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NEANDERTHAL OCCUPATION OF THE CHANNEL PLAIN: PALAEOENVIRONMENTS, TECHNOLOGY AND LANDSCAPE IN THE EARLY MIDDLE PALAEOLITHIC

by

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Thesis for the degree of Doctor of Philosophy

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ABSTRACT

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NEANDERTHAL OCCUPATION OF THE CHANNEL PLAIN: PALAEOENVIRONMENTS, TECHNOLOGY AND LANDSCAPE IN THE EARLY MIDDLE PALAEOLITHIC

Samuel Peter Griffiths

The Channel Plain Region, now largely submerged by high sea-level, incorporates the UK Crown dependencies of the Channel Islands, Northern France (specifically Brittany and Normandy), and southern Britain. La Cotte de St Brelade sits within this landscape, and is pivotal in understanding the Early Middle Palaeolithic Neanderthal occupations of the area. This research presents a series of new palaeogeographic models, new analysis of the lithic assemblages of the lower, Saalian deposits at La Cotte, and chronostratigraphic and technological relationship(s) across the region. This includes sites such as Piégu, Menez-Dregan, Grainfollet and Les Gastines.

Overall, this provides an up-to-date synthesis of Neanderthal behaviour between c. 220 – 160 kya within North Western Europe. Specifically, continuities and changes in behaviour over the period in question are highlighted, including changes in lithic acquisition practices related to climate and landscape changes. Finally, this research adds to the recent re-analysis of the upper “bone heap” assemblages (Pope *et al.* 2012; Scott *et al.* 2014; Smith 2015; Shaw *et al.* 2016), within the later Saalian (>160 kya), and the upper Weichselian deposits (Wragg Sykes 2011; Bates *et al.* 2013; Scott *et al.* 2014; Shaw *et al.* 2016), at La Cotte de St. Brelade.

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DECLARATION OF AUTHORSHIP

I, Samuel Peter Griffiths 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.

Neanderthal occupation of the Channel Plain: Palaeoenvironments, technology and landscape in the Early Middle Palaeolithic.

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

First, I would like to thank my supervisory team that have both supported and enhanced this research. Specifically, my main supervisor Dr John McNabb, Mac, to whom I owe a debt of gratitude for continual support throughout the past six years, despite problems and setbacks. Thanks also to both Dr's William Davies and Fraser Sturt for advice and support on my upgrade viva, specifically Fraser for guidance after on chapter 4 (Palaeogeographic modelling). In addition to these three individuals, I would like to thank staff and colleagues in the Department of Archaeology and the Humanities Faculty Office.

I was part of the Ice Age Island Project (and associated research groups) for the six years of my research. The list of volunteers and students who helped re-organise and re-archive the 96,000 lithic artefacts from La Cotte (including material accessed within this thesis) is endless. Without this massive undertaking, this research would not have been possible. Specifically, I would not have been able to undertake this thesis without the project leaders support of Dr's Beccy Scott and Andy Shaw and Matt Pope, who allowed me to work alongside them, and for their encouragement and guidance.

In addition, I would like to extend thanks to those members of the team who have become close friends as well as colleagues during this time. Namely, Dr Andy Needham, Josie Mills, Tabitha Patterson, Dr Dave Underhill, Dr Anne-Lyse Ravon and Antoine Sylvain. Particular thanks go to Anne-Lyse and Antoine for accommodating me during a research trip to Rennes in September 2016.

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Chapter 1: Introduction

1.1 Aims and objectives

This thesis investigates Neanderthal behaviour in a selected region of North Western Europe, the Channel Plain Region (see Figure 1.1); specifically the western half (see below). By using stone tool technology and palaeo-geographic modelling, I will investigate whether Neanderthal lithic behaviour is influenced by geographic landscape changes e.g. sea-level fluctuations. To achieve this, the research specifically re-accesses the large (>250,000) lithic assemblage of La Cotte de St Brelade (La Cotte), other associated assemblages within the region, and regionally important chronostratigraphic sequences.

Figure 1.1: Channel Plain Region showing the key sites discussed throughout this thesis. The region will be presented fully in Chapter 2.

Patterns in behavioural change can be picked up through proxy data; in this case lithics. Therefore my research question is structured as follows.

Research Question: Can changes in lithic behaviour across the MIS 7/6 boundary (c. 220-160 kya), at La Cotte de St Brelade and related assemblages, be used to model changes in Neanderthal landscape behaviour across the region?

My interpretations centre on whether groups did respond, and if so how, to landscape changes we can see and infer from the record of the Middle Pleistocene. To direct my research I will approach four research objectives that will provide data to assess my research question. They are:

1. By combining knowledge related to climate of the MIS 7/6 boundary from across the Channel Plain Region, do we see significant changes in landscape across the period?
2. Adding to the already important record of La Cotte, with regards to Neanderthal lithic technology, can we show particular patterns of subsistence and technological behaviour?
3. Can these patterns at La Cotte relate to landscape changes within the region during Neanderthal occupation of this landscape (c. 220 – 160 kya)?
4. Do these patterns relate to archaeological observations across the Channel Plain Region, specifically the geographically connected area of modern Brittany, France?

1.2 Chapter outlines

Chapter 1

Introduction. I open my thesis by discussing my research question and objectives. In the following sections key themes will be introduced to better aid understanding of ideas explored in subsequent chapters.

Chapter 2

Research Context: Neanderthal behaviour and lithic technologies of North Western Europe. A literature review of current published research relating to Neanderthal behaviour, subsistence, Pleistocene landscape and climate, and the relationships between them. This chapter will provide a more in-depth discussion of the data, already published and available, to discuss Neanderthal behaviour within this region and further afield. I will discuss the possible impacts related to hominin behaviour and subsistence within these landscapes (i.e. raw material availability; foraging strategy; hunting etc.). Further, I will review published records and summarize personal observations that will go towards investigating some of the questions raised within my research objectives.

Chapter 3

Pleistocene climate, Neanderthal landscape behaviour, and the Channel Plain Region. This chapter will present and critique the current knowledge of chronology, geology and their associated evidence for landscape changes in the region in question. This data will have specific relevance for the palaeogeography of the western Channel Plain Region during the Early Middle Palaeolithic, MIS7/6 boundary (c.220 – 160 kya). Not only will this feed into the palaeogeographic modelling presented in chapter 4, but also provide an overall chronology for the region and period in question. This chronology draws directly on the chrono-stratigraphic sequence at La Cotte de St. Brelade; which is presented in depth here.

Chapter 4

Palaeogeographic Modelling: exploring raw material availability and habitats in the Channel Plain Region. This chapter will present a set of new Palaeogeographic models to discuss the Channel Region and its landscape evolution during the MIS 7/6 boundary (c. 220 – 160 kya). These models will be used to highlight changes in landscape over time, and investigate subsistence possibilities (e.g. resource opportunities) developed from the discussion in chapters 2 and 3. It will show that the Channel Plain Region is a highly dynamic landscape throughout the Early Middle Palaeolithic. From this I will connect these models to broad time-frames of occupation at La Cotte (i.e. c. 220 – 160 kya), based on chronological correlations in chapter 3. These models will allow a heuristic framework for investigating Neanderthal landscape behaviour through the following chapters, i.e. directly tying into my research question (above), as well as adding to discussion of objectives 1 - 4.

Chapter 5

Lithic Analysis: methodology. Here I will present the methodologies used for lithic analysis and encompassing frameworks. After reviewing the relevance of other methodologies (i.e. Schick and Toth 1994; Kuhn 1995; Ashton and McNabb 1996; Inizan *et al.* 1999), I have chosen to adapt a methodology devised by Scott (2006) and Shaw (2012). In this chapter I will describe my adaptations and how they relate directly to my research question and objectives 2 - 4.

Chapter 6

Lithic Analysis: the Neanderthal lithic industries of La Cotte de St. Brelade. Here I present the results of the lithic analysis of La Cotte, layers H-A. The implication of these changes will then be discussed within chapter 7.

Chapter 7

Trends and patterns from La Cotte de St. Brelade: Lithic and landscape behaviour of the La Cotte Neanderthals. This chapter will review the overall patterns and trends within the data presented within chapter 6. I will show that there are some significant behavioural changes and continuities present in Neanderthal lithic and landscape behaviour through the La Cotte sequence. This chapter will answer both objectives 2 and 3 as well as directly expanding on the research question.

Chapter 8

Neanderthal occupation of the Channel Plain Region within the Early Middle Palaeolithic. Finally, the conclusion of the above chapters will be brought together. Firstly, this chapter will present a review of the archaeological investigations, published and personal, of material from Brittany and Normandy, chronologically connected with occupations at La Cotte. Secondly, all this material will be brought together, with the evidence for landscape evolution from chapter 4, to provide a synthesis of Neanderthal lithic and landscape behaviour within the Channel Plain Region during the penultimate stages of MIS 7 and subsequent MIS 6 (c.220 – 160kya).

Chapter 9

Conclusions and future work. This final chapter will present an overall conclusion, directly answering my research question and reviewing the answers to the research objectives. In addition I highlight a number of potential areas for future work, to better understand this region and its importance in discussing Neanderthal occupation of North Western Europe.

1.3 Key themes

1.3.1 A Chronological overview

Within this section, I will present an overview of Pleistocene chronology and its relationship to archaeological and geological sequences across the study region. Table 1.1 presents a simplified summary that links these relationships providing the reference source used throughout this research. Because of the long research history within this region, from four different language backgrounds (French, Dutch, German and English), there is often confusion over terminology (Michel 1971; Cliquet *et al.* 2003; Toucanne *et al.* 2009b; Westaway and Bridgland 2010). There are three terminological frameworks, and research objectives differ. For example, French and British research has long been based on the climatic system defined via river terrace sequences (i.e. Antoine 1994; Bridgland 1994). Central European research has instead followed the alpine glacial framework (Ellwanger *et al.* 2011; Klasen *et al.* 2015) originally set out in *Die alpen im Eiszeitalter*, published in 1909 by Penck and Bruckner. These various chronologies are still under debate (Cordier *et al.* 2014 and refs therein).

Chronological Framework for the later Middle Pleistocene						
Archaeological period	MIS	From	To	**Regional Terminology**		
				Britain	France and Lowlands	Central Europe
Later Middle Palaeolithic	3	60	25	Devensian	Weichselian	Wurm II
	4	72	60	Early Devensian		Pleniglaciaire
	5a-d	114	72	Early Glacial		Wurm I
Early Middle Palaeolithic	5e	127	114	Ipswichian	Eemian	Mindel-Riss or Holstein
	6	186	127	Saalian Glacial	Saalian	Haslach-Mindel complex
	7	242	186	Aveley Interglacial		
	8	301	242	Early Saalian Glacial		
Lower Palaeolithic	9	312	301	Purfleet Interglacial		
	10	364	312	-		

Table 1.1 Chronological framework for the later Middle Pleistocene. Middle Pleistocene dates >MIS 5e based on Penkman et al. (2008) Later Middle Palaeolithic after W. Davies (2015; pers. comms.). N.B. the Haslach-Mindel complex is a addition to the original Penck and Bruckner framework which recognises the additional complexity of the later part of the Middle Pleistocene.

Modern research across this region still follows this key framework of five major glaciations over the past 500ky. Dates and chronostratigraphy, however, are now based on ice core and marine core data, i.e. the Oxygen or Marine Isotope Record (Martinson *et al.* 1987; Shackleton 1987; Zazo 1999; Lisiecki and Raymo 2005; Lowe and Walker 2015). Hereafter I will use the marine isotope sequence, specifically based on (Spratt and Lisiecki 2016). Marine Isotope Stages (MIS) are inferred from Deep Sea Core and/ Ice Core drilling data. Both these application's methodologies work on the basis that the ratio of two stable isotopes of Oxygen can highlight sea surface temperature (SST) and Deep Sea Temperature (DST) and changes between them (Walker 2005; Lowe and Walker 2015). These records, then, are proxies for global sea-level and global mean atmospheric temperature (Martinson *et al.* 1987; Shackleton 1987; Lisiecki and Raymo 2005; Lowe and Walker 2015; Spratt and Lisiecki 2016).

The newly published Spratt and Lisiecki MIS curve (Spratt and Lisiecki 2016) alongside the (Rohling *et al.* 2014) curve associated with the Mediterranean/Red Sea RSL data, have been chosen for the relative sea-level estimates (RSL). The Spratt and Lisiecki (2016) curve is a recent development on the Lisiecki and Raymo (2005) example, used widely within North-Western Europe (Monnier *et al.* 2011; Bahain *et al.* 2012), and uses the same data, among other global proxies, to provide a more *globally* comparable isotopic dataset. Overall, the Spratt and Lisiecki (2016) curve displays a ±6-26m confidence dependent on time period. This is also presented alongside the regionally constrained curve of Rohling *et al.* (2014) providing a further critical investigation of landscape change within the period and region in question. The Spratt and Lisiecki example is used for the chronological ties presented within chapter 3 to correlate multiple geological and archaeological sequences from across the region.

The Early Middle Palaeolithic falls within the Saalian geological and climatic complex as identified by Zagwijn (1973) and broadly dated to between ≈300 kya – 125 kya. British terminology refers to MIS 7 as the Aveley Interglacial (Ashton and Lewis 2002; McNabb 2007) following the type site of Aveley (West 1969). The two glacials (stages 8 and 6) are referred to as the Saalian *senso lato* and Saalian *senso stricto* respectively (e.g. Callow and Cornford 1986). This separation is also made within some of the French literature, with MIS 7 often referred as the *intra-Saalien* stage or *Saalien interglaciaire* (Auguste 1995; Antoine *et al.* 1998). Equally, French literature can still group the three climatic periods into one Saalian complex (Hérisson *et al.* 2013).

Where possible I have employed the modern MIS terminology to avoid confusion within this thesis. The separation of the MIS's in to various sub-stages (e.g. 7a) is discussed in more depth in chapter 2; alongside the chosen MIS curves.

1.3.2 Landscape changes, climate and human evolution: an overview

Hominin behaviour and evolution has been connected to climate change throughout human origins research (Trinkaus and Shipman 1993; Stringer 2006; Klein 2009; Grove 2011). Specifically, the localised (to region or locale) influence on landscape change, resource shifting, sea-level movement and erosional cycles. Within my study region the sea-level changes associated with glacial retreat would have revealed large areas of previously submerged landscapes, subsequently inundated as glacial melt occurs in interglacial conditions. The changing habitats associated can be connected to changing mammalian guilds, including the open landscapes associated within the megafaunal bone heaps of La Cotte (Callow 1986h; Scott 1986a). In chapter 3 I will discuss these changes as well as their important influence on resource availability for Neanderthal groups in the Channel Plain Region.

This record is, in a similar way to the archaeological record, fragmentary and dependent on small pockets of sediment preservation to allow us glimpses of evidence of the past. The interdisciplinary connections that have grown from quaternary research highlight the need for mixed sets of data from varying fields to fully begin to understand the quaternary; and in particular hominin behaviour. This was no more apparent than in the well published Stage 3 Project (van Andel *et al.* 2003). With a number of key aims centred around Neanderthal and *Homo sapiens'* occupation of Europe, and the influences of the MIS Stage 3 climates on these occupations, the project employed research from across the quaternary sciences (e.g. Palaeo-environmentalists; geologists; archaeologists; palaeo-ecologists etc.).

Advances in environmental science over the last decades (Coutard and Cliquet 2005; Walker 2005; Lowe and Walker 2015), further discussed in chapter 3, and the continual re-evaluation of data, can add to our understanding of this connection (Bates *et al.* 2010; Bates *et al.* 2014). La Cotte is an ideal chronostratigraphic and climatic proxy sequence, as well as providing a mass of the Neanderthal occupation data. It provides a rich archaeological and geological setting for the understanding of Neanderthal behaviour local to La Cotte (Callow and Cornford 1986; Scott *et al.* 2014), and sits in a region with a rich quaternary record (Monnier 1979, 1980; Keen 1982; Monnier 1982; Lautridou *et al.* 1986b; Coope *et al.* 1987; Cliquet and Monnier 1993; Keen 1995; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003; Coutard and Cliquet 2005; Goval and Hérisson 2006; Cliquet 2008c; Hérisson 2012; Laforge 2012; Hérisson *et al.* 2013; Danukalova *et al.* 2015; Hérisson *et al.* 2016a; Hérisson *et al.* 2016b; Locht *et al.* 2016; Monnier *et al.* 2016; Ravon *et al.* 2016a; Ravon *et al.* 2016b). The record of fluctuating landscapes over time (≈80ky) across the Early Middle Palaeolithic of the region, preserved through sedimentology, palynology and palaeoecology, as well as a detailed understanding of the archaeological record, provide a test for these proxies, and related hominin behaviour.

1.4 Conclusions

In summary, my research will investigate whether there is a close link between climate driven landscape change within the Early Middle Palaeolithic and material culture of Neanderthal groups. The intricate changes of techno-economic strategies are connected with changes in subsistence strategy and raw material acquisition that can be mapped onto the increasingly resolute environmental/landscape record provided from a number of key sources. The methodologies I have employed will be shown to be appropriate for the research questions posed above; namely to investigate impacts on Neanderthal behaviour through lithic analysis and landscape modelling. Through the use of these methodologies on the La Cotte material, and from selected assemblages from Brittany, I will show the character of the Early Middle Palaeolithic record that exists within my personally defined region.

Chapter 2: Research context

2.1 Introduction

In this chapter I will critically evaluate currently published research relating to Neanderthal lithic and landscape behaviour, subsistence and climate related to the Early Middle Palaeolithic of the region. Firstly, I will introduce the Channel Plain Region, as defined here, which is the regional setting for this research. I will then discuss the chronology of the Early Middle Palaeolithic (EMP) within Northern Europe (i.e. France, Britain and the lowlands). The chronological frameworks of the Pleistocene were presented in chapter 1; this section will be an in-depth discussion of the EMP. Finally a number of sections will present current knowledge on Neanderthal behaviour related to lithics, landscape use and subsistence strategies in general; and then with specific relevance to the region in question. These insights provide the overall setting for investigating the research objectives and research question highlighted within chapter 1.

Figure 2.1: The extent of the Channel Plain Region with sites mentioned within the text and discussed within the following chapter.

The Channel Plain Region stretches from western Brittany in the west, to Normandy and North Western France in the east, and forms a part of North Western Europe (Figure 2.1). This incorporates Brittany and Normandy, the Channel Islands, the English Channel maritime area and the southern coast of the UK. Its significance lies in its constant coastal fluctuations throughout the Quaternary (and later) due to large sea-level changes related to Quaternary climate change (Callow 1986h; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003; Bates *et al.* 2007; Monnier *et al.* 2011; Laforge 2012). Terrestrial landscapes and liminal marine landscapes along the modern coastline provide the perfect opportunity to investigate Pleistocene geography and Neanderthal landscape behaviour (Michel 1971; Monnier 1976; Monnier 1980; Monnier 1986, 1988a; Cliquet and Lautridou 2005; Coutard and Cliquet 2005; Bates *et al.* 2007; Bates *et al.* 2010; Monnier *et al.* 2011; Bahain *et al.* 2012; Hérisson 2012; Hérisson *et al.* 2013; Hérisson *et al.* 2016a; Lefort *et al.* 2016; Locht *et al.* 2016; Monnier *et al.* 2016; Ravon *et al.* 2016a; Ravon *et al.* 2016b). These circumstances allow not only the investigation of archaeological material, e.g. La Cotte de St. Brelade (Callow and Cornford 1986), Ranville (Cliquet 2008c), Menez-Dregan (Ravon *et al.* 2016b), but also key climatic indicators linked to them such as the raised beaches and head sequences of the French coastline (Coutard and Cliquet 2005; Coutard *et al.* 2006; Bahain *et al.* 2012; Laforge 2012; Danukalova *et al.* 2013; Danukalova *et al.* 2015), or the Seine river terraces (Antoine *et al.* 2000; Antoine *et al.* 2015). La Cotte itself provides both the archaeological signature of Neanderthal lithic and landscape behaviour *and* the landscape history within which hominin occupation occurred (Callow and Cornford 1986; also see chapter 4).

This area, as I have defined it, is designed to constrain analysis, and by no means represents an assumption of hominin landscape *choice*. By restricting the area of study I will highlight the patterns and variability within stone tool assemblages, closely linked geographically as well as chronologically, and the landscapes changes within which they occur. While other regions have often been discussed in a similar fashion (e.g. Mellars 1996; White and Pettitt 2011; Shaw 2012), the Channel Region provides the perfect test case, with a well preserved and detailed climatic record (Keen 1982, 1985; Coope *et al.* 1987; Callow 1993; Keen 1995; Keen *et al.* 1996; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003; Bates *et al.* 2010; Lefort *et al.* 2011; Danukalova *et al.* 2015; Pope *et al.* 2015), a substantial archaeological signature (Giot and Bordes 1955; Michel 1971; Monnier 1980, 1982; Monnier *et al.* 1985; Monnier 1986; Boëda 1988; Monnier 1988a; Cliquet and Monnier 1993; Auguste 1995; Cliquet 2008c; Hérisson 2012; Monnier *et al.* 2016; Ravon *et al.* 2016b), and the key site of La Cotte that links the two. Using lithic analysis as the proxy for behaviour I will highlight patterns within that record. My results, including newly developed palaeogeographic models, will allow a more in depth discussion of behavioural changes employed by Neanderthals in reaction to the landscape changes of the Pleistocene.

2.2 Chronological overview: Part 2

Overall this research concentrates on the Neanderthal occupation of the Channel Plain Region within the Early Middle Palaeolithic (EMP), from the end of MIS 8 to the end of MIS 6, c. 301 kya – 127 kya (Table 2.1). Across Europe the EMP (MIS 8-6) is often referred to as the Saalian Complex as a whole, representing two glacial periods sandwiching the MIS 7 interglacial. Climatically, we can present a simplified picture by describing the glacials as cold and dry periods, and the interglacials as being temperate and more humid. I will discuss in depth why the climactic scene is more complex below; and in more detail in chapter 3. Briefly, MIS 7 can be split into two very distinct periods, represented by sub-stage 7e and an amalgamation of stages 7c-a, with 7d representing a significant cold sub-stage (Schreve 2001b; Desprat *et al.* 2006; Rohling *et al.* 2014; Rowe *et al.* 2014; Lowe and Walker 2015; Berger *et al.* 2016; Spratt and Lisiecki 2016). This complex climatic history has a significant influence on the landscape and archaeological signature of the period in question within this research.

Complex	Sub-complex	MIS Stage	Dates		Period
			From	To	
Saalian	Saalian *senso lato*	6	186	127	EMP
	Saalian Interglacial	7	242	186	
	Saalian *senso stricto*	8	301	242	

Table 2.1: Chronology of the Early Middle Palaeolithic or Saalian complex. Approximate dates taken from Penkman et al. (2008).

2.2.1 The Early Middle Palaeolithic and its importance

The Early Middle Palaeolithic is a relatively new addition to archaeological terminology (Scott 2006). This separation is based on the globally significant glacial of MIS 6. The stone tool assemblages of the Late Middle Palaeolithic, post-dating MIS 6, are often dominated by a resurgence of bifacial technology (e.g. Ruebens 2013); especially across North Western Europe. By contrast, the preceding period of the later Lower Palaeolithic includes the beginnings of a

Prepared Core Technology repertoire (Bolton 2015), hereinafter PCT, and the overlap of handaxe technology with PCT, e.g. Orgnac 3 (Moncel *et al.* 2005), Cagny le Garenne (Leopold 1997; Tuffreau *et al.* 2008) and Harnham, UK (Bates *et al.* 2014). Despite some reservations over the identification of Levallois at Purfleet (Bates *et al.* 2014) *contra* a number of authors (Schreve *et al.* 2002; Scott and Ashton 2010; Bridgland *et al.* 2013), here we can accept a PCT presence from at least MIS 9 in the southern part of the region in question, i.e. Cagny le Garenne. Its presence within MIS 7 across the region is well documented (Giot and Bordes 1955; Monnier 1976; Monnier 1980; Delagnes and Ropars 1996; Ropars *et al.* 1996; Locht *et al.* 2010a; Hérisson 2012; Hérisson *et al.* 2016a; Lefort *et al.* 2016; Shaw *et al.* 2016)

Unlike the preceding period, the EMP is characterised by core and flake-dominated assemblages, often using PCT (Ropars *et al.* 1996; Scott 2011; Hérisson 2012; Hérisson *et al.* 2016a; Hérisson *et al.* 2016b). However, there are occurrences of handaxe dominated assemblages within the Saalian of the Channel Plain, at sites such as Ranville (Cliquet 2008c), Gentelles (Tuffreau *et al.* 2008) and Harnham (Bates *et al.* 2014), as well as further afield at Pontnewydd (Green 1984). The increasing recognition of variability within Middle Palaeolithic assemblages and technology is of major interest (Hovers and Kuhn 2006 and refs within; Meigan *et al.* 2009; Turq *et al.* 2013; Hérisson *et al.* 2016a). This variability is evident in a number of ways within this region, e.g. core working practices (Delagnes and Ropars 1996; Hérisson 2012), tool production and maintenance (Cornford 1986; Boëda 1993; Debenath and Dibble 1994; Dibble 1995) and raw material use (Monnier 1979, 1980; Monnier 1988b; Huet 2007; Lefort *et al.* 2007; Huet 2010; Lefort *et al.* 2016).

2.2.2 Changing landscapes and climate through the EMP of the Channel Plain Region

MIS 7 has been seen as a unique interglacial within the Middle Pleistocene, based on its global climatic signature (Waelbroeck *et al.* 2002; Lisiecki and Raymo 2005; Berger *et al.* 2016; Spratt and Lisiecki 2016), and its faunal and floral record (Auguste 1995; Schreve 2001a, b; Auguste 2009). Globally, strong evidence suggests the legitimate separation of MIS 7 into two distinct interglacial cycles, MIS 7e and MIS 7c - a (Berger *et al.* 2016). Specifically for North Western Europe (and the Channel Plain Region), there is strong evidence for significant environmental discontinuity between the two periods (Schreve 2001a; Auguste 2009). There is noteworthy evidence for unusually dry, open landscape conditions within MIS 7 c - a (Schreve 2001b; Auguste 2008; Cliquet and Auguste 2008; Auguste 2009), with a more typical (humid, forested environments) within the earlier, MIS 7e. Typical open, steppe-like, terrain species are abundant in zooarchaeological collections from MIS 7c - a, such as La Cotte (Scott 1986b), Piégu (Monnier 1976; Bahain *et al.* 2012; Danukalova *et al.* 2015), Les Vallées (Huet 2010), Moru and Sempigny (Auguste 1995, 2009), and Tourville-la-Rivière (Descombes 1983; Auguste 2009). These include mammoth, wholly rhino, red deer, horse, *Megaloceros giganteus* (giant deer) and aurochs. Along-side these are species indicative of typical, warm interglacial, environments similar to modern conditions, such as the European pond tortoise in Britain (Stuart 1979), and various thermophilous ostracods and molluscs (Green *et al.* 1996; Danukalova *et al.* 2015). This is significant for the hominin occupations of the Channel Plain, in connection to the MIS 7 c - a and MIS 6 occupations at La Cotte (Callow and Cornford 1986). The chronological and stratigraphic significance of La Cotte is discussed in depth throughout chapter 3.

Returning to globally significant evidence for environmental conditions of MIS 7, the separation is observable within the climatic record i.e. marine isotope curves (Waelbroeck *et al.* 2002; Lisiecki and Raymo 2005; Berger *et al.* 2016; Spratt and Lisiecki 2016). Relative sea-levels estimates for MIS 7 show a different signature to other periods (e.g. MIS 11 and 9), with two high stands, MIS 7e and MIS 7c-a, separated by a significant low sea-level event (Figure 2.2). This is further discussed in chapter 3 and 4 with specific reference to Neanderthal occupation of the Channel Plain. These changing sea-levels provide the centre piece for changing landscape in the Channel Plain, throughout MIS 7, and specifically towards the end of the period and the related Neanderthal occupations.

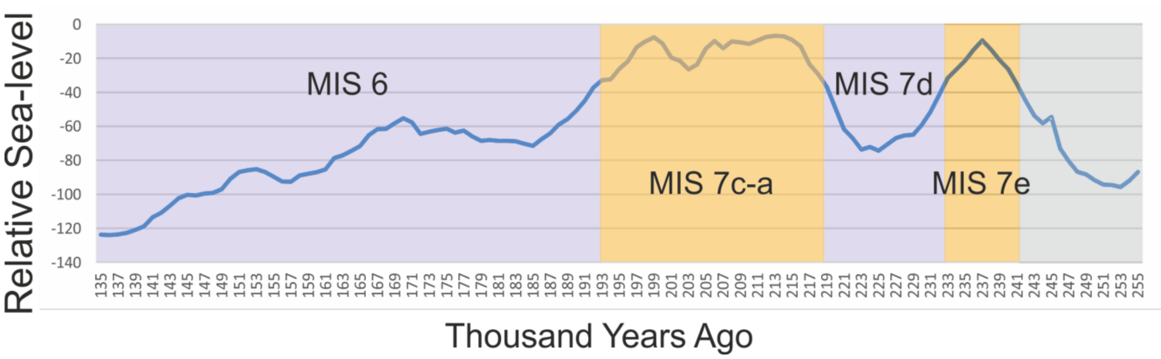

Figure 2.2: MIS curve for MIS 8-6 (Saalian) based on proxy data from Spratt and Lisiecki (2016).

More regionally, a lack of archaeological evidence suggests a desertion of the northern part of the Channel Plain Region by Neanderthal groups from the beginning of MIS 6 (Ashton and Lewis 2002; Ashton and Hosfield 2010; Lewis *et al.* 2011). This specifically affects the archaeological record of Britain, where there is no evidence of occupation through MIS 6, 5 and 4; with the possible exception of artefacts from Dartford, Kent (Wenban-Smith *et al.* 2010). While the lack of hominin activity within MIS 6, to the north of the region, is to be expected (due to severe glacial conditions), there also seems a general decrease in populations, post MIS 6, within North West Europe anyway (Adler *et al.* 2003; Adler and Conard 2005). The warm interglacial of MIS 5e provides a limited archaeological record in Northern France and the Channel Plain (Goval 2008; Goval and Locht 2009; Locht *et al.* 2010b). This has led some to suggest a preference for occupation in areas with locally more open terrain within MIS 5e (e.g. east of the Rhine; Adler *et al.* 2003), rather than the denser forested areas (Adler and Conard 2005). In my opinion, this could be connected to an evolutionary trajectory associated to the development of dry, open landscapes from the onset of MIS 7c - a, specifically across North-Western Europe. Behaviourally then, representing a tracking of preferred habitats/resources, eventually ending with occupation centred more to the east (i.e. after a re-expansion from southern refugia). This further links to the apparent decline in populations suggest by a number of studies (i.e. Ashton and Lewis 2002; Ashton and Hosfield 2010; Ashton *et al.* 2011) and further associations to habitat preferences.

The Channel River would have been a large barrier for movement across the plain at various points throughout prehistory, both for terrestrial animals and hominins (Ashton and Lewis 2002; Ashton and Hosfield 2010). This major river system would have run centrally through what is now the English Channel (La Manche), during eustatic low stands, from at least the post-Anglian glacial, i.e. <MIS12 (Gupta *et al.* 2007; Toucanne *et al.* 2009a; Toucanne *et al.* 2009b; Westaway and Bridgland 2010; Hijma *et al.* 2012; Gupta *et al.* 2017). The most recent research from fieldwork in the Netherlands and the southern area of the North Sea (Hijma *et al.* 2012), now suggests two distinct phases of the Channel Rivers' evolution post MIS 12, after the breach of the Weald-Artois ridge. This breach allowed the Thames and other smaller tributaries and rivers to flow south west, through the Dover Straits, and into the Channel Plain. The Rhine and Meuse, however, continued to flow north, blocked to the south by a sub-crop of Upper Eocene/Lower Oligocene clay, 140 km north of the Weald-Artois ridge (Hijma *et al.* 2012: 34). The final breach of this sub-crop occurs, in similar circumstances to the Weald-Artois ridge, with the advance of the Drenthe (major Saalian) glaciation within MIS 6 (Hijma *et al.* 2012). This caused the outflow to run towards the Atlantic, creating the major Channel River system, today submerged. During maximum glacial low sea-level this channel was joined by the Somme, Seine (France), and Palaeo-Solent (UK), and would include other smaller tributaries running across the area now around the Channel Islands.

This two-stage breach model has clear implications that relate both to the environmental and landscape development of this region, but also directly to my models produced within chapter 4. The initial breach, < MIS12, would have produced a landscape barrier during low sea-level stands (e.g. MIS 8), affecting all terrestrial fauna, including hominids. This fact and its implications are discussed throughout this thesis in relation to the Neanderthal occupations at La Cotte. Secondly, the second breach poses a problem for understanding and reconstructing the quaternary landscape prior to MIS 6, including those landscapes associated to the occupations of the region in question within this thesis. This not only has implications for the main river valley of the Channel River, its erosional capabilities (i.e. previous landscape evidence such as coastal formations, tributary valleys/estuaries etc) but also has implications on understanding upper tributary valley(s), access to and through them and coastal movement across the terrestrial land surface. This is further discussed in chapter 4.

The dry open landscapes, within a warm interglacial setting and transition into cooler climates, provide the backdrop to the occupations discussed within the following chapters. Chapter 3 specifically discusses the landscapes and habitats associated with the dynamic environmental changes of the later part of MIS 7 and beginning of MIS 6. These are also drawn upon to discuss my newly developed palaeogeographic models, presented in chapter 4.

2.2.3 Middle Palaeolithic lithic variability and research history

The surviving Palaeolithic archaeological record is dominated by stone tool technologies. As I have briefly highlighted above these technologies are varied in character (Boëda 1994; Moncel 1999; Hovers and Kuhn 2006; Monnier 2006; McNabb 2007; Scott 2011; Turq *et al.* 2013; Hérisson *et al.* 2016a; Locht *et al.* 2016). A host of factors can affect inter- and intra-site variability of lithic technology and debitage production (e.g. raw material quality). Within this section I will summarize the assemblage variability of the Channel Plain during the EMP, also incorporating examples from further afield where appropriate. We will see that both assemblage variability and technological continuity are prevalent in this record (e.g. Otte *et al.* 1990; Hérisson 2012). This variability of lithic technology sites within an overall discussion of Mousterian tool technology/facies. This research aims to move on from a Eurasian centric standardisation of technological description that places Neanderthal lithic technology within this overall Mousterian facies (Bordes and Bourgon 1951; Bordes 1961; Binford and Binford 1966; Bisson 2000; Monnier and Missal 2014). Instead we can discuss the variability *and* continuity of Neanderthal lithic behaviour based on site and landscape specific situations (e.g. Sharon and Oron 2014) and further support ideas of Monnier and Missal (2014) by discussing more holistic views of assemblage composition rather than “assemblage types” often based solely on a presence of a tool type(s) or *fossil directeur*. This application allows a better understanding of Neanderthal lithic and landscape behaviour across the Middle Pleistocene.

2.2.3.1 Techniques of production: early Neanderthals and the Early Middle Palaeolithic

Within raw material reduction, the production techniques used by the individual knapper heavily affect the end product (Boëda 1994; Guilbaud and Carpentier 1995; Delagnes and Ropars 1996; Kuhn 1997). With particular relevance to the European EMP, there are four main methods of core reduction strategy employed:

- Migrating platform exploitation (unprepared);
- Fixed margin exploitation (e.g. discoids);
- Prepared Core Technologies (PCT);
- Prismatic Technology/prismatic blade production.

These techniques, particularly the first three, lead to a wide range of end-products (Bordes 1961; Rolland and Dibble 1990; Inizan *et al.* 1999; Kuhn 2012; Tostevin 2013; Turq *et al.* 2013); this is discussed in depth within the next section. It is variations on these techniques and their preferences by certain Neanderthal groups at certain times/in certain places that leads to assemblage variability (e.g. Otte *et al.* 1990; Auguste 1995; Moncel 1999), and the Channel Plain Region records this variability within its archaeological record (Fosse 1982; Callow 1986d; Hutcheson and Callow 1986; Auguste 1995; Delagnes and Ropars 1996; Cliquet 2008b).

2.2.3.1.1 Migrating platform cores

The simplest form of core working, grouped here as migrating platform exploitation strategies, is highly effective at producing high yields of debitage. The technique involves the removal of flakes via percussion from an unprepared platform. This can either be in sequences, a sequence being anything with three or more connected removals (McNabb 2007), or as single removals. Three exploitation methods can be employed to leave a migrating platform core: single removals, parallel knapping sequences and alternate knapping sequences (Figure 2.4). Further, all of these methods can be employed on the core in one or more episodes, i.e. a core can have a sequence of alternate, and parallel and a number of single removals, or simply a number of single ones.

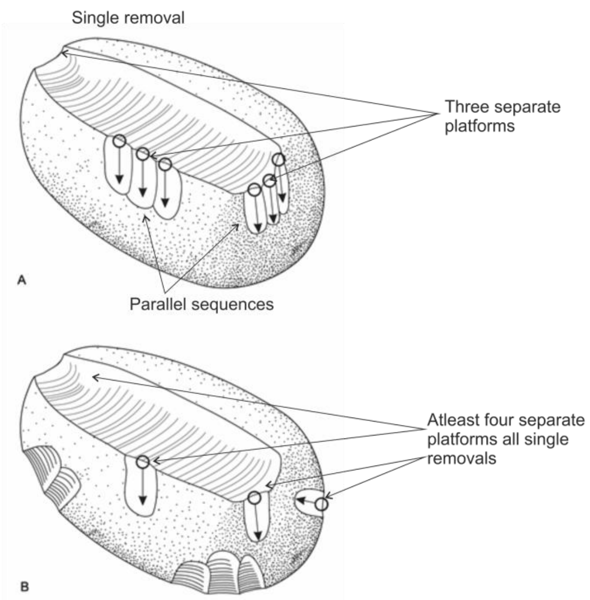

Figure 2.3: Two examples of migrating platform cores. Also showing single removals and parallel sequences, for alternate sequences see Figure 2.4. Image adapted from (McNabb 2007).

The debitage produced can be very varied in both shape and size. Behaviourally we often see this technique employed within *ad-hoc* circumstances, such as at Ranville, Normandy, MIS 7c-a (Cliquet 2008c). Here the remains of a bovid with butchery marks were associated with a small assemblage of flint debitage (Cliquet 2008b). The debitage was interpreted (Cliquet *et al.* 2008) as a number of removals (not in sequence) from one nodule, with the primary purpose of carcass processing (butchery, skinning or marrow extraction). In other examples we see more structured use of this method for the final exploitation of nodules to fully exploit raw material. This is evident at Piégu and Les Vallées, Brittany (Monnier 1976; Huet 2010) where, at both locales, small nodules of flint are exploited to their maximum extent using single removals and very short sequences to produce the highest yield of end-products possible (pers. obs.). This technique of exploitation is highly productive and adaptable, especially when employed towards the end of a core's life or on poorer quality materials; La Cotte is the perfect example of this (pers. obs.; see chapter 6).

2.2.3.1.2 Fixed margin exploitation

These are cores with a single, fixed perimeter (over 60%) upon the nodule knapped, usually created by the use of alternate flaking, i.e. producing a discoid or bi-conical shape (Figure 2.5). These can further be split into three exploitation strategies based on alternate knapping repertoires; classic alternate; complex alternate and simple alternate (Figure 2.4).

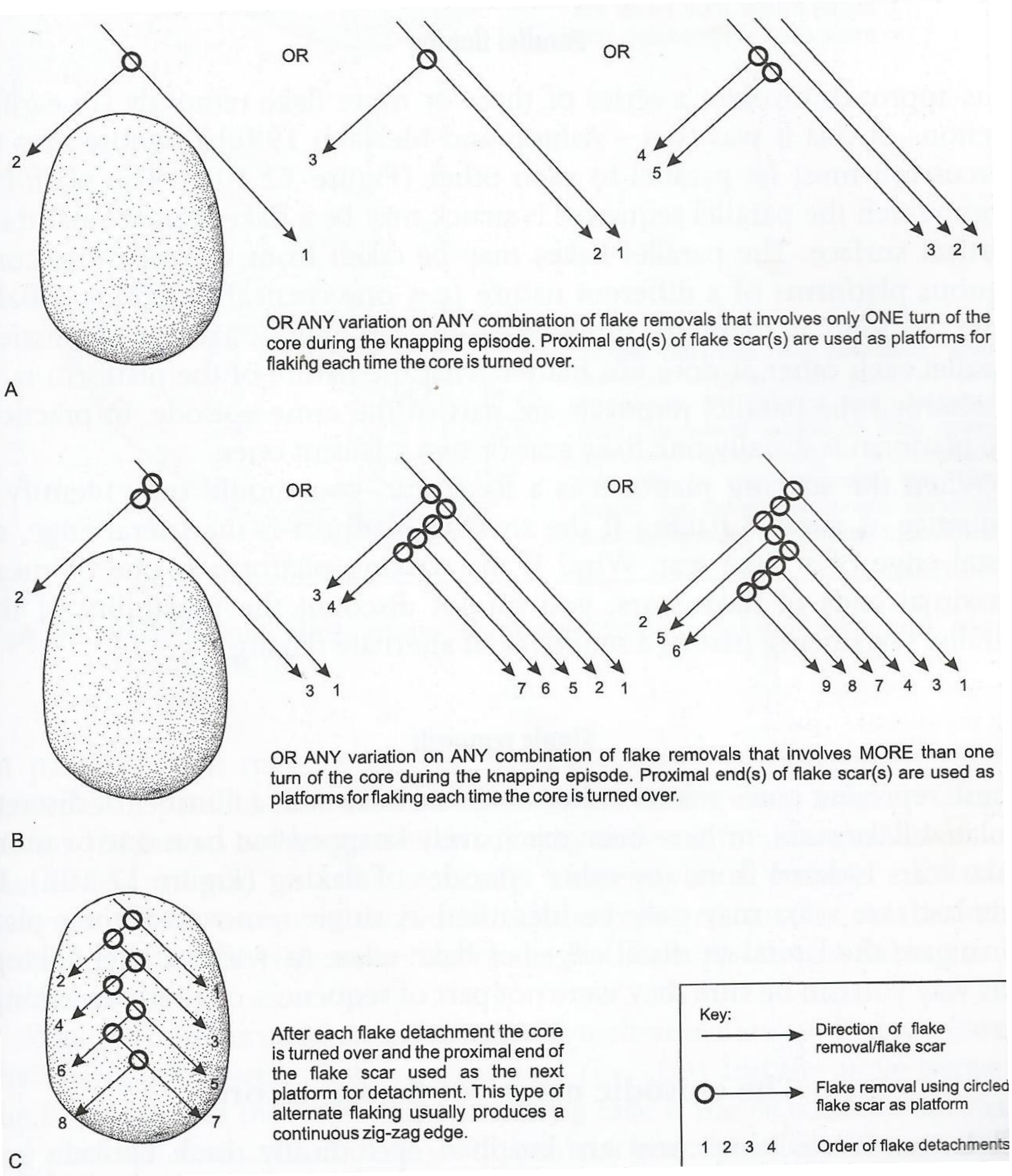

Figure 2.4: Alternate knapping sequences. Image taken from McNabb (2007: 321)

Technologically, discoids are highly effective at producing debitage with a semi-standardised shape. There are many discussions on the effectiveness of this technique, including Peresani and Soressi (2005) and additional papers therein. While shape is often essential to core classification it must be remembered that fortuitous shaping can occur from methods that would be classified under migrating platform cores (pers. obs.). The key element is the deliberate use of previous platform scars in a combination of turns (i.e. switching of the core's vertical orientation by 180˚ to access the bulb scar of the previous removal) and employment of centripetal knapping from one plane of intersection, i.e. a fixed margin (Figure 2.5). For example *classic alternate knapping* is the removal of a flake, turning over of 180˚ and the removal of a second flake from the same position but alternate to its original axis, followed by the same process again, and then repeated i.e. detach/turn/detach/turn and so on (Figure 2.4).

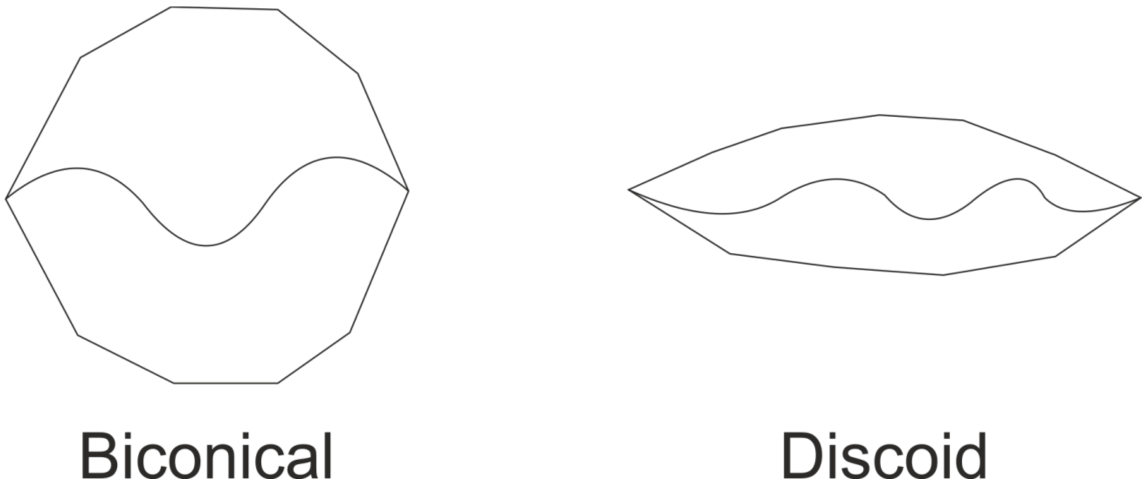

Figure 2.5: Typical schematic view of bi-conical and discoidal cores caused through alternate knapping along a fixed perimeter. This research identifies both shapes under discoids with no differentiation.

2.2.3.1.3 Prepared Core Technology (PCT)

PCT can be single or multiple platform exploitation but must show volumetric control of the nodule (Figure 2.6). While Bordes (1961) was key in the early technological and typological descriptions of Levallois, it is Boeda's (1988, 1993, 1994) definition that is followed within modern research. The preparation stage is essential in controlling the shape and size of the end product(s), maintaining lateral and distal convexities (Figure 2.6c) on the flaking surface, and allowing the production of standardised flakes with the potential for varied morphology (e.g. flakes, points, elongated flakes).

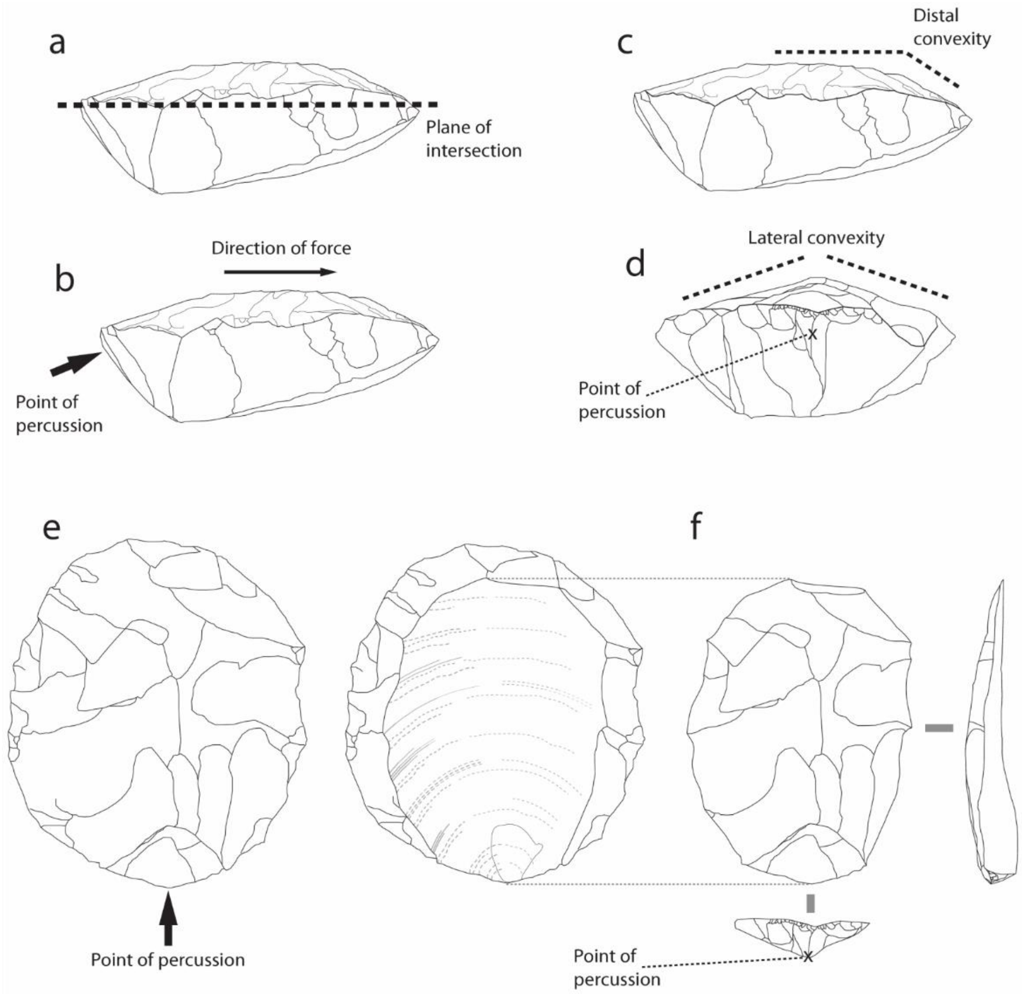

Figure 2.6: Levallois concept as described in text (image taken from Eren and Lycett 2012).

Levallois is just one example of a PCT but is the most prevalent during the Middle Palaeolithic across Europe (Chazan 1997; Eren and Lycett 2012; Bolton 2015; Ashton and Scott 2016; Hérisson *et al.* 2016a) and further afield (e.g. Shaw 2012). The apparent switch to PCT occurs in Northern Europe sometime at the end of MIS 9 (Ashton and Lewis 2002; White *et al.* 2006; Ashton and Hosfield 2010; Scott 2011; Bolton 2015), and has been suggested to be associated with the increase in mobility of hominin groups (Scott and Ashton 2010; Scott 2011). The apparent tether to raw material outcrops seen within the Acheulean (White 1998; Pope 2004; Hopkinson and White 2005; Pope and Roberts 2005) is somewhat broken by the production of transportable cores and/or standardisation of flake products (Scott 2011). We see evidence for this from a number of sites connected with this period, such as La Cotte (pers. obs.), Ranville (Cliquet 2008b), Les Gastines (Monnier 1988a; all in the Channel Plain and discussed in Chapter 5); Creffield Road, Baker's Hole and Crayford (Scott 2006; Scott 2010; Scott and Ashton 2010) in the UK, as well as Payre in southern France (Moncel *et al.* 2008) and across western Europe (Hérisson *et al.* 2016a). All these sites record the use of PCT, with a fragmented *châine opératoire,* suggesting cores and blanks are introduced or removed (e.g. Bakers Hole) at varying stages of the process of production and reduction.

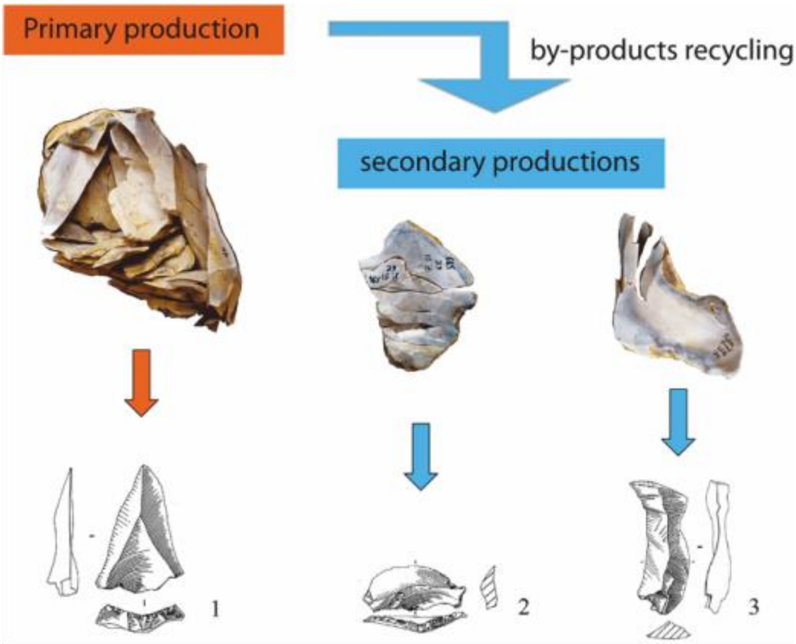

Figure 2.7: Production techniques at Le Pucheuil. Number 3 represents the “Le Pucheuil Type” elongated flakes. From Lazuén and Delagnes (2014)

At Le Pucheuil, Picardy, the use of PCT, termed “Le Pucheuil Type” (Delagnes and Ropars 1996), is a technique for production of elongated end-products, similar to Levallois blade production (Figure 2.7). Without all the elements of Levallois, as defined by Boeda (1994), the technique takes advantage of the natural shape of local raw material (irregular flint nodules from clay-with-flint deposits). By-products of initial convergent Levallois reduction (i.e. outer removals from the irregular shaped nodules) have been reduced with a series of parallel removals from the face of the cores in question (i.e. number three in Figure 2.7).

2.2.3.1.4 Prismatic Core Technology

Prismatic core technology (or blade production) is centred on the production of prismatic blades, again with standardised end-products. The key is the careful preparation of the platform and flaking surface to control long thin parallel removals. This technology is the hallmark of the Upper Palaeolithic, and is rare throughout the Early Middle Palaeolithic. However, increasing evidence for its presence in Northern France throughout MIS 5 (specifically 5d-a and later) has been attested (Goval and Hérisson 2006; Goval 2008; Goval and Locht 2009; Locht *et al.* 2010b; Ortega *et al.* 2013). Elongated end-products are present within the EMP, most often associated with PCT techniques and their variability (see above).

2.2.3.2 Retouch

Retouch of tool blanks has often been seen as the major technological signature of assemblages, especially within the Mousterian identification systems (discussed above), and therefore has often been given precedence within lithic analysis/assemblage typology. Retouch is defined as removals, obtained by percussion, with the intention of making, finishing or shaping a blank (Inizan *et al.* 1999: 81). The reshaping, re-sharpening and strengthening of tool edges is indeed an essential part of subsistence. In similar ways to core practices and debitage production, retouching provides a signature of technological choices made by hominins that directly reflect behaviour. The subsistence element of tool production and maintenance is discussed in the following section.

The analysis of retouch can be affected by a number of issues. Taphonomic processes can heavily influence the analysis of tool assemblages, as can an understanding of excavation history and post-excavation storage. At La Cotte for example, taphonomic edge damage in certain layers, specifically layer B (pers. obs.), heavily confuses the identification of retouch. Within my own analysis, therefore, I have erred on the side of caution within layers that have observable edge-damage upon artefacts (see chapter 6). Overall, factors can all affect the behavioural signature of an assemblage (for one example see Scott 2011).

The close link that has often been made between tool types and subsistence practices (e.g. scrapers for hide working; Keeley 1980), and further assemblage types and functional arguments (Binford and Binford 1966; Binford 2001) is often hard to assess. The early, subjective nature of tool typology has led to a long debate on how typology should both be used and re-vamped for modern post-processional archaeology (i.e Bisson 2000). The most widely accepted typology is of course the Bordes System already mentioned (Bordes 1961) and directly connected to ideas of a Mousterian tool tradition within Europe. Its subjective nature, with a reliance on inferred use, and morphology based on shape and size, has drawn heavy criticism (Rolland and Dibble 1990; Dibble 1995; Bisson 2000; Jelinek 2013), and yet a useful and satisfactory revision has never been proposed, despite occasional attempts (i.e Callow and Cornford 1986). This can be suggested to demonstrate the overriding need for standardisation of typological analysis and a consistency for comparison (pers. obs.). As shown by Debenath and Dibble (1994), the Bordes system, when used at its basic level, can provide this. Therefore, I will use this system (i.e. Bordes 1961) for the retouch morphology component of this research (see chapter 5). However, a number of additional variables where recorded that enhance the understanding of production and curation techniques employed in these assemblages, these are described in chapter 5; directly adding to the investigation of the research objectives and question set out in chapter 1. These ideas once again aim to support Monnier and Missal (2014) with a more holistic analysis of assemblages looking at the “properties of the lithics themselves”.

2.3 Subsistence in the Neanderthal world

Subsistence practices of Neanderthal populations are obviously key to their survival through the Pleistocene. While I will concentrate on behavioural practices related to lithics, i.e. lithic analysis, we can also assess behaviour using a number of other proxies; the main two being preserved bone and wood. Bone material preserves subsistence practices related to food acquisition, e.g. butchery and bone cracking for marrow extraction (Auguste, 1995, Auguste, 2008). It however also links to access to other faunal materials such as bone and hide, potentially for fuel (Hérisson *et al.* 2013) and clothing/cultural insulation (Wales 2012). The rare record of preserved wood has been used to shed light on hunting practices and hafting capabilities (Movius, 1950, Oakley et al., 1977, Thieme, 1997, Thieme, 2005); as well as fuel use i.e. fire. This can also be supported by micro-usewear (e.g. Keeley 1980, 1993) and the presence of certain stone tool types (e.g. denticulate and notches), a behaviour also supported by original usewear analysis of the La Cotte material (Frame 1986), the majority from layer A. The following sections discuss the evidence for subsistence in the Neanderthal world, with specific reference to the region in question. It is these ideas, alongside new lithic and landscape research presented here, that will form a synthesis for Neanderthal behaviour within the final sections of this thesis.

2.3.1 Neanderthal Diet

While in the past, later Middle Pleistocene hunting capabilities have been questioned (Binford 1981; Stiner 1991; Turner 1992; Stiner 1994; Marean 1998) a range of excavated examples of primary access to carcasses such as the mass horse hunting of Schöningen, Germany, in MIS 9 (Thieme, 2005, Rivals et al., 2014, van Kolfschoten, 2014); Mammoth butchery at Mont Dol, France, in MIS 4 (Simonet and Monnier, 1991); Bovid butchery at Ranville, France (Auguste, 2008) and elephant hunting at Lehringen, Germany (Movius 1950) have resulted in a clearer picture of hominin hunting capabilities (Gaudzinski-Windheuser and Roebroeks 2011; White *et al.* 2016).

Still under debate, however, is the wide range of techniques possible for the acquisition of meat, and the use of carcasses other than directly for nutrition (i.e. hide, bone). The use of direct hunting strategies (e.g. at Schöningen and Lehringen) has been accepted, but we cannot rule out scavenging as a key strategy when available, such as suggested at Lynford, UK (Schreve 2006; Schreve 2012). There is ample evidence for meat procurement within the region throughout the Palaeolithic (Scott 1980; Monnier 1986; Scott 1986b; Simonet and Monnier 1991; Auguste 1995;

Auguste 2008; Auguste 2009). Within MIS 7 at Ranville (Auguste 2008) and Nantois (Monnier 1986) individual bovids were excavated with clear evidence of butchery and associated lithic technology. The opportunistic nature of lithic behaviour, such as at Nantois and Ranville (see above) is mirrored here in the opportunistic exploitation of faunal acquisition *and* exploitation, including cultural insulation (pers. obs.). At Biache-Saint-Vaast a large faunal assemblage was recovered (Auguste 1995), with evidence for hafted projectile points (Rots and Plisson 2014) and evidence for butchery (Auguste 1995). The fauna included examples of butchered bear which has been further interpreted as evidence for hide procurement (Auguste 1995) and further connected to hide reduction (Hérisson 2012; Hérisson *et al.* 2016a).

Finally, La Cotte de St Brelade has two large, well preserved 'bone heaps', mostly made up of mammoth and woolly rhino (M.A. Julien, pers. comms; Scott 1980; Scott 1986a), as well as a highly fragmented faunal assemblage from various other occupations of the ravine system (Scott 1986b; Smith 2015). Two separate phases of occupation are terminated by these bone heaps (see chapter 3). Intriguingly, the bone heaps show evidence both of skeletal separation and skeletal element stacking against the fissure's western wall (Scott 1980; Scott 1986a; Scott *et al.* 2014). While production of meat from these animals would be large (whether a mass kill or series of individual kills), the use of the bone in some systematic way cannot be ruled out, perhaps for fuel (Callow *et al.* 1986), as discussed below. Microscopic usewear also attested to the reductions of hide (Frame 1986) with seventy pieces of the small sample (t= 212 pieces in the "final sample") showing evidence for hide working.

This supports evidence for Neanderthal hunting and procurement of faunal material (e.g. bone and hide) across the region during the EMP, at Piégu, Les Vallées, Tourville-le-Rivière, Moru and Sempigny (Monnier 1976; Descombes 1983; Guilbaud and Carpentier 1995; Auguste 2009; Huet 2010); showing a region wide suite of behaviour at this time. This behaviour can be connected to the general deterioration in climate conditions within this period, associated to the on-set of MIS 6 (i.e. glacial conditions), also supported by the increased evidence for fire use across the region (Hérisson *et al.* 2013; Locht *et al.* 2016). The use of hide, accessed from large mega faunal kills (e.g. mammoth, woolly rhino, bear) can also be connected to the necessity for the production of cultural insulation (e.g. clothing), also discussed elsewhere for Neanderthals (Aiello and Wheeler 2003; White 2006; Wales 2012) and other European hominids (Hosfield 2016).

Recent evidence has also suggested a dynamic use of plant materials within the Neanderthal diet (Hardy 2010; Hardy and Moncel 2011; Goren-Inbar *et al.* 2014; Sistiaga *et al.* 2014; Radini *et al.* 2016; Terradillos-Bernal *et al.* 2017; Weyrich *et al.* 2017). Dental calculus, analysed from recovered Neanderthal teeth (Hardy 2010; Ecker *et al.* 2013; Hardy *et al.* 2013; Hardy *et al.* 2015;

Radini *et al.* 2016; Weyrich *et al.* 2017), has shown a diverse use of these non-meat resources, also suggesting the potential for degree of self-medication (Hardy *et al.* 2013; Weyrich *et al.* 2017). Further evidence from faecal material preserved in the cave deposits of El Salt, Spain, (Sistiaga *et al.* 2014), and evidence for earlier exploitation of aquatic plants at Gesher Benot Ya'aqov, Israel (Goren-Inbar *et al.* 2014), support hominin use of plants within their diet. Direct evidence for floral exploitation within the Channel Region is lacking, however the environmental and landscape reconstructions discussed in the following chapter provide good evidence for the potential of non-faunal resource exploitation within these landscapes. This adds to recent hypothesised discussions on the potential of such landscapes for producing non-faunal food stuffs for hominid consumption (e.g. Bigga *et al.* 2015).

The last few decades have seen an increase in the use of isotopes for assessing Neanderthal diet (Richards and Trinkaus 2009) and faunal populations (Julien *et al.* 2015; Rivals *et al.* 2015; Bocherens *et al.* 2016). As Richards and Trinkaus (2009) highlight, isotopes of both Nitrogen and Carbon vary across regions, habitats and time, therefore intra-site comparisons are necessary to really define dietary insights. However, studies have highlighted a dominance of meat consumption (>80%) contributed the main source of protein within Neanderthal individuals (Richards *et al.* 2008; Richards and Trinkaus 2009), but with a significant dietary influence of non-meat resources (Naito *et al.* 2016), therefore supporting other studies, that diet is varied and opportunistic (Hardy *et al.* 2013; Henry *et al.* 2014). No published isotope analysis has been conducted on the limited EMP Neanderthal remains from the Channel Region i.e. Biache-Saint-Vaast (Rougier 2003) and Tourville (Faivre *et al.* 2014).

Outside the region, a number of key studies have added to knowledge of Neanderthal hunting practices (Britton *et al.* 2011; Ecker *et al.* 2013; Julien *et al.* 2015), diet (Bocherens *et al.* 2005; Bocherens 2009, 2011; Bocherens *et al.* 2016), as well as potential landscape movements related to subsistence (Makarewicz and Sealy 2015; Rivals *et al.* 2015). These have all supported and strengthened the link between Neanderthals and direct hunting, as well as beginning to support a wide ranging, opportunistic diet across western Eurasia (i.e. shell fish; birds; small game). This is specifically evident at sites such as Payre, S. France (Moncel *et al.* 2008) where isotope studies have suggested a varied use of available resources (birds, fish and small game) as well as potential of seasonal group movement (Ecker *et al.* 2013; Bocherens *et al.* 2016). Indeed the increased use of both isotope analysis on animal and Neanderthal remains (as well as more in-depth dental wear studies) are increasing our knowledge concerning mobility of animals *and* hominids, and the potential for understanding seasonality (Ecker *et al.* 2013; Julien *et al.* 2015; Rivals *et al.* 2015)

2.3.2 Use of non-stone raw materials

The use of raw materials other than stone for various subsistence-based strategies is also a key feature of hominin behaviour (e.g. Thieme 1997; Abrams *et al.* 2014). I have already mentioned evidence for hide procurement (and reduction), potentially for cultural insulation, at Biache-Saint-Vaast (Auguste 1995) and La Cotte. Bone and antler were also utilised within the EMP for soft hammer knapping methods; its shock-absorbent properties make it the perfect material as a percussor (Bello *et al.* 2013; Abrams *et al.* 2014), and in limited cases for flaking (Gaudzinski *et al.* 2005). Soft hammer flaking is persistent throughout the archaeological sequence at La Cotte (pers. obs.), but in low numbers. The use of bone for other processes is not evident in the EMP record of this region, but activities such as shelter building (Pettitt 1997; Stapert 2015), cannot be ruled out (pers. obs.). Based on detailed microscopic usewear analysis (Keeley 1980, 1993), specifically here at La Cotte (Frame 1986), not only was hide reduction evident (likely or cultural insulation; see above) but also the working of wood (40 of the t= 212 sample show evidence for wood working). This is further supported by the presence of denticulates and notches in good numbers at the site (and throughout the region) and connected to wood working elsewhere in past studies (e.g. Keeley 1993).

Use of fire within the Palaeolithic has often been a key theme of discussion throughout research history (Gowlett *et al.* 1981; James 1989; Goren-Inbar *et al.* 2004; Gowlett 2006; Karkanas *et al.* 2007; Wrangham 2009; Roebroeks and Villa 2011a, b; Sandgathe *et al.* 2011; Hérisson *et al.* 2013). The EMP of the region intriguingly displays a confusingly low level of evidence for structured combustion, i.e. hearths (Callow *et al.* 1986; Monnier 1988b; Hérisson *et al.* 2013). The capacity for *use* of fire is not in question by the EMP (MacDonald 2017), with clear evidence from earlier sites such as Gesher Benot Ya'aqov, c. 780 kya (Alperson-Afil 2008; Alperson-Afil and Goren-Inbar 2010) and Beeches Pit, UK, c. 450 kya (Gowlett 2006; Preece *et al.* 2006). Neanderthal capacity for controlled and systematic use of fire is however still under debate (Dibble *et al.* 2017; Dibble *et al.* 2018). Recently, Hérisson *et al.* (2013) have presented two well excavated examples of structured use of fire at Therdonne and Biache-Saint-Vaast, both within the Channel Plain Region. Callow *et al.* (1986) also argued for the use of fire at La Cotte, where high levels of burnt material (sediment, stone and bone), including some wood charcoal where excavated from most levels, but with little suggestion of structure. This was specifically apparent within the excavation of layers H, G and F, which are suggested to be a number of disturbed living floors (Callow 1986j; Lautridou *et al.* 1986a; van Vliet-Lanoë 1986) with high amounts of fragmented, burnt bone (Scott 1986b).

Experiments by Hérisson *et al.* (2013) that explored the potential use of bone as fuel for burning, specifically at Biache-Saint-Vaast, suggesting little or no structural integrity would remain from a bone-fuelled fire. The chemical analysis of both experimentally affected sediments and archaeological deposits found high levels of animal fats within the deposit samples. Experimentally, fat was observed to melt out of the bone and spread over the surrounding area, with dark staining of sediments and some degree of ashy remains. This was suggested as evidence for the employment of bone as fuel by Neanderthals, at least at Biache-Saint-Vaast and likely at the locale of Therdonne also. This is particularly important when reviewing the climatic evidence, which suggests open grasslands and sub-tundra landscape in later MIS 7 (i.e. MIS 7c-a) and early MIS 6, making wood a premium resource within the landscape (Pettitt 1998; White and Pettitt 2011; Pettitt and White 2012). Returning to La Cotte, the reported excavation of dark blackened sediments and burnt bone (Burdo 1960; Callow *et al.* 1986; also evident from unpublished excavation reports) could also fit the same signature, as could other excavated examples in the region at Grainfollet (Giot and Bordes 1955; Monnier 1980; Monnier 1988b), and more recently in excavated layers at Menez-Dregan (Ravon *et al.* 2016a; Ravon *et al.* 2016b). It has been argued that fire is one essential technique that would have been necessary for Neanderthal survival in northern latitudes (White *et al.* 2006; White 2006; Roebroeks and Villa 2011a; MacDonald 2017), especially through the cooler period of transitions e.g. MIS 7/6. I will revisit the idea of Neanderthal use of fire in later chapters, specifically relating to evidence from La Cotte and its importance for understanding behaviour.

2.4 Conclusion: the state of research

From published data Neanderthal behaviour can been seen as varied, opportunistic and structured towards maximum use of available resources. This is no more so than in the examples from the Channel Plain Region such as Biache-St-Vaast, Piégu, Grainfollet and La Cotte. I have discussed current knowledge of Neanderthal behaviour with specific reference to the Channel Plain Region and its archaeological record. It is this record that will feed into my own research at La Cotte, and further afield. This will begin to bring research objectives 2-4 together. While I focus on the analysis of lithic material and its related behaviour, the addition of data from surviving organic material such as bone and wood will also be essential. For this reason my methodology concentrates on the extraction of these behavioural data, assessing technological change through the EMP across the Channel Plain Region. The next Chapter will discuss geographic variation of this period with the final aim of linking behavioural proxies and landscape situations.

Chapter 3: Pleistocene climate, Neanderthal landscape behaviour, and the Channel Plain Region

3.1 Introduction

The aim of this chapter is to bring a greater understanding of the environmental changes, and subsequent landscape changes, faced by Neanderthal groups through the EMP, within the Channel Plain Region. This will form a strong link between lithic behaviour and the environmental fluctuations that effect the behavioural decisions made within this setting, therefore, this will directly investigate Neanderthal lithic and landscape behaviour. This chapter also presents the chronostratigraphic record of the key locale of La Cotte de St Brelade (Figure 3.1) and connected regional sequences.

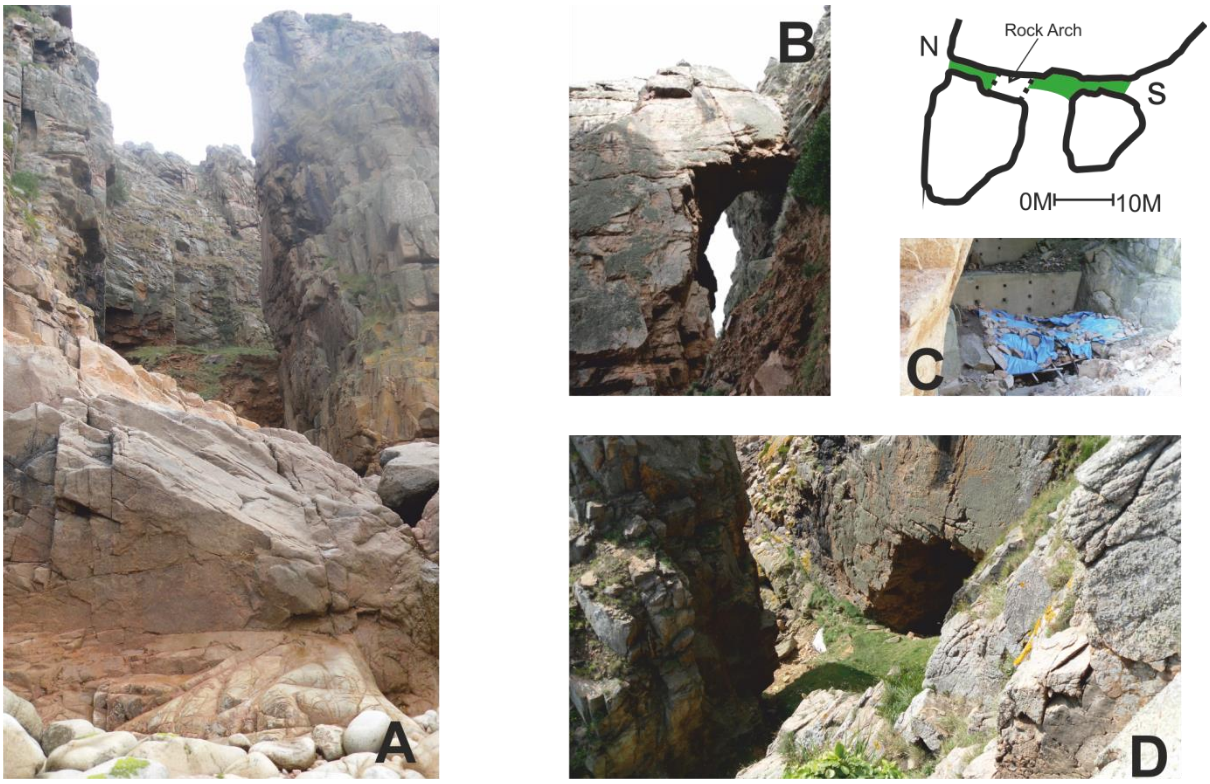

Figure 3.1: La Cotte de St Brelade, ground plan presented on top right redrawn from Callow and Cornford (1986). Pictures = A) View into the fissure system from the west. B) The rock arch, Weichselian deposits originally reach this and higher outside of the northern fissure. C) The concrete wall protecting the Saalian deposits/section excavated by McBurney. Tarpaulin is covering the deep sounding that reaches the deepest deposits yet excavated. D) Rock arch and entrance to the northern fissure taken from above the system.

La Cotte represents a chronostratigraphic reference sequence for this research from which a better understanding of broad climatic conditions, and therefore landscape change, can be derived. Here I will present the geological sequences from deposits within the site, using personal observations and published material (Burdo 1951, 1956, 1960; McBurney and Callow 1971; Callow and Cornford 1986; Pope *et al.* 2012; Bates *et al.* 2013; Scott *et al.* 2014).

3.2 The stratigraphic sequence at La Cotte de St. Brelade

3.2.1 Excavation History

Discovered in 1861, La Cotte has seen over a century and a half of research. Most of this has centred on its rich archaeological record (Sinel and Toulmin-Nicolle 1911; Marett and de Gruchy 1912; Burdo 1960; McBurney and Callow 1971; Callow 1986d; Scott 1986a; Pope *et al.* 2012; Bates *et al.* 2013; Scott *et al.* 2014), and its geological and chronostratigraphical significance to the region (Callow 1986e; Huxtable 1986; Keen 1993; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2013). The locale is an eroded dolerite fissure system within a granite headland which preserves a series of Pleistocene and Holocene deposits, protected both by its altitude above sea-level (slightly above modern high water) and its gradually eroding roof, effectively 'capping' sediments. The first recorded and systematic excavations took place in 1910 by the Société Jersiaise (Nicolle and Sinel 1910), and were later taken over by Dr R.R. Marett (Marett and de Gruchy 1912; Marett 1916; Marett 1940). Later, in 1936, a local Jesuit priest, Father Burdo, began excavations at La Cotte (Burdo 1951, 1956, 1960). These early excavations (both Marett and Burdo) saw the removal of most of the upper sequence of Weichselian (and later Holocene) deposits within the Western fissure and into the Northern fissure (Figure 3.2; highlighted in yellow).

