

# **The Social Context of Prehistoric Extraction Sites in the UK**

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21 February, 2017.



## Abstract

The social context of mines and quarries is fundamental to the interpretation of Neolithic stone extraction. Why did communities choose to exploit certain raw materials in preference to others which were often more accessible? To address this 168 global ethnographic studies were analysed to identify common trends in traditional extraction practices and produce robust statistics about the material signatures of these sites. Repeated associations emerged between storied locations, social networks and the organisation of extraction practices on the one hand, and features of the material world on the other (e.g. landforms, extraction practices, structured deposition), suggesting that we can now *probably* identify sites which were mythologised/storied locations, those owned, seasonally used, and those practicing ritualised extraction - all leading to product objectification.

A second stage of analysis compared the ethnography to 223 global archaeological sites which produced similar patterning in the material record, while suggesting limits to interpretation. These constraints led to a revision of the interpretive framework which was then used to analyse the published excavations of 79 flint mines and 51 axe quarries in the UK and Ireland.

This analysis suggested that many extraction sites were special places, deliberately distant from settlements. They followed common practices and assemblages were carefully deposited which the framework suggests reflects technical skill and ritualised practices, but also exclusivity – the sites probably controlled by clans or technical specialists. Previous analyses, particularly of stone axes, demonstrates that many extraction site products travelled long distances, were often unused and deposited in non-settlement contexts. Conversely, artefacts knapped from expedient surface sources are generally discovered in a domestic setting, which confirms the special nature of extraction sites and their products.

Overall, this statistically-robust ethnographic probability analysis provides a more confident foundation to model the social context of extraction sites through detailed analysis of their structures and assemblages

## **Dedication**

I would like to dedicate this thesis to my wife Joyce, and daughters Emma and Lucy, who have had to live with my obsession with archaeology for so long. I would also like to dedicate this work to my late Parents, who believed in me and wholeheartedly supported my career choice, to the late Colin Burgess, friend and mentor, who steered my early career, and to my old friend the late Mark Lynott who introduced me to so much Native American archaeology.

## Acknowledgements

The author would like to thank the following for their kind assistance with this thesis: Gabriel Cooney, University College Dublin, who gave me an opportunity to participate in fieldwork at the Shetland quarries, and for providing information. The late Vin Davis for many helpful discussions about axe sourcing, and general encouragement. Michael Fuller, St Louis Community College, for guiding me around the Crescent Hills quarries, Missouri, and providing information about Native American extraction. Julie Gardiner for many helpful discussions about flint mines and lithics. Frances Healy for information about the Bayesian chronology of Grime's Graves and the site in general. John Kelly, Washington University in St Louis, for kindly leading me around Mill Creek and Kaolin Quarries in Illinois, and his Cahokia excavations. The late Mark Lynott, US National Park Service, who took me to the Flint Ridge quarries in Ohio and provided much information concerning Native American extraction. Yvan Paillet, Inrap (Grand-Ouest), for providing an informative tour of the fibrolite quarries at Plouguin, Brittany. Pierre and Anne-Marie Pétrequin who kindly guided me around the Mont Viso jadeitite quarries and provided me with one of the most exciting experiences of my career. Charles Le Roux for providing a tour of the museum and quarries at Sélédin, Brittany. The late Alan Saville, National Museum of Scotland, for sharing information about Grime's Graves and the Den of Boddam quarries, and general support. Alison Sheridan, National Museum of Scotland, for kindly hosting a field visit to Creag na Caillich and Tayside Neolithic sites, providing access to the NMS artefact store, and for information and general support. Gill Varndell, British Museum, for much helpful information and images from Grime's Graves. Marshall Weisler, University of Queensland, for information about Polynesian quarries, particularly those on Hawai'i.

The author would also like to thank Dave Field for help with the Langdale fieldwork, general support and information; Trevor Pearson, Historic England, for assistance with the Scafell fieldwork and providing illustrations; and John Hodgson, Lake District National Park Archaeologist, for facilitating access to the Langdale/Scafell quarries and general support.

Finally, thanks go to Chris Fowler, my supervisor, for carefully guiding my thesis.

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# Chapter 1. Introduction

*'Production sites may have been studied as evidence of technology and exchange, but these were probably places that possessed a special significance in their own right, and that has still to be investigated'* (Bradley 2000, 41).

## **1:1 Research context: the role of axeheads, mines and quarries in Neolithic Northern Europe**

The European Neolithic was a period of great social and technological change (Whittle *et al.* 2011) when iconic artefacts were crafted from flint, special types of toolstone and, perhaps most visually impressive of all, jadeitite derived from sources high in the Italian Alps, which were traded extensively throughout Europe (Pétrequin *et al.* 2012a). Much of the raw material produced by these mines and quarries was used for knapping axeheads (alongside other tools), which demonstrates a close connection between axeheads as a type of artefact and extraction sites. Many axeheads underpinned social transactions as demonstrated by their depositional histories. For example, they can be found in assemblages in causewayed enclosures such as Hambledon Hill (Saville 2002, 98), Etton (Pryor 1998, 261-268) and especially Windmill Hill, where 90 were recovered (Smith 1965), suggesting they had roles in ritual practises, exchange and social networks. Certain axeheads found at these enclosures exhibit evidence of use, whereas others do not, suggesting a complexity in artefact use where functionality and ritual were entangled, and the embedded symbolism of the artefact could determine its social trajectory (*cf.* Fogelin & Schiffer 2015; Fowler 2004, 60-62; Kopytoff 1986). At settlements such as Parc Bryn Cegin (Gwynedd), axeheads, or axe-working debitage, demonstrate Early Neolithic functional activities and tool production on a domestic level, which appears to have continued into Middle to Late Neolithic practises when pit deposition also included purposefully burnt axeheads suggesting the inclusion of axeheads in aspects of ceremonialism (Kenney 2008).

