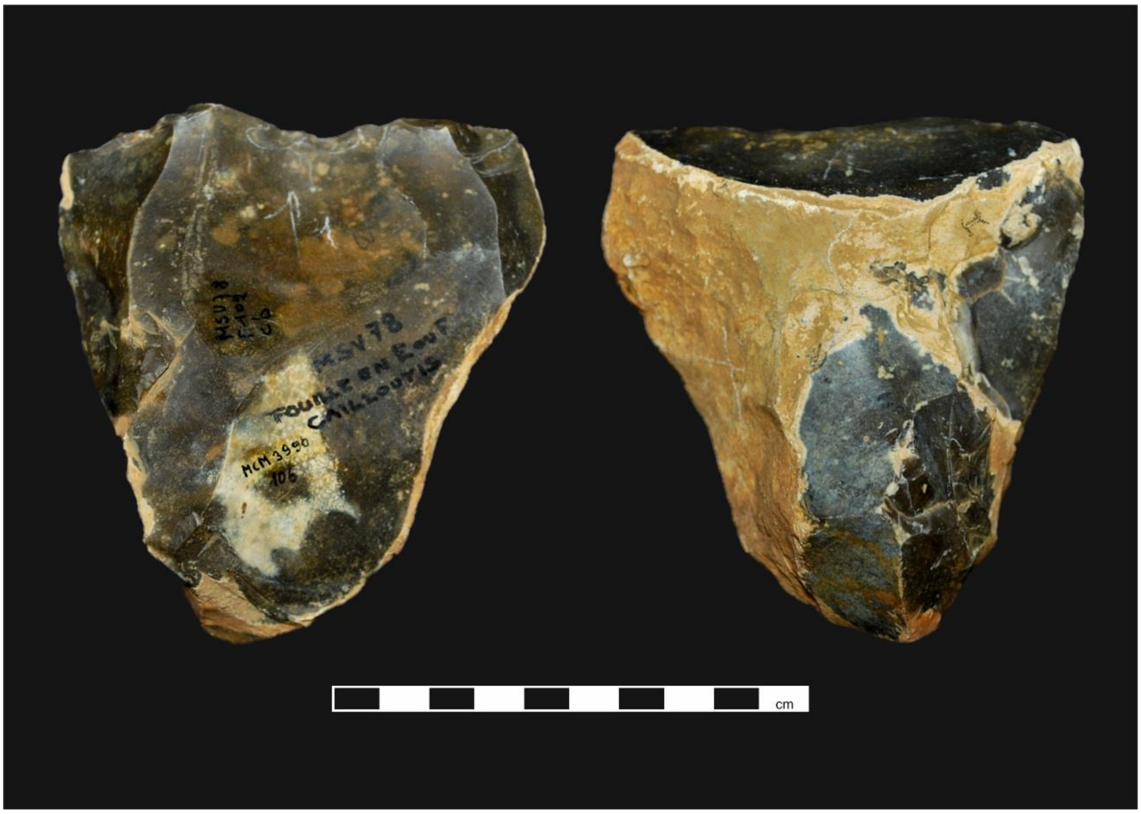


Figure 6.4 Convergent SPC from Mesvin IV

In comparison to the Levallois methods of preparation as demonstrated by Scott (2011) in the early Middle Palaeolithic of Britain, SPC technology does not demonstrate the same extent of variation.

Preparation of the striking platform surface

The degree to which the striking platform surfaces of the SPCs have been prepared was assessed by assigning the cores to one of three SPC groups, A, B and C (see Methodology on page 64). The results for the proportion of each SPC assemblage assigned to each category are presented in Figure 6.5. The aim here is to establish if SPCs became more complex, and therefore more Levallois-like, over time. The data does not support this hypothesis. The youngest sites, in particular Kesselt-Op and Mesvin IV, have a larger proportion of the least prepared cores however it should be noted that Kesselt-Op only has one SPC. With the exception of Kesselt-Op, all assemblages contain SPCs which fall into group C with preparation of two or more edges as well as the striking platform. It is suggested this type of SPC is that which most closely resembles the Levallois technique. However, at the sites where there is contemporary Levallois material, Mesvin IV, Kesselt-Op, and possibly Purfleet, it is noticeable that the group C SPCs are only a small component of the SPC assemblage. This would suggest the hominins using these cores had the ability and know-how to operate more complex core working techniques but did not routinely implement this choice.

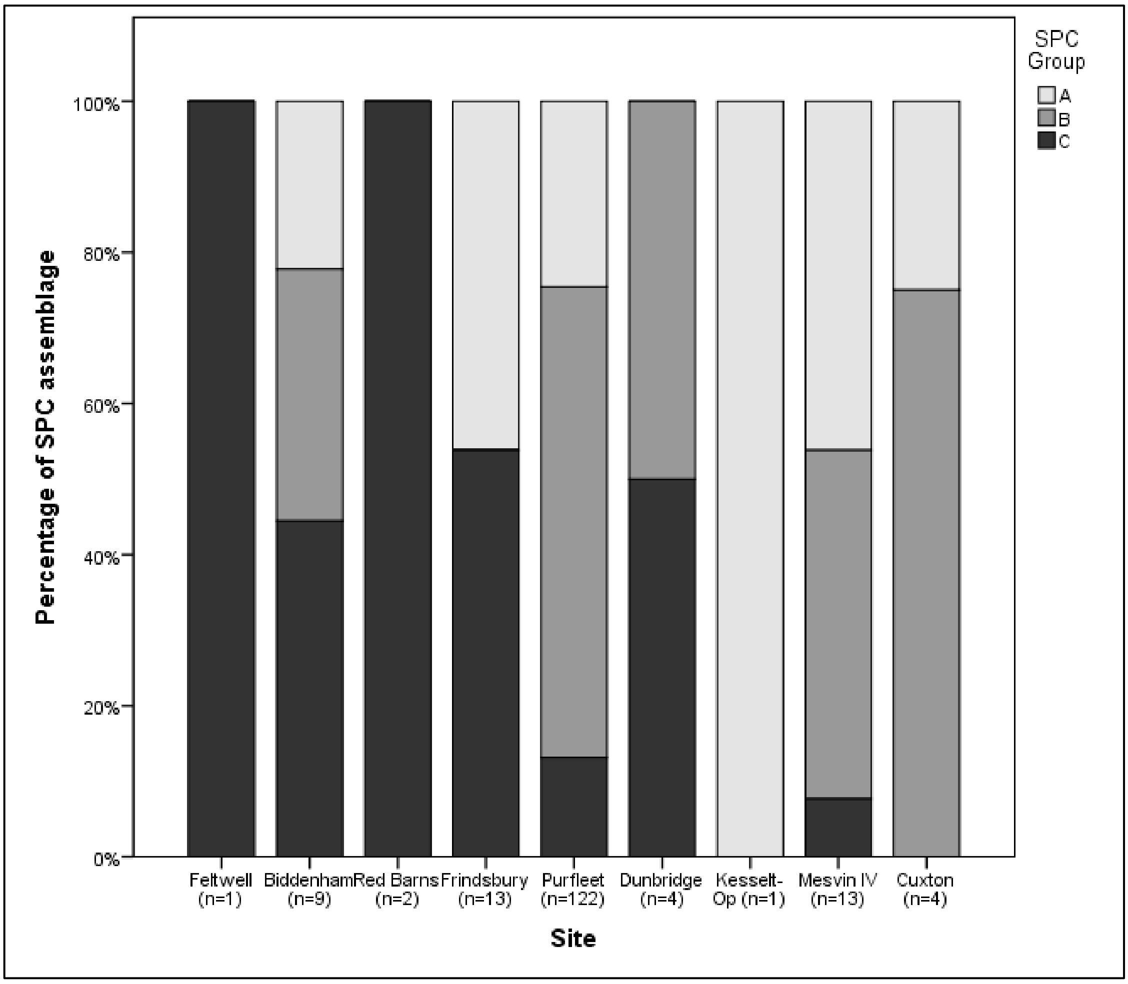


Figure 6.5 A comparison of the variation in SPC preparation from each site. The sites are presented in order of approximate MI Stage from the left.

Preparation of the striking platform surface is therefore varied within the assemblages analysed with no increase in the extent of preparation chronologically.

Striking platforms

The role of a faceted striking platform with regards to the preparation of the core and the predetermination of the product was introduced in Chapter 2. Faceted striking platforms were not thought to be a characteristic of SPCs however Table 6.3 presents the data for the presence of faceting which can be seen on 14 SPCs at Purfleet. All other SPCs have a single removal, perpendicular to the plane of intersection, as a striking platform for the preferential removal. Examples of these simple striking platforms can be seen in Figure 6.6. The simple/ single scar striking platform is quite different to the faceted striking platform seen on the Levallois material and 14 of the SPCs from Purfleet. Examples of the faceted SPCs can be seen in Figure 6.7 and examples of the faceted Levallois striking platforms can be seen in Figure 6.8.

There are no observable differences between the faceting of the SPCs and the faceting of the Levallois cores at Purfleet. However all of the cores which have been identified as faceted are SPC group C and although they do not show maintenance of the distal and lateral convexities, if they were not present in an assemblage which also contained SPCs, I think they may have been identified as Levallois cores. They were identified as SPCs as they more closely fit the criteria for SPCs as presented in this thesis, but this highlights a problem with potential for analyser bias when carrying out this particular attribute analysis.

Site	Faceting	
	No	Yes
Feltwell	1	0
Biddenham	8	0
Red Barns	2	0
Frindsbury	13	0
Purfleet	108	14
Dunbridge	4	0
Kesselt-Op	1	0
Mesvin IV	13	0
Cuxton	4	0

Table 6.3 Comparing the presence of faceted striking platforms on SPCs

Figure 6.6. SPC striking platforms. Order from top: Mesvin IV, Frindsbury and Feltwell

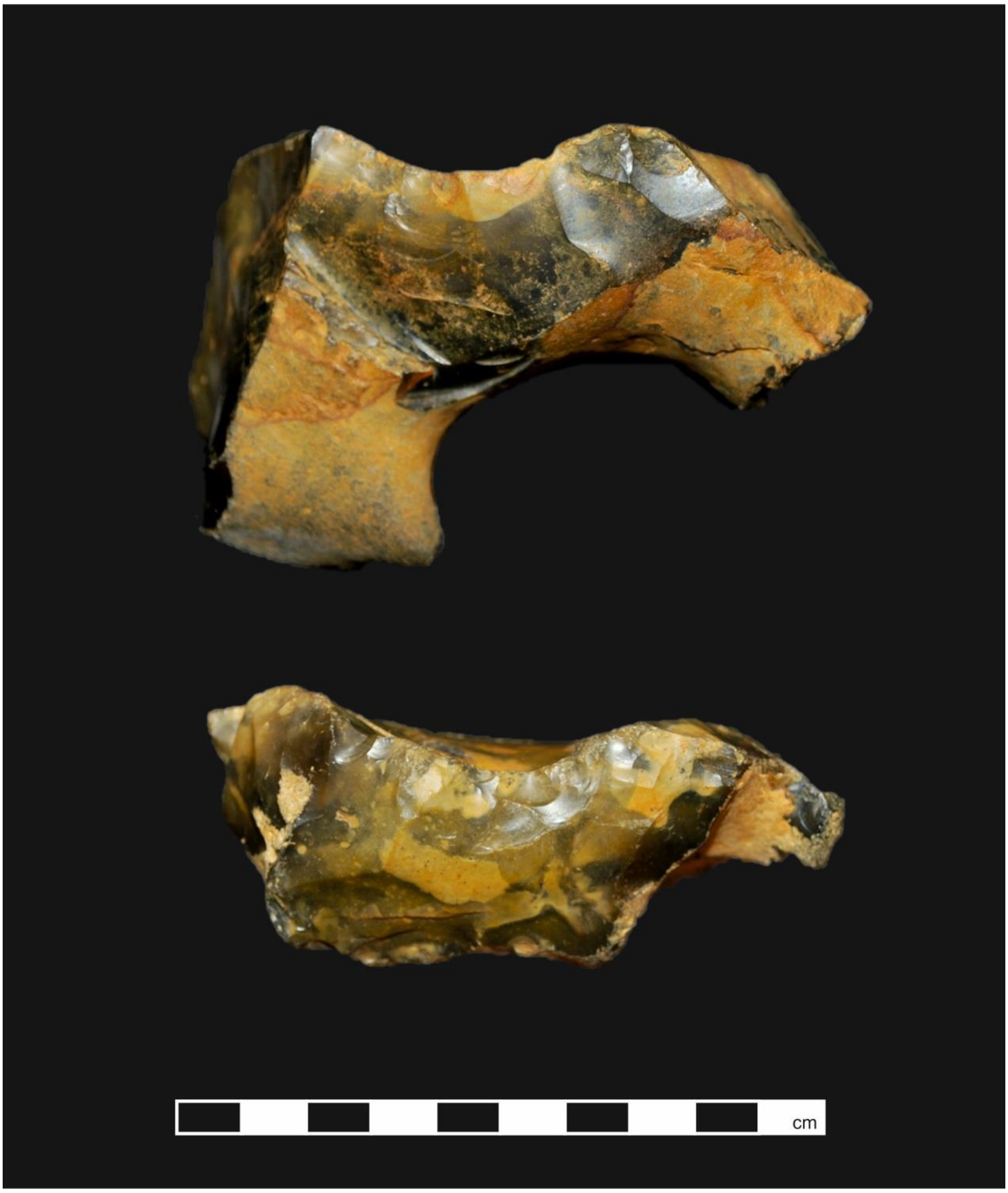


Figure 6.7 Examples of faceted striking platforms on SPCs from Purfleet.

Figure 6.8 Examples of faceted striking platforms on Levallois cores from Purfleet

To further analyse the variability within the SPC striking platforms, it would be necessary to determine the order of the removal in relation to the preparatory removals on the flaking surface. This would help to establish at what point the striking platform became a part of the reduction process. Unfortunately this was not possible due to the preferential removal removing key parts of the striking platform flake scar.

The SPC striking platforms do not demonstrate any variation with the exception of Purfleet with the small facetted component. The lack of preparation of the striking platform is a key attribute of the SPC technology as it limits the control the knapper would have exerted over the preferential removal. The significance of the simple striking platforms will be discussed at depth in Chapter 7.

Preferential removals

One of the ways in which the SPCs from Purfleet have been identified in the past is through their large preferential removals (White and Ashton 2003; Scott 2011). In order to establish how large these removals were and see if this statement can be applied to all SPCs, the percentage of flaking surface area occupied by the preferential removal was calculated for every SPC at each site. Results, seen in Figure 6.9, demonstrate the huge variation in SPC preferential removal size. The midspreads are consistently between 30-70 % but the medians for each site however all fall within 40-60%. This supports the argument that the preferential removal is large in relation to the area of the flaking surface. It must be noted that in the case of recurrent cores, this analysis, the results of which are presented in Figure 6.9, has only been applied to the most recent removal as accurate measurements were unable to be recorded for any prior removals which has been overcut.

To compare the lineal and recurrent SPC surface area coverage by preferential removals, the total area for all preferential removals on a recurrent core was calculated. The numbers of recurrent cores for all assemblages with the exception of Purfleet are too small to make any meaningful comparisons. However the data from the Purfleet cores is presented in Figure 6.10. The median for both datasets is identical at 58% and the results of a Mann-Whitney U test demonstrate there is no statistically significant difference between the two exploitation methods in relation to preferential removals size, U =843.5, z = -.516, p = .606.

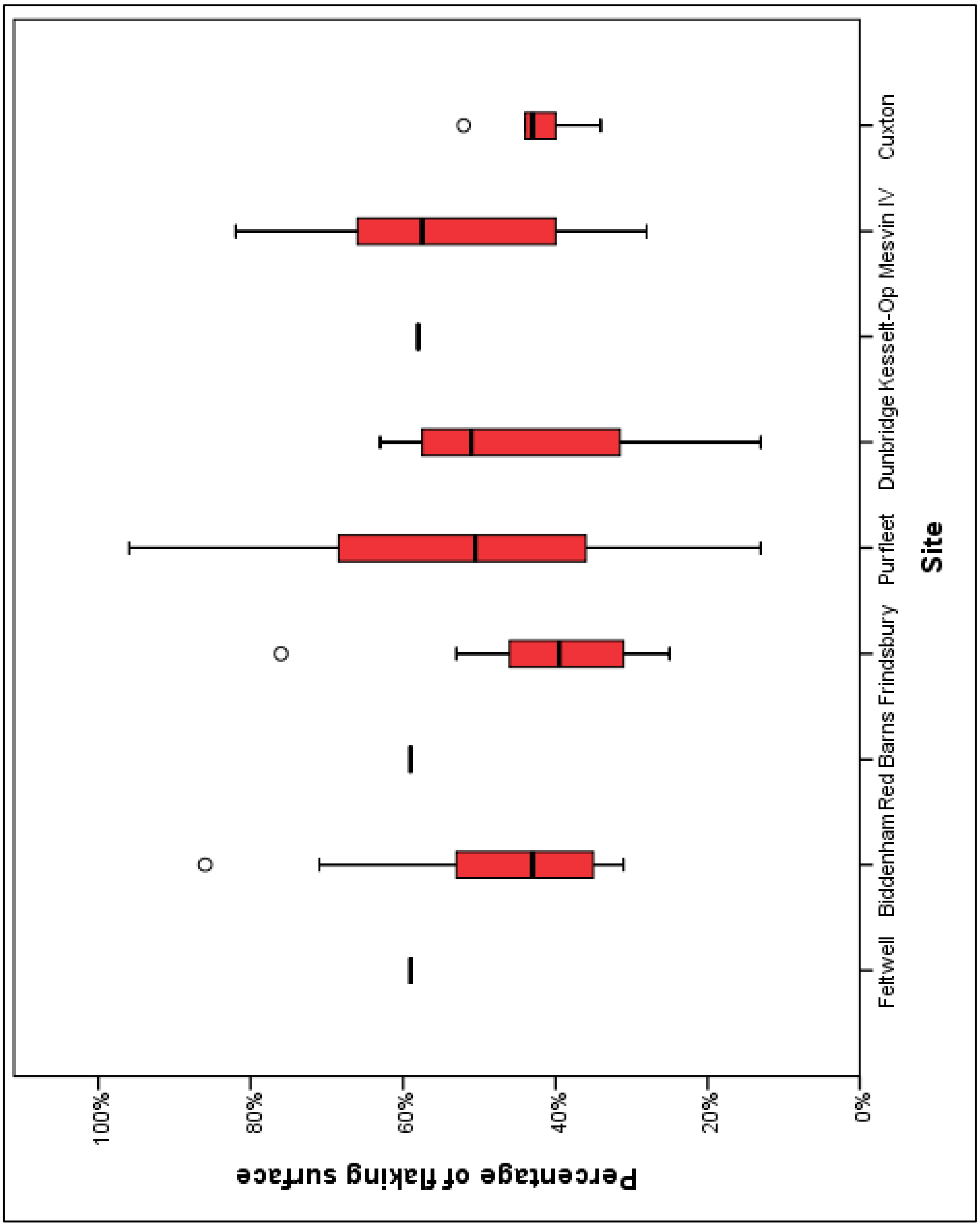


Figure 6.9 A site by site comparison of the percentage of flaking surface covered by the SPC preferential removal at each site

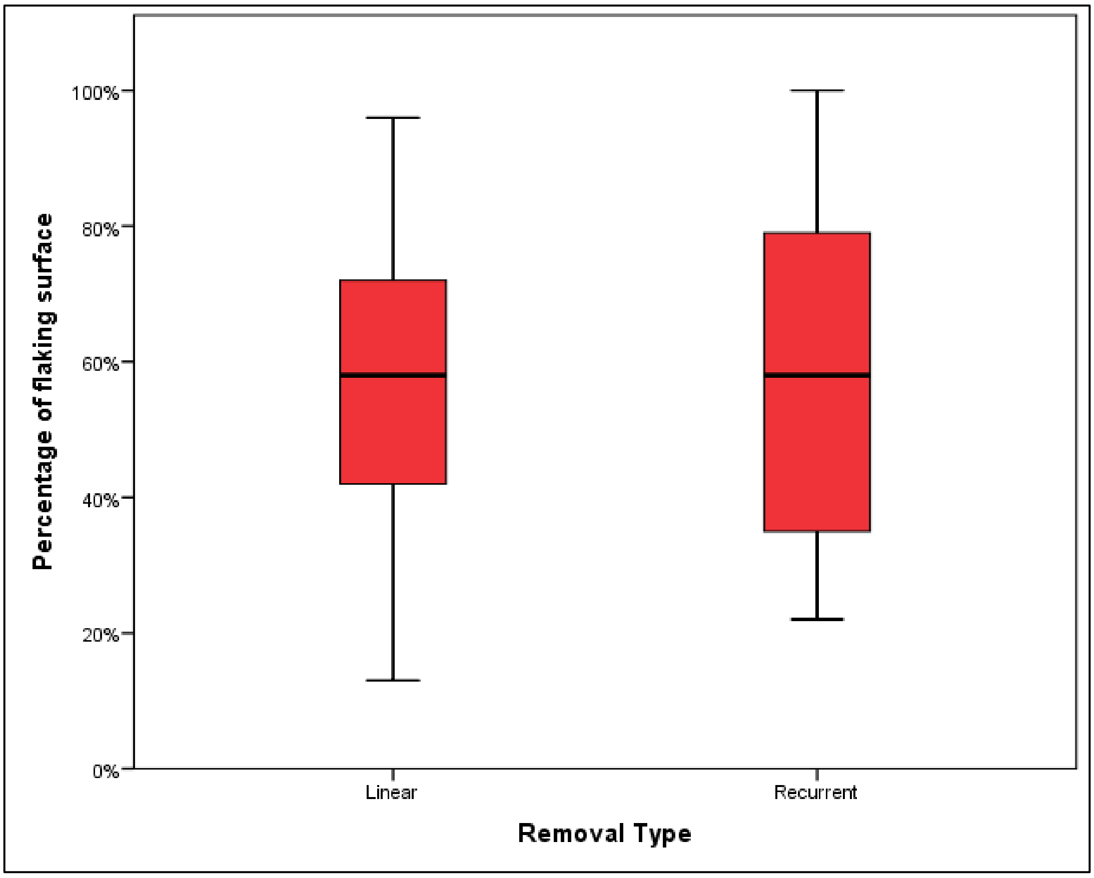


Figure 6.10 A comparison of the linear and recurrent SPC preferential removal(s) coverage of the flaking surface.

The same analysis has been applied to the Levallois cores when present to see if the same patterns are present. The one Levallois core from Kesselt-Op has been excluded from this analysis as refitting flakes attached to the surface prevented accurate measurements of the scars from being taken. The data from the three remaining assemblages with Levallois cores is presented alongside the SPC data in Figure 6.11. For Dunbridge, the median percentage of preferential scar coverage on the Levallois cores is 40% which is slightly lower than the equivalent median for the SPCs. For Purfleet the median is almost identical for both SPCs and Levallois preferential scars. Mesvin IV displays the largest difference between the two medians with the Levallois preferential scars covering almost 20% less of the flaking surface area.