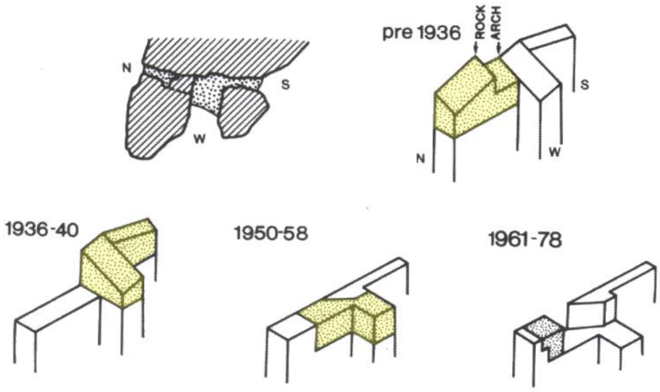

Figure 3.2: Removal of deposits from the fissure system of La Cotte de St Brelade, separated by period of fieldwork. Highlighted in yellow = post-MIS 6 deposits. Image annotated from Callow and Cornford (1986)

In essence, the quaternary deposits can be split into two archaeological periods, the Early and Later Middle Palaeolithic. No evidence for an Upper Palaeolithic presence can be unequivocally identified, although some of the Marett material could indeed be from this period (pers. obs.). This thesis concentrates solely on the lower sequence, which represents the Early Middle Palaeolithic deposits (MIS 7-6). The upper deposits have been recorded and discussed in depth by both Marett and Burdo (Marett 1916; Burdo 1960; Callow 1986a) and also by more recent investigations (Pope *et al.* 2012; Bates *et al.* 2013; Scott *et al.* 2014; Pope *et al.* 2015). The whole sequence of currently excavated deposits was further described and summarized by Callow (1986e), after significant excavations by Prof. Charles McBurney from 1961-78 (McBurney and Callow 1971; Callow and Cornford 1986). It is these investigations that most interest us here.

McBurney separated the stratigraphic formation of the site into five "stages" (not to be confused with MIS) which can be viewed on Figure 3.4 (values in roman numerals). In addition, McBurney split the sequence into a total of 18 layers, each representing a difference in depositional conditions. The layers are numbers 14 - 3 and letters A-H (in stratigraphic order from the top). The upper, Weichselian sequence, layers 14 - 8.3 of McBurney, were a series of loessic head deposits sandwiching granitic sands and with some evidence for humic soil formation (Callow 1986j). These sediments were deposited on a slope originating from a raised beach deposit correlated to the MIS 5e eustatic high stand (Callow 1986e; Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). The upper deposits then represent MIS's 5-2 and have evidence of intermittent hominin occupation (Callow 1986a; Bates *et al.* 2013).

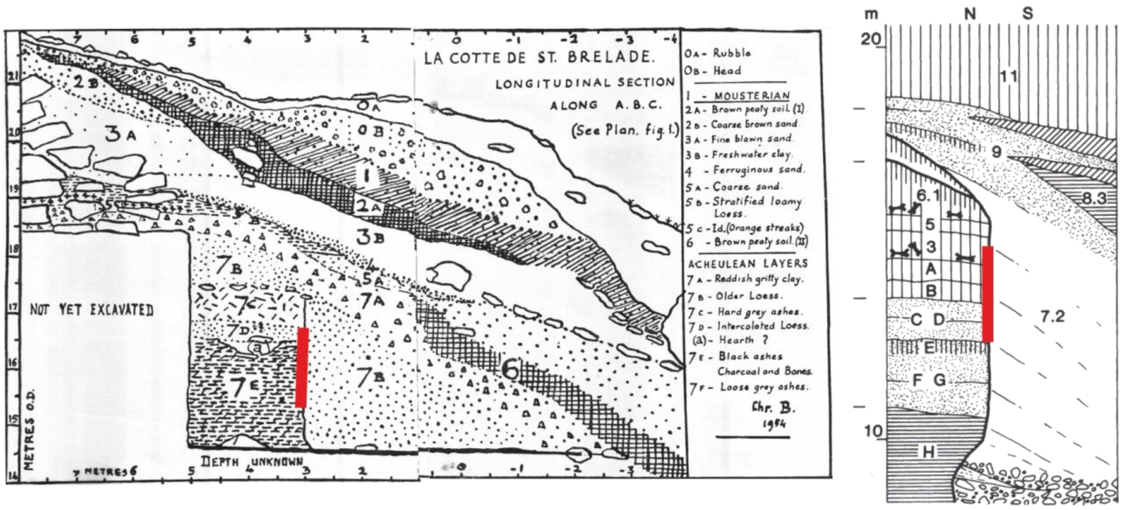

Figure 3.3: Sections of Burdo (altered from Burdo 1960) and Callow (1986e), both west facing. Red Lines highlight the "cliff" interpreted by McBurney and Callow (1971) as a feature of the MIS5e eustatic high.

Figure 3.3 shows the correlation of the Burdo stratigraphic sequence (1960) and the McBurney example. Specifically relevant here is the correlation of the palaeo-“cliff” that represents the surviving deposits of EMP age, at the time of McBurney excavations in 1966. It is these deposits that are discussed in more depth below.

3.2.2 The Early Middle Palaeolithic sequence

Throughout this overview I will concentrate on stages I – III (layers H-6; see Figure 3.4), and the very beginning of stage IV (layer 7.1). These layers represent the late MIS 7 (MIS 7a - c) and MIS 6 sequence, up to the incursion of a high sea-level event believed to be MIS 5e (Callow 1986e). This eustatic high stand is believed to have removed a proportion of the Saalian deposits within the western fissure, and certainly encroached into the northern fissure, creating the “fossil cliff” (Burdo 1960; Callow 1986e). The situation in the southern fissure and the eastern wall of the western fissure, however, is unknown, due to a lack of excavation. The following section will summarize the current published knowledge of lower deposits within the fissure system based on excavations in the 1960’s and 70’s (McBurney and Callow 1971; Callow and Cornford 1986) and I will include a number of personal observations. This review will start with the deposits representing stage IV i.e. the eustatic high stand, as this represents the most evident *terminus ante quem* when discussing the lower deposits of the “cliff”.

3.2.3 Layer 7: the raised beach

As a whole, the sequence at La Cotte represents a series of cold stage, reworked aeolian loessic deposits sandwiching warm stage soils and granitic sands. The striking difference between the previously mentioned upper Weichselian layers (7.2-11; Stage IV and V; see Figure 3.4), and those towards the base of the sequence is significant. As Figure 3.4 shows, those layers associated with the Weichselian (the upper deposits) observably slope towards the entrance of the fissure (i.e. westwards towards the sea). Those below and of Saalian age were deposited largely horizontally, and show little evidence of marine interference (but see the description of Layer H below). However, water activity was observed throughout the sequence, related to runoff from the headland, and is likely the cause of some sloping of deposits throughout (pers. obs.).

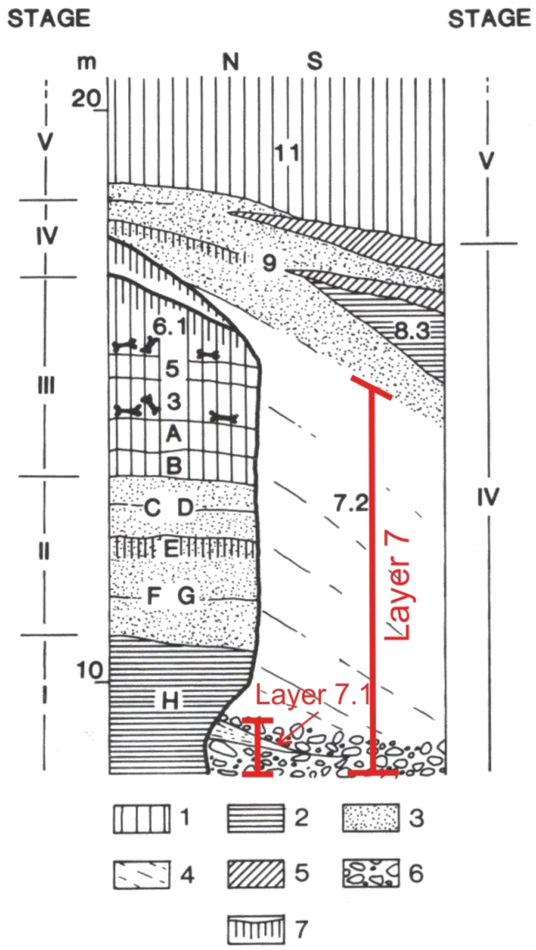

Figure 3.4: La Cotte stratigraphy from McBurney excavations. Image taken from Callow (1986j). 1 Loess/loessic head; 2 water lain silts; 3 granitic sand; 4 talus; 5 humiferous deposits (ranker soils); 6 marine gravels; 7 truncated forest soil.

Geologically, this difference, represented at the layer 6-7 interface, is highly significant, both locally and regionally. Layer 7.1, at the very base of the Weichselian deposits, is a mixture of marine pebbles and sands. In places this was deposited on the fissure's bedrock surface (Callow 1986j), but only from its opening to the sea (entrance to the west ravine) up to the junction of the two fissures. The beach deposits do not extend considerably into the north ravine, and abut and undercut the lower deposits, creating a 'fossil cliff' (Figure 3.3 and Figure 3.4). The situation within the south ravine is not known, as there has been no recorded excavation. Layer 7.1 then represents a high sea-level period, and the deposits represent a beach laid down within that stand, presumably as high sea-levels receded (Callow 1986i). This eustatic high stand is also the cause of the palaeo 'cliff', having eroded, undercut and removed the southern portion of the lower deposits from the northern fissure sometime during the Pleistocene. The aeolian loess of 7.2 has then capped these deposits and protected the palaeo 'cliff' from additional erosion.

This eustatic high-stand could in theory represent any high sea-level stand prior to the Weichselian. Its height above modern sea-level does, however, strongly point to the Eemian high stand of MIS 5e. This is supported by recent dating at La Cotte (Bates *et al.* 2013) and a strong correlation to other 5e sequences at Belcroute and Belle Hougue (both in Jersey) and Pleneuf-val-Andre (Brittany) which are described in section 3.3.1.1. (Keen *et al.* 1996; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003; Monnier *et al.* 2011; Renouf and James 2011; Bates *et al.* 2013).

Belle Hougue has been U-Series and AAR dated to MIS 5e (121 ± 14 kya), and on altimetric grounds matches layer 7 at La Cotte, as do deposits at Belcroute and Portelet on the south of the Island (Keen *et al.* 1981; Keen *et al.* 1996; Bates *et al.* 2003). At Belcroute, deposits of head and loessic material are sandwiched by marine deposits representing two temperate phases which may or may not be full interglacials (Keen *et al.* 1996; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003). Through pedostratigraphy, these have also been linked to a raised beach at Portelet (Keen *et al.* 1996). This connection with Belle Hougue can be supported by the stratigraphical position of the deposit, sitting below a cold stage head and thick loess (up to 3m thick at Portelet). As this deposit represents deposition after the last recorded high sea-level stand, it almost certainly represents a Weichselian accumulation.

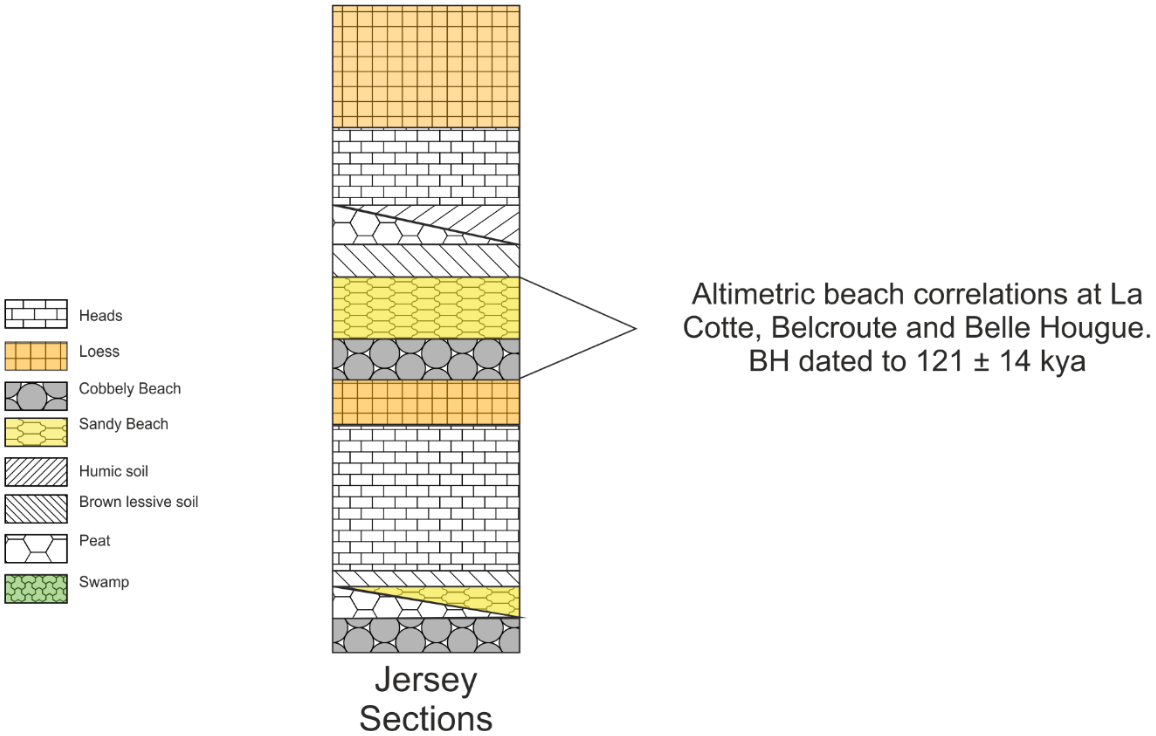

Figure 3.5: My simplified correlated section from chronostratigraphic sequences on Jersey at La Cotte, Belcroute and Belle Hougue.

3.2.4 Layers 6 to H; the "fossil cliff"

The following synthesis brings together aforementioned published data on the lower deposits at La Cotte, as well as personal observations from both fieldwork in Jersey and data analysis of lithic material from the site. These insights form the understanding of taphonomic and climatic interpretations presented throughout this thesis and are based on these personal observations.

As previously mentioned, the deposits of the "fossil cliff" were laid down roughly horizontally. Layer H sits upon the bedrock surface, in the exposed/excavated areas. Callow asserts on several occasions (Callow 1986e, j, 1993) that the deposits were only bottomed (to bedrock) in a small section of the site; there is a possibility that there is a deeper, older sequence of deposits within the fissure system.

Deposits discussed in depth here represent McBurney's depositional stages I-III (Figure 3.3 & 3.4):

Stage	Description
I.	Fluvially re-deposited loess and rock falls; represented in the very base of layer H, i.e. laying on bedrock. Seen as evidence for ponding in a warming environment
II.	Granitic Sandy Matrix; some rock falls but lower in granite blocks compared to stage I and above; represented by the layers H-C and seen as a temperate climate
III.	Loessic matrix; increasing occurrence of granite blocks from roof and sides; represented by layers B-6.1 and showing a clear deterioration of climate

Table 3.1 McBurney depositional Stages adapted from (Callow 1986j).

Knowing that these deposits pre-date the last interglacial (see above), therefore providing a terminus *ante-quem*, I will begin with the stratigraphically lowest layer, H. It is worth mentioning here that McBurney (Callow and Cornford 1986) suggested there was inadequate evidence to fully discuss the initial formation of the fissure system (his stage 0). As mentioned above (section 3.2.1; Figure 3.2), the deposits of the north fissure were not fully excavated, and only small areas of the bedrock were reached underneath layer H. The relationship between Stage 1 and the formation of the fissure can then only be hypothesised. The fissure could represent similar situations to other sea caves in the region, such as La Cotte à la Chèvre (Callow 1986b) or Port Pignot (Michel

1982). It seems most likely that while a single sea-erosion event is possible, the softer dolerite of the fissure eroded over multiple events to leave the situation seen today (pers. obs.).

3.2.4.1 Stage I

Stage I is only indirectly represented within the deposits of La Cotte, and represents a previous episode of cold climate and aeolian loess deposition. These deposits/phase are represented by material that has subsequently been reworked into the matrix of Layer H (see below). The rock fall at the base of Stage II, lying on bed rock, could equally be related to Stage I cold events. This is why layer H is noted in McBurney's text and figures as being both Stage I and Stage II (Figure 3.3 & Figure 3.4). Overall, further fieldwork would be needed to clarify this situation.

Layer H is a temperate deposit and the beginning of the temperate Stage II (Callow 1986j), with the initial stages represented by ponding of the loessic material of Stage I, derived from the immediate surroundings of the fissure (probably the headland, pers. obs.). McBurney saw this as evidence of a loessic deposition across the region that predated its final reworking within the fissure system (Callow 1986e: 64). This loessic material subsequently infilled the cavities between the boulders and rock-fall lying on bedrock, likely through a series of events, including the ponding episodes. Stage I then, represents a cold stage (i.e. aeolian loess formation within the landscape) predating Stage II.

3.2.4.2 Stage II

Stage II is represented by layers H-C and is a series of temperate deposits of interglacial or interstadial type. The archaeological material shows some evidence of re-working (Callow 1986e, j), but is believed to be largely in-situ, unlike layer B and there is no suggestion of material being introduced from other layers or elsewhere (pers. obs. see chapter 6). Material from layers H and G are relatively fresh (see chapter 6), with edge damage easily related to general trampling and rock fall normally associated with cave sites (McBrearty *et al.* 1998). Lithics from these layers show low levels of post-depositional effects (pers. obs.) and support the idea of an *in situ* deposit. Similarly to H, layer G and F also contained evidence of ponding, and the presence of small rolled pebbles (pers. obs.) suggests an element of fluvial activity within/on-top of deposits here.

The high degree of burnt, fractured bone and ash material (making up large portions of layers H-F's matrix) suggests these deposits are disturbed living floors (Callow 1986e; Lautridou *et al.* 1986a; Scott 1986b). A granitic sand matrix increases upwardly throughout Stage II, originating from the surrounding bedrock, and pointing to an increase in fluvial activity within or above the fissure system causing erosion. F is only significantly different from G due to the lower number of frost fractured blocks, which almost cease, and are observably smaller, suggesting less freeze-thaw action.

Layer F also preserved a pollen record, but of low frequencies (<25 spores/grains were used for some samples due to poor preservation) (McBurney and Callow 1971; Jones 1986). This record supports the general amelioration of conditions in the region, represented within this layer, with an increase in woodland species. However, a sample from the G-F boundary suggested evidence for open steppic conditions, i.e. cold stage. This sample from the G-F boundary was also from an area of ponding within the fissure, which could be affecting the local catchment (Callow 1986j; Jones 1986). Equally the constant influx of material from the headland above does not preclude the possibility this is a chronologically earlier sample of floral material (pers. obs.). This sample does not match the depositional situation overall and probably relates to the suggested erosional zone, in places, between the two layers (Callow 1986e, j).

Layer E preserved a more stable matrix, with some soil formation still present, and evidence for clay illuviation. Archaeological material within this layer is fresh (pers. obs.) and almost certainly represents an occupation floor in areas (Callow 1986d). Unfortunately no pollen data was recorded from this layer. However, it was suggested it represents a temperate soil horizon (van Vliet-Lanoë 1986). There is also a suggestion that sea-level is relatively high during this occupation timeframe, based on phosphate analysis (Giresse and Van Vliet-Lanoë 1986), which show high levels of guano, indicative of nesting sea birds. Callow (1986i) suggested the coastline would have reached within 3 km during Neanderthal occupation. Layer E is certainly a maximum warm stage within this sequence. The formation of a soil suggests this warm stage was stable enough (and long enough) for this formation to occur (van Vliet-Lanoë 1986). However, its preceding and subsequently related deposits suggest it was a warm stage within a progressively cooling climate which is also mirrored in deposits across the region (pers. obs.; see Figure 3.14).

Layer C and D see a return to the colluviated granitic sand matrix, with evidence for channelling on the surface. There is also a return of larger granite blocks suggesting increased freeze-thaw action. The beginning of D is a mixed deposit of material from layer E, in other words an erosional surface. These layers provided the published TL dates for the lower deposits at 238 ± 35 kya. This was an averaged date from six samples taken from within layers C and D (Huxtable 1986). However, there were a number of problems with the sampling and final dating of this material. Samples from layer E were rejected as the samples had been exposed to high levels of radioactivity from granite blocks within layer F. Generally, Huxtable (1986) raises the issue of radioactive dose rate for all the deposits due to granite bedrock and leaching into groundwater. Finally, some samples where rejected outright, as they had been exposed to light i.e. bleached, after excavation and were unsuitable for TL dating. Overall, the single date from layers C and D strengthens an MIS 7 build-up of deposits, but should be viewed with caution for any direct correlation.

Uranium-Series (U-Pb) dating was also attempted on various bone samples, but was unsuccessful (Szabo 1986). Bone preservation is mixed throughout Stage II. Layers H-E had large amounts of bone fragments, often burnt, and seen as anthropic (Lautridou *et al.* 1986a; Scott 1986b). No identification was possible on these samples, apart from a number of Rhinoceros sp. dental elements (Scott 1986b). However, evidence strongly suggests an anthropogenic association to the accumulation of burnt bone.

Overall, Stage II shows a full cycle from cool to temperate and back to cool. Pollen is poorly preserved and mixed, and suggested there was a cold phase within Stage II, which somewhat contrasts with the excavation and laboratory evidence (Callow 1986e; Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). However, the limited sample size and evidence for slumping of head deposits into the fissure throughout all periods probably preclude the pollen sample as evidence for a direct climatic indicator (pers. obs.). It does however give strength to open, non-forested environments prevailing throughout the build-up of deposits. Archaeologically the high amounts of burnt material and density of lithics, within ashy matrices, and high degrees of fragmented bone, point towards disturbed living floors from Neanderthal occupation of the fissure system (pers. obs.).

3.2.4.3 Stage III

Stage III presents the first significant aeolian loess deposition of the excavated sequence and is largely a loessic matrix throughout (Figure 3.4), with a high occurrence of granite blocks; indicative of freeze thaw action (Callow 1986e). Layer B is a discontinuous aeolian loess, with some foreign material (including lithics), presumed to derive from either (or both) layer C or the headland above (Callow 1986e; Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). The lithic material shows high degrees of edge damage and significant amounts of scratching; abrasion is however largely absent (see chapter 6) which could suggest rapid accumulation of deposits therefore representing a relatively short period of time. Damage then could represent trampling effects within the fissure, potentially including significant Neanderthal group activity. Overall, significant evidence of freeze thaw action, heavily damaged lithic material, and correlation to a cool period at the onset of MIS 6 (Figure 3.7; pers. obs., see chapter 4) based on surrounding depositional correlations (i.e. layer A and E), suggest there was no evidence for Neanderthal use of the fissure system within layer B (pers. obs.).

Layer A is a combination of granitic sands and re-worked loessic material, both originating from Layer B and from headland deposits brought down through alluvial action and colluviation (Callow 1986e). The archaeological material from throughout layer A suggests that the deposit is only slightly disturbed. Lithics show low levels of edge damage and next to no scratching, abrasion or patination (pers. obs.), suggesting limited movement of deposits, and therefore artefacts, over time. The large lithic collection supports a palimpsest of occupations and deposits with little observable separation (pers. obs.), also supported by Callow (1986j). Again the limited evidence for artefact damage could suggest a relatively rapid accumulation of deposits within a relatively well used site (i.e. returned to/occupied frequently). Pollen for the whole of this stage is too sparse for analysis. This could point to the reduction in vegetation within the region, but more likely represents poor preservation within a loessic matrix (McBurney and Callow 1971; Jones 1986).

Faunal preservation is largely restricted to two layers, A/3 and 5/6 (Scott 1986a, b); both layers are referred to as the "bone heaps". The first bone heap sits at the transition between A and 3. Layer 3 is a classic loess deposit from an aeolian source (Callow and Cornford 1986; Lautridou *et al.* 1986a). The base of this deposit also incorporates a mudflow and fluvial element in places. Above the bone heap, large granite blocks are often incorporated within the section. The loess and granite blocks almost certainly contributed to the relatively good preservation of the bone material here (Scott 1986a), effectively capping the bone accumulation. Layer 4 seems to represent a discontinuous, and often mixed junction, between layers 5 and 3 (Callow and Cornford 1986; Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). This probably represents a slumping of material from the headland into the fissure in one or more events (pers. obs.), also suggested by Bates and Shaw (pers. coms). Therefore, layer 4 potentially represents a short-term amelioration of climate, with an increase in either fluvial activity or melt water from permafrost causing slumping (pers. obs.). No archaeology is related to layer four.

Layer 5 is a return to colluvial deposition of loessic material, and seems similar to the layer A/3 boundary (Callow and Cornford 1986). Layer 5 is topped by the second bone heap. Scott (1986a) suggested this was truly embedded within layer 5 in places. Layer 6 represents cryoturbated loess split into 6.1 and 6.2, and a further deterioration in climate. 6.2 contained more head deposit from above the fissure; both contain large granite blocks indicative of major freeze-thaw action events. These deposits are at the top of the 'fossil cliff', which was eroded by the subsequent high sea-level stand of the Eemian (layer 7.1) and later capped by Weichselian heads (layers 7.2-11). Overall, this thesis does not discuss archaeology from above layer A (i.e. layers 3 and 5/6) and the related bone accumulations. However, their depositional situation is of interest for the following chorological discussion based on personal observations.

3.2.5 Current knowledge of the Chronology

The chronology of La Cotte, presented below, has been based on investigations by Burdo, McBurney and Callow (Burdo 1960; Callow and Cornford 1986), as well as later chrono-stratigraphic correlations across the region (Keen *et al.* 1981; Keen 1982, 1985; Lautridou *et al.* 1986b; Coope *et al.* 1987; Keen 1993; Keen 1995; Keen *et al.* 1996; Bates *et al.* 1997; Antoine *et al.* 1998; Bates *et al.* 2003; Coutard and Cliquet 2005; Coutard *et al.* 2006; Bates *et al.* 2007), and my own personal observations presented above. The formation of the fissure certainly predates MIS 6, following the geo-chronological correlations and dating of Huxtable (1986); but when exactly it formed is still uncertain. Callow suggested three possibilities for the broad date of the formation of Stage II (Callow 1986e):

1. An MIS 9 deposit - largely eroded
2. An early MIS 7 deposit, i.e. 7e (c. >230 kya)
3. A late MIS 7 deposit (i.e. 7c-a) with stage III as a MIS 6 depositional sequence

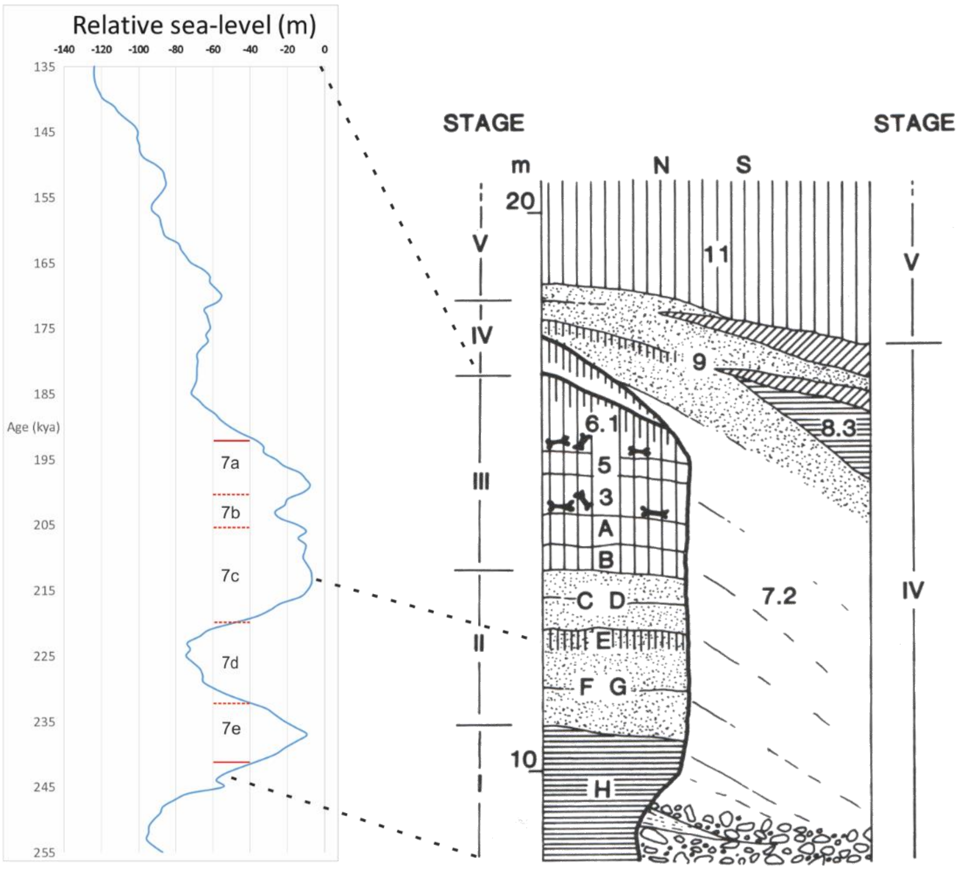

Figure 3.6: Callow (1986e) interpretation of chrono-stratigraphy. The right hand section is taken from Callow and Cornford (1986). MIS curve drawn from Spratt and Lisiecki (2016) data.

Figure 3.6 presents the Callow (1986e) interpretation of the chronological sequence, based on knowledge of climate and deposition within the region and published data at the time. Without further excavation to reveal the basal deposits and bedrock, the initial formation of the fissure system still remains unknown. It certainly predates the raised beach sequence of layer 7, which is assigned to MIS 5e (as above). Equally the deposits the initially fill the fissure system, being temperate in character, cannot correlate to the glacial conditions of MIS 6 c. 186kya. Therefore, we can point to a > MIS 6 erosional event (>186 kya). Callow chose to follow the second scenario, presented above, but with reservations over the correlation of layer F (Callow 1986e: 79).

I would suggest, without the benefit of further excavation, that the fissure system was a series of erosional events of the softer dolerite throughout at least MIS 7e-d. Potential build-up of earlier deposits cannot be ruled out, and the latter were either un-excavated or eroded by earlier eustatic high-stands or erosional events.

Here I suggest, based on observations and current archaeological and geological knowledge Callow's third model is *closest* to the depositional scenario at La Cotte. Figure 3.7 shows this interpretation, with adaptions based on more up-to-date knowledge. It is likely that the initial formation of excavated deposits, i.e. Stage II, relate to MIS 7c with Stage I related to a transitional period, MIS 7d/c. The figure below uses this as a base to begin to describe the depositional build up within the fissure and its related chronology.

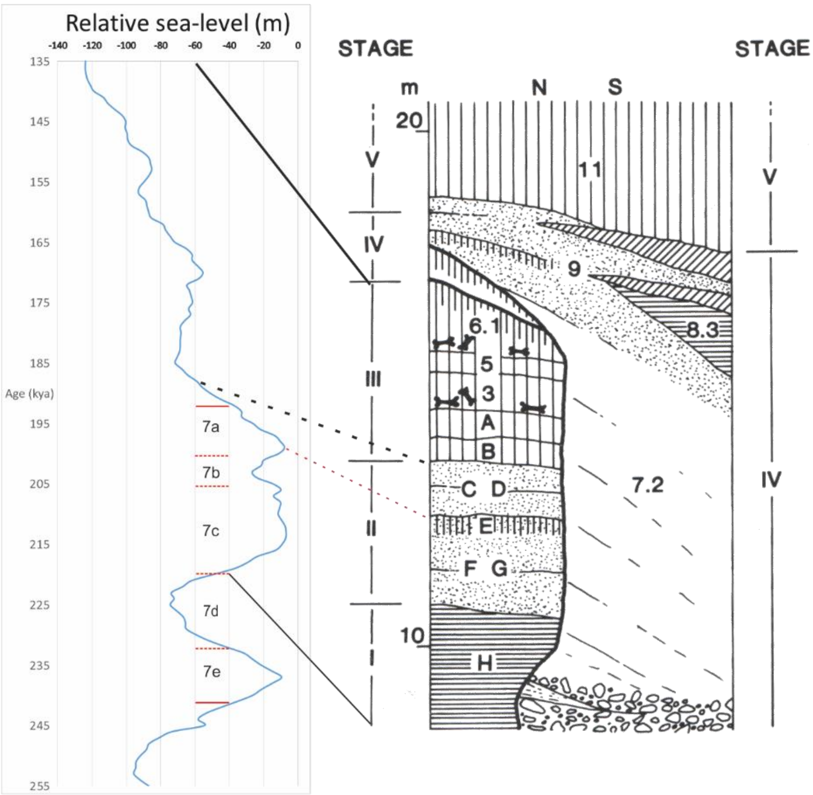

Figure 3.7: Chrono-stratigraphic interpretation of La Cotte sequence after full review of site and regional data presented here (pers. obs.). The right hand section is taken from Callow and Cornford (1986). MIS curve drawn from (Spratt and Lisiecki 2016) data.

This scenario allows the build-up of deposits within the temperate stages of MIS 7/6. Layers H-F, overall, show a general stabilization of conditions with the potential of some small deteriorations within the depositional period (e.g. G/F boundary). The G/F erosional event and deterioration, then, could represent the unstable conditions of MIS 7b. However, this kind of resolution is very tentative. More so, we can associate the cool conditions indicated by Stage I (i.e. loess deposition) to MIS 7d and the amelioration starting in Stage II (layer H) as the transition into MIS 7c.

Layer E in this situation represents the final amelioration of MIS 7a and is supported by the high phosphate levels at La Cotte *and* high sea-level recorded globally (Zazo 1999; Rohling *et al.* 2009; Rohling *et al.* 2014; Rowe *et al.* 2014). Elsewhere in the region, a number of locales do record archaeology at the 7/6 boundary, such as Les Gastines, Brittany (Monnier 1988a) which would be in a similar landscape scenario to the lower occupations at La Cotte i.e. on the edge of a flat open terrestiral landscape (see chapter 4). The cold stage deposits of Stage III, particularly the aeolian loess of layer B, represent ever-cooling conditions and falling sea-levels. The rich assemblage of layer A could then represent an amelioration or stable period within MIS 6. The cold stage megafauna (Scott 1986a) and pedology (Lautridou *et al.* 1986a; van Vliet-Lanoë 1986) support a periglacial occupation of the fissure. The layer 5 bone heap could represent a much later occupation within the MIS 5-6 transition. The industrial change (Callow 1986d: A. Shaw pers. comms.), and suggestion of amelioration of climate within layer 6 (Callow 1986e; Jones 1986; Lautridou *et al.* 1986a) could support this.

3.2.6 Conclusion: the La Cotte Sequence

On a basic level, two overall depositional signatures can be highlighted, a loessic deposition (including classic aeolian loess) and a granitic sand-derived matrix (originating from the fissure's bedrock and cliff top). These are included with infrequent but observable soil formations such as layer E. The deposits at La Cotte represent a complex sequence of changing depositional situations. The warmer stage can be correlated to the interglacial period of MIS 7c-a. This further suggests the deposits and occupations of layer A are within MIS 6. This provides a chrono-climatic comparative sequence for understanding and discussing palaeo-climate and landscape of the Channel Plain Region, which I present next.

3.3 Quaternary geology and Chrono-stratigraphy of the Channel Plain

The geological record of the Quaternary preserves a window into past climate and landscape evolution. Sediment sequences, such as La Cotte, can be correlated with other data (e.g. Deep Sea Cores; Pollen sequences; geophysical survey etc.) to both broadly age and understand environment and landscape change through time. Across the Channel Plain Region there are a number of preserved terrestrial and marine sediment sequences, which aid the understanding of environmental change and its implication across the region through the later Middle Pleistocene. Evidence for global sea-level and landscape change and their implications are further discussed, in-depth, in the next chapter where, bringing all this evidence together, a series of palaeogeographic models are produced.

In rare but important circumstances, we have archaeological and osteological material preserved within sediment systems and capture points. Therefore, their investigation can directly link to the greater understanding of habitats, as well as hominin behaviour. This is particularly evident at La Cotte, as well as locales such Les Vallées, Piégu and Nantois (Monnier 1976; Monnier 1980; Monnier 1986, 1988a; Loyer *et al.* 1995; Huet 2010; Monnier *et al.* 2011; Bahain *et al.* 2012), among others, outside of this region and period in question (Cliquet and Monnier 1993; Moncel *et al.* 2005; Scott 2006; Cliquet 2008c; Moncel *et al.* 2008; Cliquet and Lautridou 2009; Scott 2010; Scott *et al.* 2010; Scott 2011; Hérisson 2012; Hérisson *et al.* 2013; Hérisson *et al.* 2016a; Hérisson *et al.* 2016b; Locht *et al.* 2016). In the next three sections I will discuss sequences directly related to the understanding of chronology, environment and landscape of the Channel Plain Region.

3.3.1 Raised beaches

Raised beaches are the result of beach accumulations on a coastal platform and subsequent uplift. They record the succession of erosional episodes at high sea-level stands, mostly related to global climatic conditions and ice build-up at the poles. Each erosional episode produces a wave-cut platform, providing the surface for beach aggradation on the coastal landscape. Sequences such as this provide windows into past landscape change (Keen 1982, 1993; Keen 1995; Bates *et al.* 2000; van Vliet-Lanoë *et al.* 2000; Ashton *et al.* 2005; Coutard and Cliquet 2005; Coutard *et al.* 2006; Bates *et al.* 2010; Laforge 2012). Some of these deposits often preserve a number of high sea-level stands, sandwiching deposits from colder (often glacial) conditions, i.e. they can record broad scale environmental change over many thousands of years in one sequence. A number of relative and actual dating techniques can be applied to these deposits to gain an age of aggradation (Laurent *et al.* 1994; Bates *et al.* 2010; Antoine *et al.* 2011; Bahain *et al.* 2012; Laforge 2012).

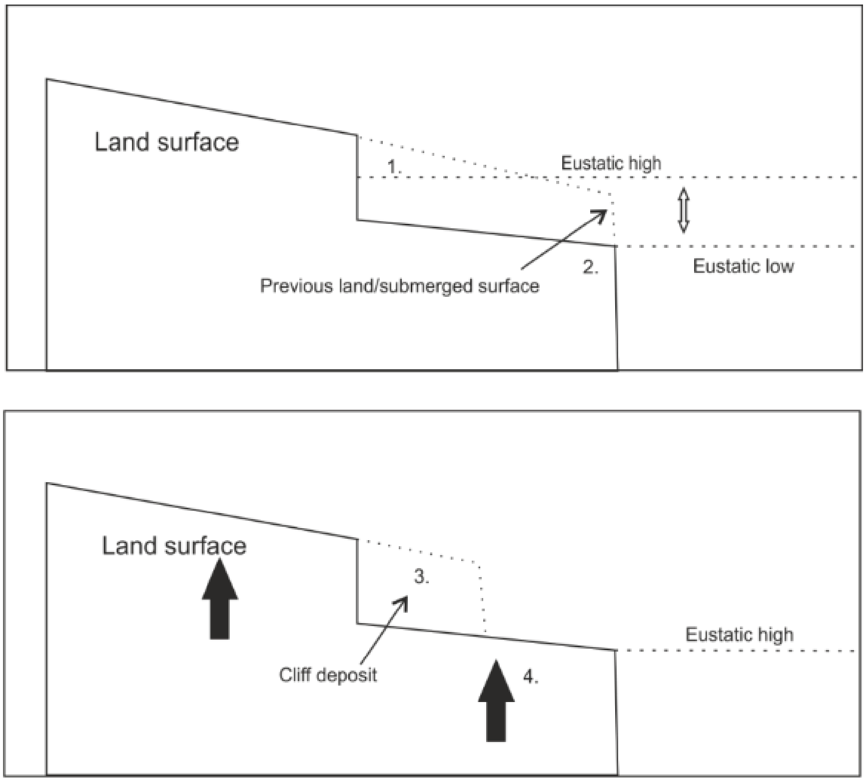

Figure 3.8. Simplified model for coastal erosion, beach accumulation and subsequent uplift cycle. Erosion (1) due to eustatic high created a new surface (2) for beach accumulation as sea-levels recede. (3) The accumulation of cliff deposits against the old land surface can be of beach deposits and cold stage sediments such as heads or Aeolian loess. (4) These are subsequently preserved in a number of cases due to land surface uplift.

3.3.1.1 Pleneuf-Val-Andre, Brittany

Three geological sequences have been investigated around the small town of Plenéuf-Val-André, Brittany (Figure 3.9). I have here chosen to consolidate these sequences (Nantois, Piégu and Les Vallées) into one description, based on published works (Monnier 1976; Monnier 1979, 1980; Monnier *et al.* 1985; Monnier 1986; Monnier *et al.* 2011; Bahain *et al.* 2012; Laforge 2012) and personal observations. This consolidation is based largely on recent dating and sedimentological work conducted on the sequences, specifically described in (Bahain *et al.* 2012). The sequences and area around Plenéuf-Val-André also preserves some important archaeological assemblages (Monnier 1976; Monnier 1980; Monnier *et al.* 1985; Monnier 1986; Monnier 1988b; Bahain *et al.* 2012; Laforge 2012) discussed in the following chapters. Briefly, the three assemblages are largely collected from cliff sections and display a range of technological attributes, including PCT, multi-platform core reduction and some discoid core working, as well as significant use of local non-flint material. Importantly at Nantois (Monnier 1986), ahead of the cliff line, under the modern beach, an in situ bovid butchery locale was excavated with an *ad-hoc* multi-platform core assemblage associated with Neanderthal butchery on-site (see section 2.2.3.1.1)

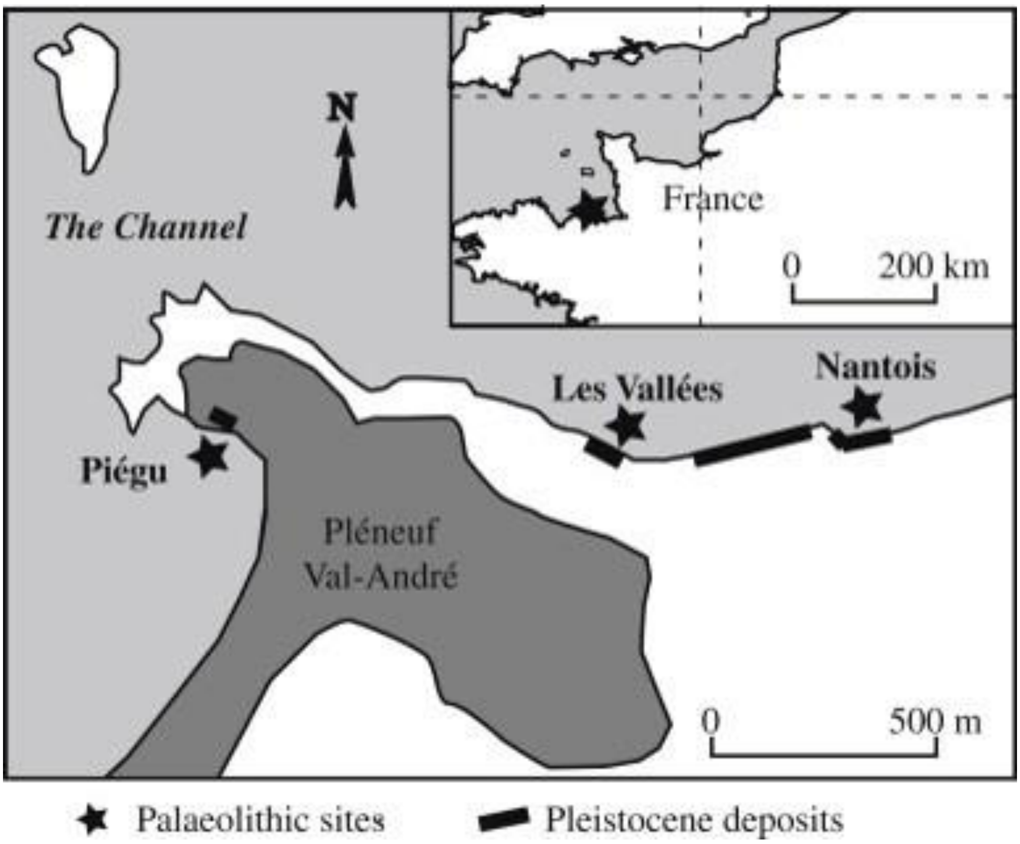

Figure 3.9 Section and site locations for the Pleneuf Val-Andre raised beach sequences, Brittany. Image taken from Bahain et al. (2012).

The complex sequence of slope deposits of the Nantois cliff section abuts and covers the bedrock cliff (Monnier 1980; Monnier 1986; Monnier *et al.* 2011; Bahain *et al.* 2012; Laforge 2012). A sequence of sediments is deposited, with a mixture of sands, loess and loam representative of depositional changes through the later Middle and Late Pleistocene and capped with Holocene soils. TL dating of loess (Loyer *et al.* 1995) within the sequence gave an MIS 6 date of deposits sitting stratigraphically above interglacial temperate sands. Further, these sands (layer 35) were dated at 166 ± 8 (Bahain *et al.* 2012; Laforge 2012) and correlated to the end of MIS 7 and beginning of MIS 6 (i.e. MIS 6e). It is these sands which are correlated with the archaeology bearing deposits, which sat 20 metres in front of the cliff line, under the modern beach (Monnier 1986; Monnier *et al.* 2011). This connection was made based on sediment composition and altimetric correlation of the separate deposits.

An MIS 7/6 date for the lowest deposits is supported by a combination of systematic sedimentological analysis comparisons (Monnier *et al.* 2011) and the recent dating (Bahain *et al.*

2012), connecting the Nantois deposits to ESR and U-Series/ESR results conducted at Les Vallées and Piégu. A number of bone and teeth samples where dated producing averaged ages of 193±6 kya (Layer G at Piégu) and 164±13 kya (Layer 21 at Les Vallées); both coming from deteriorating climate deposits. At Les Vallées, a similar situation to Nantois was discovered with an archaeological layer, under the modern beach, excavated with numerous butchered faunal elements and associated lithics. These two sites where seen as chronologically associated (Huet 2010; Monnier *et al.* 2011; Bahain *et al.* 2012; Laforge 2012; pers. obs.). Piégu is earlier, and associated with interglacial conditions and is therefore within MIS 7 (likely MIS 7a; pers. obs.)

We can chronologically connect the colder deposits of Nantois and Les Vallées with layer A at La Cotte, i.e. the early deterioration of climate into MIS 6 glacial conditions (see Figure 3.14). Piégu can be, more broadly, correlated chrono-stratigraphically with deposits of layers E-C at La Cotte i.e. the later, *interglacial,* conditions of MIS 7 (pers. obs.).

3.3.1.2 Ecalgrain

Ecalgrain bay lies on the northern west tip of the Cotentin Peninsula. Two cycles of head deposit are represented in the cliff line with layers of interstratified finer sediments, e.g. sands (Figure 3.10); a palaeosol sits between the lower and upper head depositsv(Coope *et al.* 1987; van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003; Coutard *et al.* 2006). van Vliet-Lanoë *et al.* (2000) suggested that the palaeosol represented a MIS 5e warm stage deposit altimetrically similar to La Cotte, layer 7.1 (i.e. MIS 5e). The dates for the lower beach deposits have been heavily debated (van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003; Coutard *et al.* 2006). van Vliet-Lanöe *et al.'s* (2000) initial interpretation of an MIS 9 age, based on pedostratigraphical correlation with other regional sequences and their sedimentary build up, has limited support based on recent radiometric dating. New IRSL dating, 190 ± 19 kya for the lower beach deposit (Cordier 2010), suggests a terminal MIS 7 age. This follows stratigraphic and altimetric correlations elsewhere, and supports other research (Bates *et al.* 2003; Coutard and Cliquet 2005).

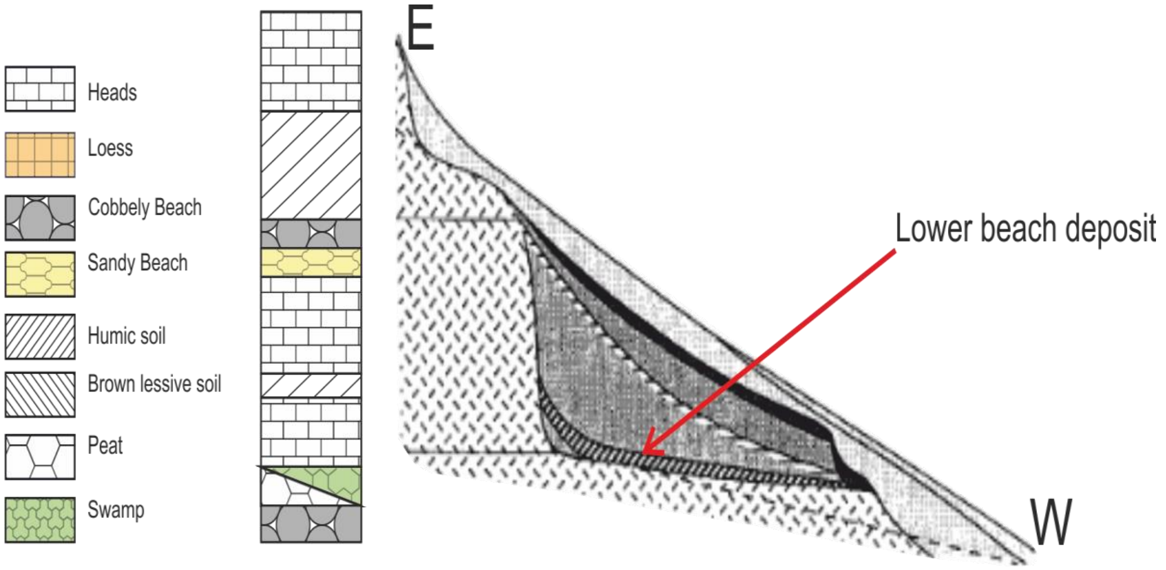

Figure 3.10: Sections from Ecalgrain adapted from van Vliet-Lanoë et al. (2000).

Therefore it is suggested that the upper head deposit represents the Weichselian complex, and the lower head is presumed to represent the MIS 6 cold stage. Pollen and insect analysis from the peat deposits above the raised beach suggest a salt marsh environment (Coope *et al.* 1987), and has led to the suggestion of a eustatic high during a cooling climate (van Vliet-Lanoë *et al.* 2000; Bates *et al.* 2003). This is also seen geochronologically for other MIS 7 – 6 sequences across the region, such as La Cotte layer F/E (Callow 1986e; Jones 1986; Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). Therefore not only does Ecalgrain show a correlation of MIS 5e beaches in the region, underlining the chrono-stratigraphy for La Cotte discussed above, but can also be connected to the high sea-level, and warm climatic conditions within layers F and E at La Cotte (pers. obs.). This has a direct relationship to regional landscape and habitats discussed within chapter 4, namely a high sea-level with significant areas of coastal marsh and peat accumulation.

3.3.1.3 Val de Saire, Normandy

The Val de Saire peninsula, Normandy, preserves a series of deposits which sit upon a sequence of wave-cut platforms stretching inland up to 7km (Coutard *et al.* 2005). These platforms are the result of geological uplift, sea-level fluctuations and the nature of the Channel's tides. In total there are four platforms positioned between 38 m above mean sea-level (a.m.s.l.) and today's coastline, and each represents at least one high sea-level episode. Anse du Brick, dated to 121 ±12 kya (Coutard *et al.* 2006), has shown the deposits of Platform I formed sometime in MIS 5, likely after the eustatic high of MIS 5e (Coutard and Cliquet 2005; Coutard *et al.* 2006). This also follows Keen's earlier assumption, based on altimetric and sedimentary correlation with Belle Hougue on

Jersey (Keen *et al.* 1981; Keen 1993), and fits with the interpretation of La Cotte, specifically layer 7.1.

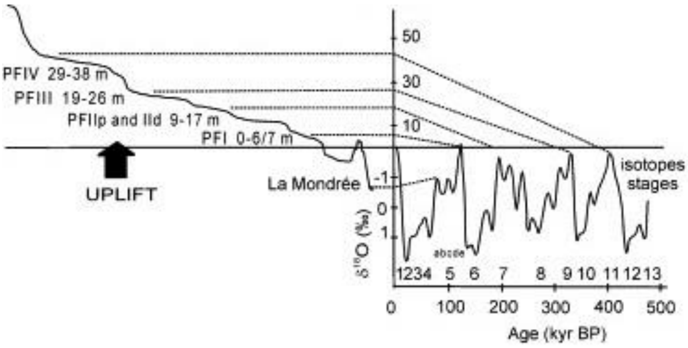

Figure 3.11: Chronostratigraphy of the Val de Saire raised beach sequences, taken from Coutard et al. (2006).

Platform II of the sequence is of particular interest. It seemingly represents the record of two sea-level stands within the same interglacial based on altimetric separation of wave-cut platforms (Coutard and Cliquet 2005; Coutard *et al.* 2006). Being higher than platform I the most likely age correlation for this platform would be MIS 7 (Coutard *et al.* 2006). Dates from archaeological evidence within the sediments of the overlying Cap-Levi sedimentary formation suggest a MIS 7 age at La Roche-Gélétan, Hague (TL- 207±16/214±17) lying at 14 a.m.s.l. (Cliquet *et al.* 2003). Chronostratigraphic and sedimentary correlations suggest the Cap-Levi formation, on-top of Platform II, is equivalent to the Brighton-Norton deposits on the Sussex coast (Bates *et al.* 2010), and similar formations at Portland and Torbay, UK (Davies and Keen 1985; Keen 1985; Bates *et al.* 2003; Bates *et al.* 2010). With the dating from Roche Gélétan, and the correlation with other platforms across the region, a Saalian age for platform II and its sedimentary formations is accepted. Therefore the two cuttings within platform II, lying between 9-17 m, represent the two warm peaks within MIS 7 (7e and 7c-a; see Figure 3.11). Importantly, the dating and stratigraphic position on the lower platform at Roche Gélétan allow a correlation to La Cotte (i.e. MIS 7c-a; pers. obs.), and the high eustatic level (i.e. the formation period of the platform) therefore relates to the occupation within and around layer E as well as high sea-level indicated at Ecalgrain (see above).

3.3.2 River terraces

River terrace formation is the result of both geological processes and climatic fluctuations (Antoine 1994; Bridgland 1994; Westaway *et al.* 2006; Antoine *et al.* 2007; Busschers *et al.* 2008; Bridgland 2010; Antoine *et al.* 2015; Vandenberghe 2015). Early research expressed the link between terrace formation i.e. fluvial erosion/down cutting, and the 100 ky Milankovitch cycle (i.e. Bridgland 1994); suggesting that each terrace represented deposits of one specific glacial-interglacial (cold-temperate) cycle. While this fitted a number of terrace scenarios, especially in the UK, e.g. the Thames Valley, a more complex set of processes have been shown to occur within other river systems across North Western Europe (Westaway *et al.* 2006; Antoine *et al.* 2007; Busschers *et al.* 2008; Antoine *et al.* 2015; Vandenberghe 2015). Vandenberghe (2015) proposes there are three main “scenarios” for terrace formation, see Figure 3.12, the first of which is analogous to the situation common in the Thames Valley (Bridgland 2010) with the large scale removal of warm stage deposits due to fluvial incision. In this scenario, for example, warm stage deposits (in red, see Key in Figure 3.12) abut and cover a series of cold and cold/warm transition deposits (i.e. an initial glacial to periglacial cycle). These warmer deposits are then removed by the subsequent next stage of warm/cold transition erosion phase and replaced by new deposits (e.g. gravels and sands). Scenario 2 in contrast details the preservation of a portions of these previous warm stage deposits below the fluvial incision channel, with scenario 3 showing a model for large scale preservation of deposits with only minimal erosion/incision.

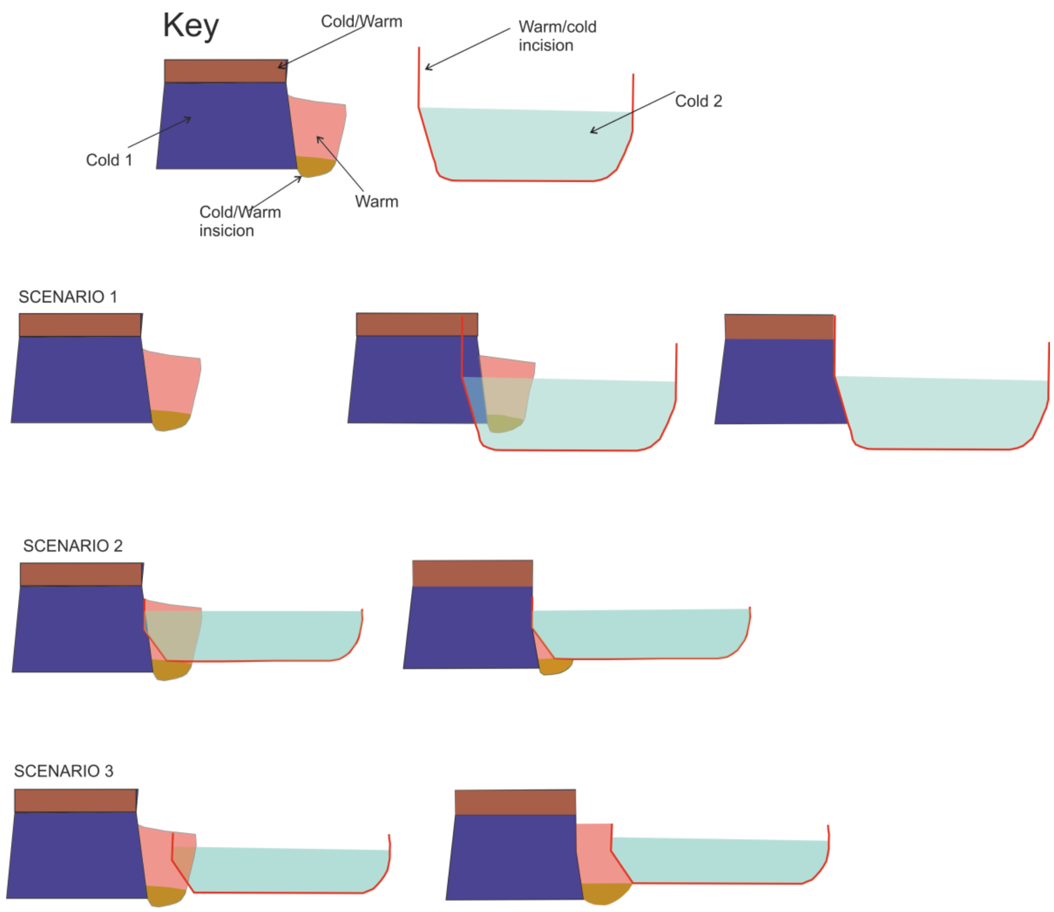

Figure 3.12 River terrace scenarios of Vandenberghe (2015), redrawn based on Figure 2 (ibid: pg 7).

All these scenarios can subsequently be preserved through uplift of the landmass to raise this plain above subsequent erosional events. It is suggested (Antoine *et al.* 2011; Antoine *et al.* 2015) these conditions occur most dramatically at the transitions of the major glaciation periods, when terrain is more susceptible to erosion. Within Northern France terrace sequences of major interest are the Somme and the Seine, as well as some knowledge of the now fully submerged Channel River system.

3.3.2.1 The Somme and Seine Valleys

The Seine and Somme river valleys preserve relevant quaternary deposits worthy of discussion, with direct correlations to the raised beaches of the regional coastline discussed above (see Figure 3.14). The Seine preserves seven stages of incision and subsequent aggradation (Antoine *et al.* 2000; Antoine *et al.* 2007). The deposits of most interest here are those of the lower Seine valley which have been affected by sea-level changes throughout the quaternary (Balescu *et al.* 1997). At Tourville-le-Rivière a series of deposits preserved on the incised bedrock terrace at 17-18m above the Holocene valley floor preserve a deep sequence of deposition units from at least MIS 9 onwards (Antoine *et al.* 1998; Antoine *et al.* 2000; Antoine *et al.* 2007; Faivre *et al.* 2014). The sequence is represented by two interglacial estuarine silt beds, sandwiched by three stacked, coarse grained alluvial deposits (Figure 3.13). Initial dating (Balescu *et al.* 1997) suggested the lower sequences of temperate deposits (see Figure 3.13) was of MIS 9 age, with the upper silt beds deposited within MIS 7 (c. 200 kya). This has been supported by more recent U-Series dating (Faivre *et al.* 2014) that suggested D2-D3, and subsequent periglacial units, built-up somewhere within the MIS 7-6 transition (c. 183-226 kya). Malacological analysis and faunal investigation has shown these deposits built-up in an open landscape within a cooling, but humid, environment. Importantly these deposits (D2 and D3) hold both archaeological evidence (core and flake, with some elongated Levallois production), and Neanderthal remains (Faivre *et al.* 2014). This sequence, specifically layer D1, D2 and D3, is analogues to the La Cotte Saalian layers E – A (see Table 3.2)

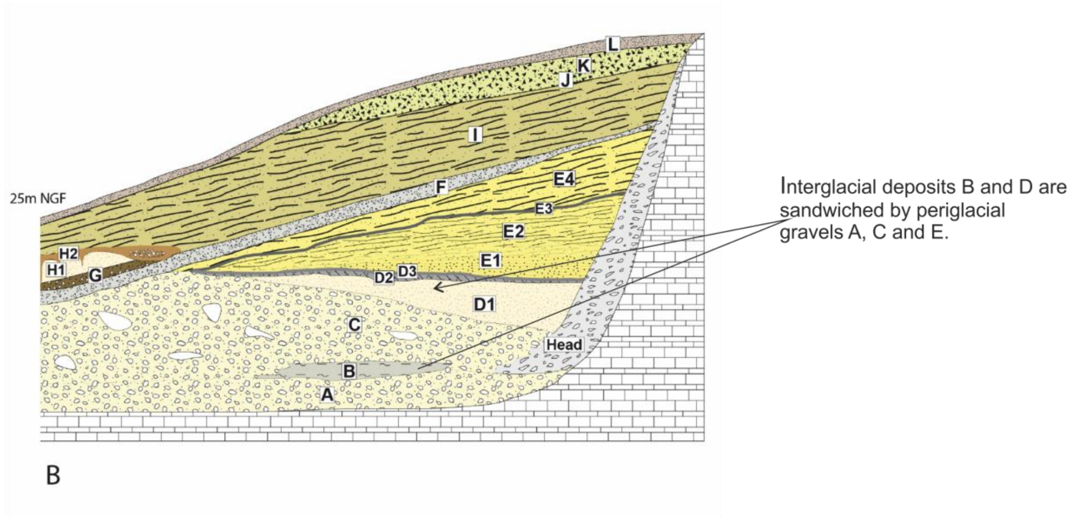

Figure 3.13: Stratigraphic section from Tourville-le-Rivière taken from Faivre et al. (2014).

Within the Somme the sequence is more complex (Antoine *et al.* 2000; Antoine *et al.* 2007; Bahain *et al.* 2007b; Hérisson *et al.* 2016b), with ten terraces preserved. Largely these terraces do follow the interglacial-glacial cycles, described above (i.e. Bridgland 1994; Vandenberghe 2015), but Formation II and III are somewhat different (Tuffreau and Antoine 1995; Antoine *et al.* 2007). A series of ESR dates from the formations has provided a confident chronology, and places Formation II and III within MIS 7 (Bahain *et al.* 2007a). These sediments also show evidence of a later (i.e. MIS 7c-a), open interglacial landscape compared to other interglacial environmental conditions (i.e. MIS 5e). While this sequence is more complex then within the Seine, it does support the complex situation of climatic and environmental succession during the MIS 7 interglacial, specifically across Northern France (pers. obs.). For example the open interglacial conditions signified within the chronologically earlier Formation III correlate with those discussed at Tourville (see Table 3.2) as well other evidence across the region discussed in previous chapters.

Tourville Deposit	Climate	Corresponding La Cotte Layer
D1	Forested landscape, interglacial character	Layer F/E
D2	Open environments, cooler but humid	Layer D/C
D3	Cold and humid	End of Layer C

Table 3.2: Summarized personal correlation between Tourville-le-Rivière and La Cotte de St Brelade. Deposits and the La Cotte sequence is shown in Figure 3.7 along with chronostratigraphy.

3.3.3 Sea caves and fissure systems

Sea caves and fissure systems are much rarer than the previous two sediment occurrences discussed. This is probably due to their occurrence in harder geology, only present in the western area of this region (Michel 1982; Callow and Cornford 1986; Renouf and James 2011; Monnier *et al.* 2016), and their formation at or close to eustatic high stands (i.e. sea-erosion of softer veins of material). Sediment build up within these natural traps often include fine-grained deposits, and preserve fragile material (such as pollen, bone, charcoal etc.). Due to this they provide key sequences for changes over time in climate, environment, and sea-level. Further, in some circumstances, changes in hominid behaviour (i.e. technology, occupation, subsistence) can also be seen within these sequences in the same way as inland cave systems (Barkai *et al.* 2003; Karkanas *et al.* 2007; Sandgathe *et al.* 2011; Jelinek 2013; Naito *et al.* 2016). From an archaeological perspective they often provide the best chance of any relatively in situ evidence for occupation, such as layer E at La Cotte (pers. obs.). The Channel Plain Region has preserved a number of other similar situations along the coast line (e.g. Menez-Dregan, La Cotte à la Chèvre, Port Pignot) often related to archaeology (Michel 1982; Callow 1986b; Ravon *et al.* 2016a; Ravon *et al.* 2016b).

3.4 Conclusion

As an overview, the associated evidence can be split into two separate depositional regimes, broadly split east and west along the modern English Channel. The eastern section preserves very few raised beach deposits but, particularly in Northern France, deep terrace sequences preserve evidence of past climatic pulses and conditions, e.g. the Somme. The western section does however have a multitude of raised beach deposits, often in long sequences and relatively well dated e.g. the Plenéuf-Val-André sites. Limited numbers of terrace sequences occur to the west with the Solent in the UK being one exception. It is these western areas where caves and fissure systems occur within the igneous bedrock (often granite); to the east chalk dominates. The western section provides arguably the most interesting sequence of quaternary deposits for the understanding of quaternary climate and landscape of the Channel Plain Region; especially for the EMP.

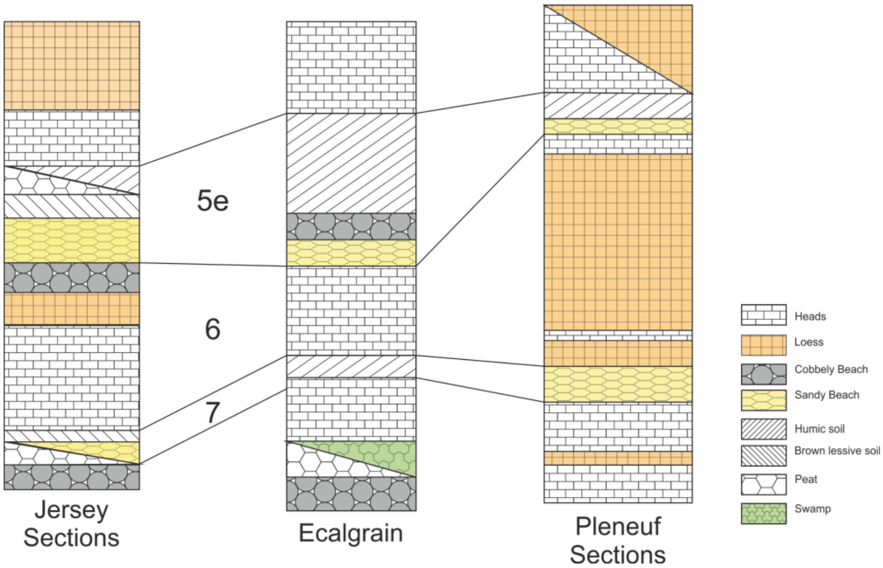

Figure 3.14: Raised beaches of the Channel Plain Region based on personal correlations, described in-text, connected, chrono-stratigraphically, via marine isotope stages. The *Jersey* and *Pleneuf* sections represent broad correlations between connected stratigraphical examples, fully presented above. Ecalgrain and Jersey re-drawn from van Vliet-Lanoë *et al.* (2000). Pleneuf Sections re-drawn from Bahain *et al.* (2012).

Overall, the chronological correlation of the stratigraphic sequences described is presented in Figure 3.14. We can see that, while MIS 7 itself is influential in the record, the transition between this and MIS 6 is well represented (i.e. La Cotte, Nantois, Piégu, and Les Vallées). The climatic scenario for this period is a transition from interglacial conditions (i.e. MIS7c-a) into periglacial conditions, progressively cooling, and development of more cool steppic scenario (

Table 3.3). This is important for the discussions of the archaeological record and landscape change, within the next chapter, and my presentation of lithic material. Specifically for La Cotte, comparable evidence from Ecalgrain and the Val de Saire suggests a high sea-level event towards the end of MIS 7, which matches evidence from layer E and supports Callow (1986h), as well as other global research (Zazo 1999; Rohling *et al.* 2009; Rohling *et al.* 2014; Rowe *et al.* 2014). Further afield there is key evidence for a dry-open interglacial stage within MIS 7 c –a, as discussed by Schreve (1997; 2001; 2002), and supported elsewhere within this region (Auguste 1995; Auguste 2008; Huet 2010).

MIS sub-stage	**Correlations**	**Environment**	**Age**	**La Cotte correlation**
7c – a	Jersey sections (Peats, forest soils and beach deposits)	Dry, open with intermittent eustatic highs	c.220-186 kya	H-C
	Ecalgrain (Humic soils)			

	Pleneuf sections (Beach deposits)			
6e-a	Jersey sections (Heads and loess)	Cooling and cold, dry with intermittent amelioration. Open steppe.	c.186 - 127 kya	B-6.2
	Ecalgrain (Heads)			
	Pleneuf (Deep loess and heads)			
5e	Jersey sections (Sandy beach deposits)	Warm, forested. Humid with early eustatic high.	< 127 kya	7.1
	Ecalgrain (Peat and sandy beach deposits)			
	Pleneuf (Sandy beach and peat deposits)			
	Portland (Swamp and peat deposits)			

Table 3.3: Correlation table for chronostratigraphic sections discussed in chapter 3.

These records can bring out a better understanding of landscape changes within this complex region. The data within them can add to our understanding of landscape change and hominin behaviour. This all ties in to set research objectives, and my overall research question. The next chapter will take these key sequences, along with more robust geophysical data, and model the changing landscape of the Channel Plain through the end of MIS 7 and beginning of MIS 6.

Chapter 4: Palaeo-geographic modelling

Previous chapters have presented a review of the current archaeological knowledge of Neanderthal activity and behaviour from the Channel Plain Region, and its broad-scale landscape evolution, specifically related to the occupations at La Cotte and the Brittany coast. This chapter presents a set of palaeo-geographical models to assess landscape changes, resource access, and environments of the region. This modelling will allow a heuristic study of relative sea-level situations and landscape changes through the period and region in question; i.e. MIS 7-6 c. 220 – 160 kya, something which has never been attempted on this scale before. While it is still impossible to ascertain the extent of Neanderthal occupation across what is now a submerged landscape, using palaeo-geographic reconstructions as a heuristic tool we can begin to highlight the *potential* for specific landscapes (flat plain; upland, coastline), with connections to habitats (e.g. salt marsh; open plains), and resource patterns (e.g. lithic raw material sources from fluvial gravels; beach accumulations; fresh outcrops). This chapter will *aid* investigation of the terrestrial land surface accessible during the latter part of MIS 7 and beginnings of MIS 6.

In previous chapter sections I have highlighted the current knowledge of broad landscape changes in the region (section 3.3), and Neanderthal behaviour associated to certain landscapes (section 2.3), both within this region and further afield. From this, we can highlight four key issues that need to be developed to better understanding Neanderthal lithic and landscape behaviour. They are:

1. Potential habitats and non-lithic resources across the area
2. Raw material availability within the region
3. The potential changes in the access to these resources over time, due to varying geographic processes (e.g. sea-level change, accumulation and erosion of deposits, atmospheric climate change)
4. The relationship between these resources and currently known archaeological accumulations e.g. La Cotte de St Brelade, Pleneuf-Val-Andre sites and the St. Malo area.

Table 4.1: Key issues, highlighted and developed-on within the text, and used for investigation of Neanderthal lithic and landscape behaviour here and in future chapters.

To address these issues a programme of palaeo-geographic modelling was undertaken. For reasons discussed below, it is readily apparent that any such models will carry a number of inherent caveats. However, by using them as a heuristic framework we can highlight potential, behaviourally significant, signatures as well as elucidating current areas where our knowledge is lacking. By examining areas of research previously not investigated, for this timeframe and across this region, these models will develop current knowledge of Neanderthal behaviour, as well as illuminate areas for future research.

4.1 Palaeo-geography and landscape modelling of the Channel Region

A number of in-depth critiques and reviews of palaeogeography and its research history and application in archaeology have been published (e.g. Gibbard 2007; Lambeck *et al.* 2010; Bradley *et al.* 2011; White and Pettitt 2011: 213; Cohen *et al.* 2012; Sturt *et al.* 2013; Cohen *et al.* 2014; Gibbard and Cohen 2015). Briefly, we can track the discipline back to the nineteenth century and William Boyd Dawkins' identification of previous inhabitable land surfaces now submerged by the sea (Dawkins 1880: pg. 248). Continued work throughout the 20th century (Clark and Godwin 1957; Jacobi 1976; Coles 1998; Coles 2000) highlighted both the potential and the restraints on discussing submerged landscapes. In archaeological contexts this led to changing thoughts and perspectives on the shallow sea areas of North Western Europe, including the Channel Plain Region (Sturt 2006; Gaffney *et al.* 2007; Pedoja *et al.* 2011; Sturt *et al.* 2013; Cohen *et al.* 2014; Gibbard and Cohen 2015; Conneller *et al.* 2016; van der Plicht *et al.* 2016). This area of palaeo-geography has developed alongside computer technology, specifically GIS, allowing more stringent testing of data and more applicable applications to archaeological research (e.g. Shennan *et al.* 2006; Bradley *et al.* 2011; Sturt *et al.* 2013).