I believe these differences are a reflection of the extent to which the flaking surface has been controlled. As mentioned in Chapter 2, it is the control of the distal and lateral convexities which controls the size of the preferential removal. As the SPCs do not have this control, there is no restriction of the size of the preferential removals. Mann-Whitney U tests were run for each assemblage to establish is the differences were statistically significant but in each case the differences between the medians were not statistically significant; Dunbridge $U = 2$, $z = -.926$, $p = .533$; Purfleet $U = 435.5$, $z = -.790$, $p = .430$; Mesvin IV $U = 40.5$ $z = -1.520$, $p = .128$.

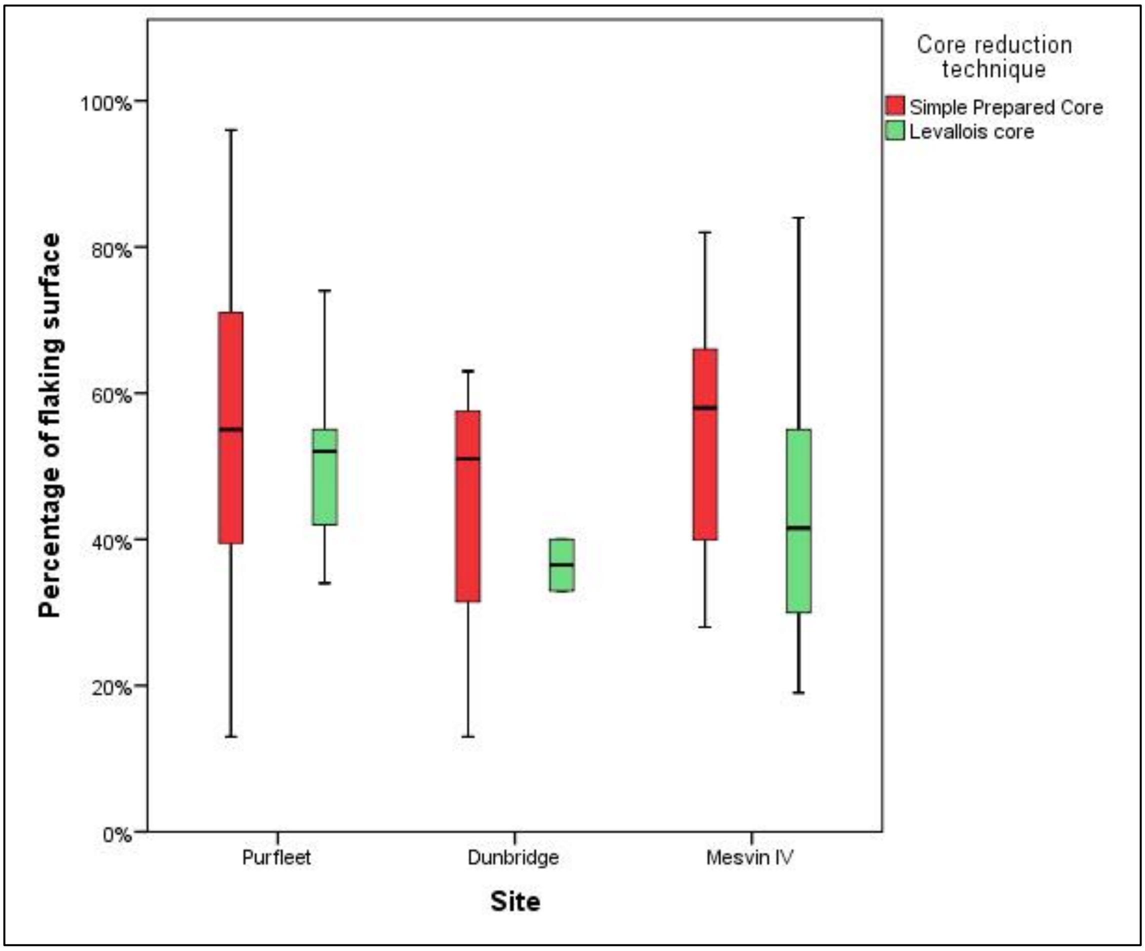


Figure 6.11 A site by site comparison of the percentage of flaking surface covered by the Levallois preferential removal at each site

The SPC product analysis demonstrates how similar the products of SPCs and other flaking techniques would have been in terms of their size. However SPC products do not display the same degree in variation as the Levallois products as they do not include products such as points.

In summary, the above analysis has identified some of the key attributes of the SPCs and addresses some of the issues surrounding the degree to which these cores are prepared. The implications for this preparation will be discussed in Section 7.2. The analysis of SPC variation presented above demonstrates SPCs share many attributes with Levallois cores however the SPCs do not show the same degree of variation as seen with the Levallois technique.

6.2.5 SPC Products

Without the ability to identify the products of the SPCs, it is difficult to appreciate the advantages of this technique over the many other ways of producing flakes. In order to try and discover what the SPC products were like, the dimensions of the preferential removals were compared with the dimensions of the flakes and flake tools at each site. The results of these comparisons were presented individually in the previous chapter but in Figure 6.12 the data for each site is presented together to allow for inter-site analysis.

The differences in sample size are clear and Feltwell, Red Barns and Kesselt-Op should be treated with particular caution especially as these are the three datasets which show the SPC products to be considerably larger than the median and midspread of the flake and flake tool data, but have very small sample sizes. Purfleet, which has by far the largest SPC sample size, along with Frindsbury, show the median preferential removal dimensions were almost identical when compared with the flake and flake tool dimensions. The results from Biddenham and Dunbridge show the SPC preferential removals in these assemblages were on average slightly smaller than the average flake and flake tool dimensions. Cuxton, Feltwell, Red Barns, Kesselt-Op and Mesvin IV all have the median dimensions of the SPC preferential removals larger than the median flake and flake tool dimension. With the exception of Feltwell, these assemblages are those which were excavated as opposed to collected. The differences in methods of recovery could explain why the smaller flakes may have been missed or overlooked by the collectors. However in terms of the ranges shown, none of these differences between the preferential scars and flake sizes are particularly large.

With this data we can say that at the majority of sites studied, the SPCs were, on average, producing products which were slightly larger than the flakes produced from other core working techniques. However sample size has probably affected the results. As there is not much of a difference in size, and as all of the SPC data for eight of the nine sites with SPCs falls within the flake and flake tool range, the results do not seem strong enough to be able to confirm the hypothesis that the SPC technique was utilised to produce larger flakes.

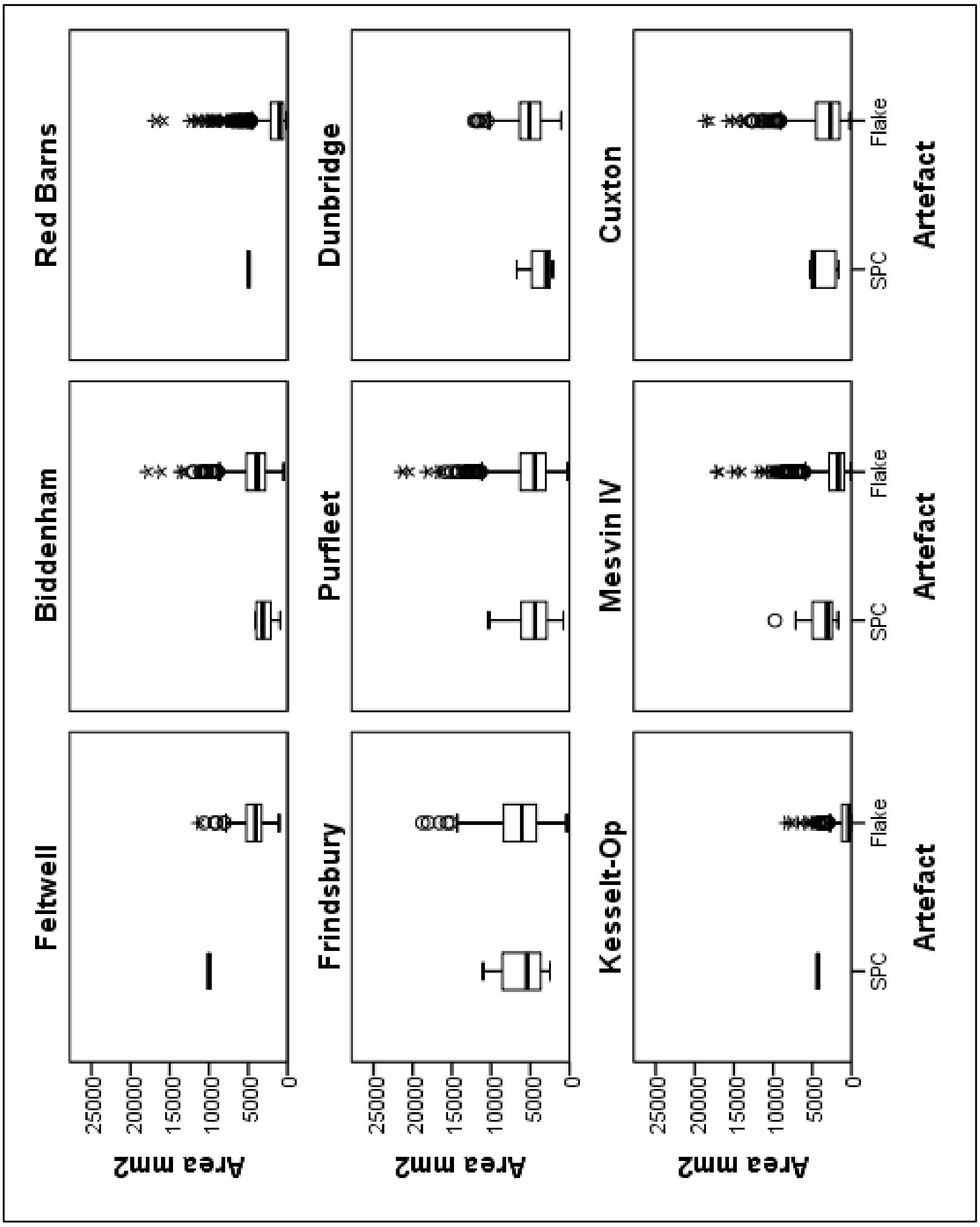


Figure 6.12 A comparison between the SPC preferential removal area and the flake/flake tools area at each site

In order to see if the Levallois preferential removal scars followed a similar pattern, the same analysis was carried out on the assemblages which also contain Levallois cores with the exception of Kesselt-Op which as previously mention was inaccessible for flake surface measurements. The results presented in Figure 6.13 demonstrate the Levallois preferential flake scars have very similar medians and midspreads as the SPC data. Mesvin IV is the only assemblage with a slight difference. Here the Levallois median is slightly lower compared to the SPC median and the range is also smaller. This corresponds with the earlier analysis (page 191) which suggests the Levallois products were smaller than the SPC products.

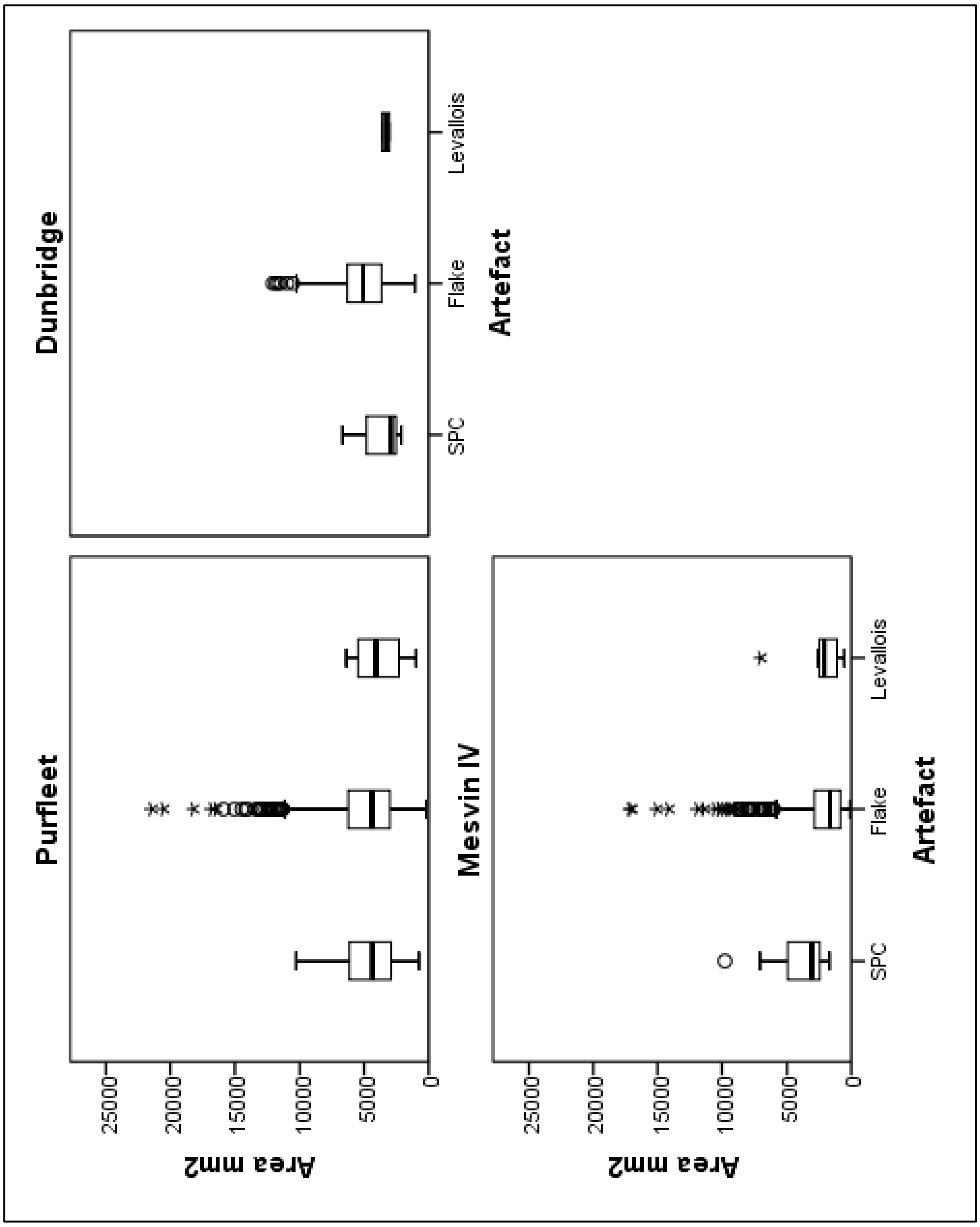


Figure 6.13 A comparison between the SPC preferential removal area, the flake/ flake tools area and the Levallois preferential removal area at each site with Levallois cores.

The results of the comparison of end product thickness analysis do not suggest the flake tools and Levallois flakes were thinner than other flakes. The problem with this analysis is the general flake category would have included all flakes, no matter what stage of the reduction process, which naturally included some very small flakes. These small, thin flakes may have affected the results in the comparisons and made the flake tools and Levallois products seem disproportionally thick. Future analysis could only compare the thickness of Levallois flakes with flakes and flake tools of similar sizes. This was not carried out for this research as the sample size for the Levallois products is very small and without comparisons to SPC products the information gained would still be limited.

The results on product size address both the main Research Question and Research Sub-question 2. The similarity in size between the SPC products and the overall flake assemblage implies the SPC technique was not employed to produce flakes of a particular size. There must therefore be a different reason(s) for why this particular technique was employed. A possible answer could be related to the thickness of the flake which were produced from the flatter flaking surface of the SPCs as opposed to the migrating platform and discoidal techniques. However, without the SPC products to compare with the thickness of the flakes in the assemblage, this hypothesis will remain untested.

The slight difference in size between the Levallois products and the SPC products and the products of other flaking methods suggests Levallois cores were producing flakes which were smaller. This demonstrates a difference between the SPC and the Levallois technique as the Levallois method was employed to produce flakes which were different.

6.2.6 Caddington

There were no SPCs identified in the Caddington assemblage but there were three cores which require further discussion in relations to this investigation (see Chapter 5 page 129). Two of the items in question are migrating platform cores and the third is somewhat harder to categorise. All three have attributes similar to elements of SPC technology.

The first migrating platform core had a number of refits permanently glued to it making analysis of what could potentially have been a flaking surface impossible (see Figure 6.14). The visible surfaces have some residual cortex which could suggest flaking was focused on one surface. However the few scars which are visible appear to cut into the volume of the material. It is this, along with the lack of a striking platform which has prevented this core from being classified as a SPC.

Figure 6.14 Caddington migrating platform core with refits

The other migrating platform core which could be considered to be a SPC is shown in Figure 6.15. It could be argued that this core has two preferential removals on a flaking surface and three removals on a striking platform surface. However none of the removals on the would-be striking platform surface seem to be a striking platform specifically for the removals on the would-be flaking surface. This core has therefore been labelled as a migrating platform core and more specifically a core with multiple episodes of parallel flaking. The variation in the condition of the material at Caddington is particularly clear when comparing Figure 6.14 and Figure 6.15.

Figure 6.15 Caddington migrating platform core with SPC attributes

The final core of note from Caddington is slightly harder to categorise and can be seen in Figure 6.16. Initially this core was considered to be a small roughout with two subsequent removals, potentially comparable with the cores from Cagny-la Garenne (Lamotte and Tuffreau 2001). However the small size and the conical shape of one of the surfaces discounted this. There are clearly two surfaces which have been worked but the flaking is too intensive to be a SPC. The flaking around the perimeter suggests this is possibly a discoidal core with the two large removals having removed the conical shape of the second surface. Regardless of the technological category assigned to this one item, it is quite out of character when compared to the rest of the assemblage and demonstrates core variability as well as the limitations of the classification method.

Figure 6.16 Caddington handaxe with two removals

6.2.7 Comparison between British and Belgian data

The SPC components of the British and the Belgian assemblages analysed in Chapter 5 are very similar. Technologically there are no differences between the material which confirms the need to use uniform terminology for all (see Appendix B for images of all SPCs). Both Belgian sites have SPC as well as Levallois material within the assemblages confirming the co-occurrence of the techniques and providing a potential comparison to the Purfleet material. The single SPC in the Kesselt-Op assemblage also justifies the inclusion of the British assemblages low sample sizes. Overall the inclusion of the Belgian assemblage has been a valuable contribution to this research, demonstrating SPC technology is not unique to the UK.

6.3 Summary

This chapter has discussed the raw data presented in Chapter 5 and in doing so has addressed the first part of main Research Question and two of the Research Sub-questions. Firstly, SPCs can be said to be a components of the core working assemblages at nine of the 10 sites analysed. The cores which have been described in the past as proto, reduced and Levallois-like are therefore technologically the same, and clearly distinguishable from other cores/ core working techniques.

Secondly, though not as numerous as migrating platform cores in many cases, SPCs are found alongside all the other Lower Palaeolithic core working techniques. The migrating platform category may be the most common method of flake production but it is an umbrella term for multiple reduction sequences.

In relation to the main Research Question, SPC technology is similar to Levallois technology in many respects including the hierarchical organisation of the core and the production of a target flake(s). The technological relationship and the wider implications will be addressed in greater depth in the following chapter.

Overall, the analysis of these assemblages has demonstrated the low frequency of cores within every assemblage and though SPCs are not numerous, they are an important component which, if over looked, excludes this new technological development. The results of this analysis also demonstrate this technology was present in Britain from MIS 11/9 and possibly as early as MIS 14.

Chapter 7: Discussion of Implications

7.1 Introduction

Having interpreted the data in Chapter 6, this chapter will discuss the behavioural implications of the presence of SPCs within Lower Palaeolithic assemblages. The technological attributes of these cores will be addressed along with the wider cognitive implications for the hominins employing this technique in order to answer the main Research Question and Sub-research Questions.

7.2 Technology

Having analysed these 10 assemblages, it is clear the SPC technique is a method of core reduction conceptually separate to that of other Lower Palaeolithic core working techniques. This section will examine what it is about this technology that makes it a separate technique.

In order to present what SPC technology is, it is important to emphasise the ways in which this technique is different to migrating platform, discoidal and Levallois cores. This research has shown that there are three key differences which separate SPCs from other flaking methods in the Lower Palaeolithic. The main difference between SPCs and the discoidal and migrating platform cores is the approach to the volume of the material. The second difference is the way in which the core is prepared; the third is the use of a simple striking platform.

The way in which the volume of the core is worked with SPCs is the same as Levallois. As with a Levallois core, there are two different flaking surfaces which have different roles within the reduction sequence. In both Levallois and SPC techniques, one is referred to as the preferential flaking surface, the surface from which the preferential removal or removals are obtained, and the other which is referred to as the striking platform surface. In the reduction sequence of both techniques, these surfaces are not interchangeable. It is this approach and the organisation of the volume which separates the SPCs from the migrating platform and discoidal cores. The migrating platform cores have no volumetric organisation with the distal, lateral and proximal edges of previous flake scars are used as striking platforms for subsequent removals. With the discoidal technique there are two flaking surfaces separated by a plane of intersection however this intersection is created by the alternate removals and both surfaces have the same role. The differences in approach to volume between SPCs, discoidal and migrating platform techniques can be seen in Figure 7.1, Figure 7.2 and Figure 7.3.

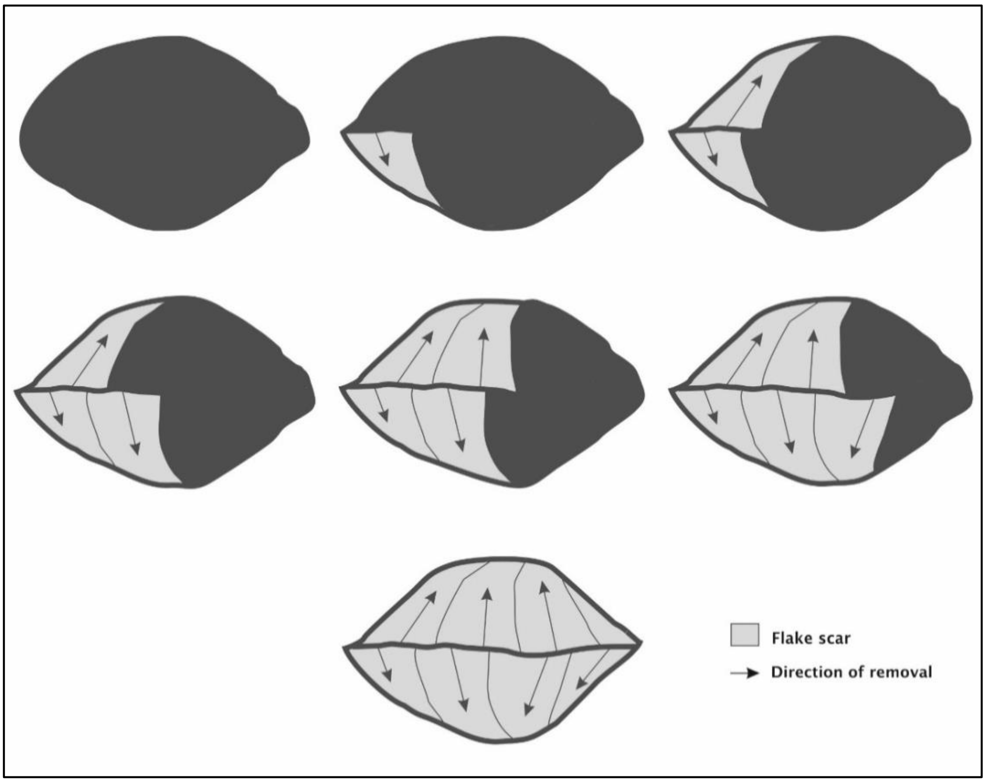


Figure 7.1 A schematic diagram of a discoidal core where flaking alternates around a plane of intersection.