The main concern for these regions, including the Channel Plain Region defined in chapter 2, is an accurate understanding of relative sea-level (RSL) i.e. the understanding of sea-level in relation to ocean volume and earth surface changes at a specific time in the past. Lambeck *et al.* (2010) highlight five key problems to consider when modelling relative sea-level:

1. Ocean volume changes
2. Changing load on land surfaces (also related to the uplift discussed in chapters 2 and 3)
3. Gravitational changes
4. Related changes in ocean basin shape and size
5. Subsequent changes in the distribution of water across the land surface

It is apparent that the effects of these issues can be substantial and hard to model (Bates *et al.* 2003; Shennan *et al.* 2006; Bates *et al.* 2007; Gibbard 2007; Laforge 2012; Sturt *et al.* 2013; Gibbard and Cohen 2015), especially when considering MIS 7 NW Europe. The use of Glacial Isostatic Adjustment (GIA) models (e.g. Shennan *et al.* 2006; Bradley *et al.* 2011), for post LGM, has simulated these points to produce more accurate representations of relative sea-level from

≈21k to present day (Sturt *et al.* 2013). GIA data such as Bradley *et al.* (2011) uses an ice volume model for the British and Irish Ice Sheet (BIIS), an earth surface model and sea-level index points. The data then represents the difference between modern land surface elevation and the elevation of a given time slice in the past, and is used to offset modern elevation data points accordingly. This offset value is related to glacial mass causing lowering of the land surface below it and subsequent uplift and deformation elsewhere on the same crust, in this case to the south (i.e. Southern Britain and the Channel Region).

Global GIA models have been discussed for MIS 11 (e.g. Roberts *et al.* 2012) and MIS 5e (e.g. Pedoja *et al.* 2011). Similar research for MIS 7 however has not been published. After reviewing sea-level evidence based on geographically relevant raised beaches (section 3.3.1) or global proxies, the discontinuous and often uncertain nature of the record for this time period (i.e. c.220 – 160 kya) would preclude the use of a GIA analogue from the LGM – Holocene data (i.e. Bradley *et al.* 2011). In addition to this, Peltier (2004) suggests isostatic influence on the earth's crust, is weak or non-existent after a few thousand years of interglacial conditions i.e. once ice sheet reduction has occurred and crustal rebound has "settled". For this reason, I do not apply a GIA analogue to my final output models (presented below) that present scenarios within the full interglacial conditions of MIS 7 and the beginnings of MIS 6. Instead, current knowledge of land surface, based on bathymetric data of seabed topography, is used directly. It must however be remembered that towards the latter period of occupations discussed here (i.e. into MIS 6, see Figure 3.7) ice sheets are likely to develop to the north and could have caused isostatic uplift across the region in question and could suggest an increase in terrestrial land surface at this time. Overall it can be suggested that a significant increase in ice sheet development across Northern Europe would actually coincide with a general Neanderthal abandonment of more northerly latitudes, including the Channel Plain.

These models therefore do not aim to discuss uplift based on isostatic influence, however uplift related to the many tectonic influences within the region can be assessed. Simplified, uplift in the area of Brittany and the Channel Islands is the cause of many tectonic faults associated with the Armorican Massif (Lefort 2011; Laforge 2012; Lefort *et al.* 2016), as well as being influenced by a large depression feature associated with the initial (and ongoing) formation of the Alps (Lefort and Agarwal 2002; Lefort 2011). These influences lead to a general trend of uplift in the east and north and stability in the south and west (M. Bates, pers. comm.). Specifically, this relates to the apparent lack of significant uplift in the area of Pleneuf-val-Andre (Lefort 2011), sitting within the deformation. This can be directly observed when reviewing the sites of Nantois and Les Vallees which site below or at modern sea-level despite > 200ky of regional uplift visible at sites such as Menez-Dragan and Rozel (pers. obs; discussed in depth in chapter 8). When taken into account regionally, *overall* uplift, either related to the sediment loading of successive outwash events of the Channel River and its tributaries (Bates *et al.* 2003), *or* the underlying movements related to the Alps' formation and the collision of African and European continental shelves (Lefort and Agarwal 2002; Lefort *et al.* 2011), correlates to around 7mm – 6mm per 1 ky, or c. 12 – 14 m over the last 200 kya, with a general acceptance of closer to 12m (Coutard *et al.* 2005; Coutard *et al.* 2006; Lefort 2011; Renouf and James 2011).

This figure is also key in understanding the preservation of MIS 7 deposits on the modern foreshore, specifically in Jersey, Pleneuf-Val-Andre and the St Malo area i.e. Grainfollet and Les Gastines. Importantly, this standard, regional uplift figure allows for the use of direct correlations using modern bathymetry within the scope of my heuristic models. I have applied a 12m reduction to my models to explore minimal uplift in the region; however the full range of uplift is discussed in the final conclusions.

Further aggradation of deposits in areas of modern shallow sea depth is a key issue; specifically those associated with the lower reaches of rivers (i.e. estuarine areas). One prominent example of this is in the North Sea and Fenland area of Eastern Britain i.e. the Wash (Sturt 2006). Sturt discussed how the build-up of sediment outwash from rivers running into the Wash (e.g. Rivers Witham, Welland, Nene and Ouse) infills and raises land-surface altitude, or a.s.m.l., extending the river delta area i.e. progradation, and therefore effecting palaeo-modelling of prehistoric land-surfaces. Aggradation, however, is hard to predict for *any* prehistoric land-surface, especially those with limited suitable analogy such as the MIS 7 landscape of the Channel Plain. In the same way, erosion of deposits due to marine transgression or fluvial activity is also a key connected factor. For example the large erosional channel of the Channel River, seen within Figure 4.1, would have heavily affected the northern areas of this region. Interestingly, surveys conducted within the English Channel and the Bay of Biscay (on the continental shelf and based on outwash sediments of the Channel River) shows that outwash throughout MIS 7 (including the 7d/7c-a transition) is relatively negligible (Toucanne *et al.* 2009b; Cohen *et al.* 2014). Therefore my models do not aim to assess any possible progradation effects across the now submerged land-surface. These studies also show that it is the climatic transition zones, associated with mass ice-sheet melting (also discussed above; see Figure 3.12), that correlate to mass accumulations of sediment outwash (Busschers *et al.* 2008; Toucanne *et al.* 2009a; Toucanne *et al.* 2009b; Hijma *et al.* 2012; Cohen *et al.* 2014; Gibbard and Cohen 2015). Further, my literature review has shown there is no significant mention of preserved estuarine sediments across the submerged landscape of the modern St Malo gulf. In part this is due to the lack of Quaternary based research into this area of prehistoric submerged land surfaces, but also supported by the low outwash levels recorded in MIS 7 Channel River deposits within the Bay of Biscay.

No attempt to model or correct for aggradation effects has been attempted within my models due to the lack of access to sub-bottom data, or any analogous data (e.g. sediment cores), at the time of research. Aggradation of terrestrial sediments from fluvial outwash (progradation) could however be more influential, temporally, for these models. Within the relatively stable conditions of interglacial MIS 7, outwash would be influential on the relatively flat coastal plain around the modern Channel Islands and coastal areas of modern Brittany and Normandy (pers. obs.). However, there is no direct, available geophysical data to base a discussion on these sediments, and allow modelling of these effects to be accurately estimated. Similarly, while the presence of a number of fluvial systems associate with the modern Rance and Sélune, for example, can be suggested their influence on terrestrial land surfaces seems minimal. These systems can however influence ideas of Neanderthal landscape behaviour and mobility, further discussed in chapter 8. Once again knowledge/data associated with erosion rate through specific time periods, like the end of MIS 7, is varied and difficult to estimate. While data from various geophysical survey techniques exist, it is often connected to current commercial development projects and in the hands of industry (pers. obs.). In addition, for this data to be applicable for projects such as this one presented here, would need very stringent dating programmes attached to associated erosional situations of certain time periods. These features also include periods of retreating sea-level and development of sandbars/sandwaves, creating an ever shifting terrestrial surface; one that cannot be satisfactorily modelled for quaternary marine systems, such as those present within the St. Malo gulf during sea-level rise and fall at the end of MIS 7.

4.2 A Coastal Terrain Model for the Channel Plain Region: the General Bathymetric Chart of the Oceans (GEBCO 2014)

The recently updated GEBCO 2014 grid (The GEBCO_2014 Grid, version 20150318, www.gebco.net'), downloaded from the British Oceanographic Data Centre’s (BODC) website (https://www.bodc.ac.uk), has been used to produce the models presented here (Figure 4.4), and provides a 30-arc second (≈926 m) coastal terrain model (CTM). This CTM is a combined dataset of the EMODnet data and USGS’s SRTM30 data, among additional, more localised (finer resolution) sources (Weatherall *et al.* 2015). This combination of datasets allow for the use of CTM’s directly from download (i.e. without the need for cleaning the data). This data produces a directly downloadable source that is adequate for the investigation of submerged land surfaces in the Channel for the temporal scale I am assessing here (i.e. over thousands of years); although the continuous development of this data source will allow for better more accurate updated versions to become available.

Overall, the GEBCO 2014 based models, produced as part of this research, provide landscape scenarios that can be scrutinised to investigate research objectives set out within chapter 1; these are represented by the *key issues* highlighted within Table 4.1. Figure 4.1 displays the basic GEBCO data output for the region in question, i.e. representing the modern scenario of sea-level (a.s.m.l.), and the coastlines of the Channel Plain associated with La Cotte.

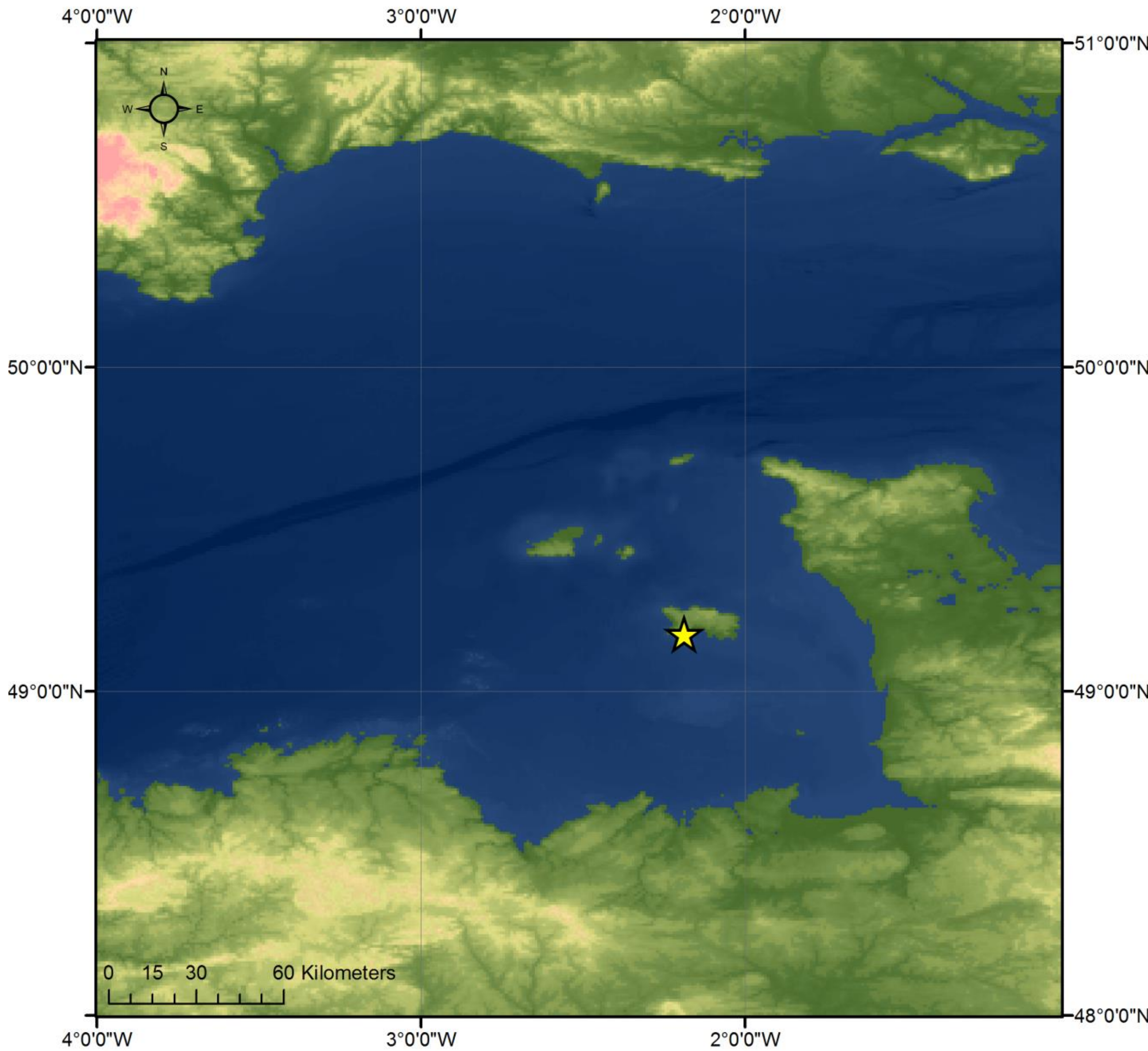

Figure 4.1 Coastal Terrain Model of the Channel Plain Region using GEBO 2014 data, centred on La Cotte de St Brelade, Jersey.

The GEBCO CTM provides the best openly accessible dataset for the purpose of this study i.e. to begin a discussion of landscape, habitat and coastline presence during the occupation of La Cotte. The models connected to the occupations of La Cotte are presented and discussed below (Figure

4.4) after the selection and application of relative sea-level estimates is discussed. This short review further highlights the need for future research and data collection, specifically for Quaternary timeframes, to refine these models, and develop palaeo-geography within a Palaeolithic research frame.

4.3 Relative Sea-levels

Relative sea-level (RSL) estimates for this study have been taken from two sources. The first dataset is the deep sea temperature proxy coupled with ice volume of Rohling *et al.* (2014). Deep sea temperature of the Mediterranean and Red Sea Basins (Rohling *et al.* 2009; Grant *et al.* 2012) is estimated from presence of ^{18}O (from carbonate microfossils in the Mediterranean and foraminifera recorded in the Red Sea) and coupled with a modelled hydraulic flow *through* the basin and estimates of evaporation and Oxygen ratios *within* the basin. The ranges of confidence stretch up to ±22m of relative sea-level.

Figure 4.2: Relative sea-level curves used for RSL estimates used in the models (below). A=Rohling et al. (2014), “smoothed” data with upper and lower boundaries. B= Spratt and

Lisiecki (2016) in blue and Rohling et al. in orange. Red transparent columns display ten thousand year brackets of occupations based on Table 4.2.

The second curve is a stack of separate RSL proxies (i.e. Deep sea cores, coral samples) from a number of source locations, mostly related to the Atlantic (Spratt and Lisiecki 2015; Spratt and Lisiecki 2016). The composite stack enables the reduction of temporal and geographic "noise" caused by local conditions (e.g. isostatic uplift; continental shelf shift etc.). This is applicable here as there are no RSL curves for the English Channel, or North-Western Europe as a whole, that covers MIS 7. The Spratt and Lisiecki (2016) curve automatically "flattens" the data, so where temporal extremes occur elsewhere in the proxies (for example in Bermuda coral proxy, mentioned in chapter 3 (Rowe *et al.* 2014)), they are not translated onto the stack. Overall, the Spratt and Lisiecki (2016) curve displays a ±6-26m confidence dependent on time period.

Figure 4.2 shows the RSL curves of both datasets. Estimates have been chosen to show *potential* reduction in sea-level for occupation periods at La Cotte (Table 4.2). These occupation periods relate to chronostratigraphic correlations discussed within chapter 3, and presented again in Figure 4.3. Dating is correlated to two tie points. Firstly, a MIS 5e beach (c. 127 kya), represented by layer 7.1 in Figure 4.3. The second tie point relates to knowledge of a eustatic high stand and associated full interglacial environmental conditions within layer E (and seen on the Cotentin at Roche Gélétan), related to the Spratt and Lisiecki (2016) RSL curve (see Figure 4.3), and also seen within the Rohling *et al.* (2014) example (see Figure 4.2.). This high stand was suggested based on the development of a warm/temperate soil, indicated by clay illuviation, within the sequence at La Cotte (exclusive to layer E see section 3.2.4.2), and phosphate levels indicative of nesting sea birds (also seen in layer F but not elsewhere; section 3.2.4.2). It could be argued this does not directly indicate proximity to the sea based on modern analogues (where sea-bird species have nested in colonies inland, pers. obs.); however overall it is supported by the climatic indicators e.g. soil development and sea-level proxies. From these tie points broad timeframes of ten thousand years have been associated with other layer occupations at La Cotte, (the red bands in figures 4.2 and 4.3) based on further chronostratigraphic indicators and environmental ties (see Figure 3.7 & Figure 4.3). Timeframes used for analysis are;

- Layers H/G (c. 220 – 210 kya)
- D/C (c. 195 – 185 kya)
- A (c. 177 – 167 kya).

Curve		La Cotte layer:		
		H/G	D/C	A
Rohling et al. 2014 Short	Mean	-35.32	-45.77	-60.7
	High	-26.08	-24.92	-52.79
	Low	-39.04	-67.15	-69.73
Spratt & Lisiecki 2016 PC1	Mean	-15.4	-51.63	-60.92
	High	-6.78	-32.43	55.34
	Low	-36.81	-71.5	-64.34

Table 4.2 Relative sea-level estimates from two curves, Rohling *et al.* (2014) and Spratt and Lisiecki (2015). See text for discussion of selected estimates.

These dates are chosen based on matching the eustatic curve (a global environmental proxy, with a chronology) with the depositional situation at La Cotte (a local environmental proxy, with a chronology). A ten thousand year timeframe is presented as a restraining factor, and for consistency when comparing the three scenarios. The layers discussed here represent a bracket of the occupations at La Cotte from the top (layer A), broad middle (layers D/C) and bottom (layers G/H). Therefore, the palaeo-geographic scenarios presented within Figure 4.4. represent these separate occupation brackets discussed here. These models aim to aid a discussion into the possibilities for Neanderthal landscape behaviour related to sea-level rise and fall across the region between c. 220 kya and 160 kya.

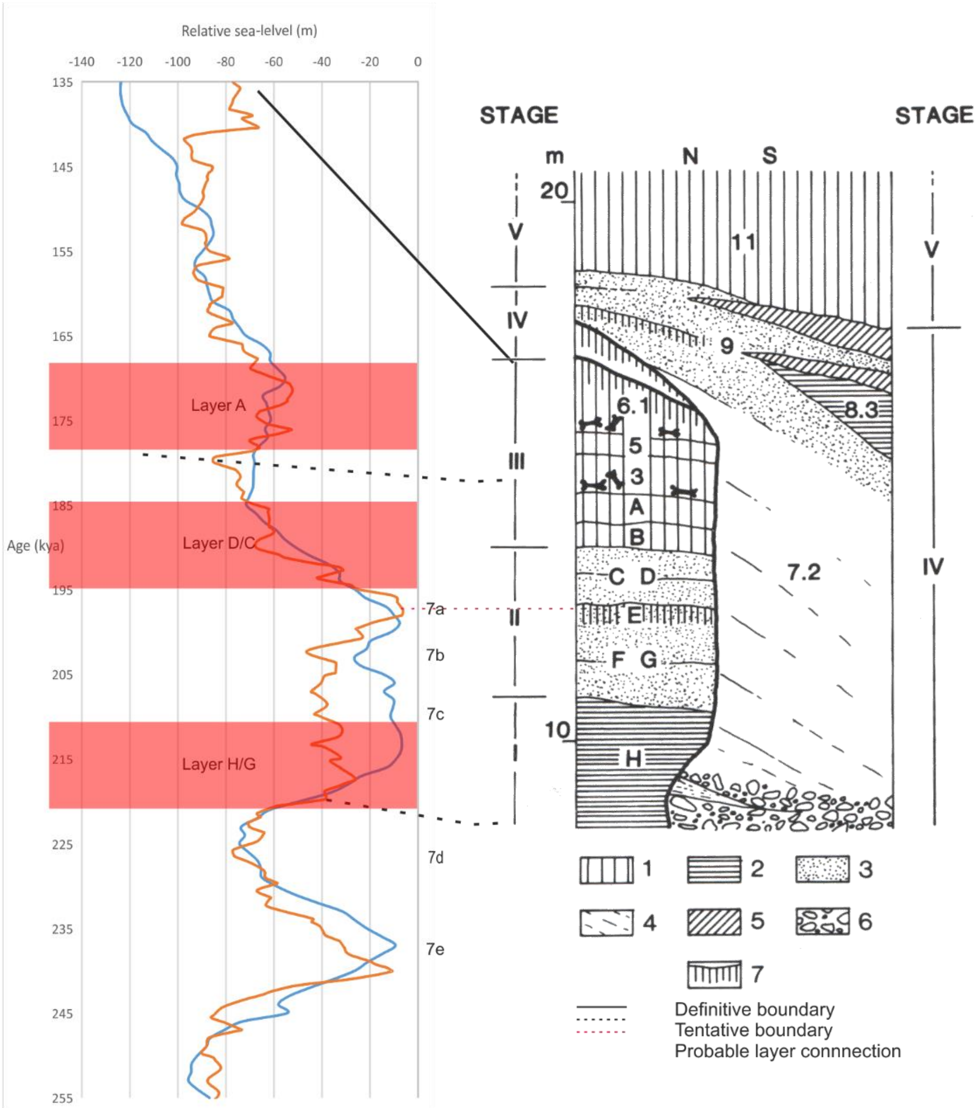

Figure 4.3: La Cotte chrono-stratigraphy, repeated from Figure 3.7, with additional annotation. Note the high varaibility based on sea-level proxies within each time slice.

The time slices selected above (Table 4.2) are chosen to represent broad timeframes of occupation within the region to aid discussion within this study. As accepted elsewhere (e.g. chapter 2), the low resolution of quaternary dating and the similarly low resolution of RSL estimation values (often due to quaternary dating issues), limits the validity of a more robust chronological framework. What I can highlight is that variability *within* these time slices is suggested to be high, for example associated to layer D/C (195 – 185kya) where climate and sea-level drastically deteriorate (see Figure 4.3). What this means is that my final presentations represent *brackets of investigation* or time frames within which sea-level lies between or around the high and low estimates of both curves. This bracket could then represent pto 20m o difference in sea-level (in the case o scenario 2). For consistency I keep these brackets at an arbitrary 10, 000 years. I feel this provides the best way to begin to discuss submerged landscapes of the Channel Plain, in direct relationship to the occupation of Neanderthal groups and their connected landscape behaviour related to its archaeology. However, a more robust understanding of climatic variability and its influence on short-term (i.e. decade/century level) behavioural change is something that cannot be fully accessed here, but is discussed further in chapter 8.

4.4 The models: methodology

Figure 4.4 displays the six palaeo-landscape models produced to discuss landscape change, resource accessibility and, eventually, Neanderthal landscape behaviour. Each model represents a mean RSL for each timeframe-scenario from Table 4.2/Figure 4.3. The final outputs were created using ArcMap 10.2.2., using GEBCO data downloaded and imported in .tif form. Firstly, 12 metres was subtracted from elevation values using Raster Calculator (as seen below) to represent a pre-uplifted landscape, based on discussion within section 4.1.

Methods for producing each individual image where:

ArcToolbox _> Spatial Analyst Tools _> Map Algebra _> Raster Calculator

Within *Raster Calculator* the conditional expression:

Con([GEBCO.tif] <= [RSL value], 1, 0)

Is used, i.e. taking all pixel values below the chosen RSL, previously displaying altitudinal data based on bathymetric survey, and displaying as 1. For final image presentation, using the raster produced from *Raster Calculator*, all 1 values were set as blue (to display sea water) and 0 values set to transparent. The GEBCO CTM was used to show terrestrial landsurface. To draw the RSL estimates the following was followed for each scenario:

ArcToolbox _> Spatial Analyst Tools _> Surface _> Contour List

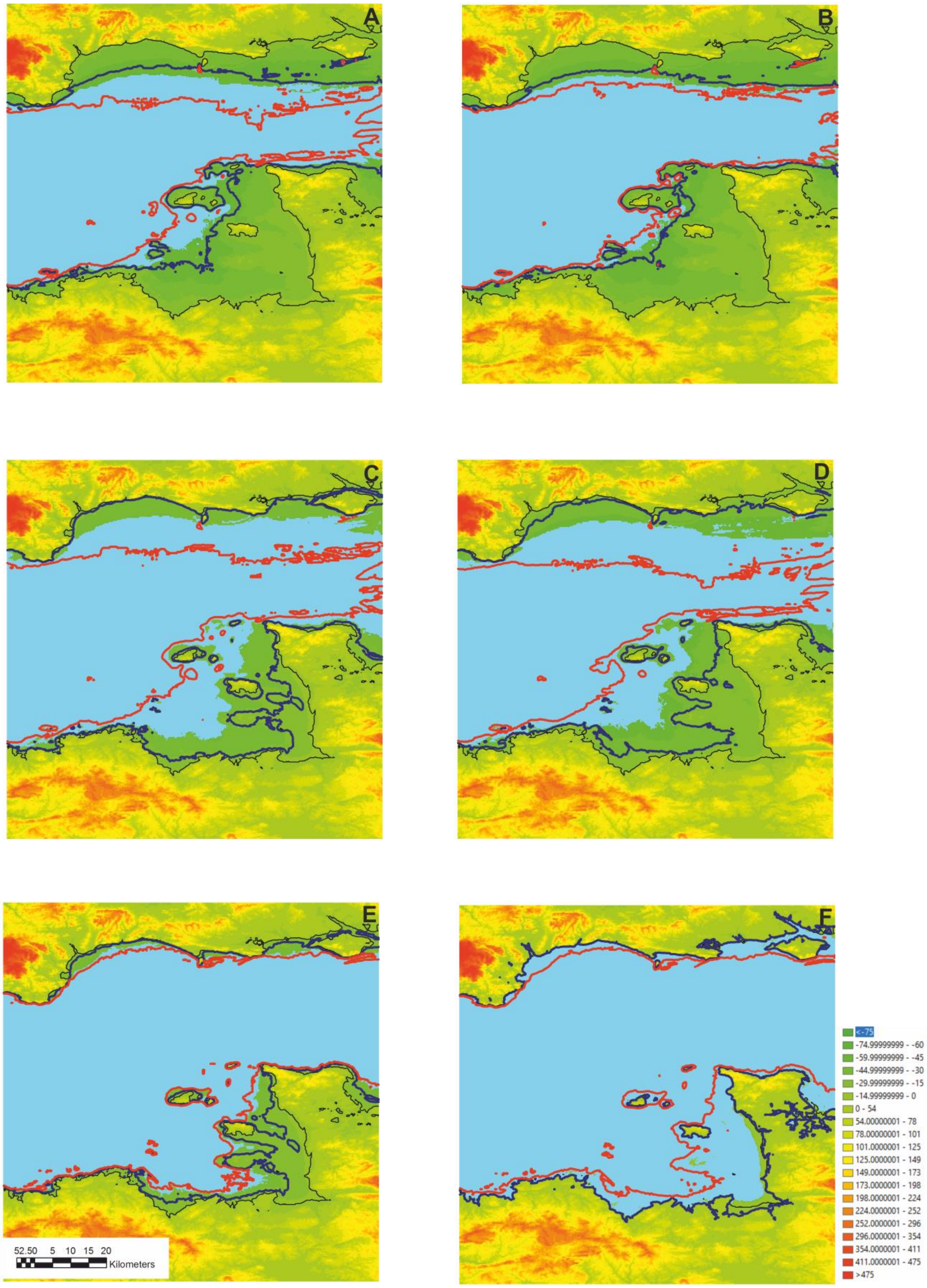

Figure 4.4: Palaeo-geographic models displaying RSL scenarios from the late MIS 7/MIS 6, related to Neanderthal occupation periods. RSLs are based on the mean values, with red lines displaying the lower limit and blue displaying the upper (Table 4.2). Left hand side (A, C and E) are based on Rohling et al. (2014) while the right hand side is based on Spratt and Lisiecki (2016). A and B represent, layer A (i.e. 177 – 167 kya), C and D

represent layers D/C (i.e. c. 195 - 185 kya) and E and F represent layers H/G (i.e. c. 220 – 210 kya.

The models presented within Figure 4.4 allow an assessment of landscape and environment within the region at various time slices of the EMP, in other words, point one of the key issues presented in Table 4.1. Firstly, it becomes apparent that, as discussed above, tidal activity on the low laying areas around the Channel Islands and Cotentin coast would be highly influential during high sea-level periods due to the low lying landscape, now submerged, within the region. This is important in understanding access across this landscape, and is used here to begin to explain the sporadic occupation at La Cotte (pers. obs.). It is also worth mentioning that this record can be used to explain the low level of Pleistocene archaeology across the islands compared to the mainland French coastline throughout the Palaeolithic.

Secondly, knowledge of both climate (i.e. declining interglacial conditions), and environment (relatively open landscapes/mammoth steppe like conditions) allows us to discuss broad habitat presence across the region. Faunal evidence at sites such as La Cotte, Nantois, Pleneuf-val-Andre, and Biache St. Vaast, Picardy, show a good presence of large herbivores (i.e. Mammoth, Wholly Rhino and Bovid), with direct links to Neanderthal interaction (i.e. butchery, hide procurement). This open, largely flat, landscape provided the perfect setting for a mega-faunal population, providing a desirable hominin habitat niche in the EMP (pers. obs.). We can also propose that this situation would have become more “desirable” as sea-level dropped and more open, flat landscape became colonised by terrestrial niches (i.e. grasslands, pers. obs.). This then provides the basis for hominin occupation of this region within the transition of MIS 7/6.

4.5 Bedrock geology and resource availability

Figure 4.5 presents the general bedrock geology of the St Malo Bay area (re-drawn from Keen 1986: pg. 44), to begin discussion of lithic resource availability within the now submerged land area of the region. This again highlights potential rather than definitive location of available material based on limited availability of sub-bottom data (pers. obs.).

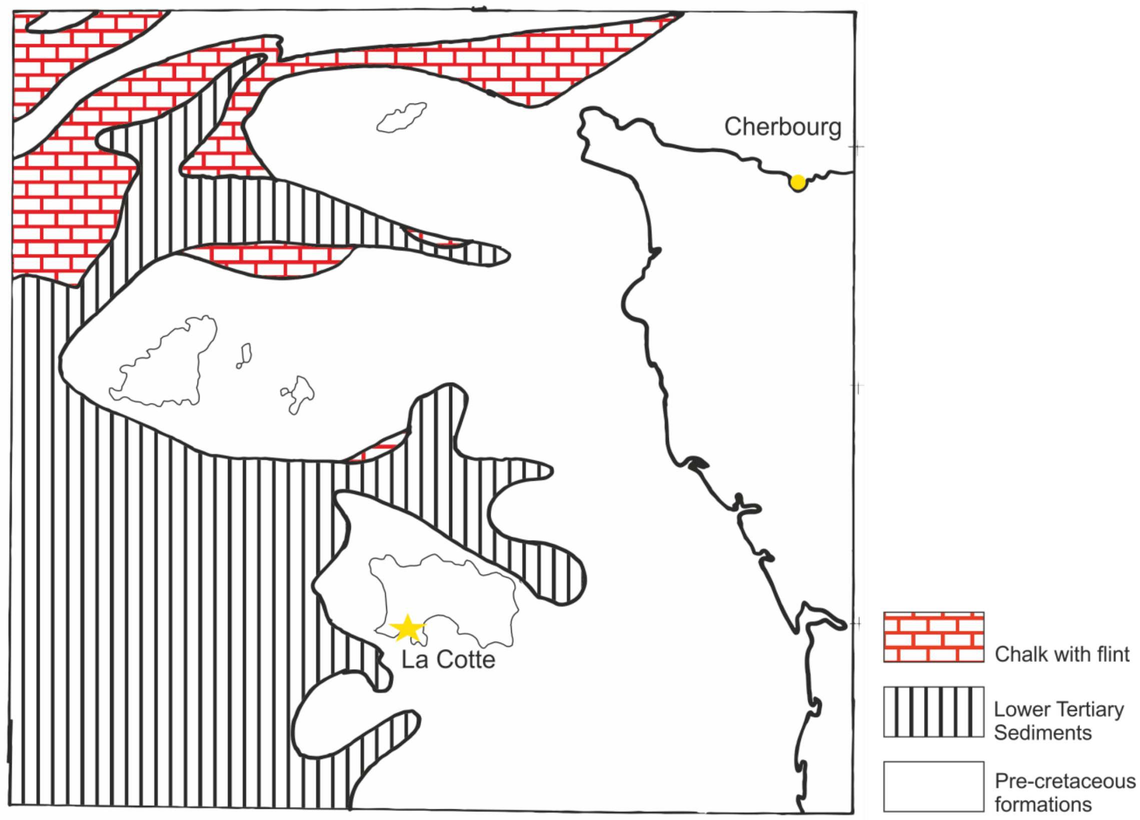

Figure 4.5: Simplified bedrock geology of the Channel Islands area and Cotentin coastline, re-drawn from Keen (1986: pg. 44)

Using this basic bedrock geology map the palaeo-geographic models presented within Figure 4.4, provide scenarios for accessing raw material and availability that are presented below (i.e. addressing point 2 within Table 4.1). It is also worth highlighting here the close proximity of chalk with flint to the north of the Cotentin. A number of archaeological locales are present in this area, i.e. Port Pignot (Michel 1982), Gouberville and Roche Gélétan (Coutard and Cliquet 2005; Auguste 2008; Hérisson *et al.* 2016a; Locht *et al.* 2016), and are discussed in more detail in chapter 8. It is also more extensively spread to the east (Figure 4.5), close to the north of the Cotentin, as has been shown elsewhere (Coutard and Cliquet 2005; Coutard *et al.* 2006). It should also be highlighted that, while flint is the preferred raw material within all associated archaeological assemblages (see section 2.2 and reference therein), the pre-Cretaceous and Lower Tertiary bedrocks provide access to other materials such as quartzites and the islands themselves (e.g. Jersey) are largely granitic, holding seams of quartz and dolerites.

For the image presentation (e.g. Figure 4.6) Keen's (1986) bedrock geology map (Figure 4.5) was geo-referenced within ArcGIS using the *Geo-referencing* tool:

ArcToolbox _> Geo-referencing_> Add control points

Finally, the output raster was saved, and added to each palaeo-geographic model in-turn, and a 60% transparency was added to allow both visuals to be displayed (e.g. see Figure 4.6).

LAYER H/G, c. 220 - 210 kya

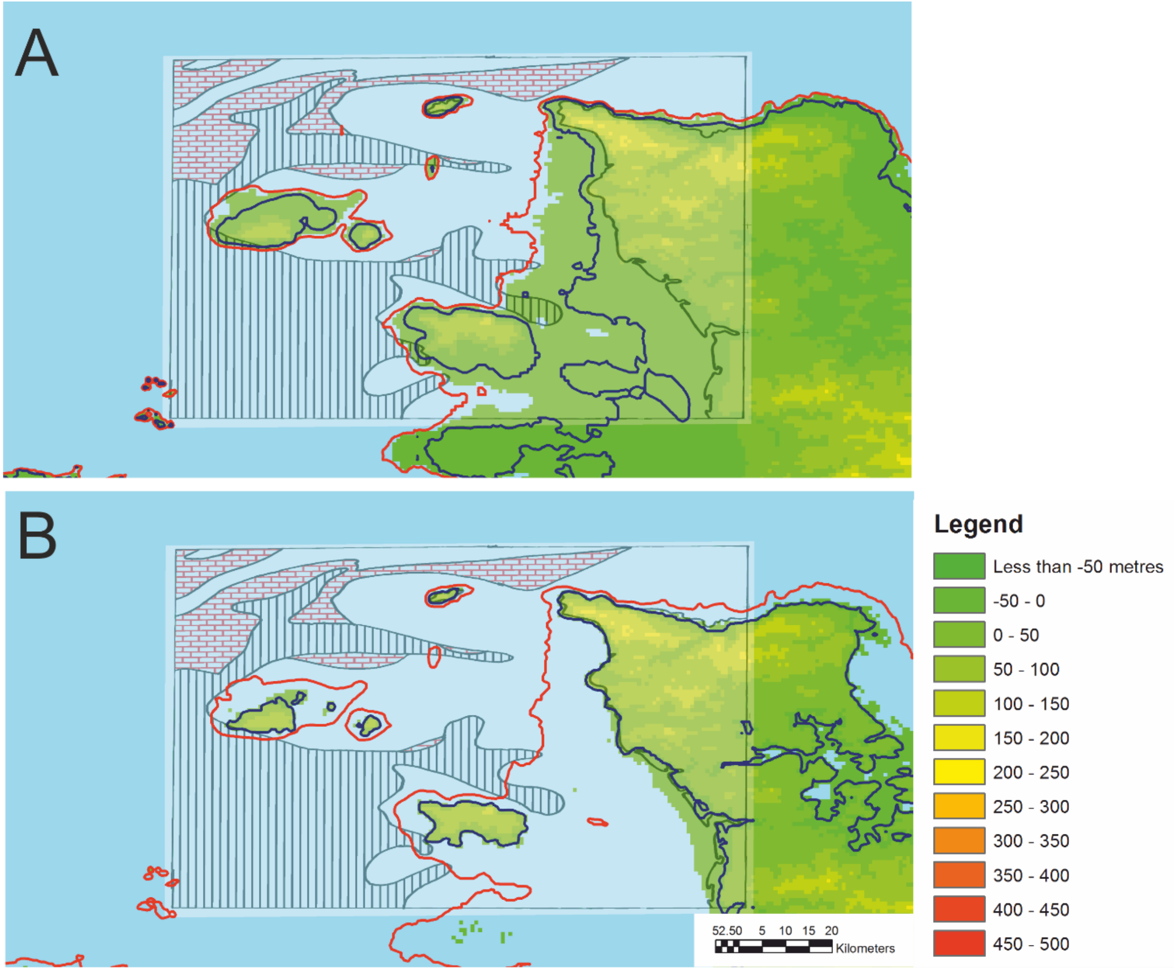

Figure 4.6: Geology base map based on Keen (1986), displayed upon palaeo-geographic models A and B from Figure 4.4.

Starting with the occupation periods of layer H/G (c. 220 – 210 kya) the sea-level scenarios based on the Rohling *et al.'s* and Spratt and Lisiecki's RSLs show no direct access to bed-rock sources of flint within the immediate region. However, knowledge that these occupations correlate to a period of rising sea-level (i.e. beginnings of MIS 7c-a), allows the strong suggestion that flint would have been available within beach accumulations around the coastlines. Based on both RSL situations Chalk-with-flint is closest to coastal regions on the north-western extent of the Cotentin Peninsula, potentially suggesting the best access area to this raw material. Other raw materials (i.e. quartzites, quartz and dolerites) would have been accessible from both beach accumulations (i.e. similar to modern beach deposits of the region; pers. obs.), and outcrops of bedrock.

LAYER D/C, c. 195 – 185 kya

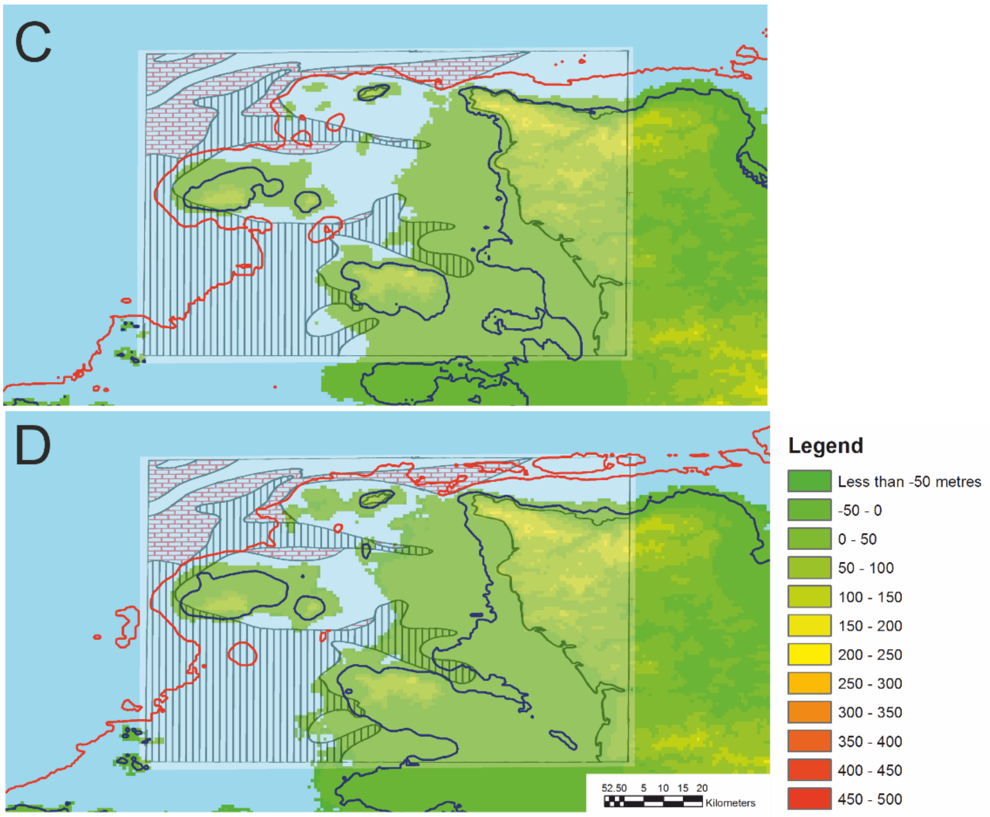

Figure 4.7: Geology base map based on Keen (1986), displayed upon palaeo-geographic models C and D from Figure 4.4.

The layer D/C occupation period (c. 195 – 185 kya) shows an increased terrestrial land area from that of layer H/G (Figure 4.7). This then coincides with access to fresh chalk-with-flint outcrops, both on the northern edge of the region and also potentially centrally, between the modern islands of Jersey and Guernsey. Once again the sea-level change also allows a contribution of this material in eroded beach deposits, and as with layer H/G occupations, other materials would be accessible in exposed outcrops such as the island of Jersey itself as well as accumulations within beach deposits.

LAYER A, c. 175 – 165 kya

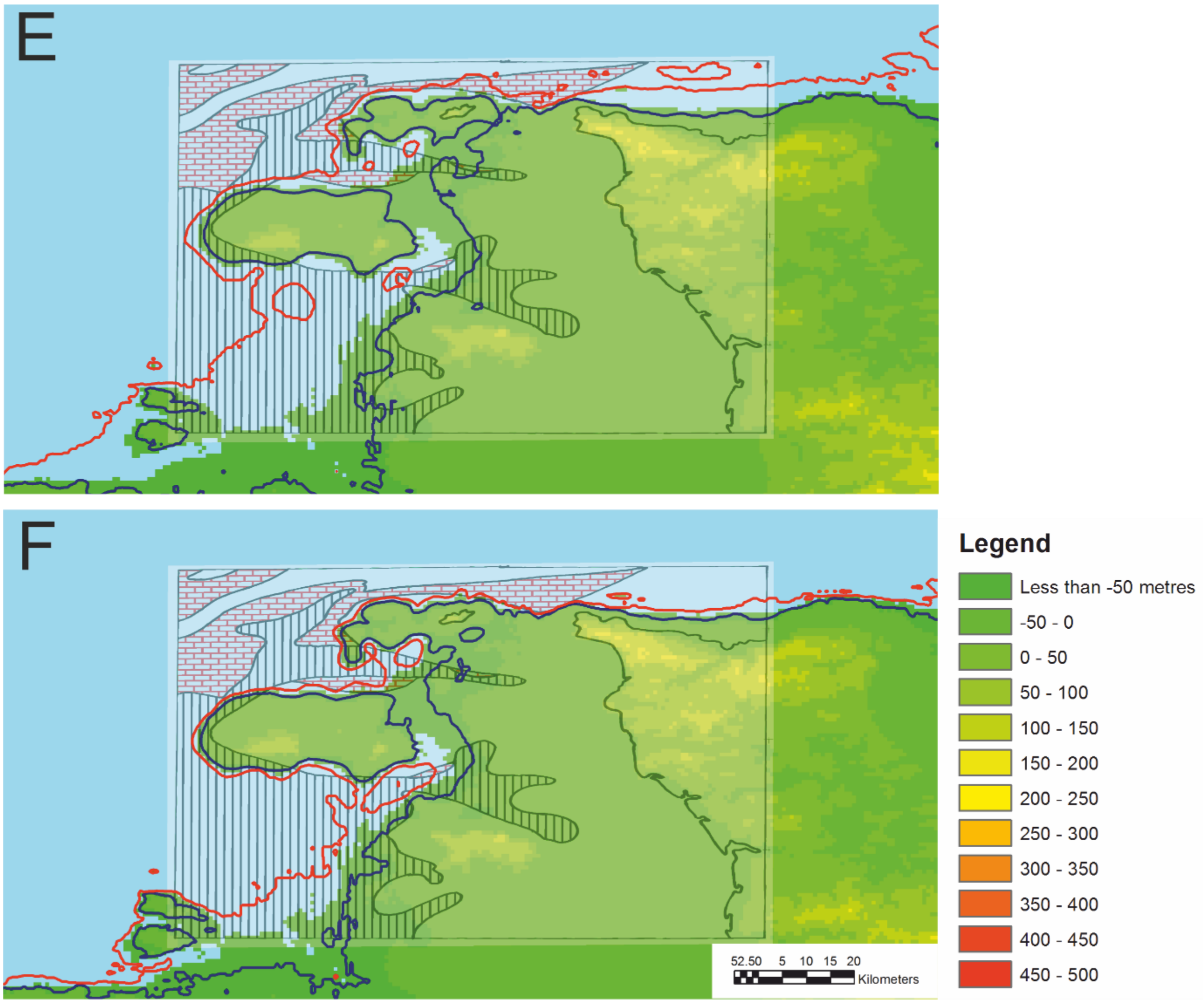

Figure 4.8: Geology base map based on Keen (1986), displayed upon palaeo-geographic models E and F from Figure 4.4.

The RSL situations of layer A (c. 175 – 165 kya) show the largest exposed land-surface area discussed by this research (i.e. layers H-A). This in turn shows the largest exposure of chalk-with-flint outcrops. This does therefore coincide with the largest distance from sites, such as La Cotte and Piégu, to the active beach accumulations. This occupation scenario would however not drastically change (in comparison to those above) access to other, non-flint raw materials such as quartz.

4.6 Conclusion

These models, presented above, show differing scenarios for landscape situations, and in turn resource access, for the Channel Plain Region during the EMP. They therefore aid discussion of both Neanderthal landscape practices and Neanderthal lithic behaviour. Specifically, the three scenarios are connected to occupations at La Cotte and connected locales, based on the chronostratigraphic correlations of chapter 3 and broad timeframes of occupation discussed above, to begin to discuss raw material availability and habitat within the landscape. These are returned too in the final chapters, after presentation of lithic material in the following sections.

Based on the key issues presented in Table 4.1 a number of conclusions can be presented here before presentation and discussion of the archaeological record in more detail (Chapters 6 and 7). Firstly, habitats change overtime within this landscape, as expected, based on sea-level rise and fall. The higher sea-level situation of MIS 7c-a (i.e. analogous to layer H/G models) show limited exposed terrestrial surface area. The region presented here would have been dominated by tidal/liminal niches rather than open, mammoth steppe like habitats. This situation would also have restricted direct access to better quality raw materials, such as flint. This however would have been a period of sea-level rise, and therefore coastal erosion of outcrop sources, providing access through beach accumulations. This situation changes with sea-level fall, associated with occupations in C/D (c. 195 – 185 kya). In this scenario, land surface exposure increases, which can be associated with an increase in open landscapes and mega-faunal guilds. The variability within this time period is suggested to be drastic based on sea-level proxies discussed above. However, a better understanding of this variability and its potential influence on Neanderthal groups is not accessible based on present data. Equally, raw material outcrops, especially Chalk-with-flint, would also be exposed if not more accessible. Importantly this scenario would not reduce access via beach accumulations i.e. coastline area would not be reduced, just moved. Finally, the later occupations in this region (e.g. layer A at La Cotte) would coincide with minimum sea-level drop within the period discussed by this research and consequently a deterioration in climatic conditions. With this, maximum land-surface exposure, including raw material outcrops across the region, would be exposed providing conditions for mega-faunal herds and hominin occupations before the final deterioration, and increased periglacial conditions of MIS 6.

The models presented here have developed a resource for discussing Neanderthal lithic and landscape behaviour in the Channel Plain Region, previously unstudied for the period in question (c. 220 – 160 kya). These situations suggest access of material from beach deposits, archaic and/or extant, within the landscape. Lithic analysis, presented in the next chapters, also show a significant use of coarser grained materials, such as quartz and sandstone, from more local sources. These behavioural signatures have major implications for discussing the lithic material present within layers studied, and directly relate to Neanderthal lithic behaviour at La Cotte. Finally, they will have significant importance in the final discussion of Neanderthal landscape behaviour in the Channel Plain, presented in the final chapters. A broad understanding of climatic conditions and habitat variability from these models allows a better discussion of Neanderthal group needs in these landscapes for example use and control of fire or production of cultural insulation (e.g. clothes).

Chapter 5: Lithic Analysis: Method

5.1 Introduction

This chapter will detail the methodological frameworks followed throughout this thesis for analysing the La Cotte lithic sample; with the aim of answering the research question and addressing objectives 2 and 4 (set-out within chapter 1). Here I will present data collected from the regionally key locale of La Cotte (for chrono-stratigraphic and archaeological history see section 3.2). My methodology highlights 10 primary attributes with a further set of variables for each to be recorded; for example quantitative flake variables which includes length, breadth, thickness and number of dorsal scars. These are presented within the first section of this chapter. All these variables will go towards addressing assemblage composition, and therefore reveal key information on the Neanderthal lithic behaviour overtime. I will highlight this potential information for each attribute described; discussing for each how it adds to my research objectives.

Overall the majority of this methodology has been co-opted from Dr Beccy Scott's doctoral research (Scott 2006) which in turn has used a number of other well-known methodologies such as Ashton and McNabb (1996) for core attributes. I have adapted a number of Scott's attributes to better fit my research question; these adaptions are explained in full below. Finally, a number of other sections have been added to this chapter to fully explain and summarize both the framework, and the reasons behind this framework i.e. what and how it adds to our knowledge of Neanderthal lithic and landscape behaviour of the Channel Plain Region within the Early Middle Palaeolithic, and the potential influences on that behaviour. This all leads to the next chapter where I will present the data collected using this methodology and show that my attributes have highlighted patterns within the lithic assemblages previously unseen. These patterns are then discussed in depth within Chapter 7 and directly linked to changes in landscape use that have affected Neanderthal lithic behaviour throughout the Early Middle Palaeolithic.

5.2 Sampling

La Cotte has an assemblage of over 200,000 artefacts, and therefore I have chosen to systematically sample the assemblage. As discussed within chapter 3, this research will concentrate upon the Prof. C.B.M. McBurney excavations (1961-78), which consists of a lithic sample of > 96,000 artefacts. I sampled the lithics by choosing a 1 x 1 metre vertical transect (one grid square from these archaeological investigations) within the excavated area of the site, investigating each layer as a single unit, and re-analysing ***all*** lithics present in the collection (t= 6591).

This provided the perfect situation to compare my data with other published work, i.e. Callow and Cornford (1986), where each layer is presented as a separate entity. My research then adds variables that previous research did not collect e.g. dorsal scar patterns and retouch variables (as opposed to just Bordes Typology), variables that are specifically tailored to answering my research question. Importantly this strategy also preserves the opportunity to do intra-site, and potential inter-site, behavioural comparisons over a broad periods of time i.e. c220 - 160 kya (see future work).

5.2.1 Grid Square 100/-100

The grid square chosen, 100/-100 from grid origin, was chosen after analysing artefact counts and distribution to ascertain the best sized sample possible. Grid square 100/-100 provides a well distributed (see Table 5.1) sample of over 6000 artefacts. All pre-MIS 5 layers (i.e. below layer 7; see section 3.2.1) are represented. However, the top of this sequence is sparse. Due to my sampling strategy layers 3, 5 and 6 have a combined total of 39 artefacts, for that reason, and their widespread distribution (Jersey, British Museum, Caen, Cambridge and potentially unknown) I chosen to leave these thirty-nine elements out of the empirical analysis. It is also important to note that the whole sample of artefacts from the excavated area in each layer drastically varies, as does lithic density within the excavated area (Table 5.1). It was also observed through excavation that distribution of anthropogenic material was affected by both large granite boulders from the roof of the fissure (i.e. rockfall) and, in layers 3 and 5/6.1, large megafaunal remains (Callow 1986e; Scott 1986a). Therefore my metre square sample of 6591 artefacts, down the stratigraphic column, provides a more robust and consistent artefact sample to assess Neanderthal lithic behaviour over time, at La Cotte.

Layer within La Cotte Sequence	Study sample for this thesis	Excavated Sample (Callow and Cornford 1986)	Density / 20cm/20cm/5cm spit (across whole excavated area)
A	1417	39155	4.7
B	329	5801	4.06
C	1110	9616	6.29
D	1490	7606	11.19
E	663	6396	9.78
F	758	6320	7.07
G	503	4805	5.13
H	321	2135	3.66
Total	6591	81834	Average: 5.45

Table 5.1: Lithic sample studied for this thesis from grid square 100/-100, La Cotte de St Brelade.

5.2.2 On-site recording

All lithics were recorded with three dimensional co-ordinates. In the later years, particularly 1977-78, artefacts are recorded and stored by 20 cm/ 20cm/ 5cm spits. However, depths are specifically recorded to each artefact. This restricts the spatial analysis which can be conducted. Therefore, a truly accurate horizontal relationship of artefacts is impossible.

5.3 The Attributes

This section will introduce the quantitative and qualitative variables collected for the lithic assemblage, whose results are discussed within chapter 6. The primary attributes are:

- Condition of artefact (all artefacts)
- Raw material and technological characteristics (all artefacts)
- Quantitative flake variables (non-PCT)
- Qualitative flake variables (non-PCT)

- Quantitative flake variables (PCT)
- Qualitative flake variables (PCT)
- Quantitative core variables (non-PCT)
- Qualitative core variables (non-PCT)
- Quantitative core variables (PCT)
- Qualitative core variables (PCT)
- Retouched tool variables

Recorded flake and core attributes have been split between non-PCT and PCT elements. This is both to provide an easy way to complete an inter-site variability study and due to the specific nature of PCT manufacture, and the need for differing variables to fully understand the process. This methodology also included a separate set of variables for bifaces (handaxes). As I identified only one handaxe within my sample, here I have saved the time and space and left this attribute out and presented it briefly in appendix A.

5.3.1 The Variables

5.3.1.1 Condition of artefact

Six variables have been analysed to record the condition of ***ALL*** artefacts. These variables will highlight any post-depositional effects upon the artefacts, helping to highlight possible post-depositional movement (Wood and Johnson 1978; Villa 1982); deterioration of surfaces or edges (McBrearty *et al.* 1998; McPherron *et al.* 2014); or, in the case of battering, potential hominid effects upon artefact surfaces that can tell us more about behaviour (pers. obs.). These variables feed into our knowledge of site depositional processes that not only inform on broad climatic affects but also allow a greater confidence for technological interpretation.

The variables are:

Abrasion (see Figure 5.1):

1. Unabraded. Where all artefact edges and dorsal arêtes (scar ridges) show no sign of post-depositional movement i.e. rounding of edges due to rolling or movement of sediments and/or artefact(s).
2. Slightly abraded. Slightly abraded artefacts will show minimal, but observable, degrees of rounding due to post-depositional effects
3. Moderately abraded. Moderately abraded artefacts will show a considerable degree of rounding of edges and arêtes, however flake scars are not obscured fully (i.e. direction is ascertainable via conchoidal fracture ridges).

4. Heavily abraded. Often leading to indeterminate pieces, heavy abrasion displays degrees of rounding that total obscure dorsal scar patterns (see above) and significant proportions of all edges are lost i.e. eroded from abrasion.

The assessment of edge damage is key in discussing post-depositional effects on edge morphology caused by a number of possible conditions (e.g. rock fall, fluvial action, slumping). The identification of this is not only key to understanding sediment build up and movement but also potential loss of behavioural data such as retouch or scar patterns. Again this variable is directed at answering the research question by adding key climate and immediate habitat data as well as feeding into objective 1 and 4. Figure 5.1 displays some of the variation seen within this study. The left-hand image displays both abrasion of the edges (i.e. rounded and not sharp) and the arêtes; this would constitute a Moderately Abraded artefact. Further this artefact is from a derived assemblage associated with the erosion of artefact bearing deposits of Grainfollet, Brittany (see section 8.2.4.). The right hand image is from layer G at La Cotte and shows significantly less abrasion of arêtes and edges (highlighted within the rectangle), with some additional scratching, suggesting some movement of deposits over this and associated artefacts.

Figure 5.1: Examples of scratching and abrasion (various) on artefacts from Grainfollet (left) and La Cotte (right). The Grainfollet example also highlights post-depositional staining.

Patination:

Patination is a chemical process where-by lithic surfaces (materials containing silica e.g. flint) are altered, often causing colour changes and/or degrading (Thiry *et al.* 2014). This is most observable in flint (pers. obs.), and displays most often as a white or light blue sheen on affected surfaces.

1. Unpatinated artefacts will display no changes to any exposed surface.
2. Lightly patinated. Lightly patinated artefacts will show some level of surface alteration/colouration from exposure.
3. Moderately patinated. Moderately patinated artefacts will show large portions of surface alteration, often causing some obscuring of knapping patterns on dorsal surfaces.

4. Heavily patinated. Heavily patinated artefacts are often totally obscured across the whole surface (dorsal and ventral).

Patination was little represented within this study sample and often only partial i.e. Lightly Patinated (see Figure 5.2). Where viewed in other assemblages it can suggest material has been exposed to surface alteration (e.g. sun light) or percolating water (i.e. a chemical reaction). At La Cotte I have encountered artefacts with variable patination which suggests exposed material from within the landscape is being re-worked i.e. Parush *et al.* (2014). In a small amount of cases reused material is also present i.e. the blank is a previous knapped artefact found within the landscape, identified as unpatinated and patinated knapped surfaces. This is also noted within other studies of the La Cotte material (Callow 1986d; Callow 1986i, c; Hutcheson and Callow 1986), suggesting an element of transportation, further discussed within the following chapters. This variable then not only adds to the research question but again develops on objective 1.

Figure 5.2: Evidence for post depositional staining (top) and patination (bottom) with comparison with un-affected artefact (right hand side).

Staining:

Staining can be due to a number of processes but is most often associated with mineral bearing water either percolating in deposits or directly flowing over artefact surfaces (i.e. within a fluvial system).

1. Unstained artefacts show no signs of this process.

2. Stained. Stained artefacts show patches (large or small) of colour alteration, often from depositional staining (e.g. a yellow loess deposit). Within this study no attempt was made to ascertain any further knowledge of causes (see Figure 5.1 and Figure 5.2).

Similar to patination, post depositional staining is low within the assemblage studied, in this case suggesting limited movement of mineral rich water through the sequences. There is evidence of pre-depositional staining, similar to patination, suggesting the acquisition of exposed raw material from within the fissure or elsewhere in the landscape. From this we can discuss sedimentology and conditions affecting this as well as Neanderthal behaviour (specifically raw material acquisition) and therefore answering the research question and investigating objective 1.

Surface scratching:

Scratches will take the form of incisions (often minute) into dorsal or ventral surfaces.

1. No scratching - no evidence of this.
2. Scratched. Scratched artefacts are most often observed by the naked eye, and most often run in a singular direction, however a hand lens can aid identification (see Figure 5.1 or example).

Once again, scratching on any surface is indicative of sediment movement over and around an artefact suggesting re-working of deposits. These conditions can be interpreted as climatic indicators (e.g. periglacial) and therefore are included to answer the research and support discussion concerning objective 1.

Battering (characterised by incipient cones visible on any surface):

Battering is here defined by incipient cones and small hinge fractures caused by failed removals during knapping events.

1. Not battered
2. Battered

This is one variable I have altered from Scott (2006) original methodology. While original to (Scott 2006) methodology, this variable was purely taphonomic and indicative of heavy collision of artefacts with other material, I believe the last 5 variables cover this consideration. I therefore adapted this purely to hominin caused battering on artefact surface(s) from knapping episodes. Anthropogenic battering is determined by isolated areas of damage, often associated with a platform from a subsequent successful removal, and other surfaces are in fresh, un-altered condition suggested no *post*-depositional effects. As with other identification categories (e.g.

retouch), caution is taken identifying anthropogenic battering when post-depositional effects are clearly present on the associated assemblage e.g. edge damage. Therefore this ties directly into the main research question, looking at Neanderthal lithic behaviour.

With the case of *edge damage* there were times where two recordings were taken. These were where artefacts clearly displayed two phases or degrees of damage identified on surfaces. This has been used to discuss both taphonomic conditions of the site and potential reuse of artefacts within the locale and the landscape (see chapter 3) helping to further investigate Neanderthal behaviour.

5.3.1.2 Raw material and technological characteristics

These five variables will both characterise the raw material use of the assemblage and allow a comparison between assemblages in the region. Raw material source identification relates to preserved cortex on the outer surface of artefacts and is used as a proxy for identifying the source of the raw material (i.e. river terrace flint/rolled; marine pebbles; fresh outcrop; Hosfield 1999).

Raw material:

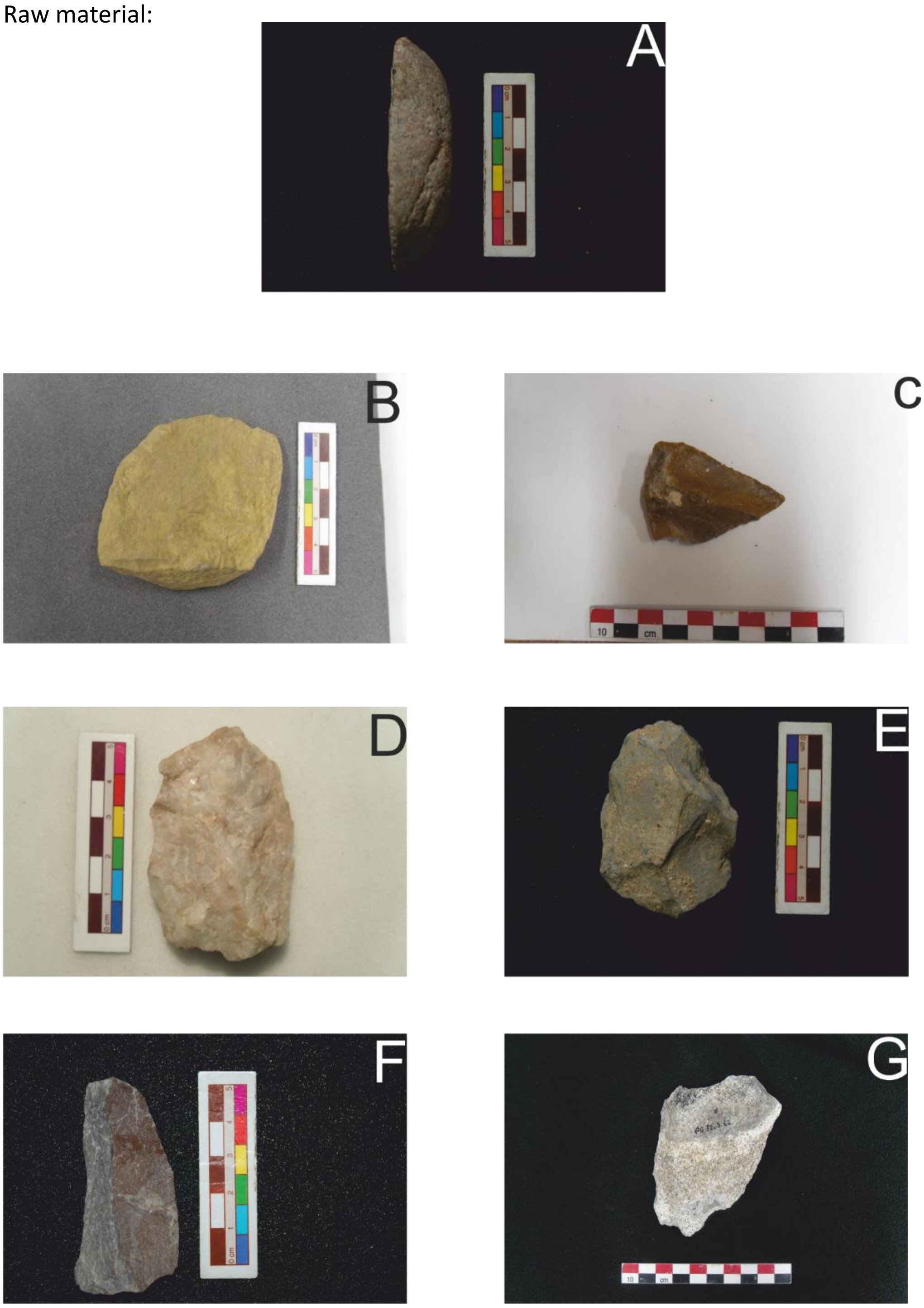

Figure 5.3: Raw material categories of the main non-flint and chert materials identified by this study (for flint variability see Figure 5.4 and subsequent detailed figures in chapter 6). A – Granite (in this case a broken hammerstone fragment on a beach pebble); B – Sandstone; C – *Grès lustrés;* D – Quartz, E – Siltstone; F and G – Quartzites, medium and course grained respectively.

I identified eleven raw material types; not including sub-divisions of cherts and flints which is deemed unreliable here (pers. obs.; see Figure 5.1). I've retained the fourteen categories from my original methodology. The understanding of raw material practice will provide an essential understanding of Neanderthal behaviour and landscape movement (see chapter 8). The identification of these raw materials has been a work in progress with contributions to my current understanding of raw materials from Dr Andy Shaw, Dr John Renouf and Dr Ralph Nichols. I have been granted access to a reference collection of raw material-from the surrounding area. This has included local Jersey material, submerged outcrops recovered by divers and material from Brittany and Normandy. Access to this collection has been invaluable in developing the knowledge and confidence of raw material identification present within the landscape, further allowing a better understanding of transport and landscape change overtime.

1. Flint
2. Chert
3. Basic igneous (see Callow 1986i: 207)
4. Jersey Shale
5. Granite
6. Sandstone
7. *Grès lustrés*
8. Quartz
9. Dolerite
10. Siltstone
11. Basalt
12. Feldspar Porphyry
13. Quartzite
14. Unidentified

Probable raw material source:

1. Primary. Cortex on surfaces of artefacts is chalky and often thick (dependent on outcrop source). These surfaces will also show no signs of a derived nature i.e. rolling or significant battering indicative of movement before acquisition.
2. Derived. Derived sources of material are recorded when cortex has any evidence for natural movement before acquisition, this can be indicated by staining of cortex and/or rolled, abraded surfaces of cortex.
3. Indeterminate. Cortical material is either absent or has obscured by knapping scars on the dorsal surface, removing indicative signs of source origin.

The variable is employed to investigate raw material acquisition strategies (i.e. fresh outcrop; fluvial/marine gravel; etc.), and follows Scott (2006: pg 36). Again I aim to investigate landscape behaviour, here related to raw material movement, and associated lithic behaviour, therefore contributing to answering the overall research question and objectives 1, 2 and 3. Figure 5.4 shows some of the variation on material studied as part of this thesis. The upper three examples show fresh, chalky cortex, with no evidence for surface battering. The bottom five examples show the variation on both thickness and character of derived material found within the study sample. The bottom two for example show extremely thin and battered/pitted surfaces suggesting they derive from high energy systems. Here this is interpreted as marine sources (at least for the final acquisition) due to the materials character and the general lack of evidence for any large high energy fluvial systems in the region (see chapter 4). The more evenly rounded material would be more indicative of a lower energy system; and likely represents acquisition from a derived fluvial source i.e. river gravel bars. This is general supported by the staining variability, with those interpreted as fluvially derived often displaying more opaque staining. The definitive identification however has been less easy to tie down. The thicker cortical retention on some pieces could suggest access to material close to its fresh outcrop in some cases, which therefore could represent material from either source derived source type. Finally, the knowledge of landscape changes in the region discussed in chapter 4 shows that large portions of the landscape underwent several marine intergressions within the timeframe of Neanderthal occupation(s) (and likely previously). Therefore, we should expect that some degree of material will show this evidence but could have been acquired from marine accumulations subsequently abandoned by the coast. For these set of complex reasons no hard separation of marine/fluvial material has been attempted but personal observations based on studied material is discussed throughout chapter 6.

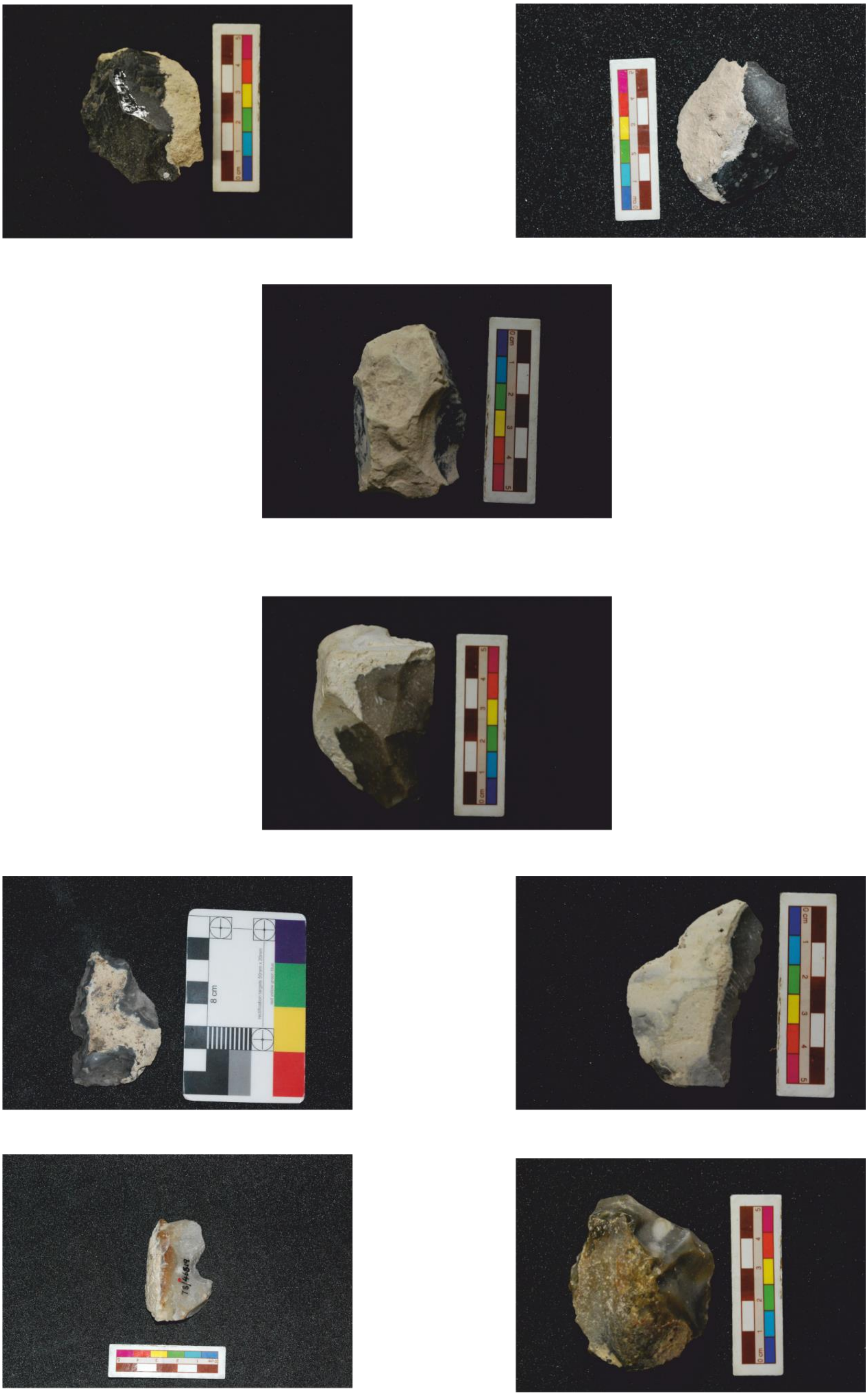

Figure 5.4: Examples of source variability and flint variability within material from La Cotte (within this study sample). See text for further description.

Mode of percussion used to produce a product, or to flake a nodule. Criteria of recognition are standard and drawn from established methodologies (e.g. Inizan *et al.* 1999):

1. Hard, identified as a large bulb of percussion (or negative) and often with a large platform.
2. Soft, identified primarily with a subtle lip upon the bulb (or negative), flakes are more often than not thin with wide marginal platform.
3. Mixed, largely for core elements only; an artefact that retains scars of both soft and hard hammer flaking.
4. Indeterminate.

This variable id directly related to technology and therefore lithic behavioural choice and is key to investigating objectives 2 - 4.

5.3.1.3 Quantitative flake variables (non-Levallois)

These variables relate to the broad technological characteristics of an assemblage, for example size distribution and can help intra and inter-site comparisons of lithic behaviour.

Maximum length (mm), recorded as the absolute maximum length of an artefact form one edge to another, this does not automatically record the axial length (i.e. from platform edge following the line of percussion).

Maximum breadth (mm), same as above but recorded at 90 degrees to the maximum length, again from one edge to the other.

Maximum thickness (mm), measured at the point of maximum thickness.

Number of dorsal flake scars. These only include scars with a minimum dimension of at least 5mm. Within the database “99” is coded for obscured dorsal surface e.g. broken or stained/patinated.

These variables produce data that can be statistically analysed for comparison between assemblages allowing a discussion of patterns within that data and investigating the main research question as well as objectives 2 - 4.

5.3.1.4 Qualitative flake variables (non-Levallois)

These variables are directly related to the technological choices made by individuals and groups through lithic production; therefore answering the main research question through investigating objectives 2 and 4. It's worth mentioning that some of this element of the assemblage could be related to PCT (or other specific core working practices) but without the benefit of large scale refitting (see chapter 3) we cannot confidently assign most debitage to a specific reduction strategy.

Portion:

1. Whole.
2. Proximal.
3. Distal.
4. Mesial.
5. Siret; flake has split along or parallel to the axis of percussion.
6. Chunk/chip; defined by no observable ventral surface

Portion of artefact must be considered for two reasons. Firstly, when addressing a number of variables, such as length, only whole artefacts can be used to accurately access any patterns in production. Secondly, this data can support conclusions made using taphonomic data discussed above i.e. where largely broken assemblages can suggest destructive movement of deposits.

Butt type:

1. Plain.
2. Dihedral.
3. Cortical.
4. Natural (but non-cortical).
5. Marginal.
6. Soft hammer.
7. Mixed (e.g. combination of natural and flake surfaces).
8. Facetted.
9. Missing.
10. Trimmed; small flake scars running into dorsal surface along same axis as the product itself.
11. Chapeau de Gendarme.
12. Obscured (e.g. by damage).

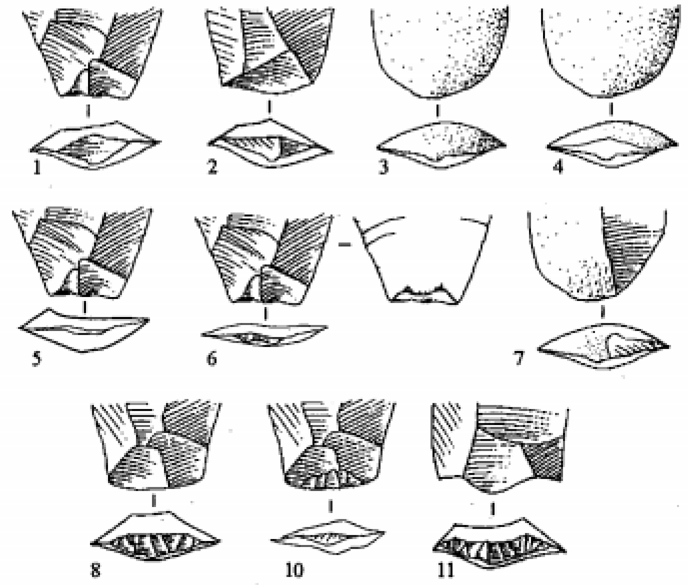

Figure 5.5: Butt type, as referred to in the list above, image taken from (Scott 2006: pg. 50).

Butt type directly relates to research objective 2 by investigating technological behaviour through lithic production strategies. For example high numbers of examples 8, 10 and 11 shows the preparation of platforms suggesting preparation and of control of the final product.

Cortex retention: The percentage of the total surface area of a dorsal face, determined by eye, that retains any cortex, or consists of a natural surface (Ashton *et al.* 1998).

0. 0%.
1. <50%.
2. >50%.
3. 100%.

Cortex retention provides a proxy for the stages of production present within an assemblage. Initial stages will have high percentages, the very first flakes often being fully cortical. We can therefore discuss technological practices related to objectives 2 - 4.

Knapping scar direction:

1. Proximal
2. Proximal and 1 lateral
3. Proximal and both laterals
4. Proximal, distal and 1 lateral
5. One lateral
6. Distal
7. Proximal and distal
8. Both laterals

9. All
10. Natural/cortical
11. Distal and both laterals
12. Distal and one lateral
13. Obscured/damaged
14. Flaked flake spall (including Janus flakes). Retains an “archaic” ventral surface, identified as unworked surface with conchoidal ridges observable.

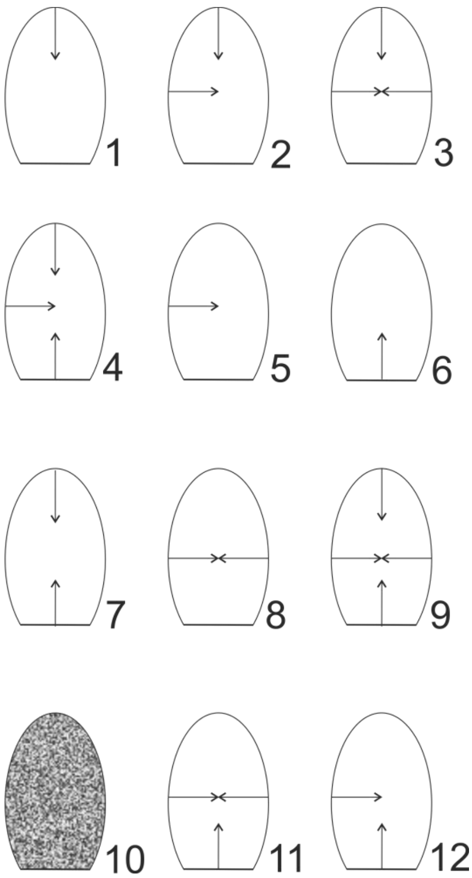

Figure 5.6: Knapping patterns recorded on dorsal surfaces of whole flakes. Numbers relate to the text.

Again, knapping scar patterns are technological proxies, indicative of lithic behaviour, for the overall reduction of an assemblage and can be related to core reduction strategies. These address objectives 2 and 3.

Relict core edge (RCE): Identified by the negative scars of previous removal(s), specifically the proximal scars (i.e. the archaic platform), often identified along a central arête on an artefacts dorsal surface. They indicate the removal of a cores edge, often a battered/abandoned core edge, and either imply rejuvenation of a platform or potential final reduction of a small core before abandonment (i.e. the RCE is not the primary motivation for removal of the flake).

0. Absent

1. Present

Cordal flake: Similar to some RCE’s, cordal flakes are indicative of the final stages of small core reduction. They are indicated by the presence of a small portion of a core surface (i.e. cortical or naturally stained), on the distal end of an artefact, and represent overshot flake removals.

0. No
1. Yes.

Pseudo-Levallois point: I follow the definition, but not typological inclusion as a tool, of Bordes (1961). Identification is based on by-eye morphological similarities to a Levallois point (i.e. solely based on shape), but the axis of percussion *does not* bisect the point (from proximal to distal).

0. No.
1. Yes.

Retouch: Recognised and recorded based on definable anthropogenic removal(s) from the artefact after its removal from the core. These can be singular (flaked flakes) or multiple; invasive or minimal and/or large or small.

0. None.
1. Yes; further recorded in Retouched artefacts (see section 5.3.1.11)

The final five variables are presence of absence categories only. Retouched elements are investigated elsewhere. The other three provide data related to reduction of the assemblages, again related to core reduction strategies. For example a high degree of RCE can suggest heavy reduction and the need to rejuvenate or equally a lack of control of reduction leading to the same purpose. These support and add to discussion connected to research objectives 2 - 4.

5.3.1.5 Quantitative flake variables (PCT)

These variables are essentially the same as for non-PCT flakes however some significant differences need discussing. I have chosen to follow the definition detailed by (Scott 2006). Firstly, for ease of comparison with assemblages outside of this study, I have chosen to measure length and breadth in relation to axis of percussion. This relates to research objective 4 i.e. comparing the Channel Plain record with other regions relating to Neanderthal lithic behaviour.

Length (mm) measured along the axis of percussion (unlike other artefacts, see section 5.2.1.3.)

Breadth (mm); refers to the maximum width at 90° to the axis of percussion.

Maximum thickness (mm).

Number of dorsal scars with a minimum dimension of at least 5 mm.

Number of preceding Levallois removals.

5.3.1.6 Qualitative flake variables

These variables are recorded to allow a comparison between the assemblages studied here as well as providing a means to compare assemblages further afield. They are selected to highlight technological patterns and characteristics specifically related to Levallois production methods. They will feed into discussions related to research objectives 2 - 4.

Confidence of being a deliberately detached Levallois end product:

1. Definite. Following criteria set out by Boëda (1994) fully presented within chapter 2 i.e. the artefact retains tell-tale signs of detachment from a Levallois core e.g. evidence for preceding preparation of the dorsal surface (e.g. centripetal/convergent); distal and/or lateral convexities remains; has a overshot (distal) or debordant (lateral) edge which retains evidence for a striking platform. Often only identified if whole.
2. Probable. Does not maintain obvious indicators of Levallois criteria, but may maintain some form of evidence (e.g. evidence for a preparatory surface). These are nearly always broken or obscured in some way (pers. obs.)
3. Possible**.** Recorded if some evidence is present for PCT, but it is too unclear to tell. These are nearly always broken or obscured in some way (pers. obs.).

Type of Levallois product in morphological terms:

1. Flake.
2. Point.
3. Elongated flake.
4. Debordant flake. One or both lateral edges retain portions of the original striking platform (see chapter 2).
5. Overshot. Distal retains a portion of the original striking platform.
6. Debordant and overshot.
7. Indeterminate.

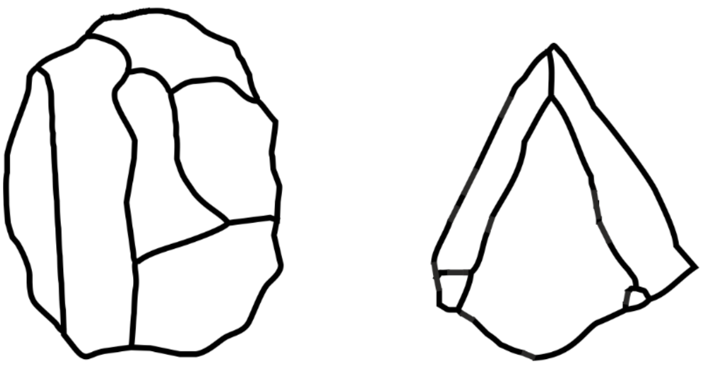

Figure 5.7: Basic Levallois end-products. 1 = Flake, 2 = Point, 3 = Elongated flake.

This variable can be split into two sections. The first three when identified can suggest patterns in production of specific end-products. 4-6 however can suggest failed removals and therefore can shed light on knapping practices, raw material quality or a combination of both. Additionally, these distinct products can give a character of size and shape of cores/potential end-products where such evidence is lacking within the excavated assemblage. Therefore assessment of these variables will add to research objectives 2 - 4 while contributing to the overall research question.

Portion:

1. Whole.
2. Proximal.
3. Distal.
4. Mesial.
5. Siret; product has split along or parallel to the axis of percussion.
6. Chunk/Chip; no discernible ventral surface.

Cortex retention. The percentage of the total surface area of the dorsal face with observable (by-eye) cortex or natural surfaces (Ashton *et al.* 1998):

0. 0%.
1. <50%.
2. >50%.
3. 100%.

Both these two variables contribute in the same way as for all flakes, as described in section 5.2.1.4.

Method of preparation. Recorded based on the dorsal scar directions (see Figure 5.8).

1. Unipolar.
2. Bipolar.
3. Convergent unipolar.
4. Centripetal
5. Unipolar lateral.
6. Bipolar lateral i.e. preparatory scars run in from both edges.
7. Unipolar from distal.
8. Indeterminate.

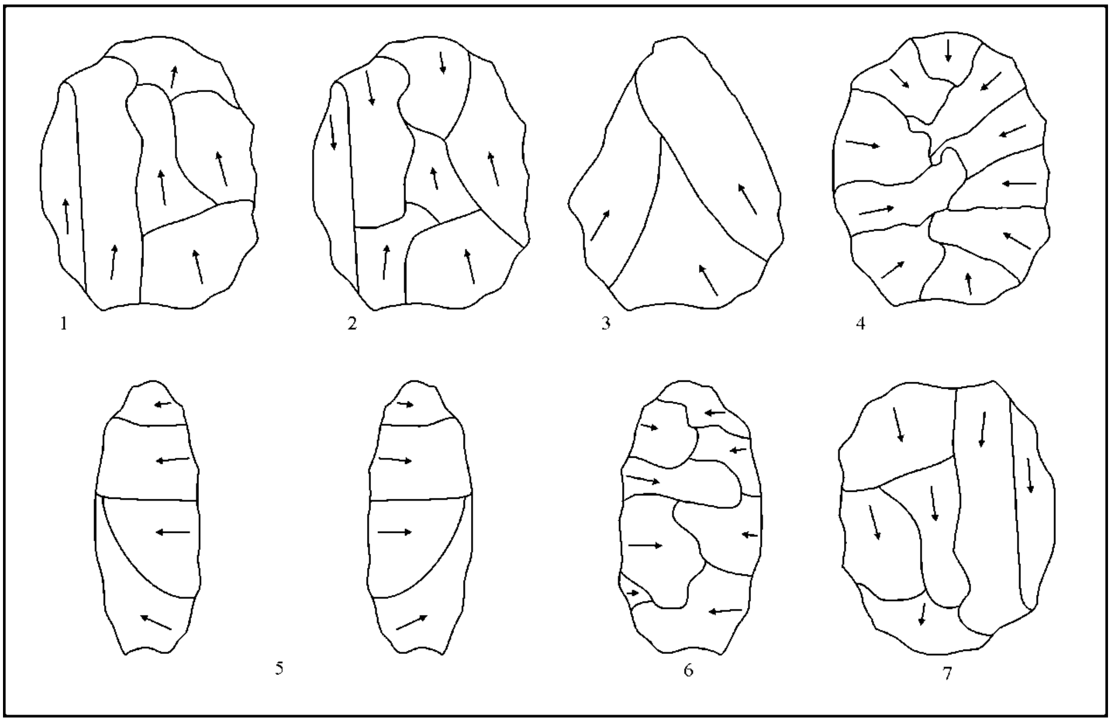

Figure 5.8: Method of preparation after Scott (2006). 1. Unipolar, 2. Bipolar, 3. Convergent, 4. Centripetal, 5. Unipolar lateral, 6. Bipolar lateral, 7. Unipolar distal. Image taken from Scott (2006).

Method of exploitation. Recorded from the direction(s) of any preferential removal(s), see Figure 5.9.

1. Lineal. Identified when flake runs up to core edges and therefore clearly prevents identification of prior removal(s).
2. Single removal.
3. Unipolar recurrent.
4. Bipolar recurrent.
5. Centripetal recurrent.
6. Indeterminate.

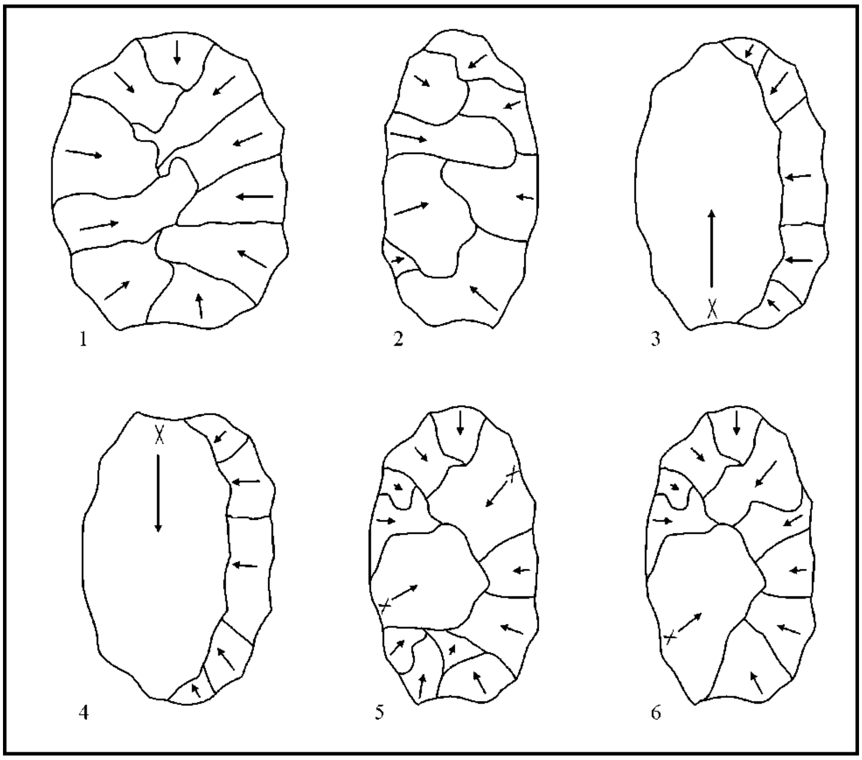

Figure 5.9: Methods of Levallois exploitation after Scott (2006). X marks direction of previous removal. 1. Lineal, 2. Single removal, 3. Unipolar removal, 4. Bipolar recurrent, 5. Centripetal recurrent, 6. Indeterminate. Image taken from Scott (2006).

The method of both exploitation and preparation, in a similar way to product type, allows an assessment of desired end-products and patterns of production used. Again, this allows a discussion of Neanderthal subsistence and extended behaviour adding to research objectives 2 and 4.

Evidence of re-preparation of the flaking surface preceding the removal of the final flake. This is displayed in the form of smaller, less invasive scars cutting an obvious large, invasive Levallois removal:

0. No.
1. Yes.

Identifying definitive evidence of re-preparation allows the assessment of reduction intensity as well as contributing to assessing the movement of raw material, potentially both on a inter and intra site bases. This then can be key to answering research objectives 2 - 4 as well as the overall research question.

Retouched:

0. No
1. Yes; further recorded in Retouched artefacts (see section 5.3.1.11).

5.3.1.7 Quantitative core variables (non-PCT)

Core analysis for all assemblages follows Ashton and McNabb (1996) with a few modifications. These variables are used to discuss the overall technological characteristics of the assemblage i.e. reduction intensity, adding to data recorded from debitage analysis (above) and PCT analysis. Overall we can begin to discuss the fragmentation of the reduction sequences within the assemblages (Turq *et al.* 2013).

Maximum length (mm)

Maximum breadth at 90º to length (mm)

Maximum thickness (mm)

Weight (grams).

5.3.1.8 Qualitative core variables (non-PCT)

Characterisation of *overall* core-reduction method for non-prepared core-reduction:

1. Migrating platform. Presented in depth within section 2.2.3.1.1, identified by multiple removals from multiple platforms, often using different strategies (see below)
2. Single platform reduction, i.e. sequence of parallel removals or sequence of alternate removals that does not exceed 60% of a fixed margin (discussed in section 2.2.3.1.1)

3. Bipolar unprepared, removals from (typically) two platforms at opposite edges to each other and un-connected (i.e. cannot be the same sequence). Not identified within this study.

The discoidal categories are discussed within section 2.2.3.1.2, under Fixed Margin reduction.

4. Discoidal simple (reduction concentrated on one fixed margin, often with the final stages solely from one surface using simple alternate flaking)
5. Discoidal bifacial (classic discoidal flaking).
6. Discoidal hierarchical (one striking platform, part prepared - i.e. one side then other).
7. Indeterminate.

Core reduction is identified using the dominant method displayed on a cores surface and not just morphology alone. This gives an overall pattern of reduction employed within the locale and added to variables provides a baseline for strategies employed throughout a sequence.

Portion:

1. Whole.
2. Fragment.

Blank type. Defined by any retained cortex/natural surface(s), due to the positions of the cortex/natural surface. This variable is unlikely to be identified for none flint/chert material, other than categories 4 and 5. Categories are:

1. Tabular nodule. With opposing cortical/natural surfaces indicative of flint, from within long, thin (in comparison to length and breadth) veins of intrusive bedrock flint/chert.
2. Lenticular nodule. Similar to tabular nodule, identified if cortical material can be show to indicate an original lenticular (biconvex) shape to the nodule i.e. tapering cortical surfaces.
3. Spherical nodule. Nodule was roughly circular in shape, but can be globular or irregular, but retains the remains of multiple natural or cortical surfaces that would not indicate a tabular or lenticular morphology.
4. Flake.
5. Shattered nodule. Nodule has been broken prior to (or potentially between) episodes of knapping. This displays irregular surfaces (not smooth like a knapped surface) and is hard, but not impossible to identify on non-flint material.
6. Indeterminate. No convincing indications of original nodular sharp are retained.

Cortex retention. Percentage of the total surface area of a core which displays evidence of cortex or of a natural surface (Ashton *et al.* 1998), identified by-eye:

0. 0 %.
1. <50 %.
2. >50 %.
3. 100 %.

Total number of core episodes: One core episode is indicated by a remaining flake scar or sequence of flake scars (parallel; alternate; see Figure 5.10) identified on a cores surface. Multiple episodes can be recorded *if* these episodes are separated by unconnected edges i.e. natural edges or portions of previous flake scar, clearly unconnected to the sequences in question (e.g. opposing directions). Identification has followed Ashton and McNabb (1996). These episodes are only recorded on whole cores, where all potential core surfaces can be assess.

Length of longest remaining scar (mm.)

Width of widest remaining scar (mm.)

Total number of removals: where one removal is a clear scar displayed on the core surface.

Number of removals per core episode after Ashton and McNabb (1996). Core episodes are in alphabet order with A, B, C, and D; representing Single removals; parallel sequences; alternate sequences and indeterminate categories in respective order, following McNabb (2007).

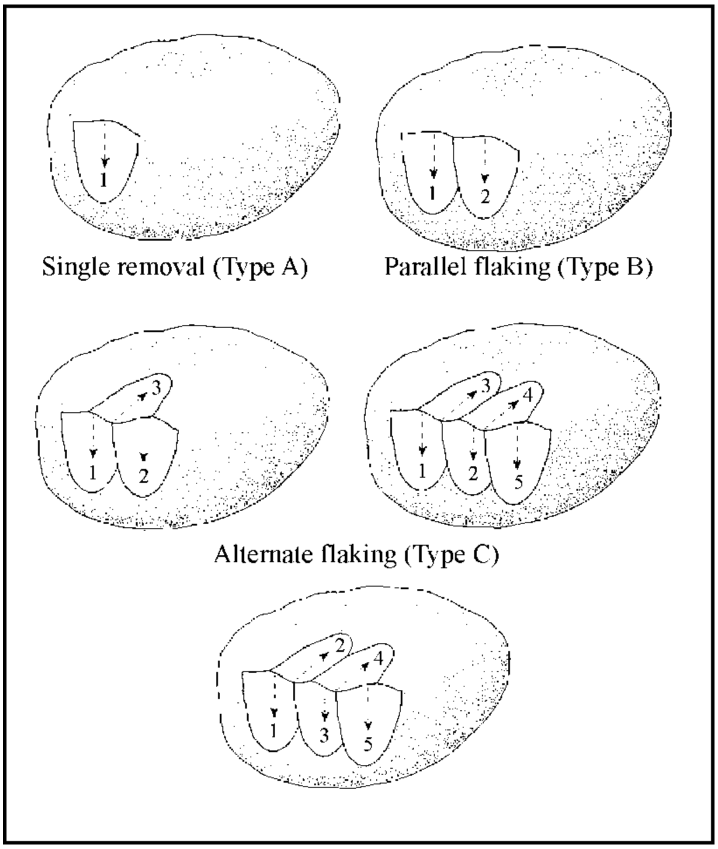

Figure 5.10: Core episode types after Ashton and McNabb (1996) but with modification following McNabb (2007). Image taken from Ashton (1998c).

Retouched:

0. No
1. Yes; further recorded in Retouched artefacts (see section 5.3.1.11)

Re-used as hammerstone: Identified by indicative battering and pitting on one or more surfaces of the nodule. Precaution is taken, especially for cores, as battering can be from *direct* knapping using a hammerstone (i.e. falls within the battering category discussed above) and could also be natural.

0. No
1. Yes

5.3.1.9 Quantitative core variables (PCT)

Again this follows Scott's (2006) definition of Levallois. These variables are included specifically to investigate Levallois production strategies employed for an inter-site comparison with other locales. Further they can be discussed in relation to overall technological characteristics such as dimensions relating to reduction intensity of an assemblage. Eight variables are defined within this attribute set.

Maximum length (mm).

Maximum breadth at 90º to length (mm).

Maximum thickness (mm).

Weight (grams).

Number of preparatory scars visible on the striking platform surface with a minimum dimension of at least 5 mm.

Number of preparatory scars visible on the flaking surface with a minimum dimension of at least 5 mm.

Number of definite Levallois products detached from the final flaking surface.

Dimensions of final Levallois products:

1. Length (mm).
2. Breadth (mm).

5.3.1.10 Qualitative core variables (PCT)

Once again these variables are used both to investigate PCT reduction strategies alone and feed into wider discussions of reduction intensity and technological practice i.e. directly relating to aims 2 and 3 and objectives 3-6. The identification of Levallois follows Boëda (1994) and Scott (2006) and is fully presented within chapter 2 and briefly reviewed in the list below:

1. Observable volumetric control, where two separate surfaces can be identified, separated by a plane of intersection (i.e. Figure 2.6a).
2. The separate surfaces can be identified as a flaking surface (aimed at exploitation), and striking platform surface (for preparation and maintenance of convexity). These are hierarchically discrete.
3. The flaking surface maintains both distal and lateral convexity (i.e. Figure 2.6c & d).
4. The plane of intersection (1 above) is parallel to the flaking angle of the final removal(s) (i.e. Figure 2.6b).
5. The angle created by the flaking surface and the striking platform approach 90 degrees (ideally are perpendicular) to the flaking axis of final removal(s)
6. Hard hammer percussion used.

Type:

1. Levallois.
2. Simple prepared. Discussed in section 2.2.3.1.3, and defined based on Bolton (2015) as the fortuitous natural shaping or minimal shaping of a nodule before a final removal.

Blank type: Following section 5.2.1.8 for non-PCT cores.

1. Tabular nodule.
2. Lenticular nodule.
3. Spherical nodule.
4. Flake.
5. Shattered nodule.
6. Indeterminate.

Measured (as a percentage) of the total area (by-eye) of the core's striking platform surface (see section 2.2.3.1.3.), which displays evidence of cortex/natural surface(s):

1. 0%
2. >50 %
3. <50 %
4. 100 %

Method of preparation of final flaking surface. This can be recorded for either exploited, i.e. based on location of remain preparatory scars present in the exploited final flaking surface (see Figure 5.11), or unexploited/failed examples, after Scott (2006):

0. Unprepared; striking platform orientated, but not a deliberately shaped flaking surface.
1. Unipolar.
2. Bipolar.
3. Convergent unipolar.
4. Centripetal.
5. Unidirectional lateral.
6. Bipolar lateral.
7. Unipolar from distal.
8. Indeterminate.

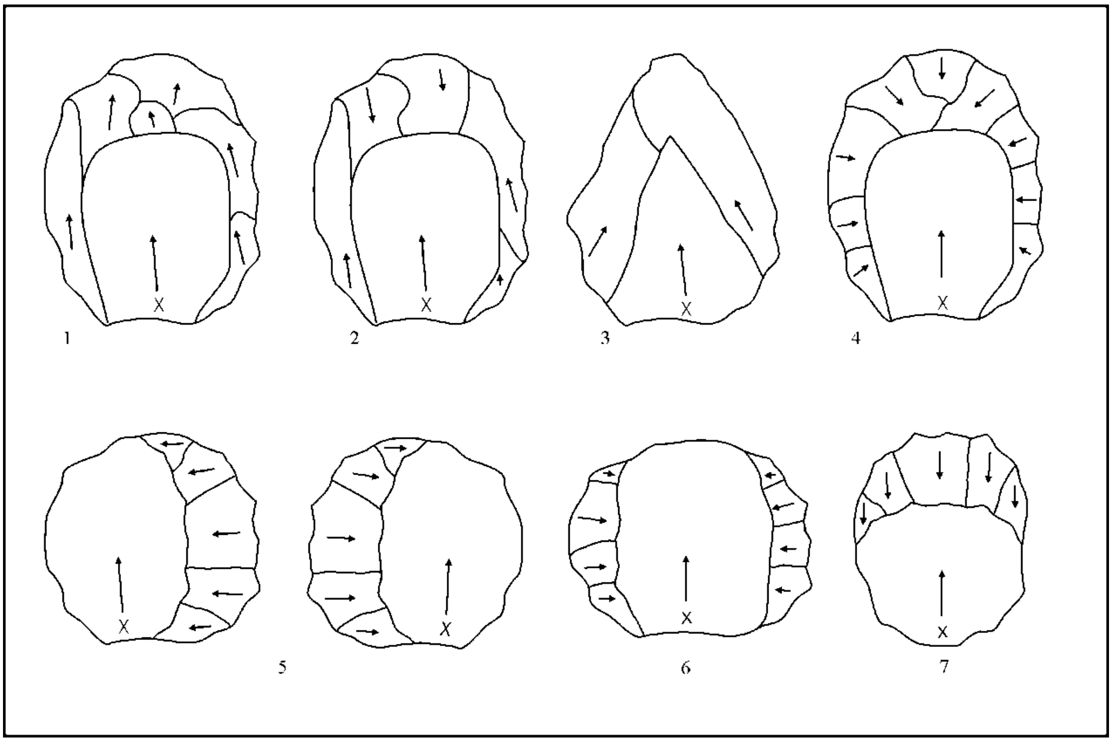

Figure 5.11: Method of Levallois core preparation of final flaking surface. 1. Unipolar, 2.Bipolar, 3. Convergent, 4. Centripetal, 5. Unidirectional lateral, 6. Bipolar lateral. 7. Unipolar distal. Image taken from Scott (2006).

Method of exploitation of final flaking surface. Based on flaking direction of preferential flake scars (see Figure 5.12):

1. Unexploited. Re-prepared flaking surface, but no evidence for attempted at final preferential removal.
2. Lineal. Singular removal from the final flaking surface, with no evidence for a previous removal from the same surface.
3. Unipolar recurrent. At least two removals from the final flaking surface and from one striking platform; must be from the same surface i.e. no evidence for re-preparation.
4. Bipolar recurrent. At least two removals from the final flaking surface from opposing platforms; must be from the same surface i.e. no evidence for re-preparation.
5. Centripetal recurrent. Removals from the flaking surface, from various (two or more) platforms.
6. Re-prepared but unexploited.
7. Failed final removal (e.g. displays hinging or battering).
8. Overshot. Distal end of flaking platform is removed, flake would retain some striking platform.

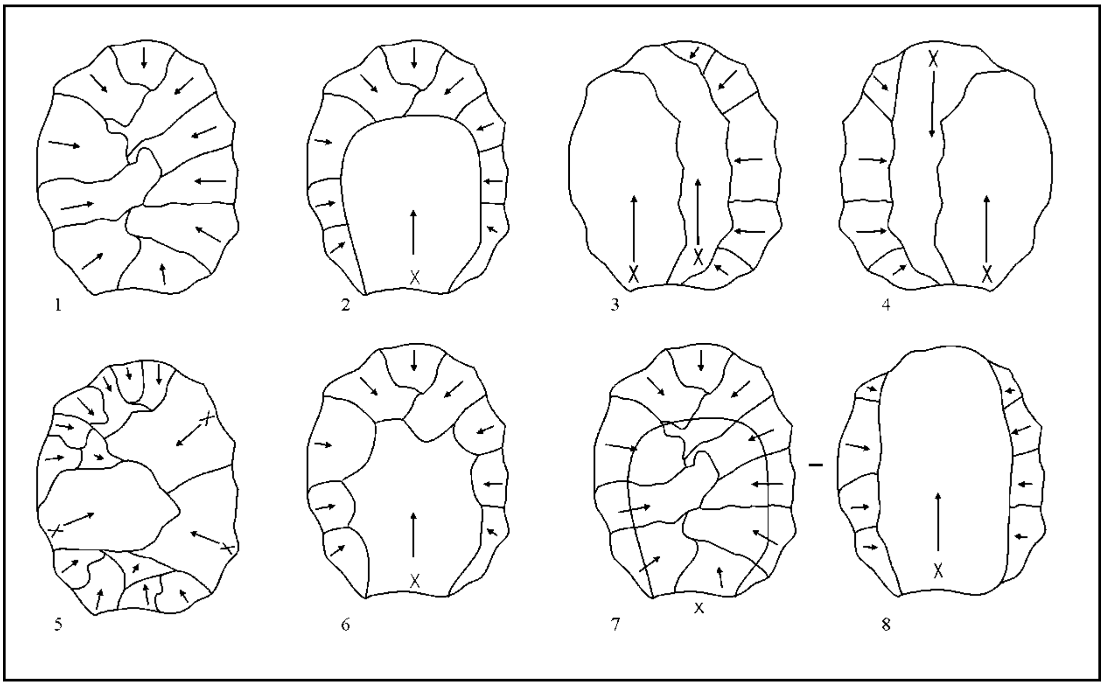

Figure 5.12: Method of exploitation of final flaking surface after Boeda (1985; 1995). 1. Unexploited, 2. Lineal, 3. Unipolar recurrent, 4. Bipolar recurrent, 5. Centripetal 6. Re-prepared but unexploited, 7. Failed, un-detached, 8. Failed, overshot. Image taken from Scott (2006).

Evidence of an earlier flaking surface: Identified by observable preparatory flake scars (most often small), cutting a previous phase of PCT flaking/exploitation.

0. No.
1. Yes.

Morphological description of Levallois products from final flaking surface: Flake scar displayed on the final flaking surface resembles the morphologies displayed within Figure 5.12.

1. Unexploited
2. Flake.
3. Point.
4. Blade.
5. Debordant flake - has removed one or both lateral core edges.
6. Overshot distal end.
7. Debordant and overshot.
8. Failed removal(s).

Length of final removal from flaking surface (mm).

Width of final removal from flaking surface (mm).

Retouched:

0. No
1. Yes; further recorded in Retouched artefacts (see section 5.3.1.11)

5.3.1.11 Retouched Artefacts (typological examples in Figure 5.14)

Position of primary retouch:

1. Direct; retouch is located on the dorsal face
2. Inverse; retouch is located on the ventral face
3. Alternate; retouch is located on the same edge of both faces, but cannot be defined as bifacial at any point (see below).
4. Bifacial; retouch is directed into both faces from the same point of the same edge.

Location of retouch:

1. Proximal/butt.
2. Distal/tip.
3. One lateral edge.
4. Both lateral edges.
5. Continuous except proximal edge/butt.
6. Continuous except other portion of edge (specified in notes).
7. Continuous.

Distribution of retouch:

1. Continuous.
2. Discontinuous. Connected retouch scars (such as on a scraper edge) but not along multiple portions of an edge, separated by a plain edge.
3. Partial. Single, short section of retouched edge, defined here as less than 50% of an edges length.
4. Isolated removal i.e. a flaked flake or notch. This can refer to multiple notches on opposing edges.
5. Burin like removal.

Extent of retouch:

1. Marginal.
2. Minimally invasive.
3. Semi-invasive.
4. Invasive.

Angle of retouch:

1. Abrupt (approaching 90°).
2. Semi-abrupt (~45°).
3. Low (thinning).
4. Mixed, at least two of the above categories observed (additional notes taken).

Form of retouched edge:

1. Rectilinear.
2. Convex.
3. Concave.
4. Retouched notch.
5. Denticulate.
6. Flaked flake.
7. Backing, identified as low angle, minimally invasive scars opposite an opposing edge (so often on a lateral). Often associated with retouched opposing edge (pers. obs.) and therefore become “Mixed”.
8. Mixed (additional notes taken)

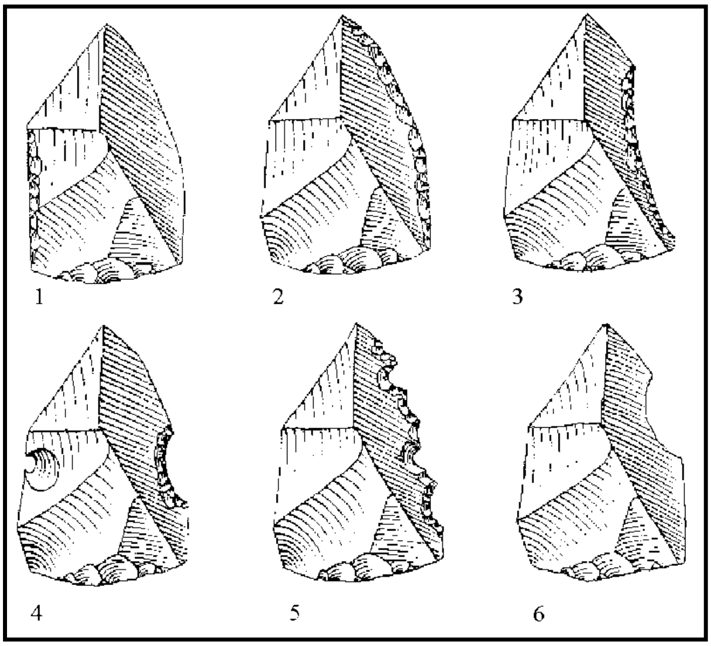

Figure 5.13 Form of retouched edge. 1 = rectilinear, 2 = convex, 3 = concave, 4 = retouched notch, 5 = Denticulate, 6 = Flaked flake.

Regularity of retouched edge:

1. Regular.
2. Irregular, e.g. denticulated
3. Single removal.
4. Obscured e.g. by damage that cuts across the retouch

Morphology of retouch:

1. Scaly.
2. Stepped.
3. Sub-Parallel.
4. Parallel.
5. Single removal.
6. Mixed (additional notes taken)

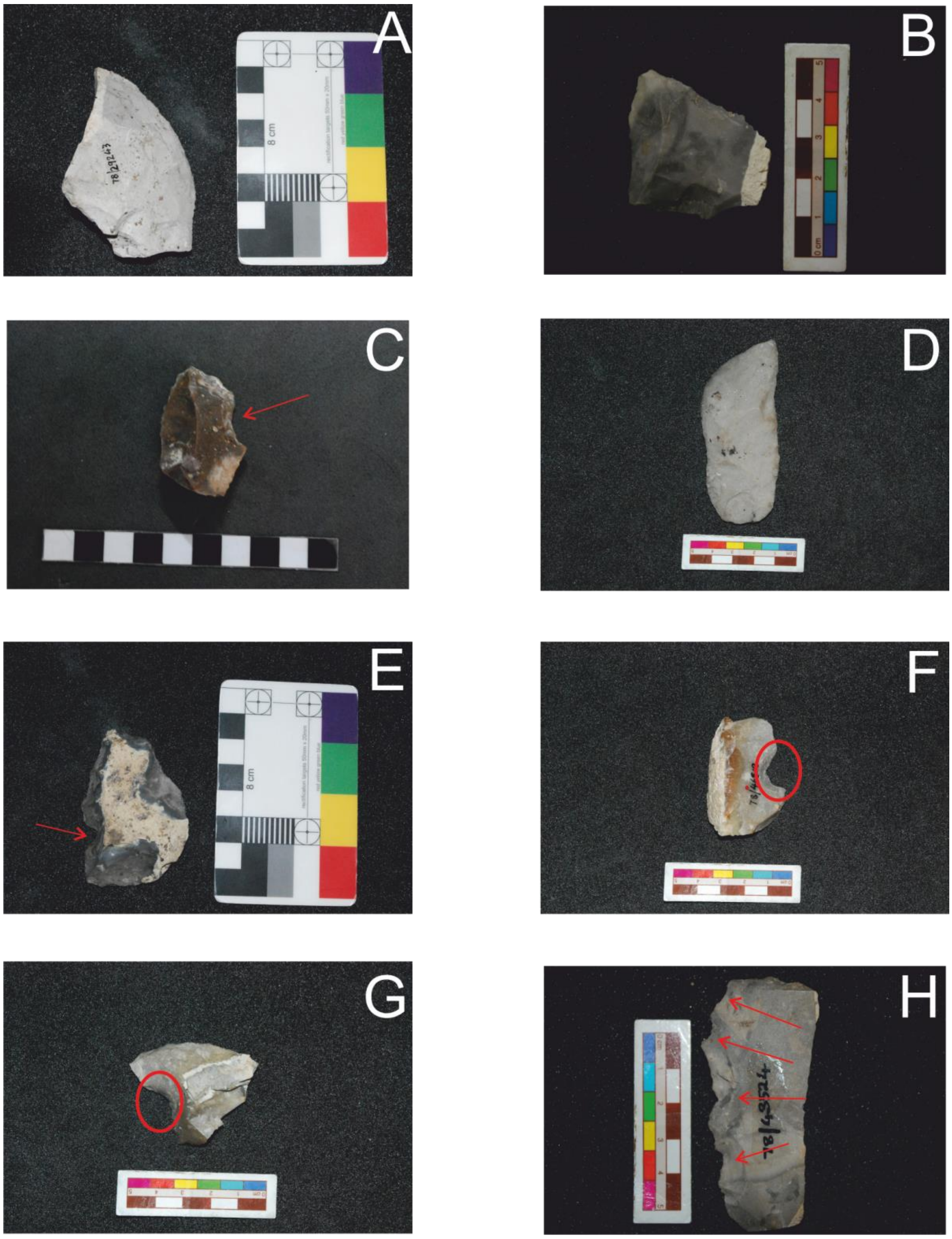

Figure 5.14:Various artefacts takes from layers studied within this study sample. A= Single sided scraper; B= Dejete scraper; C= Multi-tool (convergent scraper with retouched notch on right lateral; D= Convergent scraper; E= Multi-tool (Double scraper with notch into left lateral); F= Notch; G= Retouched notch; H= Denticulate. Also note range of flint material present.

Re-sharpened (see section 5.3.2 for identification and full discussion).

0. No
1. Long Sharpening Flakes (LSF's) and Transverse Sharpening Flakes (TSF's)following Cornford (1986) and discussed specifically in section 5.3.2.
2. Other version of re-sharpening, further detailed in notes. This follows the identification of a secondary episode of retouch that overlaps or largely removes a first. Often evidence for this is totally removed by retouch episodes i.e. (Dibble 1995).

These set of variables will allow a much great understanding of the assemblages studied both from a technological outlook and the understanding of the archaeological conditions and depositional situation. The understanding of an assemblage's depositional situation and its importance was discussed within Chapter 2 and 3. These variables also add important data to the reduction intensity of the assemblage. Not only the discussion of re-sharpening but also the intensity to which pieces are retouched (retouch angle; extent of retouch etc.) among other variables within the full assemblage analysis (Jelinek *et al.* 1989; Dibble 1995). These directly add to the discussion of aims 2 and 3 and objectives 3, 4 and 6.

5.3.2 Re-sharpening techniques

Through the initial stages of research for this thesis and the literature review of the Channel Plain Region (fully presented in chapter 2), specifically La Cotte (i.e. Cornford 1986) it became apparent that a number of distinct re-sharpening techniques were employed by Neanderthal populations of this region throughout the EMP (Michel 1982; Cornford 1986; Monnier 1988a; Hérisson *et al.* 2016b; Locht *et al.* 2016). These techniques are also well documented from across the Neanderthal occupied Eurasia i.e. the Levant (Parush *et al.* 2014; Assaf *et al.* 2015), and is further discussed within this context within chapter 8. Most re-sharpening techniques are identified by overlapping scars from differing episodes of retouch (pers. obs.), often related and responsible for heavy reduction of volume of the final tool (Dibble and Mellars 1992; Debenath and Dibble 1994; Dibble 1995).

At La Cotte, and as yet un-recorded elsewhere in the region (pers. obs.), two specialized re-sharpening techniques where identified by Cornford/McBurney (Cornford 1986). The identification of these separate techniques follows a number of criteria set out here for observation within my own analysis. The two techniques where originally defined as Long Sharpening Flakes (LSF's) and Transverse Sharpening Flakes (TSF's), and are displayed in Figure 5.15 and Figure 5.16.

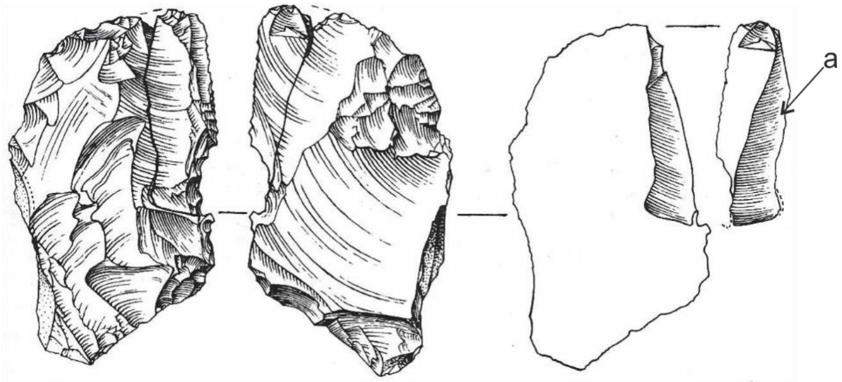

Figure 5.15: Long Sharpening Flake (LSF) alongside its “parent” artefact. Annotated from Cornford (1986: 339).

Based on personal observation and Cornford (1986) there are four criteria for identification of LSF’s and four for TSF’s. Criteria are:

Long Sharpening Flakes

- Length is over twice as long as breadth (most often significantly so), i.e. elongated.
- A facet running the length of the ventral surface (see Figure 5.15, annotated “a”), which represents an “archaic” surface from the parent material, often an “archaic ventral” and often displaying prior retouch.
- Often truncated. This could be due to excessive thinness of many examples, especially in comparison to burin spalls.
- Distinct butt/platform type. Although not a definable criteria, butt/platform type is often telling. A number of examples show clear evidence for the use of a truncation (either of a broken artefact or deliberate creation of a platform for these removals). Another common example is very fine, elaborate faceting, often with a bulbar lip, indicative of soft hammer flaking for final removal.

LSF’s are not confused with burin spalls due to two characteristics. Firstly, the angle between the “new” ventral surface and the “archaic” surface (facet) is always above 90 degrees (pers. obs.). This is the opposite within burin spalls, due to their specific aim to produce a burin or chisel like tool (pers. obs.). Secondly, the two ventral surfaces are observably different in surface area on a LSF, producing a scalene triangle like cross section. In burin spalls, the area of these two surfaces are often broadly identical, by-eye, and produce an equilateral triangle (pers. obs.).

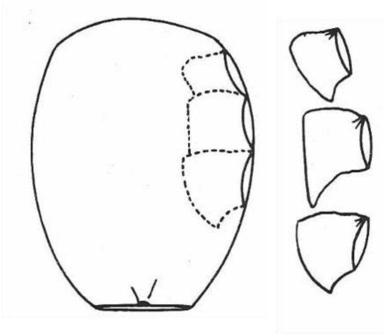

Figure 5.16: Transverse Sharpening Flakes (TSF) with sketched removal scars on parent artefact. Image from Cornford (1986: 345).

Transverse Sharpening Flakes:

- Breadth is most often larger or identical to length.
- Platform is highly distinct and always plain
- Prior episode(s) of retouch are present on the dorsal surface of the platform (i.e. convergent with it), see Figure 5.16. These are distinct from bifacial thinning flakes as only one surface retains retouch/sharpening (always the dorsal, pers. obs.).
- Angle of platform is always low, due to the angle needed to remove a TSF from a retouched artefact and with a observable lip indicative of soft hammers flaking (also noted by Cornford 1986: pg 345).

From a technological point of view, LSF's and TSF's obviously differ. Long sharpening flakes remove the whole edge (occasional partial if failed or hinged, pers. obs.) of the re-sharpened artefact and produce a fresh and continuous, sharp edge; interestingly a small percentage of these retained no prior retouch, but remove a denudated edge (Cornford 1986; pers. obs.). Transverse examples remove part of an edge (or discontinuous removal of a whole edge if removed in a parallel sequence as in Figure 5.16). The possibility of the use of the removed artefacts as tools is highlighted by Frame (1986) whose study identified 71 of the 117 LSF's displaying usewear. The usewear was largely indicative of hide (t= 37) and wood working (t= 23). This was similar to the whole, "final sample" of artefacts studied using this technique (see section 2.3) showing mainly hide and wood working at La Cotte with limited evidence for butchery, bone and antler working (ibid: 355) with most (t= 41; 35%) showing no evidence for use. It is likely based on this limited sample/record that LSF's are not part of a production technique, rather they are used within the general techno-economic strategy at La Cotte (see later chapters).

Their investigation leads directly to the understanding of raw material economy based on climatically driven availability of raw material within these landscapes i.e. providing answers for aims 2 and 3 and specifically objectives 3 and 4.

5.4 Archaeological Site Selection Criteria

After conducting a literature review of archaeological research within my defined region (see section 2.1) four archaeological locales have been chosen for further discussion; in addition to the full presentation of La Cotte. These sites have been chosen after matching one of a number of criteria; geography, chronology, stratigraphical context, and assemblage size. All sites chosen are within Brittany. Sites within Normandy (also part of my personally defined Channel Plain Region) are also briefly discussed within this thesis. The four locales discussed in depth were also part of a more detailed review by myself after a research visit to Rennes, Brittany. This visit did not include a systematic analysis following the methodology set out above, (i.e. as undertaken for La Cotte de St Brelade); this was due to the storage and organisation of these assemblages. Due to both financial and time constraints no sampling, along the same lines as at La Cotte (discussion in section 5.2) could, or can at the time of writing, be undertaken on these assemblages.

Only Menez-Dregan could have seen any full scale analysis, still with considerable re-organisation of the assemblage (i.e. months of work). It was decided (by the author) to conduct a short review of these assemblages, based on what was present within the storage facility of Renne University (no full assemblage was present in one place due to movement for museum exhibitions, general curation issues and a lack of a full inventory from excavation). The review undertaken concentrated on identifying differing raw materials within each present sample, and using personal knowledge and observation from assessing there broad origin. For example, with flint in the region two sources are often most prevalent, beach cobbles and riverine nodules, and both have implications on landscape behaviour of Neanderthal groups. At the same time, it was possible to conduct a search for any possible technological connections to the assemblages of La Cotte, specifically degrees and use of re-sharpening. These results are presented in depth in chapter 6.

5.4.1 Geography

The geographical context for the sites chosen is defined by my definition of the Channel Plain Region defined within section 2.1. As mentioned the region is used to constrain analysis rather than as a belief of Neanderthal range or landscape preference.

5.4.2 Chrono-stratigraphy

Chronologically my research concentrates on the period of Saalian occupation at La Cotte, c. 220 – 160 kya or the later stages of MIS 7 (MIS 7c-a) and into the glacial of MIS 6. Therefore, all the chosen sites are confidently correlated to this period using either radiometric techniques (OSL, ESR, TL etc. (e.g. Bahain *et al.* 2012) or they are related with strong chrono-stratigraphic correlations (Monnier *et al.* 2011; Laforge 2012). All of these correlations follow personal observations presented within chapter 3.

5.4.3 Assemblage size

Due to the previous four criterions assemblage size becomes heavily restrictive. While it would be ideal to set a minimum assemblage size at 500 artefacts, some sites with excellent behavioural data preservation have small assemblages. For example, within this period and region the Nantois butchery site (Plenéuf-Val-André) has 35 lithics which provides substantial evidence for Neanderthal subsistence practises. Therefore assemblage size is varied and has to be discussed individually, based on all criteria.

From these criteria I have selected five sites:

La Cotte de St Brelade
Plenéuf-Val-André (Nantois and Piégu)
Les Gastines
Grainfollet
Menez-Dregan, layer 4

5.5 Conclusion

The methodologies presented here have been used on the layer assemblages studied at La Cotte de St Brelade i.e. layers H - A, and informed the review of assemblages highlighted from Brittany. By employing the full assemblage analyse at La Cotte I have been able to highlight patterns within Neanderthal lithic behaviour employed in different layers throughout this sequence, covering c. 220 – 160 kya. These patterns provided the perfect base for looking further afield, across the region, to assess landscape behaviour of Neanderthal populations. Further, these patterns can be discussed in the wider context of Neanderthal behaviour within Eurasia, and allow the investigation of the research objectives set out within chapter 1. The next chapter presents the results of this assemblage analysis at La Cotte.

Chapter 6: Lithic Analysis: Results

6.1 Introduction

This chapter will present the results and interpretation of data collected using the methodologies discussed within chapter 5. This will then form the basis for a discussion of Neanderthal lithic behaviour within the Channel Plain Region in the following chapters. In total this chapter will present 6591 artefacts from La Cotte (see Table 6.1).

Layer	Artefact total (from Callow database)	Density lithics (/spit)	Study database (recorded as part of this study)	Non-Flint (all artefacts; %)	Taphonomic Edge damage (%)	Denticulate types/Scraper types	Intensity of core working/ core episodes	Overall core reduction	Sea-level (based on fig 4.6)	Environment
A	40388	4.70	1417	33.24	48	Scraper dom.	Heavy/2.47	Mig. Plat/ Fix.Peri./ PCT	Low (6e/d)	Cool, dry
B	5192	4.06	329	15.20	73	Scraper dom.	N/A	N/A	Low (6e)	Cold
C	9772	6.29	1110	24.14	22	Scraper dom.	Heavy/2.5	Mig. Plat/ Disc.	Low, dropping (7a/6e)	Cool, dry
D	7686	11.19	1490	23.09	19	Even	Heavy/2.3	Mig. Plat/ Disc./ PCT	High, dropping (7a)	Cool, dry
E	6443	9.78	663	9.65	26	Scraper dom.	Medium/1.8	Mig. Plat/ Fix.Peri./ Disc.	High, maximum (7a)	Temperate, dry
F	6404	7.07	758	4.88	62	Denticulate dom.	Heavy/2.3	Disc. Hier/ Mig. Plat./ PCT	High rising (7b/7a)	Temperate, dry
G	4825	5.13	503	7.16	21	Denticulate dom.	Medium/1.8	Disc. Hier/ Mig. Plat	High (7c)	Temperate, dry
H	2235	3.66	321	8.10	34	Denticulate dom.	Heavy/2.3	Disc. Hier/ Mig. Plat	High, rising (7c)	Temperate, dry
Total	82945	5.45	6591		Average: 38					

Table 6.1: Summary table for La Cotte based on personal observations and published data (McBurney and Callow 1971; Callow and Cornford 1986); Highlighted in red = published data; highlighted in orange = pers. obs. "Denticulate types" refers to Bordes' (1961) types 42 and 43 i.e. denticulates and notches (both types). Overall core abbreviations refer to overall core reduction strategies set-out in chapter 5: Mig. Plat. = Migrating Platform cores; Fix.Peri. = Fixed Perimeter cores; Disc. = Discoidal classic; Disc. Hier. = Discoidal hierarchical; PCT = Prepared Core Technology.

Table 6.1 displays a summary of both my data, presented throughout this thesis, and published data (McBurney and Callow 1971; Callow and Cornford 1986; Callow 1993). Subsistence strategies and technological repertoires are highlighted from the study database of 6591 artefacts. These are also discussed in relation to original excavation data. This is assessed in two forms, firstly using data published in Callow and Cornford (1986), and discussed elsewhere (e.g. McBurney and Callow 1971; Callow 1993). Secondly, using the original database, compiled largely by P. Callow and provided by A. Shaw, after it was updated to a working Excel file format from original SPSS formats. This database includes a number of data categories not discussed elsewhere (e.g. butt type). It also provides a better understanding of the full signature of the assemblages.

Taphonomic data are presented first within each layer section (H - A), and compared to Callow (1986j) which is presented in depth in the review of La Cotte stratigraphy (chapter 3). Results from other categories are displayed in sections:

1. Cores and core working (PCT and non-PCT)
2. Flakes (PCT and non-PCT)
3. Retouched elements (inc. sub category of biface elements when evident)
4. Micro-debitage (only layer E)
5. Manuports and hammerstones

6.2 Analysis

6.2.1 Layer H

6.2.1.1 Introduction

Layer H represents the smallest of the lower assemblages at only 322 pieces; one was found to be missing during analysis and three natural, fissure granite chunks were also identified (Table 6.2). The excavated whole layer H assemblage totals 2235 (i.e. Callow database count), with 2144 presented in Callow and Cornford (1986).

Artefact type	**Count**	**%**
Flakes	277	86.02
Retouch	29	9.01
Non-PCT cores	9	2.8
Manuports	3	0.93
Misc.	3	0.93
Missing	1	0.31
Total	**322**	**100**

Table 6.2: Artefact list for this study, layer H, grid square 100/-100.

The majority of material from layer H shows no edge damage (Figure 6.1) and supports the assumption of "*slight disturbance*" of the layer H deposits (Callow 1986e). Only 34% shows any damage, with 19% of that recorded as only '*slight*'. Further, only 22 individual pieces show secondary degrees of edge damage (all slight) and patination and scratching is extremely low (11 and 7 respectively).

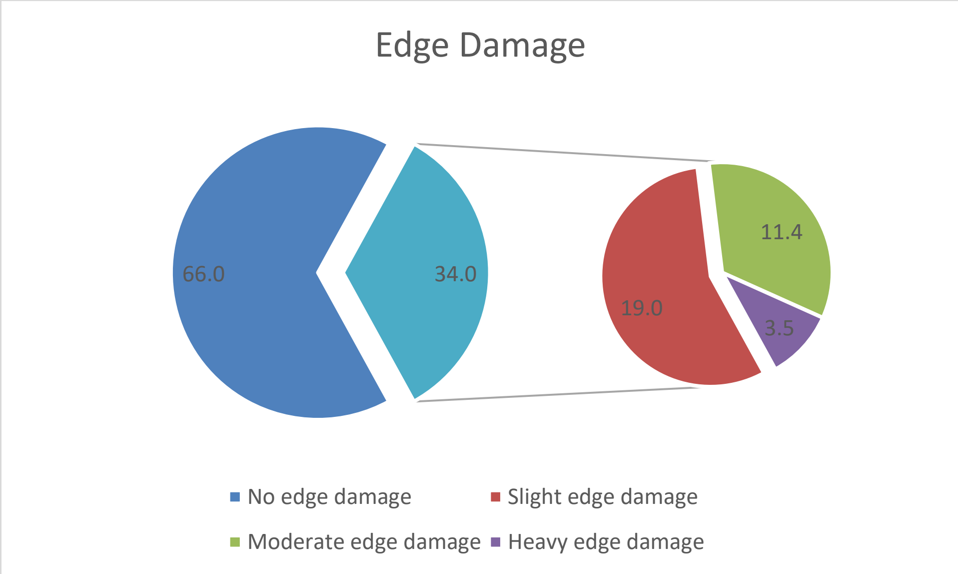

Figure 6.1: Edge damage recorded on all artefacts from this study sample (t= 318), layer H, grid square 100/-100.

However, nearly half (47%) of the flake material recorded was fragmented. This could be both related to trample activity (animal and hominid) and to the degree of rock fall in these lower layers, recorded during excavation (Callow 1986j). This has led to caution when analysing the retouched material i.e. identification of notches and denticulate edges. Micromorphology and sedimentology (Lautridou *et al.* 1986a; van Vliet-Lanoë 1986) of the deposits showed that the limited exposed deposits of layer H where heavily affected by the collapse of the "fossil cliff" (see chapter 3). Infiltration of loess and faunal material (Scott 1986b) from above suggest that some percentage of the archaeological material is also derived and not likely in situ.

6.2.1.2 Cores and core working

6.2.1.2.1 Non-PCT

Flint dominates the raw materials identified, with eight of the nine artefacts (Table 6.3), the only exception being a large quartz core on a flake. The quartz example is the largest of the cores and matches examples from other layers; large, multi-platform core, in this case, with four single removals. The other quartz core identified by Hivernel (1986), within the whole layer H assemblage, was a discoid and one other non-flint example was identified (Callow 1986g: 220). This is not discussed by (Callow 1986c) but the database suggests it is of *grès lustré* and could provide valuable evidence for raw material sourcing for La Cotte's earliest known occupations (pers. obs.).

RM Type	Count	%
Flint	8	88.89
Quartz	1	11.11
Total	**9**	**100**

Table 6.3: Raw material type for all cores in this study sample (t= 9), layer H, grid square 100/-100.

All identifiable raw material sources are derived (Table 6.3), however cortex is noticeably thick and chalky and indicative of nodules which have seen limited movement from their original outcrop source.

RM source	Count	%
Primary	0	0
Derived	4	44.44
Indeterminate	5	55.56

Table 6.4: Raw material source for all cores in this study sample (t=9), layer H, grid square 100/-100.

Core metrics (Table 6.5), and range and variance are high due to a single larger core nodule, in this case the single quartz core on a flake. The low sample size of whole examples (t= 8) precludes statistical analysis, unlike later layers (i.e. layer D).

	Length (mm)	**Breadth (mm)**	**Thickness (mm)**	**Weight (g)**
Mean	43.4	34.9	22.0	32.0
Standard Deviation	9.0	8.0	8.0	21.0
Variance	79.0	66.0	65.0	432.0
Range	28	23	20	51

Table 6.5: Metrics for all whole cores within this study sample (t= 8), layer H, grid square 100/-100.

All the identifiable core blank types are flakes (Table 6.6) i.e. cores on flakes. The lack of other identifiable blank types indicates the later stages of reduction of cores are present i.e. cortex and natural surfaces removed. Use of flakes as blanks also show a high degree of reduction of any available, good quality material e.g. flint.

Blank Type	Count	%
Flake	5	55.56
Indeterminate	4	44.44
Total	**9**	**100**

Table 6.6: Blank type of all cores within this study sample (t= 9), layer H, grid square 100/-100.

Migrating platform reduction was most common of the overall reduction methods employed for all whole cores (Table 6.7). *Discoidal hierarchical* examples are significant, when compared to other layers (see Table 6.1), and no *classic discoids* where identified, but the low numbers in this study sample preclude a full discussion of preference in reduction strategy. Migrating platforms, often with single final removals, are most prevalent; again indicative of the final stages of reduction before abandonment.

Reduction Method	Count
Migrating platform	4
Single platform, unprep.	1
Discoidal, hierarchical	3
Total	**8**

Cortex Retention	Count
0%	4
<50%	4
>50%	0
100%	**0**

Table 6.7: Reduction method and cortex retention for all whole cores in this study sample (t= 8), layer H, grid square 100/-100.

Cortex retention is low overall across this sample with no cores recording more than 50% surface cortex (Table 6.7); potentially due to heavy reduction of cores on flakes. The relatively small nature of the cores could suggest these are heavily reduced from distant outcrops of material within the landscape. Number-of-removals per core is high at 6.3 flake removals per core (Table 6.8). This represents one of the highest scars per core counts of this sample (Table 6.1). Overall alternate categories dominate the knapping strategies i.e. category C. The migrating platform strategies discussed above relates to alternate sequences, often followed by single removals before abandonment i.e. category A removals.

Removals / episode	Count
A	11
Bi	0
Bii	0
Ci	4
Cii	24
Ciii	5
Mean	**No. Removals**
	6.3
	No. Episodes
	2.3

Table 6.8: Removal per core episode recorded from final core surfaces of all whole cores (t= 8), layer H, grid square 100/-100.

6.2.1.2.2 PCT cores

No PCT core elements where identified within this sample. Hutcheson and Callow (1986) identified 8.8% Levallois cores in their study (t= 5), however its worth mentioning that only 68 cores where identified within layer H as a whole.

6.2.1.3 Flakes

RM Type	Count	%
Flint	287	93.79
Basic Igneous	2	0.65
Granite	2	0.65
Sandstone	2	0.65
Quartz	6	1.96
Siltstone	1	0.33
Quartzite	5	1.63
Unidentified	1	0.33
Total	**306**	**100**

Table 6.9: Raw material type for all flake artefacts from this study sample (t= 306), layer H, grid square 100/-100.

Debitage, as with cores (section 6.2.1.2), is dominated by flint (see Table 6.9), with only 6.2% non-flint. The non-flint materials are varied in comparison to the core-elements. All the non-flint material is available within the immediate vicinity of La Cotte (see chapter 4). As suggested with cores, this study identified thick, chalky cortex on flint, believed to be indicative of riverine material from gravel sources that are close, if not immediate, to the eroded outcrops i.e. nodular material has not travelled and rolled far from a fresh source. Three individual pieces were also identified as *primary*, suggesting fresh, cretaceous outcrops of material were also available within the area. These could however be transported in from further afield; as seen elsewhere in the EMP (i.e. Les Gastines, Brittany).

RM source	Count	%
Primary	3	0.98
Derived	136	44.44
Indeterminate	167	54.58

Table 6.10: Raw material source of all flake pieces within this sample (t= 306), layer H, grid square 100/-100.

Metrics (Figure 6.2 and Table 6.11) broadly match that from the cores (section 6.2.1.2.1), and there is no definitive suggestion that material is not all produced from cores present (or similar examples). This is also indicative of the later stage of reduction, or reduction of small nodules, in short sequences. The general lack of larger flakes also points to this and suggests that the cores on flakes may be related to other reduction sequences, not present in this sample. The Callow database only identifies one *grès lustré* and the two quartz cores, suggesting some non-flint may be brought in as blanks and working flakes as opposed to knapped within the locale. Flint is on average smaller than the other present raw material flakes (see Figure 6.2). This is also seen throughout the assemblage studied as part of this research.

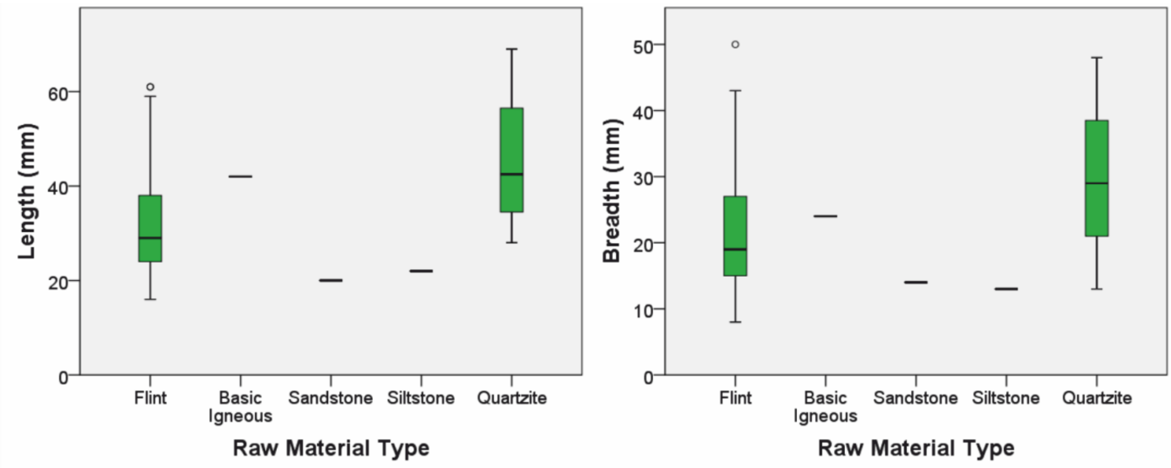

Figure 6.2: Boxplots describing length and breadth distribution of all whole flakes (t= 144) within the layer H sample.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	33.2	22.7	8.5
Standard Deviation	11.3	9.3	4.7
Variance	128.4	86.7	22.5
Range	53	43	23

Table 6.11: Metrics for all whole flake artefacts (t= 144) recorded by this study, layer H, grid square 100/-100.

Cortex is also relatively low on whole artefacts (Figure 6.3), with only 17% (t= 25) with more than 50% retention. This could suggest some movement of material into the locale, with low percentages of highly cortical examples suggesting decortication and initial core working elsewhere. Only two pieces were fully cortical. This also matches the use of cores on flakes, as discussed above.

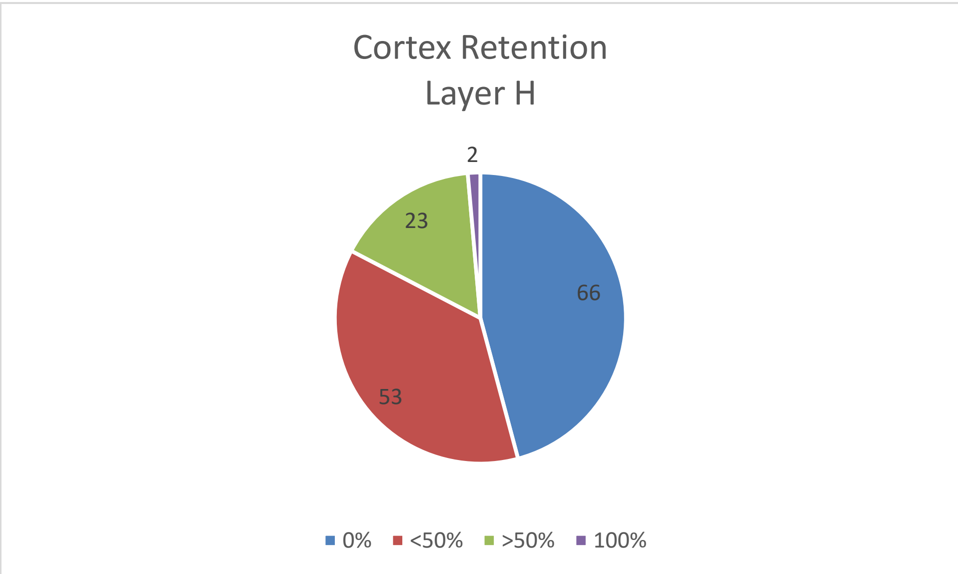

Figure 6.3: Cortex retention on all whole flake elements within this study sample (t=144), layer H, grid square 100/-100.

Cortical butts are also low, again suggesting low degrees of cortical material transported into the locale (nodules, cores or cores on flakes), potentially indicative of the movement and use of relatively small, irregular nodules. This would also support the lack of evidence for blank types of cores (see above), and the general small nature of core material. Again the cortex is often thick and chalky with observable, but low, levels of evidence for rolling (pers. obs.). Overall plain platforms dominate and dihedral elements are significant (Table 6.12). Obscured elements are often due to shattered material, indicative of use of heavily flawed nodules and/or significant edge damage due to taphonomic effects.

Butt Type	**Count**	**%**
Plain	77	44.5
Dihedral	33	19.1
Cortical	11	6.4
Marginal	6	3.5
Soft hammer	7	4.0
Facetted	8	4.6
Missing	6	3.5
Obscured	25	14.5
Total	**173**	**100**

Table 6.12: Butt type for all whole and proximalments of this sample (t= 173), layer H, grid square 100/-100.

6.2.1.4 PCT Products

A single denticulate on an elongated Levallois flake, was identified as the only Levallois product within this sample. The piece is larger than the majority of non-PCT debitage (68mm x 30mm). Callow (1986d) identified very few Levallois products and the Callow database documents 20 individual elements of PCT production (0.89%). Its presence overall is important (pers. obs.), but it is the least significant PCT assemblage within the La Cotte sequence (Callow 1986g).

6.2.1.5 Retouched Elements

Retouched elements are heavily dominated by notches and denticulates (Table 6.13), with only two other well retouched types. As discussed above, identification of notches and denticulates has been conducted with caution due to high degrees of rock fall, and those discussed here (and throughout this thesis) are definite examples of retouch (based on pers. obs.).

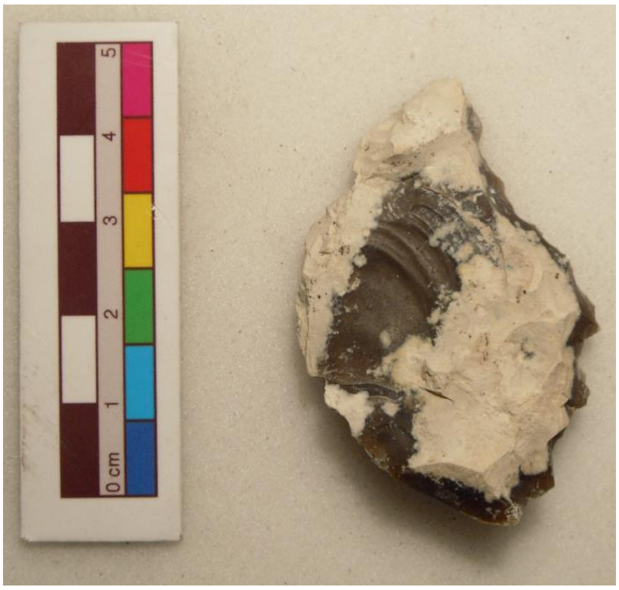

Figure 6.4: Example of a denticulate from layer H. Note the thick chalky cortex.

Two of the "*mixed*" elements identified (i.e. those with two or more differing retouch types) have scraper edges, and all three have notches and/or denticulate edges. Again the broken/shattered elements are probably due to rock fall rather than any evidence for heavy use. The single siltstone chopper within the Callow database could suggest some degree of heavy duty tasks taking place. This signature is supported by Callow (1986d) where only 13.8% where identified as scrapers types.

Bordes typology	**Count**
Déjeté scraper	1
Notch	10
Denticulate	7
Tayac point	1
Mixed	3
Broken and Misc	8
Total	**30**

Table 6.13: Bordes typology after Bordes (1961) for all retouched elements of this sample, layer H, grid square 100/-100.

All the retouched elements discussed here are flint, no retouched non-flint was identified by this study. Again only one piece is mentioned by Callow (1986c) and four by Hivernel (1986) in the full, published sample (t= 2022). Metrics for the retouched flint (Table 6.11) are larger than the remnant cores (Table 6.5), and could suggest movement of retouched material or blanks into the locale from further afield i.e. from earlier or separate stages of reduction. The belief of a relatively fresh source of flint (i.e. thick, chalky but derived cortex) could also suggest material is traveling some distance from the north (see chapter 4) and is heavily reduced over time.

	Length (mm)	**Breadth (mm)**	**Thickness (mm)**
Mean	41.6	29.7	13.0
Standard Deviation	11.3	9.9	4.8
Variance	127.5	98.0	23.4
Range	41	42	19

Table 6.14: Metrics for all whole, retouched elements of this sample (t= 21), layer H, grid square 100/-100.

Platforms on retouched elements are similar to the non-retouched flake elements, with little influence of faceting, and a dominance of plain platforms (Table 6.15). There are no cortical or marginal examples however, but cortex retention is still noteworthy on dorsal surfaces (see below).

Butt Type	**Count**
Plain	10
Dihedral	3
Facetted	1
Missing	6
Indeterminate	3
Total	**23**

Table 6.15: Butt type for all whole or proximal retouched elements of this study sample (t= 23), layer H, grid square 100/-100.

Cortex retention, as mentioned, is relatively high with only 24% showing no cortex at all (Figure 6.5). This could be indicative of preference for initial core reduction elements for retouch blanks i.e. selection of larger blanks.

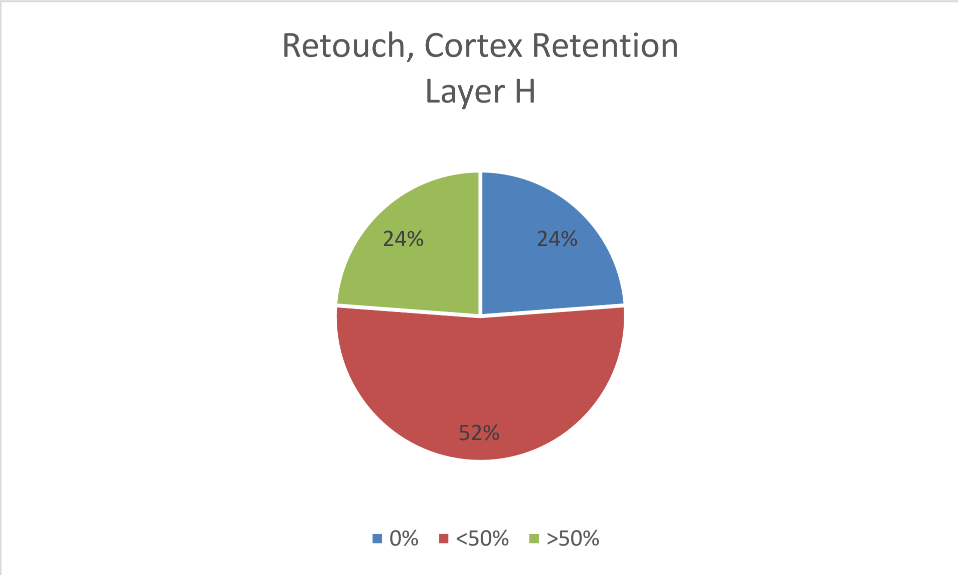

Figure 6.5: Cortex retention on whole retouched elements for this study sample (t= 21), layer H, grid square 100/-100.

Direct evidence for re-sharpening is also present within this sample. This study identified two flakes representing Cornford's (1986) specialized sharpening techniques (one LSF and one TSF). The database documents 22 of these flakes, slightly dominated by TSFs (t= 12). One burin spall was also noted by this study (t=2 in the Callow database).