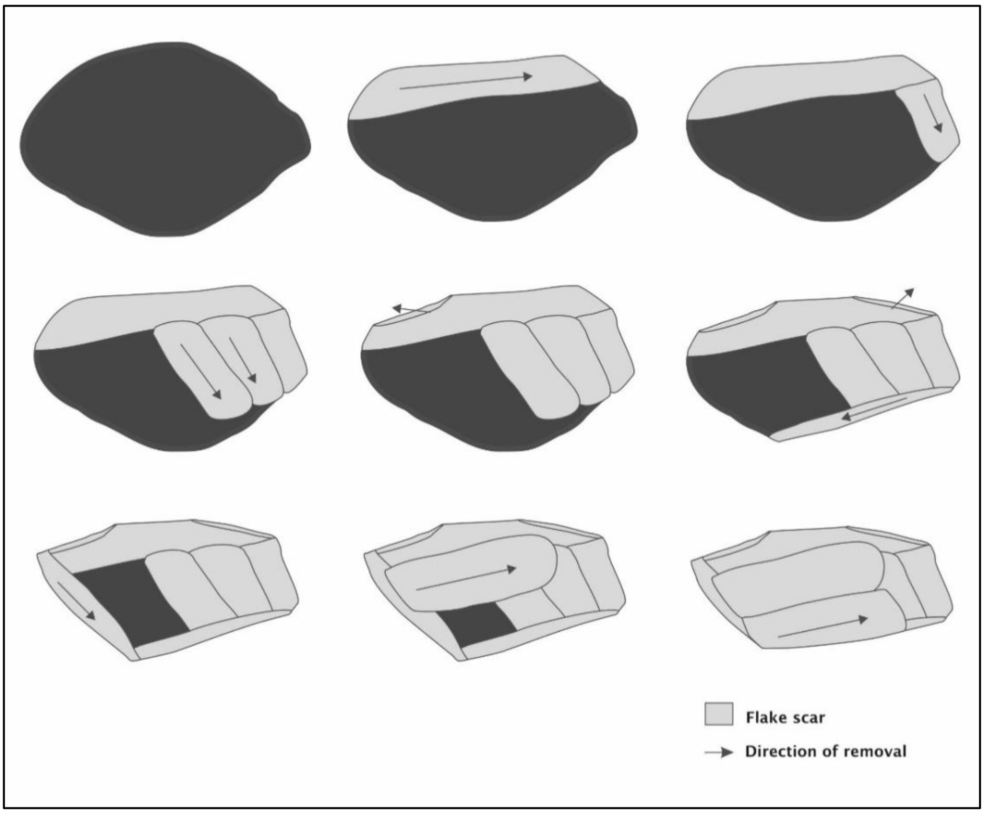


Figure 7.2 A schematic diagram of a migrating platform core, showing the way in which flake removal follows a non-volumetric approach. The strategy of where to flake and when to move the flaking on is more influenced by the productivity of striking platforms.

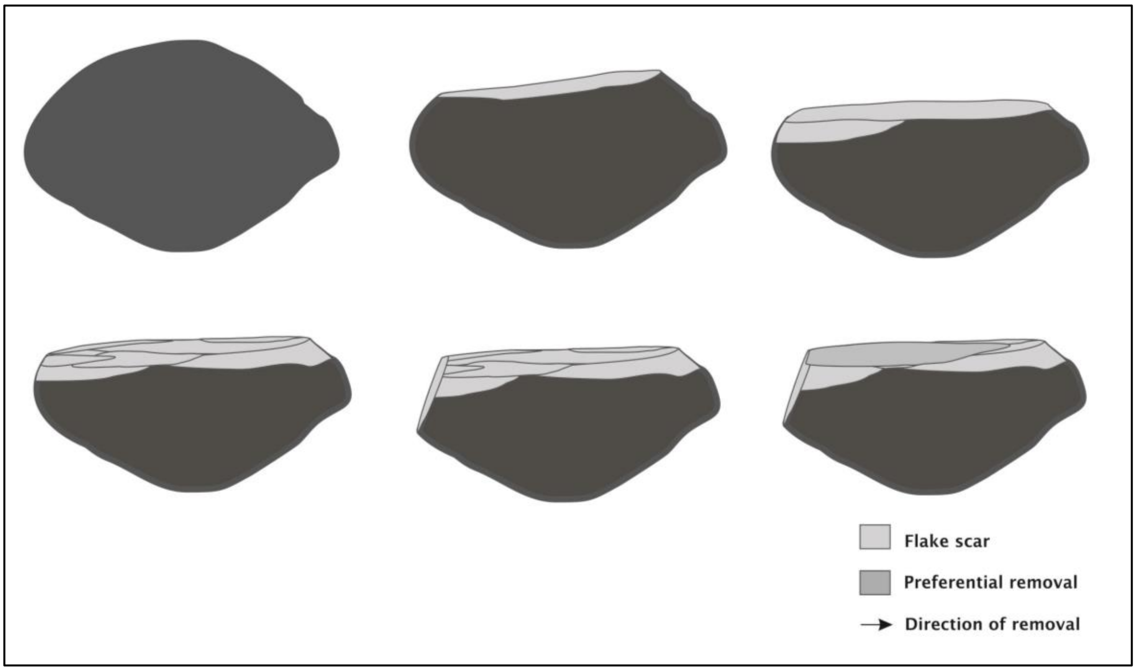


Figure 7.3 A schematic diagram of a SPC to demonstrate approach to volume.

The second difference between SPCs and the discoidal and migrating platform cores is the preparation of a specific surface, the preferential flaking surface, for the production of a specific flake or flakes. In both the discoidal and migrating platform techniques, the knapper is removing flakes wherever possible. With discoidal this is following the circumference of the core through alternate flaking and with migrating platforms the process is determined by the availability and productivity of suitable platforms. With SPCs we see the preparation of a surface prior to the removal of large flakes. Whilst this difference is linked to the approach taken to core volume, it also signifies preparation which is previously unseen in the other Lower Palaeolithic core working techniques.

The final difference which separates SPCs from the other methods is the use of a specifically created striking platform. All removals require an angle to enable the flake to be removed but it is with SPCs we see the creation of a platform in relation to the flaking surface when other removals may have sufficed.

It could be argued that some of the technological attributes for SPCs are similar to the parallel flaking method of flake production seen in migrating platform cores. As described in Chapter 3, parallel flaking is the removal of flakes in succession from one striking platform. In practice there are some clear similarities between cores which demonstrate parallel flaking and SPCs. SPCs prepared through centripetal flaking cannot be included in this comparison as they utilise multiple areas on the core as striking platforms. In this investigation, 42.6% of the SPCs have been prepared through unipolar flaking and all of these cores are unipolar proximal, meaning that the preparatory flakes on the preferential surface, and the preferential removal, are all in the same direction. What separates SPCs from cores with parallel flaking, which have been recorded as migrating platform cores with parallel flaking, following the methodology presented in Chapter 3, is the order, orientation and size of the removals prior to the preferential removal. An example of a SPC prepared through unipolar flaking is presented in Figure 7.4. The position of the preparatory removals in relation to the preferential removal demonstrates organisation not seen in parallel flaking. If this core was to be categorised as an episode of parallel flaking, all of the removals would also need to come from one striking platform.

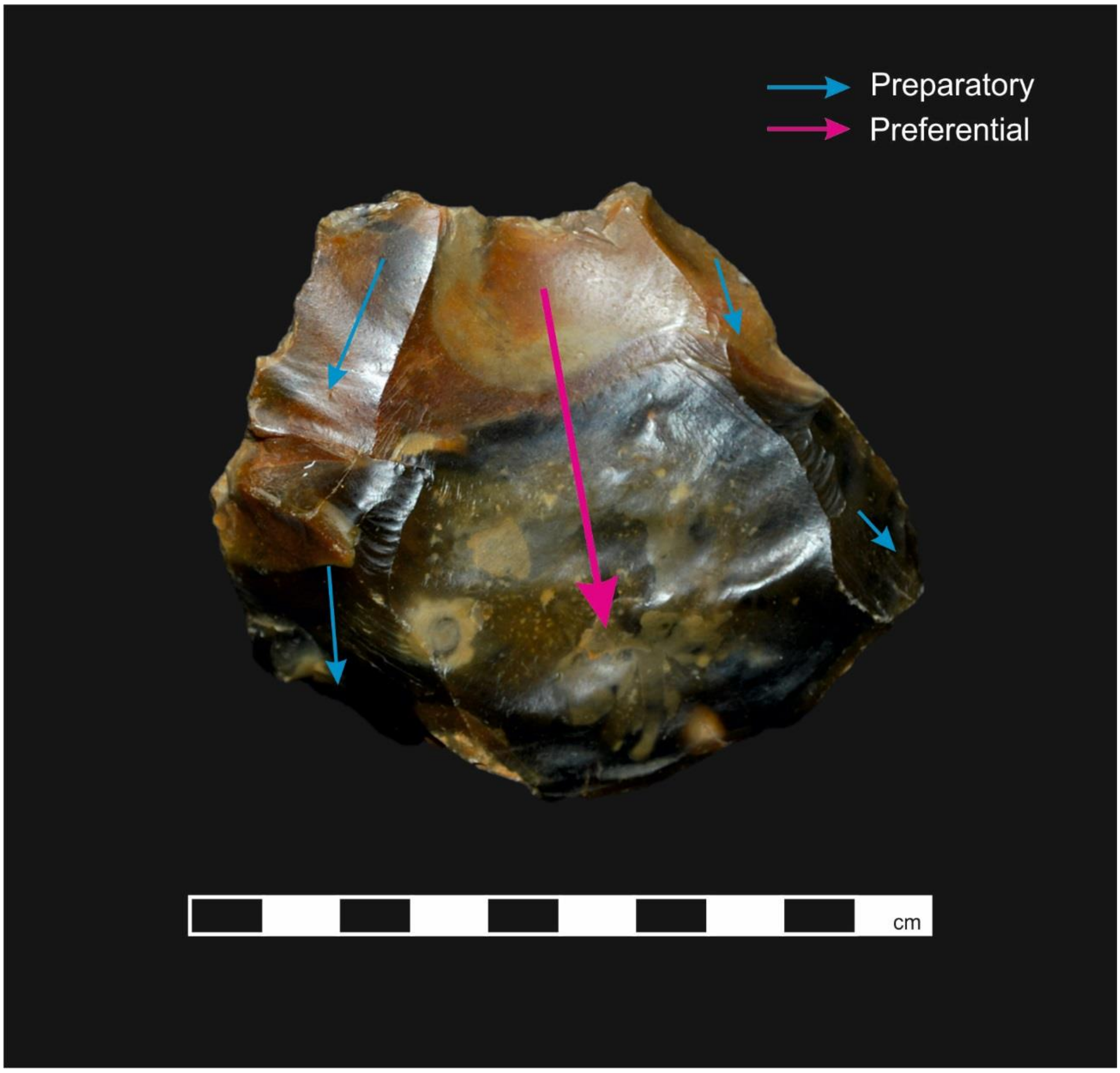


Figure 7.4 A SPC from Purfleet demonstrating the preparatory and preferential removals.

Conceptually SPC technology is similar to the Levallois technique but there are still some notable differences. The main is the extent to which the preferential flaking surfaces are worked in order to prepare for the preferential removal. Figure 7.6 and Figure 7.7 demonstrate the preparation of the preferential flaking surface in each technique. The Levallois example is a centripetal, recurrent core and, although Chapter 2 has highlighted the variation in Levallois preparation and exploitation as well as the need to not focus solely on this particular iteration of the technique, for the purposes of comparing schematic approaches the most familiar Levallois imagery is used here. The same principles can be applied to all Levallois approaches.

<u>Extent of preparation on the preferential flaking surface</u>

The removals on the preferential flaking surface of a Levallois core create the convex surface which predetermines the size and shape of the preferential removal. The removals on the SPC preferential flaking surface do not shape the surface but they do flatten in. Figure 7.5 demonstrates the difference between the two preferential flaking surfaces.

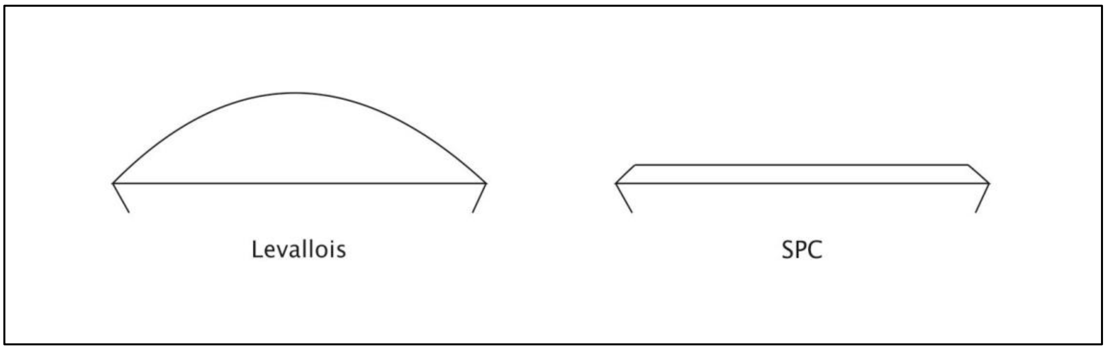


Figure 7.5 A schematic comparison of the preferential flaking surfaces of both a Levallois core and a SPC.

The lack of prepared distal and lateral convexities on SPCs is also apparent in the extent to which the preferential flaking surface has been worked. Figure 7.6 and Figure 7.7 demonstrate the differences between the two techniques. This research has shown SPCs have considerably fewer preparatory removals displayed on the preferential flaking surface compared with Levallois cores. The fewer removals combined with the lack of convexities results in a lack of control over the final product shape in SPC products. The lack of control means the products of SPCs cannot be considered predetermined. The behavioural and cognitive implications of this will be discussed in the following section.

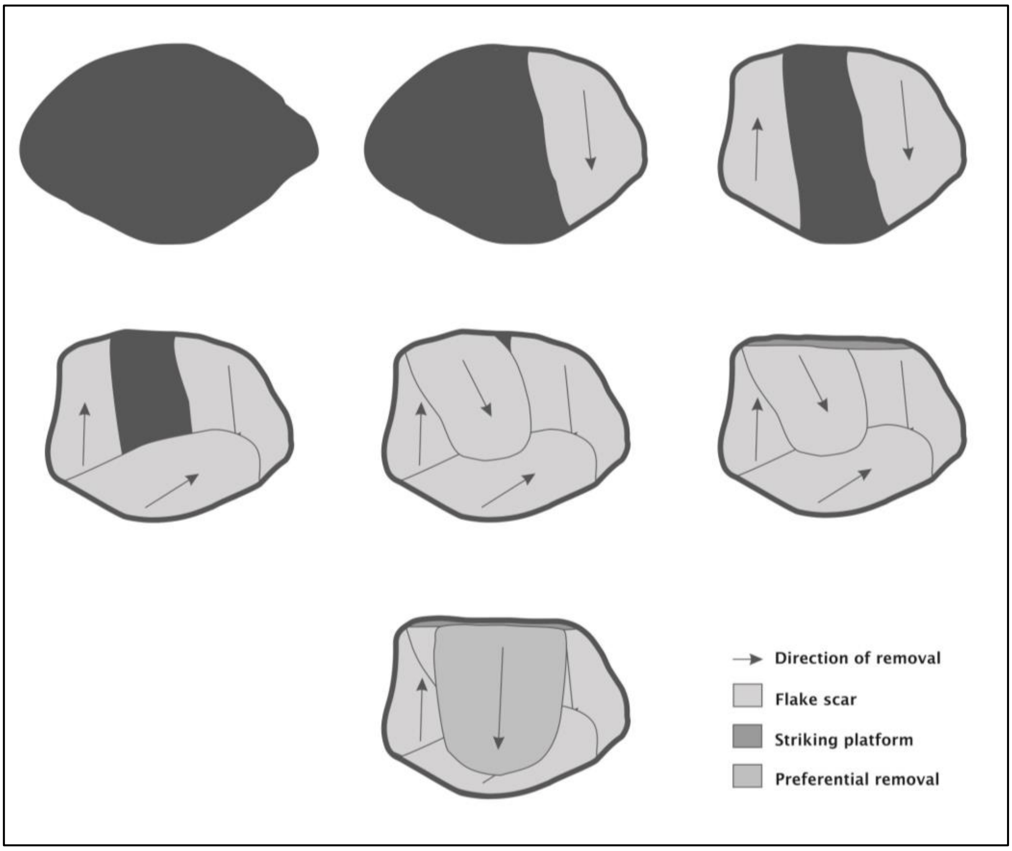


Figure 7.6 A schematic, planform view of the SPC preferential flaking surface.

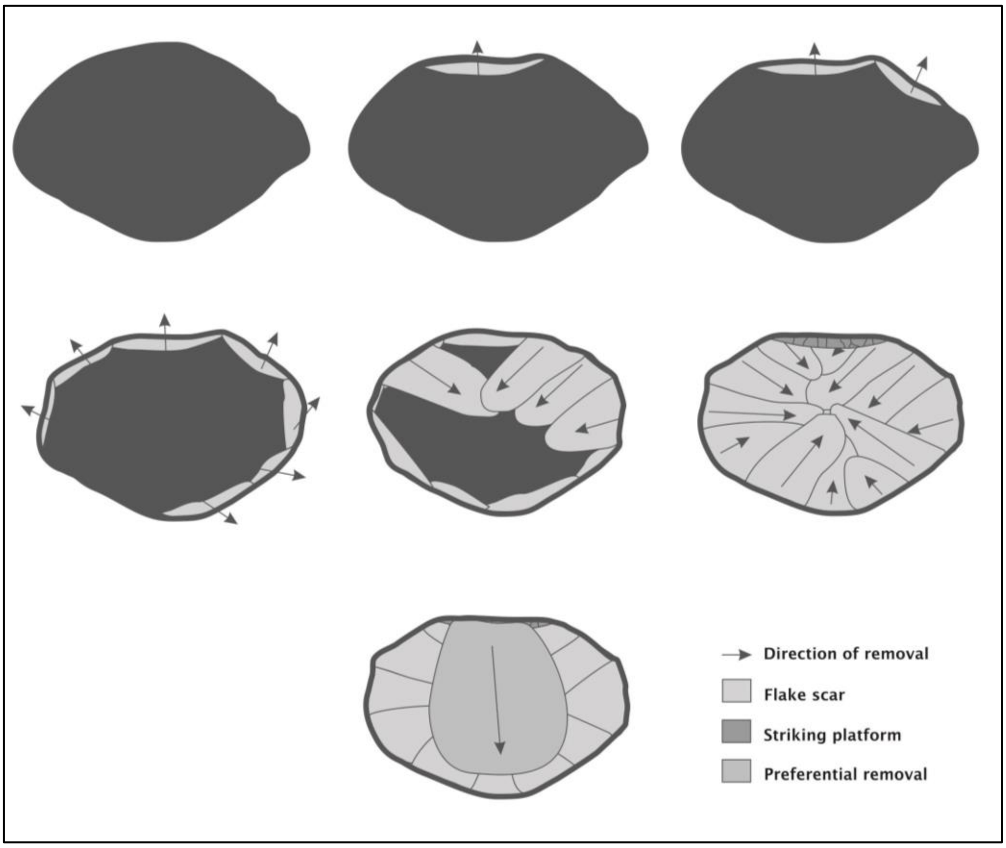


Figure 7.7 A schematic, planform view of the Levallois preferential flaking surface.

In Chapter 2, Section 2.3.3, it was noted there may have been issues with identifying cores which have been prepared centripetally with more than one preferential removal, thereby making them centripetal recurrent. This research has however, identified several such cores and demonstrates this combined method of preparation and exploitation can be seen in practice (see Figure 7.8.).

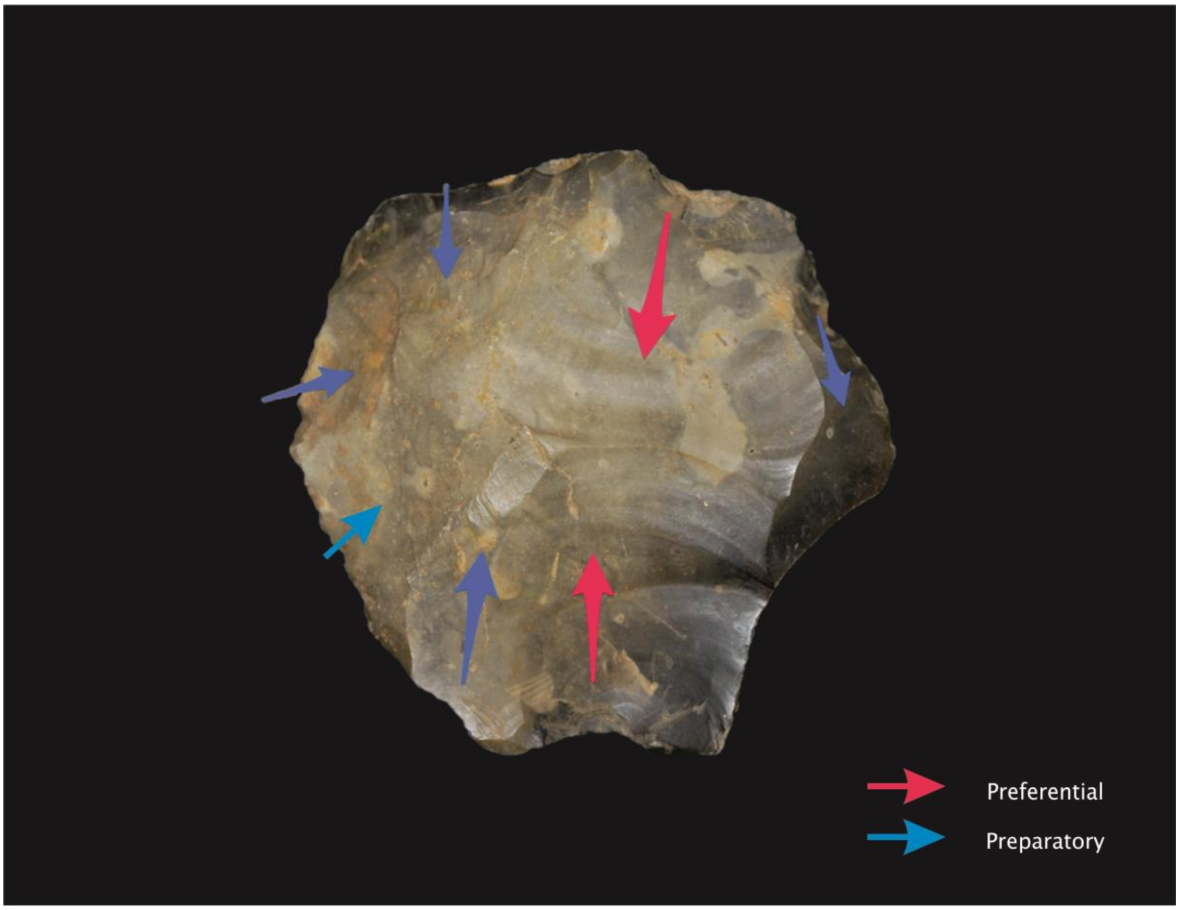


Figure 7.8 An example of a centripetal recurrent SPC from Purfleet

<u>Extent of flaking on the striking platform surface</u>

During this analysis 45 (26.8%) SPCs were classified as group A (see Table 7.1), meaning they have no preparation of the striking platform surface at all, other than a single removal acting as the striking platform for the preferential removal on the preferential flaking surface. This is clearly a fundamental difference to Levallois with its extensive creation of a striking platform surface to facilitate removals which shape the convexities on the preferential flaking surface.