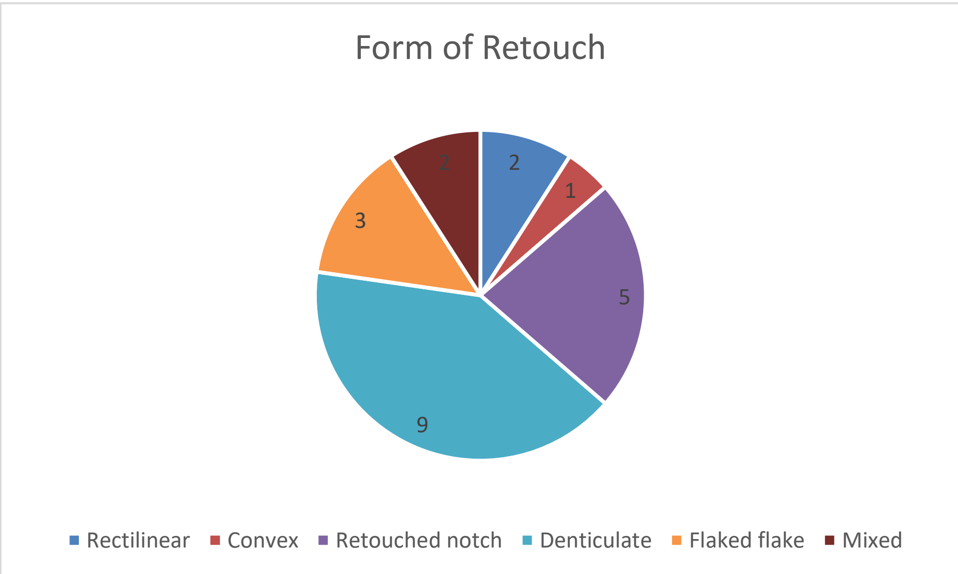

Figure 6.6: Form of retouch recorded for all whole, retouched artefacts (t=22) form layer H, grid square 100/-100.

The additional retouch variables add more evidence for a dominant presence of denticulates and notch types (Table 6.2); this is also discussed by Callow (1986d). No bifacial working was identified within this study, the Callow database documents three bifacially worked pieces; all scrapers.

6.2.1.6 Manuports and Hammerstones

In total this study identified one granite hammerstone and two manuports (one flint cobble and one uncertain). Both the manuports are likely to be from exposed beach outcrops, potentially archaic, with indicative thin, stained cortex or irregular battered surfaces. This hammerstone was the only one identified within the layer H sample from excavation (i.e. from the Callow database), with three small rolled pebbles making up the manuport count. These three elements could represent fluvial activity in the fissure but could also relate to material from above or even remnant material from the original wave scoring of bedrock from the fissures origins i.e. a marine cave/gully.

6.2.1.7 Conclusion: Layer H

Layer H is the smallest of the samples, both in my sample presented here and from excavation (i.e. within the Callow database), and the sample size limits our confidence in an overall behavioural signature. This is also affected by the disturbed and derived nature of sediments (and certainly some of the lithics) from layer H sedimentology (Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). However, the use of denticulates and notches, and acquisition of good quality flint over immediately sourced non-flint, fits patterns that develop over the following layers (see Table 6.1; and below). This is further discussed in comparison to other layers in the proceeding sections.

6.2.2 Layer G

6.2.2.1 Introduction

In total 503 artefacts were recorded from layer G, with nine missing at the time of recording (Table 6.16). As with other layers, non-retouched debitage is dominant. Layer G totals 4924 recorded pieces within the Callow database, 4825 mentioned and discussed in Callow and Cornford (1986).

Artefact type	**Count**	**%**
Flakes	432	84.38
Retouched	47	9.18
Non-PCT Cores	19	3.71
Hammerstone	1	0.2
Natural	4	0.78
Missing	9	1.76
Total	**512**	**100**

Table 6.16: Artefact designation for this study sample (t= 512), layer G, grid square 100/-100.

Taphonomically layer G shows some degree of post-depositional damage (Figure 6.7). Only thirty-two individual artefacts recorded any kind of secondary degree of edge damage, all '*slight*'. This supports the idea of the "*slight disturbance*" of deposits observed in excavation (Callow 1986c: 80). However, 45% of flake material is broken (similar to layer H), and unlike layer H, a large amount of edge damage is moderate or heavy, as opposed to light. Like layer H, this signature can be related to the high amounts of rock fall recorded in excavation (Callow 1986e), rather than any Neanderthal behavioural signature.

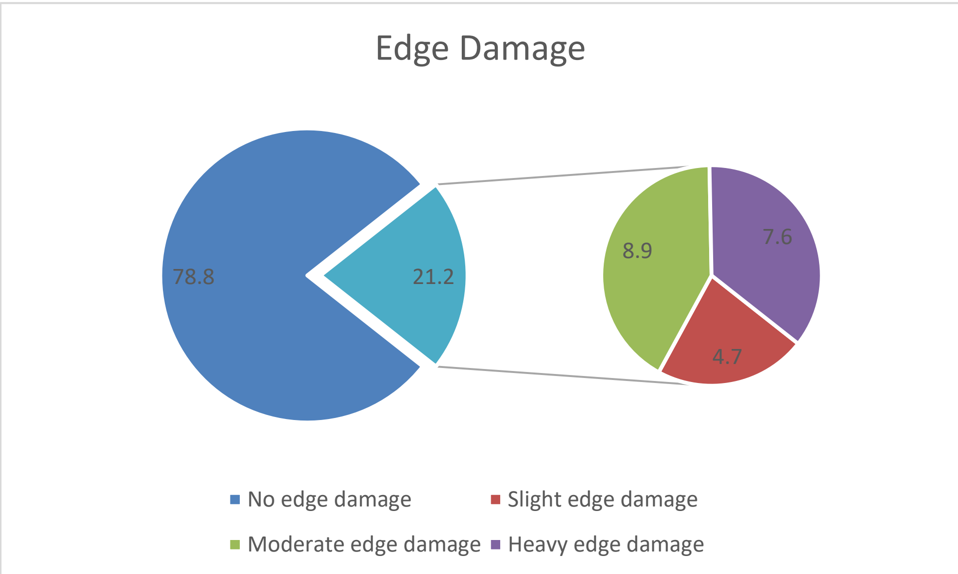

Figure 6.7: First degree of edge damage recorded on debitage artefacts (t= 503) from layer G, grid square 100/-100.

The database also records 16 "*rolled pebbles*", un-concentrated, but indicative of some fluvial activity. This could also relate to the sporadic erosional surface towards the top of layer G and into layer F i.e. increased runoff, also mentioned by (Callow 1986e).

6.2.2.2 Cores and core working

6.2.2.2.1 Non-PCT

In total nineteen cores were identified, none showing any degree of PCT on the final flaking surface. All cores are on flint and show hard hammer reduction. The majority have been sourced from derived sources (Table 6.17), interestingly one is on fresh, cretaceous material; this signature is supported by Hutcheson and Callow (1986).

RM source	Frequency	%
Primary	1	5.3
Derived	13	68.4
Indeterminate	5	26.3

Table 6.17: Raw material source recorded from core surfaces (t= 19) from this sample, layer G, grid square 100/-100.

Of the seventeen whole examples, only six show any signs of blank type and all are cores on flakes (Table 6.18), a similar to signature to layer H (above).

Blank Type	Count	%
Flake	6	35.29
Indeterminate	11	64.71
Total	**17**	**100**

Table 6.18: Blank type for all whole cores in this sample (t= 17), layer G, grid square 100/-100.

Cores are varied in size (Table 6.19), and the large range values, can be connected to outliers (in this case four +50 mm examples within this study sample). The small sample size precludes a larger discussion of metrics. Referring back to Hutcheson and Callow (1986), metrics are also varied (ibid: 244) and are comparable to those produced within this study. Interestingly two of the larger examples studied are clearly products of beach cobble transport/testing (one single removal and one large cortical flake with a number of removals). These examples are discussed further in connection to the untested manuports below. Two of the other examples are hierarchical discoids with larger flake scars representing the final removals of a simple alternate sequence.

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Mean	43	33	22	30
Std. Deviation	8	9	6	19
Variance	58	88	33	347
Range	28	32	22	76

Table 6.19: Descriptive statistics for whole cores (t= 17) from this sample, layer G, grid square 100/-100.

Cortex retention is relatively high, with only three examples displaying no cortex at all (Figure 6.8). Again this supports the use of beach cobble material with multiple platforms and varied cortex retention across surfaces of nodules. This conclusion was also suggested by Callow (1986e) based on potential available raw material sources for the lower layers (i.e. H-F).

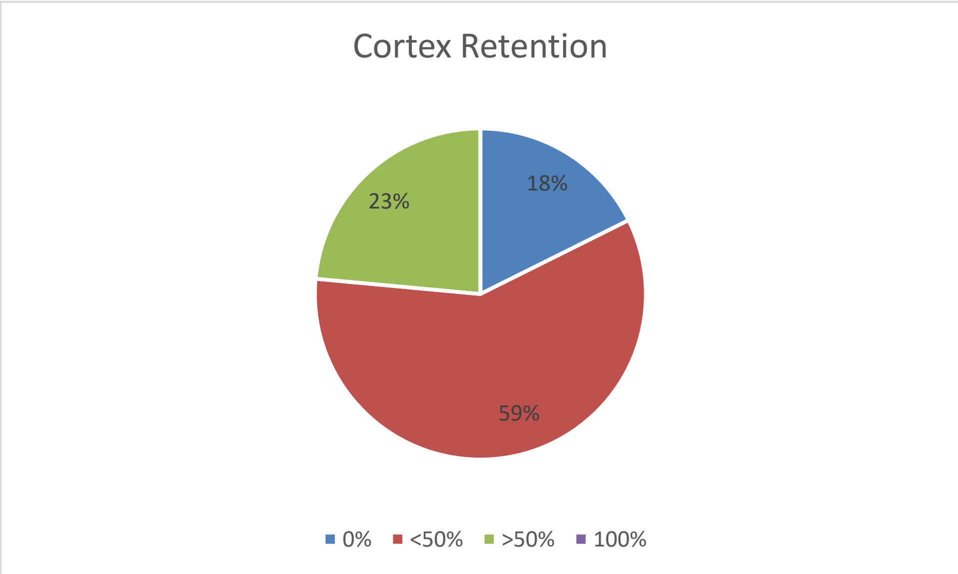

Figure 6.8: Cortex retention on surfaces of all whole cores (t= 17) from this sample, layer G, grid square 100/-100.

Alternate knapping dominates overall (Table 6.16) with removals in simple alternate sequences most prevalent (t=24). Parallel sequences are significantly higher than in layer H. Following the overall core reduction set out in the methodology, none of the alternately reduced examples fit a classic discoidal strategy (

Reduction Method	Count	%
Migrating platform	6	35.29
Single platform, unprepared	7	41.18

Discoidal hierarchical	3	17.65
Indeterminate	1	5.88
Total	**17**	**100**

Table 6.20), rather hierarchical discords are present (as discussed above) but with an overall dominance of single platform, alternate reduction.

Reduction Method	**Count**	**%**
Migrating platform	6	35.29
Single platform, unprepared	7	41.18
Discoidal hierarchical	3	17.65
Indeterminate	1	5.88
Total	**17**	**100**

Table 6.20: Overall reduction method recorded from final flaking surfaces of all whole cores (t= 17) within this study sample, layer G, grid square 100/-100.

This somewhat differs from Hutcheson and Callow (1986) where a high degree (27.3%) where still recorded as informal, but discoids and pyramidal types are high (27.4%). In comparison to other layers, e.g. A or E (see Table 6.1), migrating platforms are not as dominant; neither are single removals (i.e. removals per episode; category A).

Removals / episode	**Count**
A	14
Bi	20
Bii	6
Ci	24
Cii	4
Ciii	10
Mean	**No. Removals**
	4.9
	No. Episodes

	1.8

Table 6.21: Reduction methods and removals recorded on all whole cores (t= 17) from this sample, layer G, grid square 100/-100.

6.2.2.2.2 PCT cores

No evidence of PCT was present within this study sample. Hutcheson and Callow (1986) identified just 2.5% Levallois cores, by far the lowest of the La Cotte excavated samples.

6.2.2.3 Flakes

RM Type	**Count**	**%**
Flint	452	94.0
Quartzite	2	0.6
Granite	14	2.9
Sandstone	3	0.6
Quartz	9	1.9
Total	**480**	**100**

Table 6.22: Raw material counts for all flake artefacts within this sample, layer G, grid square 100/-100.

As with cores (see above) the layer G flake sample is dominated by flint (Table 6.22). This matches Callow (1986g), and is very similar to layer H (see above) and is only seen more so in layer F (see Table 6.1). Of the granite only three are flakes, the rest '*chunks*', with three natural pieces of fissure granite. Micro-granite is present, including the three flake pieces and likely to have been sourced from Beauport headland >1km (see chapter 4). Two pieces are unrecognisable within this study and could represent manuports of some description. Of the other non-flint all but one, a large quartz flake, are fragments (medial or distal).

RM source	**Count**	**%**
Primary	2	0.42
Derived	216	45
Indeterminate	262	54.58

Table 6.23: Raw material source recorded from this sample (t= 480), layer G, grid square 100/-100.

The majority of the material is of beach cobble origin, indicated by thin, stained cortex with areas of battering (natural), and highly flawed. Two individual elements show fresh, chalky cortex similar to the single core example, likely from cretaceous outcrops within the modern channel or Normandy peninsula, up to 20km away (see chapter 4).

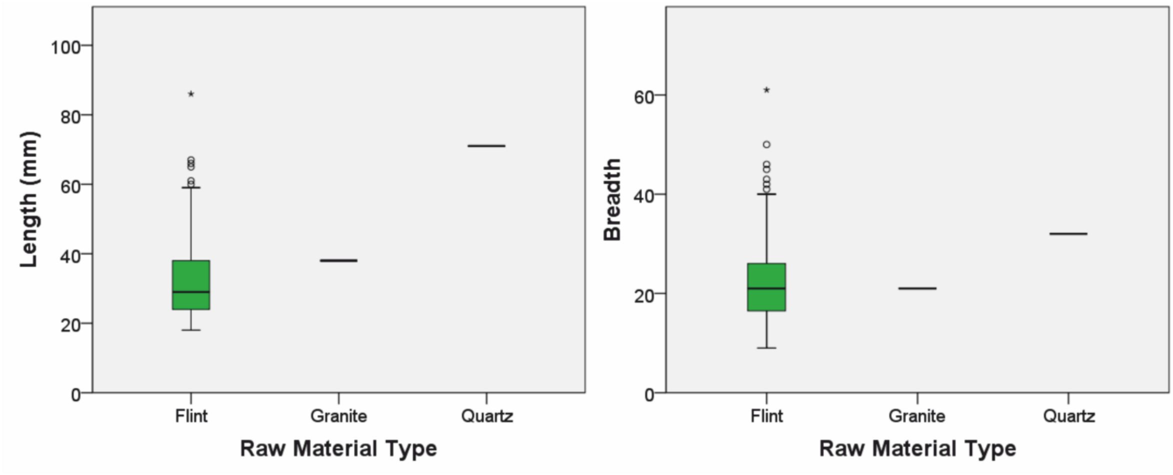

Figure 6.9: Boxplots describing length and breadth distribution of all whole flakes (t= 219) within the layer G sample.

	Length (mm)	**Breadth (mm)**	**Thickness (mm)**
Mean	34.2	23.7	9.0
Standard Deviation	12.2	9.2	4.6
Variance	148.4	83.7	20.8
Range	68	52	21

Table 6.24: Metrics for all whole elements of this sample (t= 219), layer G, grid square 100/-100.

Metrics of the flake debitage (Table 6.24) are comparable to the cores and core scar size (presented above). These values do not fully match those of Hutcheson and Callow (1986), for the whole excavated assemblage from layer G; those from the original study being generally wider and shorter. The distribution of flake size (see Figure 6.9) shows material is on the whole small but range is large with a number of outliers showing a lack o general standardization. Again this can be explained by the variability if raw material type (i.e. of flint) and quality. The small amount of non-flint is not significantly different in size from the flint material in this sample.

Cortex retention	Count
0%	103
<50%	76
>50%	33
100%	7

Table 6.25: Cortex retention for all whole flake artefacts within this sample (t= 219), layer G, grid square 100/-100.

Of the whole elements of the flake assemblage (t= 219) the majority have little or no cortical retention (Table 6.25), this supports the reduced nature of this assemblage, as within layer H. Seven examples show fully cortical dorsal surfaces suggesting some degree of initial core reduction in, or close to, the locale.

Finally, the dominance of plain, hard hammer platforms (Table 6.26) suggests simple core and flake reduction of beach cobble flint, sourced relatively locally. Cortical butts are somewhat high, further supporting the use of irregular cobble beach flint with irregular cortical surfaces and further supporting a degree of initial core working.

Butt Type	Count	%
Plain	143	50.9%
Dihedral	36	12.8%
Cortical	33	11.7%
Natural	3	1.1%
Marginal	6	2.1%
Mixed	3	1.1%
Facetted	22	7.8%
Missing	4	1.4%
Obscured	31	11.0%

Table 6.26: Butt type recorded on all whole and proximal elements of this sample (t= 281), layer G, 100/-100.

6.2.2.3.1 PCT

This study identified no evidence of PCT but it has been identified elsewhere within layer G by Callow (1986e). Four percent Levallois elements where identified within the flint tool artefacts (Callow 1986b: 257). Overall PCT is still low within layer G.

6.2.2.4 Retouched elements

The retouched assemblage (t= 47) is dominated by notches and denticulates (Table 6.27). Scrapers are often irregular in nature and the high number of miscellaneous elements represent mixed and informal tools, often with scraper edges and denticulates/notches both present.

Broken shattered fragments are the joint highest category with some potential of breakage through use or attempts at re-sharpening. The fragmentation and evidence for rock fall precludes a full discussion of this. Overall this further supports the heavily reduced nature of this sample, a similar pattern was also discussed by Callow (1986d: 257).

Bordes typology	**Count**
Single straight scraper	1
Single convex scraper	1
Abrupt side scraper	1
Bifacial side scraper	1
Typical percoir (awl)	1
Notch	13
Denticulate	7
End Notched piece	1
Misc.	8
Broken and Misc.	13
Total	**47**

Table 6.27: Bordes typology after Bordes (1961) for this study sample, layer G, grid square 100/-100.

The whole, retouched elements are slightly smaller metrically than both H and F (Table 6.28). It could be retouched material is in the later (or last) stages of use within the techno-economic system (pers. obs.).

	Length (mm)	**Breadth (mm)**	**Thickness (mm)**
Mean	43.4	32.3	12.6
Std. Deviation	10.8	9.1	4.6
Variance	116.5	82.7	20.8
Range	47	41	18

Table 6.28: Mean metrics for all whole, retouched pieces from this sample (t= 29), layer G, grid square 100/-100.

Butt type of all retouched elements closely mirrors that of all flake elements (Table 6.26), with no suggestion of increase in faceting or preparation. Cortical examples are similar in frequency, suggesting the same use of cobble material for retouch elements with cortical surfaces i.e. beach cobbles. All the retouched material here is on flint and Callow (1986e) highlights only one non-flint, "*well retouched*" tool from layer G and Hivernel (1986), a further 17 on quartz, mostly denticulates and notches.

Butt Type	**Count**	**%**
Plain	17	36.17
Dihedral	3	6.38
Cortical	4	8.51
Natural	1	2.13
Facetted	4	8.51
Missing	5	10.64
Obscured	13	27.66
Total	**47**	**100**

Table 6.29: Butt type of all retouched elements of this study sample (t= 47), layer G, grid square 100/-100.

Cortex retention is relatively high on retouched tools (Figure 6.10) with 59% showing over fifty percent cortex retention. This is indicative of initial stages of production for blanks and/or use of small irregular cobbles; similar to layer H.

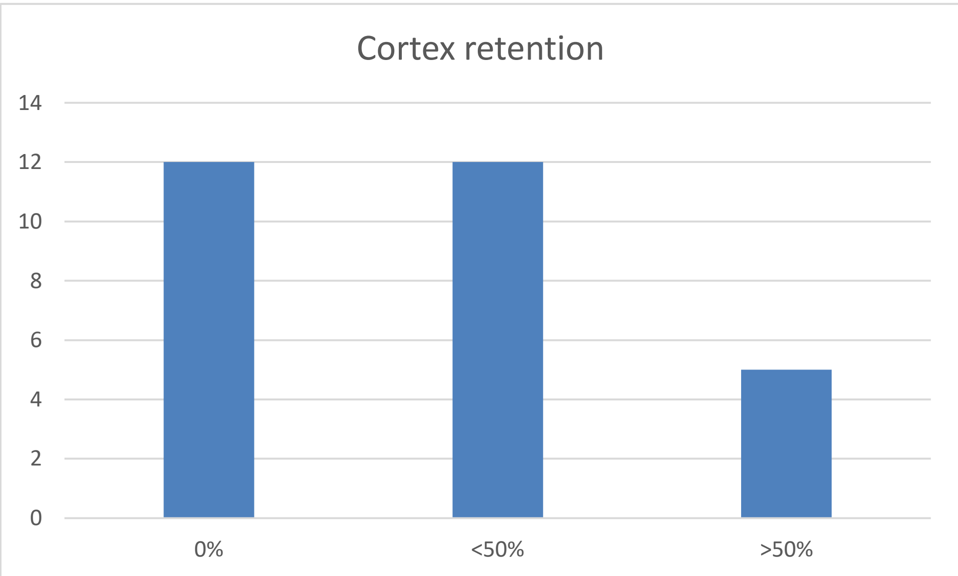

Figure 6.10: Cortex retention for all whole, retouched elements (t= 29) of this study sample, layer G, grid square 100/-100.

Direct retouch dominates, with just one example of bifacial retouch and six alternate examples. Fifty percent of retouch edge forms are notches or denticulates, as suggested from Bordes type (above).

Invasive and abrupt retouch are also high; further supporting heavy reduction of retouched tools. Re-sharpening is also evident with three LSFs and a single TSF as well as two examples of re-sharpening removals.

6.2.2.5 Manuports and Hammerstones

A single, broken quartzitic sandstone hammerstone was identified within this sample (Table 6.30). Its shows clear evidence of use and probably was broken during use (pers. obs.). The database documents a further basic igneous hammerstone and three manuports (sandstone and BI) from layer G.

	Length (mm)	**Breadth (mm)**	**Thickness (mm)**	**Weight (g)**
Hammerstone	39	35	24	53.5

Table 6.30: Hammerstone metrics for single example from this sample, layer G, grid square 100/-100.

The two tested beach cobbles discussed under cores do suggest the movement of material in relatively large cobbles/flakes. However, it is hard to tell from these examples (and no refitting undertaken) in what size and state they entered the locale.

6.2.2.6 Conclusion: Layer G

Overall, evidence suggest some degree of full reduction of beach cobble material, including the possible transport of unused beach flint and two examples of tested cobbles. This could also suggest material is being moved through the locale (and not picked up in analysis), similar to the pattern suggested at Ranville, Normandy (Cliquet 2008). Overall material is larger than the upper layers presented here as part of this study, and similar to those from layer H (see Table 6.1). As in H, denticulate types (i.e. Denticulates, retouched notches and flaked flakes) dominate. Reduction shows a signature of short sequences, often using alternate strategies, but parallel and single removal strategies are present to maximise final reduction. The relationship between final core size and flake size suggests reduction in or close to the locale.

Only one preserved dental fragment was identified during excavation (Scott 1986b; pg. 112), however “vast quantities” of fragmented bone and burnt ashy material was recorded (Lautridou *et al.* 1986a; van Vliet-Lanoë 1986). This suggests these deposits are disturbed living floors, a palimpsest of multiple occupations within the ravine system which included the use of fire. Low levels of none flint material (7.2 %) and the appearance of some small amounts of fresh primary flint suggest transport of raw material from accumulations to the north-east of the Island of Jersey (see chapter 4). Evidence for rising sea-levels (i.e. increasing temperate, stable conditions) and erosion of outcrops via marine and fluvial activity would provide these opportunities for raw material collection.

6.2.3 Layer F

6.2.3.1 Introduction

Layer F has a total, excavated, artefact count of 6404. My sample represents 794 pieces, 36 where missing at the time of recording (Table 6.31). Natural elements are represented by three small fluvial pebbles (presumably washed in from above the site) and one angular granite piece (certainly rock fall) i.e. not artefacts. Taphonomically, this could suggest the potential for a change in water runoff similar to layer G and in comparison to layer E (see chapter 3).

Artefact type	**Count**
Flakes	656
Cores none PCT	19
Cores PCT	4
Levallois products	2
Retouched	71
Hammerstones	2
Natural	4
Total	**758**

Table 6.31: Artefact sample recorded for this study from layer F, grid square 100/-100.

Edge damage is relatively high with over 60% showing some degree of damage and 24% showing moderate or heavy damage on flake edges. Callow (1986c) interpreted the deposits as "*slightly disturbed*" but mentions the presence of "few large granite blocks" (ibid: 80) in comparison to other layers e.g. layer H and G. The high degree of significant edge damage could relate to rock fall associated with wall erosion. The appearance of (at least) three fluvial pebbles (pers. obs.) suggests movement of water through the site, and an erosional surface identified at the top of layer F also indicates disturbance. There is also suggestion of localised erosional surface between F and G. All together this suggests that material is likely, on the whole, to be more disturbed than

Callow (1986c) suggests, however there seems no reason to believe an overwhelmingly large amount of post-depositional movement.

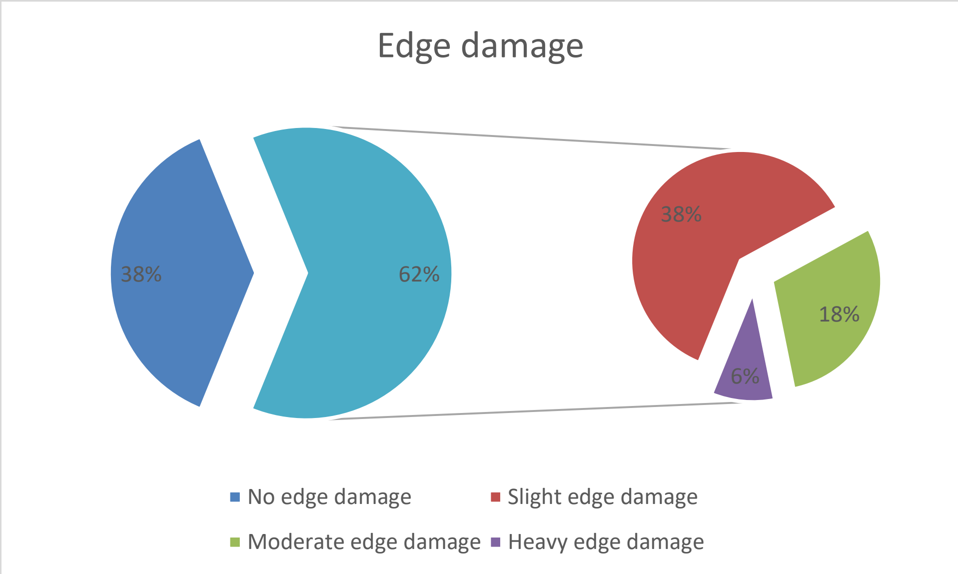

Figure 6.11: First degree of edge damage recorded on all artefacts from this study sample (t= 754), layer F, grid square 100/-100

A further 20% shows evidence for secondary degrees of edge damage, nearly all recorded as "*slight"* (Figure 6.11). This is by far the highest amount of secondary degrees of edge damage from this study sample and maybe related to the erosional situations identified by excavators at the top and bottom of layer F deposits (Callow 1986c). Staining and patination are low (t= 32 and 11 respectively), and could also relate to water action through and on top of deposits. There are 13 elements identified as burnt, higher than other samples but still not overly concentrated. This fits evidence discussed by Callow *et al.* (1986) for fire use within the fissure and discussion by Lautridou *et al.* (1986), supporting the conclusion that layer F and G are disturbed living surfaces rich in ashy burnt material (see chapter 3).

6.2.3.2 Cores and core working

Twenty three individual pieces were identified as cores within this study, four are Levallois cores and are discussed separate in section 6.2.3.2.2.

6.2.3.2.1 Non-PCT

All non PCT cores are on flint, there are few non-flint elements within the whole excavated sample (Callow 1986b, a). Overall, material is often flawed and shows heavy degrees of battering and incipient cones i.e. poor quality overall. This has restricted overall analysis of all core variables. Cortex is relatively high on core surfaces, with 80% retaining some cortex, a third with more than 50% (Table 6.32).

Cortex retention	**%**
0%	20.0
<50%	46.7
>50%	33.3
100%	0.0

Table 6.32: Cortex retention of core surfaces of all whole cores recorded within this study sample (t= 15), layer F, grid square 100/-100.

Once again the appearance of fresh, chalky cortical material is of interest (as in layer G). While derived material dominates (Table 6.32), there were two examples with fresh cortical retention. Both are relatively large (55cm and 45cm maximum length) but don't show the heavy degrees of battering and can be suggested as better quality raw material (pers. obs.).

RM source	**Count**
Primary	2
Derived	11
Indeterminate	6

Table 6.33: Raw material source of all whole cores from this study sample (t= 19), layer F, grid square 100/-100.

As with layers G and H, cores on flakes are present in significant numbers (Table 6.34), but indeterminate examples are the norm due to small reduced cores and highly flawed material. The two spherical examples relate to two larger nodules, only minimally tested, and described below.

Blank Type	**Count**
Spherical	2
Flake	5
Indeterminate	8
Total	**15**

Table 6.34: Blank type of all whole cores form this study sample (t= 15), layer F, grid square 100/-100.

Due to the highly flawed raw material, measurements are varied especially when considering weight (13g - 114g; see Table 6.35). This also seems to be related to the high level of battering and abandonment of poor quality nodules.

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Mean	46.3	34.3	22.8	34.7
Std. Deviation	8.8	8.8	7.5	24.6
Variance	77.4	77.4	55.6	605.9
Range	29	34	24	101

Table 6.35: Descriptive statistics of all whole cores for this study (t= 15), layer F, grid square 100/-100.

Overall reduction strategy is clearly dominated by migrating platform reduction (Table 6.36), often with the use of single or double removals followed by failed removals and hinges. Discoidal core working is present but low in comparison to other layers (Table 6.1). Hutcheson and Callow (1986) also highlight a high degree of migrating platform type examples as well as a lower degree of discoidal forms, more than any following layer. Overall discoidal forms gradually increases from layer F upward.

Reduction Method	Count
Migrating platform	12
Discoidal hierarchical	2
Indeterminate	1
Total	**15**

Table 6.36: Overall reduction method employed for core reduction of all whole elements of this study sample (t= 15), layer F, 100/-100.

Were more precise analysis of reduction sequences was possible (t= 10) all strategies are employed with a slight dominance of single removals (Table 6.36). Alternate knapping matches discoidal working and could suggest a more prevalent use of discoidal core working in previous, unrecognisable, episodes.

Removals / episode	Count
A	18
Bii	6
Ci	7
Cii	6
Mean	**No. Removals**
	5.2
	No. Episodes
	2.3

Table 6.37: Reduction strategies for whole cores from this study sample (t= 10), layer F, grid square 100/-100.

6.2.3.2.2 PCT cores

In total six individual artefacts are highlighted as representative of PCT. These definitive pieces are four cores and two flakes. The four cores have similar metrics to the overall core assemblage but with one larger piece (57cm; 72g). All examples show battering and evidence for failed removals and abandonment.

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Average (minus large example)	43.3	33.3	16.7	24.7
All	46.8	37.5	20.0	36.5

Table 6.38: Core metrics for Levallois cores identified within this study sample (t= 4), layer F, 100/-100.

Three of the four are worked centripetally, the other unipolar, with two overshot flakes and one typical flake being the likely end-products. The unipolar example would have produced a point but not through conventional convergent preparation. None show any clear sign of an earlier flaking surface or attempts after final removal to reform a flaking surface. Hutcheson and Callow (1986) identified 6.8% (t= 11) of Levallois examples from a much larger core sample size than the previous two layers (t= 168). Overall evidence of PCT at the locale is low within layer F (as with all layers discussed here).

6.2.3.3 Flakes

RM Type	Count	%
Flint	703	96.7
Granite	5	0.7
Sandstone	1	0.1
Quartz	14	1.9
Dolerite	1	0.1
Siltstone	2	0.3
Quartzite	1	0.1
Total	**727**	100.0

Table 6.39: Raw material for all flakes identified within this study (t= 727), layer F, grid square 100/-100.

As previously mentioned flint dominated the layer F sample with 96.7% of the represented flake debitage (Table 6.39). There is some evidence for breakage through use (flexion breaks and heavy damage indicative of use), but the high degree of natural edge damage (Figure 6.11) and suggestion of rock fall episodes by Callow (1986c) and excavation notes (pers. obs.) prohibits this conclusion.

RM source	Count	%
Primary	2	1.1
Derived	111	61.3
Indeterminate	68	37.6
Total	181	100

Table 6.40: Raw material source for all whole flake elements within this study sample (t= 181), layer F, 100/-100.

As with layer G and H material is mostly derived with only 1.1% identified as fresh, with thick chalky cortex (Table 6.40). As with layer G the majority is believed to be from beach accumulations, with a highly flawed and battered appearance and often shattered surfaces from knapping.

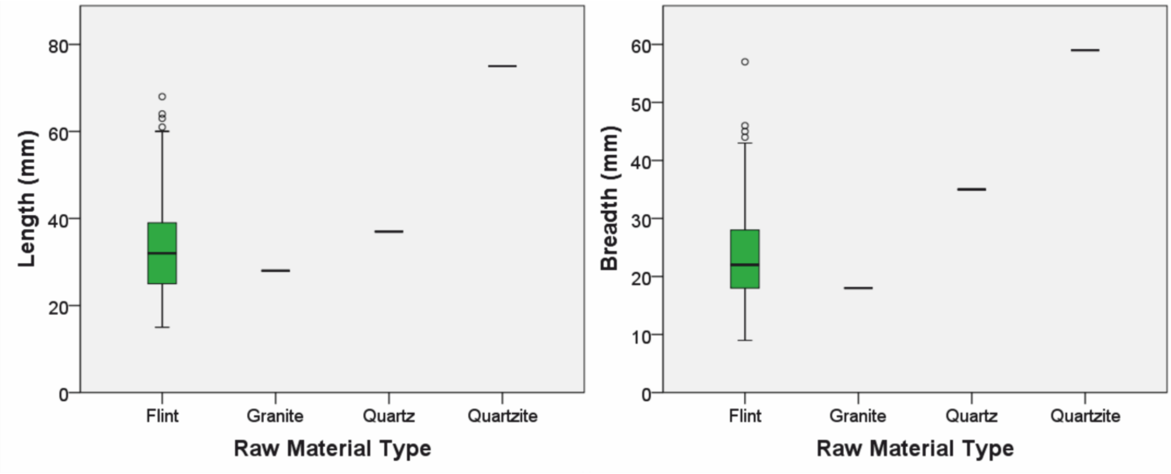

Figure 6.12: Boxplots describing length and breadth distribution of all whole flakes (t= 181) within the layer F sample.

Table 6.41 shows metric values for all whole elements of flake debitage (t= 181), which broadly match those for cores (Table 6.35). Length and breadth are the largest of all layer samples within this study. Figure 6.12 shows that range and general distribution of length and breadth figures are similar to the two previous layer samples and still overall small with some significant outliers.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	35.3	25.3	8.7
Std. Deviation	11.9	9.5	4.4
Variance	141.8	89.6	19.3
Range	60	50	20

Table 6.41: Descriptive statistics for all whole flake elements within this study sample (t= 181), layer F, 100/-100.

Scar size on core surfaces was largely impossible due to the battered nature of whole cores (see above). Of the ten cores with well-preserved surfaces scar size was on average 29.9 mm x 19.4 mm (SD 7.5 and 4.6 respectively); Hutcheson and Callow (1986) produced a scar size of 35.9 mm (SD= 22.2) for all whole cores from layer F.

Cortex retention	Count	%
0%	65	35.9
<50%	89	49.2
>50%	25	13.8
100%	2	1.1

Table 6.42: Cortex retention on all whole flake elements within this study sample (t= 181), layer F, 100/-100.

The appearance of 1.1% fresh raw material is of interest (Table 6.40), as is cortex retention (Table 6.42). Thick but derived cortical material is also present and it could be that fresh, chalky material is exposed, or disturbed, to the north-west. Cortex retention is certainly relatively high (only 35% non-cortical) but this is once again related to the prevalent use of beach and riverine cobble material with thin, often battered cortex (hence the flawed material present as cores). This pattern is also reflected in the butt type analysis where natural and cortical examples represent the second most recorded category (24.3%). Plain, hard hammer platforms are still dominant (Table 6.43), as in most layers.

Butt Type	**Count**	**%**
Plain	118	39.9
Dihedral	17	5.7
Cortical	71	24
Natural	1	0.3
Soft hammer	1	0.3
Facetted	10	3.4
Missing	5	1.7
Trimmed	1	0.3
Obscured	72	24.3
Total	**296**	**100**

Table 6.43: Butt type of all whole and proximal elements of this study sample (t= 296), layer F, grid square 100/-100.

6.2.3.3.1 PCT products

Both end-products from Levallois core working also show previous PCT removal scars on their dorsal surface. Both are relatively large (56mm and 43mm maximum length) and average removal length on the three exploited cores is only 26mm. It seems likely these are not related to the cores present and may suggest movement of material within the site or further afield. The recorded, previous removal scars are also indicative of material through the locale. Typologically one is the proximal fragment of a typical flake while the other is the medial section of a convergent point; potentially snapped/broken elsewhere. As they are both broken method of exploitation is uncertain.

6.2.3.4 Retouched elements

In total there are 71 retouched elements, including one retouched core. Forty-seven of these are whole, well retouched forms and have been used for Bordes (1961) typology. The whole sample is used further below to discuss other variables within this study's methodology. Only one non-flint examples was identified, a quartz scraper on a *siret* flake; the rest are flint. Twenty quartz tools where identified by Hivernel (1986) with denticulates and notches dominating. A further single sided convex scraper on quartzite was also identified elsewhere (Callow 1986c).

Bordes type	Count	%
Single straight scraper	2	4.3
Single convex scraper	5	10.6
Single concave scraper	1	2.1
Double straight scraper	1	2.1
Convex convergent scraper	1	2.1
Déjeté scraper	5	10.6
Ventral side scraper	2	4.3
Notch	9	19.1
Denticulate	16	34
Miscellaneous	5	10.6
Total	**47**	**100**

Table 6.44: Bordes type for well retouched elements identified within this study sample (t= 47), layer F, grid square 100/-100.

Again the assemblage has a typical EMP character (pers. obs.) with notches, denticulates and scrapers all well represented (Table 6.44). This is the first significant appearance of scrapers and distal/déjeté scrapers play a major role in that sample. Denticulates alone represent 34% (t= 16) only one less than all combined scraper types (t= 17). Further, all the "*multi*" tools identified by this study have denticulate edges present, in combination with preceding evidence for scraper edges. This could suggest scraper edges are more prevalent within Neanderthal technology of layers H-F in general; but aren't present/required at La Cotte i.e. re-worked or abandoned.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	43.3	31.1	11.4
Std. Deviation	11.7	10.1	5.3
Variance	137.2	101.0	28.4
Range	42	40	18

Table 6.45: Descriptive statistics for all whole, retouched elements of this study sample (t= 33), layer F, grid square 100/-100.

Once again, as with layer G and H, mean length and breadth of retouched material (Table 6.45) is larger than the average flake material (Table 6.35). Plain platforms dominate within the sample (Table 6.46), with no evidence for facetted or trimmed types.

Butt Type	**Count**
Plain	17
Dihedral	5
Cortical	8
Missing	5
Obscured	10
Total	**45**

Table 6.46: Butt type for all whole and proximal, retouched elements identified within this study (t= 45), layer F, grid square 100/-100.

Cortex retention on dorsal surfaces mirrors non-retouched examples (Figure 6.13) and supports use of beach cobbles. It could be suggested that better quality material is not being selected specifically for retouch, or more likely that material (especially cores) are being fully reduced but have high cortex retention due to their original, nodular form i.e. small beach cobbles.

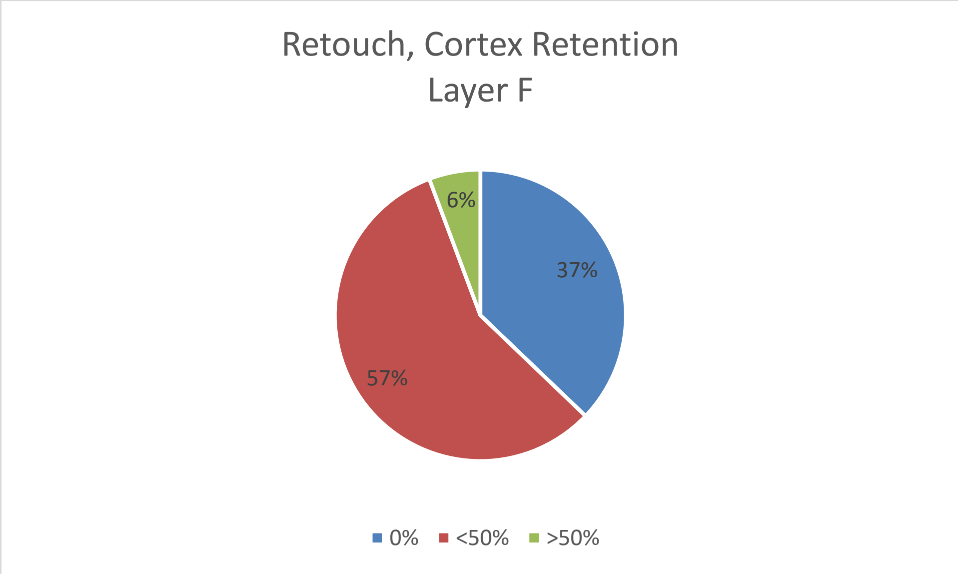

Figure 6.13: Cortex retention for all whole elements identified within this study sample, layer F, grid square 100/-100.

In total, six TSF's and six LSF's where identified within this sample with a further six elements displaying re-sharpening removals. One convergent scraper displays three LSF removals from its surface. Overall this is significantly higher than in the previous two layers throughout layer F where 58 were recorded (LSF 35:TSF 23; Callow database). Bifacial retouch appears only twice in this sample; the database records six examples of bifacial tools. There is still no evidence for the presence of handaxes or evidence of handaxe manufacture.

6.2.3.5 Manuports and Hammerstones

Two hammerstones where identified within this sample, one of quartzite one of sandstone with clear evidence of use (i.e. battering and pitting). The dominance of hard hammer flaking and the two hammerstones points to on-site knapping. Neither of the hammerstones suggests long distance transport, but equally both could be from various sources within the local region. The database documents a further two hammerstones within layer F with no obvious preference for raw material.

6.2.3.6 Conclusion: Layer F

The layer F sample is dominated by poor quality, highly flawed, raw material. However, this factor can also be used to add to the behavioural signature of the assemblage i.e. the poor quality, more so than both previous layers, has effected Neanderthal technological decision making. The cores present have been reduced in short, often failing (i.e. hinged or shattered), sequences, tools are heavily reduced, and there is clear evidence for transport of material through the locale, most likely concentrated on higher quality materials.

Through occupation of layer F sea-level continues to rise and cover exposed flint outcrops to the north (≈20km; see chapter 4), but the appearance of fresh material here and two cores could suggest the sea-level estimates are off. Another suggestion is an unknown fresh source, probably further to the east towards the rich cretaceous outcrops of the eastern Cotentin. Current knowledge prohibits further discussion on this and exploitation of the originally discussed deposit is favoured. Overall the raw materials used are often poor, flawed and retain high degree of anthropogenic battering and are indicative of beach accumulations from erosion as sea-level rises.

The single Levallois point could suggest hunting behaviour with broken elements being un-hafted in the fissure or remaining inside animal carcasses brought into the locale. This is hard to fully support without substantial refitting, but is seen elsewhere across northern France (i.e. Le Pucheuil). Overall movement of lithic material through the locale seems highly likely. This could be related to the reduction of poorer quality flints and non-flint material on site for certain practices and the carrying of high quality, freshly sourced flint from further afield which only drops out here if fully reduced. This is further discussed and linked to other layers in the final concluding chapters. As with layer G, no faunal material is preserved to species identity level, but deposits are rich in burnt, fragmented bone and ashy material, indicative of fire use on-site.

6.2.4 Layer E

6.2.4.1 Introduction

The deposition of layer E was a build-up of granitic sands with a distinct forest soil horizon late in its formation, indicative of progressively stable temperate conditions (see chapter 3). In total 6443 artefacts were recovered from this deposit. This study sampled 663 artefacts (Table 6.47), of which 5 were found to be missing during analysis.

Artefact Type	Total	%
Flakes	568	85.67
Non-PCT cores	20	3.02
PCT cores	1	0.15
Retouched	68	10.26
Missing	5	0.75
Total	**663**	**100**

Table 6.47. Artefact count for this study sample (t= 663), layer E, grid square 100/-100.

Taphonomically, my data show there is limited evidence of movement of artefacts (Figure 6.14), supporting Callow (1986f) that this is a mostly in situ assemblage from within the La Cotte sequence.

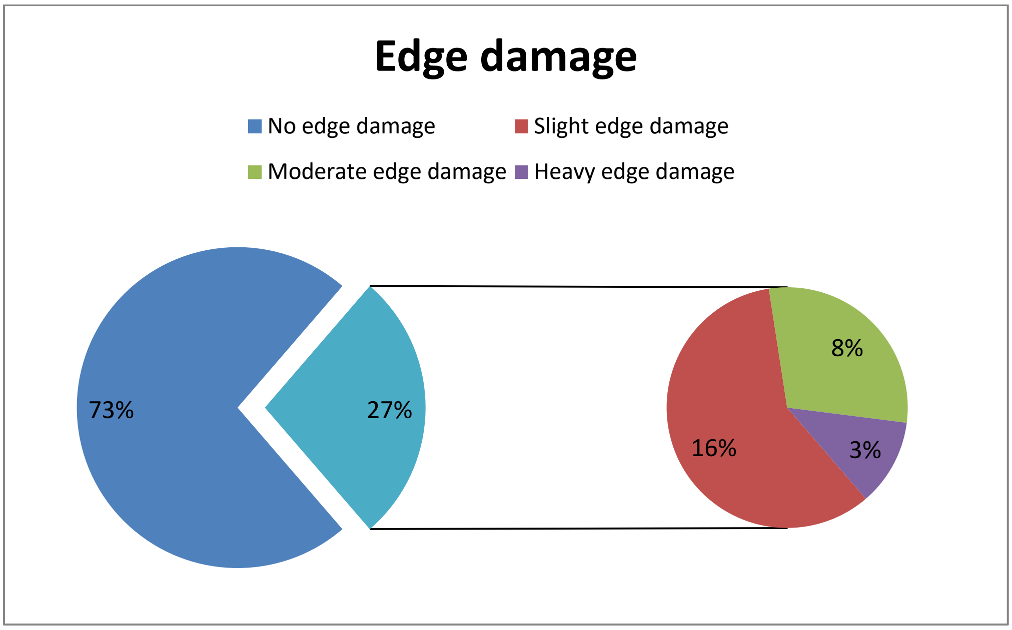

Figure 6.14: Edge damage on all artefacts from this study sample (t= 663), layer E, grid square 100/-100.

In total only 27% of layer E debitage displays damage, of which most is only '*slight*' (Figure 6.14). Conversely, a refitting exercise performed by Andy Shaw on the whole layer assemblage located very minimal refits (pers. obs.); most of which were flake breaks. This does not significantly add to the nature of the whole vs broken elements of layer E. I suggest two potential explanations for this.

1. The low edge damage upon artefacts suggests that this assemblage is largely in situ. The lack of refitting is therefore a product of hominin behaviour i.e. material has been removed from the excavated area.
2. The lack of refitting suggests that material has moved through post-depositional processes. The lack of edge damage could therefore suggest that the processes where minimally destructive.

The excavation of micro debitage (<2.5cm; described below) as well as the limited edge damage to the assemblage from this layer strongly suggest scenario 1 is the best fit hypothesis.

6.2.4.2 Cores and core working

Twenty one cores were identified from this assemblage. These are heavily dominated by flint with just one quartz example (Table 6.48). Hivernel (1986) identified fourteen quartz cores (2.5% of the quartz artefacts).

6.2.4.2.1 Non-PCT cores

RM Type	Frequency	%
Flint	19	95
Quartz	1	5
Total	**20**	

Table 6.48 Raw Material type for all cores within this study sample (t= 20), layer E, grid square 100/-100.

The majority of cores from this sample retained evidence of source type, with derived elements dominating (Table 6.48). One element is a fresh, primary cortical example, and suggests some movement of material from outside the immediate area, as suggested for previous layers (i.e. layer G). Again the derived elements show evidence or the use/collection of beach derived cobbles of flint.

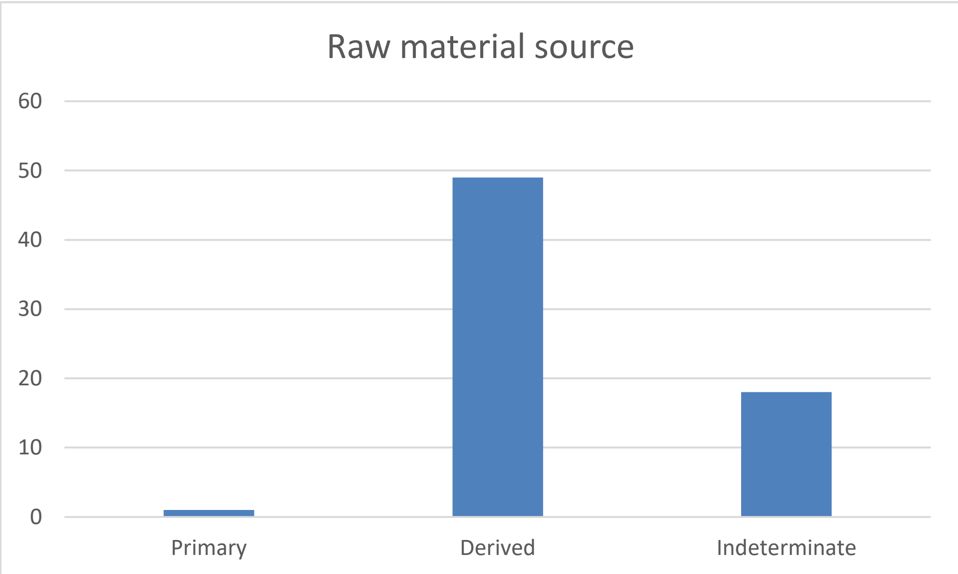

Figure 6.15: Raw material source analysis for all cores in this study sample (t= 20), layer E, grid square 100/-100.

Blank type follows the trend for previous layers (i.e. H-F) with high degrees of indeterminate examples (Table 6.49). This scenario is due to heavily reduced core surfaces of small, nodular/irregular cobbles (pers. obs.). The identification of cores-on-flakes also mirrors that from previous layers.

Blank Type	Count
Flake	6
Indeterminate	6
Total	**12**

Table 6.49: Blank type for all whole cores for this study sample (t= 12), layer E, grid square 100/-100.

Overall cores are small with an average length of 40mm (Table 6.50), suggesting high levels of reduction or (and) smaller nodules. A total of 8 of the 20 cores are broken, all of which relate to flaws in material, likely due to their derived origin. The weight is considerably reduced in comparison to layers H-F.

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Mean	40.08	31.08	17.17	20.75
Standard Deviation	6.86	5.18	4.51	7.88
Variance	46.99	26.81	20.33	62.02
Range	21	17	17	27

Table 6.50 Descriptive statistics for all whole cores from this study sample (t= 12), layer E, grid square 100/-100.

Table 6.51 displays the core working methods employed for artefacts identified within this assemblage. Six retain evidence of migrating platform exploitation as their final episode of knapping. As discussed elsewhere, use of migrating platform strategies on small, exploited cores suggests the need or desire to reduce material as much as possible. Discoidal exploitation is minimally represented in comparison, but is still significant; no classic discoids appear until layer E. Alternate knapping strategies are well represented but parallel episodes (type B) are highest (Table 6.52).

Reduction Method	Count	%
Migrating platform	6	50
Single platform, unprepared	5	41.67
Discoidal, classic	1	8.33
Total	**12**	**100**

Table 6.51: Reduction strategies employed for core working, recorded on all whole cores in this study sample (t= 21), layer E, grid square 100/-100.

This studies core episode analysis supports the general conclusion that this material is heavily exploited and reduced. Table **6.52** shows the total number of core removals recorded from a core surface. Over 66% were recorded with more than four clear removals. The majority of core elements only preserve one or two core episodes due to the size of the final elements. However, of the ten recorded with migrating platforms (as their final removal(s)) 6 recorded a previous, different episode of exploitation (all parallel sequences). Of these, three record a third episode of exploitation (one alternate, two a further parallel sequence). The complex nature of core exploitation is suggested as a direct response to raw material economy where the techno-economic strategy is tailored toward the maximum exploitation of available raw material.

Removals / episode	**Count**
A	22
Bi	31
Bii	5
Ci	24
Mean	**No. removals**
	5.3
	No. Episodes
	1.8

Table 6.52: Knapping strategies employed on all whole cores from this study sample (t=12), layer E, grid square 100/-100.

To support the pattern described here, one core (78/5233) is worthy of further discussion. This example (see Figure 6.16) is of specific interest as it retains two clear episodes of differing exploitation. It has been finally exploited with a parallel sequence of three removals and a single removal. This episode is however preceded by the hierarchical preparation and exploitation of the opposite surface using a typical, recurrent Levallois technique. This supports the assumption above that core strategies are changed within an artefact's exploitation life and earlier strategies employed are masked.

Figure 6.16: Multi-platform core, described above. Left hand side, upper surface displays initial, final flaking surface of centripetal Levallois core (flake scar defined in yellow). Right hand side shows final parallel sequence of removals on opposite surface (highlighted in red).

Finally, cortex retention is mostly <50% (Table 6.53) and has all been interpreted as '*derived*'. The derived nature of adhering cortex is once again suggesting the use of material from beach cobble origin, rather than rolled, fluvial nodules; supporting Callow (1986i) assumption that Neanderthals where exploiting beaches (see chapter 4). In layer E material is nearly exclusively light grey, high in observable flaws and often with marine stained cortex different from the majority of material in previous layers (pers. obs.). This could however relate to the hypothesised proximity of active beaches (i.e. high sea-levels) to the north of the area, associated with erosion of liminal zones with chalk-with-flint outcrops present (see chapter 4).

Cortex retention	**Count**	**%**
0%	3	25
<50%	7	58.33
>50%	2	16.66
100%	0	0

Table 6.53. Cortex retention recorded from all whole core surfaces within this study sample (t= 12), layer E, grid square 100/-100.

6.2.4.2.2 PCT

The single PCT element is also on a beach cobble of flint, with no observable difference from other raw material across the assemblage (i.e. layer E). It shows evidence for centripetal preparation but heavy battery along the lateral (left hand) of the final flaking surface likely accounts for its abandonment before exploitation. The striking platform shows clear preparation (faceting). There was no identification of PCT products in this study sample and Callow discussed 6.46% of Levallois material present across the whole assemblage.

6.2.4.3 Flakes

RM Type	**Count**	**%**
Flint	573	90.4
Granite	4	0.6
Sandstone	4	0.6
Grès lustré	12	1.9
Quartz	37	5.8
Quartzite	4	0.6
Total	**634**	**100**

Table 6.54: Raw materials for flake debitage from this study sample (t= 634), layer E, grid square 100/-100.

Table 6.54 displays raw material types identified for this study sample of layer E (t=634). The assemblage is dominated by flint (90.4%) with only a small amount of quartz present (5.8%). Layer E represents one of the lowest non-flint counts throughout this assemblage (Table 6.1). *Grès lustré* is relatively well represented and is higher than both quartzites and sandstones. This could support the belief that these specific, fine grained *grès lustrés* are currently submerged and end up in beaches with the flint during the high eustatic stages of MIS 7 (also see below). Callow (1986e) identified 3.9% (t= 247) as non-flint or quartz. 16.5% of the non-flint and quartz was *grès lustrés*, but quartzites (29.2%) and basic igneous (32.5%) dominate overall (ibid: 204).

RM source	**Count**	**%**
Primary	2	0.3
Derived	338	53.3
Indeterminate	294	46.4
Total	**634**	**100**

Table 6.55: Raw material source based on cortex analysis for this study sample (t= 634), layer E, grid square 100/-100.

Where source analyse was possible from adhering cortex, material was nearly exclusively derived. This supports Callow (1986e) and Shaw (pers. comm.), and suggests the majority of material is from semi-local beach deposits (see chapter 4). 84% of the material was recorded with less than half cortex adhering to the dorsal surface (Table 6.56), similar to core analyses (above) and supporting Hutcheson and Callow (1986). Interestingly 3.5% (t= 6) had full cortex adhering, suggesting small amounts of initial stages of reduction within the fissure, or close by.

Cortex Retention	%
0%	44.20%
<50%	39.50%
>50%	12.80%
100%	3.50%

Table 6.56: Cortex retention on dorsal surfaces for all whole elements within this study sample (t= 172), layer E, grid square 100/-100.

After a general increase up to layer F there is a considerable reduction in size of flake elements in layer E, which continues as an overall trend till layer A. There is no suggestion from metrics that the flake debitage cannot be connected to the cores (presented above). This, along with cortex retention, suggests some degree of all stages of reduction represented in the excavated sample. Figure 6.17 highlights layer E is the first significant appearance of quartz (quartzite features somewhat in the small sample of layer H) with no significant difference in size distribution or range. However the distribution between breadth and length of quartz artefacts shows the general nature of this material and its fracture quality from small irregular cores, causing small squat flakes. This material become increasingly important for Neanderthal knapping practices in later layers.

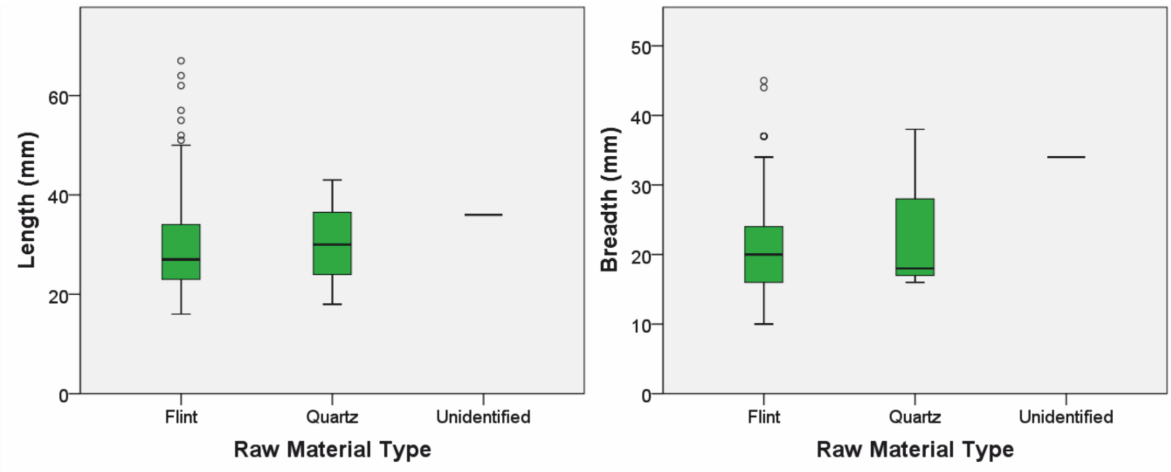

Figure 6.17: Boxplots describing length and breadth distribution of all whole flakes (t= 172) within the layer E sample.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	32.5	22.6	8.1
Std. Deviation	11.2	8.3	4
Variance	124.5	68.3	16.1
Range	51	39	21

Table 6.57: Metrics for all whole elements from this study sample (t= 172), layer E, grid square 100/-100.

Butt type suggests a heavy preference for plain butts (46.8%). 9.6% retain prepared (trimmed or facetted) examples and this is likely related to the reduction of small, irregular cores (see above). Only 10% of material preserves a dihedral platform and further the 20.7% cortical examples support the use of small irregular beach cobbles. Cordal and relict core edges are present in low numbers (

RCE	Cordal
26	11

Table 6.59). Their presence further supports the conclusion of working down of small cores (removing Cordal flakes) and the need to rejuvenate material to exploit resources fully (causing RCEs).

Butt Type	Count	%
Plain	131	46.8
Dihedral	28	10
Cortical	58	20.7
Marginal	4	1.4
Soft hammer	1	0.4
Facetted	23	8.2
trimmed	4	1.4
Missing	4	1.4
Obscured	27	9.6
Total	**280**	**100**

Table 6.58: Butt type recorded for whole and proximal elements (t= 280), layer E, grid square 100/-100.

RCE	Cordal
26	11

Table 6.59: Presence of attributes recorded during analysis; Relict Core Edge (RCE) and Cordal flakes from within this study sample, layer E, grid square 100/-100.

Overall this data shows that debitage material from layer E is overwhelming dominated by small flake production resulting from intensive working of cores, largely using migrating platform techniques. The size of cores and flakes and cortex analysis suggests this is from derived beach pebble material. Cortex retention across the assemblage suggests all stages of the reduction sequence are present; if in small numbers.

There is no evidence for presence of PCT products within the flake assemblage.

6.2.4.4 Retouched elements

There were a total of 72 elements of this sample displaying retouch (

RCE	Cordal
26	11

Table 6.59). There is only one non-flint example, a broken quartzite scraper, again paralleling initial raw material analysis of cores and flakes with limited use of non-flint raw material within layer E. Hivernel (1986) highlighted 53 quartz tools with 26.4% notches (11.2% end-scrapers), further Callow (1986d) highlights six further tools on non-flint or stone (five scrapers and a single denticulate). Overall flint dominates the tool list.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	41.1	28.8	10.4
Std. Deviation	11.5	10.3	4.6
Variance	132.2	106	21.1
Range	39	38	21

Table 6.60: Metrics whole retouched elements (t= 34) within this sample, layer E, grid square 100/-100

Metrics are on average larger than non-retouched elements within the assemblage (Table 6.60); as with layers H - F. Scrapers of all types dominate overall (t= 37) with notches and denticulates also significant (20%). Callow's (1986d) assessment of flint tools from layer E described a similar pattern, with 55.5% of retouched elements being scrapers; single sided straight were most significant. Notches and denticulates are significantly reduced compared to lower layers i.e. H and G (Table 6.1). Only nine pieces show bifacial retouch and once again no handaxes where suggested from within the layer E sample.

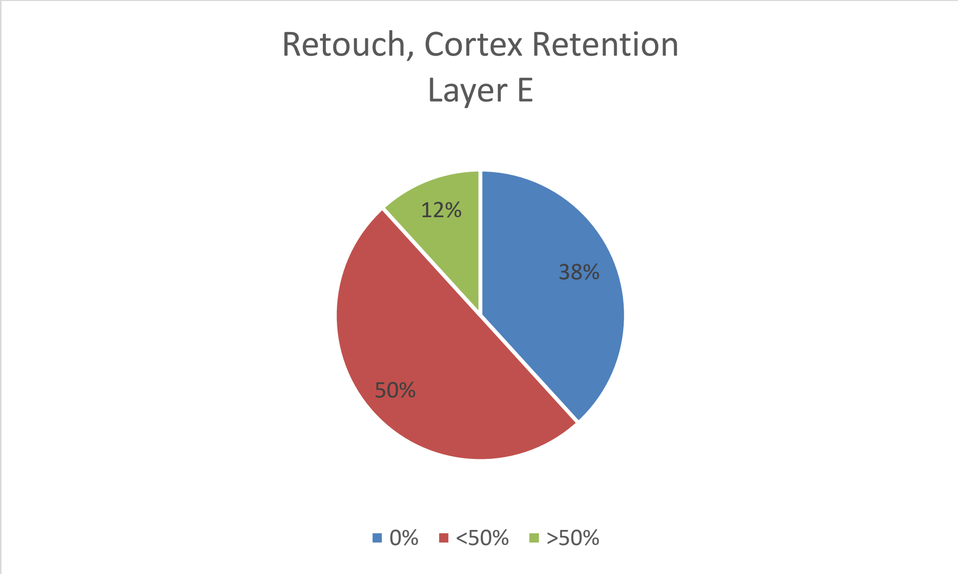

Figure 6.18: Cortex retention on all whole retouched elements within this study sample (t= 34), layer E, grid square 100/-100.

Cortex retention, as with layer F, is relatively high on retouched artefacts (Figure 6.18). 62% of these elements retain cortex, only one shows evidence for a fresh material source. The rest support the use of derived, small, beach cobble material.

Bordes typology	Count	%
Limace	1	1.8
Single straight scraper	10	18.2
Single convex scraper	9	16.4
Single concave scraper	2	3.6
Double straight scraper	1	1.8
Double straight-convex scraper	1	1.8
Double straight-concave scraper	1	1.8
Straight convergent scraper	2	3.6
Convex convergent scraper	4	7.3
Concave convergent scraper	1	1.8
Déjeté scraper	3	5.5
Convex transverse scraper	2	3.6
Typical percoir (awl)	1	1.8
Raclette	1	1.8
Notch	6	10.9
Denticulate	5	9.1
Abrupt retouched piece - thin	1	1.8
Mixed	4	7.3
Total	**55**	**100**

Table 6.61: Bordes typology (1961) for all whole tools (t= 34) from this study sample, layer E, grid square 100/-100.

Table 6.62 displays butt type of all whole and proximal elements of the retouched assemblage. Cortical examples are still present, plain examples dominate and there is no significant increase in faceting compared to non-retouched elements. This once again is similar to layers H – F overall.

Butt Type	Count
Plain	20
Dihedral	2
Cortical	7
Facetted	5
Missing	4
Indeterminate	6
Total	**44**

Table 6.62: Butt type for all whole and proximal retouched elements of this study sample (t= 44), layer E, grid square 100/-100.

There is a high degree of *semi* or fully *invasive* retouch (52.9%) and abrupt retouch is also present (Table 6.63) suggesting a degree of curation/reuse, reducing the retouched elements significantly, in size. The evidence for heavy reduction, as well as the re-sharpening techniques employed (see below), suggests a raw material economic strategy aimed at the preservation of flint material within layer E. In total nine re-sharpening flakes representing the LSF and TSF techniques (Cornford 1986) are present, with a further twenty removals preserved on artefacts, without refitting examples. This is the highest evidence for re-sharpening noted so far in this sample.

Extent of Retouch	
	Count
Un-retouched	4
Marginal	3
Minimally invasive	9
Semi-invasive	9
Invasive	9

Angle of Retouch	
	Count
Un-retouched	4
Abrupt	10
Semi-abrupt	20
Low	0
-	-

Table 6.63: Reduction of retouched assemblage; Extent of retouch and Angle of retouch for this study sample, layer E, grid square 100/-100.

The use of small, rolled beach cobbles leads to a small (i.e. metrically) retouched assemblage within layer E. Unlike layers H-F scrapers dominate over notches and denticulates. This suggests a change in behavioural practice within these occupations. It could relate to La Cotte's position within a new landscape (i.e. coastline cave system not a high point in large open plain). This is further discussed in the concluding chapters.

6.2.4.5 Micro-debitage

Micro-debitage was counted and weighed by myself for the whole of layer E. In total 454 individual pieces were identified from 67 of the 73 excavated spits that lay within grid square 100/-100. Therefore, micro debitage evidence shows that knapping and/or tool modification is occurring onsite and throughout the accumulation of layer E. The dominance of flint matches the rest of the assemblage (Table 6.64). Siltstone doesn't appear elsewhere within my sample but is present within the assemblage from layer E presented elsewhere (Callow 1986e).

Raw Material	Count	Weight
Flint	395	188.2
Quartz	43	19.8
Quartzite	5	1
Siltstone	1	0.1
Sandstone	4	2
Chert	6	0.2

Table 6.64: Micro debitage count and weight from layer E, grid square 100/-100.

6.2.4.6 Manuports and Hammerstones

No elements have been identified as manuports or hammerstones within this sample. Within layer E as a whole (i.e. the Callow database) three individual elements fit this category, a hammerstone and manuport of "stone" and a further hammerstone of granite. Only two are mentioned by Callow (1986c), and their presence supports on-site knapping, micro debitage and evidence for curation techniques.

6.2.4.7 Conclusion: Layer E

This assemblage is a heavily reduced core and flake assemblage. I suggest this is due strongly to the lack of local "good quality" raw materials i.e. fine grained cretaceous flint. The technological signature is a preference for hard hammer reduction of small nodules of flint, with some use of quartz (5%). Layer E sees the first significant appearance of *grès lustrés* which becomes increasingly important as a support for lack of flint in the following layers (D-A). The small nodules do retain a high degree of cortex, only three show no cortex at all. As described in chapter 4 the closest source for fresh material to La Cotte is >20km to the north-west. During layer E occupations (MIS 7a) sea-level is suggested to be at its peak (see chapter 4, page 62), submerging fresh flint outcrops to the north, and likely restricting acquisition site to beaches and riverine gravels (pers. obs.). Layer E is the most noticeable of the samples so far that displays relatively full exploitation of beach cobble material, with battered surfaces and high levels of flaws (pers. obs.) which is also evident on dorsal surfaces (see below).

Typologically the assemblage is dominated by scrapers. This element of the assemblage is also highly reduced but there is an observable selection of larger blanks for retouch. These blanks presumably originate from previous sequences of knapping within or close to La Cotte. There is limited but significant suggestion of longer transport of material into the locale from fresh outcrop sources to the north (see chapter 4). The degree of reduction throughout is further supported with the presence of convergent and déjeté scrapers (i.e. Dibble 1995) and an element of re-sharpening as discussed elsewhere by Cornford (1986). This use of re-sharpening techniques is employed to extend the use life of artefacts, often by completely changing their morphology and presumable intended use. Layer E is largely undisturbed and could represent a number of in situ occupations, unlike layer G and F. Again, as with previous layers, deposits where rich in burnt, fragmented faunal material; none of which was identifiable to species level (Scott 1986b).

6.2.5 Layer D

6.2.5.1 Introduction

Layer D represents the largest sample for this study, from grid square 100/-100 (t= 1503), representing nearly 20% of the whole, excavated layer D assemblage (t= 7686; within the Callow database). In total 13 where recorded as missing at the time of recording, therefore total analysed sample size is 1490 (Table 6.65). Retouched elements are particularly well represented in comparison to other layers, as is prepared core technology.

Artefact Type	**Count**	**%**
Flakes	1304	87.52
Levallois products	9	0.6
Cores (non-PCT)	30	2.01
PCT cores	1	0.07
Retouched	146	9.8
Total	**1490**	**100**

Table 6.65: Artefacts for this study sample (t= 1490), layer D, grid square 100/-100.

Taphonomically the assemblage shows minimal evidence for disturbance, with only 19% showing any evidence for edge damage (Figure 6.19); this is the lowest from throughout this study sample. Of those with damage 46% is only *slight* and only 5% (t= 73) show any evidence of a secondary degree of edge damage. No other taphonomic indicators are present other than six elements with small degrees of patination.

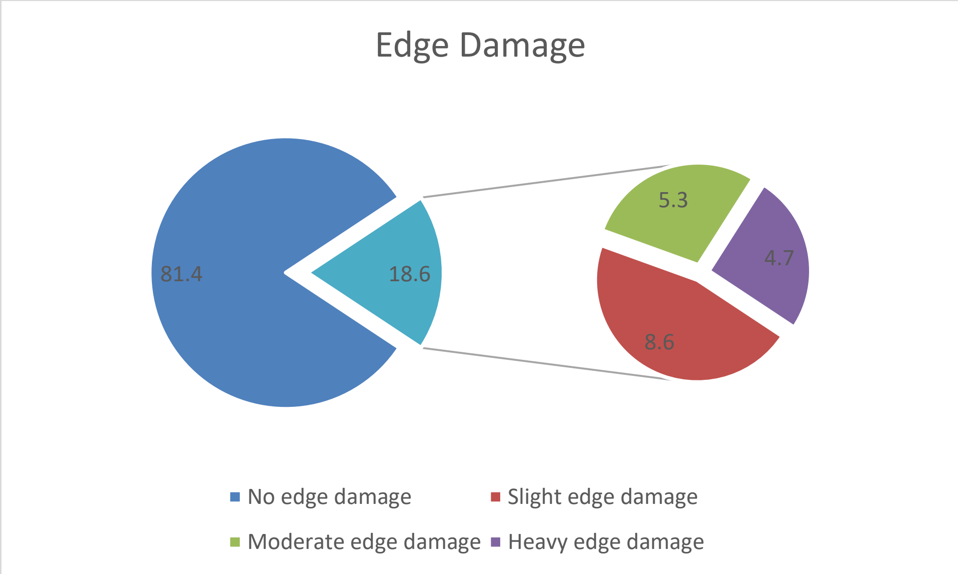

Figure 6.19: Edge damage on all artefacts from this sample (t= 1490), 100/-100, layer D.

Callow (1986e) interpreted the layer D deposits as "*slightly disturbed*" occupation floors (Lautridou *et al.* 1986a; van Vliet-Lanoë 1986), mostly in a granitic sand matrix with few large granite blocks, related to rock fall. This can be seen as very similar to layer F, with a slight deterioration in conditions compared to layer E, and a general lowering of sea-levels (see chapter 4).

6.2.5.2 Cores and core working

31 individual elements are identified here as cores with one Levallois core (discussed separately) and 30 non-PCT elements.

6.2.5.2.1 Non-PCT

Flint dominates with only four of the total being on quartz (Table 6.66). Callow (1986g) also identified high numbers of flint examples (t= 143, whole and broken) and Hivernel (1986) identifying just 32 quartz examples. However, overall layer D represents the second largest quartz sample from the layers studied here i.e. H-A. There were also three non-flint examples mentioned (Callow 1986a: 326), specific raw material not mentioned.

RM Type	Count	%
Flint	26	86.7
Quartz	4	13.3
Total	**30**	**100.0**

Table 6.66: Raw material type for all cores recorded within this sample (t= 30), layer D, grid square 100/-100.

Only on a few examples was it possible to identify raw material source (Figure 6.20), significantly a single element displayed fresh, chalky cortex. It is interesting that this signature (i.e. low but present fresh material) appears in both F and D as well as during the high sea-level scenario within layer E (this is further discussed in the next chapter). The majority is however recorded as derived, and once again a large proportion of this is likely to have been from a beach cobble origin; however layer D does show some cortical staining, suggesting a riverine source. Both these sources could sit within a few km of the locale and/or each other.

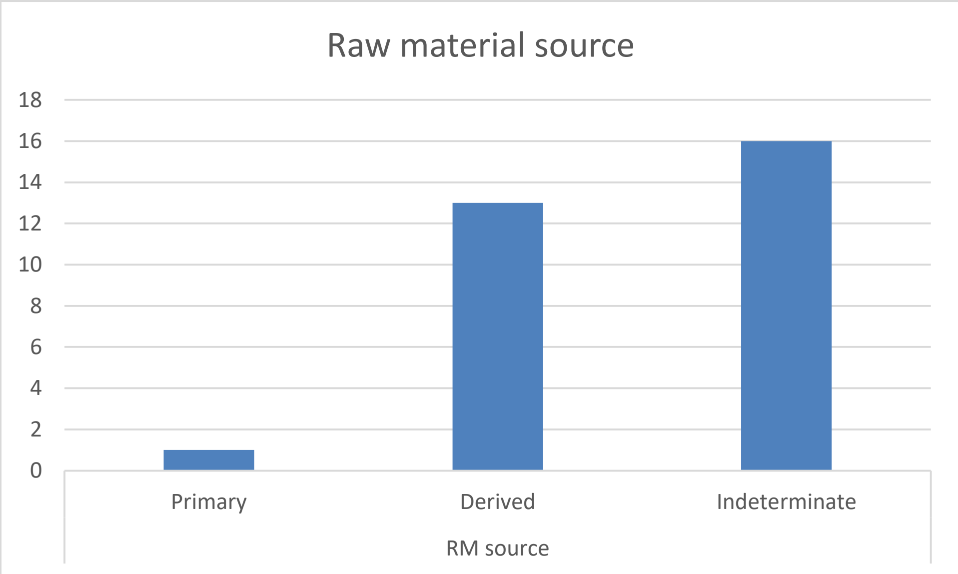

Figure 6.20: Raw material source analysis for all cores recorded (t=30), layer D, grid square 100/-100.

Metrics of cores are relatively small (Table 6.67), and the values for weight are prone to variability because of significant outliers, including the quartz elements (i.e. denser, heavier material). Comparable data is unavailable for quartz examples from original analysis (Hivernel 1986). However, the signature is of heavy reduction of core material within layer D. The reduction in size could be an increase in quality of material within layer D (pers. obs) compared to E and F (i.e. less flaws). This is supported by the general lack of anthropogenic battering within layer D (t= 1; all artefacts) compared to layer E (t= 17, including eight on core surfaces).

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Mean	38	30	19	24
Standard Deviation	6	7	5	15
Variance	42	45	20	220
Range	31	26	17	55
Mean (Flint only)	37	28	18	19

Table 6.67: Descriptive statistics for all whole cores (t=18) for this sample, layer D, grid square 100/-100.

Even more so than the previous layers (H-E), the majority of the examples show no evidence for blank type. Of the five that do, all show previous ventral surfaces i.e. cores on flakes (Table 6.68). Again the lack of blank type evidence can be related to heavy degrees of reduction masking/removing indications of blanks. The relative lack of cores on flakes compared to both layer F (33%) and E (50%) could suggest this technique was less commonly practiced within later D (Table 6.68). However, low numbers of cores overall precludes more discussion here.

Blank Type	Count	%
Flake	5	16.67
Indeterminate	25	83.33
Total	**30**	**100**

Table 6.68: Blank type present within this sample, layer D, grid square 100/-100.

The layer D sample of cores (t= 30) is dominated by alternate flaking (Table 6.69), with examples of all strategies (simple, complex and classic). Single removals are also well represented (29.7%) with an average of 5 flakes per final core surface. Hutcheson and Callow (1986) recorded a higher average scar count (6.98) for flint only. Number of episodes per core surface remains above two despite the reduction in size of cores, and once again the use of single removals from the final surface is a significant practice for final reduction.

Removals / episode	**Count**
A	27
Bi	6
Ci	27
Cii	6
Ciii	25
Mean	**No. Removals**
	5.1
	No. Episodes
	2.3

Table 6.69: Knapping strategies employed on whole cores from this sample (t= 18), layer D, grid square 100/-100.

Alternate knapping is also prevalent within final core shape; both this sample (Table **6.70**), and Hutcheson and Callow (1986) show an important appearance of discoidal core working (23.3%), unlike previous layers (i.e. H - E). Multi-platform examples still dominate, again related to the final use of single removals to exploit flint to the full (pers. obs.)

Reduction Method	**Count**	**%**
Migrating platform	11	61.1
Single platform, unprepared	4	22.2
Discoidal (classic)	3	16.7

Table 6.70: Overall reduction method on final flaking surfaces for all whole cores (t= 18) for this study sample, layer D, grid square 100/-100.

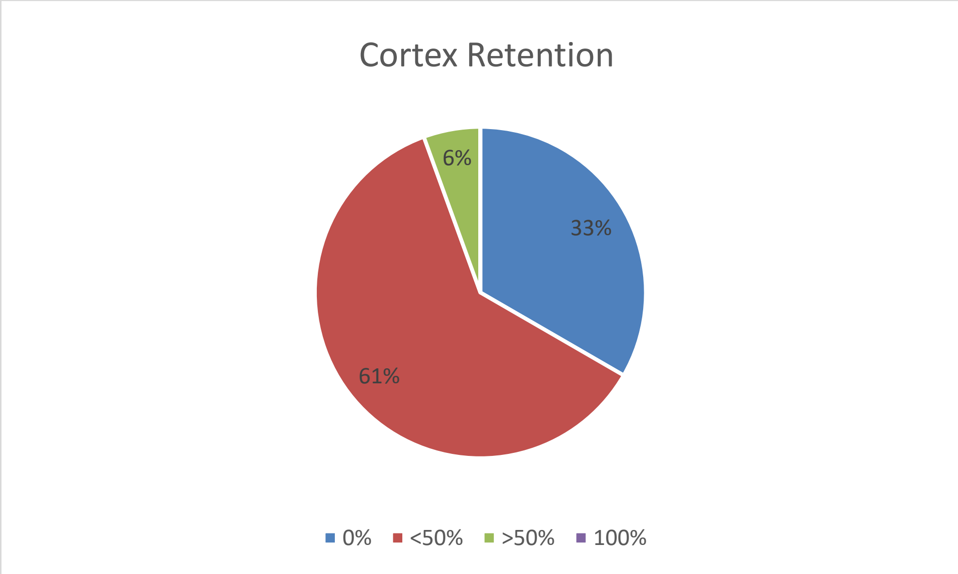

Figure 6.21: Cortex retention on all whole cores from this study sample (t= 18), layer D, grid square 100/-100.

In total only a third of the whole examples display no cortex, but only one shows more than 50% (Figure 6.21). The majority of those cortical examples are small remnant surfaces of thin cortex (pers. obs.), and indicative of beach cobbles. The high degree of cortex on small cores once again suggests the use of small nodules, as in layer E. As with other previously discussed layers, core flaking is exclusively hard hammer.

6.2.5.2.2 PCT

The single recorded flint PCT core is larger than the average for non-PCT examples (Table 6.71). Interestingly, this was produced on, what would have to have been, a large flake and shows at least one (likely only one, due to is size and morphology) previous exploited flaking surface. The final flaking surface is damaged (also varnished for archive i.e. somewhat obscured), and not fully exploited; this probably accounts for its abandonment at this stage. It does however, display contrary evidenced to the continued exploitation of material to its full, as seen for non-PCT core elements (above); there is no suggestion of extended use life after the failed removal(s). Hutcheson and Callow (1986) identified 1.1% PCT examples, this is the same singular example discussed here, and represents the lowest within their study from all layers.

L (mm)	B (mm)	Th. (mm)	Weight (g)
54.0	45.0	21.0	46.8

Table 6.71: Metrics for the single PCT core element from this sample, layer D, grid square 100/-100.

6.2.5.3 Flakes

RM Type	Count	%
Flint	1119	77.2
Granite	17	1.2
Sandstone	35	2.4
Glossy Sandstone	3	0.2
Quartz	256	17.7
Siltstone	3	0.2
Quartzite	17	1.2
Total	**1450**	**100**

Table 6.72: Raw material type for all flake elements of this sample, layer D, grid square 100/-100.

The flake portion of the debitage is the most substantial (Table 6.72), with flint dominating once again. Non-flint is significant however, with Quartz (17.7%) being the most prominent. Layer D represents the first significant non-flint assemblage of this sequence; this is also supported by Callow (1986i, 1986c, 1986g) and Hivernel (1986). This is not mirrored by raw material of cores (see above) or retouched material (see below) suggesting an overall preference for flint reduction within the locale, and the transport of non-flint as blanks and/or end-products into the locale. The very low *grès lustré* suggests a good local supply of flint or the lack of this material in the landscape at this time; also discussed by Callow (1986d). The quartz assemblage is the largest studied here other than layer A (19%; presented below) and was also discussed in more detail by Hivernel (1986).

RM source	Count	%
Primary	6	0.41
Derived	357	24.62
Indeterminate	1087	74.97

Table 6.73: Raw material source analysis for this study sample (t= 1450), layer D, grid square 100/-100.

Fresh, chalky cortical retention is still rare (Table 6.73), but present. Again the derived element is indicative of the use of beach cobble material, but with a significant influence of riverine stained cobbles/gravels too (pers. obs.), as with cores (see above). Metrics, after increasing until layer F, remain similar here to layer E, and represent a general reduction from earlier layers. This also matches core analysis, suggesting the heavy reduction of nodules producing small flakes onsite or within the immediate vicinity. This is either indicative of short sequences of reduction from small core nodules (supported here) or longer sequences elsewhere and transport of smaller cores (pers. obs.).

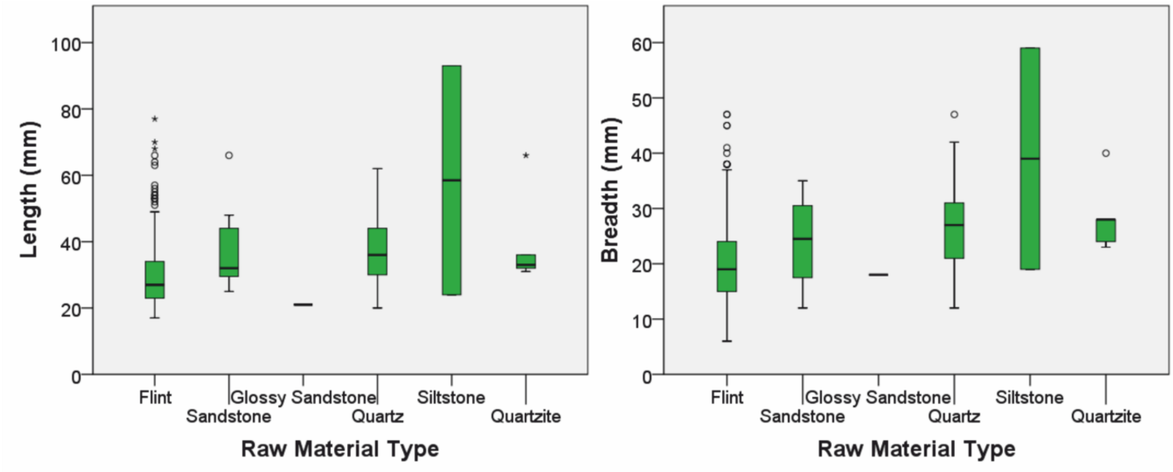

Figure 6.22: Boxplots describing length and breadth distribution of all whole flakes (t= 570) within the layer D sample.

Range distribution of flint material increases within this layer (see Figure 6.22) although the main distribution is still clustered around the mean in similar fashion to previous layers. Figure 6.22 also shows that raw material type doesn't significantly change the overall distribution, specifically or length. As with quartz in the previous layer, breadth is more distributed in both this material and sandstone (the significant non-flint materials) again relating to the less predictable fracture qualities. The range in flint pieces and cases of outliers supports the conclusion in later E of varied use of flint quality.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	32.2	22.2	7.6
Std. Deviation	11.6	8.7	4.4
Variance	134.9	75.6	19.8
Range	76	65	28

Table 6.74: Metrics for all whole flake elements for this study sample (t= 570), layer D, grid square 100/-100.

Table 6.75 shows the butt types on whole and proximal elements of this sample (t= 762). Plain platforms heavily dominate (51.6%) with good representation from dihedral and facetted elements. The prepared, faceted butt types complement the evidence for PCT and use of more structured knapping techniques and degrees of preparation within layer D. Cortical examples are present once again, indicative of the raw material source used i.e. small irregular cobbles, most often from beach origin.

Butt Type	Count	%
Plain	393	51.6
Dihedral	88	11.5
Cortical	70	9.2
Natural	3	0.4
Marginal	25	3.3
Soft hammer	14	1.8
Facetted	88	11.5
Missing	14	1.8
Trimmed	1	0.1
Obscured	66	8.7
Total	**762**	**100**

Table 6.75: Butt type for all whole and proximal elements from this sample, layer D, grid square 100/-100.

Cortex retention on dorsal surfaces is relatively high at 44% with a total of ten individual elements with 100% cortex. Again cortical presence supports the use of small cortical pebbles from either beach or riverine sources rather than large, fresh nodules. There were twenty three occurrences of relict core edges and three cordal elements, which supports the presence of final reduction of small core nodules, in short sequences of exploitation.

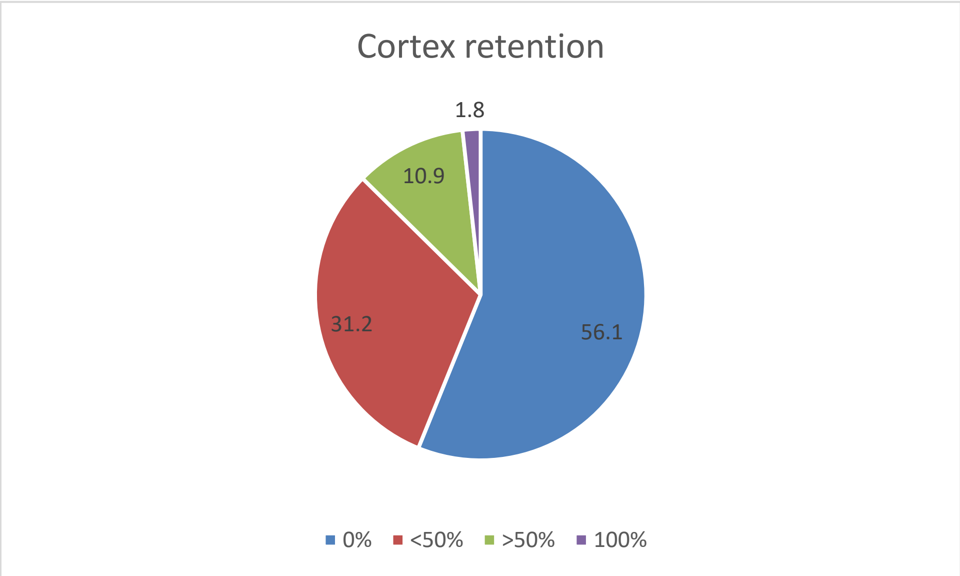

Figure 6.23: Cortex retention on whole flake elements of this sample (t= 570), layer D, grid square 100/-100.

However, the six fresh, primary examples are important for discussing landscape movement (see below). The predicted drop in sea-level throughout layer D (and further into C) is seen to expose fresh material (see chapter 4), at significant distance (>20 km) to the north.

6.2.5.3.1 PCT products

A total of nine flake elements were recorded separately using the PCT products methodology. This is the largest sample in this study, but still extremely small. All but one are flint; 78/31397 (Figure 6.24) is a large (Table 6.76) Levallois point with heavy (denticulate like) scraper retouch on both laterals. Because of the rough nature of the sandstone used this has been classified as a denticulate but could easily fit into an abrupt convergent-straight scraper category.

Figure 6.24: Sandstone Levallois point, 78/31397, described in text.

	Length (mm)	Breadth (mm)	Thickness (mm)
All PCT products	64.0	41.3	10.9
Minus 78/31397	55.3	35.3	7.6

Table 6.76: Average metrics for whole Levallois products (t= 9), layer D, grid square 100/-100.

Products are generally large and do not match the average metrics for cores or other debitage; even when the large point is removed from analysis. As there is limited sandstone working (2.4%, no cores) we can suggest this point was brought into the excavated area and core working is mostly happening elsewhere. Further, the general larger size of flint examples suggests transport in of material as end-products *and/or* removal of cores from the site. The single PCT core supports this movement through the site; this example was abandoned due to flaws and failed reworking (see above).

This small sample represents one of the highest PCT occurrence of this study sample. PCT was also relatively highly represented when originally studied Callow (1986b) at 7.79% of the flint tools/flakes. The low core count by Hutcheson and Callow (1986) (1.1%) suggest movement of material through the locale i.e. PCT cores moving out and/or PCT products moving in. As well as being related to Neanderthal landscape behaviour this signature could also be related to Neanderthal spatial organisation (intra-site), as layer D is not fully excavated.

6.2.5.4 Retouched elements

Bordes typology	**Count**	**%**
Single straight scraper	8	9.5
Single convex scraper	3	3.6
Single concave scraper	2	2.4
Convex convergent scraper	1	1.2
Déjeté scraper	11	13.1
Ventral side scraper	3	3.6
Bifacial side scraper	5	6.0
Alternate side scraper	1	1.2
Atypical burin	2	2.4
Atypical piercer	1	1.2
Notch	20	23.8
Denticulate	11	13.1
Misc.	16	19.0
Total	**84**	**100**

Table 6.77: Bordes typology, based on Bordes (1961), of all whole elements of the retouched sample (t= 146), layer D, grid square 100/-100.

Table 6.77 shows typology of retouched elements (t= 84) based on Bordes (1961). Scraper types dominate (46%) with déjeté and single, straight examples most prevalent. Denticulates and notches are significant; notches being the highest single category (23.8%). The sixteen miscellaneous examples are mostly mixed tools with at least two edges of differing retouch. Ten of these show episodes of scraper retouch, three with notches and two with denticulate edges.

Overall, production or use of scrapers is dominant potentially suggesting hide working and meat processing. After the increase in scraper types within layer E, the general mix of scrapers vs denticulate types return to similar levels seen in layer F (Table 6.1).

Position of Retouch	Count
Direct	65
Inverse	16
Alternate	17
Bifacial	4

Extent of Retouch	Count
Marginal	1
Minimally invasive	23
Semi-invasive	29
Invasive	32

Table 6.78: Tables displaying position and extent of retouch recorded for retouched elements of this study sample, layer D, grid square 100/-100.

Analysis using the retouched methodology described in chapter 5 supports and adds to the Bordes typological analysis. Direct retouch dominates (63.7%) with broadly equal amounts of alternate and inverse retouch present (Table 6.78). Bifacial retouch is present in both analysis methodologies but no true handaxes where identified within this study; Callow (1986d) highlights the presence of four true bifaces on flint and Hivernel (1986) suggests two potential examples on quartz. Other variables of interest are dominance of single edge retouch (73.3%), and invasive or semi invasive removals (66.3%). The prevalence of notches and denticulates within the Bordes types is matched by high amounts of single removals (morphology of retouch) and flaked flake edges (form of retouch).

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	44.0	31.2	11.5
Standard Deviation	13.0	10.3	4.4
Variance	169.9	106.3	19.6
Range	115	83	36

Table 6.79: Descriptive statistics for ALL whole retouched elements from this study sample (t= 84), layer D, grid square 100/-100.

Retouched material is once again, on average, larger than the rest of the flake assemblage (Table 6.79), and flint is preferred as retouch blanks. However, this is the largest non-flint assemblage, in this study, other than layer A. Of the Saalian layers (H-6) only D and A-5 have significant quartz assemblages discussed in depth by Hivernel (1986). There were a total of 84 quartz tools identified (ibid: pg. 320) with notches dominant (t= 27).

RM Type	Count	%
Flint	136	93.15
Sandstone	4	2.74
Quartz	5	3.42
Quartzite	1	0.68
Total	**146**	**100**

Table 6.80: Raw material type for all retouched elements of th9s study sample (t= 146), layer D, grid square 100/-100.

There is only one large change in frequency of butt types between retouched (Table 6.81), and non-retouched elements, and that's the increase in removed platforms (i.e. *missing*). These are both as single removals but also as scraper or denticulate edges which reflects a continuation of retouch around all possible free edges. As with plain flakes facetted and cortical examples are present, suggesting a mix of production and selection of blanks.

Butt Type	Count	%
Plain	36	45
Dihedral	6	7.5
Cortical	7	8.75
Natural	1	1.25
Facetted	9	11.25
Missing	10	12.5
Obscured	11	13.75
Total	**80**	**100**

Table 6.81: Butt type for whole and proximal retouched elements from this study sample (t= 80), layer D, grid square 100/-100.

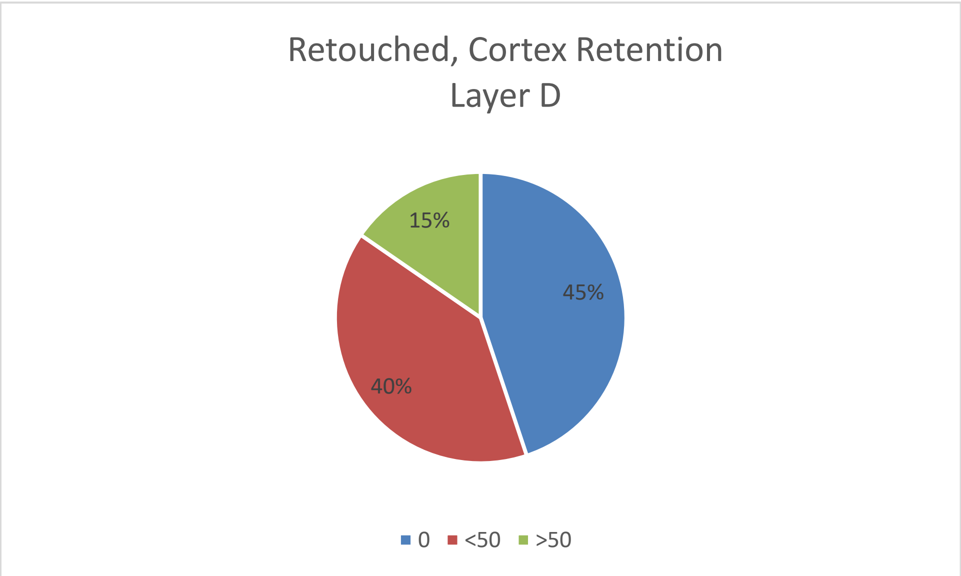

Figure 6.25: Cortex retention for all whole retouched elements within this study sample (t= 78), layer D, grid square 100/-100.

Cortex retention on retouched artefacts is similar to other layers (Figure 6.25). Again the retention of cortex, especially 15% over fifty percent, suggests the potential use of initial stages of reduction (also supported by increase metrics, despite retouch reduction). Therefore some percent of the retouched assemblage could be produced away from the locale, from initial stages of reduction of cores, further suggesting the transport of retouched artefacts (or blanks) and semi-reduced cores. This is not seen in layer E, and not suggested for other layers already discussed (H - F).

In total re-sharpening is well represented with eight LSF's and two TSF's as well as three re-sharpening negatives on retouched pieces (all LSF technique). There are also two burin spalls and a further two flaked flake spalls, all representing retouch and re-sharpening activity. These elements further add to the reduction necessity of this assemblage, as with other layers. This is the first dominance of LSF over TSF for this sample and the database documents 59 LSF and 17 TSF form layer D.

6.2.5.5 Manuports and Hammerstones

No elements of this study sample where identified as manuports or hammerstones. Callow (1986e) identified two elements from layer D (documented in the database); one on granite and one on basic igneous, both hammerstones.

6.2.5.6 Conclusion: Layer D

Layer D shows a good level of stasis (reduction techniques; limited PCT; size and character), compared to previous layers (especially H-F), as well as some general trends of change (increased use of LSF technique). These ideas are discussed in more depth with further examples in the summary and concluding chapters. *More than other layers already discussed there is evidence for the movement of material in and through the locale (pers. obs.).* PCT material appears in the form of end-products and abandoned cores, and it's suggested PCT cores are moved through the site, potentially un-exploited at the locale (or spatial organisation within the locale). Only relatively short sequences of reduction of non-PCT elements can be attested by the recorded debitage and core removals, suggesting the small, abandoned cores are at their final stages of reduction and/or are generally small in character from the outset.

Scrapers still dominate, but less so than the previous two layers (F and E). This could be related to raw material use i.e. notches and denticulates on hard, non-flint material, but could also represent a change in Neanderthal use of La Cotte after the rising, high sea-levels of F-E occupation of the Channel Plain. The lowering sea-levels of layer D would have begun to expose raw material outcrops (especially good quality flint), to the north (see chapter 4). Again mammoth and woolly rhino are present with horse and red deer, in low numbers, but fragmented bone material attests to a large accumulation of faunal material (as with layer H-E).

6.2.6 Layer C

6.2.6.1 Introduction

The layer C sample represents the third largest from this study with a total of 1124 individual artefacts. Layer C as a whole is represented by 9772 artefacts in total. Fourteen of my sample where found to be missing during analysis; therefore a working study sample size is set at 1110 (Table 6.82).

Artefact type	Count	%
Flakes	969	87.3
Retouch	109	9.82
Non-PCT cores	15	1.35
PCT cores	1	0.09
Levallois products	7	0.63
Handaxes	1	0.09
Hammerstone/ manuport	5	0.45
Natural	3	0.27
Total	**1110**	**100**

Table 6.82: Overview of lithic assemblage form this sample (t= 1110), layer C, grid square 100/-100.

Taphonomically, analysis suggests material has seen little movement or damage, and supports Callow (1986c) that layer C experienced little post depositional disturbance. Edge damage was apparent on only 22% of artefacts (Figure 6.26), with a further 11% displaying an additional, secondary degree of damage. This further 11% was only '*slight*' in all cases and there was no significant amounts of scratching or patination across the sample. Staining appears on a number of artefacts but is seen to-be pre-depositional and represents use of fluviatile sources of raw material, this is further discussed below.

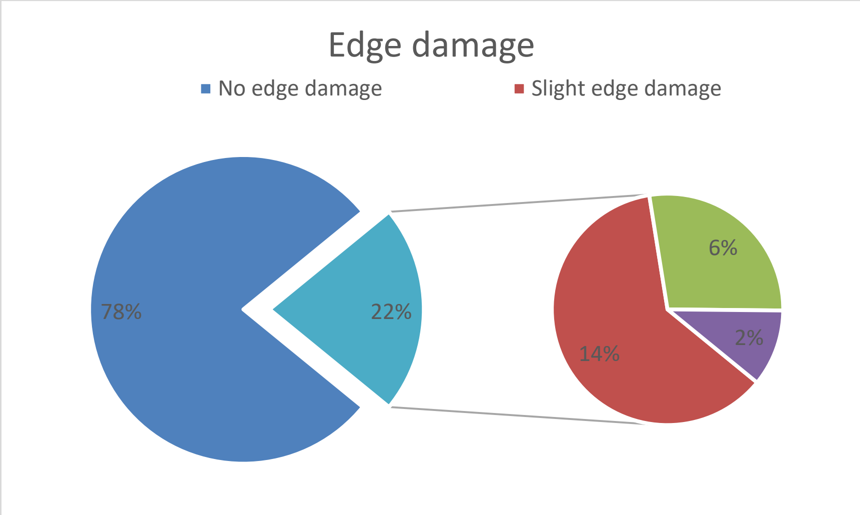

Figure 6.26: Edge damage recorded from all artefacts from this study sample (t= 1110), layer C, grid square 100/-100.

This study also highlighted a number of immediate refits, simply from identification and testing as analysis was conducted; these are discussed in more depth below. Their presence further supports the limited post-depositional movement of material within deposits of layer C; at least within the excavated area. Again, this study supports Callow (1986c), that some archaeological material within layer B (stratigraphically above) is reworked from somewhere within layer C, from banked material against fissure walls slumping and reworking, due to culluviation and potential periglacial activity, at the onset of the "layer B" deterioration in climate. This truncation was not identified during excavation, however, evidence could exist in remnant deposits that abut the far western wall. Due to this we can't rule out that, as a whole, material is lost from the upper section of layer C.

6.2.6.2 Cores and core working

There is one example of PCT working within the core assemblage. This piece is discussed separate below and excluded from the following presentation of data.

6.2.6.2.1 Non-PCT cores

RM type	Count
Flint	14
Quartz	1
Total	**15**

Table 6.83: Raw material type for all cores from this study sample (t= 15), layer C, grid square 100/-100.

The core assemblage is dominated by flint (Table 6.83), and as with other layers, is largely from derived sources (Table 6.84). However the single fresh, *primary* example, is of significance for Neanderthal raw material sourcing and suggests movement of material through the landscape from >20km to the north-east of La Cotte (see chapter 4). Unlike other layers (e.g. layer E) there is a larger influence of riverine stained material in layer C, however beach cobble material is still believed to dominate, indicated by battering on irregular cortical surfaces and flawing (pers. obs.).

RM source	Count
Primary	1
Derived	7
Indeterminate	7

Table 6.84: Raw material source analysis for all cores within this study sample (t= 15), layer C, grid square 100/-100.

Whole cores (t= 10) have similar metrics to those of layer H and G, with a relatively high mean weight of 30.4 grams (Table 6.85). This signature could relate closely to Neanderthal landscape behaviour and discard patterns at La Cotte. One whole core was on Quartz, this is included within the overall analysis and shows no observable variance to the results. The low assemblage size presented here provides a limited window into core practices and raw material use in layer C. However, the general signature matches that discussed by Hutcheson and Callow (1986) and overall the core sample of layer C is one of the lowest within the excavated assemblage (Callow 1986c: 219).

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Mean	43.6	32.5	18.8	30.4
Std. Deviation	4.6	5.9	6.4	24.0
Variance	20.7	34.7	40.4	575.8
Range	13	19	19	81

Table 6.85: Descriptive statistics for whole cores identified within this sample (t= 10), layer C, grid square 100/-100.

Blank types present match those from layer H - F, with limited evidence for any blank type, and those identified are all cores on flakes (Table 6.86). Again this is indicative of heavy reduction of generally small irregular nodules with the additional use of transported flakes.

Blank Type	Count
Flake	4
Indeterminate	6
Total	**10**

Table 6.86: Blank type recorded from all whole cores within this study sample (t= 10), layer C, grid square 100/-100.

Overall reduction strategies are also similar to elsewhere with a dominance of migrating platform reduction (Table 6.87). Two of these where classified as classically discoidal continuing the trend after its appearance in layer E. Overall the signature highlights the varied nature of core strategy employed. Once again the small sample size from layer C prohibits a stronger analysis.

Overall reduction type	Count
Migrating Platform	7
Classic Discoid	2
Indeterminate	1

Table 6.87: Overall reduction type for all whole (t= 10) recorded in this study sample, layer C, grid square 100/-100.

Unlike other layers, no cores retain over 50% (Figure 6.27), but this is likely due to the low numbers present rather than a behavioural signature. Overall, 70% retain some cortex on the core surface.

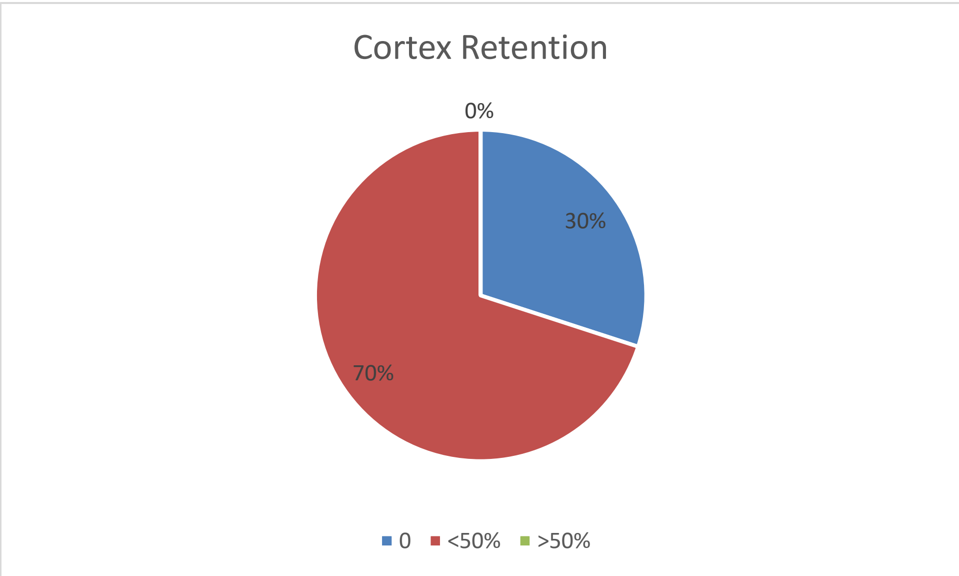

Figure 6.27: Cortex retention for all whole cores (t= 10), layer C, grid square 100/-100.

Analysis of working strategies employed shows a relatively even spread of reduction employed between the four different examples present; but with a clear preference for simple alternate flaking (C1; Table 6.88). Alternate flaking clearly dominates overall with 48% recorded with either simple or complex alternate sequences. No evidence for classic alternate was recorded; this, again, could relate to the size of recorded cores. The presence of two classic discoids and the high number of alternate reduction episodes suggests a preference for this technique, with the use of other strategies for final reduction of the smaller, remaining material.

Removals / episode	**Count**
A	13
Bi	20
Ci	23
Cii	12
Mean	**No. Removals**
	6.8
	No. Episodes
	2.5

Table 6.88: Number of core episodes and core reduction strategies employed following Ashton and McNabb (1996), for this study sample (t= 10), layer C, grid square 100/-100.

6.2.6.2.2 PCT cores

There is one example of prepared core working within the core assemblage, a Levallois core. Its broad size and weight fit within the range for other cores present. The core was re-prepared centripetally, after at least one previous core episode, potentially also using a PCT method (obscured). The final flaking surface has evidence (two hinge fractures) of attempts at a final removal(s), from a prepared striking platform. It is possible these hinge fractures could represent an attempt to prepare the surface more substantially, but seems more likely they are failed removals from a small Levallois core, subsequently abandoned. Hutcheson and Callow (1986) identified 4.2% Levallois cores (t= 4) within their excavated sample. PCT products are discussed below.

Metrics	35.0mm	32.0mm	15.0mm	19.0g

Table 6.89: Metrics for a single Levallois core from within this study sample, layer C, grid square 100/-100.

<u>**Cores: conclusion**</u>

Despite the small sample size of whole cores (t= 10 + 1) some key behavioural signatures can be inferred and fit within the trend for this study. There is some evidence for movement of material into and through the site, with the small, exhausted cores and flakes (see below) discarded and potentially larger flake/processed material moving out. These larger pieces could be a combination of pieces produced on, i.e. related to knapping sequences enacted within the locale, or pieces transported used/reduced/curated and removed with the aim of further use within the landscape. This fits well with other data recorded from layer C (see below), and elsewhere within the La Cotte assemblage. Flint is again dominant, the introduction of minimal amounts of fresh, primary sourced material of specific interest and is discussed in depth with relation to palaeo-geography and regional data; presented as part of this study within chapter 4.

6.2.6.3 Flakes

In total, 1086 pieces fall into this category, with 109 of those displaying retouch (see below). Only 39% of the sample was whole. Flint dominates (Table 6.90), but there is a significant non-flint element (24.3%) within this sample. This is depleted within the whole of layer C sample (Callow 1986d), where flint represents 82.9% with quartzites and sandstones only representing 3.6% (as opposed to 9.2% within my sample). Unlike other samples within this study, this non-flint assemblage is not overwhelmingly dominated by quartz (just 5% in both studies).

RM Type	Count	%
Flint	822	75.7%
Chert	2	.2%
Basic Igneous	39	3.6%
Jersey Shale	1	.1%
Granite	20	1.8%
Sandstone	49	4.5%
Glossy Sandstone	18	1.7%
Quartz	54	5.0%
Siltstone	27	2.5%
Quartzite	51	4.7%
Unidentified	3	.3%
Total	**1086**	**100**

Table 6.90: Raw materials for flake debitage for this sample, layer C, grid square 100/-100.

The high degree of breakage is mirrored within the whole layer C assemblage (Callow 1986b; Callow 1986f). The high degree of chunks (13.2%) could further compliment the refitting and micro debitage evidence for suggesting onsite, *in situ,* knapping. Again, Callow's (1986c) interpretation of a relatively in situ deposit is supported here. The low degree of frost fracturing, i.e. rock fall, and evidence for warmer climate in comparison to layer B (Callow 1986h; Jones 1986), could suggest some element of breakage/shattering through use and/or active trampling of material. Bone material is largely un-identified due to fragmentation (Scott 1986), so degrees of butchery and bone breakage can't be linked to Neanderthal behaviour (Scott 1986).

Portion	Count	%
Whole	423	39.0%
Proximal	95	8.7%
Distal	239	22.0%
Mesial	144	13.3%
Siret	42	3.9%
Chunk	143	13.2%
Total	**1086**	**100**

Table 6.91: Portion of artefact recorded within this sample, layer C, grid square 100/-100.

Once again the majority of material is from derived raw material sources (Table 6.92). As with other layers, the bulk seems to be of beach cobble origin, with some that could be defined as river rolled and stained (similar to layer D). This fits with knowledge of the surrounding landscape and likely raw material availability (see chapter 4). Interestingly eight pieces are clearly fresh in origin, suggesting a source different from those exploited in layer E, but more comparable to layer D; fresh material is also present within the core sample.

RM source	Count	%
Primary	8	1.0%
Derived	319	38.8%
Indeterminate	495	60.2%

Table 6.92: Raw material source for all flint elements (t= 822) from this study sample, layer C, grid square 100/-100.

Overall, metrics are comparable to other layers and most likely connected to the size of the dominant available raw material (Figure 6.28). The reduction in size (on average) is continued from layer E. This signature is also matched with a reduction in range and variance of material (Table 6.93), suggesting a degree of standardisation of production, probably linked to size and character of raw material (i.e. small but less flawed than other layers) but could have some functional element, further discussed in the next chapter. There is no suggestion that the material is not connected to cores present in the sample (i.e. knapped on or close to the locale).

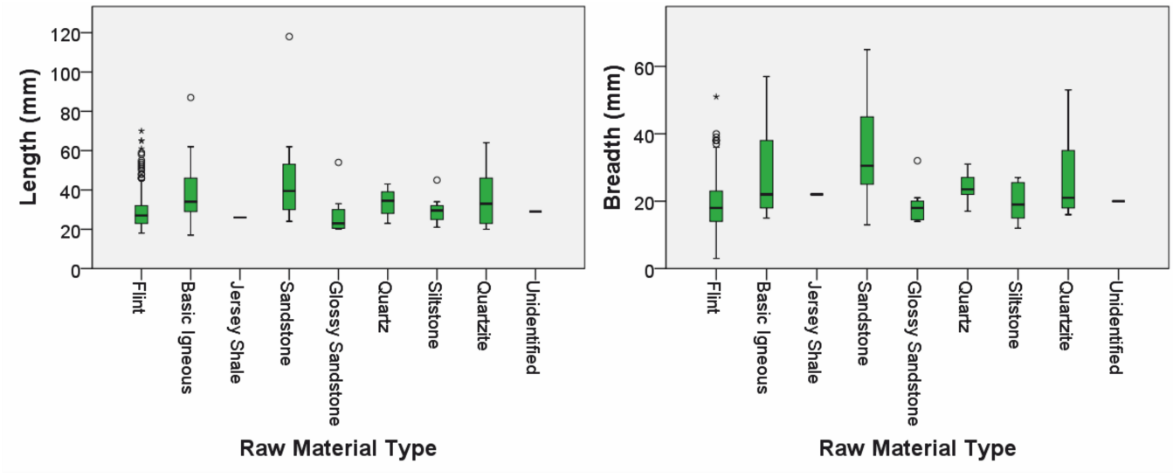

Figure 6.28: Boxplots describing length and breadth distribution of all whole flakes (t= 423) within the layer C sample.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	31.2	21.2	6.5
Std. Deviation	11.4	8.5	3.6
Variance	131.0	72.3	13.0
Range	101	62	22

Table 6.93: Metrics for all whole flake elements from this study sample (t= 423), layer C, grid square 100/-100.

The degree of cortex retention also supports reduction on site (Figure 6.29). Firstly, some degree of all stages of reduction is present. However, the low amounts of elements with >50% cortex retention suggests very little initial reduction overall. This is also likely to relate to small irregular cores with little initial volume from the start. This was also supported by core variables recorded and discussed above.

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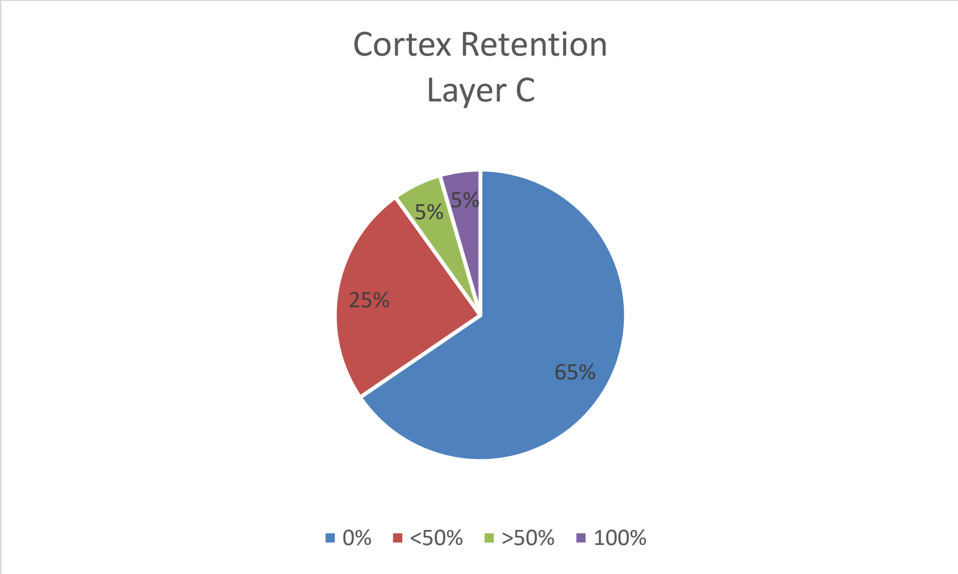

Figure 6.29: Cortex retention from dorsal surfaces of all whole elements of the flake assemblage for this study sample (t= 423), layer C, grid square 100/-100.

While plain platforms are dominant on proximal and whole elements (Table 6.94), faceting represents the second largest category; the largest percentage across this study. As with layer D, dihedral platforms are significant but cortical platforms are similar, further a sign of different use of material compared to the lowest two layers (i.e. H and G) or different stages of reduction. 2.7% of this sample retain a relict core edge on the dorsal surface, further supporting the continued reduction of material towards the end of its use life.

Butt Type	**Count**	**%**
Plain	196	37.8
Dihedral	70	13.5
Cortical	30	5.8
Natural	2	0.4
Marginal	30	5.8
Soft hammer	20	3.9
Mixed	2	0.4
Facetted	78	15.1
Missing	4	0.8
Trimmed	2	0.4
Obscured	84	16.2
Total	**518**	**100**

Table 6.94: Butt type for all whole and proximal elements of this study sample (t= 518), layer C, grid square 100/-100.

6.2.6.3.1 PCT products

In total seven Levallois products where identified within this study; six are whole and one proximal fragment. Two flakes show evidence of previous removals. Butt type is dominated by faceting (t= 4) with one plain and one missing example (Figure 6.30).

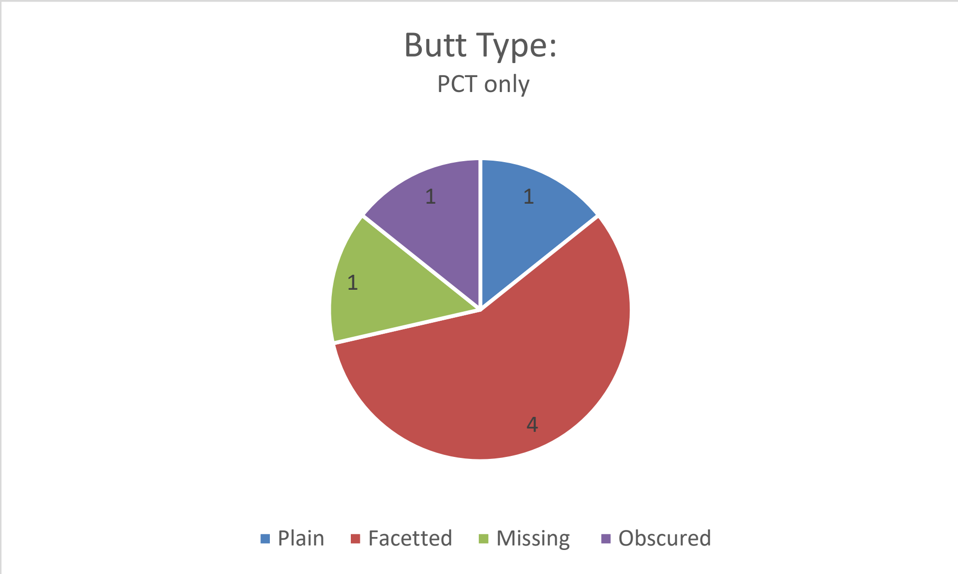

Figure 6.30: Butt type for all Levallois products from within this study sample (t= 7), layer C, grid square 100/-100.

Metrically Levallois products are larger than other debitage material (see above) and also considerable larger than the single PCT core. All examples are Levallois flakes with one elongated example; also overshot. There is no evidence of recurrent practices of removal and most examples (t= 5) show centripetal preparation on dorsal surfaces. Only one retains any cortex (<50%).

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	54.7	33.5	8.0

Table 6.95: Metrics for whole Levallois products (t= 7) form this sample, layer C, grid square 100/-100.

Callow (1986b) discusses 5.57% of Levallois material from the excavated sample, with atypical flakes dominating (t= 25) and the Callow database documents 209 elements of Levallois with 150 of them displaying retouch. Two elements of this study sample show retouch; both convergent scraper types and discussed more below.

6.2.6.3.2 Refits

A total of two refits where identified within the sample and both are *siret* refits, and presumed as breakage through knapping. They were also both immediate to each other in deposits and show no evidence for breakage through excavation. These where both identified through general analysis, and no full scale attempt at refitting was conducted. Their presence does point to some degree of in situ archaeology within layer C.

6.2.6.4 Retouched elements

In total, 109 elements of this sample display retouch. The large majority are broken or shattered fragments of retouched pieces, likely related to rock fall and general fragmentation. The formal tools that fit within Bordes' typology (1961) are displayed in Table 6.96. Side scrapers (combined) dominate with 45%. There is a significant appearance of bifacial (14.8%) and ventral (11.1%) scrapers, unlike other layer samples such as H-E. Denticulates and notches are fairly low but six of the fourteen examples classified as mixed, show retouched notches or denticulate edges. All these examples are on reworked scraper "blanks" (i.e. where originally scrapers) which still retain significant scraper edges, i.e. multi tools.

Bordes typology	**Count**
Single straight scraper	1
Single convex scraper	4
Double straight-convex scraper	1
Double convex scraper	1
Straight convergent scraper	1
Convex convergent scraper	1
Déjeté scraper	2
Ventral side scraper	3
Bifacial side scraper	4
Atypical Burin	1
Raclette	1
Notch	2
Denticulate	3
Ventral retouched piece	1
Mixed	14
Total	**40**

Table 6.96: Typology based on Bordes (1961) for all whole retouched elements from this sample (t= 28), layer C, grid square 100/-100.

Once again there is an observable difference between mean length, breadth and thickness of retouched and non-retouched elements (Table 6.97), this is indicative of earlier stages of core reduction used as retouch blanks.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	38.4	26.9	9.2
Std. Deviation	12.3	9.0	4.8
Variance	150.9	80.2	22.7
Range	51	37	22

Table 6.97: Metrics for all whole retouched elements of this study sample (t= 40), layer C, grid square 100/-100.

Other technological attributes show an overwhelming preference for hard hammer flaking but with a diverse mix of platform types (Table 6.98). Plain butt types are still dominant (32.2%) but faceting is significant and the second most prevalent butt type (27.1%), more than any other layer. This category was also high in the plain debitage artefacts, but is most significantly dominant in PCT as well as retouch elements. There is a drop in overall significance of both dihedral and cortical butt types.

Butt Type	Count
Plain	19
Dihedral	4
Cortical	2
Marginal	3
Soft hammer	2
Facetted	16
Missing	5
Obscured	8
Total	**59**

Table 6.98: Butt type for whole and proximal retouched elements for this study sample (t= 59), layer C, grid square 100/-100.

Flint overwhelmingly dominates the assemblage (Table 6.99). While it almost certainly represents a preference for flint blanks for retouch, there is also a strong suggestion of movement of non-flint material out of the site (i.e. debitage present, but low tools and retouch). Retouched non-flint material is also low within the whole assemblage (Callow database). While Hivernel (1986) does show Quartz is less significant that in layer E and D (as within debitage; pers. obs), it still represents a larger assemblage (t= 28) than other non-flint (t= 22) within the Callow database.

RM Type	Count	%
Flint	100	91.7
Quartzite	4	3.7
Basic Igneous	1	0.9
Sandstone	1	0.9
Glossy sandstone	2	1.8
Quartz	1	0.9
Total	**109**	**100**

Table 6.99: Raw material types for all retouched elements from this study sample (t= 109), layer C, grid square 100/-100.

Cortex retention is similar to both layers E and D, with a relatively low retention on dorsal surfaces (Figure 6.31). Again this seems indicative of heavy reduction of retouched material (i.e. re-sharpening) and the lack of evidence for the use of initial flake removals from cores.

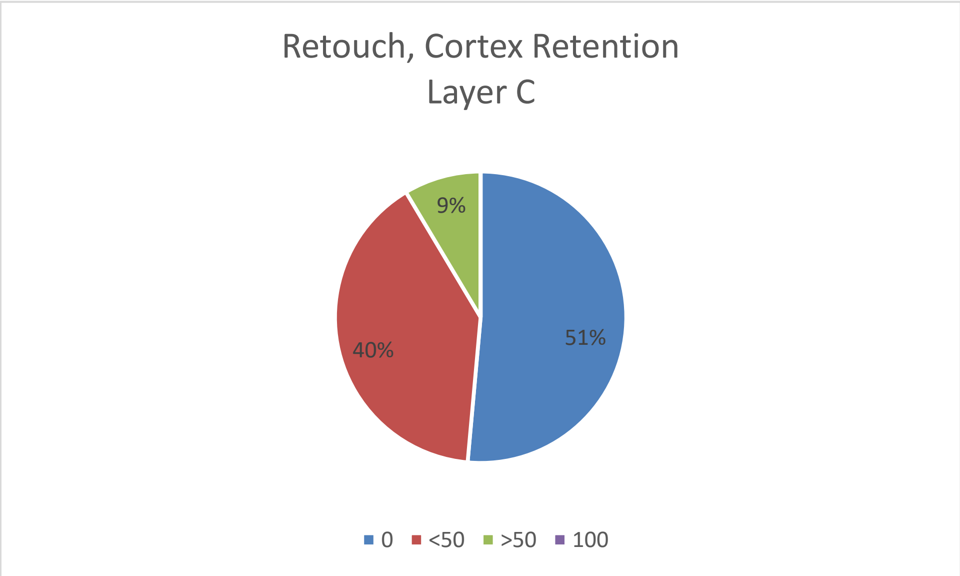

Figure 6.31: Cortex retention for all whole retouched elements within this study sample (t= 35), layer C, grid square 100/-100.

There is further support for increase in both bifacial (t= 7) and alternate retouch (t= 12). Semi abrupt, semi invasive retouch dominates across the 109 elements analysed. This is not the case in some other retouched study samples from within this research (e.g. layer A). Finally, similar to the increase in layer D (compared to all lower layers) layer C sees significant evidence for re-sharpening. Again there is dominance for LSF removals over TSFs (11:3). This usage is exclusively on flint within my study sample and highlight a technological necessity to exploit flint examples to the maximum (although three non-flint elements from layer C where identified within the Callow database). Flake flaked spalls (displaying two “ventral” surfaces and often a second, relict bulb i.e. janus) are also relatively high in comparison to other layers (t= 9), these are not mentioned in the monograph or database.

6.2.6.5 Handaxes

As well as the increase in bifacial retouch present in layer C, there is a single siltstone biface identified, as well as a potential broken flint example. The broken example is too shattered to fully determine its original typology. The siltstone example is a sub-cordate (amygdaloid), with relatively large dimensions in comparison to the rest of the assemblage at 56mm, 44 grams (Table 6.100). There is no evidence for re-sharpening or later use as a core.

Metrics	**L (mm)**	**B (mm)**	**Th (mm)**	**Weight (g)**
	56.0	40.0	18.0	44

Table 6.100: Length, breath, thickness and weight for single siltstone handaxe (78/29435) from this study sample, layer C, grid square 100/-100.

One bifacial re-sharpening flake of fine quartzite, not dissimilar to *grès lustré*, was also identified. A further four potential examples where also highlighted. However, with the preponderance of re-sharpening of various techniques and the degree of bifacial retouch these examples could be associated with retouched tools rather than bifaces *per se*. The one clear example fits the other known thinning flakes and handaxes within layer C (Callow database) and other Middle Palaeolithic assemblages (pers. obs.).

Callow (1986a) identified seven flint and three “stone” handaxes (including this siltstone example) from layer C. This layer is also described as the first appearance within the sequence of “*classic Acheulean*” tools (Callow 1986e: 230). However, they do not dominate the assemblage, any more than bifacial scrapers for example, and are comparable to any typical Middle Palaeolithic bifacial tool kit (pers. obs.). Both these repertoires together do suggest a subtle change in Neanderthal lithic behaviour, which is discussed in more depth below.

6.2.6.6 Manuports and Hammerstones

A total of 5 pieces were identified as hammerstones or manuports, with a further three being natural granite pieces, almost certainly from the fissure itself. The one flint example, defined here as a broken hammerstone, could be defined as a large cortical flake off a cobble. The concentrated battering on the dorsal surface and undefined bulb however seems indicative of use as a hammerstone (pers. obs.). The other example, of course sandstone, is much clearer and fully supports the discard/abandonment of hammerstones within layer C, further supporting on-site knapping. Callow (1986e) also identified a further two hammerstones, one of flint and one of sandstone.

The three manuports have no clear evidence to suggest they are from debitage i.e. no flat surfaces; sharp edges. Further, they are of micro granite which is infrequently used (one example identified within this study). The granite is not local to the fissure (probably Beauport type, within 100m of the fissure), but may not necessarily be evidence for human transportation, and therefore interpretation is reserved.

6.2.6.7 Conclusion: Layer C

Overall this sample highlights a combination of Neanderthal behavioural suites. The final discarded, whole elements of retouched pieces are variable and high in mixed examples (i.e. denticulate and scraper edges), pointing to a mixed activity lifestyle. There is also a significant appearance of bifacial retouch, unlike other layers and the use of PCT mirrors layer D (unlike layers H - E). Layer C also highlights the varied use of retouch and re-sharpening techniques, that extend throughout the assemblage; once again highlighting the drive to extend the use life of better quality raw material (mostly flint). LSF technique dominates here, a trend that extends from layer E upwards.

Unlike previous layers an appearance of riverine sourced cobbles for core blanks is suggested from cortical staining, potentially indicative of a change in Neanderthal landscape behaviour. However, beach cobble material does still dominate, and the location of fluvial gravels and cobble beaches is likely to be similar i.e. to the north of the modern island of Jersey (> 20km; see chapter 4). The varied use of non-flints, i.e. not just a dominance of quartz, also suggests a change in behaviour within layer C. Fauna is still poorly preserved with some identification of horse, red deer, reindeer and mammoth and woolly rhino (Scott 1986b), again no butchery is recorded due to degraded bone surfaces. Fragmented bone material is still high, and certainly represents some degree of Neanderthal activity, but burning is lower than other layers (i.e. H-E). Rock fall is significant in layer C and was seen to increase upwards (see chapter 3) and defiantly accounts for some of the fragmentation (pers. obs.).

6.2.7 Layer B

6.2.7.1 Introduction

As discussed in chapter 3, the deposition of layer B was a build-up of loessic head material and frost shattered granite. Therefore the deposit and the assemblage are disturbed, much more than any other assemblage discussed in this study Table 6.1. The total sample from within grid square 100/-100 equals 331 (Table 6.101), representing 6.3% of the whole layer B assemblage (t= 5192). Two were missing from the collections during analysis.

Artefact type	Count
Debitage	293
Cores none PCT	4
Retouched	32
Missing	2
Total	**331**

Table 6.101: Artefact type count for this study sample (t= 331), layer B, grid square 100/-100.

Callow (1986c) originally suggested layer B was somewhat disturbed and reworked based on the high proportion of frost shattered material and the general sloping nature of deposits. This disturbance is supported by the results of taphonomic analysis conducted within this study, which show 73% of material was edge damaged to at least one degree (Figure 6.32), and is heavily fragmented.

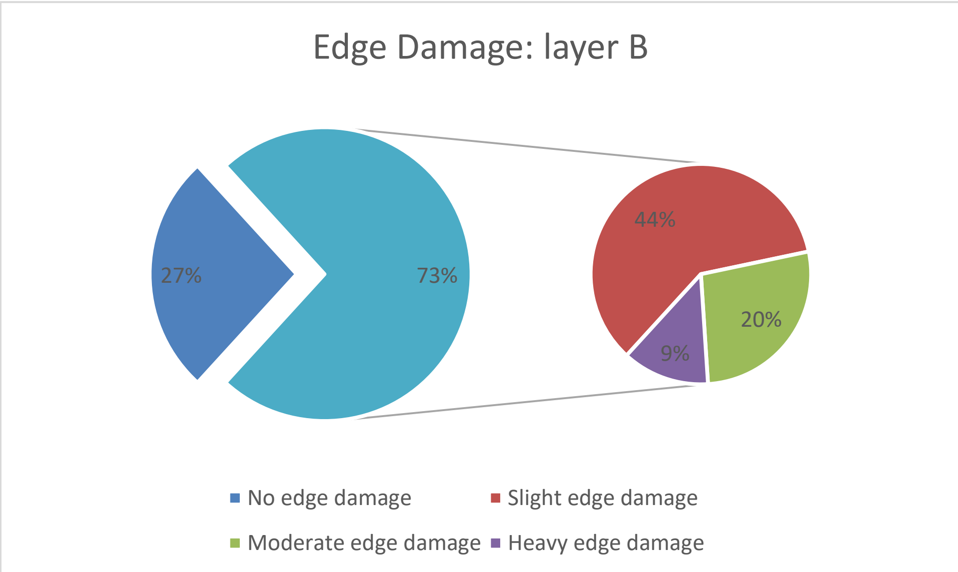

Figure 6.32: Edge damage recorded from all artefacts in this study sample (t= 329), layer B, grid square 100/-100.

Layer B also displays a higher frequency of moderate and heavy edge damage than other deposits and evidence for scratching upon flake surfaces is at its highest (t= 45). With this taken into account this study supports the assumption that layer B archaeological material is derived from elsewhere, probably a mix of layer C (due to initial erosion of upper C deposits), layer A (through infiltration) and potentially from above the fissure (colluviation, certainly responsible for input of deposits).

6.2.7.2 Cores and core working

6.2.7.2.1 Non-PCT cores

Four cores were identified within the layer B sample, for this reason and their derived nature they are only briefly discussed here. All where alternately worked, with three classic discoidal forms. The other was a core on a retouched tool; with further evidence for a previous episode of core working (i.e. core > tool > core). Again, taphonomy of the material suggests re-working from elsewhere within the sequence or a totally new, fully disturbed assemblage (further discussed below). The four examples are all hard hammer on flint. Hutcheson and Callow (1986) identified 49 cores across the layer B assemblage with discoidal and pyramidal highest in number (58%) and sixteen non-flint examples (Callow 1986c; Hivernel 1986).

6.2.7.2.2 PCT cores

No evidence for PCT was found within this sample, Hutcheson and Callow (1986) highlight 14.3 % PCT types. This is the highest of all the layer assemblages, but sample size and ease of identification despite edge damage may contribute to this.

6.2.7.3 Flakes

The debitage of layer B is dominated by flint (87%), similar to other samples (i.e. layer E), with a small use of other materials. Quartz is most prevent of the non-flint materials.

RM Type	Count
Flint	281
Quartz	19
Grès lustré	2
Quartzite	4
Granite	4
Sandstone	9
Siltstone	3
Unidentified	3
Total	**325**

Table 6.102: Raw material type for all recorded debitage (t= 325), layer B, grid square 100/-100.

The majority of the material is broken (Table 6.103), again, supporting a considerable amount of re-working of material as well as fragmentation throughout rock fall events.

Portion	Count
Whole	116
Proximal	43
Distal	72
Mesial	54
Siret	15
Chunk/chip	25
Total	**325**

Table 6.103: Portion of recorded debitage from this flake study sample, layer B, grid square 100/-100.

The taphonomic condition of the material prohibits a true understanding of the assemblage but a few key elements are worth discussing. Prepared elements of the assemblage are relatively high in comparison to other layers, with faceting most prevalent (15%; Table **6.104**); this could be connected with the high degree of evidence for PCT (see below). Further, dihedral platforms could support a preferred use of discoidal, alternate knapping, evident from the small core sample (see above). This record is similar to both layers C and A.

Butt Type	Count	%
Plain	56	35.2%
Dihedral	21	13.2%
Cortical	14	8.8%
Marginal	3	1.9%
Soft hammer	10	6.3%
Facetted	24	15.1%
Missing	5	3.1%
Trimmed	1	.6%
Obscured	25	15.7%

Table 6.104: Butt type for whole and proximal elements of the sample, layer B, grid square 100/-100.

No elements of the recorded sample were of *fresh* origin with only 11 individual artefacts recording more than 50% cortex on their dorsal surface. The derived nature of the source material is again believed to be of beach cobble origin, similar to examples in earlier layers. In total, 9.8 % of the sample is recorded with retouch (see below); this could be under represented here due to the nature of the preserved material, equally no material was seen to be utilised. A full study of the entire character of layer B would allow more confidence, for or against, these suggestions.

6.2.7.3.1 PCT products

Hutcheson and Callow (1986) identified some Levallois material from within layer B including one of the lost artefacts from my sample (78/26219; Mousterian Point on typical Levallois flake). Overall, only low numbers where identified from layer B as a whole but as a percentage (5.15%) Levallois is higher than any other layer other than 5. The small numbers overall and the conclusion of considerable reworking suggest this is misleading as a behavioural signature.

6.2.7.4 Retouched elements

In total 33 elements of the layer B sample were recorded with retouch with a total of 20 whole examples. As with other layers, retouched elements are quantitatively larger (Table 6.105). All the retouched elements are on flint.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	42.7	29.4	10.2
Std. Deviation	12.9	8.5	5.1
Variance	166.8	72.9	25.6
Range	50	36	19

Table 6.105: Descriptive statistics for whole retouched element of this study sample (t= 21), layer B, grid square 100/-100.

Typologically, using Bordes type list, layer B is dominated by scrapers (50% of whole elements). There is no real dominance of any specific scraper type. Two pieces presented bifacial retouch but nothing was considered as a handaxe from within this sample. Callow (1986b) identified 639 well retouched flint tools from the layer B assemblage, including three handaxes. Scraper types where dominant but notches and denticulates made up a significant portion (11%), similar to this study sample.

Bordes typology	Frequency	Percent
Single straight scraper	2	6.1
Single convex scraper	2	6.1
Double convex scraper	1	3.0
Déjeté scraper	3	9.1
Straight transverse scraper	1	3.0
Bifacial side scraper	1	3.0
Typical burin	1	3.0
Notch	3	9.1
Denticulate	1	3.0
Bifacially retouched piece	1	3.0
Misc.	3	9.1
Broken and misc.	13	39.4
Mixed tool	1	3.0
Total	**33**	**100.0**

Table 6.106: Bordes' typological list for retouched elements from this sample (t= 33), layer B, grid square 100/-100.

Of the other elements in the sample seven pieces show evidence of re-sharpening, with four examples of LSF/TSF sharpening. The single thinning flake does retain retouch but no evidence for bifacial retouch suggests it is not from a bifacial LCT. The two re-sharpened elements both have removed LSF's from lateral edges. Neither is subsequently reworked after the removal of the LSF. Hivernel (1986) also discusses a further 46 tools on quartz, also dominated by scraper types (29%), and notches and denticulates (33%). Finally, Callow (1986a) discussed one flake cleaver on dolerite from layer B, making the LCT count four.

6.2.7.5 Manuports and Hammerstones

There were no hammerstones or manuports present within this sample. Callow identified 13 examples of hammerstones and manuports within the excavated assemblage (Callow database). All were on stone materials other than flint, including "basic igneous", sandstone and siltstone.

There is no immediate suggestion of long distance travel of these examples, they could all be collected within a few hundred metres of the site.

6.2.7.6 Conclusion: Layer B

My conclusion supports Callow's assumption that this material was reworked mostly from layer A (high Levallois and flint frequencies; scrapers dominant), but some could equally be from initial slumping and mixing of layer C. Overall, no true behavioural signature for this assemblage can be discussed and climatic proxies suggest occupation of the fissure did not take place within the depositional build-up of layer B. This is supported by the presence of reindeer, hare and chamois (all cold, glacial species) as well as the typical faunal guilds present in other layers (i.e. mammoth, horse woolly rhinoceros etc.).

6.2.8 Layer A

6.2.8.1 Introduction

Layer A consists of over 40,000 excavated lithic artefacts and represents the largest single layer assemblage from the site (Callow 1986g). In total grid square 100/-100 produced 1442 artefacts (Table 6.107), and represents the stratigraphically highest, and last, assemblage discussed within this research. There were 25 missing from the assemblage during this study analysis. The size of this assemblage is potentially slightly misleading, layer A is the thickest of the depositional layers and Callow (1986j) suggests that there could be some cultural or even minor depositional separation within it. However, this would need to be investigated with further excavation and full analysis of the 40,366 artefacts (Callow database).

Layer A was described as a loessic matrix with a granitic sand component (Callow 1986e; Lautridou *et al.* 1986; van Vliet-Lanoë 1986). Callow (1986e) suggested the deposit was slightly disturbed and climatically signalled a period of amelioration (after layer B) within a general deterioration into glacial conditions, personally interpreted as within the earlier stages of MIS 6 (chapter 3).

Artefact Type	Count
Debitage	1231
Retouched	141
Levallois products	12
Cores	24
PCT cores	2
Hammerstones	7
Missing	25
Total	**1442**

Table 6.107: Artefact type from this study sample (t= 1442), layer A, grid square 100/-100.

Edge damage on the layer A assemblage is high, with 47.7% displaying some level of edge damage (Figure 6.33), suggesting some post depositional effects. This also concurs with research by Hutcheson and Callow (1986), and suggests deposits were at least slightly disturbed. Taphonomic analysis shows more edge damage than most layers discussed in this study (Figure 6.33), but less than the fully disturbed layer B. Ninety-one elements show a secondary degree of edge damage, mostly only *slight*. Recovered micro debitage and insignificant levels of abrasion and scratching suggests limited spatial movement of archaeological material however.

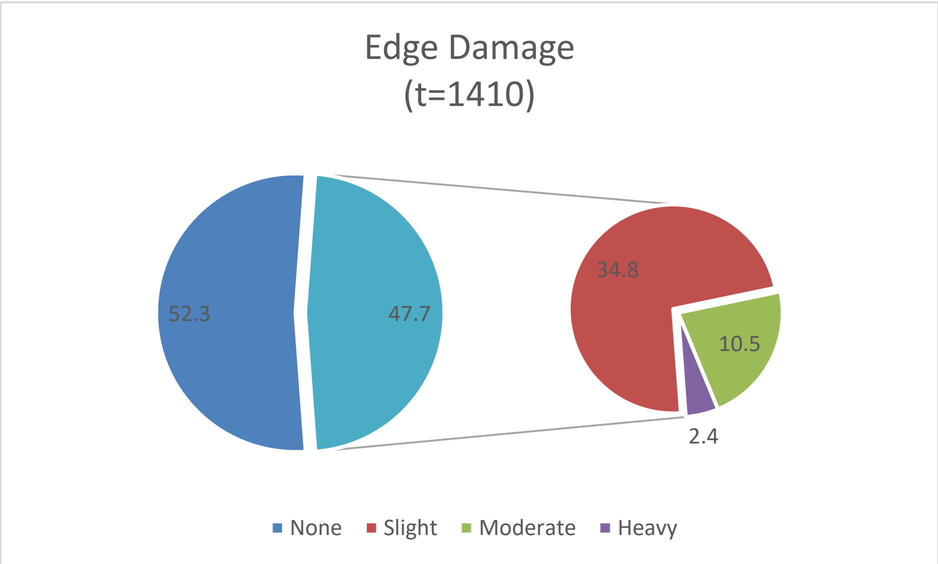

Figure 6.33 Edge damage for all artefacts within this study sample (t= 1410), layer A, grid square 100/-100.

6.2.8.2 Cores and core working

6.2.8.2.1 Non-PCT core working

In total 24 non-PCT cores were recorded from this sample (Table 6.108) with the majority on flint; however 29% of those recorded where non-flint (quartz and *grès lustré*), the highest non-flint core total within this study sample. Quartz represents 18.5% of all artefacts from layer A (Callow 1986g; Hivernel 1986), as opposed to just 7% of total artefacts from Layers H - B, most of which occurs in layer D (t= 1200). This data parallels the whole of the layer A assemblage (Callow database).

RM Type	Count
Flint	17
Grès lustré	1
Quartz	6
Total	**24**

Table 6.108: Raw material type for all cores from this study sample (t= 24), layer A, grid square 100/-100.

All materials, where source was identifiable, are from derived sources (Figure 6.34). However, only 9 of the 24 had any tell-tale signs of source location (i.e. cortex staining). The heavy reduction and small nature of material restrict the identification of source type overall (pers. obs.). Much of the flint material within layer A is of better quality than other layers, such as layer F (pers. obs.), and cortical material on cores is generally thicker than observed throughout the sequence, other than some examples within layers H - F. Personal observations, based on stained cortex similar to modern, personally observed, fluvial material in Brittany, suggests a fluvial source of material, likely close to fresh outcrop sources, which may also account for the small degree of fresh material (see debitage), including one Levallois core (see below). Beach cobble material, as seen in other layers, is not as prevalent (or not identifiable), suggesting a change in raw material acquisition and Neanderthal landscape behaviour (see chapter 4).

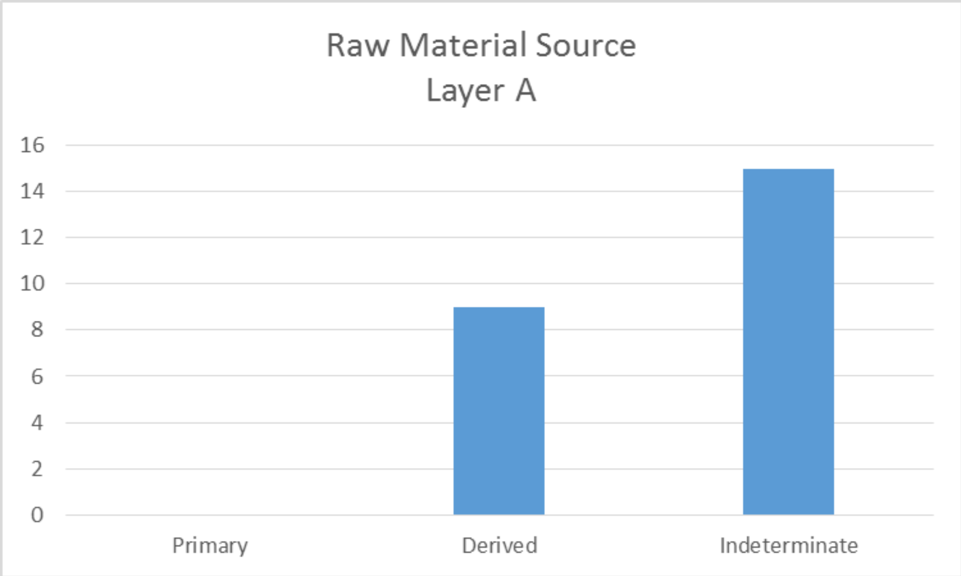

Figure 6.34: Raw material source for all cores in this study sample (t= 24), layer A, grid square 100/-100.

The broken and highly reduced nature of core material also has influence over the blank types identified with only one third showing definitive signs of blank form (Table 6.109). As with other layers all of those identified are cores on flakes.

Blank Type	**Count**
Flake	6
Indeterminate	13
Total	**19**

Table 6.109: Blank type present for all whole cores within this study sample (t= 19), layer A, grid square 100/-100.

Descriptive statistics (Table 6.110) suggest that variance for weight measurements (specifically) is high, similar to other layers and due to both raw material use and a general lack of standardised core reduction (i.e. PCT or discoidal). Unlike some other examples (e.g. layer D) this variance can be accounted for as a genuine heavy exploitation of good quality material and a use of various different raw materials (e.g. quartz). Range for weight is 86g-2g, both these extreme elements are good quality flint with the largest being a retouch core (turned into a “chopper” or LCT); the smallest a multi-platform core with evidence for two remaining small removals. Overall, there is no evidence for standardised core practices within layer A, which also mirrors the high degree of indeterminate blanks present. This signature also supports Hutcheson and Callow (1986), who showed both the general reduction in size of material through the sequence (bottom to top).

	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)
Mean	38.3	29.2	19.2	24.0
Std. Deviation	10.3	8.8	10.5	21.5
Variance	106.9	76.6	110.3	460.7
Range	38	38	31	84

Table 6.110: Descriptive statistics for whole cores (t= 19) identified from layer A, grid square 100/-100.

Overall, Hutcheson and Callow (1986) compared the core assemblage from layer A closest to layer D (other than the disturbed and possibly derived layer B). This conclusion is supported here with similarities in overall reduction, size and reduction strategy. As with all layers however, migrating platform cores dominate (Table 6.111). There is limited retention of discoidal forms in this sample (t= 1), but this category was present in the overall excavated sample (32.6%).

Reduction Method	Count
Migrating platform	12
Single platform, unprepared	5
Discoidal classic	1
Indeterminate	1
Total	**19**

Table 6.111: Overall reduction strategies employed on all whole cores recorded within this study sample (t= 19), layer A, grid square 100/-100.

Reduction strategies for cores recorded within this sample (Table 6.111) suggest a techno-economic practice tailored towards maximum exploitation of raw materials available; especially flint. Average episodes per whole core is 2.47, these final episodes are dominated by migrating platform strategies directly employed to remove maximum number of flakes from small cores, in short, often single flake, core episodes (Table 6.112). Interestingly, all the Quartz examples are reduced using single removals, while the single *grès lustré* example is migrating but has used two episodes of alternate reduction. This further supports the belief that *grès lustrés* are used as an alternative/support for the lack of available flint locally (pers. obs.). The quartz reduction strategies represent 17 of the category A removals but do not affect the average core episodes for the whole sample.

Removals / episode	Count
A	28
Bi	15
Bii	7
Ci	37
Cii	4
Mean	**No. Removals**
	5.4
	No. Episodes
	2.5

Table 6.112: Reduction strategies employed within the whole cores (t= 19) for this study sample, layer A, grid square 100/-100.

Cortex retention is relatively high on core surfaces (Figure 6.35) compared to other layers, despite the overall small size. Once again this is indicative of some use of small, irregular beach cobbles as raw material. However, the majority still retain no cortex and suggest later stages of reduction of nodules takes place within the locale. This is supported by debitage and retouch material (below) as well as the evidence for short sequences of reduction indicated by analysis of the removal/episodes (above).