The most common SPC Type is that of group B with over 50% of the cores displaying removals on a small part of the striking platform surface. This is a long way from the control exhibited on the Levallois cores but not in terms of flaking concept.

SPC Group	*Count*	*Percentage*
A	45	26.8
B	90	53.6
C	33	19.6
Total	**168**	**100**

Table 7.1 Combinded data to show frequency of SPC Type

The smallest group of SPCs are those which are categorised as group C and are considered to be the most similar to Levallois as they have the most preparation of the striking platform surface. However these removals are not used as striking platforms for removals which shape the preferential flaking surface and therefore cannot be considered preparation to the same extent as the Levallois cores.

The striking platform

The extent to which the surfaces have been prepared is not the only way in which SPCs differ from Levallois. As mentioned above, the SPCs have a striking platform which consists of a large removal perpendicular to the flaking surface. Levallois cores also have a striking platform however this platform is, in most cases, carefully prepared through faceting to obtain greater precision. Whilst a few cores from Purfleet demonstrate removals which appear to be simple faceting, these are not as refined as the striking platforms on Levallois cores. The presence of a specifically created striking platform like this is not seen in other Lower Palaeolithic core techniques and demonstrates how SPC technology is conceptually on a similar trajectory towards Levallois technology.

In summary, the discussion above has presented technological similarities and differences between SPCs, Levallois and other Lower Palaeolithic core techniques providing a partial answer to the main Research Question and Sub-research Question 2. The technological relationship between SPCs and the Levallois technique is in the form of a close conceptual link, but the two technologies are not physically the same. SPCs cannot be seen to predetermine the product in the same way as the Levallois cores can. However there are several technological similarities which would group the two techniques together in terms of the approach to the volume of the core and the preferential exploitation of a single surface. SPCs are conceptually quite different to other Lower Palaeolithic core working techniques. SPCs demonstrate a new volumetric approach which creates a wide flat flaking surface for the production of flake/flakes which are large in relation to that surface.

7.3 The Origins of Levallois

The analysis of Levallois material has only been a small element of this research as many of the sites analysed pre-date the widespread appearance of the technique in the UK. It has been the aim of this thesis to investigate the technological relationship between SPCs and the Levallois technique in an attempt to better understand the origins of the latter.

As discussed in Chapter 2, the origins of the Levallois technique are highly debated, however most researchers now favour the *in situ*, local, development of the technique from the Acheulean (White and Ashton 2003; Scott 2011; White *et al.* 2011; Adler *et al.* 2014; Wiśniewski 2014). Through the analysis of SPCs from assemblages dated prior to, and on the cusp of, the first appearance of Levallois in northwest Europe, it was anticipated that a better understanding of this technique would help reveal whether it was already present in embryonic form in the Lower Palaeolithic archaeological record. The four sites with a known Levallois element were included in order to make the technological comparisons between the two methods and to establish of the two techniques were contemporary at any point. The analysis of this material has enabled a better understanding of the ways in which SPCs are not Levallois and why the presence of SPCs cannot be considered to imply the same behavioural changes associated with the Levallois technique. These behavioural implications will be discussed in detail in Section 7.4.

The technological similarities between SPCs and Levallois cores demonstrate an unquestionable conceptual link between the two methods of flake production. The approach to the volume of the material with the focus of flaking on one surface above any other option is not seen with any other techniques in these assemblages. This link strongly implies the Levallois technique developed *in situ* in Europe rather than being a technique which was introduced when fully developed.

The varying degrees of preparation seen in the SPCs as demonstrated by the preparation of the preferential flaking surface and the striking platform surface are also indicative of *in situ* development. Although the degree of preparation does not increase chronologically, as demonstrated in Section 6.2.4 (page 209), this variation does suggest that the technique was developed rather than introduced as a finished method of producing flakes.

This research has found no evidence to support the argument that the Levallois technique developed from accidental removals during handaxe production. With the exception of the one questionable core from Caddington, this investigation has not produced material which is comparable to the descriptions of that from Cagny-la Garenne. However photos of the Cagny-la Garenne material do seem more SPC-like and less handaxe-like than expected and a possible future goal in this area of research would be to analyse these artefacts using the same methodology.

The SPCs analysed during this research seem to be very similar, if not the same technologically, as the material from Orgnac 3, France. Moncel and colleagues (2012) have demonstrated the *in situ* development of the Levallois technique at Orgnac from 'unifaced discoid cores' through to the fully developed Levallois technique over a well dated stratigraphic sequence of 10 layers. Moncel and colleagues (*ibid*.) argue the Levallois technique develops from unipolar to centripetal preparation. Unfortunately none of the sites studied in this investigation have the same highly detailed chronostratigraphic sequence as seen at Orgnac 3 and as a result it has not been possible to track the development of the technique through time. The resolution of the data means subtle differences such as the change from unipolar to centripetal preparation over time cannot be established at these sites. However on a wider scale is can be seen that even the oldest sites with a SPC presence demonstrate centripetal preparation which would suggest the progression from unipolar to centripetal is not a pattern seen everywhere.

Based on the cores analysed in this investigation, SPCs most likely have their origins in parallel flaking. Though the organisation of the preferential flaking surface clearly indicates a greater degree of complexity in SPCs, the difference between a SPC and a core reduced through parallel flaking could be considered to be a fine distinction in some cases and relies upon the way in which the preferential flaking surface is prepared along with the volumetric approach to the material. This close relationship could imply SPCs developed from fortuitously flat cores which were flaked in a parallel manner. If this was the case, the origins of the Levallois technique lies in pre-existing core working techniques present long before the appearance of Levallois and SPC technology.

SPCs demonstrate the first occurrence of the preparation and organisation in cores which becomes standard with the Levallois technique. However this research has not identified any evidence of the predetermination which is so integral to the claims for cognitive advancement with the Levallois technique. The analysis of the SPCs has however identified the presence of the hierarchical concept along with physical and conceptual preparation. The implications for these developments will be discussed further in the next section.

Overall this research demonstrates the origins of the Levallois technique, in northwest Europe at least, are within existing Lower Palaeolithic core technologies and not introduced as a complete technique. Thereby rejecting the claims for a monocentric origin and supporting the *in situ* evolution of the Levallois technique from pre-existing Lower Palaeolithic core working techniques, one of which is SPCs. This is not to suggest the Levallois technique developed in northwest Europe and was then dispersed throughout Europe and further afield, rather the technique developed independently, most likely on multiple occasions, in multiple locations.

7.4 Implications for Behaviour and Cognition

The results of this analysis have demonstrated hominins were producing flakes through the SPC method as part of their Lower Palaeolithic core working repertoire. As previously mentioned this supports the arguments for greater technological variation in the Lower Palaeolithic and contradicts the arguments for a prolonged period of stasis only broken by the appearance of Levallois technology.

The data presented in Chapter 5 and discussed in Chapter 6 clearly demonstrates SPCs are a change in technology. The SPC flake size data combined with the analysis of the preparation of the preferential flaking surface indicate this new technology was focused on the production of flakes. The point at which the cores are abandoned after the removal of the proportionally large flake also confirms these were the desired end products, as these cores are far from exhausted.

The production of flakes which are then retouched into tools (or perhaps used as large sharp flakes) is not new and can be seen throughout the Lower Palaeolithic. However, the planning and preparation evident in SPC technology is the first time this organisation is seen for the sole purpose for producing flakes. In terms of hominin behaviour and cognitive ability, this new technology could demonstrate the conceptual shift away from core-based tool strategies towards the flake based approach as seen in the Middle Palaeolithic and in association with Neanderthals.

The question then becomes, why would hominins start producing flakes in a different way? Establishing the purpose of the SPC products without the ability to identify them within the assemblage is challenging, however their purpose must fall into one of two categories. Either the hominins were using this new method to produce something which is also new, or they were using this as a new method for doing something they were already doing. As there are no other noticeable differences in the composition of the assemblages analysed, the latter suggestion is favoured here.

The SPC preferential removal scars are larger on average when compared to the other flakes in the corresponding assemblages. The preparation of the flaking surface also results in preferential flakes which are flatter in profile and have less residual cortex. These suggestions are based on observations of the material and cannot be quantified without refitting, though experimental knapping might be useful for future work in exploring these suggestions. There are several problems associated with experimental knapping which will be addressed in the future work section of the following chapter.

If the function of the SPC products is not new but the method for producing them is, it could suggest SPCs were a more reliable or expedient way of producing large flat cores compared to the other techniques. A simple way to explain this would be if the end product is the same but the method of getting it changes, the new method must be better either in terms of effectiveness or efficiency or both.

Although SPCs are on the same trajectory as Levallois, these cores do not give the release from proximity which comes with Levallois technology. The re-preparation and ability to produce multiple tools; points, flakes and elongated flakes, from a single volume of material is what enables the Levallois technique to be considered mobile. SPC technology is less flexible with the production of a few large flakes at most thereby limiting the release of proximity from sources of raw material. This research has identified a small number of SPCs which appear to have more than one preferential removal and have been categorised as recurrent. These cores are not recurrent in the same way as recurrent Levallois cores are, as the products are not predetermined in shape, but they could represent the earliest iterations of the process.

With the exception of two fortuitously pointed SPC preferential flake scars, there is no evidence to suggest SPCs were used for the production of points. Levallois points and the association with composite tools is one of the arguments for increased cognitive ability. As discussed in Chapter 2, composited tools require planning and the combining of multiple elements such as a haft and binding in addition to the stone point. As discussed in reference to the presence of fire, the lack of evidence for the production of points should not suggest the hominins lacked the cognitive ability to do so. However, the lack of points does suggest the behavioural changes associated with composite tools, for example, changes in hunting strategies, are not introduced with this method of flake production.

Many of the behavioural changes associated with the Levallois technique, which include greater mobility within the landscape, higher levels of tool curation, changes in habitat preference, specialised hunting, and changes in group dynamics, have been characterised as Neanderthalisation. If the development of Levallois technology was facilitated by the existence of pre-existing core working techniques such as SPCs, it could be inferred that the behavioural changes associated with Levallois were developing with the earlier techniques as well. However, as with the example of points and hafted tools, this does not appear to be the case.

With the exception of the changes in hunting as seen at Schöningen (and even then those changes are associated with wooden spears and not composite technology), SPCs cannot be indicative of the changes in behaviour in a way that the Levallois technique can. This is due to the lack of predetermination of the SPC products. Changes in raw material transport distances do not appear to increase with the appearance of SPC technology because all of the assemblages included in this investigation were made on local raw material which the sites themselves were in close proximity to. The hunting practices at Schöningen indicate changes in group dynamics as hunting in this way would have required social organisation (Villa and Lenoir 2009; Julien *et al.* In press; Rivals *et al.* In press). The recent re-dating of Schöningen now places the assemblage in MIS 9 at approximately 300ka. This date is contemporary with the earliest examples of Levallois in Nor Geghi 1 (Adler *et al.* 2014) and many of the SPC assemblages in this investigation. The change in hunting practices cannot be attributed to either technique but is evidence of change in behaviour occurring at this time.

Many of the behavioural changes associated with Neanderthalisation do not appear in the archaeological record until the early/late Middle Palaeolithic transition once the Levallois technique has been widely adopted (Féblot-Augustins 1999; Gaudzinski 1999b; Scott 2011). It is therefore unsurprising that so few behavioural changes can be associated with the SPC technique. The new technology may be one of the earliest forms of evidence for the behavioural changes. The method is certainly a different way of thinking about flake production from a conceptual perspective and should be considered to be associated with the beginnings of Neanderthalisation.

Although SPC technology cannot be directly linked with many of the changes in behaviour associated with Levallois technology, this is still a conceptual change in the approach to tool making. Whilst the tools in their final form and the tasks they were used for might not have changed, the process of making them is clearly changing with the appearance of SPCs. This conceptual change towards a more flake based approach to tool use could represent a cognitive shift as knappers develop more complex reduction strategies.

Though lacking in preparation and maintenance of the distal and lateral convexities, there is still a conceptual shift between SPCs and the Levallois technique. By lacking this shaping, the SPCs are lacking the *façonnage* element as seen with Levallois and it is the fusion of *débitage* and *façonnage* which represents this conceptual shift (White and Pettitt 1995). SPCs therefore represent the conceptual shift from the Acheulean to a more flake based approach and the transition from SPCs to Levallois marks the conceptual shift which combines *débitage* and *façonnage*.

Increases in brain size does not correspond with the appearance of SPC or Levallois technology (Shultz *et al.* 2012). The research presented in this thesis is therefore another example of how the archaeological record does not correlate with physiological development. However the problems with attempting to match the biological, cognitive and behavioural data are numerous and have been described in Chapter 2. The changes in behaviour, which are seen in the form of technological change, will be the last to manifest. Much like Gowlett and colleagues' (2012) example of the capacity to create fire, the cognitive capacity to implement the Levallois technique may have been inherent long before it is visible in the archaeological record. The same argument could be applied to SPC technology and the presence of SPCs at an earlier date is evidence for the cognitive development in a direction towards Levallois capabilities.

My research suggests SPCs were present in small numbers, not necessarily continuously, at more sites than just Purfleet at MIS 9 and Kesselt-Op at MIS 8. Table 7.2 demonstrates the range of approximate dates for the assemblages in this study. Although many of the sites cannot be well dated, the presence of the SPC at Feltwell potentially places this technology as early as MIS 14. This obviously has significant repercussions for considering the cognitive implications, as previously discussed, along with behavioural implications. The reservations surrounding Feltwell are not related to the SPC itself. The core is almost identical to one of the cores from Frindsbury and can be seen in Appendix B. The issue with Feltwell is the reliability of the context as very little about the exact location of the material is currently known. This is an area for potential further research which is addressed in the following chapter.

It is unlikely that isolated instances of an innovation like SPC technology would be visible in the archaeological record. Although both Feltwell and Kesselt-Op demonstrate a single SPC within the assemblages, it is extremely unlikely these cores represent the origin point of the technique as they are both extensively prepared. This research has demonstrated just how small the core component of an assemblage can be with Caddington and Dunbridge being the only two sites studied where cores contribute 10% or more of the total assemblage. SPCs are technologically significant and they represent a part of the core working repertoire however the frequency of these cores is still low. This suggests the SPC technique was not implemented as often as the more established, and less complex techniques. The nine assemblages with SPC presence are geographically and chronologically varied and could represent multiple reinventions of the technique.

Site	*Date*	*MIS*	*SPCs?*
Feltwell	n/a	14?	Y
Biddenham	n/a	11/9	Y
Caddington	n/a	11/9	N
Red Barns	200,000-425,000PB	11/9	Y
Frindsbury	n/a	n/a	Y
Purfleet	329±30ka	9	Y
Dunbridge	n/a	9b	Y
Kesselt-Op	300,000BP	9/8	Y
Mesvin IV	250,000-300,000BP	8	Y
Cuxton	230,000BP	8/7	Y

Table 7.2 A comparison of the assemblage date estimates and the presence or absence of SPC technology.

The Levallois cores and SPCs from Dunbridge are not considered to be of the same age and questions remain about the precise relationship between the Levallois material and the SPCs at Purfleet (page 101). Both technologies from Kesselt-Op are contemporary, and the material from Mesvin IV is also stratigraphically secure. Hominins at these sites are continuing to use the SPC technique after the invention of the Levallois technique. Again without the ability to directly compare the products of the two techniques, it is difficult to establish why one technique would be favoured over the other however it may be that on occasion the extra time and investment potentially required to use the Levallois method was not necessary for the intended purpose of the product.

A final point regarding the behavioural implications of SPC technology is why it appears when it does. However as SPCs have been identified in all but one assemblage in this investigation, it cannot be assumed that the earliest iteration is represented here. Instead this research has demonstrated the variation in Lower Palaeolithic core assemblages which has previously been over-looked, possibly because cores are less atheistically pleasing than handaxes. An answer as to why this technology appears now cannot therefore be given as it is not presumed this is the beginning. Instead it is must be accepted that hominins present in the relatively large time span the sites analysed represent were capable of producing this technique but did not always chose to.

Hominins in northwest Europe by MIS 11 and potentially earlier were therefore using core technologies which were more conceptually complex than they have previously been given credit for. This technology facilitated the *in situ* development of the Levallois technique and whilst it signals the beginnings of the processes of Neanderthalisation and a greater conceptual awareness to other Acheulean core techniques, the behaviour associated with SPCs cannot be considered to be synonymous with that of those producing the Levallois technique.

7.5 Terminology

To return to one of this issues which prompted this research, the analysis of SPCs and their relationship to both Levallois technology and other core working techniques has clarified much of the confusion regarding different terminology. In terms of the technology, the cores which have been referred to as 'Proto-Levallois' 'reduced' Levallois, 'Levallois-like', 'not quite Levallois' and 'simple prepared core technology' are all the same. As discussed in Chapter 2, White and Ashton (2003) used the term simple prepared cores to describe the cores from Purfleet as they felt the term proto-Levallois was loaded. However in their paper, White and Ashton (*ibid.*) concluded the cores from Purfleet do represent a proto-Levallois technology as they demonstrate a volumetric concept with the organisation of two surfaces and a plane of intersection between them. Whilst it is clear the cores from all assemblages share these characteristics, the term proto-Levallois is still loaded and not helpful when talking about core variation.

By definition the word 'proto' means earliest, original, primitive or at an early stage of development. This is confusing as technologically something is either the earliest/original example of something or it is in development. It also seems contradictory to have proto-Levallois and Levallois technology in the same contexts, either the technology is present or absent. Scott (2011) has demonstrated the huge variation in Levallois technology and yet it seems 'proto' is also a term used when someone remains unconvinced that a core is Levallois as it does not conform to the centripetal, linear form or appears to be crude.

The term proto is misleading as it suggests all of the behavioural implications associated with Levallois technology but to a lesser extent. This research has demonstrated SPCs are more prevalent over a wider time period than previously thought. By calling them proto or reduced it could be inferred that the behavioural changes associated with Levallois can also be stretched back and we have no other evidence to support that. If the cores from Cagny-la Garenne are the same technologically as the SPCs analysed in this thesis, evidence of this technique can be reliably traced back to MIS 11. If the Feltwell assemblage is accepted, this date is pushed back to MIS 14. This is very early to be suggesting the presence of the behaviour associated with Levallois although Beaumont and Vogel (2006) identified very early examples of such in Africa.

It is the complexity and planning seen in the Levallois technique which separates it from the Lower Palaeolithic core working methods and yet this research has shown SPCs demonstrate a level of complexity not seen before in the Lower Palaeolithic. By defining SPCs as proto/reduced Levallois, it could be argued that the complexity of the SPCs are the same or similar to that of Levallois and yet this thesis has demonstrated there is still a degree of conceptual change between the SPC and Levallois technique.

As mentioned in relation to Figure 2.12 in Chapter 2, there are no known SPCs or cores which fit the description from Africa. As this research has demonstrated, it is possible that such cores do exist but have been overlooked or wrongly classified due to confusion surrounding the technology. Research to establish if Victoria West cores could be considered to be Proto-Levallois was undertaken by Lycett (2009) with results concluding the technologies were distinctly separate. Without assessing all PCT variants using the same methodology, it is not clear why SPCs may be considered to be a proto stage but other forms of PCT are not. By adding the term proto-Levallois into the African record we will perpetuate the confusion previously seen with the British assemblages. Without further analysis, there remains the possibility that SPCs are a precursor to other forms of PCT as well as the Levallois technique. Technological analysis of non-Levallois PCTs is rare and should be investigated further. This will be addressed in more detail in the following chapter.

Finally, it seems illogical to continue to refer to the same technology by different terms on the continent and here in the UK. The single core from Kesselt-Op is referred to as simple prepared technology in all publications since it was identified in 2007.

7.6 Data Interpretation Summary

This chapter has addressed the implications of the presence of SPC technology and highlighted the ways in which this novel technology is a step towards the Levallois technique. Differences in the preparation of the flaking surfaces prevent SPCs from demonstrating predetermination thereby restricting the cognitive and behaviour associations which can be associated with SPC technology. SPCs do demonstrate increased complexity towards the production of flakes prior to the widespread appearance of Levallois technology and undoubtedly facilitated the development of the technique. Though not indicative of the changes associated with Levallois, SPCs demonstrate increased core variation in the Lower Palaeolithic and are argued to represent increasing cognitive ability.

Chapter 8: Conclusion

8.1 Summary

This research has aimed to increase our understanding of the variation in Lower Palaeolithic core working techniques prior to the widespread appearance of Levallois technology and in doing so better understand the origins of the technique.

This has been carried out through the detailed attribute analysis of the lesser known reduction technique, SPCs, and applying the following Research Questions.

Prior to this research, opinions on the cognitive implications for the origins of Levallois were divided. One school of thought favoured the cognitive leap which argued the sudden, widespread appearance of Levallois technology after the long stasis of the Acheulean as evidence for significantly advanced cognition. The opposing argument was for a gradual cognitive progression made evident by pre-existing flaking techniques. The results of this research favour elements of both arguments suggesting the appearance of SPCs demonstrates a lack of stasis at the end of the Lower Palaeolithic and yet significant differences in core concept separate the Levallois from the SPC technique in terms of cognition.

The results and implications presented in this thesis have addressed the following Research Question and Sub-research Questions.

Research Question

What is the precise technological relationship between SPCs and the Levallois technique, and what will this tell us about the behaviour of the hominins associated with these new ways of making stone tools?