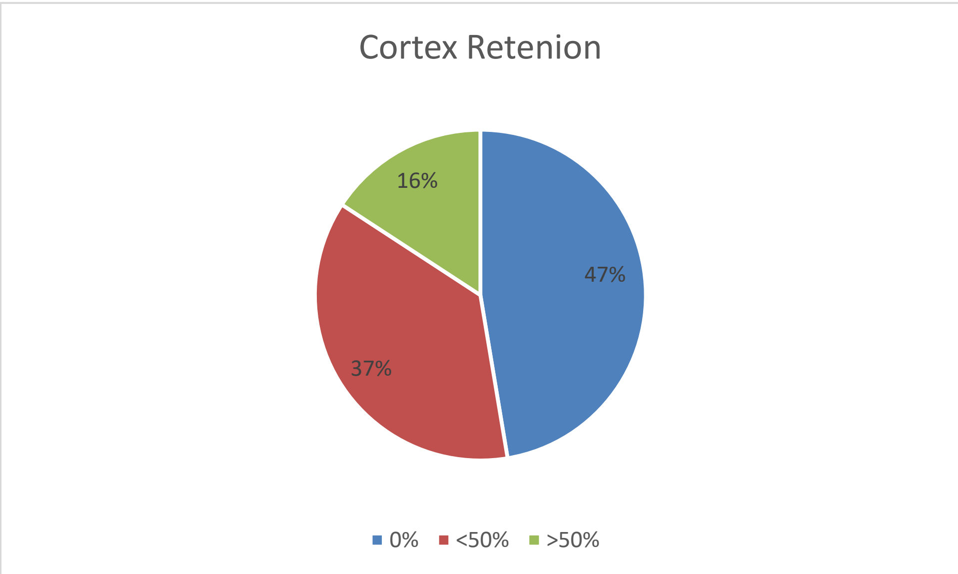

Figure 6.35: Cortex retention on final core surfaces for all whole cores (t= 19) for this study sample, layer A, grid square 100/-100.

6.2.8.2.2 PCT core working

Two PCT cores were also recorded and together with the twelve PCT products present within this sample represent the largest PCT sample for this study. Both cores are heavily reduced and show re-preparation on the preferential flaking surface. 78/24989 retains fresh chalky cortex, one of only 6.4% of this sample and could suggest a preferential use of this material for PCT (pers. obs.). The final flaking surface shows previous centripetal Levallois and is un-exploited after re-preparation. 78/25013 is also unexploited and not fully re-prepared, a number of flakes have been taken into the lower surface to prepare a platform for the final preparation of the flaking surface. However, a series of failed removals, evident from battering and incipient cones, seems to have led to the artefacts abandonment at this stage.

Hutcheson and Callow (1986) identified 6.9% of the assemblage as Levallois cores; with no further discussion of attributes. The products identified by Callow (1986b) are discussed below.

6.2.8.3 Flakes

RM Type	**Count**	**%**
Flint	932	67.9
Basic Igneous	4	0.3
Jersey Shale	5	0.4
Granite	20	1.5
Sandstone	70	5.1
Grès lustré	31	2.3
Quartz	260	19.0
Dolerite	1	0.1
Siltstone	10	0.7
Quartzite	32	2.3
Unidentified	7	0.5
Total	**1372**	**100**

Table 6.113: Raw material type for all flake elements of this sample (t=1372), layer A, grid square 100/-100.

Layer A produced the largest non-flint assemblage for those sampled by this study (Table 6.113), and fits in with an overall reduction in the use of flint after layer E. This fits with Callow (1986d) who identified 30.1% non-flint material for the whole layer A assemblage. The significant appearance of *grès lustré* (Table 6.113) suggests a drive for the replacement of *locally* unavailable flint. The use of immediately sourced quartz also points to a lack of flint in the immediate-to-local vicinity. Callow (1986d) identified 18.6% quartz across layer A; of the non-flint or quartz 14.7% was *grès lustré* (t= 644). Again the majority of all flakes preserved cortex that is indicative of derived raw material source (Table 6.114).

RM source	Count	%
Fresh	69	5.0
Derived	305	22.2
Indeterminate	998	72.7

Table 6.114: Raw material source for this study sample (t= 1372), layer A, grid square 100/-100.

87.5% of the whole flakes preserved under half cortex on the dorsal surfaces (Figure 6.36), similar to core analysis. All stages of reduction are present but the earlier stages (i.e. decortification) are low. This suggests the majority of debitage on site represents just the later stages of reduction, therefore retaining little cortex. The 12% of flakes with over 50% cortex could relate to the use of smaller nodules, as in other layers, or to near full core reduction.

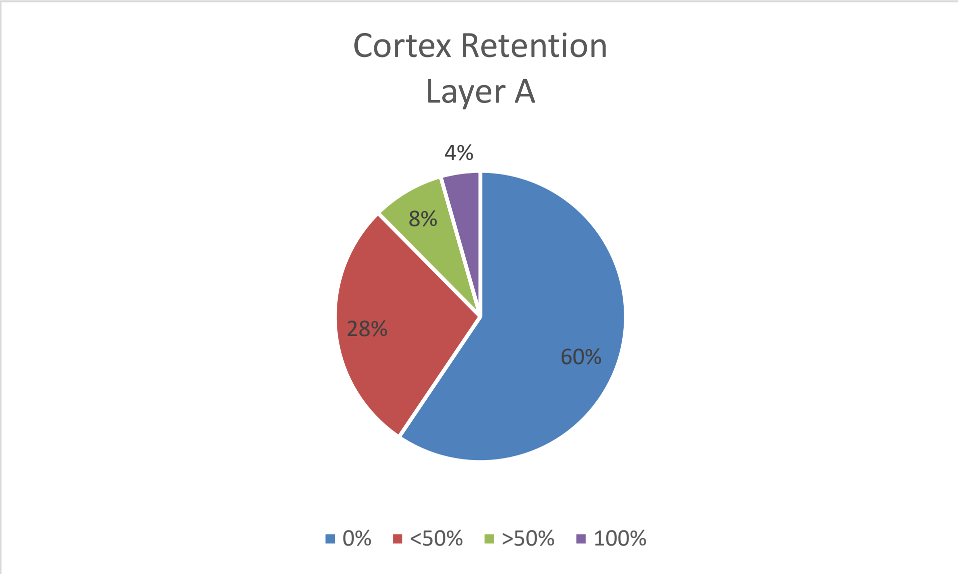

Figure 6.36: Cortex retention for all whole flake artefacts (t= 473) for this study sample, layer A, grid square 100/-100.

Metrics for the whole flake artefacts (Table 6.115), after increasing up till layer F is the smallest in layer A. Hutcheson and Callow (1986) also suggests a reduction in size of the layer A flake production compared to many other layers, particular highlighting the thinness of material. This also matches the reduction in size of the final, abandoned cores discussed above.

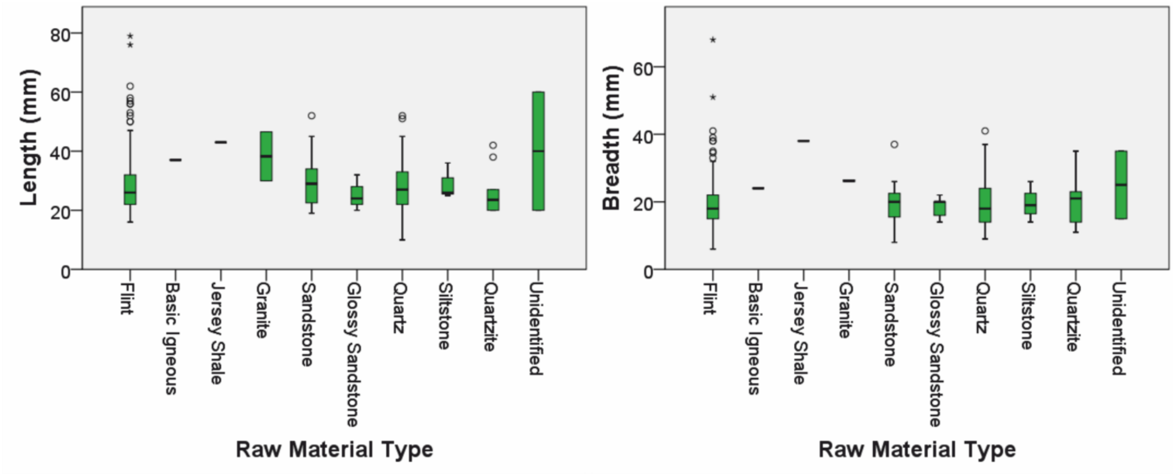

Figure 6.37: Boxplots describing length and breadth distribution of all whole flakes (t= 473) within the layer A sample.

The distribution of size of the various raw materials (see Figure 6.37) is similar to the last three layers. While the signature for non-flints can be related to size and quality of the nodules available and chosen from the immediate area (i.e. there use as a ad-hoc support for the lack of immediate flint material), there relatively small ranges and distribution is significant. Again it is somewhat similar to the flint materials and shows a tendency towards smaller elements, as with the rest of the this sample. This again could relate to a functional need or useable by product that is further discussed in the following chapter.

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	29.8	19.9	6.3
Standard Deviation	9.9	7.4	3.7
Variance	98.3	54.8	14.0
Range	78	62	27

Table 6.115: Metrics for all whole flake elements for this study sample (t= 473) layer A, grid square 100/-100.

Hard hammer, plain platforms still dominate, 46.4% of the assemblage, an increase from the immediate layer C and B. Again cortical platforms are present in significant numbers (t= 84). Similar to other layers (e.g. E and F) this is connected to some use of small, cortical nodules; likely from fluvial origins. However, the idea that most material is in the later stages of reduction of transported nodules/blanks is still supported overall.

Butt Type	Count	%
Plain	320	46.4
Dihedral	59	8.6
Cortical	84	12.2
Marginal	19	2.8
Soft hammer	7	1.0
Facetted	68	9.9
Missing	5	0.7
Trimmed	9	1.3
Obscured	118	17.1
Total	**689**	**100**

Table 6.116: Butt type for all whole and proximal elements (t= 689) from this study sample, layer A, grid square 100/-100.

There were 85 examples of relict core edges (6.2%) and a further 16 examples of cordal flakes, both indicative of small heavily reduced cores, were older platforms and edges were removed, either deliberately (to rejuvenate a surface) or accidentally due to their size. Overall the flake sample from layer A is indicative of a small core and flake assemblage with limited evidence of PCT (as with core working practices). Plain platform, hard hammer flaking is dominant, producing relatively small blanks. Combining this with core analysis the assemblage is dominated by the final reduction stages of small cores. The retention of cortex on cores and flakes is suggested as indicative of raw material nodules used (i.e. small, irregular cortical pebbles/cobbles), especially for flint. The use of non-flint is significant and the largest appearance of *grès lustré* is suggested as a support for the lack of locally available flint material as with other layers such as layer D.

6.2.8.3.1 PCT products

There are nine whole and three broken Levallois elements within this sample. They are, on average, considerably larger than the other flake elements within layer A (Table 6.117). This small sample is all composed of flint and only two retain cortex, both showing evidence for derived sources. The two cores (fully discussed above) are very similar to the flake length and breadth in maximum dimensions. As both where unexploited they do not relate directly to any of the products but the use of similar cores for this production is proposed.

	Length (mm)	Breadth (mm)	Thickness (mm)
Levallois products	45	31.4	12.5

Table 6.117: Average metrics for whole Levallois products from this study sample (t= 9), layer A, grid square 100/-100.

In total, seven typical flakes (two broken) and five overshot or debordant (t= 2 and 3 respectively) where identified. Centripetal preparation dominates (t= 5) with a further five undetermined (obscured) and two bipolar. Further, exploitation of the final flaking surface is predominantly lineal (t= 6), significantly with three unipolar recurrent examples. In contrast to the non-PCT debitage none of this sample displays plain platforms (Figure 6.38); most significantly seven are prepared (5 facetted and 2 trimmed). Finally, four of the products show evidence for a previous Levallois knapping episode.

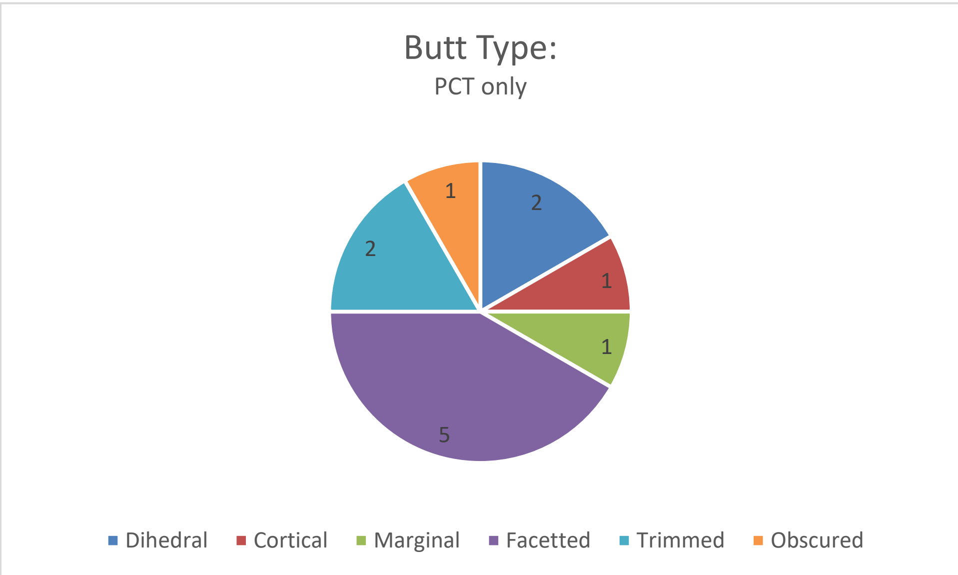

Figure 6.38: Platform types for all whole or proximal elements (t= 12) for Levallois products in this study sample, layer A, grid square 100/-100.

Callow identified a total of 1.7% PCT elements (Callow database), mostly typical flakes making up 4.52% of flint tools (Callow 1986d). Overall, the PCT assemblage is small and statistically insignificant, however a few key points can be discussed relating to Neanderthal behaviour. The larger size of Levallois flakes and use of better quality flint material (inc. the one fresh cortical core; see above) suggest PCT is more important within the knapping repertoire than it appears in number. This, and the low degree of PCT within the whole layer A assemblage based on Hutcheson and Callow (1986), suggests a significant movement of PCT material *through* the site (still potentially within the immediate area). Another alternative is that most of the PCT material in the techno-economic system never reaches La Cotte, and is used up elsewhere in the landscape. Both these scenarios could be co-existent within Neanderthal lithic behaviour of the Channel Plain.

6.2.8.4 Retouched elements

A total of 148 artefacts have been recorded with retouch (Table 6.118), these include re-sharpening flakes themselves i.e. LSF's and TSF's (t=50) even where they preserve no retouched edges. This category is significantly higher than in any other layer.

Once again the retouched tool assemblage indicates both an opportunistic use of raw materials and techno-economic strategy employed for maximising the exploitation of flint (also apparent in core reduction). Flint again dominates, with only 7.4% non-flint, retouched artefacts present in this sample (Table 6.119).

Bordes typology	**Count**
Single straight scraper	12
Single convex scraper	8
Double straight scraper	2
Double straight-convex scraper	1
Convex convergent scraper	1
Déjeté scraper	5
Convex, transverse scraper	1
Ventral side scraper	1
Backed side scraper	1
Bifacial side scraper	5
Alternate side scraper	1
Typical burin	1
Typical percoir (awl)	2
Raclette	1
Notch	10
Denticulate	11
Thick, abrupt retouched piece	1
Mixed	5
Broken and Misc.	79
Total	**148**

Table 6.118: Bordes typology based on Bordes (1961) for this sample, layer A, grid square 100/-100.

Notches and denticulates are still important but scrapers are more significant than any other layer, specifically single sided scrapers. Bifacial elements are also more apparent than in any other layer, which is also noted by Callow (1986f). No true handaxes where identified in this study, however layer A represents the highest handaxe total (t= 70, flint only) for the La Cotte sequence (Callow 1986d). Callow (1986d) identified 57.79% flint scrapers (26% single sided examples) with one of the lowest recorded denticulate and notch counts (15.86%), with *the* lowest of all notch samples (4.8%). The one major alteration from *this* studies identification is the significance of burins (Callow 1986a: 295), which peak in layer A at 5.9%.

RM Type	**Count**	**%**
Flint	137	92.6
Sandstone	1	0.7
Gres lustré	5	3.4
Quartz	3	2.0
Siltstone	1	0.7
Quartzite	1	0.7
Total	**148**	**100**

Table 6.119: Raw material for all retouched elements of this sample, layer A, grid square 100/-100.

Hivernel (1986) identified 4.7% of quartz artefacts in layer A are tools, with notches and denticulates dominating (35%) and, significantly, eight large handaxes. This suggests a use of this material, sourced locally, for larger tools/heavy duty tasks. Two of my examples fall above the average but not significantly so. The average metrics for all non-flint in this study broadly match that for the whole retouched sample (Table 6.120). Of the non-flint or quartz material, Callow (1986a) discusses a total of 137 well retouched examples, once again side scrapers dominate (t= 61) and denticulates and notches are significant (t= 35) with a further 20 bifaces of various sizes. 39.7 % of these retouched examples (i.e. non flint artefacts) where on *grès lustrés*.

Just 58% of the retouched elements are whole (t= 86). Breakage through use cannot be ruled out, a number appear to be flexion or pressure inflicted breaks, two record macro damage through use. However, as with all layers, the degree of rock fall limited the legitimacy of this interpretation. Many of the broken pieces are no more than short sections (<5mm) of shattered tools and therefore typologically are impossible to define. Of the whole, non-Levallois elements (t= 81) metrics are, on average, smaller than any other layer (Table 6.120).

	Length (mm)	Breadth (mm)	Thickness (mm)
Mean	35.3	21.9	8.1
Standard Deviation	12.5	9.3	5.6
Variance	157.0	87.0	31.5
Range	88	50	28

Table 6.120: Metrics for all whole retouched elements in this study sample (t= 81), layer A, grid square 100/-100.

Again plain platforms dominate the butt type categories but, as with Levallois flaking, faceting is significant (Table 6.121). Overall this does suggest a more tailored use of preparation for the production of retouched blanks, something not observable in other layers, specifically layers H-E.

Butt Type	**Count**
Plain	41
Dihedral	3
Cortical	8
Marginal	4
Soft Hammer	1
Facetted	26
Missing	5
Trimmed	1
Indeterminate	13
Total	**102**

Table 6.121: Butt type for all whole and proximal elements of this study sample (t= 102), layer A, grid square 100/-100.

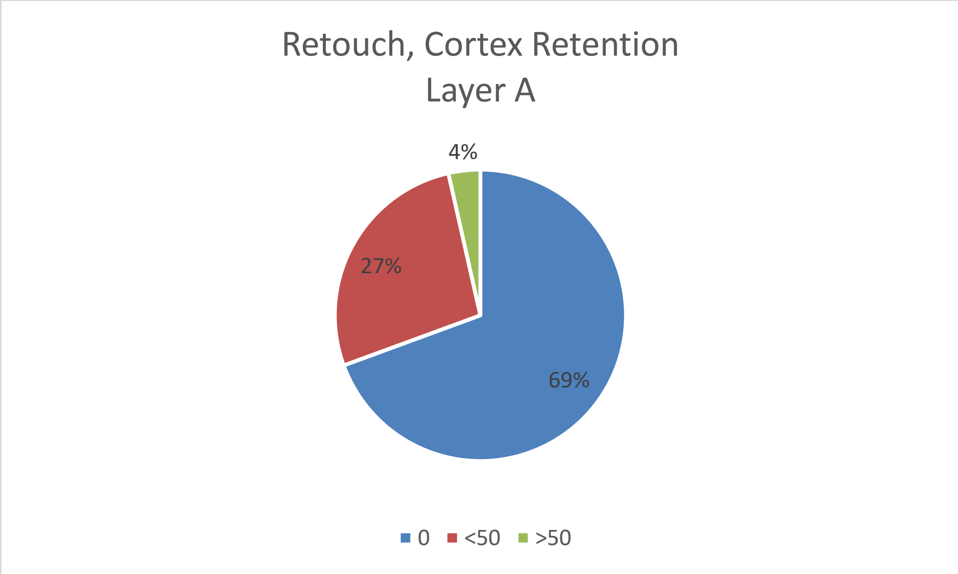

Figure 6.39: Cortex retention for all whole retouched elements within this study sample (t= 85), layer A, grid square 100/-100.

Cortex retention on retouched artefacts is relatively low in layer A (Figure 6.39), following a decreasing trend from layer E onwards, and at its lowest within this study sample. This could be indicative of the use of later stages of reduction of large nodules, compared to other layers, where cortex is removed in earlier stages of core reduction. The increase in re-sharpening and overall reduction in size of the retouched elements, however, suggests an increased need or choice to fully exploit raw material, causing a reduction in cortex material on dorsal surfaces through retouch and re-sharpening. Regularity and angle of retouch also support this necessity (Table 6.122), where abruptness represents increased reduction through reshaping. But neither of these categories is dominant overall.

Regularity of Retouch	Count
Regular	53
Irregular	29
Single removal	2
Obscured	2

Angle of Retouch	Count
Abrupt	36
Semi-abrupt	43
Low	5
Mixed	4

Table 6.122: Regularity and angle of retouch for this retouched sample, layer A, grid square 100/-100.

Further, to support the hypothesis of heavy reduction within layer A, angle of retouch is high with 40% showing angles approaching 90˚. Convex and rectilinear forms of retouch are prevalent, in contrast to other layers, the increase in convex retouch within layer A was also highlighted by Callow (1986b). There is an overwhelming dominance of direct retouch i.e. retouch into the dorsal surface (73%). Bifacial retouch is however significant (t= 14) compared to other layers. Interestingly, two of the broken pieces also show bifacial retouch, where found in the same spit and one could be interpreted as a biface tip (no other suggestion of handaxe use or manufacture is present in this sample). The use of bifacial retouch is certainly present in layer A and total of 70 flint bifaces were also identified in previous analysis (Callow 1986d).

There is no obvious heavy reduction of tools using convergent or distal retouch as would be suggested by Dibble (1995) and Jelinek (2013). I propose two potentially mutual hypothesis to explain this. Firstly the tools present, even when whole, are already small and show heavy reduction of at least one edge. Therefore it seems the need for single edges was dominant, however this does not explain the lack of déjeté scrapers. Secondly the use of re-sharpening techniques counters the need for heavy reduction of two edges. Instead the technique (as explained on pg. 102) naturally creates a “new” edge with which to work, in a minimum number of blows, without the need to rework a whole edge (pers. obs.). The implications of this will be discussed in the next chapter.

6.2.8.5 Manuports and Hammerstones

A total of eight artefacts have been recorded as hammerstones or manuports. Hammerstones have localised battering on at least one surface while manuports are (in this case) beach/worn pebbles of non-local material and worthy of further explanation as there is no evidence of strong fluvial or marine intergression within layer A. The four hammerstones suggest onsite knapping but could equally have been used elsewhere. Two were recorded broken and the use of Basic Igneous material seems to be preferential (Table 6.123).

Raw materials	**Hammerstones**	**Manuports**
Quartzite	1	0
Basic Igneous	3	2
Siltstone	0	1
Microgranite	0	1
Total	**4**	**4**

Table 6.123: Hammerstones and manuports recorded from layer A, grid square 100/-100.

The quartzite example is the largest piece recorded at 57x50mm. The four manuports, as mentioned, are of beach cobble origin and are likely to have been sourced relatively locally. As raised beaches are presumed to be covered during the occupation of layer A (see chap 4) the likely origin of this material is from head deposits or on-surface scatters of material within the immediate area. The manuports could suggest a further link to transport of material into the locale from the surrounding landscape, potential for future use as hammerstones (pers. obs.).

6.2.8.6 Conclusion: Layer A

Layer A represents a Neanderthal lithic behavioural signature of maximum reduction and exploitation of better quality raw materials, specifically flint. In addition, and more so than most other layers within La Cotte (with the exception of layer D), the use of non-flint is significant. Fresh, primary sourced flint, as well as riverine stained cobbles are present in the assemblage alongside the still dominant use of beach cobbles. These materials would be present in the landscape to the north of the modern island of Jersey. Active beaches could be as much as 60 km away however, and an unrecognisable archaic source of this material could instead be in use. The fresh and riverine material can be related to the exposure of a known outcrop, approximately 20 km to the north. However, this layer retains the lowest amount of cortical retention, and therefore indicative evidence, for discussing source type. The mix of sources used (including non-flints) does suggest a dynamic landscape behavioural signature. The large lithic collection and presence of a quantity of fauna could suggest we have a more intense use of the ravine system within layer A than other layers discussed; especially the mass accumulation of mammoth and rhino individuals, butchered, within the A/3 boundary. However, the large time span of accumulation of layer A suggests instead a number of intermittent occupations causing a palimpsest of deposits and material.

The fauna of layer A is one of the better preserved (along with layer C) and also includes the mass accumulation of woolly rhino and mammoth at the very top, the layer A/3 bone heap (Scott 1986a, b). Throughout the deposits of layer A open steppe like fauna are present, including horse, reindeer, mammoth, woolly rhino and bison, indicative of cold, glacial like climate. Overall preservation was poor and recovery hard due to brecciation (Scott 1986b). Presence of oak, as charcoal (Callow 1986e), and other organic deposits (described as “ranker”) highlight a warmer climate than within layer B, with an extremely low sea-level exposing significant landmasses to the north and west (see chapter 4 and following discussion). Fragmentation of archaeological material is largely associated with significant rock fall events rather than Neanderthal behaviour (pers. obs.).

Chapter 7: Trends and patterns from La Cotte de St. Brelade: Lithic and Landscape behaviour of the La Cotte Neanderthals

7.1 Introduction

This chapter will present the trends and patterns highlighted from my comprehensive, lithic analysis of the La Cotte assemblage, presented within chapter 6. These patterns will be discussed in relation to Neanderthal lithic and landscape behaviour, also including material discussed and presented in chapter 4, relating to landscape changes across the Channel Plain Region, and throughout this thesis. Having answered objective 1 (discussion of landscape changes presented within chapter 4), this chapter will discuss objectives 2 and 3, related to lithic technology at La Cotte and landscape connections in relation to Neanderthal behaviour (see page 2). Both continuities and changes in technology are highlighted, providing the basis to discuss Neanderthal behaviour and evidence in a broader, regional setting in the following chapter (i.e. objective 4). These three initial objectives are overall directly related to answering my research question:

Can changes in lithic behaviour across the MIS 7/6 boundary (c220 - 160 kya), at La Cotte de St Brelade and related assemblages, be used to model changes in Neanderthal landscape behaviour across the region?

Four key areas of evidence have been selected here to discuss Neanderthal lithic and landscape behaviour, centred around the research question, and objectives 2 and 3, set-out on page 2. These four areas are:

1. Raw material availability
2. Core reduction strategies (including debitage production)
3. Retouch elements and implications
4. Re-sharpening evidence and implications

Table 7.1 displays an overview of both chapter 6 and evidence from throughout this thesis, as a basis to discuss the patterns and trends presented throughout this chapter. Through each section, an additional key theme is discussed, transport/movement of raw materials within the landscape. This is not separated as it applies to all key areas presented, i.e. transport of raw materials; implications of re-sharpening and reduction of specific raw materials, etc.

Layer	Artefact total (from Callow database)	Density lithics (/spit)	Study database (recorded as part of this study)	First frequent RM (%)	Second frequent RM (%)	Third frequent RM (%)	Intensity of core working/ core episodes	Overall core reduction	Denticulate types/Scraper types	Handaxe presence (n=)	Sea-level (based on fig 4.6)	Environment
A	40388	4.70	1417	Flint (66.76%)	Quartz (19%)	Sandstone (5.1%)	Heavy/2.47	Mig. Plat/ Sing. Plat/ PCT	Scraper dom.	Yes (n=70)	Low (6e/d)	Cool, dry
B	5192	4.06	329	Flint (84.8%)	Quartz (5.8%)	Sandstone (2.7%)	N/A	N/A	Scraper dom.	Yes (n=3)	Low (6e)	Cold
C	9772	6.29	1110	Flint (75.86%)	Quartz (5%)	Quartzite (4.7%); Sandstone (4.5%)	Heavy/2.5	Mig. Plat/ Disc.	Scraper dom.	Yes (n=7)	Low, dropping (7a/6e)	Cool, dry
D	7686	11.19	1490	Flint (76.91%)	Quartz (17.4%)	Sandstone (2.3%)	Heavy/2.3	Mig. Plat/ Disc./ PCT	Even	Yes (n=4)	High, dropping (7a)	Cool, dry
E	6443	9.78	663	Flint (90.35%)	Quartz (5.7%)	Gres Lustre (1.8%)	Medium/1.8	Mig. Plat/ Sing. Plat./ Disc.	Scraper dom.	No	High, maximum (7a)	Temperate, dry
F	6404	7.07	758	Flint (95.12%)	Quartz (1.8%)	Granite (0.7%)	Heavy/2.3	Disc. Hier/ Mig. Plat./ PCT	Denticulate dom.	No	High rising (7b/7a)	Temperate, dry
G	4825	5.13	503	Flint (92.84%)	Granite (2.7%)	Quartz (1.7%)	Medium/1.8	Disc. Hier/ Mig. Plat	Denticulate dom.	No	Rising (7c)	Temperate, dry
H	2235	3.66	321	Flint (91.9%)	Quartz (2.1%)	Quartzite (1.5%)	Heavy/2.3	Disc. Hier/ Mig. Plat	Denticulate dom.	No	Low, rising (7c)	Temperate, dry
Total	**82945**	**5.45**	**6591**									

Table 7.1: Summary table of data and observation from chapter 4 (environment, sea-level and landscape) and 6 (lithics).

7.2 Raw material variability

Flint use is dominant overall (see Table 7.1), due to its superior conchoidal fracture properties over other raw materials e.g. Quartz. Of the flint used, beach cobble material is the most likely source used in all layers (pers. obs.), but in varying degrees. Fresh, *primary*, material is rare throughout, as is evidence for large scale use of riverine associated source material (i.e. river gravel cobbles) largely due to the low degree of evidence for this source type across the landscape (see section 5.3.1.2. and chapter 4).

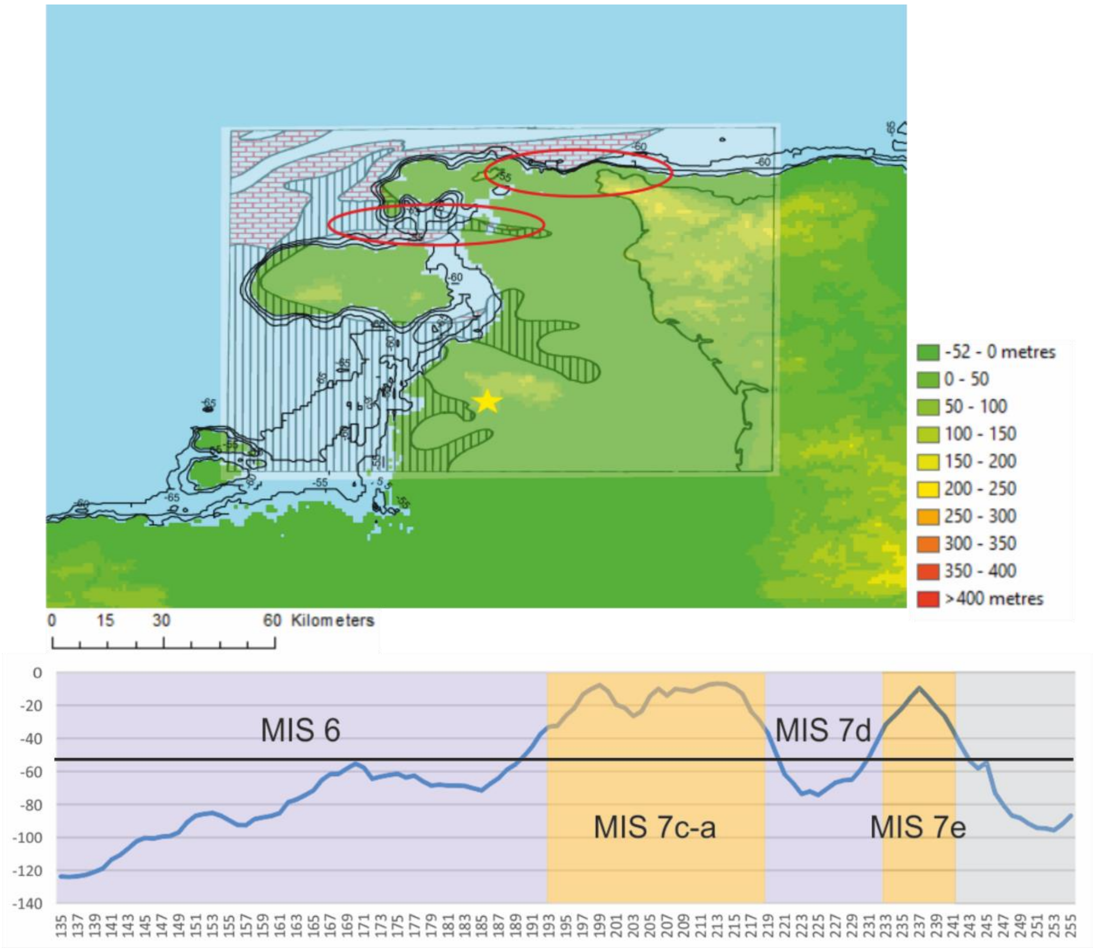

Figure 7.1: Channel Plain Region including location of La Cotte de St Brelade. RSL, based on Spratt and Lisiecki (2016), show a sea-level of -52 metres a.m.s.l. The two main areas of outcropping flint, described in detail in chapter 4, highlighted within red ellipses.

In chapter 4 I presented a number of landscape models (Figure 4.6, Figure 4.7 and Figure 4.8), showing that the closest known source of *fresh* material was to the north of the island of Jersey, approximately 20 km in a direct line (see Figure 7.1). This source is submerged by the English Channel with any sea-level *higher* than -52 a.m.s.l., restricting access during these sea-level situations (further discussed in section 4.5). However, material would be under tidal and erosional effects throughout sea-level rise and fall, releasing material to build up in beaches along the moving coastline, therefore creating resource accumulations along the littoral. Despite the modern distances from these sources for example flint material still appears in low levels on beaches around the modern coast of Jersey, and more so to the north, on beaches facing those submerged outcrop (pers. obs.). It is those hypothesised beaches of later MIS 7 that are the likely locations for lithic raw material acquisition of the large majority of nodules throughout the various occupations from layer H - A. However, as sea-level is ever changing, exact transport distances are impossible to ascertain with current knowledge, something highlighted within individual time slices discussed within chapter 4.

Non-flints are still significantly in use throughout the sequence, likely because of the large distances from those flint raw material sources mentioned above. These examples also fit into a techno-economic strategy of transport of material in the more immediate area. While it is impossible to ascertain the direct sources of the various non-flint materials, based on personal local knowledge the majority of material present within the assessed collection can be sourced on the modern day submerged landscape around south and south-west Jersey, and some remain naturally in the modern headlands and coastline (e.g. quartz, microgranite and shale). However, it could be these materials are acquisitioned closer to the Massif itself, for example outcrops around the chronologically connected site of Grainfollet (c. 60 km south), discussed in the following chapter.

What is of interest is the varying degree(s) of non-flint material which displays a pattern connected to sea-level. In general, the non-flint proportion increases throughout the sequence (see Table 7.1), at its highest in layer A (33 %), with significant amounts in layer D and C (Table 7.1). The highest supposed sea-level situation relates to layers E and F, both representing the lowest use of non-flints. One suggestion could be that non-flint outcrops become submerged during these higher eustatic levels, but all models presented in chapter 4 show this not to be the case. The relationship between flint use and sea-level is therefore a positive one i.e. high sea-level is related to increased use of flint. This relates to accumulations of material in beaches (and potential low levels is fluvial sources), which are closer and more active to the fissure system at higher sea-levels (potentially within 5km during periods of layer E occupation). Therefore the use of beach material, and the preference for flint overall, is directly related to Neanderthal lithic acquisition behaviour, as a direct response to availability, throughout the multiple occupations at La Cotte (c. 60ky). Simply Neanderthal groups are using more flint in the vicinity of La Cotte during high sea-level situation associated with increased proximity to eroded beach accumulations. In these situations limited or potentially no better quality “fresh” material is acquired. Further, these transport distances can be directly connected to mobility of associated Neanderthal groups, if over un-known time scales (e.g. seasonal/annual). That is to say that when “fresh” material is available more readily (i.e. not submerged) it is acquired but is used more intensively and therefore still only appears in low numbers within the associated excavated assemblages. We can also connected this evidence with potential resource encounters other than lithic material e.g. fauna; plant material; fresh water etc. Knowledge of these complex transport strategies, highlighted directly by this study, therefore further aids our understanding of Neanderthal movements within the wider landscape.

7.3 Cores and core working and implications on raw material transport

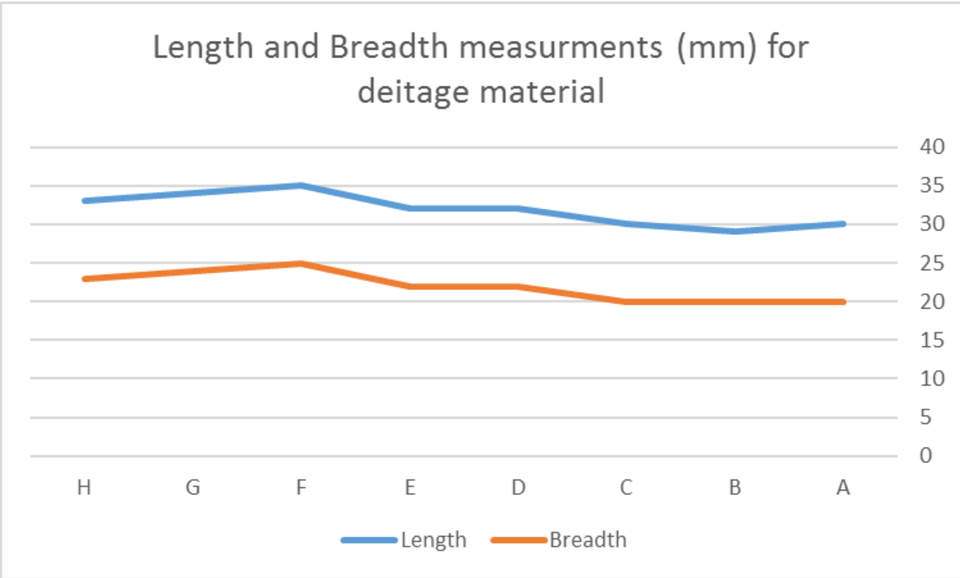

Figure 7.2: Average length and breadth measurements of all whole debitage from all layers.

Overall reduction in size of debitage (Figure 7.2), cores (Figure 7.3) and retouched material, of all raw materials, from layer E onwards (i.e. layer E - A), seems to represent the heavy exploitation of nodules of raw material, most often flint. This again can be linked to distance from raw material, with transport and use, before discard and abandonment. All elements of the knapping process of flint material are present in most layers, from decortification to final, single flake, reduction and re-sharpening of retouched material. However, this study has shown the earlier stages (i.e. decortification) are always in small numbers, with later stages most represented (un-cortified, small and unused; re-sharpening). This evidence suggests short reduction sequences of available material, specifically transported flint (i.e. all flint). Further, material such as *grès lustré* and sandstone mostly appear in small, single artefacts or final retouched products, with limited evidence (if any) for production or reduction on site.

I have discussed the fragmented nature of Middle Palaeolithic assemblages found elsewhere across Eurasia (see section 2.2), where assemblages show evidence of previous (i.e. off-site) reduction processes, followed by onsite reduction, production and abandonment and then evidence for removal of material back into the landscape (Turq *et al.* 2013), often better quality material and likely usable end-products (pers. obs.). Here I suggest this is evident within the occupations of La Cotte based on materials present in each category (i.e. cores and debitage). Again, this adds support to ideas such as those of Monnier and Missal (2014) regarding the revaluation of ideas around “Mousterian” technology and the validity of this research framework for understanding Neanderthal behaviour.

Additionally, there is only limited evidence for the initial stages of reduction, and only of flint material (although identification of non-flint cortical surfaces is more complex due to their geological properties). Use of non-flint material also mirrors this signature of the fragmented nature of the assemblage. The material often appears as fine retouched tools (especially *grès lustrés*), re-sharpening flakes and occasional small debitage. The overall absence of cores, full reduction sequences, and use of curation techniques of these materials highlighted within this new data strongly suggests the transportation of this material, both into and out of the immediate area of excavation. Abandoned flint material (i.e. the excavated assemblage) is small in dimension, often showing battering (especially on core surfaces), and in the case of PCT (see below), often un-exploited or failed in character due to battering and flaws within the raw material.

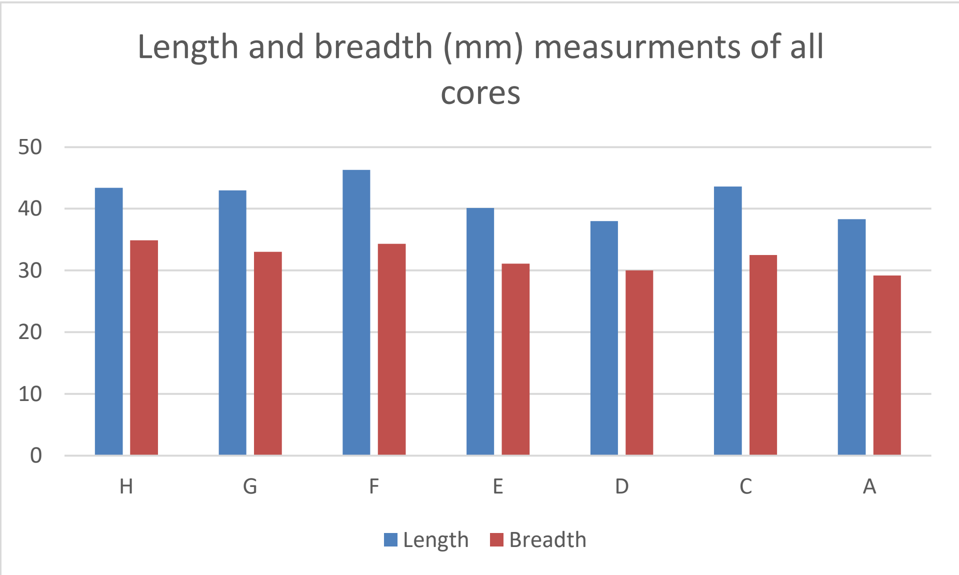

Figure 7.3 Maximum average length and breadth of cores for all layer samples, other than the derived assemblage of layer B.

Finally, the use of PCT is of interest and is relatively rare throughout, most often present as unexploited or failed cores and broken end-products. Overall, the PCT assemblage is small and statistically insignificant, however this new analysis has highlighted a few key points can be discussed. The larger size of the few Levallois end-products (t= 26 from this study), and use of better quality flint material, suggest PCT is more important within the knapping repertoire away from La Cotte itself (pers. obs.). There is no direct evidence for PCT reduction/preparation strategies onsite, however refitting would be needed to further this argument. However, the abandonment of failed or unexploited cores, highlighted by my methodology suggests the attempted/failed use of PCT reduction onsite, in low quantity. The low amounts of good quality PCT end-products *or* presence of exploited cores suggest this element of the assemblage is also fragmented here. This can be related to PCT reduction elsewhere, out of the excavated area, with movement of end-products and cores through the site. While some of the end-products seem to relate to failed knapping episodes some elements, for example points, could relate to episodes of re-hafting/retooling, also suggested at Biache-St-Vaast, Hauts-de-France (Rots 2013) and elsewhere i.e. Crayford, UK (Scott 2006; Scott and Ashton 2010; Scott 2011; Ashton and Scott 2016). Again, this study highlights direct evidence for transport and mobility of Neanderthal groups at La Cotte, with movement of lithic material, curation strategies and fragmentation of the overall assemblage.

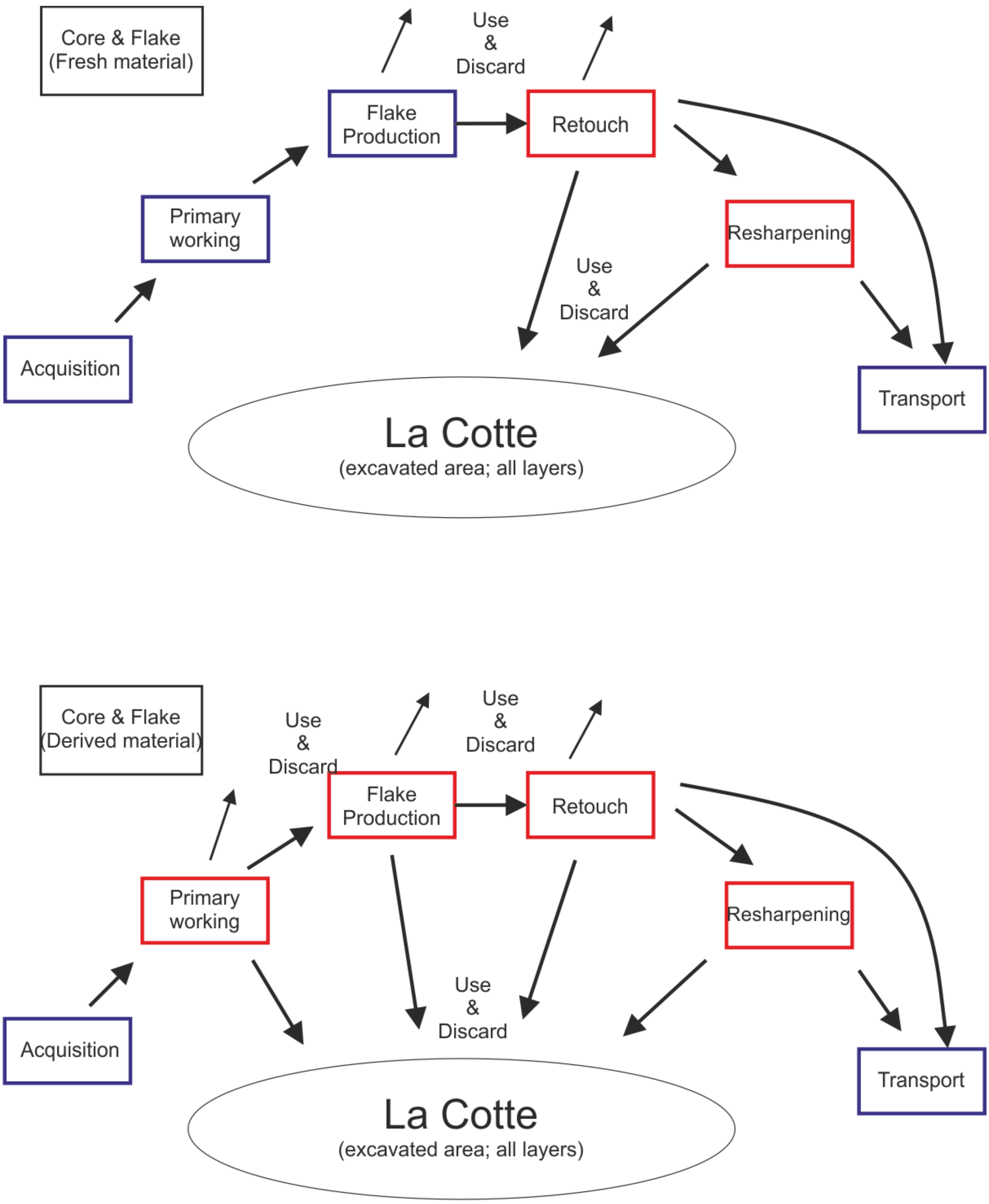

Figure 7.4: Schematic transport model for fresh (upper) and derived (lower) for flint throughout the MIS 7 occupations of La Cotte based on this study. Blue boxes represented those behaviours/practices unseen or rare at La Cotte whereas red examples describe those practices most seen or inferred from the material sample studied.

All together this study highlights significant evidence for dispersal of material (and reduction sequences), with material transported in as pre-knapped cores and some end-products, often worked, reworked (i.e. re-sharpened) and potentially used/broken onsite and finally abandoned. This is schematically simplified in Figure 7.4, closely based on similar models of Hallos (2005) based on the Lower Palaeolithic site of Barnham. At La Cotte some material almost certainly leaves the locale, based on the low numbers of refitting sequences (pers. obs. i.e. layer E and C) and limited refitting sharpening flakes identified (Cornford 1986). It is likely that better quality raw material and larger nodules are transported (as cores and retouched material) when the site is abandoned (pers. obs.). Onsite knapping can be seen as short reduction sequences (small cores and debitage material) and retouch sequences (i.e. micro debitage and re-sharpening flakes). This is also supported by the limited refitting in layer E and C, (single flakes, some from small alternately worked cores) highlighted within this study.

7.4 Retouch elements and potential subsistence implications

Retouched elements vary throughout this assemblage. Analysis here has shown that the upper layers (E - A) are largely dominated by scraper types, with decreasing numbers of denticulates and notches (Table 7.1), with an increase in bifacial elements. This is the opposite for lower layers H - F, and this signature is here related to the subsistence need and potential use of these products within the fissure system by Neanderthal groups (pers. obs.). All layers are connected to heavy ashy deposits with high concentrations of burnt shattered bone; therefore scrapers could be connected to preparation of animal materials such as hide for production of associated cultural insulation. This is seen elsewhere (Keeley 1980), and is also mentioned by Callow (1986f) and suggested at other sites in the region e.g. Biache-St-Vaast (Auguste 1995; Hérisson 2012). This also fits with the general deterioration in climate within the upper layers where scrapers are more prevalent.

However, I believe it highlights another behavioural signature related to landscape, Neanderthal movement and discard patterns, and not just use practices. The high concentrations of notches and denticulates in the lower layers suggests heavier duty tasks (in comparison to the use of scrapers) at La Cotte itself, or the immediate area, as discussed in chapter 2. But nearly all examples show evidence for previous scraper edges within their use life (i.e. they have been re-sharpened/re-shaped), potentially suggesting differing tasks enacted within the landscape or outside the area of excavation. New palaeo-geographic models, presented within chapter 4, alongside raw material analysis highlight that better quality material within the upper layers at La Cotte is transported over larger distances (see section 7.2), and the use of the LSF technique to re-sharpen and rejuvenate edges (see section 7.5) allows scrapers to remain in the system for longer within the upper layers, as shown by the increase in these elements i.e. LSF's (see Figure 7.6).

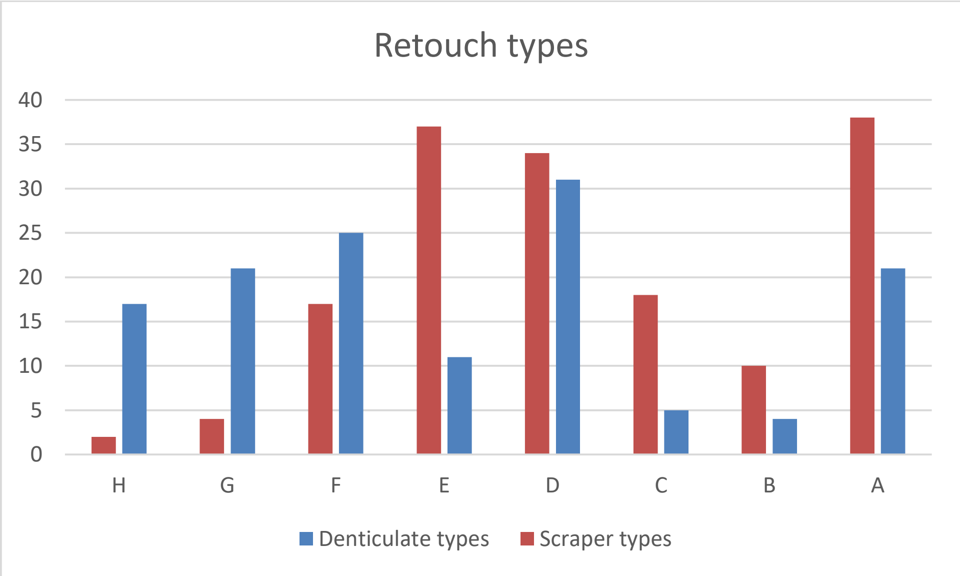

Figure 7.5: Retouch types for this sample, from all layers analysed here. Denticulate type include both retouched and flaked flake notch types.

The mixed activity lifestyles, e.g. heavy duty tasks and scraper maintenance, are therefore not only enacted within La Cotte, but certainly within the wider landscape, this seems especially apparent in the layers from D - A. Callow (1986g) highlights the increased "Acheulean" nature of the assemblage from layer C upwards, largely based on the appearance of handaxes. My methodology highlights the increased use of bifacial retouch (both scrapers and LCT's; pers. obs.), and this is further connected to layer D (Table 7.2); if in a much less pronounced degree than C. Again a direct connection to the faunal subsistence evidence is un-attainable due to poor preservation to species level throughout the sequence, but larger species, such as mammoth, woolly rhino, red deer, and horse are all identified within layer C and A. These larger species and appearance of bifaces and bifacial tools could support use of LCT's as butchery implements for larger game (pers. obs.), as suggested elsewhere (Mitchell 1995; Schreve 2006; Wenban-Smith *et al.* 2006; Vicente Gabarda *et al.* 2016). These observations can also be connected with the increasing terrestrial landmass (i.e. drop in sea-level), and developing steppe habitats and connected mammal guilds, associated with the decline in environmental conditions into MIS 6, as discussed in chapter 4.

	Bifaces Based on (Callow 1986g)	Bifacial elements from within this study (%)
A	70	7.4
B	3	6
C	7	12
D	4	6
E	0	0
F	0	0
G	0	2.1
H	0	0

Table 7.2: Appearance of bifaces from original excavations (i.e. whole assemblage) and percentage of bifacial elements (bifaces, bifacial scrapers and bifacial retouched pieces).

Finally, as mentioned within the last section (section 7.3), Levallois material is low in number but does appear; often in the form of retouched elements. Again this is connected here to the transport of this material into the locale from further afield (i.e. produced elsewhere within the landscape). The appearance of low numbers of broken Levallois points is further connected with re-hafting/retooling and transport. Broken retouched Levallois elements fit into a similar discard strategy of abandonment of material at the end of its use life (pers. obs.). It can be proposed that some Levallois material is moving through the locale in the form of retouched tools; as suggested for PCT cores. A similar strategy of movement, curation and discard was suggested at Ranville, Normandy (Cliquet 2008b; Cliquet and Auguste 2008), and is discussed further in regard to other locales in the following chapter.

Overall, I suggest the retouch composition is a direct result of sea-level change and Neanderthal landscape behaviour (directly effecting lithic behaviour), and raw material transport. As sea-level rises during H - F (over thousands of years), raw material acquisition is directly affected, mainly altering beach accumulations around the coastal area. In later layers (D - A) falling sea-levels (again over thousands of years) opens up landscapes, once again causing changes in Neanderthal movement as well as, and ultimately, Neanderthal lithic behaviour. Unfortunately the poor preservation of faunal material restricts further discussion of direct subsistence behaviour throughout this sequence (i.e. below the bone heaps). The high degree of burnt, fragmented bone and associated ashy material (specifically mentioned for layers G - E) suggest some degree of faunal processing in the fissure (e.g. marrow extraction), which could also be related to use of bone for fuel by Neanderthals, similar to evidence seen at Biache-St-Vaast and Therdonne, northern France (Hérisson *et al.* 2013). This is further connected to the increase in terrestrial land surface in the region, development of steppe habitats and assumed increase in large mega fauna, such as mammoth and woolly rhino within these landscapes.

7.5 Evidence for re-sharpening techniques and it's frequency

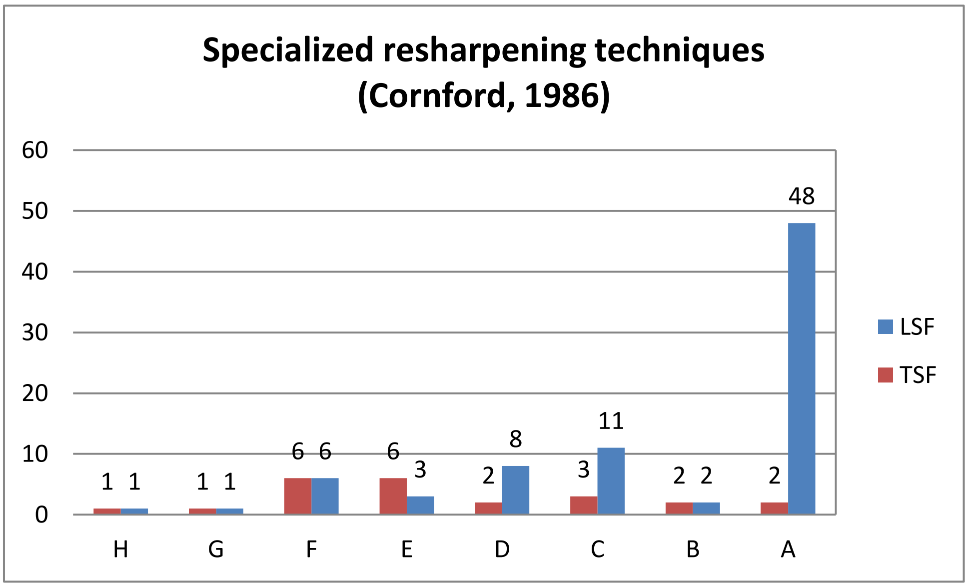

Figure 7.6: LSF and TSF counts from all layers from this study sample.

The observable increase in the use of LSF technique from layer D onwards, and specifically layer A (Figure 7.6), is also described by Cornford (1986: pg 343), and is not merely due to general increase in excavated assemblage size (pers. obs.). Cornford shows an increase in frequency, by ratio of appearance, at 0.5 for LSFs *and* TSFs in layers A – 3, with layer C at 1.5 and H – D at less than 0.1 (ibid: pg 343). Using the Callow database (see section 6.1) to access actual total numbers of LSFs alone, this is also apparent (Figure 7.7). This increase, as suggested in section 7.4, can be connected with the use/production of scrapers, over denticulates and notches, and could relate to changes in faunal processing within the fissure (pers. obs.), where scrapers are indicative of hide processing/reduction. This then connected to the detrriorated in climate and the supposed need or cultural insulation within these situation as well as use of bone for fuel in more open (i.e. not forested) landscapes (pers. obs.).

This signature can also be related to landscape movement and raw material transport. The increase in distance from the coast, as sea-level drops, directly relates to the increase in use of this technique for preserving flint material. This change occurs, most notable in the data, after the occupation of layer E (i.e. after the eustatic high stand), overall contributing to a techno-economic strategy towards preservation of flint material when outcrops/accumulations are more distant.

This strategy can also relate to the increase in bifacial elements within the assemblage (see Table 7.2), and could therefore be a direct response to habitat development i.e. steppe landscapes/open plain, and their associated mammal guilds.

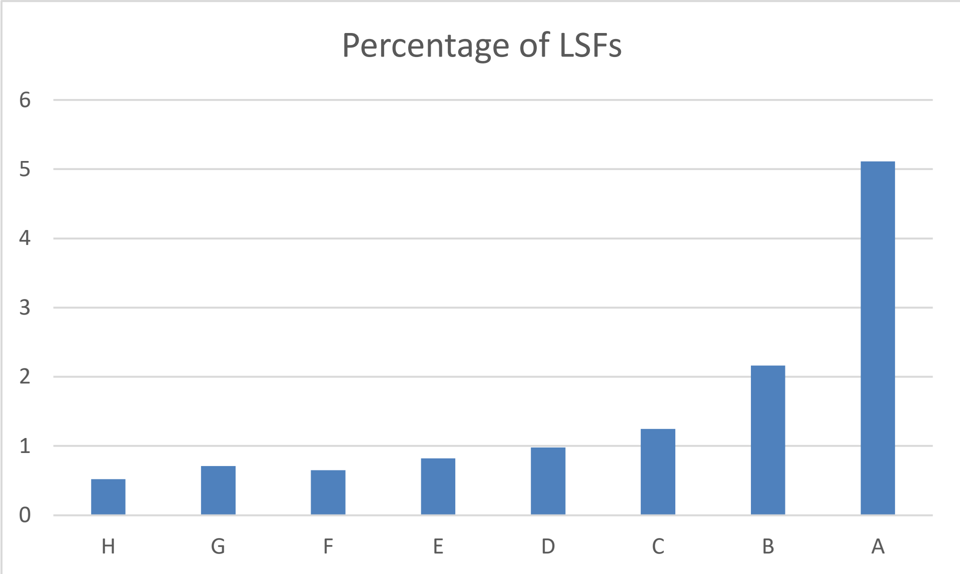

Figure 7.7: Percentage of Long Sharpening Flakes to whole assemblage size from the Callow database (excluding unidentified pieces, manuports and non-artefacts i.e. rolled pebbles).

Overall the high degree of re-sharpening, and evidence elsewhere for reduction and fragmentation of this assemblage further suggests a techno-economic strategy tailored towards the maximum exploitation of raw material within the La Cotte landscape, specifically flint. Further, retouched material is curated when and where possible using a multitude of other curation strategies (e.g. burins, retouch reduction). The small cores and debitage metrics and larger size of retouched examples (Figure 7.8) also suggests the selection of larger material for retouch blanks i.e. from earlier episodes of reduction, but also the probable movement of material into the locale after production elsewhere, similar to suggested for PCT end-products and cores (see section 7.3), with some use of short reduction sequences of available cores. This is especially relevant for those layers where core average length is less than average length of retouched elements (i.e. layer E and D; see Figure 7.3), but even those with comparable metrics suggest limited, if any, production of blanks on site. This can also be supported by the non-flint assemblage where cores and production material are present in low numbers (if at all), even where retouched material is present (i.e. layer A).

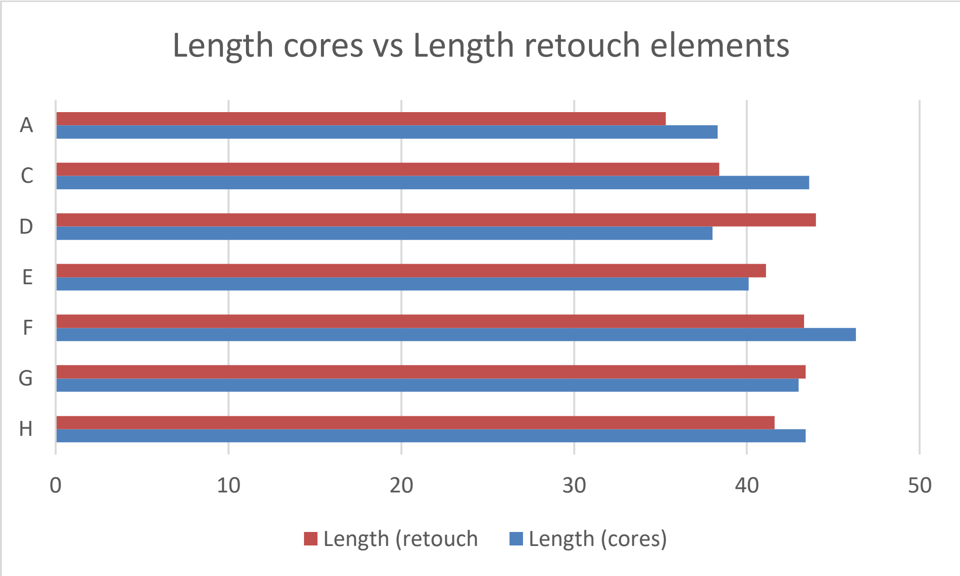

Figure 7.8: Average length of debitage and retouched elements of each layer assemblage assessed within this thesis, and presented in chapter 6. Layer B has been excluded due to its low assemblage size and derived nature.

7.6 Conclusion

Chapter 4 addressed and answered this studies research objective 1. The following two chapters, summarised here, have further addressed and answered research objectives 2 and 3. These relate directly to the Neanderthal lithic and landscape behavioural signature apparent within the La Cotte assemblages. Objective 2 aimed to directly investigate Neanderthal lithic technology. The new data, using my methodology presented in chapter 5 shows a distinct change from the lower (layer H - E) and upper (D – A) assemblages when compared together. The lower layers are dominated by denticulate types, with a total absence of bifaces and limited use of Levallois. The upper layers however are dominated by scrapers (apart from layer D) with presence of bifacial implements and a general increase in Levallois (which is still never overly significant). The poor preservation of faunal material (or other organic remains) precludes a direct association to subsistence. However, the appearance of larger mega fauna from at least layer C, associated with progressively steppe like conditions, could link to biface use and hide processing (i.e. scraper production) and connections to production of cultural insulation.

Throughout all assemblages flint is dominant and curated in a multitude of techniques. From a subsistence perspective, this can be seen as a techno-economic subsistence strategy for preservation of an essential resource. Therefore, the change/increase in use of the specific sharpening technique, LSF, relates directly to this subsistence strategy as well as associated landscape behaviour. As to be expected, the distance from raw material, both known fresh sources and presumed littoral/beach accumulations, links to curation. Specifically, the layer A assemblage shows that when distance to the coastline is at its maximum (for this study), based on the newest models presented in chapter 4, curation is at its most prevalent (specifically using LSF technique). This further connects to a logistical use of landscape, and objective 3, by Neanderthal groups. The immediate, geological, lack of flint in all layers from D – A leads to an increase in non-flint materials (e.g. Quartz and sandstone) as support for the lack of better quality material. This directly links objectives 2 and 3, where Neanderthal lithic and landscape behaviour effect technological and techno-economical decisions for subsistence of Neanderthal groups.

The preceding discussion(s) of functional elements of the assemblage (i.e. retouched elements, bifaces, bone accumulations etc.) have highlighted a number of subsistence based strategies of Neanderthal groups occupying the La Cotte landscape. One element un-discussed is the small nature and high frequency of non-retouched flakes and small heavily reduced cores (see Figure 7.9). I have already connected this element of the assemblage to a general trend in raw material economy, aimed at maximising flint; their functional application however is unclear. I here rule out a purely non-functional aim to this strategy due to the evidence for maximisation of material (e.g. LSF sharpening; multi-tools) and the effort and time in-put necessary for such a task on the scale enacted at La Cotte, throughout all layers studied (i.e. small non-retouched flakes of flint make up the large majority of all layer assemblages; see chapter 6). This can also be supported by the size distributions of non-flints seen in layers D-A (excluding B) which broadly matches that of the present flint materials i.e. this practice cannot just be explained solely as a maximisation of the flint material alone.

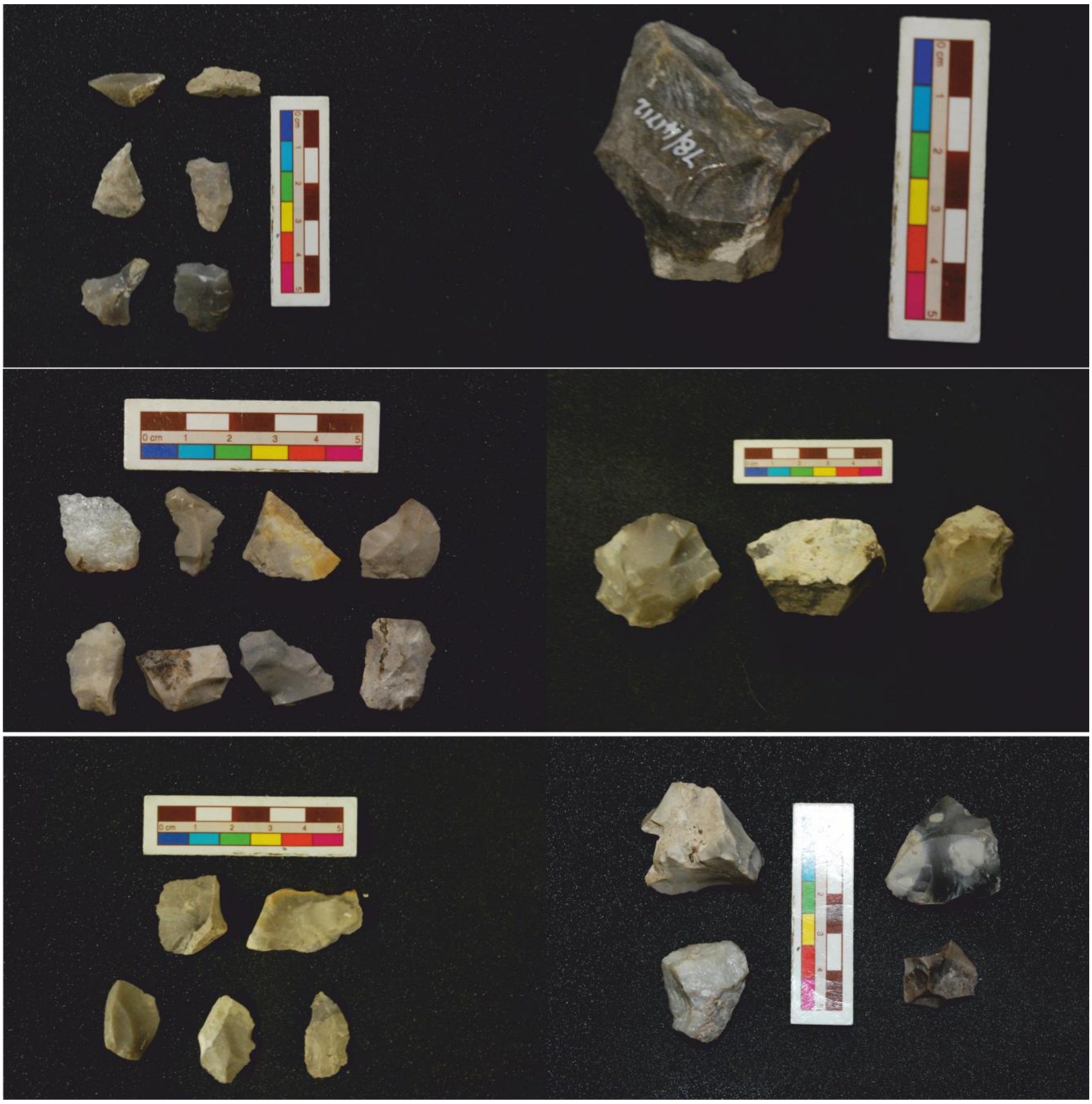

Figure 7.9: Selection of flakes and cores from, various layers within this study sample.

One possible scenario could relate to hafting of small flakes in a similar fashion seen in the later Palaeolithic of the Howiesons Poort (McCall 2007; Soriano *et al.* 2007). This connection is tentative but capability of hafting or composite tool production is a defined Neanderthal trait (e.g. Rots 2013; Rots and Plisson 2014) as is use of non-stone raw materials for varying tasks such as wooden spear production (Thieme 1997). Evidence for smaller game and fish acquisition in Sothern France (Hardy and Moncel 2011; Ecker *et al.* 2013) could highlight a subsistence need for smaller, lighter duty hunting technologies (pers. obs.). Equally evidence for acquisition and use of non-faunal material (discussed in section 2.3) for food, medication and other non-consumption tasks (e.g. use in cultural insulation) could explain the use of a lighter duty tool kit for associated cutting/slicing/reduction tasks. This could also relate to those LSF examples with usewear, as identified by Frame (1986) as a useful by-product of re-sharpening in the upper layers at La Cotte.

Within both these examples the use of smaller material directly, i.e. simply as a cutting technology, cannot be ruled out.

Chapter 8: Neanderthal occupation of the Channel Plain Region in the Early Middle Palaeolithic

8.1 Introduction

Chapter 7 discussed and presented data directly answering research objectives 2 and 3. This chapter will extend this, focussing directly on objective 4 and the overall research question set out on page 2. I will focus on the extended evidence for Neanderthal occupation and behaviour in the wider Channel landscape, specifically locales and associated research from the Brittany region, and investigate if patterns of behaviour within the La Cotte landscape can be related across the region. The insights presented relate to a research trip to the Université de Rennes 1, where archaeological material and associated fieldwork reports where consulted. The locales discussed were highlighted in section 5.4. As discussed in chapter 5, these assemblages were not investigated using my in-depth methodology due to unanticipated issues with assemblage storage, and time constraints associated with this. However, detailed observation made throughout this trip, in addition to focussed dialogue with other researchers at the University, allow a more in-depth understanding of these assemblages. Overall, these assemblages are here directly associated with those at La Cotte, discussed in the previous chapter (summarised in Table 8.1), based on my new data, presented within chapters 4 and 6, and personal observations from across the region.

Layer	First frequent RM	Second frequent RM	Overall core reduction	Denticulate type/Scraper types	Handaxe presence	Sea-level situation
A	Flint (66.76%)	Quartz (19%)	Mig. Plat/Sing. Plat/PCT	Scraper dom.	Yes (n= 70)	Low, ≈ -60 m/(6e/d)
B	Flint (84.8%)	Quartz (5.8%)	N/A	Scraper dom.	Yes (n= 3)	
C	Flint (75.86%)	Quartz (5%)	Mig. Plat/Disc.	Scraper dom.	Yes (n= 7)	Low, dropping > -40 m/(7a/6e)
D	Flint (76.91%)	Quartz (17.4%)	Mig. Plat/Disc./PCT	Even	Yes (n= 4)	High, dropping (7a)
E	Flint (90.35%)	Quartz (5.7%)	Mig. Plat/Sing. Plat/Disc	Scraper dom.	No	High, maximum (7a)
F	Flint (95.12%)	Quartz (1.8%)	Disc. Hier./Mig. Plat./PCT	Denticulate dom.		High rising (7b/7a)
G	Flint (92.84%)	Granite (2.7%)	Disc. Hier./Mig. Plat.			Rising (7c)
H	Flint (91.9%)	Quartz (2.1%)				

Table 8.1 Technological summary of La Cotte assemblages, layer H – A.

8.2 Observed lithic assemblages of Brittany

Figure 8.1: Site locations of sites across Brittany and Normandy.

Table 8.2 displays a summary of the chronostratigraphic correlations described within chapter 3 (section 3.4, page 51), technological attributions based on published data and personal observations (described below), and sea-level situations based on the new palaeo-geographic models presented in chapter 4. Through the following sections objective 4 will be answered, bringing together this research to present a new up-to-date understanding of Neanderthal lithic and landscape behaviour of the Channel Plain Region, with implications for Neanderthal behaviour elsewhere across eurasia.

La Cotte: Layer	Locales correlated to La Cotte occupations (pers. obs.)	Chronostratigraphic evidence with references (pers. obs. see page 52)	Technological attributions (pers. obs. and refs; see text)	Sea-level situations (based on chapter 4)/MIS attribution
A	Grainfollet	ESR/U-Th, 168 ± 18 (Laforge 2012)	Relatively high in Levallois; presence of laminar PCT; potential bone as fuel; high degree of fragmented faunal material (Giot and Bordes 1955)	Low, ≈ -60 m/(6e/d)
	Nantois & Les Vallées	ESR/U-Th, 166 ± 8 & 164 ± 17 (Bahain *et al*. 2012)	Mig. Plat. cores and flakes; mixed raw materials (Monnier 1986)	
C	Piégu	ESR/U-TH 192.5 ± 17.7	Highly reduced cores; mixed raw materials; use of beach cobble material; large Levallois points (Monnier 1976)	Low, dropping > -40 m/(7a/6e)
	Grainfollet	Chrono-stratigraphy	Denticulate types and bifaces; high in Levallois (Giot and Bordes 1955)	
D	Piégu	ESR/U-TH 192.5 ± 17.7	Highly reduced cores; mixed raw materials; use of beach cobble material; large Levallois points (Monnier 1976)	High, dropping (7a)
E	Les Gastines	Chrono-stratigraphy (Monnier *et al*. 2011)	Use of beach cobble material; high in denticulate types; good use of non-flint material (Monnier 1988a)	High, maximum (7a)
F	Les Gastines	Chrono-stratigraphy (Monnier *et al*. 2011)	Technological attribution; limited use of non-flint and presence of Levallois points (Monnier 1988a)	High rising (7b/7a)
G-H	Menez-Dregan, layer 4	TL 223 ± 23 (Mercier *et al.* 1994); 7c - a (Ravon, pers. comms.)	Use of beach cobble material; high in non-flint, heavy duty cobble tools (c. 50%); high in denticulate types (Ravon *et al.* 2016b)	Rising (7c)

Table 8.2: Chrono-stratigraphic correlations and technological summaries for sites connected to the assemblages of La Cotte across Brittany. Multiple chronological interpretations for Grainfollet, Piégu and Les Gastines are further discussed within the text.