This question has provided the overarching theme for the entire thesis. Analysis of the two techniques has shown many technological similarities and two fundamental differences. The lack of maintenance of the distal and lateral convexities renders it impossible to define the products of SPCs as predetermined. As it is the predetermination of the final product which is linked with the cognitive complexity required to implement the Levallois technique, the hominins responsible for SPCs cannot be considered to demonstrate the same level of cognition through the production of flakes as those with Levallois technology.

Of all Lower Palaeolithic core working techniques, Levallois technology most closely resembles SPC technology. The approach to the volume of the core with a surface specifically selected for flaking and the construction of a striking platform solely for the removal of the preferential flake clearly demonstrates SPC technology is on the same conceptual path towards Levallois technology. The planning and organisation evident in the SPC technique is suggestive of hominins changing their approach from ad hoc methods towards methods offering more control over outcomes.

This research clearly demonstrates the origins of the Levallois technique are present in pre-existing core reduction techniques and the origins of SPCs are most likely from parallel flaking. The behavioural element of this question is addressed by Sub-research question 3.

Sub-research Question 1

How prevalent are SPCs within Lower Palaeolithic assemblages in northwest Europe?

Confusion regarding terminology and technological identification within assemblages has prevented the recognition of SPC technology for many of the sites analysed in this investigation. The sites were selected on the basis that they might include examples of the SPC technique based on numerous different descriptions. This research has defined this technology and all but one assemblage was found to have cores which conform to this definition. The results of this study have therefore demonstrated SPC technology was more widely employed at the end of the Lower Palaeolithic.

Sub-research Question 2

What is the relationship between SPCs and other Lower Palaeolithic core working techniques?

SPCs are conceptually very different to other Lower Palaeolithic core working techniques as they demonstrate an organisation of the volume and preparation of the material not present in other methods. Whist rarely the dominant method of flaking within an assemblage, the SPCs are often less intensively worked and often abandoned before they are exhausted, indicating the knapper has produced the flakes they desire.

Although the products of the SPCs have not been identified within the assemblages, comparisons between the preferential scar size and the flakes and flake tools in each assemblage suggests the products of the SPCs were generally larger than other flakes. The organisation of the volume of the core with flaking focused on a single surface also suggests SPCs maximise the surface area and produce a preferential flake which is between 40-60% of the flaking area.

This research demonstrates increased variation within core working techniques and promotes the inclusion of SPCs within the Lower Palaeolithic core working repertoire.

Sub-research Question 3

What are the behavioural and cognitive implications of the identification and presence of SPCs from Lower Palaeolithic assemblages in Britain, and across Europe?

SPCs are not indicative of the cognitive change attributed to the makers of the Levallois technique due to lack of predetermination of the final products. It is this predetermination which enables those with the Levallois technique to be mobile and facilitates the behavioural changes associated with that. However SPCs are a technological innovation which suggests hominins in the Lower Palaeolithic were becoming cognitively more advanced. This new method of core reduction signals hominins changing the way they approached flake production and although this does not immediately lead to a change in tool production, conceptually the change ultimately leads to a completely different global tradition.

8.2 Future Work

This thesis has only addressed a small aspect of the wider issue of PCT variation and there are many directions for future research including the technological analysis of the African PCT record, experimental investigation into flaking surface control, reinvestigation and possibly further exploration of the deposits from sites analysed in this thesis and finally the application of this methodology to other early Levallois and SPC assemblages.

Analysis of the origins of the Levallois technique through detailed attribute analysis of African PCTs would be the largest contribution to this research area. Levallois technology appears earlier in African and there are more examples of other PCT variants. However, no mention of material which appears to resemble SPCs has been found in the literature. A critical re-examination of the African assemblages would also clarify if SPCs are only a precursor to Levallois technology or if all PCTs have their origins in a less conceptually complex version of the individual techniques. This would also clarify which non-Levallois PCTs, if any, can be considered to be ‘proto-Levallois’.

Throughout this research the extent to which cores are prepared and predetermined has been an ongoing discussion. An experiment which replicates these cores and analyses the processes by which they are reduced would be beneficial to improve the overall understanding. However such an experiment would have to engage with the problem that any knapper today is cognitively more advanced compared with the hominins producing these cores. A further problem would be to find a candidate who was sufficiently competent to produce handaxes and tools from the

Lower Palaeolithic but who was not aware of the Levallois technique. In all likelihood, an experiment which would resolve these issues would require many years to complete which is why this was not included in the framework for this thesis.

The sites of Feltwell and Biddenham could be reinvestigated to provide a better chronostratigraphic framework for the assemblages analysed. Very little is known about the deposits from which both of these assemblages originated and yet Feltwell, if it can be reliably attributed to MIS 14 could be an exciting site for the origins of SPC technology.

Finally, as stated from the outset, the inclusion of key sites such as Cagny-la Garenne and Orgnac would be highly desirable. It would also be of great interest to analyse some of the newly discovered early Levallois material and the material from any older stratigraphic layers to see if the origins of this material is gradual like the assemblages in this investigation.

8.3 Concluding Remarks

Although the aim of this thesis has been to gain a clearer understanding of the origins of Levallois technology, this has not been with the intention of pushing back the first appearance of the technique or the behavioural associations with it. If this technology has developed from pre-existing techniques, as this research would support, there will be no specific point of origin in terms of time or space and earlier examples will undoubtedly be discovered.

Appendices

Appendix A Potential SPC location, reference and terminology

Site	Country	References	Terminology
Barnham, Suffolk	*UK*	*(Wymer 1985)*	*Proto*
Biddenham, Bedfordshire	*UK*	*(McNabb 2007; Roe 1981; Harding et al. 1992)*	*Proto*
Caddington, Bedfordshire	*UK*	*(McNabb 2007; Roe 1981)*	*Proto / Reduced*
Cuxton, Kent	*UK*	*(McNabb 2007; White et al. 2006)*	*SPC*
Dunbridge, Hampshire	*UK*	*(Harding et al. 2012)*	*Proto*
Elveden, Suffolk	*UK*	*(Wymer 1985)*	*Proto tortoise core*
Feltwell, Norfolk	*UK*	*(MacRae 1999)*	*Proto*
Frindsbury, Kent	*UK*	*(McNabb 2007)*	*Proto*
Furze Platt, Berkshire	*UK*	*(Roe 1981)*	*Early Levallois*
High Lodge, Suffolk	*UK*	*(Field 2005)*	*"Levallois- like" removals on a handaxe*
Highlands Farm, Oxfordshire	*UK*	*(McNabb 2007)*	*Proto/ Reduced*
Hildersham, Furze Hill, Cambridgshire	*UK*	*(Wymer 1985)*	*Possible miss- struck tortoise core*
Morton on the Hill, Norfolk	*UK*	*(Wymer 1985)*	*Degenerate Levallois type*
Purfleet, Essex	*UK*	*(Roe 1981; Wymer 1985; White and Ashton 2003; McNabb 2007)*	*SPC/ Proto*
Red Barns, Hampshire	*UK*	*(Wenban- Smith 2000)*	*Early Levallois*
Ruscombe, Berkshire	*UK*	*(Wymer 1968)*	*Proto tortoise core*
South Acre, Norfolk	*UK*	*(Wymer 1985; MacRae 1999)*	*Proto*
Stoke Newington, London	*UK*	*(Field 2005)*	*"Levallois- like" removals on a handaxe*
Swanscombe, Rickson's Pit and Barnfield Pit, Kent	*UK*	*(Roe 1981)*	*Early Levallois*
Tabor's Pit, Bocking, Essex	*UK*	*(Wymer 1985)*	*Proto tortoise core*
Kesselt- Op de Schans	*Belgium*	*(White et al. 2011)*	*Simple prepared cores*
Mesvin IV	*Belgium*	*(Scott and Ashton 2011; McNabb 2007)*	*Proto, Simple Prepared Levallois Cores and Reduced Levallois*
Cagny La Garenne	*France*	*(Lamotte and Tuffreau 2001; Field 2005)*	*Levallois element*
Orgnac 3	*France*	*(White et al. 2011)*	*Early Levallois*

A1. 1 Sites with potential SPCS, references and terminology

Site	Assemblage Location
Barnham, Suffolk	*Franks House (FH), Bury St Edmunds (MHM) Cambridge (A&E), Cambridge (S), Edinburgh (NMA), Ipswich Museum, Leeds (CM), Norwich (CM) Wisbech Museum*
Biddenham, Bedfordshire	*Bedford Museum, Bristol (CM) FH, Cambridge A&E, Cambridge (s) Glasgow H, Leicester Museum, Luton Museum, Manchester Museum, Oxford (A) and (PRM), Salisbury*
Caddington, Bedfordshire	*Luton, FH, Ashmolean, Aylesbury Museum, Bedford Museum, Birmingham (CM), BM (NH) Cambridge (A&E) Geol Museum, Glasgow (H), Gloucester Museum, Oxford A, Oxford PRM, St Albans (VM) Salisbury Museum, Stroud Museum*
Cuxton, Kent	*FH - London, Natural History, Cambridge A&E, King's Lynn Museum, Norwich CM, Oxford PRM, J Nicholls Coll, Maidstone, Rochester, Dartford, Canterbury*
Dunbridge, Hampshire	*Salisbury, Winchester, Bristol, Cambridge University Museum, Leicester, Soton*
Elveden, Suffolk	*FH, Cambridge A&E, Elveden Estate Office and Ipswich Museum*
Feltwell, Norfolk	*Salisbury, Birmingham (CM), Brighton Museum, FH, Natural History, Cambridge (A&E), Cambridge (S), Exeter Museum, Glasgow (H), Ipswich Museum, Maidstone Museum, Norwich (CM), Oxford (A), Oxford (PRM), Plymouth*
Frindsbury, Kent	*Canterbury, FH, Maidstone, Rochester, PRM*
Furze Platt, Berkshire	*FH*
High Lodge, Suffolk	*FH*
Highlands Farm, Oxfordshire	*Unknown*
Hildersham, Furze Hill, Cambridgshire	*Cambridge A&E, Cambridge, Ipswich Museum*
Morton on the Hill, Norfolk	*Norwich*
Purfleet, Essex	*Franks House (FH) – British Museum*
Red Barns, Hampshire	*FH*
Ruscombe, Berkshire	*Reading Museum*
South Acre, Norfolk	*FH - London, Natural History, Cambridge A&E, King's Lynn Museum, Norwich CM, Oxford PRM, J Nicholls Coll*
Stoke Newington, London	*Oxford PRM*
Swanscombe, Rickson's Pit and Barnfield Pit, Kent	*FH, London University Institute of Archaeology, Ipswich Museum, Rochester*
Tabor's Pit, Bocking, Essex	*Stratford (PEM) - closed Poss BM?*
Kesselt- Op de Schans	*Leuven, Belgium*
Mesvin IV	*Museum of Natural Sciences in Brussels*
Cagny La Garenne	*Lille, France*
Orgnac 3	*Tautavel, France*

A1. 2 Sites with potential SPC, assemblage location

Appendix B Skitch Photos

Appendix B is on the accompanying discs.

Appendix C SPC data for all sites

Site	Collection	Box no.	Id no.	SPC Type	Prep. Method	Exploit. Method	Pref Rem. Length	Pref Rem. Breadth	Recurrent Rem. Length	Recurrent Rem. Breadth	Core Length	Core Breadth	Core Thickness	Total no. rems.	No. of flaking surface rems.	Faceting	Residual cortex	Condition	Staining	Patination	Raw Material
Biddenham	Knowles	165	1909.66.7	C	Unidirectional	Recurrent	68.3	46	63.9	39.4	95.1	84.7	41.5	13	7	No	<25%	Fresh	Heavy	Light	Flint
Biddenham	Knowles	165	1909.66.2	B	Bipolar	Linear	40.8	52.1			52.6	56.7	24.8	7	5	No	25 - 50%	Fresh	Heavy	Heavy	Flint
Biddenham	Knowles	166	1909.66.47	B	Centripetal	Linear	46	73.3			80.2	79.8	26.6	11	4	No	<25%	Slightly Rolled	Heavy	Light	Flint
Biddenham	Knowles	167	1909.66.113	B	Centripetal	Linear	60.6	65.1			88.1	93.6	25.5	15	10	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Biddenham	Knowles	169	1909.66.162	C	Centripetal	Linear	31.1	29.3			57.6	45.5	16.9	20	11	No	25 - 50%	Slightly Rolled	Heavy	Heavy	Flint
Biddenham	Knowles	170	1909.66.180	A	Unidirectional	Non-exploited					81.5	52.1	37.9	7	0	Yes	25 - 50%	Slightly Rolled	Heavy	Heavy	Flint
Biddenham	Knowles	173	1910.75.126	C	Bipolar	Linear	62.6	64.2			73.6	63.3	22.5	11	9	No	0%	Slightly Rolled	Heavy	None	Flint
Biddenham	Knowles	173	1910.75.1	A	Centripetal	Linear	46.6	41.7			75.7	84.1	53.2	9	5	No	25 - 50%	Slightly Rolled	Light	Heavy	Flint
Biddenham	Knowles	174	1911.81.13	C	Centripetal	Linear	64.6	61.4			88.9	102.6	49.1	13	5	No	<25%	Slightly Rolled	Heavy	None	Flint
Cuxton	Cogger	2	P.1985 10-1 10	A	Centripetal	Recurrent	33	60.7	30.5	54.7	86.6	44.4	29	9	7	No	25 - 50%	Slightly Rolled	Light	Light	Flint
Cuxton	Tester	Box 60	527	B	Centripetal	Linear	77.6	63.3			94.9	129.6	50.2	4	3	No	50 - 75%	Fresh	Light	None	Flint
Cuxton	Tester	Box 61	531	B	Centripetal	Recurrent	85.6	61.9	60.7	84.5	113.8	105.9	66.5	9	5	No	25 - 50%	Fresh	Light	None	Flint
Cuxton	Tester	Box 66	574	B	Centripetal	Linear	71.9	63.8			129.6	105	51.9	10	5	No	25 - 50%	Fresh	Light	None	Flint
Dunbridge	Wessex	Cores	586	C	Centripetal	Linear	60.1	48.4			72.8	79.4	26.9	15	6	No	0%	Heavily Rolled	Heavy	None	Flint
Dunbridge	Wessex	Cores	513	B	Unidirectional	Linear	93.3	71.8			114.9	92.3	54.5	13	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Dunbridge	Wessex	Cores	665	C	Centripetal	Linear	46	46.4			104.8	154.9	79.4	11	5	No	<25%	Fresh	Heavy	None	Flint
Dunbridge	Wessex	Cores	653	B	Unidirectional	Linear	57.1	51.7			92.1	61.6	41	7	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Feltwell	MacRae		SPC 1 RJM Feb 1999	C	Centripetal	Linear	112.5	89			124	136.9	48.9	12	7	No	<25%	Slightly Rolled	Heavy	Heavy	Flint
Frindsbury	Cook	2 (not on box)	1925 11-12 unreg	C	Centripetal	Recurrent	122.5	69.8	123.1	71.2	145.6	141.7	60.9	12	6	No	<25%	Fresh	Light	Light	Flint
Frindsbury	Cook	2 (not on box)	1925 11-12 unreg	C	Centripetal	Linear	125.3	87.99			140.2	157.5	70.5	10	4	No	<25%	Fresh	Light	Light	Flint
Frindsbury	Cook	02-Mar	1925 11-12 11	A	Unidirectional	Linear	50.6	72.59			91.4	87.6	34.7	7	5	No	25 - 50%	Slightly Rolled	Light	Heavy	Flint
Frindsbury	Cook	6a	1925 11-12 44	A	Unidirectional	Linear	52.15	75.34			105.4	131.6	36.7	6	4	No	25 - 50%	Fresh	None	Heavy	Flint
Frindsbury	Cook	8	1925 11-12 unreg	C	Centripetal	Linear	57.9	87.23			112.1	126.8	46.1	9	3	No	<25%	Fresh	None	Light	Flint
Frindsbury	Cook	8	1925 11-12 unreg	C	Unidirectional	Linear	111.15	51.69			100.4	75.5	37.5	6	4	No	0%	Fresh	Light	Light	Flint
Frindsbury	Cook	8	1925 11-12 unreg	A	Unidirectional	Linear	52.83	54.98			87.3	131	32.2	4	3	No	25 - 50%	Fresh	Light	Heavy	Flint
Frindsbury	Cook	8	1925 11-12 unreg	A	Unidirectional	Linear	76	44.55			76.6	136.9	93.5	4	3	No	50 - 75%	Fresh	None	Light	Flint
Frindsbury	Cook	7	1925 11-12 unreg	A	Unidirectional	Linear	97.46	79.59			112	130.9	47.5	6	4	No	25 - 50%	Fresh	None	Heavy	Flint
Frindsbury	Cook	7	1925 11-12 unreg	C	Centripetal	Linear	89.24	28.02			90.2	73.6	30	7	4	No	<25%	Fresh	None	Light	Flint
Frindsbury	Cook	13?? IF 23/18	1925 11-12 8	C	Centripetal	Linear	91.22	106.65			128.2	180.7	72.9	12	6	No	25 - 50%	Fresh	Light	Light	Flint
Frindsbury	Cook	13??	1925 11-12 9	C	Unidirectional	Linear	67.87	85.01			128.4	144	81.9	10	8	No	<25%	Fresh	Light	Light	Flint
Frindsbury	Cook	13??	1925 11-12 10	A	Centripetal	Linear	55.28	77.32			108.4	131.1	48.1	7	6	No	50 - 75%	Fresh	Light	Light	Flint
Purfleet - BP	Snelling	Box 2	6	B	Unidirectional	Linear	73.7	63.7			119.3	98.3	56.3	5	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 3	10	B	Centripetal	Linear	86.1	54.6			120.9	93.2	54.1	9	6	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 20	161	B	Centripetal	Linear	80.6	74			80.2	91.3	34.1	8	5	Yes	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 22	1	C	Unidirectional	Linear	59.1	87.4			112.3	122	49	11	9	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 22	7	B	Centripetal	Linear	49.8	52.4			74.8	64.1	30.7	9	6	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 23	1	B	Centripetal	Linear	46	55.9			69.6	76.1	38.7	10	7	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 23	3	B	Centripetal	Linear	53.3	40.5			80.9	103.8	62.6	15	7	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 23	7	B	Centripetal	Linear	67.2	43			103.9	90.6	49.1	6	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 24	1	C	Unidirectional	Linear	44.6	63.7			91.1	111.1	58.7	10	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 24	6	B	Centripetal	Non-exploited					99.4	71.1	29.9	9	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 24	7	C	Centripetal	Linear	83.4	79.8			84.5	106.6	33.8	9	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 25	6	B	Unidirectional	Linear	84.4	63.1			94.9	99.4	51.3	6	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint

C.1 Continued

Site	Collection	Box no.	Id no.	SPC Type	Prep. Method	Exploit. Method	Pref Rem.		Recurrent Rem.		Core			Total no. rems.	No. of flaking surface rems.	Faceting	Residual cortex	Condition	Staining	Patination	Raw Material
							Length	Breadth	Length	Breadth	Length	Breadth	Thickness								
Purfleet - BP	Snelling	Box 26	3	B	Unidirectional	Linear	93.9	58.55			106.9	77.7	72.4	7	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 26	4	B	Unidirectional	Linear	77.8	97.87			87.2	98.4	75.1	8	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 27	3	B	Unidirectional	Linear	73.1	80.08			71.5	92.5	41	4	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 27	6	A	Centripetal	Linear	88.89	80.73			102.2	108.1	72	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 28	1	A	Unidirectional	Linear	105.56	61.4			108.1	74.1	46.3	5	2	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 28	5	B	Unidirectional	Linear	66.39	42.06			114.2	74.3	54.8	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 29	1	C	Centripetal	Recurrent	37.38	55.84	30.9	44.1	55.7	81.4	31.7	14	10	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 29	2	B	Unidirectional	Linear	61.32	73.42			85.3	111.5	58.5	9	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 30	1	B	Unidirectional	Linear	59.02	65.19			85	96.3	35.9	10	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 30	5	C	Unidirectional	Linear	106.72	65.75			107	98	45.1	8	2	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 31	1	A	Bipolar	Linear	55.92	81.9			81	85.2	41.5	6	2	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 31	2	A	Centripetal	Linear	65.19	44.53			103.5	78.4	42.5	9	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 31	5	A	Unidirectional	Linear	63.25	49.25			88.3	103.5	42.2	9	5	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 32	1	A	Unidirectional	Linear	74.72	56.27			77.5	59.7	28.7	6	2	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 32	3	B	Unidirectional	Linear	57.15	55.54			92.9	88.9	56.8	7	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 32	4	C	Centripetal	Linear	47.91	45.45			73.1	66.5	32.9	12	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 32	5	C	Centripetal	Non-exploited					71.1	63.3	27.2	12	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 32	6	C	Centripetal	Recurrent	42.34	30.18	28.7	26.3	62.7	52.9	21.7	16	8	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 32	7	C	Centripetal	Recurrent	28.98	55.26	67.4	36.92	81.8	60.4	31	10	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 33	2	B	Unidirectional	Linear	72.16	55.83			92.8	73	57.6	8	5	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 33	5	B	Unidirectional	Linear	37.44	33.45			85.3	109.4	43.2	7	5	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 33	6	B	Unidirectional	Recurrent	71.56	46.19	75.9		118.1	101	42.3	6	4	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 33	7	C	Unidirectional	Linear	52.35	76.41			79.2	93.1	50	10	4	No	0%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 34	2	A	Centripetal	Linear	74.64	55.07			72	73.2	28.9	14	6	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 34	4	A	Unidirectional	Recurrent	72.64	85.05	76.1	33.2	72.5	96.6	39.2	4	2	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 34	5	B	Centripetal	Non-exploited					69.9	81.3	21	12	7	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 34	6	B	Unidirectional	Linear	75.06	58.84			83.6	86.6	45.4	12	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 34	7	A	Centripetal	Linear	85.91	94			82.8	104	39.2	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 34	8	B	Convergent	Linear	85.62	50.86			101.2	77.8	31.8	11	5	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 35	1	B	Centripetal	Linear	82.7	70.6			85.5	99	49.2	10	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 35	2	B	Centripetal	Linear	59.1	38.4			84.7	70.6	23	11	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 35	3	B	Centripetal	Linear	38.4	43.1			66.7	59.7	23.2	10	5	No	25 - 50%	Slightly Rolled	Light	None	Flint
Purfleet - BP	Snelling	Box 35	4	B	Unidirectional	Linear	81.5	66.6			80.8	98.2	39.2	9	7	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 35	6	B	Centripetal	Linear	101.7	60.9			128.5	88.4	32.3	13	5	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 35	7	B	Centripetal	Linear	82.7	70.6			96.1	92.8	48.5	8	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 37	4	B	Unidirectional	Linear	68.7	75			67.6	84.2	31.4	5	2	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 37	5	B	Unidirectional	Linear	82.2	91.8			84	102.3	30.3	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 38	1	B	Centripetal	Linear	90.2	63.7			91.8	77	45.7	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 38	2	A	Unidirectional	Linear	57.7	97.1			78.5	116.9	62.8	5	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 38	3	A	Unidirectional	Linear	69.6	70.9			84.6	109	44.9	4	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 38	4	B	Unidirectional	Linear	110.7	56.4			109.7	76	48	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 38	7	B	Unidirectional	Linear	63	39.1			84.5	94.6	39.1	10	7	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 39	2	B	Centripetal	Recurrent	67.8	39.6	47.7	52.9	113.5	106.5	38.8	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 40	1	B	Unidirectional	Linear	72.2	57.1			73.4	58.5	23.2	5	2	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 40	3	B	Centripetal	Recurrent	108.4	38.1	105.8	41.6	144.3	83.3	33.7	11	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint

C.1 Continued

Site	Collection	Box no.	Id no.	SPC Type	Prep. Method	Exploit. Method	Pref Rem.		Recurrent Rem.		Core			Total no. rems.	No. of flaking surface rems.	Faceting	Residual cortex	Condition	Staining	Patination	Raw Material
							Length	Breadth	Length	Breadth	Length	Breadth	Thickness								
Purfleet - BP	Snelling	Box 40	5	B	Unidirectional	Linear	83.2	77.3			88	102.8	34.2	8	4	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 40	6	C	Bipolar	Linear	96.2	70.1			107	88.9	42.3	7	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 41	2	B	Unidirectional	Linear	57.6	62.2			82.2	132.2	38.5	7	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 41	3	B	Unidirectional	Linear	83.1	52.9			84.1	79	51.6	7	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 41	5	B	Unidirectional	Linear	101	90.2			104	133.8	48.3	5	2	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 41	6	B	Bipolar	Recurrent	78.3	39.1	57	36.6	80.7	62.3	31.8	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 42	1	A	Unidirectional	Linear	96.3	68.8			108.9	102.5	38.7	5	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 42	2	B	Unidirectional	Recurrent	73.9	76.7	84.4	58.3	113.4	123.7	59.7	5	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 42	5	B	Unidirectional	Linear	79.5	97.8			102.3	139.7	55	5	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 42	6	B	Bipolar	Recurrent	106.3	58.1	106.3	46.8	106.9	112.2	50.4	7	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 43	1	B	Bipolar	Recurrent	53.1	34	49.1	30.4	79.7	62.1	28.7	8	4	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 43	6	B	Bipolar	Linear	96.2	75.9			106.2	81.2	60	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 43	7	B	Centripetal	Linear	92.7	101.4			95.1	119.2	55	11	7	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 44	6	B	Centripetal	Recurrent	46.5	53.3	47.3	49.1	88.2	87.8	44.7	12	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 45	1	B	Centripetal	Linear	88.9	79.6			99.3	99.5	40.4	7	5	Yes	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 46	1	C	Centripetal	Linear	77.9	68.9			77.1	77.7	20.9	8	5	No	0%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 46	3	B	Unidirectional	Linear	71.5	38.1			99.8	66.5	28.2	6	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 46	5	B	Centripetal	Linear	75.4	82.9			81.7	83.1	49.3	6	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 47	1	B	Centripetal	Linear	55.2	73.6			115.4	101.2	47	11	7	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 47	3	B	Centripetal	Recurrent	49.8	58.4	55	71.2	105.5	106.7	48	9	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 47	5	B	Unidirectional	Linear	79.4	56.7			115.8	98.9	50.4	6	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 47	6	A	Bipolar	Non-exploited					110.9	74.6	47.9	9	7	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 48	3	C	Unidirectional	Linear	95.9	47.3			105.9	99.5	32.3	4	3	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 48	4	B	Unidirectional	Linear	56.8	93.5			85.4	112.6	43.1	5	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 49	7	B	Centripetal	Recurrent	87.8	63.2			111.3	114.7	55	9	6	Yes	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 50	1	B	Unidirectional	Linear	104.7	98.3			120	104.5	36.1	4	2	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 50	2	B	Centripetal	Linear	92	84.4			94.5	104.7	53.6	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 51	1	A	Unidirectional	Linear	81.7	58			108.4	68.3	42	4	2	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 52	3	A	Unidirectional	Linear	73.4	47.4			72.8	66.7	40.7	4	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 52	8	B	Unidirectional	Linear	66.9	58.7			67	75.4	35.2	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 53	1	A	Unidirectional	Linear	60.1	49.3			98.3	93.4	60.1	6	4	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 53	3	A	Unidirectional	Linear	52	28.2			85.9	74.5	39.8	6	5	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 53	4	A	Centripetal	Non-exploited					77.2	75.5	35.9	13	6	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 53	6	B	Centripetal	Linear	88.6	48			102.5	75.3	30.9	10	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 54	1	B	Unidirectional	Linear	76.6	55.7			78	73.1	49.1	4	2	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 54	2	A	Unidirectional	Linear	107	74.1			111.5	88.9	46.4	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 54	6	B	Unidirectional	Linear	84.7	87.3			87	126.6	42	6	2	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 55	2	B	Centripetal	Linear	87	62.9			116.4	86.4	40.7	10	6	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 55	5	B	Centripetal	Recurrent	67.7	53.5	51.3	44.7	87.6	81.2	44.5	10	6	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 56	2	B	Centripetal	Non-exploited					94.7	80.5	31	11	7	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 56	5	C	Centripetal	Linear	70.5	72.5			85.4	102.3	53.5	8	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 57	1	B	Centripetal	Linear	57.7	42.9			72	60	24.8	8	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 57	2	B	Unidirectional	Linear	59.7	71.1			61.2	77	29.7	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 57	3	B	Unidirectional	Linear	89.3	77.6			99	97.7	42.2	13	3	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 58	4	B	Bipolar	Non-exploited					95.3	76.3	34.8	9	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint

C.1 Continued

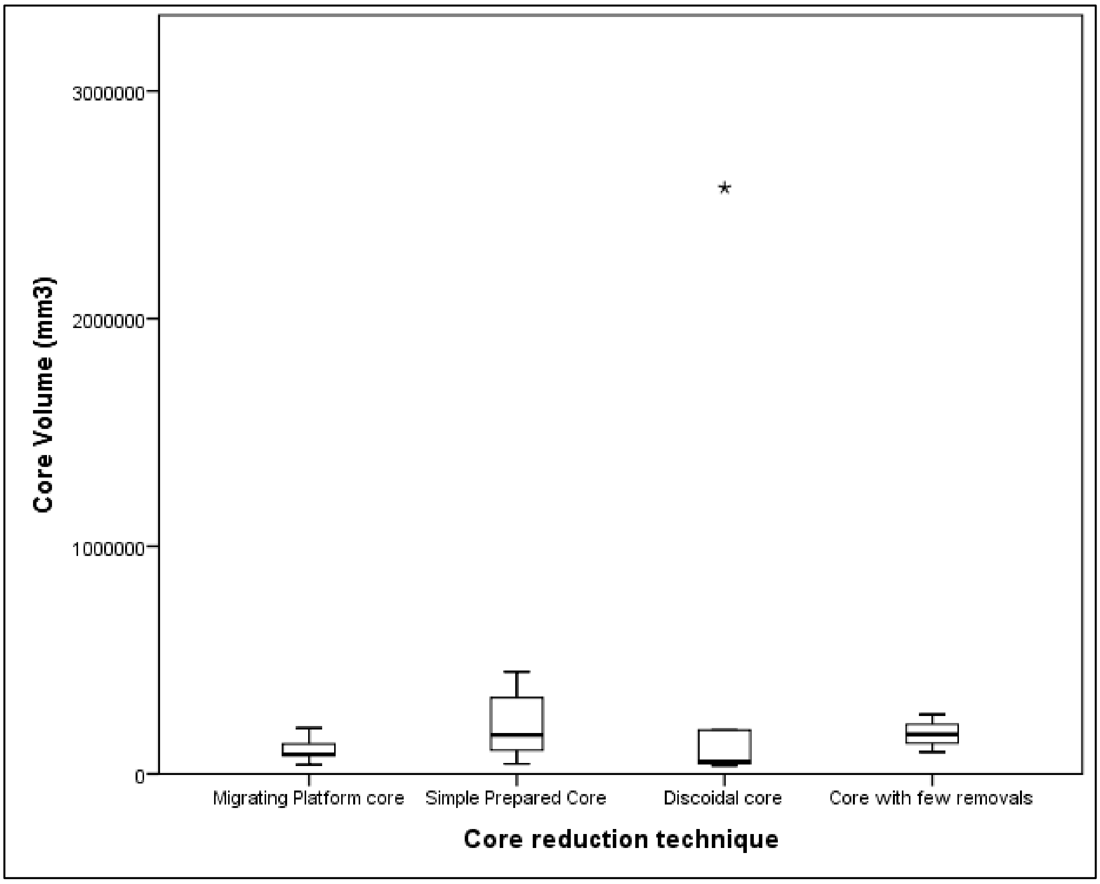
Site	Collection	Box no.	Id no.	SPC Type	Prep. Method	Exploit. Method	Pref Rem.		Recurrent Rem.		Core			Total no. rems.	No. of flaking surface rems.	Faceting	Residual cortex	Condition	Staining	Patination	Raw Material
							Length	Breadth	Length	Breadth	Length	Breadth	Thickness								
Purfleet - BP	Snelling	Box 59	6	B	Centripetal	Linear	70.6	50.9			95.8	79.4	60.1	11	5	No	<25%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 60	2	B	Centripetal	Linear	78.6	83.1			94.8	106.1	64.1	8	4	Yes	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 61	3	A	Unidirectional	Recurrent	88	49	112	27.9	132.9	87.9	70.7	5	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 62	7	C	Centripetal	Linear	87.2	73.5			102	130.1	67.9	7	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 63	3	A	Unidirectional	Linear	81.6	90.7			109.7	94.2	58.3	4	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 64	2	B	Centripetal	Linear	59.8	70.2			115	147.9	65.6	7	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 64	3	B	Unidirectional	Linear	85.7	81.9			110.4	112.2	70.8	5	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 64	6	B	Unidirectional	Recurrent	114.9	85.6	99.2	69.7	112.6	127	78.2	7	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 65	2	B	Unidirectional	Recurrent	80.3	66.9	86	49.7	109.3	107.3	57.6	6	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 65	3	A	Centripetal	Linear	52	43.5			76.8	88	67.4	5	3	No	50 - 75%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 65	4	A	Unidirectional	Linear	97.1	64.3			115.9	107.2	62.2	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	Box 65	6	B	Unidirectional	Linear	53.3	87.7			97.2	152.1	68.1	6	4	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	OR/S/ID29/21 Box 18	P2006.1101.96	A	Unidirectional	Linear	45.5	47.7			63.2	84.3	32.3	5	3	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	OR/S/ID29/21 Box 19	P2006.1101.99	A	Bipolar	Linear	49.9	60.7			85.1	72.6	20.1	9	8	Yes	25 - 50%	Slightly Rolled	Light	Light	Flint
Purfleet - BP	Snelling	OR/S/ID29/21 Box 19	P2006.1101.100	A	Centripetal	Linear	76.4	46.5			93	77.2	46.7	7	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	OR/S/ID29/21 Box 19	P2006.1101.101	A	Centripetal	Linear	73.1	73.3			118	111.7	70.8	9	8	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Purfleet - BP	Snelling	OR/S/ID29/21 Box 19	P2006.1101.102	A	Bipolar	Recurrent	84.3	45	78.3	53.3	146.3	94.2	47.3	9	6	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Red Barns	Soton/SHARG	Box 5	P2000-0602-20	C	Centripetal	Linear	62	79.9			97.7	84.6	46.6	10	3	No	<25%	Fresh	None	Heavy	Flint
Red Barns	Portsmouth	1	6100.063	C	Centripetal	Linear					138.5		69.9	12	5	No	<25%	Fresh	None	Heavy	Flint
Kesselt	ODS4	General	4.1	A	Bipolar	Recurrent	76.5	56			88	84	38	20	10	No	50 - 75%	Fresh	None	None	Flint
Mesvin IV		Mesvin 4 1269	MSV77 A 110-120 151	A	Unidirectional	Linear	85.9	30.3			107.7	61.1	30.9	9	5	No	50 - 75%	Fresh	None	None	Flint
Mesvin IV		10.8.2 cupboard	MSV80 F93 75 - 100 132	C	Centripetal	Linear	88.9	79.8			111.7	109.7	34	11	7	No	0%	Slightly Rolled	Light	Light	Flint
Mesvin IV		10.8.2 cupboard	MSV79 F161 -105 174	B	Centripetal	Linear	89.2	55.5			89.7	79.3	65	9	4	No	25 - 50%	Slightly Rolled	Heavy	Heavy	Flint
Mesvin IV		10.8.2 cupboard	MSV80 F92 - 114 148	A	Unidirectional	Linear	59.5	28.6			74.1	62.2	28.7	6	5	No	25 - 50%	Slightly Rolled	Heavy	None	Flint
Mesvin IV		10.8.2 cupboard	MSV_IV H132 - 150 162	B	Centripetal	Linear	98.9	98.8			105.7	117.5	57.2	6	2	No	25 - 50%	Heavily Rolled	Heavy	Heavy	Flint
Mesvin IV		10.8.1 cupboard	MSV_IV G122 -115 134	B	Centripetal	Linear	72.6	67.3			72.6	81.8	34.7	7	6	No	25 - 50%	Slightly Rolled	None	Heavy	Flint
Mesvin IV		10.8.1 cupboard	MSV78 F102 cb MCM399b 106	A	Convergent	Linear	63.7	50.1			112.5	100.6	49.8	6	5	No	25 - 50%	Fresh	Heavy	Light	Flint
Mesvin IV		10.8.1 cupboard	MSV_IV G132 125-135 117	A	Unidirectional	Linear	54.1	37.8			54.1	57.2	33.7	5	4	No	0%	Fresh	Heavy	Light	Flint
Mesvin IV		10.8.1 cupboard	MSV80 G144 165 111	A	Unidirectional	Linear	59.9	45.2			96.7	72.5	37	8	6	No	25 - 50%	Fresh	Heavy	Heavy	Flint
Mesvin IV		10.8.1 cupboard	MSV79 E144 50-55 135	B	Centripetal	Recurrent	84.7	41.5	70.9	41.9	98.1	61.6	45.4	11	4	No	25 - 50%	Heavily Rolled	Heavy	Light	Flint
Mesvin IV		10.8.1 cupboard	MSV80 F82 86-110 118	B	Unidirectional	Linear	92.5	59.8			95.4	110.2	48.6	8	4	No	25 - 50%	Slightly Rolled	Heavy	Light	Flint
Mesvin IV		10.8.1 cupboard	MSV78 F121 cb 113	A	Unidirectional	Linear	54.3	41.3			66.9	58.6	25.2	7	5	No	25 - 50%	Fresh	Heavy	Heavy	Flint
Mesvin IV		10.8.1 cupboard	MSV78 F124 cb 138	B	Centripetal	Linear	59.1	41.6			60	69.3	32.2	8	5	No	0%	Heavily Rolled	Heavy	Heavy	Flint

Appendix D Supporting Statistics

Biddenham

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=10)	Mean	72.0	57.1	25.4
	Median	72.0	54.5	25.1
	Std. Deviation	16.3	16.3	6.8
	Range	49.9	44.5	23.2
SPC (n=9)	Mean	77.0	73.6	33.1
	Median	80.2	79.8	26.6
	Std. Deviation	14.2	19.9	12.7
	Range	42.5	57.1	36.3
Discoidal (n=5)	Mean	82.4	82.5	32.8
	Median	60.3	46.1	23.8
	Std. Deviation	48.3	67.5	25.6
	Range	113.5	156.6	61.7
Core with few removals (n=3)	Mean	81.8	70.2	30.4
	Median	74.4	64.2	30.1
	Std. Deviation	17.9	11.6	10.4
	Range	33.3	20.8	20.8



Test N	27
Test statistic	3.638
Degree of freedom	3
Asymptotic Sig. (2-sided test)	.303

Report

Core Volume (mm^3)

Core reduction technique	N	Median
Migrating Platform core	10	87806.6015
Simple Prepared Core	9	170238.9360
Discoidal core	5	55851.2220
Core with few removals	3	173377.2040
Total	27	132148.7820

Flake scars

Test N	27
Test statistic	9.490
Degree of freedom	3
Asymptotic Sig. (2-sided test)	.023

Report		
Number of flake scars		
Core reduction technique	N	Median
Migrating Platform core	10	8.00
Simple Prepared Core	9	11.00
Discoidal core	5	12.00
Core with few removals	3	3.00
Total	27	9.00

SPCs vs Migrating Platform

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	31.500
Wilcoxon W	86.500
Z	-1.125
Asymp. Sig. (2-tailed)	.261
Exact Sig. [2*(1-tailed Sig.)]	.278[b]
Exact Sig. (2-tailed)	.277
Exact Sig. (1-tailed)	.142
Point Probability	.014

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

SPC vs Discoidal

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	21.000
Wilcoxon W	66.000
Z	-.201
Asymp. Sig. (2-tailed)	.840
Exact Sig. [2*(1-tailed Sig.)]	.898[b]
Exact Sig. (2-tailed)	.872
Exact Sig. (1-tailed)	.435
Point Probability	.022

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

Appendix D

SPCs vs Cores with few removals

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	6.000
Z	-2.514
Asymp. Sig. (2-tailed)	.012
Exact Sig. [2*(1-tailed Sig.)]	.009[b]
Exact Sig. (2-tailed)	.005
Exact Sig. (1-tailed)	.005
Point Probability	.005

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

Products

Test Statistics[a]	
	Area mm^2
Mann-Whitney U	1196.000
Wilcoxon W	1241.000
Z	-1.969
Asymp. Sig. (2-tailed)	.049

a. Grouping Variable: Artefact

Report

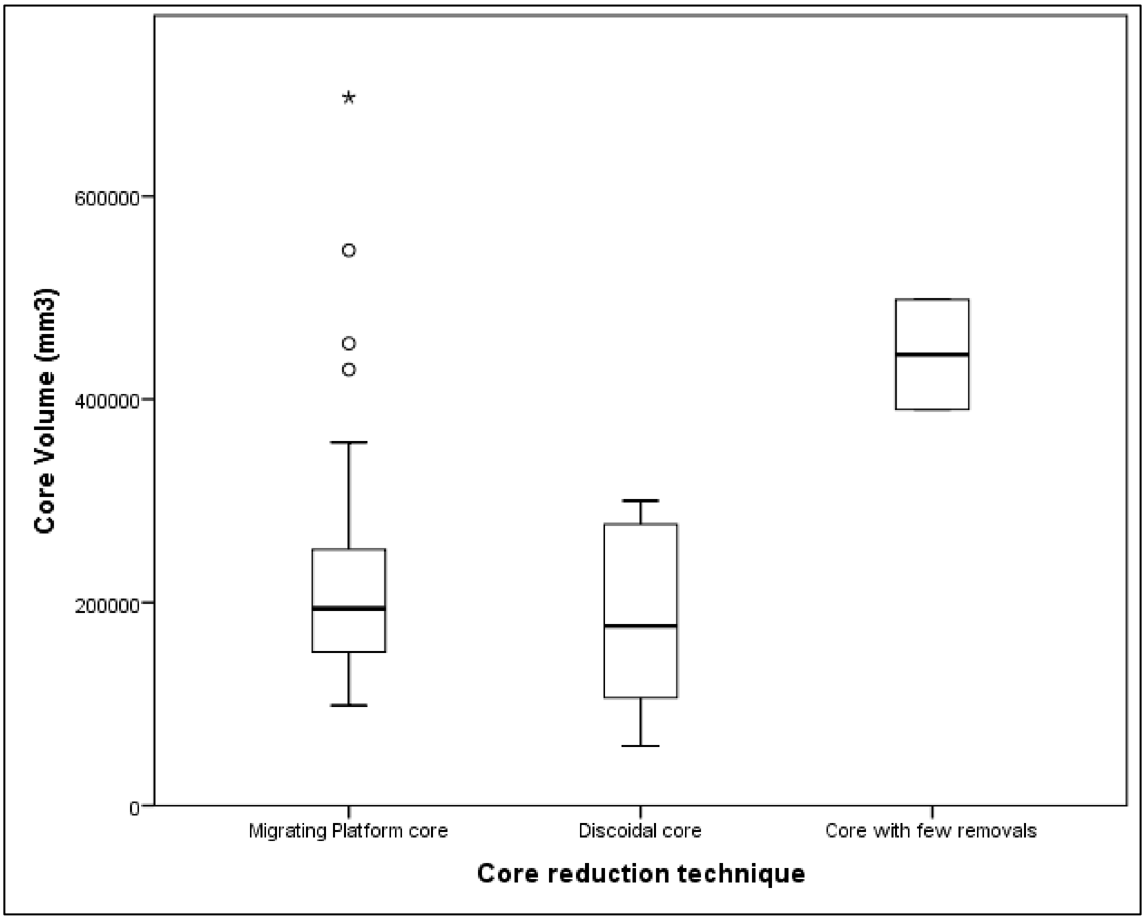
Area mm^2

Artefact	N	Median
SPC	9	3141.8000
Flake	431	3861.9000
Total	440	3844.5200

Caddington

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=26)	Mean	84.1	66.2	40.5
	Median	84.1	65.0	39.5
	Std. Deviation	18.7	13.2	10.1
	Range	63.6	46.8	44.5
Discoidal (n=8)	Mean	75.1	61.8	37.7
	Median	73.1	66.5	34.4
	Std. Deviation	17.4	14.7	9.4
	Range	49.7	40.0	30.0
Core with few removals (n=2)	Mean	127.5	83.6	43.3
	Median	127.5	83.6	43.3
	Std. Deviation	27.8	23.1	10.0
	Range	39.3	32.7	14.2



Test N	36
Test statistic	4.353
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.113

Report

Core Volume (mm^3)

Core reduction technique	N	Median
Migrating Platform core	8	402747.7475
Simple Prepared Core	1	830106.8400
Discoidal core	1	101268.8450
Total	10	402747.7475

Flake scars

Test N	36
Test statistic	16.061
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.000

Appendix D

Migrating Platform vs Discoidal

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	20.000
Wilcoxon W	371.000
Z	-3.430
Asymp. Sig. (2-tailed)	.001
Exact Sig. [2*(1-tailed Sig.)]	.000[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

Discoidal vs Cores with few removals

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	3.000
Z	-2.095
Asymp. Sig. (2-tailed)	.036
Exact Sig. [2*(1-tailed Sig.)]	.044[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

Migrating Platform vs Cores with few removals

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	3.000
Z	-2.338
Asymp. Sig. (2-tailed)	.019
Exact Sig. [2*(1-tailed Sig.)]	.005[b]