8.2.1 Pleneuf-val-Andre (Nantois, Piégu and Les Vallées)

Section 3.3.1.1 (page 44) discussed the raised beach stratigraphy of the Pleneuf area. This section presents my personal observations of the archaeological evidence from these locales. All three main stratigraphic sequences (Nantois, Piégu and Les Vallées) have associated lithic assemblages (Monnier *et al.* 1985; Monnier 1986; Bahain *et al.* 2012). The lithic assemblage of Les Vallées has seen little publication, the material is also stored away from the main collection at the Université de Rennes, and was not observed as part of this thesis. The assemblage correlates to occupation at the earlier stages of MIS 6 (6e), dating to 164 ± 17 kya (Huet 2010; Bahain *et al.* 2012; Laforge 2012), similar to Nantois (see below) and broadly correlating to occupations within layer A of La Cotte (see Table 8.2). The assemblage is characterised by it high quartz content (82.3%; but highly fragmented, as at La Cotte), and a lack of Levallois material. The excavated material, recovered through emergency excavation in 2010, due to marine erosion (Huet 2010), was associated with the remains of horse, again indicative of open landscapes.

The lithic industry of Nantois is small but significant and has been separated into a number of related assemblages (Monnier 1986). Layer 35 is potentially most relevant here; excavated in situ and related to the partial remains of a single bovid (*Bos primigenius*). The assemblage is mostly on frost shattered flint (Monnier 1986), with battered surfaces and limited staining. The in situ artefacts (t= 28) represent a flake industry with a small percentage of retouch (Monnier 1986). There is associated debris material and eight cores (some fragments) recovered from around the faunal material. Only one example of Levallois working was recovered; a broken atypical flake, also with a notch and semi-abrupt retouch i.e. a mixed tool. Monnier suggested that the assemblage displayed use wear associated with the processing of the bovid (ibid: pg 147). Two pieces within the assemblage are on quartz and one core was produced on a volcanic green stone, sourced locally (ibid: pg 147). Layer 35 was dated to 166 ± 8 (Bahain *et al.* 2012) and therefore seen as occupation within a temperate stage of MIS 6 (Laforge 2012) and, as with Les Vallées, chronostratigraphically relates to the earlier MIS 6 occupations of La Cotte, within layer A (pers. obs.). This then relates to low sea-levels, with both locales being over 50km from the coast (to the north) and therefore the primary access to beach accumulations.

Outside of layer 35 there was also material found both from the cliff section (layers 38 and 27), and from the foreshore, with no obvious stratigraphic assignment (Monnier 1986; Loyer *et al.* 1995). Interestingly the collected assemblage does include a percentage of Levallois material (Monnier 1986). Within layer 38, from within the cliff-line, one flint flake was recovered; this was suggested to have been reworked from the beach deposits. The single artefact from layer 27 was heavily patinated and rolled and has presumably been reworked. The collected material was taken from along the foreshore, and could have related to either the in situ material of layer 35 *or* the cliff-line itself. Most noteworthy is three Levallois flakes and one core (a discoid). The other, retouched pieces, where a denticulate, a scraper and two naturally backed knives (Monnier 1986). The Nantois assemblage is technologically, loosely, connected to layer A at La Cotte (as well as chronostratigraphically; see above) with use of *ad-hoc* techniques to reduce/maximise transported flint material (> 50km to the liminal zone). Some PCT use is indicated, but there is no suggestion of any full reduction of material on site, and all reduction can be suggested as directly connected to the processing of the associated bovid (e.g. butchery or bone cracking). The signature is similar at Les Vallées, associated with the butchery and processing of horse, and both locales highlight short term episodes of activity related to mobile groups immediately related to direct access to faunal material (i.e. butchery), with evidence for short reduction sequences of available material. This behaviour is not signalled directly at La Cotte, where faunal material is highly fragmented, likely associated with both marrow extraction and bone as fuel. Technologically however, the *ad-hoc* use of available material (i.e. quartz and transported flint) does match similar practices at La Cotte during the occupations of layer A (heavily reduced transported flint supported by local quartz and sandstone). The lack of bifacial elements and Levallois further supports the mobility of these specific technological elements through the landscape.

Figure 8.2: Flint Levallois points from Piégu, unknown provenance.

Piégu's assemblage is larger in number (t= 859) and is 99.6% flint material (Monnier 1976; Monnier 1980; Monnier *et al.* 1985), and stratigraphically split over four layers, D, F, G and J (Monnier *et al.* 1985; Bahain *et al.* 2012; Laforge 2012; Danukalova *et al.* 2015). Occupation was associated with a shallow rock-shelter, now destroyed, with some material suggested to have collapsed from above (layer G), including evidence for butchery and faunal processing, but no suggested evidence for use of fire (Monnier *et al.* 1985; Bates *et al.* 2003; Bahain *et al.* 2012). 220 cores were described by Monnier *et al.* (1985) with relatively small average dimensions (mean L= 58mm). Levallois is present in abundance, with points, typical flakes and laminar material all present. Bifaces are rare (t= 2) as is laminar Levallois material. Points are often large (Figure 8.2), a trait that seems observable across Northern Western France (Hérisson *et al.* 2016a) for this period. Overall, all typical Mousterian tool types are present with a slight dominance in scrapers (all forms) and a high proportion of backed knives (Monnier *et al.* 1985).

The dating of layer G using U-series and ESR gave a mean age of 193 ± 6ka (Bahain *et al.* 2012) supporting Monnier *et al.* (2011; see section 3.2.1.1). Dating and chronostratigraphy then suggests this occupation at Piégu took place through the MIS 7/6 boundary, during dry, open cooling conditions (Bahain *et al.* 2012; Laforge 2012; Danukalova *et al.* 2015), and therefore correlates to the occupations of La Cotte throughout layers D and C. Interestingly these layers at La Cotte also have the highest proportions of Levallois (still low), and included large points (section 6.2.5.3.1). This connection can be strengthen with the use of bifacial elements at Piégu, as at La Cotte (see Table 8.1), occupation of a rock shelter at the head of a gully system, use of beach cobble material, and dominance of scrapers and associated processing of faunal material. This evidence then provides a key tie between Neanderthal behavioural practices across this landscape. Transport distances for major accumulations of flint material at both locales (i.e. littoral beach accumulations) would have been similar, c. 20-30 km.

8.2.2 Les Gastines

Situated at the confluence of the River Rance, St Malo, Brittany (see Figure 8.1), Les Gastines represents an open-air, in situ locale chronostratigraphically correlated to the later part of MIS 7 (Monnier 1988a; Monnier 1988b; Monnier *et al.* 2011). The industry from Les Gastines has been associated with layers F and G from La Cotte by Monnier (1988a) as well as close connection to Grainfollet (1.7km to the south; see below) and Piégu (Monnier 1988a; Monnier *et al.* 2011). The original excavation area sat below the modern high tide level, 50m from a rocky outcrop, under a periglacial sand and gravel deposit, associated with a retreating high sea-level stand. It is the cliff that provides the geological comparison for the dating of the artefact-bearing deposits, attributed to the late Saalian after corresponding granulometric analysis of layer 9 of the cliff line (Monnier *et al.* 2011; Laforge 2012). The full sequence (i.e. the cliff line) is a series of heads and marine/beach deposits (Figure 8.3).

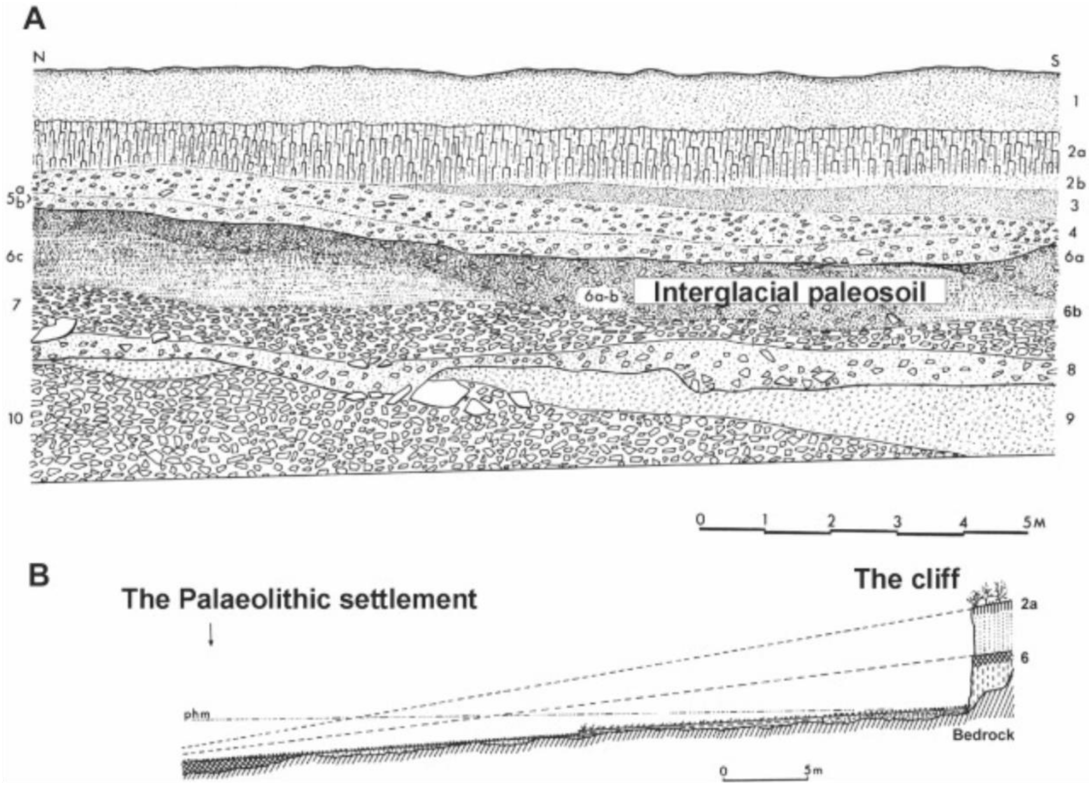

Figure 8.3: Situation of the Les Gastines archaeological locale, image adapted from Monnier et al. (2011). A) represents the cliff section with layer attribution (described further in text), B) represents the association of the cliff section and the excavated "Palaeolithic settlement".

The assemblage at Les Gastines (t= 452) has been described as a Mousterian industry with a high proportion of denticulates and notches present (Monnier 1988a; pers. obs.). Levallois material is well represented, with Typical Levallois present in abundance (*ILty* = 28.6; 90% of the Levallois material). Flint dominates the assemblage (81.6%) and is mostly of local marine pebbles but quartz, *grès lustré* and quartzite are also present (Figure 8.4). The Levallois material is only on flint and *grès lustré* and includes points as well as typical flakes. Cores represent 18% (t= 83) of the assemblage as a whole and again are mostly on local flint, typical of beach accumulations (pers. obs.), and relatively small. However there is a good presence of large, fully cortical flakes from the initial stages of reduction of larger beach cobbles. This material is also present as Levallois cores, but is not obviously observable within the non-Levallois core material (pers. obs.). Retouch is relatively high (20.8%) with 34.8% of that described as notches and denticulates (Monnier 1988a). Scrapers are represented in low numbers and there were no observable bifacial elements.

Correlation to the lower part of La Cotte's Saalian sequence i.e. layer H - E is favoured here based on the chronostratigraphy of (Monnier 1988a; Monnier *et al.* 2011; Bahain *et al.* 2012) interglacial deposits overlain by evidence for a retreating sea-level situation. Further support for this can be seen with the high dominance of beach cobble flint material used by Neanderthal groups at the site i.e. a close proximity to beach accumulations, correlating to models presented in chapter 4. I interpret the specific correlation with La Cotte to be with layers F and E. Technologically the high degree of denticulate types and overwhelming dominance of flint (despite local quartz' and quartzites) suggest very similar practices to those highlighted by my analysis within layer F at La Cotte (see section 6.2.3). The high and rising sea-level during this period reduces the distance to beach accumulations and the use of flint at both locales highlights similar lithic and landscape behaviour of Neanderthal groups in the area during the EMP.

Figure 8.4: Levallois point (*grès lustré*) from Les Gastines.

8.2.3 Grainfollet

Grainfollet lies just 1.7km to the south of Les Gastines, on the estuary of the River Rance (Figure 8.1). The site, not fully excavated, sits on the current intertidal zone, with initial excavations (Giot and Bordes 1955) concentrating on the area lying under a rock overhang (Brioverian Schist cliff) with a S.W. orientation (Figure 8.5). Material (lithics and fauna), still lying within Pleistocene sands but likely moved somewhat, still lie below the rock fall and a course fluvial sand deposit (pers. obs.). Faunal material was highly fragmented but preserved within the lower, finer sands with a multitude of open habitat species recorded, including mammoth, horse, and deer (Giot and Bordes 1955), all identified from teeth and mandible fragments. The lithic assemblage is separated into two, an in situ assemblage (> 6000 pieces) and a scattered one (t= unknown to date) from within the beach deposits (Giot and Bordes 1955; Monnier 1980). Both assemblages are dominated by flint (90.1% and 97.5% respectively), with quartz making up the rest, apart from a few stray artefacts (total not reported) on *grès lustré* and microgranite (both outcrop within 10km of the site).

Figure 8.5: Modern site of Grainfollet, with over hang (under yellow line; Figure 8.6), and broad area of initial, main investigations (Giot and Bordes 1955) circled in red. Image taken from the South West.

The lithic assemblage is typified by a low Levallois presence (13% within the excavated assemblage), high in denticulates and notches, from both the in situ and beach assemblages. Bifaces are present but in low numbers, t= 6 reported for the in situ assemblage (Monnier 1980: pg. 200). Of the Levallois products present, laminar production is well represented, with few points and mostly atypical flakes, similar to layers D - A at La Cotte. Conversely, high amounts of denticulate types, and low appearance of scrapers makes the assemblage technologically different from both Les Gastines and the upper layers at La Cotte. An area of concentrated burnt material was highlighted (Figure 8.6), consisting of charred bone and lithics, and charcoal. There was also a reported area of “paving”, connected elsewhere (Monnier 1982; Monnier 1988b) to other such excavated features from across Brittany (e.g. Menez-Dregan) and Normandy (e.g. Port Pignot, see below).

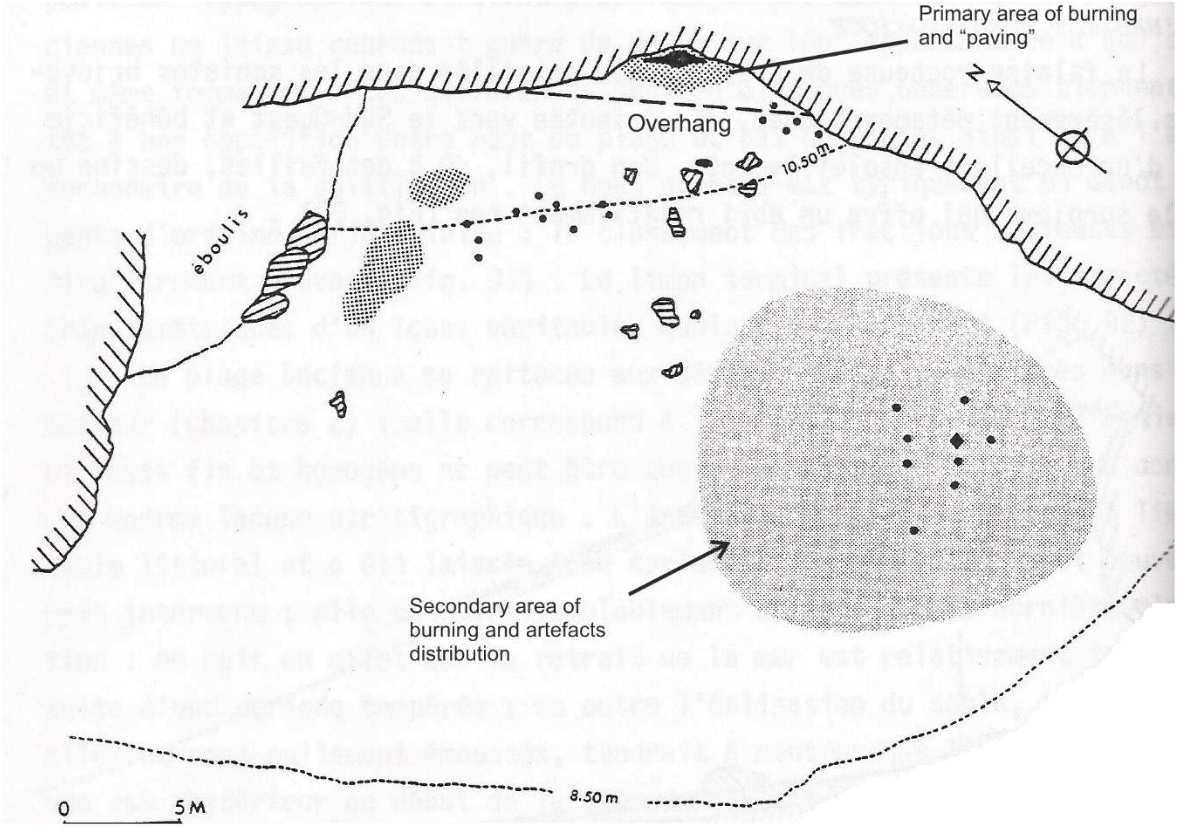

Figure 8.6: Sketch of excavated area at Grainfollet, based on Giot and Bordes (1955), adapted from Monnier (1980: pg. 194) .

Chronostratigraphy places the site within the later stages of MIS 7 or earlier stages of MIS 6 (Monnier 1980; Monnier *et al.* 2011). More recent radiometric dating supports this, with two separate dates at 168 ± 18 and 171 ± 15 ESR/U-Th for remnant loess/head deposits overlying the artefact layers (Laforge 2012). The dating, chronostratigraphy and appearance of Levallois, bifaces and significant use of non-flint material support a connection with layers D - A at La Cotte. The dated head deposits could relate to the same head/loess sequence in layer B, and therefore could further refine hominin occupation at Grainfollet as comparable to layers C and D in age. The appearance of denticulates and notches, unlike at La Cotte, could then relate to subsistence practices specific to both locales, with marrow extraction alongside butchery practices forwarded as one suggested practice at Grainfollet. The dominance of scrapers at La Cotte then could support differences in faunal processing, such as hide scraping and preparation. Both sites sit in protected locales with south-west facing situations, and both have evidence for use of fire, likely employing bone as fuel. Additionally, while Grainfollet can be connected to the same coastal plain as La Cotte (to the north) it also sits at the entrance of the Rance Valley, which continues inland to the Armorican Massif, and could have been associated with seasonal faunal migrations, similar to locales in south-western France, e.g. Mauran and Jonzac (Gaudzinski 1996; Britton *et al.* 2011) or Germany, e.g. Saltzgitter Lebenstedt (Gaudzinski 1999; Gaudzinski and Roebroeks 2000).

8.3 Further afield: assemblages from Normandy and Picardy

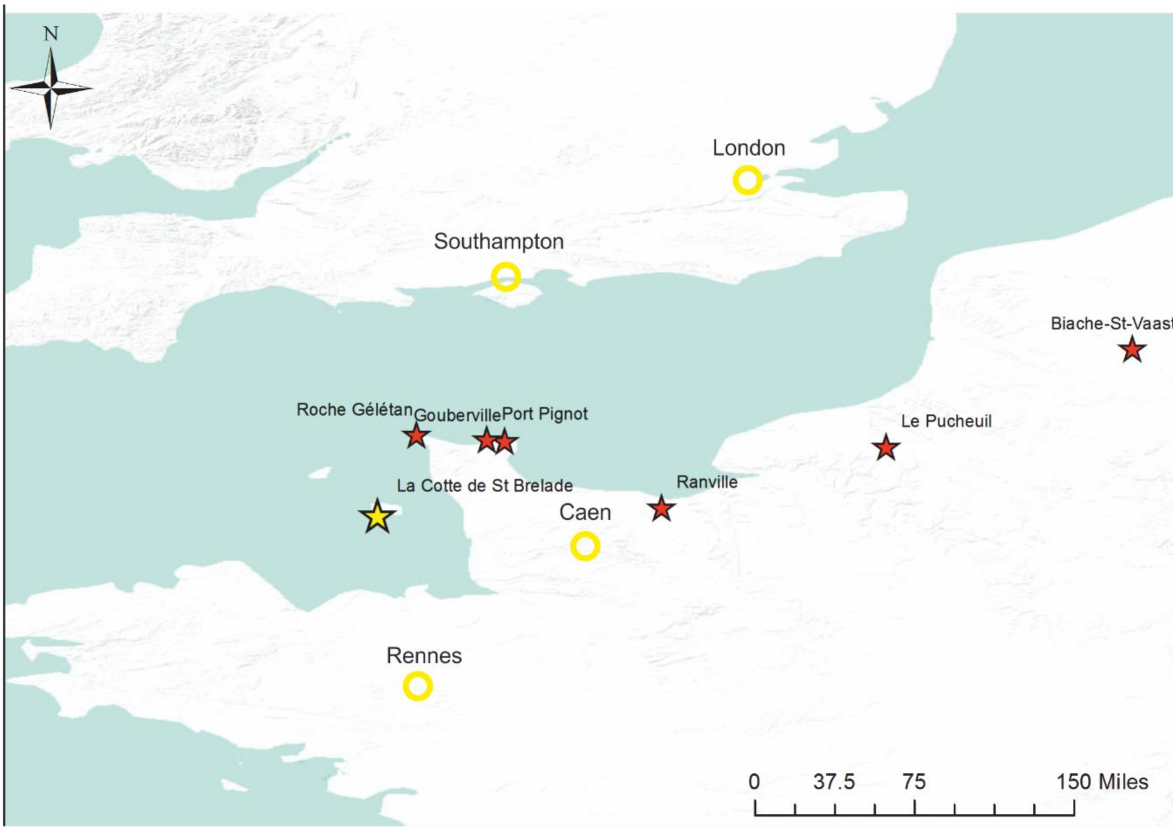

Figure 8.7: Site locations of locales across Normandy and Picardy.

This section adds a short review on the archaeologically associated material from the connected eastern areas of Normandy and Picardy (Figure 8.7). The chronostratigraphical significance of Gouberville and Port Pignot have been mentioned within chapter 3, while the archaeological significance of sites such as Biache-St-Vaast, Le Pucheuil and Ranville has been highlighted throughout this research. This section provides the basis for discussing all these occurrences in more depth, with direct connections to La Cotte (Table 8.1), and summarised in Table 8.3.

La Cotte: Layer	Locales correlated to La Cotte occupations (pers. obs.)	Chronostratigraphic evidence with references (pers. obs. see page 52)	Technological attributions (pers. obs. and refs; see text)	Sea-level situations (based on chapter 4)/MIS
A	Roche Gélétan	Archaeological material in head deposits with single TL 149 ± 11 (Cliquet *et al*. 2003); chronostratigraphic connections (pers. obs.)	Upper assemblage within a head deposit; Levallois and bifaces present	Low, ≈ -60 m/(6e/d)
	Gouberville	TL 128 ± 20 - 187 ± 26 (Cliquet *et al*. 2003)	Levallois flakes, points and laminar. No bifaces	
	Biache-St-Vaast, upper assemblages (D1 and D)	Chrono-stratigraphy (Bahain *et al*. 2015); deteriorating climate (Herisson *et al.* 2013)	Levallois material, especially points for re-tooling/re-hafting; use of bone as fuel	
	Le Pucheuil, Series B	Chrono-stratigraphy (Delagnes & Ropars 1996); deteriorating climate (pers. obs.)	Bifaces and Levallois, both with evidence for transport away from locale; specific PCT reduction practices.	
D	Port Pignot, Group III	Artefacts in coastal deposits i.e. high sea-level, dropping (Michel *et al.* 1982)	Mix of denticulate types and scrapers; bifaces and Levallois present; predominant use of flint	High, dropping (7a)
G-H	Ranville	ESR/U-series 205 - 235 kya (Bahain *et al*. 2008)	Evidence for complex transport of raw material; bifaces and denticulate types well represented	Rising (7c)

Table 8.3: Chrono-stratigraphic correlations and technological summaries for sites connected to the assemblages of La Cotte across the further region, further discussed within the text.

8.3.1 Roche Gélétan

Similar to other examples discussed in this thesis, Roche Gélétan has seen little publication. However, the site is mentioned in key chronostratigraphic and archaeological research over the past decades (Cliquet *et al.* 2003; Cliquet and Lautridou 2005; Coutard *et al.* 2005; Coutard and Cliquet 2005; Coutard *et al.* 2006). Cliquet and Lautridou (2005) discuss the initial identification of "*structure d'habitats*", including evidence for hearths and debitage concentrations. It is these features that are associated with an assemblage and interbedded within a head deposit dated to between 149-214 kya based on TL (Cliquet *et al.* 2003). There is suggested to be three assemblages (Cliquet *et al.* 2003), one from within the head deposits (fresh; t= 5700), and two within a raised beach deposit (one "edge-damaged" and one "rolled"; t= 5100 and 2600 respectively).

There is little discussion of where the material dated was obtained from other than "throughout the sequence". However, of the five pieces dated one is described as fresh and gave the younger date of 149 ± 11ky. The four other "rolled" pieces produce dates between 207 and 214 kya. All assemblages retain bifacial elements (thinning flakes within the lower, raised beach; bifaces in the upper) but Levallois is only reported within the upper head deposits (recurrent, unipolar). This assemblage also included denticulates and notches (Cliquet *et al.* 2003), and a pebble tool assemblage (raw material not mentioned). Published reviews including Cliquet *et al.* (2003) suggest the head, and therefore the associated assemblage, to be within MIS 6 and therefore the underlying beach deposit sitting within MIS 7 (Coutard and Cliquet 2005; Coutard *et al.* 2006). The reworked assemblage within the beach deposit could be extremely mixed, and as with Port Pignot (see below), also reviewed by Coutard *et al.* (2005), it could be that the bifacial elements are intrusive from an earlier, pre-EMP occupation. This interpretation is favoured here, and only the upper, fresh material, from within the head deposit is confidently correlated to occupations at La Cotte.

The head correlates to the MIS 6 occupation of the upper Saalian deposits at La Cotte (i.e. layers D - A), and relate to a drop in sea-level >60 m. Exposure of flint on the northern Cotentin occurs at as little as -20 a.m.s.l. (see chapter 4, page 70), and fresh sources, as well as eroded beaches and gravels, would be available throughout this occupation within relatively close proximity (c. 5km to the north). The appearance of bifaces in this unmixed assemblage further supports an association with layer D – A occupations at La Cotte. As bifaces are often associated with transported elements of better quality material within the occupations at La Cotte, as is Levallois material, their appearance here could be associated with the direct access to outcropping chalk-with-flint to the north of the Cotentin (see Figure 7.1), c. 10km from the locale. There is no suggested evidence for faunal processing within the excavated area from published reports consulted as part of this study. However, fire is attributed by hearth like structures and burnt artefacts. The presence of bifaces and bifacial faconage and recurrent, unipolar Levallois reduction/debitage links technologically to La Cotte layer A, but there is no mention of any other tool types (e.g. scraper types or denticulates). This signature could suggest a concentration of production by Neanderthals at Roche Gélétan associated with direct access to flint within the immediate area.

8.3.2 Ranville

The locale of Ranville, Calvados (see Figure 8.7), was excavated as an infilled fissure of sediment within a karstic limestone system, discovered though quarry working (Cliquet 2008c). The sediment was believed to have originated above the fissure (Cliquet 2008a; Coutard 2008), collapsing in through antiquity, in successive stages of erosion and re-deposition/infilling. Certain layers of the infill contained archaeology and faunal material that was little affected by post-depositional conditions, suggesting a nearby origin of the material (Cliquet 2008b). The deposits were disturbed on initial discovery, almost certainly loosing archaeological material (Coutard 2008), and not all material would have been re-deposited into the fissure from the original hominid activity area. Both relative and actual dating suggested a later MIS 7 date (MIS 7 c-a) for the archaeological occurrences within the fissure. U-series and ESR dating gave a range of 205-235 ka (Bahain *et al.* 2008). The area of hominid activity, at this time, would have sat at 30m above sea-level and ≈15m above the river valley of the Orne, at a confluence with a tributary. No pollen was evident but faunal association with the lithic bearing layers suggest a temperate climate with open prairie/parkland landscape and forested elements (Auguste 2008); similar in condition to those described for later MIS 7 elsewhere (Schreve 1997; Schreve 2001a; see section 2.2.2). Climatically temperate conditions are signified, and dating suggests a correlation to the lower sequences at La Cotte (i.e. layers H – E).

At least two separate episodes of occupation were highlighted at the locale. The initial occupation was centred on the butchery of a single elephant carcass. Osteological evidence does not suggest if the carcass was hunted or scavenged (Auguste 2008). The lithics (t= 18) associated with the butchery consisted of an *ad-hoc* flake industry made on local raw materials (fluvial flint nodules) and an imported collection, knapped on more exotic materials (e.g. Jurassic flint from outside the Orne Valley), including bifacial elements (Cliquet 2008b). A separate occupation within the fissure catchment was represented by the exploitation of deer and aurochs in associated with 303 lithic artefacts; evidence on the bones of these individuals suggests direct hunting (Auguste 2008). A mixture of formal flake tools (denticulates and scrapers), bifacial working debris and bifaces themselves where recovered (Cliquet 2008b). Complex transport of material into the activity area and out again was proposed due to the lack of a full *chain operatoire*. Both Levallois material and bifaces were introduced to the site made on exotic materials (from up to 30km away), and with no evidence of debitage related to their production. Equally there is bifacial re-working evident (thinning flakes), with no related bifaces. The faunal material from both occurrences also suggests transport of materials within the landscape (Auguste 2008; Cliquet and Auguste 2008). While the butchery of the elephant is believed to have been in situ (scavenged or hunted) there is a lack of meat bearing, nutritious bones such as the large femurs and humeri. On the contrary, the deer and aurochs remains are represented almost exclusively by nutrient rich bones but little evidence for full carcasses or entire butchery on site. Marrow extraction on large bones was practiced by shattering long bones of both deer and aurochs (Auguste 2008).

Ranville then represents a complex suite of behaviours related both to immediate activity (butchery and knapping) and transport of material and activity throughout the landscape (i.e. raw material acquisition, hunting and additional butchery). This behaviour directly links to the ideas of a logistical use of landscape proposed at La Cotte (see section 7.2), with complex movement of various resources. The difference in treatment of faunal material shows planning strategies for subsistence centred on the transport of smaller animals and exploitation of marrow, and the alternative butchery of larger mammals (elephant) to exploit nutrient rich material. This is also seen at sites such as Grainfollet and Les Vallées in Brittany, and had been suggested at La Cotte (all layers) based on high fragmentation of bone material. This evidence of transport can be related to the lithic assemblages. Raw material is introduced to the site both as final products (i.e. bifaces), as well as reduced on site, further re-sharpened and re-worked. Additionally, local raw materials are used in a more *ad-hoc* fashion for the production of further, necessary products (Cliquet and Auguste 2008). This is also seen across the region, specifically in all layers at La Cotte, were local quartz is used to support the general lack of flint (or other good quality material).

The climatic situation (temperate, dry) and dating suggest an early MIS 7 c-a attribution, most likely correlated to occupations at La Cotte within layers G and H. While connections in behaviour have been highlighted, the differences (e.g. bifaces; scraper and denticulate use; Levallois) support a logistical use of landscape by Neanderthal groups, differing here at Ranville based on drastic landscape differences. La Cotte, as seen in chapter 4, is associated with low lying, open plain landscapes within a period of rising sea-level. Neanderthal groups here focus on access to fauna on this open plain and technologically a focus on economic reduction of transported flint material. Ranville however, sits in an upland landscape during interglacial warming (i.e. rejuvenation). Again fauna is available in the immediate area (including megafauna and smaller game) as is flint within the clay-with-flint deposits of the river valley. There is no evidence for seasonality here, but it could be the occupations at Ranville are associated with summer migration routes of fauna, in the uplands of northern France (pers. obs.).

8.3.3 Gouberville

Gouberville is situated at Lande du Nau, Normandy (Figure 8.7) on a granite outcrop at 5 - 6 m a.m.s.l. Deposits infilled a basin or bowl (*cuvette*) within the granite and comprised of sandy silts and clays as well as a relic beach of sands and marine pebbles (Coutard and Cliquet 2005). The assemblage was initially assigned to the Weichselian (unpublished but mentioned by Cliquet *et al.* (2003)). However, TL dating conducted by Cliquet *et al.* (2003) firmly places the assemblage, and the deposits, as pre-Eemian, between 128 ± 20 and 187 ± 26 kya. This supports the altimetric height comparisons with other Saalian beaches along the Val-de-Saire such as Ecalgrain (see section 3.3.1.2).

The collection is large (t= 19984) and comprises two distinct assemblages, an Upper assemblage and a Lower. There is some suggestion that the lower assemblage is disturbed; again this is unpublished. Overall, both assemblages have a close technological affinity, and have been described as being dominated by unipolar Levallois aimed at the production of large Levallois flakes, points and laminar material (Coutard and Cliquet 2005; Cliquet and Lautridou 2009). Bifaces are absent and retouched pieces are dominated by notches and “*belle facture*” scrapers. This is the most ephemeral of the assemblages discussed with limited publications discussing the lithic material (Cliquet *et al.* 2003; Coutard and Cliquet 2005).

The dating of Gouberville, further chronostratigraphic correlation to later MIS 7, and its large assemblage, make this site worthy of mention. Correlations to the upper part of the sequence at La Cotte, somewhere within layers A-6, are proposed here based on environmental indicators (cold, dry), as well as the TL dating. The use of large Levallois flakes and points as well as scrapers suggest similar technological practices associated with hunting and faunal processing to those at La Cotte. Gouberville, as with Roche Gélétan, sits on the littoral of the northern Cotentin within easy access distances to chalk-with-flint deposits currently submerged under the Channel, but exposed at c.-20m below modern sea-level. The proximity could explain the lack of bifacial elements that could have moved away from the locale as part of a general landscape transport strategy (i.e. raw material economics), eventually discarded away from direct access to good quality raw material after use, such as at locales like La Cotte (pers. obs.).

8.3.4 Menez-Dregan I, layer 4

Menez-Dregan I is sited on the far western edge of this study region (Figure 8.1) on the Atlantic coast of Brittany. Menez-Dregan I has long been discussed and reviewed for its Lower Palaeolithic occupations (McNabb 2007; Lefort *et al.* 2016; Monnier *et al.* 2016; Ravon *et al.* 2016a), and its association with non-handaxe assemblages, referred to regionally as the “Colombanian”. However, there is strong chronostratigraphic and radiometric dating evidence, as well as technological characteristics within the assemblage (pers. obs.), that places layer 4 (split into a, b and c; Figure 8.8) within the Early Middle Palaeolithic (Mercier *et al.* 2004; Monnier *et al.* 2016; Ravon *et al.* 2016b).

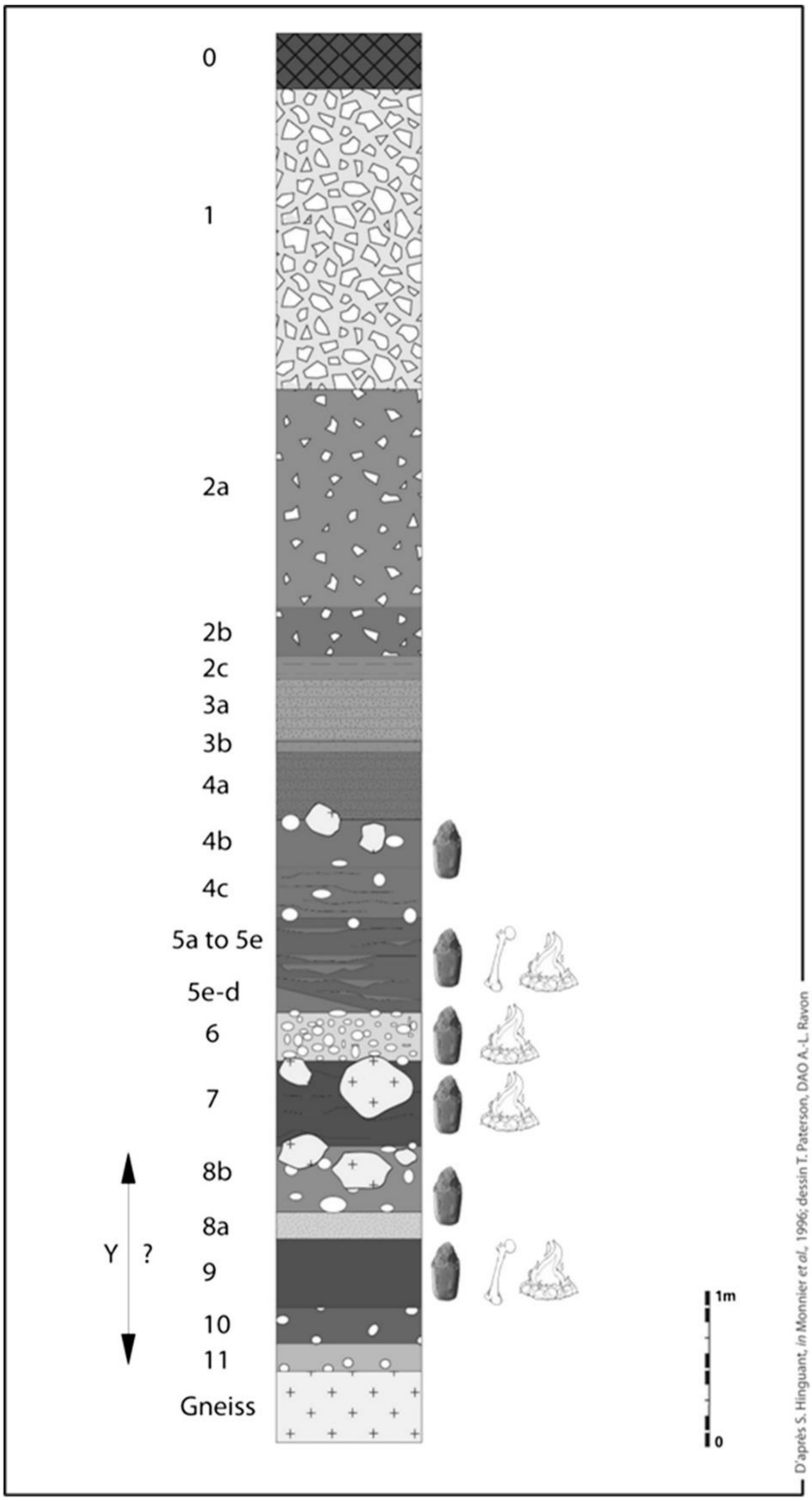

Figure 8.8: Menez-Dregan 1 chronostratigraphy, image taken from (Ravon *et al.* 2016b). Layer 4a – c represent the Early Middle Palaeolithic layers.

Layer 4c is of specific interest, and produced the largest excavated assemblage (t= 9966), with a further 4763 from 4b and just 120 from 4a. Layer 4c produced a TL date of 223 ± 23 kya (Mercier *et al.* 2004), strongly pointing to a MIS 7 accumulation of deposits. The assemblage is made up of approximately 50:50, light duty flint tool production (including the tools themselves), and heavy duty cobble tools (mostly on sandstone and microgranite). Overall, retouch is relatively scarce on flint, with the majority of the assemblage representing knapping debris. Further, a high degree of "debris/esquilles" (<5mm) or knapping chips where present across the layer 4 excavation, directly pointing to onsite knapping (pers. obs.). Raw material is nearly exclusively of beach cobble origin and connected with archaic beaches within the vicinity of the site (Ravon pers. comms.). These beaches, it is suggested, are supplied by flint outcrops to the north-west, some 40km away, and submerged through high sea-level events e.g. modern a.m.s.l. This scenario is similar to that seen around the coastline of the La Cotte landscape, discussed within chapter 4, with a low lying, open coastal plain. No direct association of fire was highlighted by the excavation team (Ravon pers. comms.), with a few highlighted burnt artefacts and presence of limited charcoal being the only evidence for burning (Ravon *et al.* 2016b).

Detailed personal observation of the layer 4 material suggests a loose technological connection to the assemblages at La Cotte, but with no suggestion of layer attribution. Quartz is present in good numbers in the Menez-Dregan assemblage, and used in very similar ways within both sites i.e. expedient use of flakes, with the occasional denticulate or notch produced, potentially associated with heavy duty tasks (at least at La Cotte). Cores of this material are also technologically associated, with high amounts of multi-platform, un-structured reduction, largely due to the raw materials fracture properties (pers. obs.). Quartz at Menez-Dregan however, is sourced from beaches (inferred from rounded, often battered natural edges), whereas at La Cotte it is exclusively (in this study) seen to be from "fresh" seams within the Granite bedrock local to the site.

Technologically, the flint material can also be connected with high degrees of denticulates at Menez-Dregan (68.2%), on often flawed, pebble flake blanks, and can be associated with the lower layers at La Cotte (i.e. H-F). Overall, flint at La Cotte is more varied in character (with some appearance of fresh, primary sourced material) and, most obviously, La Cotte does not have a high occurrence of heavy duty, cobble tools (pers. obs.). The date 223 ±23 kya (Mercier *et al.* 2004) would suggest a MIS 7 attribution (i.e. within MIS 7c-a) and therefore the early occupations at La Cotte. The use of non-flint raw materials, to support various activities, is mirrored within the La Cotte assemblages and use of denticulates and notches, supports a correlation to layers G and H i.e. early MIS 7 c-a. The technological connections then suggest a wider geographical continuity of eco-technological behaviour across Neanderthal groups of the Channel Plain. Beach accumulations have been shown to be approximately 40 km away (Monnier *et al.* 2016; Ravon *et al.* 2016b), with local outcrops of other materials within 5km (e.g. sandstones and quartz). The associated coastal plain, now submerged by the Atlantic, provides an intriguing similarity to the low lying landscape situation at La Cotte. The use of heavy duty elements at Menez-Dregan suggests a task specific behaviour, potentially associated with butchery and carcass processing (i.e. marrow extraction), which could be linked to behaviour in the lower layers at La Cotte signified by high fragmentation of faunal material. However the lack of preservation of bone at Menez-Dregan restricts this interpretation.

8.3.5 Port Pignot

Port Pignot, Fermanville (Figure 8.7) represents one of the best preserved locales in the Basse-Normandie with three stratified levels excavated by Denise Michel between 1980 and 1982 (Michel *et al.* 1982). The site has since been quarried away and even when discovered in 1979 was largely eroded. The existing deposits were found at the back of a large fissure within the granite headland siting between two coves (very similar in situation to La Cotte). Overall, the stratigraphy represents a complete sequence from the Holocene down to MIS 7. Three archaeological layers where identified, associated with a series of sand and gravel deposits (Coutard and Cliquet 2005). Three distinct assemblages were described by Monnier (Michel *et al.* 1982), Group 1, 2 and 3. The lower Group 1 was associated with a raised beach geo-chronologically dated to the Saalian. Group 2 was recovered from a series of marine deposits, and represented a coastal situation and Group 3 was in a higher level of fine sands. Only Group 3 was suggested to be relatively in situ, with no suggestion of any intrusive elements, unlike the lower two assemblages directly associated encroaching high sea-levels, and likely mixed and reworked. Group 3 was excavated from a slope sequences and almost certainly associated with a deterioration of conditions into the glacial period of MIS 6 (i.e. periglacial), but is suggested to be largely in situ (similar to conditions at La Cotte).

Michel *et al.* (1982) initially saw this assemblage as technologically late Acheulean. Later, Coutard and Cliquet have re-assigned this to a classic Early Middle Palaeolithic assemblage, with limited bifacial elements (Coutard and Cliquet 2005). They even suggest that the bifaces that are present may be intrusive from the headland. Overall the assemblage is slightly dominated by Levallois material (mainly debitage) throughout, and the three groups are extremely similar in typological classification if not condition and situation. All classic Mousterian tool types appear throughout, but in varying degrees. Overall there appears to be a dominance of around 30% of backed knives with *naturally* back knives often significantly represented. Bifaces are rare but present in all groups. There is an overwhelming pre-dominance of flint with a small amount of quartz present (<3%). As mentioned above, the flint bearing cretaceous deposits are situated close (<15km) to the modern coastline of the northern Cotentin (exposed at -20 m a.m.s.l.), and beaches and river terrace gravels contain significant amounts of flint pebble material.

The majority of this assemblage (Group III) is broken or damaged but retains a high element of notches and denticulates, and relatively sparse in backed knifes compared to the other two assemblages from Port-Pignot. Group III, based on chrono-stratigraphy, can be associated with layers D-A at La Cotte. The dominance of denticulates and notches, unlike the upper layers at La Cotte, suggest a technological connection with layer D at La Cotte, and further Piégu (Table 8.2). Scrapers and backed knives are also represented, bifaces are present but not in great numbers (t= 4) as is Levallois, including large points (Michel *et al.* 1982). Again, as with other occurrences on the Cotentin, direct access to raw material during lower (dropping) sea-levels is used here to explain the technological differences. For layer D (section 6.2.5.), I interpreted an association between the heavily fragmented bone material, dropping sea-levels and denticulates/notches. The lack of faunal material however, means the connection between marrow extraction and denticulates/notches can't be forwarded directly. Technologically, a connection to layer D Table 8.1, with limited bifacial elements and presence of denticulates and notches as well as scrapers and large points is forwarded. The dropping sea-levels could connect to changing landscape practices and mobility at both locales, associated with large points (hunting) and bifacial elements (butchery and processing).

8.3.6 Biache-St-Vaast

Biache-St-Vaast has been previously mentioned within this study in a number of contexts (i.e. fire use; faunal exploitation; specific PCT production and recovery of human remains). Here I will briefly summarise these as well as discuss the lithic technology in more detail. The site is located on a terrace within the valley of the Scarpe River, Pas-de-Calais (Tuffreau *et al.* 1988; Hérisson 2012). In total the sequence displayed eight archaeologically distinct assemblages, all from within MIS 7 deposits (Hérisson 2012; Rots 2013; Bahain *et al.* 2015).

The assemblage from IIA was the most numerous (>47,000 including knapping debris >3mm), but is reported as a palimpsest of occupations, and includes recovery of the Neanderthal cranial remains (Boëda 1988; Tuffreau *et al.* 1988; Auguste 1995; Rougier 2003; Hérisson 2012) and evidence for hafting and use of Levallois points (Rots 2013). Fire use is attested throughout the sequence (Hérisson *et al.* 2013), and has been associated with use of bone as fuel (discussed in section 2.3.2). Within layers D1 and D, small but archaeologically contained assemblages were recovered (3184 and 506 respectively), associated with cooler conditions and correlated to the onset of MIS 6 (Hérisson *et al.* 2013; Bahain *et al.* 2015), and connected here with the layer A palimpsest at La Cotte. Levallois is well attested within both these layers (and throughout), as is evidence for on-site knapping and re-tooling, with high numbers of debris (esquilles) and small flakes (<3 mm), also recovered from throughout the sequence (Hérisson 2012). Behaviourally the assemblages within layer D are connected with direct access to flint (i.e. local clay-with-flint deposits) and re-tooling, specifically associated with Levallois reduction, including the re-hafting of points. Technologically this is in contrast to the occupations of layer A at La Cotte and other associated assemblages (see Table 8.4), with transport of material away from the locale highlighted. The differing landscape within the eastern extent of this region, specifically geologically, account for differences in the logistical use of landscape by Neanderthal's at Biache-St-Vaast.

8.3.7 Le Pucheuil

Three "series" of artefacts were excavated from the deposits of an infilled doline, associated with a series of sedimentation sequences related to the gradual infilling of the natural feature (Delagnes and Ropars 1996; Ropars *et al.* 1996); similar to the situation at Ranville (above). The locale was located upon a plateau at 183 metres a.m.s.l., overlooking a series of small valleys. The sedimentary infill suggested two occupation periods for the site, both pre-dating a palaeosol of probable Eemian age (c.125 kya). One occupation was largely in situ (Series B) and directly underneath colder stage deposits, that where topped by the palaeosol, and therefore likely to be later MIS 7 or earlier MIS 6 (Ropars *et al.* 1996; Hérisson *et al.* 2016a). Interestingly the site has no evidence for human presence during the warmer phases of MIS 7 and series A/C of the assemblage have been related to late MIS 8 or earlier MIS 7. Both occupations have been related to the immediate access to raw material (clay-with-flints), similar to both Biache-St-Vaast and Ranville (Figure 8.7).

The material of series B exhibits very little post-depositional re-working, and was excavated in a fresh condition (Ropars *et al.* 1996). The in situ nature of this assemblage (t= 4111) is attested by the abundant micro debitage (>3cm), and the refitting of nodules and knapping sequences (both Levallois reduction and bifacial faconnage). Technologically this assemblage is dominated by Levallois knapping techniques, specifically convergent, but has some unusual additions to the knapping repertoire. "Le Pucheuil-type" flakes, described by Ropars *et al.* (1996) as "bird-wing" shaped, or feathered, where abundant and designated as a type flake (see section 2.2.3.1.3.). Two fragments of bifacially worked pieces were recovered, but no whole bifaces where evident within excavated sediments, with evidence bifacial working debris present (t= 265), suggesting transport of this element of the assemblage away from the locale. This is also evident for the Levallois products including points, flakes and laminar material. Overall retouched pieces were rare and here suggested to be more *ad-hoc* and un-refined. There was no suggestion of faunal preservation (Ropars *et al.* 1996).

The behavioural signature for this locale then is one of Levallois reduction/production, immediate to raw material sources, with good visibility over the surrounding valley floor. This is, technologically and geographical, distinctly different from any occupations of La Cotte, or across the western area of the region. Chronostratigraphy suggest association with occupations in the upper layer of La Cotte (D – A) and their associated locales across Brittany (see Table 8.2). The production of “Le Pucheuil-type” flakes could represent a task specific activity at the site, also associated with the final reduction of sizable blanks and cores. There is good evidence for transport of flint material in and out of the locale, as elsewhere, in this case directly associated to direct access to raw material, unlike La Cotte. Reduction centres on the production of Levallois points and flakes, which are removed, leaving the debitage and cores. Overall, the logistical use of landscape (production close to raw material; transport into wider landscape; use of high ground) is still evident within the assemblage. If technologically Le Pucheuil is different from other locales. Neanderthal behaviour is centred on production of end products, associated both with hunting practices (points) and faunal processing (bifaces).

8.4 The Channel Plain Region: towards more comprehensive understanding of Neanderthal behaviour, environment and landscape within the EMP

This new lithic analysis of the La Cotte assemblages, presented within this thesis (i.e. layers H – A), highlight both continuities and changes in Neanderthal behaviour. Table 8.4 shows these behavioural signatures, connected to new palaeo-geographic scenarios from across the Channel Plain Region and correlations discussed in the preceding sections of this chapter (8.2 and 8.3). This data is used here to discuss, and answer, research objective 4, relating these multiple occupations of multiple locales across the region. This will also add to insights presented in chapter 7 on objectives 2 and 3, as well as answering the overall research question.

Chapter 4 presented a set of new palaeo-geographic models of the Channel Plain Region, discussing the ever changing landscape situation related to both sea-level alterations and climatic changes through an interglacial cycle (i.e. MIS 7d/ 7c-a/ 6 transition). My comprehensive analysis of the La Cotte assemblage, alongside observation of material across Brittany, and intensive review of additional material from across the region allow connections between these landscape scenarios and Neanderthal behaviour in the EMP. Specifically, Neanderthal groups show a logistical use of the landscape(s) related to resource use/availability, most specifically the sourcing of flint (and other lithic material), but also faunal interaction and fuel use. In the eastern extent of the region (i.e. Normandy and Picardy) material is accessed directly from outcropping chalk-with-flint (Roche Gélétan, Gouberville and Port Pignot) and clay-with-flint (Ranville, Biache-St-Vaast and Le Pucheuil). In the western extent, material is most readily accessed via beach accumulations for locales such as La Cotte, Les Gastines and Menez-Dregan, with some degree of fresh material appearing throughout the occupations at La Cotte (see section 7.2). Sites then can be discussed related to these differing scenarios and transport distances.

La Cotte: layer	Associated Site	Bifaces	Scraper dom.	Denticulate dom.	Evidence for Faunal processing	Evidence for bone as fuel	Access to flint	Sea-level situation	Environment
A	La Cotte	X	X		X	X	Secondary	Low, ≈ -60 m/(6e/d)	Cool, dry
	Grainfollet	X		X	X	X	Secondary		
	Nantois & Les Vallées				X		Secondary		
	Roche Gélétan	X	X				Direct		
	Gouberville						Direct		
	Biache-St-Vaast (D1 and D)	X			X	X	Direct		
	Le Pucheuil, Series B	X			X		Direct		
C	La Cotte	X	X		X		Secondary	Low, dropping > -40 m/(7a/6e)	Cool, dry
	Piégu	X	X		X		Secondary		
	Grainfollet	X		X	X	X	Secondary		
D	La Cotte	X			X		Secondary	High, dropping (7a)	Cool, dry
	Piégu	X	X		X		Secondary		
	Port Pignot (Group III)	X					Direct		
E	La Cotte		X		X		Secondary	High, maximum (7a)	Temperate, dry
	Les Gastines			X			Secondary		
F	La Cotte			X	X		Secondary	High rising (7b/7a)	Temperate, dry
	Les Gastines			X			Secondary		
G-H	La Cotte			X	X		Secondary	Rising (7c)	Temperate, dry
	Menez-Dregan, layer 4	X		X			Secondary		
	Ranville	X			X		Secondary		

Table 8.4: Summary table of chronostratigraphic, technological and palaeogeographic data introduced and discussed throughout this thesis.

The assemblages have been shown to be fragmented in character, following Turq *et al.* (2013), due to Neanderthal landscape behaviour and technological practices, specifically tailored to maximisation of flint material. As mentioned above, the movement of raw material is a pivotal factor behind understanding Neanderthal lithic behaviour in this the region. This is both for understanding landscape behaviour (e.g. access and transport) and techno-economic practices (e.g. production and curation) of occupying groups. This factor is also connected to the reduction in size of flint material when transport distances are larger e.g. layer A (section 7.3), and increased curation of material at La Cotte (section 7.4), as well as Piégu and Grainfollet.

This is in contrast to material at sites such as Biache-St-Vaast and Le Pucheuil, where primary, on-site, reduction of flint is evident (i.e. refitting sequences; cores and debitage with no products). In scenarios of high transport distance of flint, material is reduced in size and frequency, replaced by more local material, at sites such as Les Vallées, Grainfollet and La Cotte, most obviously Quartz from within 5km of the locales. In the eastern extent, little appearance of other materials is apparent, other than some use/abandonment of flint(s) of differing origins (when possible to define) e.g. Le Pucheuil and Ranville. Overall, the assemblages show knowledge by Neanderthal individuals and groups about access locations to various raw materials within the landscape and distances associated with this access. This displays a logistical use of the raw material available to the groups at any one time, over the multiple occupations discussed here i.e. 220 – 160 kya.

Another key resource category in the region is fuel for controlled use of fire, evidence of which has been presented for La Cotte, Grainfollet, Menez-Dregan, Roche Gélétan, and Biache-St-Vaast. Landscape has been shown to be dominated by dry, open plain like habitats, based on limited evidence for arboreal growth, open habitat fauna (e.g. horse, mammoth) and malacological analysis across this region (Huet 2010; Monnier *et al.* 2011; Bahain *et al.* 2012; Danukalova *et al.* 2015), and further afield (see section 2.2.2.). Additionally, low lying, liminal landscapes would have seen a period of rejuvenation after the high eustatic stand of MIS 7c-a, associated with occupations of layer E at La Cotte, c. 200kya. Wood will have been a limited resource within the landscape, forcing Neanderthal groups to alter more tradition resource practices. Fragmented bone material at La Cotte (Scott 1986b), accumulated in ashy matrices (Lautridou *et al.* 1986a; van Vliet-Lanoë 1986), and appearance of areas of staining (blackened) sediments (Callow *et al.* 1986) is then associated with the burning of bone for fuel. This practice was highlighted at Therdonne and Biache-St-Vaast, and supported by experimental burning of bone material (Hérisson *et al.* 2013). The protected situation at La Cotte, a fissure system at the head of a S – SW orientated valley, and the evidence for fire, could provide one factor for understanding its continual re-occupation over 60 – 80 ky (i.e. layer H – 5). This once again fits in with the idea of a logistical use of landscape by Neanderthal groups associated with the behavioural signatures at La Cotte, and elsewhere (Biache-St-Vaast and Grainfollet).

The separation of assemblages with scraper dominated assemblages replacing denticulates and notches in MIS 7c - 7a at La Cotte is strengthened across the region (see Table 8.4). There is also support for the use/association of bifaces with scraper dominated assemblages in the later assemblages. Elsewhere (e.g. the UK) this connection has often been discussed (Scott 2006; Scott and Ashton 2010; Scott *et al.* 2010; Scott 2011), showing that bifaces are intrusive (based on rolled, secondary condition) into more classic Mousterian assemblages. The assemblages with bifaces and dominant scrapers, discussed here (La Cotte, Piégu, Roche Gélétan), have been shown to be from an unworked context, with no intrusive elements, and therefore this relationship is supported within this region. Behaviourally it seems to relate to faunal processing on site (i.e. in the locale) probably associated with both butchery and hide processing. The connection with hide processing cold also be strengthened when discussing the climate deterioration and the assumed need to cultural insulation (e.g. clothing) within these cooler environments (Wales 2012; Hosfield 2016). The connection between faunal processing and bifaces is strong (e.g. La Cotte, Piégu, Grainfollet and Le Pucheuil), however this can also be connected to the increased preservation of larger fauna in the cooler, steppe like conditions of the MIS 7/6 boundary. Further, the use of bone for fuel at Biache-St-Vaast and Therdonne (see section 2.3.2.) and potentially connected to La Cotte in layer A and Grainfollet, could be suggested elsewhere as a widespread behavioural practice, but can only be forwarded tentatively due to preservation and past excavation techniques. Certainly the large, fragmented and burnt faunal assemblages, within ashy matrices, in all layers at La Cotte suggest an extended use of this practice within a fuel scarce landscape.

The dominance of denticulates and notches in the earlier assemblages could relate to differing faunal processing practices, here suggested to connect to marrow extraction and bone fragmentation, as well as the use of wood. If the appearance of larger fauna in the later assemblages is genuine then the use of denticulates could also relate to task specific practice on small fauna (i.e. deer, horse etc.), but the poor preservation throughout the EMP of the region can't support this hypothesis. Therefore processing of wood is likely, based on the ideas of Keeley (1980), especially considering the likely lack of this material within the open, plain like landscapes. Within this situation wood, as a limited resource, becomes valued causing the subsequent use of bone for fuel, as suggested here and elsewhere at Biache-St-Vaast and Therdonne. This is likely connected to wider landscape movements (i.e. acquisition of both these materials), hafting/composite technology (e.g. use of Levallois points) and the potential for use of the smaller end end/waste-products as suggested in chapter 7. The increased use of scraper technologies in the upper layers then can be connected to deteriorating climates (i.e. MIS 7/6 transition) and the predicted need for cultural insulation as suggested in other situations (Wales 2012).

The better preserved faunal assemblage from Ranville suggests a complex transport system of small vs larger game and nutritious vs non-nutritious body elements. It was suggested nutritious elements of the smaller game (deer and aurochs) were transported to the locale from butchery activity sites elsewhere (Auguste 2008). These transport practices are also mirrored in lithic material at many locales specifically in the west (e.g. La Cotte, Piégu, Grainfollet and Les Gastines) where material is transported, reduced and moved through, back into the wider landscape (see Figure 7.4). Material abandoned was at the end of its use life, broken and/or heavily used. Those locales further to the east, associated with direct access to flint, show differing movement of material and direct evidence for production on site (e.g. refitting at Le Pucheuil), with both bifaces and Levallois removed and exploited cores and broken elements most often abandoned. These elements rarely appear in other assemblages, and when present are often heavily reduced, broken and/or denuded.

These transport practices are also then connected to a techno-economic strategy within the wider landscape. Re-sharpening/retouch reduction techniques, as mentioned, are employed throughout many assemblages within the region (e.g. La Cotte, Piegu, Les Gastines), fitting into other regional and techno-economic strategies (e.g. Dibble 1995; Kuhn 1995; Jelinek 2013). These strategies are always tailored to the techno-economic preservation of better quality material i.e. flint and occasional *grès lustrés*. However, the LSF technique (described in section 5.3.2.), as highlighted by Cornford (1986), seems to be exclusive to the La Cotte assemblages here. The lack of this technological practice elsewhere could relate to differences in group preference, the technique was not identified during observation of material from Piégu, Nantois, Les Vallées, Grainfollet, Les Gastines or Menez-Dregan (pes. obs.). Further, no mention of similar/identical techniques is mentioned in any fieldwork or published reports consulted during this study. Overall this supports a specific subsistence use for this technique in lengthening use life of material in the immediate area. The technique certainly relates to the preservation of either scraper edges or plain, un-retouched edges and could be connected to hide processing or a further, potentially associated, practice (pers. obs.).

8.5 Conclusion

This chapter then has answered research objective 4, showing clear connections and differences in Neanderthal lithic and landscape behaviour across my defined region during the EMP. These connections are highlighted/summarised in Table 8.4. Further, this chapter has added to the previous chapter's analysis of objectives 2 and 3, connecting behaviour in the wider landscape back to material at La Cotte. Overall this once again is seen to support debates for a re-evaluation and re-framing of the Mousterian technological framework employed for Neanderthal behavioural research in the past. This study adds to ideas of Monnier and Missal (2014), discussing Neanderthal behaviour in a more holistic way to understand behaviour in its setting i.e. in this case, behaviour in a climatically driven landscape effecting access to various resources. The next chapter provides a full synthesis of all this data and personal observation to answer the overall research question.

Chapter 9: Conclusions and Future Work

This thesis has brought together data, published material and personal observations from across the Channel Plain Region to answer a set of research questions and objectives. This chapter will bring the results of this work together, to answer the main research question set out in the opening chapter.

My research question was:

Can changes in lithic behaviour across the MIS 7/6 boundary (c220-160 kya), at La Cotte de St Brelade and related assemblages, be used to model changes in Neanderthal landscape behaviour across the region?

This primary question was to be investigating using four separate research objectives:

1. By combining knowledge related to climate of the MIS 7/6 boundary from across the Channel Plain Region, do we see significant changes in landscape across the period?
2. Adding to the already important record of La Cotte, with regards to Neanderthal lithic technology, can we show particular patterns of subsistence and technological behaviour?
3. Can these patterns at La Cotte relate to landscape changes within the region during Neanderthal occupation of this landscape (c. 220 – 160 kya)?
4. Do these patterns relate to archaeological observations across the Channel Plain Region, specifically the geographically connected area of modern Brittany, France?

The results of this thesis show that, yes, Neanderthal landscape behaviour can be modelled and understood related to access to a number of resources, namely lithic material (mainly flint), nutritious faunal material (i.e. food stuffs), *and* bone for fuel. The answering of objective 1, via the production of *new* palaeo-geographic models, enabled an understanding of landscape changes across the period in question (c. 220 – 160 kya). Research objectives 2 and 3, discussing and answering questions related to Neanderthal lithic behaviour and technological practices across the region then reconnected these landscape changes discussed in objective 1. These patterns then answer objective 4, connecting behaviour and landscape changes from across this region. Overall, this provides a new synthesis of Neanderthal behaviour within this region in the Early Middle Palaeolithic.

The methodologies presented here have been used on the assemblages studied i.e. La Cotte de St Brelade layers H-A, and more broadly on assemblages highlighted from Brittany. By employing the full assemblage analyse at La Cotte I have been able to highlight new patterns within the technological repertoires employed in different layers throughout this sequence. This adds weight to Monnier and Missal's (2014) ideas of understanding Neanderthal practices and behaviour in there setting/situation, as discussed in the previous two chapter. These patterns are connected to Neanderthal landscape practices, especially when discussing raw material variability, availability and technological change. They highlight a logistical use of landscape across the Channel Plain Region. This new research has shown that Neanderthal lithic behaviour in the Early Middle Palaeolithic of the Channel Plain Region is effected by landscape change throughout that period. Further, changes to lithic technologies can be used to understand Neanderthal behaviour associated with the wider landscape. For example the increased preservation of specific raw materials away from acquisition sources, and the associated movement, reduction and abandonment of artefacts, highlighted by this methodology. Equally the complex use of faunal material seen at Ranville, as well as use of bone for fuel elsewhere, fits into a logistical use of resources. This landscape practice highlights Neanderthal capability to understand and plan landscape movements based on necessary resources and their availability.

Overall, the Channel Region is typified by two differing assemblage types. A flake industry dominates early assemblages, especially in the west with sites such as the lower levels at La Cotte (H - E) (Callow and Cornford 1986), Les Gastines (Monnier 1988a), and Ranville (Cliquet 2008b). These assemblages are often on marine pebbles of flint and often have low percentages of other raw materials such as quartz and quartzite. While Levallois dominates in many, discoids and larger mixed cores are well represented in other locales (pers. obs.). These are also dominated by denticulates and notches potentially associated with processing of wood, or other heavy duty tasks, connected to the high fragmentation of faunal material at La Cotte (i.e. processing of bone/extraction of marrow). The second group incorporates bifacial elements, almost exclusively using flint, and a dominance of scraper types. Raw material use of non-flint increases, due to retreating sea-levels and distance to beach accumulations. Levallois is often present within these assemblages, including large points at La Cotte, Piégu and Grainfollet. This along with scraper dominance and the presence of bifaces suggest faunal processing is key to Neanderthal groups at these locales. Specifically, along with butchery, hide processing is signified by presence of scrapers and connected to the predicted need for cultural insulation in cooler climates (i.e. MIS 7/6 transition). These sites are separated geographically with those in the eastern extent, with direct access to primary flint outcrops, often related to production on site of both Levallois products and bifaces. These elements are later transported through the landscape, and likely associated with butchery activity sites in the wider region. Those locales with limited access to flint material, often related to beach accumulation on the littoral (i.e. La Cotte, Grainfollet, Piégu and Les Gastines) show evidence for short reduction sequences of already heavily reduced material, with the additional support of local materials such as quartz and sandstones.

Therefore I suggest that Neanderthal behaviour can be broadly modelled, as discussed within the research question, with distance from raw material, raw material quality and availability of faunal material driving behavioural practices. Transport distances heavily affect reduction of material, as seen in layer A at La Cotte, Les Gastines, Piégu and Grainfollet. Direct access to flint material often leads to locales centred on production, most often Levallois and biface manufacture. These are seen to be transported into the landscape, and associated with hunting and butchery. Those with large transport distance then only record, overall, reduced, broken abandoned material and not evidence for full production strategies. Finally access to faunal material across the whole landscape is key to subsistence both for nutrition but also for bone material, used as fuel, as shown at Biache-St-Vaast, and suggested at La Cotte and Grainfollet, and hide for the production of cultural insulation. Therefore, necessity for faunal material (widely available) and good quality lithic material (mainly flint), and the distances associated to these resources, allows us to broadly suggest a behavioural practice based on differing landscape scenarios across this region. The resource encountering of wood could also fit into this system, based on the idea that this material is in short supply and therefore a valued resource.

This study has highlighted the great potential for future research on the assemblages of La Cotte and the broader La Manche region. My sample, while adequate for the questions answered here, does not provide a full picture of the lithic assemblages and Neanderthal behaviour at La Cotte. Specifically, I feel the assemblages from layer H (metrically larger, high in denticulates, less reduced cores) and those from layer C/D (varied tool types, highly reduced cores, and Levallois material) could hold some regionally and international important behavioural signatures. Additional a extended sampling strategy across the excavated assemblage would a allow a more applicable test of these findings using statistical practices, something intended in the near future. Further afield, I believe very strong connections with the Brittany coast sites at Pleneuf and around St Malo can be made, beyond those presented here. This could be directly important for understanding the use of specific re-sharpening techniques at La Cotte, and not elsewhere. These direct links to Neanderthal subsistence behaviour within a climatically variable landscape and time frame also allows us to question a number of non-direct links to functional and subsistence lifeways of Neanderthal groups in this region and wider afield. As has been discussed elsewhere in this thesis, production of lighter duty hunting and foraging technologies (including composite examples), production of cultural insulation (e.g. clothing) and use of plant material can be questioned and investigated despite the lack of preserved elements. Finally, I presented a set of landscape models which enhance our understanding of the Channel Plain area within the Early

Middle Palaeolithic. Data for these models will only advance, and these scenarios can be enhanced due to this. Specifically, a knowledge of isostatic loading of the British and French ice sheets in MIS 7 and 6 could change our knowledge of raw material availability and locale situations across the region.

Appendices

Appendix A: Handaxe Methodology

<u>Handaxes: Quantitative variables</u>

1. Length (mm).
2. Breadth (mm).
3. Maximum thickness (mm) measured perpendicular to the long axis of the handaxe.
4. Weight (grams).
5. T1 (mm).Thickness of the handaxe at one fifth of the length from tip (see below).
6. T2 (mm). Thickness of the handaxe at one fifth of the length from butt (see below).
7. B1 (mm). The width of the handaxe at one fifth of length from the tip (see below).
8. B2 (mm). The width of the handaxe at one fifth of length from the butt (see below).
9. L1 (mm). The length of the handaxe measure from the point of maximum width (see below).
10. Total number of edges.
11. Total length of cutting edge (recorded from outline drawing; see below).
12. Total number of scars with a minimum dimension of at least 5 mm above secant plane.
13. Total number of scars with a minimum dimension of at least 5 mm below secant plane.

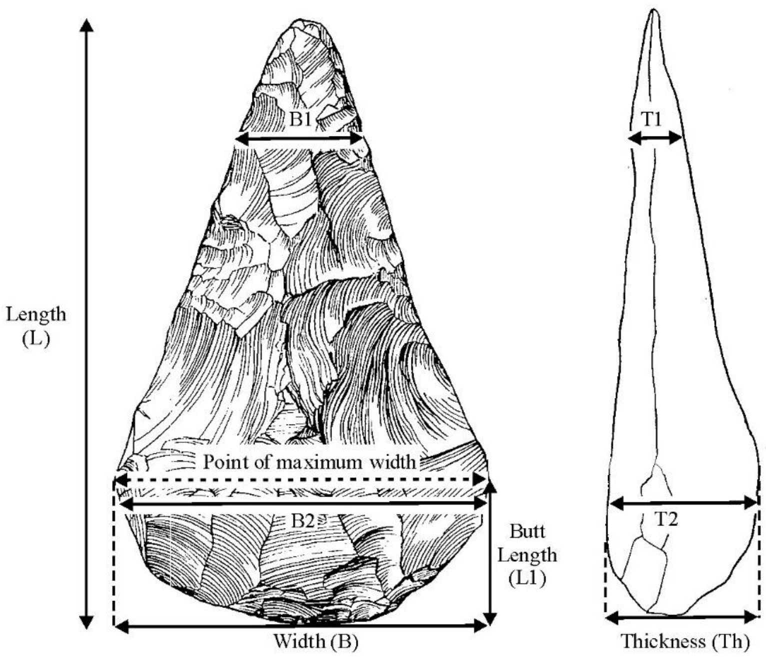

Figure: Location of handaxe measurements, after Scott (2006).

Handaxes: Qualitative variables

1. Portion:
    1. Whole.
    2. Tip.
    3. Butt.
    4. Other Portion.

2. Measure (as a percentage) of the total surface area of the handaxe which displays evidence of cortex or retains other evidence of a natural/flake surface.

    0. 0%.
    1. <50%
    2. 50<100%.

3. Position of cortex or natural surface:
    0. None.
    1. Butt only.
    2. Butt and edges.
    3. Edges only.
    4. On face.
    5. All over.

5. Evidence of blank dimensions:
    0. None.
    1. In one dimension.
    2. In two dimensions.

6. Blank type:

    1. Tabular nodule.
    2. Lenticular nodule.
    3. Spherical nodule.
    3. Flake.
    4. Thermal/frost flake.
    5. Shattered nodule.
    6. Indeterminate.

7. Edge position:
    1. All round.
    2. All edges sharp, dull butt.
    3. Most edges sharp, dull butt.
    4. One sharp edge, dull butt.
    5. Irregular.
    6. Most edges sharp, sharp butt.
    7. One sharp edge, sharp butt.
    8. Tip only.

8. Edge section:
    1. Straight.
    2. Zigzag.
    3. Twisted.
    4. Mixed.

9. Butt working:

    0. Unworked.
    1. Partially worked.
    2. Fully worked.

10. Pattern of primary flaking:
    1. Fully alternate.
    2. Hierarchical.
    3. Unifacial.
    4. Alternate edges.

11. Position of secondary flaking:
    1. Direct; located on the surface with the greatest volume above the secant plane.
    2. Inverse; located on the surface with the least volume below the secant plane.
    3. Alternate; located on the same edge of both faces.
    4. Bifacial; directed into both faces from the same edge.
    5. N/A (i.e. there is no evidence of phase of secondary flaking).

12. Location of secondary flaking:
    1. Butt.
    2. Tip.
    3. One lateral edge.

4. Both lateral edges.
5. Continuous except proximal edge/butt.
6. Continuous except other portion of edge (specify in notes).
7. Continuous.
8. N/A.

13. Extent of secondary flaking:

1. Marginal.
2. Minimally invasive.
3. Semi-invasive.
4. Invasive.
5. N/A.

14. Position of retouch/resharpening:

1. Direct; retouch is located on the surface with the greatest volume above the secant plane.
2. Inverse; retouch is located on the surface with the least volume below the secant plane.
3. Alternate. Retouch is located on the same edge of both faces.
4. Bifacial. Retouch is directed into both faces from the same edge.
5. N/A (i.e. there is no evidence of phase of secondary flaking)

15. Location of retouch/resharpening:

1. Proximal/butt.
2. Distal/tip.
3. One lateral edge.
4. Both lateral edges.
5. Continuous except proximal edge/butt.
6. Continuous except other portion of edge (specified in notes).
7. Continuous.
8. N/A.

16. Distribution of retouch/resharpening:

1. Continuous.
2. Discontinuous.
3. Isolated removal.
4. Isolated tranchet removal.
5. N/A

6. Burin-like removal.

17. Form of retouched/resharpened edge:

1. Rectilinear.
2. Convex.
3. Concave.
4. Retouched notch.
5. Denticulate.
6. Notch.
7. Backing
8. Prehensile blunting
9. N/A

18. Extent of retouch/resharpening:

1. Marginal.
2. Minimally invasive.
3. Semi-invasive.
4. Invasive.
5. N/A.

19. Angle of retouch/resharpening:

1. Abrupt (approaching 90°).
2. Semi-abrupt (~45°).
3. Low (thinning).
4. N/A.

20. Measure (as a percentage) of the scars on each face of the handaxe which are a result of primary flaking, secondary flaking and retouch.

21. Recycled; when a handaxe has been completely transformed through re-sharpening.

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