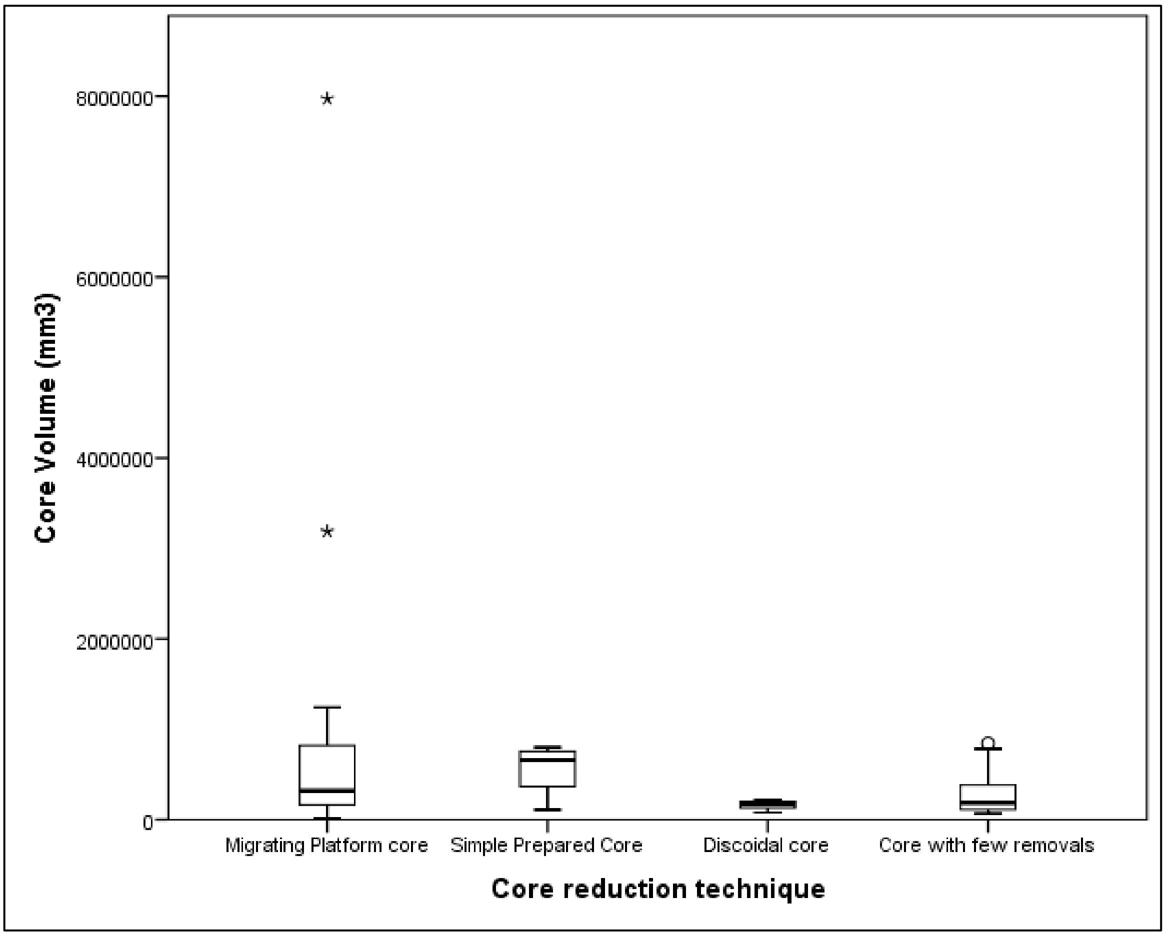
a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

Cuxton

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=44)	Mean	104.3	87.6	52.7
	Median	87.0	73.8	45.5
	Std. Deviation	47.5	64.9	23.6
	Range	259.3	420.1	112.0
SPC (n=4)	Mean	106.2	96.2	49.4
	Median	104.5	105.5	51.1
	Std. Deviation	19.3	36.4	15.4
	Range	43.0	85.2	37.5
Discoidal (n=3)	Mean	67.3	69.9	34.0
	Median	66.2	60.3	31.7
	Std. Deviation	9.0	31.9	4.5
	Range	17.8	61.7	8.2
Core with few removals (n=10)	Mean	95.7	70.5	42.5
	Median	89.7	73.0	43.0
	Std. Deviation	31.1	15.0	16.0
	Range	104.8	45.7	42.9



Appendix D

Test N	21
Test statistic	2.731
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.255

Report

Core Volume (mm3)

Core reduction technique	N	Median
Migrating Platform core	14	746386.3135
Levallois core	3	420412.8600
Simple Prepared Core	4	405297.4875
Total	21	577987.2150

Flake scars

Test N	62
Test statistic	31.749
Degree of freedom	3
Asymptotic Sig. (2-sided test)	.000

SPC vs Migrating Platform

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	70.000
Wilcoxon W	1016.000
Z	-.616
Asymp. Sig. (2-tailed)	.538
Exact Sig. [2*(1-tailed Sig.)]	.568[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

SPCs vs Discoidal

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	3.000
Wilcoxon W	13.000
Z	-1.070
Asymp. Sig. (2-tailed)	.285
Exact Sig. [2*(1-tailed Sig.)]	.400[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

SPCs vs Cores with few removals

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	78.000
Z	-3.065
Asymp. Sig. (2-tailed)	.002
Exact Sig. [2*(1-tailed Sig.)]	.001[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

Products

Test Statistics[a]

	Area mm^2
Mann-Whitney U	1358.000
Wilcoxon W	189549.000
Z	-1.103
Asymp. Sig. (2-tailed)	.270

a. Grouping Variable: Artefact

Report

Area mm^2

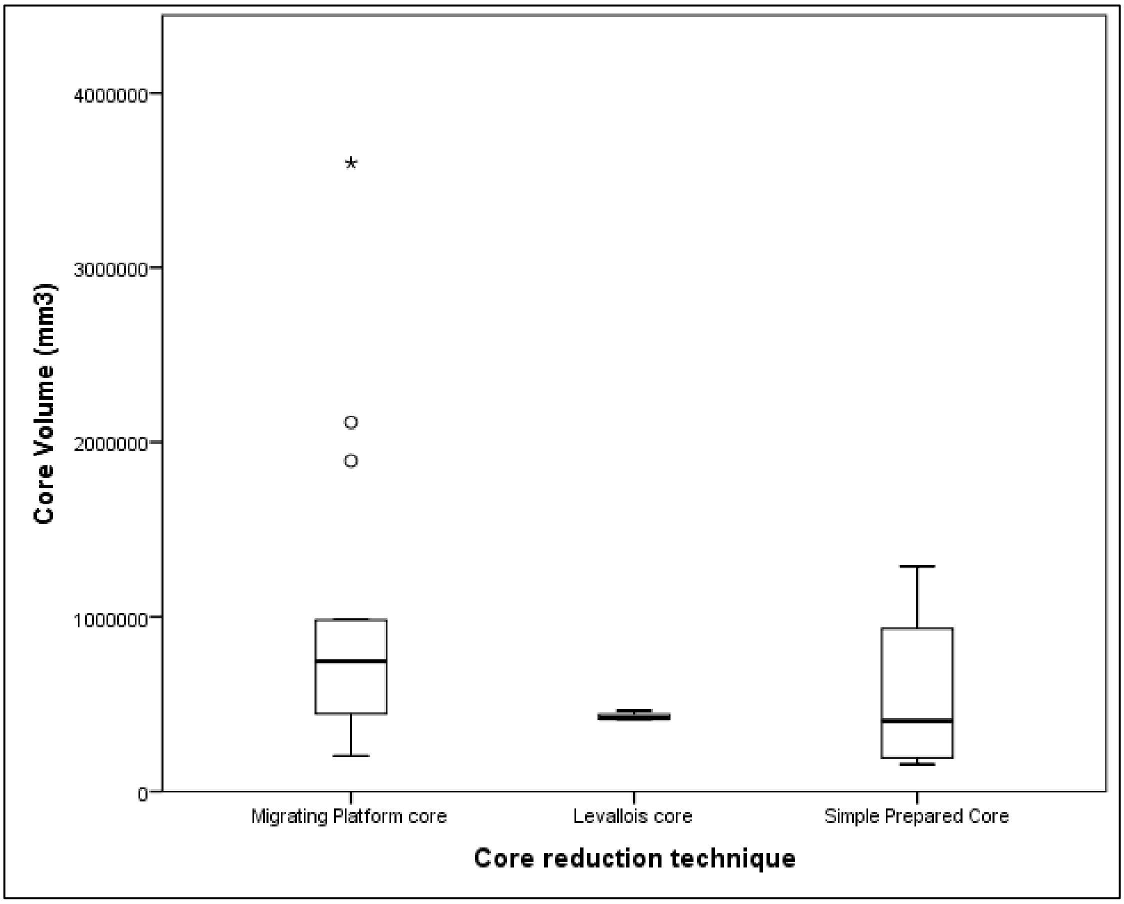
Artefact	N	Median
SPC	6	4749.6500
Flake	613	2667.0000
Total	619	2667.0800

Dunbridge

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=14)	Mean	134.3	110.2	63.0
	Median	116.5	93.7	61.2
	Std. Deviation	63.7	45.6	15.7
	Range	229.1	147.1	48.7
Levallois (n=3)	Mean	118.1	81.3	45.4
	Median	117.7	80.1	46.0
	Std. Deviation	4.3	7.6	5.7
	Range	8.5	15.1	11.4
SPC (n=3)	Mean	91.2	97.1	50.5
	Median	98.5	85.9	47.8
	Std. Deviation	18.1	40.6	22.3
	Range	42.1	93.3	52.5

Appendix D



Test N	62
Test statistic	5.033
Degree of freedom	3
Asymptotic Sig. (2-sided test)	.169

Flake scars

Test N	20
Test statistic	1.145
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.564

Products

SPC products vs other including Levallois

Test Statistics[a]

	Area mm^2
Mann-Whitney U	110.000
Wilcoxon W	120.000
Z	-1.645
Asymp. Sig. (2-tailed)	.100

a. Grouping Variable: Artefact

Report		
Area mm^2		
Artefact	N	Median
SPC	4	2930.4550
Flake	107	5082.4800
Total	111	5076.9300

Without Levallois – no difference

Thickness comparisons

Test N	107
Test statistic	.828
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.661

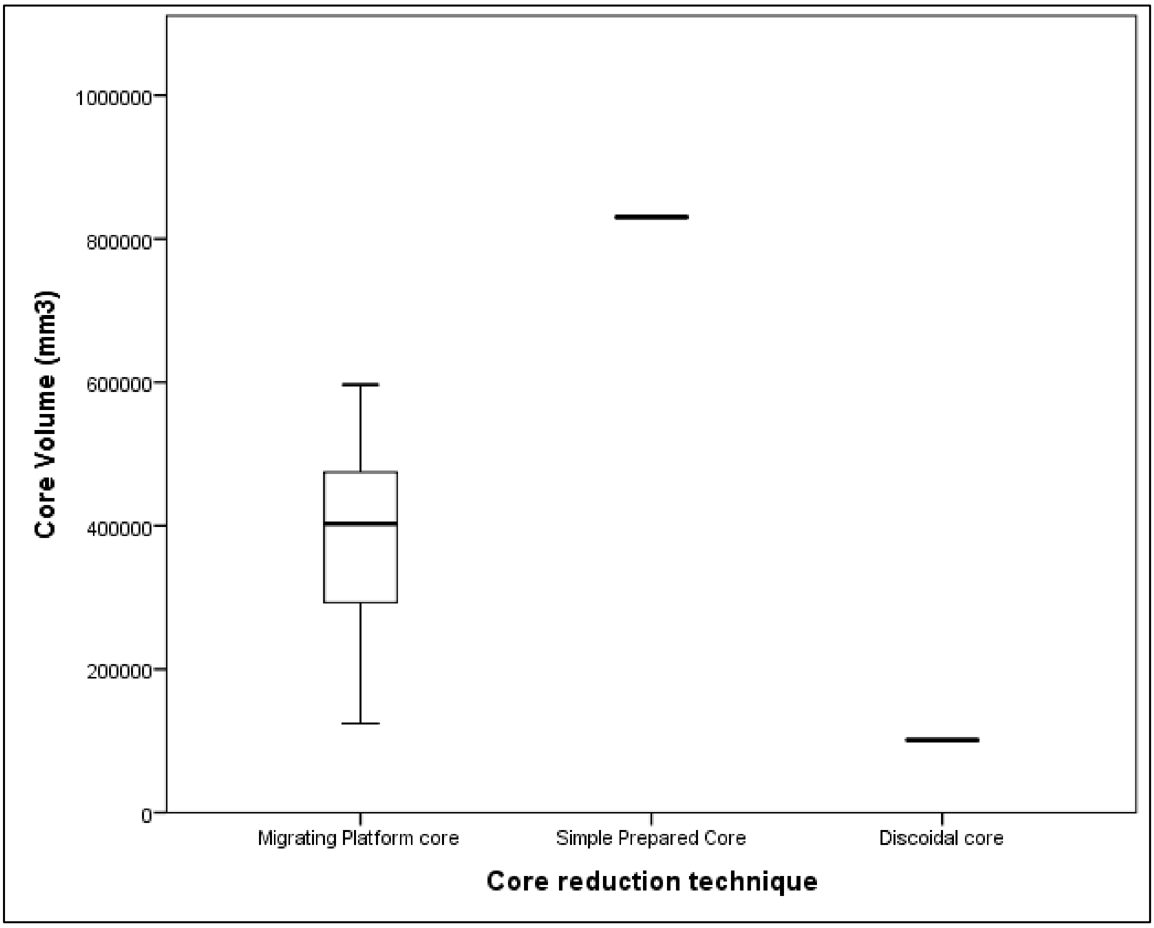
Report		
Flake Thickness mm		
Artefact	N	Median
Flake	101	22.5000
Flake tool	5	19.8000
Levallois flake/point	1	18.8000
Total	107	22.4000

Feltwell

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=8)	Mean	89.1	80.2	52.8
	Median	89.0	86.1	51.2
	Std. Deviation	14.4	18.1	15.0
	Range	43.1	46.8	43.9
SPC (n=1)	Mean	124.0	136.9	48.9
	Median	124.0	136.9	48.9
	Std. Deviation	n/a	n/a	n/a
	Range	0.0	0.0	0.0
Discoidal (n=1)	Mean	60.7	54.7	30.5
	Median	60.7	54.7	30.5
	Std. Deviation	n/a	n/a	n/a
	Range	0.0	0.0	0.0

Appendix D



Test N	10
Test statistic	4.418
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.110

Flake scars

Test N	10
Test statistic	.295
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.863

Report

Number of flake scars

Core reduction technique	N	Median
Migrating Platform core	8	10.00
Simple Prepared Core	1	12.00
Discoidal core	1	10.00
Total	10	10.00

Products

Test Statistics[a]	
	Area mm^2
Mann-Whitney U	2.000
Wilcoxon W	6443.000
Z	-1.656
Asymp. Sig. (2-tailed)	.098
Exact Sig. [2*(1-tailed Sig.)]	.053[b]
a. Grouping Variable: Artefact	
b. Not corrected for ties.	

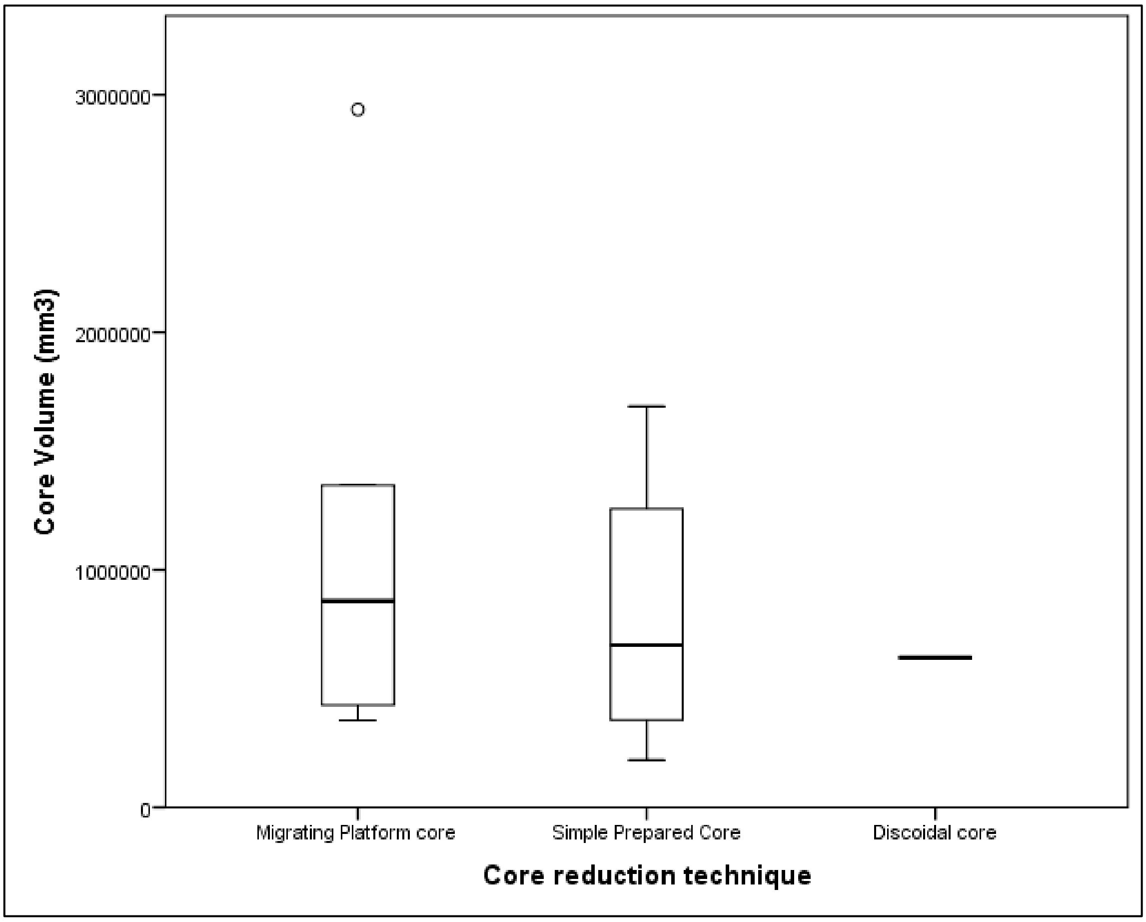
Report Area mm^2		
Artefact	N	Median
SPC	1	10012.5000
Flake	113	4037.1100
Total	114	4057.9550

Frindsbury

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=6)	Mean	145.2	99.8	69.6
	Median	143.7	93.9	57.8
	Std. Deviation	16.1	38.2	35.7
	Range	48.7	91.7	93.4
SPC (n=13)	Mean	109.7	126.8	53.3
	Median	108.4	131.1	47.5
	Std. Deviation	21.1	31.1	20.7
	Range	69.0	107.1	63.5
Discoidal (n=1)	Mean	103.1	119.9	51.0
	Median	103.1	119.9	51.0
	Std. Deviation	n/a	n/a	n/a
	Range	0.0	0.0	0.0

Appendix D



Test N	20
Test statistic	.210
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.900

Report

Core Volume (mm^3)

Core reduction technique	N	Median
Migrating Platform core	6	868285.3960
Simple Prepared Core	13	683560.6440
Discoidal core	1	630446.1900
Total	20	669419.4760

Flake scars

Test Statistics[a]

	Area mm^2
Mann-Whitney U	2397.000
Wilcoxon W	2502.000
Z	-.598
Asymp. Sig. (2-tailed)	.550

a. Grouping Variable: Artefact

Report Area mm^2		
Artefact	N	Median
SPC	14	5397.9800
Flake	378	6068.4000
Total	392	6028.0000

Products

Test Statistics[a]	Area mm^2
Mann-Whitney U	2397.000
Wilcoxon W	2502.000
Z	-.598
Asymp. Sig. (2-tailed)	.550

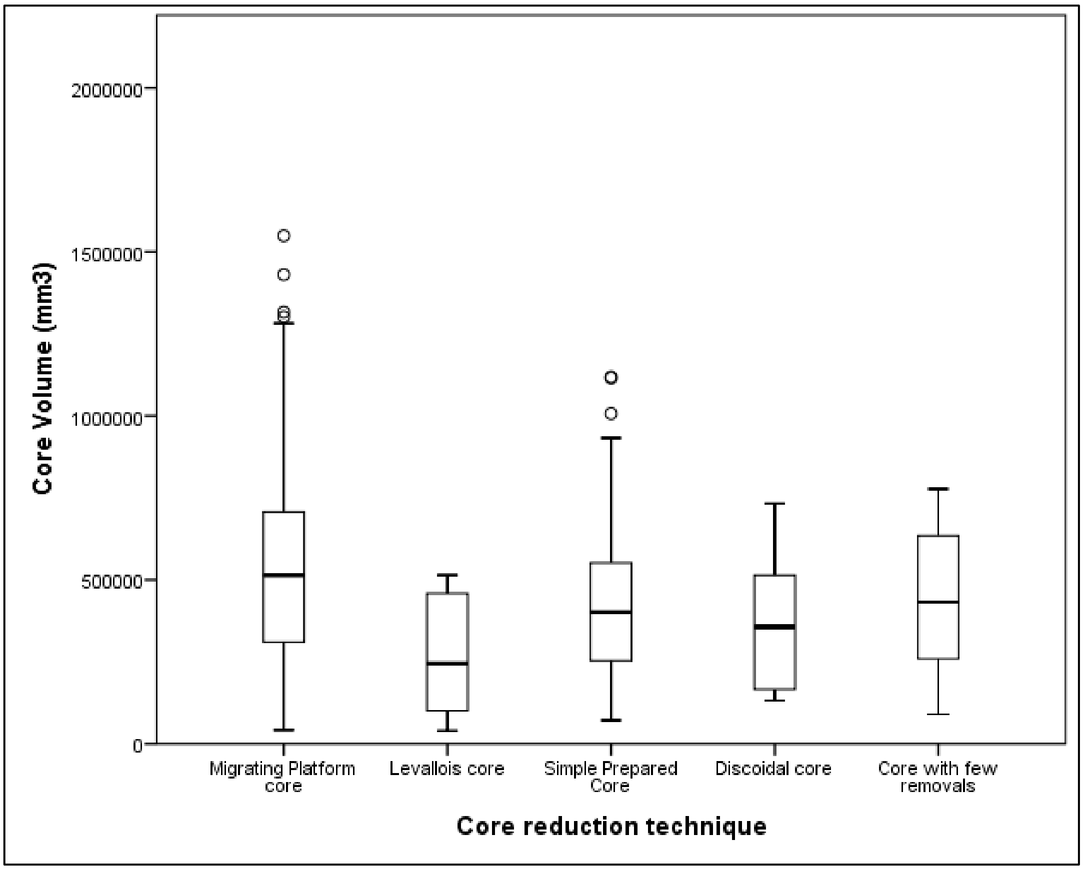
a. Grouping Variable: Artefact

Report Area mm^2		
Artefact	N	Median
SPC	14	5397.9800
Flake	378	6068.4000
Total	392	6028.0000

Purfleet

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=155)	Mean	107.0	87.4	54.5
	Median	107.2	85.9	54.4
	Std. Deviation	22.4	18.4	16.4
	Range	165.3	101.0	77.4
Levallois (n=10)	Mean	83.4	83.1	33.2
	Median	84.5	87.4	30.8
	Std. Deviation	23.2	21.3	11.9
	Range	81.1	58.1	36.2
SPC (n=122)	Mean	94.2	92.3	45.2
	Median	93.8	92.6	43.9
	Std. Deviation	17.6	19.9	13.7
	Range	90.6	99.2	58.1
Discoidal (n=18)	Mean	94.2	92.3	45.2
	Median	91.4	85.9	40.7
	Std. Deviation	20.4	14.1	12.4
	Range	64.0	45.5	47.6
Core with few removals (n=15)	Mean	106.5	79.7	47.2
	Median	107.8	82.7	48.2
	Std. Deviation	27.6	22.8	11.6
	Range	94.3	71.0	42.4



Test N	320
Test statistic	22.333
Degree of freedom	4
Asymptotic Sig. (2-sided test)	.000

SPC vs Migrating Platform

Test Statistics[a]

	Core Volume (mm^3)
Mann-Whitney U	7184.000
Wilcoxon W	14687.000
Z	-3.431
Asymp. Sig. (2-tailed)	.001

a. Grouping Variable: Core reduction technique

SPC vs Discoidal

Test Statistics[a]

	Core Volume (mm^3)
Mann-Whitney U	943.000
Wilcoxon W	1114.000
Z	-.965
Asymp. Sig. (2-tailed)	.335

a. Grouping Variable: Core reduction technique

SPC vs Levallois

Test Statistics[a]

	Core Volume (mm^3)
Mann-Whitney U	378.000
Wilcoxon W	433.000
Z	-1.995
Asymp. Sig. (2-tailed)	.046

a. Grouping Variable: Core reduction technique

SPC vs cores with few removals

Test Statistics[a]

	Core Volume (mm^3)
Mann-Whitney U	859.000
Wilcoxon W	8362.000
Z	-.386
Asymp. Sig. (2-tailed)	.699

a. Grouping Variable: Core reduction technique

Appendix D

Flake scars

SPCs VS Migrating Platform

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	5351.000
Wilcoxon W	12854.000
Z	-6.245
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Core reduction technique

SPCs vs Discoidal

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	96.000
Wilcoxon W	7599.000
Z	-6.287
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Core reduction technique

SPC vs Levallois

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	4.500
Wilcoxon W	7507.500
Z	-5.255
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Core reduction technique

SPC vs Cores with few removals

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	120.000
Z	-6.360
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Core reduction technique

Products

Test Statistics[a]	
	Area mm^2
Mann-Whitney U	90170.000
Wilcoxon W	99623.000
Z	-.411
Asymp. Sig. (2-tailed)	.681

a. Grouping Variable: Artefact

Report

Area mm^2		
Artefact	N	Median
SPC	137	4384.6400
Flake	1345	4409.1400
Total	1482	4401.9550

Thickness comparisons

Test N	1.342
Test statistic	4.150
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.126

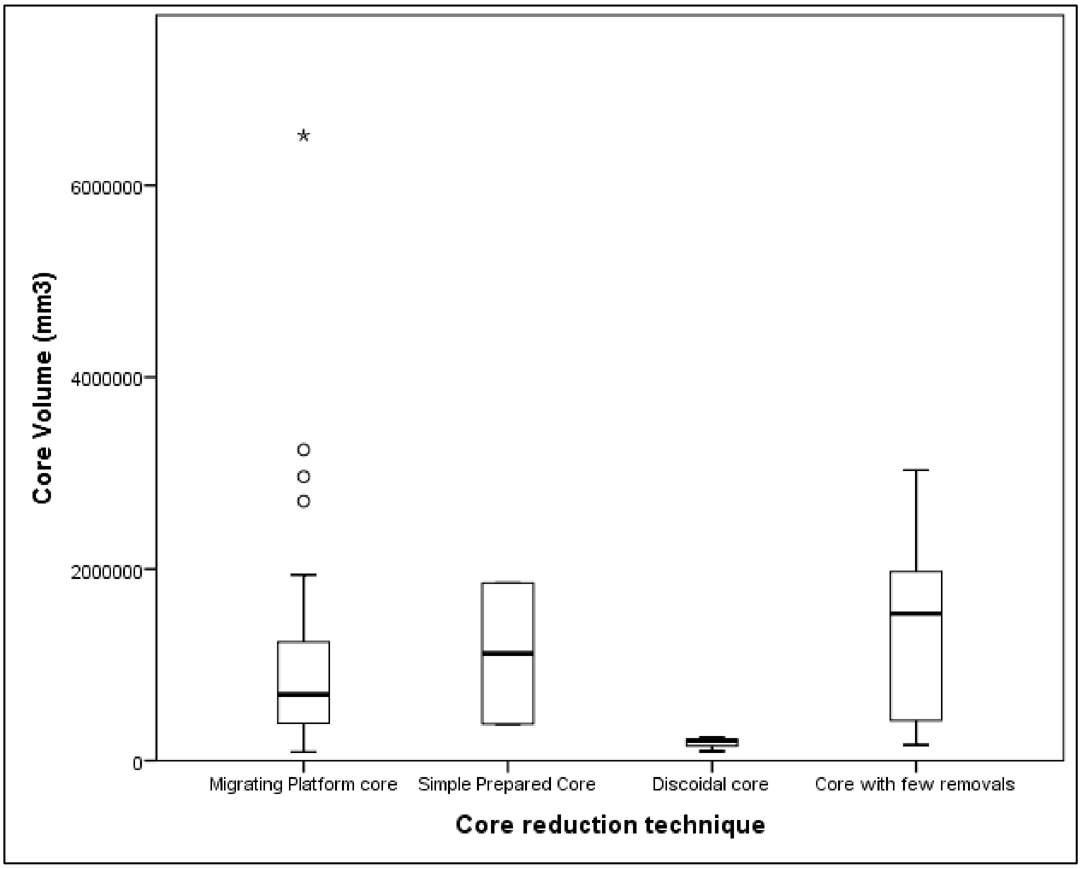
Report Flake Thickness mm		
Artefact	N	Median
Flake	1281	21.7000
Flake tool	58	23.6000
Levallois flake/point	3	19.5000
Total	1342	21.7000

Red Barns

Volume

Core Technology		***Length (mm)***	***Breadth (mm)***	***Thickness (mm)***
Migrating Platform Core (n=41)	Mean	118.5	105.6	65.0
	Median	111.8	98.4	59.1
	Std. Deviation	34.7	39.6	26.0
	Range	138.9	168.7	142.1
SPC (n=2)	Mean	118.1	138.1	58.3
	Median	118.1	138.1	58.3
	Std. Deviation	28.8	75.7	16.5
	Range	40.8	107.0	23.3
Discoidal (n=3)	Mean	72.7	62.6	39.7
	Median	74.9	61.9	39.6
	Std. Deviation	14.7	4.5	14.7
	Range	29.2	8.9	29.4
Core with few removals (n=8)	Mean	148.6	112.2	69.3
	Median	151.9	109.6	75.0
	Std. Deviation	43.6	48.9	29.0
	Range	122.8	147.3	83.8

Appendix D



Test N	54
Test statistic	6.394
Degree of freedom	3
Asymptotic Sig. (2-sided test)	.094

Flake scars

SPC vs Migrating Platform

Test Statistics[a]

	Number of flake scars
Mann-Whitney U	7.500
Wilcoxon W	827.500
Z	-1.937
Asymp. Sig. (2-tailed)	.053
Exact Sig. [2*(1-tailed Sig.)]	.046[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

SPC vs Discoidal

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	1.000
Wilcoxon W	7.000
Z	-1.291
Asymp. Sig. (2-tailed)	.197
Exact Sig. [2*(1-tailed Sig.)]	.400[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

SPC vs Cores with few removals

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	36.000
Z	-2.184
Asymp. Sig. (2-tailed)	.029
Exact Sig. [2*(1-tailed Sig.)]	.044[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

Products

Report

Area mm^2

Artefact	N	Median
SPC	1	4953.8000
Flake	553	1018.7800
Total	554	1020.6000

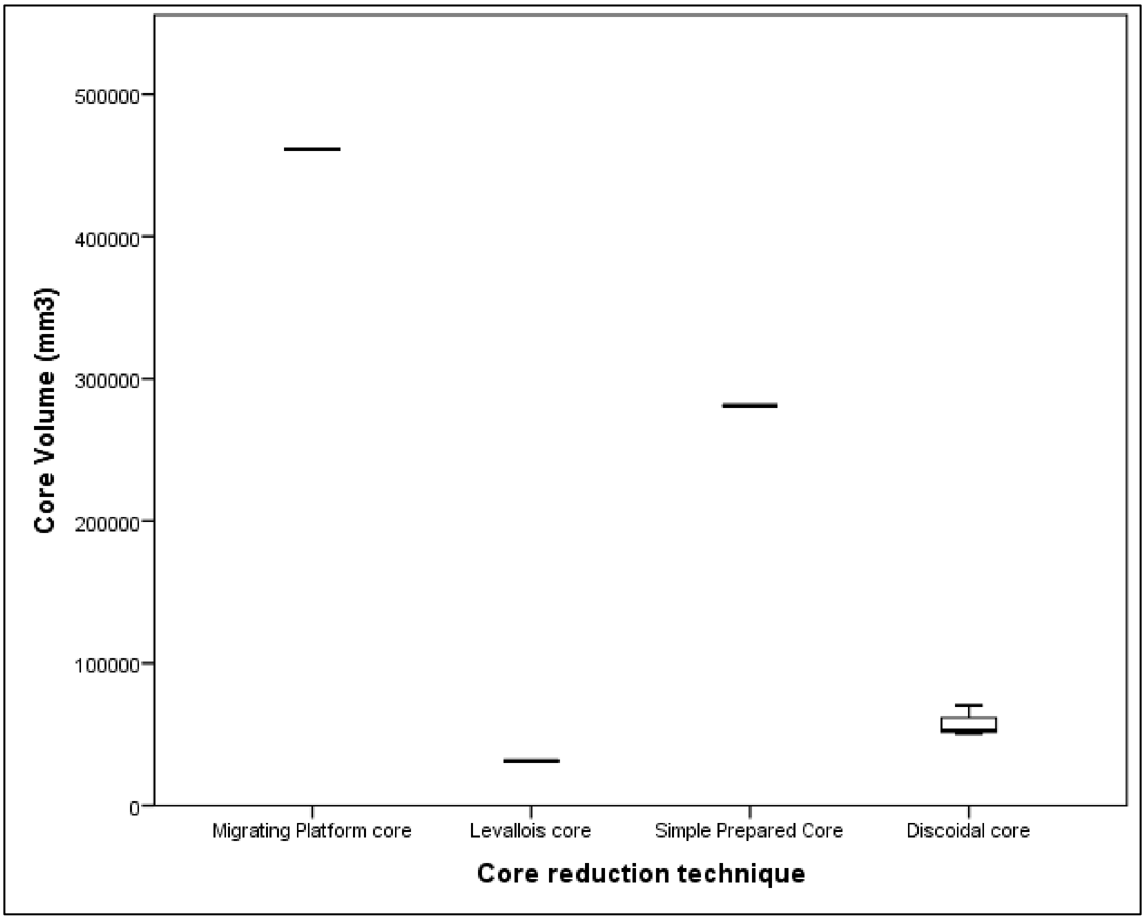
Test Statistics[a]	
	Area mm^2
Mann-Whitney U	40.000
Wilcoxon W	153221.000
Z	-1.479
Asymp. Sig. (2-tailed)	.139
a. Grouping Variable: Artefact	

Appendix D

Kesselt-Op de Schans

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=1)	Mean	91.0	78.0	65.0
	Median	91.0	78.0	65.0
	Std. Deviation	n/a	n/a	n/a
	Range	0.0	0.0	0.0
Levallois (n=1)	Mean	52.0	40.0	15.0
	Median	52.0	40.0	15.0
	Std. Deviation	n/a	n/a	n/a
	Range	0.0	0.0	0.0
SPC (n=1)	Mean	88.0	84.0	38.0
	Median	88.0	84.0	38.0
	Std. Deviation	n/a	n/a	n/a
	Range	0.0	0.0	0.0
Discoidal (n=3)	Mean	54.7	52.7	21.7
	Median	59.0	55.0	16.0
	Std. Deviation	8.4	5.9	10.7
	Range	15.0	11.0	19.0



Test N	6
Test statistic	4.429
Degree of freedom	3
Asymptotic Sig. (2-sided test)	.219

Flake scars

Test Statistics[a]	
	Area mm^2
Mann-Whitney U	8.000
Wilcoxon W	15233.000
Z	-1.564
Asymp. Sig. (2-tailed)	.118
Exact Sig. [2*(1-tailed Sig.)]	.103[b]

a. Grouping Variable: Artefact

b. Not corrected for ties.

Report

Area mm^2

Artefact	N	Median
SPC	1	4284.0000
Flake	174	316.8500
Total	175	319.2000

Products

Test Statistics[a]	
	Area mm^2
Mann-Whitney U	8.000
Wilcoxon W	15233.000
Z	-1.564
Asymp. Sig. (2-tailed)	.118
Exact Sig. [2*(1-tailed Sig.)]	.103[b]

a. Grouping Variable: Artefact

b. Not corrected for ties.

Report

Area mm^2

Artefact	N	Median
SPC	1	4284.0000
Flake	174	316.8500
Total	175	319.2000

Appendix D

Thickness comparisons

Test N	168
Test statistic	13.447
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.001

Report

Flake Thickness mm

Artefact	N	Median
Flake	159	3.8000
Flake tool	3	13.3000
Levallois flake/point	6	10.7500
Total	168	4.0000

Flakes vs flake tools

Test Statistics[a]

	Flake Thickness mm
Mann-Whitney U	56.000
Wilcoxon W	12776.000
Z	-2.268
Asymp. Sig. (2-tailed)	.023

a. Grouping Variable: Artefact

Flake vs Levallois

Test Statistics[a]

	Flake Thickness mm
Mann-Whitney U	139.500
Wilcoxon W	12859.500
Z	-2.938
Asymp. Sig. (2-tailed)	.003

a. Grouping Variable: Artefact

Flake tools vs Levallois

Test Statistics[a]

	Flake Thickness mm
Mann-Whitney U	139.500
Wilcoxon W	12859.500
Z	-2.938
Asymp. Sig. (2-tailed)	.003

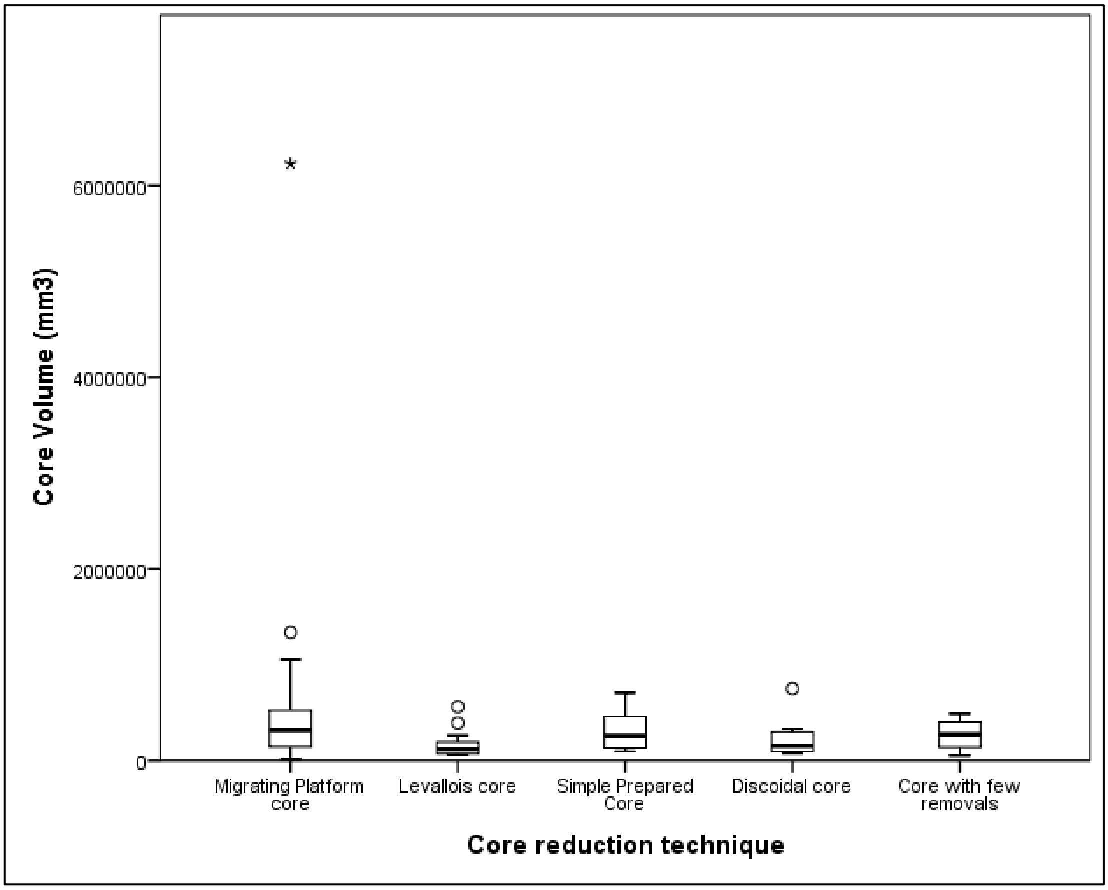
a. Grouping Variable: Artefact

Mesvin IV

Volume

Core Technology		*Length (mm)*	*Breadth (mm)*	*Thickness (mm)*
Migrating Platform Core (n=32)	Mean	95.0	77.9	51.5
	Median	86.9	72.6	50.3
	Std. Deviation	37.9	30.8	23.2
	Range	203.2	173.4	111.7
Levallois (n=15)	Mean	77.2	62.5	30.4
	Median	73.1	61.0	28.1
	Std. Deviation	21.5	15.6	8.9
	Range	67.5	59.6	30.9
SPC (n=13)	Mean	88.1	80.1	40.2
	Median	95.4	27.5	34.7
	Std. Deviation	20.2	22.0	12.0
	Range	58.4	60.3	39.8
Discoidal (n=10)	Mean	79.2	82.9	32.0
	Median	72.7	69.6	32.7
	Std. Deviation	22.0	49.3	8.2
	Range	78.2	167.0	29.1
Core with few removals (n=4)	Mean	99.4	67.9	35.1
	Median	108.8	67.6	36.7
	Std. Deviation	24.8	19.9	12.5
	Range	55.0	46.8	28.3

Appendix D



SPC vs Migrating Platform

Test Statistics[a]	
	Core Volume (mm^3)
Mann-Whitney U	184.000
Wilcoxon W	275.000
Z	-.601
Asymp. Sig. (2-tailed)	.548

a. Grouping Variable: Core reduction technique

SPC vs Discoidal

Test Statistics[a]	
	Core Volume (mm^3)
Mann-Whitney U	41.000
Wilcoxon W	96.000
Z	-1.488
Asymp. Sig. (2-tailed)	.137
Exact Sig. [2*(1-tailed Sig.)]	.148[b]

a. Grouping Variable: Core reduction technique

b. Not corrected for ties.

SPC vs Cores with few removals

Test Statistics[a]	
	Core Volume (mm^3)
Mann-Whitney U	24.000
Wilcoxon W	34.000
Z	-.226
Asymp. Sig. (2-tailed)	.821
Exact Sig. [2*(1-tailed Sig.)]	.871[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

SPCs vs Levallois

Test Statistics[a]	
	Core Volume (mm^3)
Mann-Whitney U	47.000
Wilcoxon W	167.000
Z	-2.326
Asymp. Sig. (2-tailed)	.020
Exact Sig. [2*(1-tailed Sig.)]	.019[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

Flake scars

SPC vs Migrating Platform

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	157.000
Wilcoxon W	248.000
Z	-1.154
Asymp. Sig. (2-tailed)	.248
a. Grouping Variable: Core reduction technique	

SPC vs Discoidal

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	12.500
Wilcoxon W	103.500
Z	-3.441
Asymp. Sig. (2-tailed)	.001
Exact Sig. [2*(1-tailed Sig.)]	.000[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

Appendix D

SPC vs Cores with few removals

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	10.000
Z	-2.983
Asymp. Sig. (2-tailed)	.003
Exact Sig. [2*(1-tailed Sig.)]	.001[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

SPC vs Levallois

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	3.000
Wilcoxon W	94.000
Z	-4.365
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

SPC vs Refitting

Test Statistics[a]	
	Number of flake scars
Mann-Whitney U	.000
Wilcoxon W	91.000
Z	-1.632
Asymp. Sig. (2-tailed)	.103
Exact Sig. [2*(1-tailed Sig.)]	.143[b]
a. Grouping Variable: Core reduction technique	
b. Not corrected for ties.	

Products

Report Area mm^2		
Artefact	N	Median
SPC	14	3081.0400
Flake	630	1669.9350
Total	644	1699.1000

Test Statistics[a]	
	Area mm^2
Mann-Whitney U	1985.000
Wilcoxon W	200750.000
Z	-3.522
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Artefact

Thickness comparisons

Test N	609
Test statistic	85.217
Degree of freedom	2
Asymptotic Sig. (2-sided test)	.000

Report

Flake Thickness mm

Artefact	N	Median
Flake	455	9.6000
Flake tool	76	14.6500
Levallois flake/point	78	14.8000
Total	609	10.9000

Flakes vs flake tools

Test Statistics[a]	
	Flake Thickness mm
Mann-Whitney U	8841.000
Wilcoxon W	112581.000
Z	-6.824
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Artefact

Flake vs Levallois

Test Statistics[a]	
	Flake Thickness mm
Mann-Whitney U	8781.000
Wilcoxon W	112521.000
Z	-7.133
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Artefact

Appendix D

Flake tools vs Levallois

Test Statistics[a]	
	Flake Thickness mm
Mann-Whitney U	2788.000
Wilcoxon W	5714.000
Z	-.636
Asymp. Sig. (2-tailed)	.525

a. Grouping Variable: Artefact

Glossary of Terms

Lower Palaeolithic - Defined in Europe by the arrival between 1.6 and 1.2 million years ago of hominins producing and utilising stone tools. The stone tool technologies associated with this period are the Clactonian (a core and flake industry) and the Acheulean (bifacial tools).

Middle Palaeolithic - The transition from the Lower to Middle Palaeolithic is marked by the arrival of PCT in Europe approximately 300,000 years ago. The end of the Middle Palaeolithic is considered to be approximately 40,000 years ago with the arrival of anatomically modern humans.

Middle Pleistocene - The geological time period spanning from 781,000 to 126,000 years ago.

Prepared Core Technology (PCT) – The core working technique associated with the Middle Palaeolithic. The surface of a core is shaped prior to the removal of a large preferential flake which can then be made into a tool.

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