Axeheads are also recorded in mortuary ceremonialism where they are found in elaborate grave assemblages such as Liffs Low in Derbyshire (Loveday & Barclay 2010). They played an ongoing role at West Kennet long barrow where axehead grinding occurred on Stone 18 (situated in the chamber) while the burial chamber remained accessible (Piggott 1962, 19; 22; pl XIII). Axeheads are discovered at henge monuments such as Llandegai in Gwynedd where they were deliberately buried (Lynch & Musson 2001). Apart from burial deposits, axeheads are also discovered in caches of unfinished or finished forms, possibly buried for technological reasons at a variety of site types (Pitts 1996, 340). Consequently, the range of uses for the axehead as artefact and icon, demonstrates a multiplicity of special non-functional roles alongside the more mundane, reflecting an embodied symbolism which was important in social practises. By implication this must equally apply to the sources of the raw material from which the axehead was made, i.e. the Neolithic mines and quarries.

Ethnography records that extraction sites can be storied locations, deeply embedded in the ideologies of their users (e.g. Taçon 1991), and their products used to renew or reinforce social transactions. If such practises can be transposed to the Neolithic period, and the archaeological record suggests they might, then certain extraction sites were clearly special places and not always purely functional. Consequently, some mines and quarries will have been perceived as places that were different from the everyday, positioned at an interface between the material world and the dimensions beyond (*cf.* Topping 2005, 84). Here stone could be won which could embody cultural narratives, allowing it to transmit messages to, and between, communities (Bourdieu 1990).

The quarried axehead was transformative, an icon of, or metonym, symbolising, the emerging Neolithic as it cascaded across Europe at a variety of speeds and directions. Although the axe as metaphor may have represented and functionally enabled change, it was the mines and quarries from which they emerged, and the ideologies surrounding these places, that really created the springboard to remodel society. The fact that the Sussex flint mines were some of the '*earliest Neolithic innovations in south-east England*' (Whittle *et al.* 2011, 261) underscores the emerging cultural importance of extraction sites and suggests that the first Neolithic communities might be more accurately characterised as



miner-farmers rather than the traditional 'first farmers'. This is lent weight by the fact that the few Mesolithic quarries are smaller in scale, and in less distinctive locations than those of the Early Neolithic communities (e.g. Burnetland Hill, Scottish Borders; Ballin & Ward 2013). Indeed, if one allows for the erratic onset of agriculture in the first centuries of the Neolithic period, it is arguable what impact such small-scale cultivation made upon the subsistence base of the earliest groups (Schulting 2008). Consequently, stone procurement may have been the primary motivation of many Early Neolithic communities. Extraction sites thus became a pivotal element in the roll-out of the new worlds of the Neolithic, and stimulated the gradual, or intermittent, metamorphosis from mobile foraging strategies to one of increasing sedentism, which situated communities more permanently within the landscape.

The materiality of axes operated on different levels and scales. Functionally, axes were agents of landscape change, used in clearing woodland, working wood and building settlements. However, on a more esoteric level, axeheads assumed the role of a powerful metonym for the Neolithic, particularly at pivotal locations such as Carnac and the Gulf of Morbihan where prestigious Alpine jadeitite axeheads were re-worked and distributed to many areas of Europe (Pétrequin *et al.* 2012b; Cassen *et al.* 2012). Axeheads may have been objectified as '*gifts from the earth*' (Whittle 1995), becoming '*pieces of places*' (Bradley 2000, 88) and a tangible part of a multi-layered cosmology with a clear role in defining status and prestige (e.g. Cooney 1998). The cultural significance of the axehead as *leitmotif* is demonstrated by the fact that they became memorialised in passage grave art, particularly in French tombs (Shee Twohig 1981; Demoule 2007), and arguably inspired the shaping of certain massive standing stones such as Le Grand Menhir Brisé (Tilley & Thomas 1993), Le Menhir du Champ Dolent (Giot 1995), the Menhir de Kerloas (Figure 1:1), all in Brittany, or the Devil's Arrows and the Rudston monolith in North Yorkshire. The iconography of the axehead thus became widespread through various media, and this proliferation must also have enhanced the social significance of their source – the extraction sites.



Figure 1:1. The 9.5m high axehead-shaped Menhir de Kerloas, Plouarzel, Brittany<sup>1</sup>.

## 1:2 Description of the archaeological data

The corpus of accredited Neolithic flint mines in the UK and Ireland currently stands at 17 sites<sup>2</sup>, and the data analysed in this chapter comprises 79

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<sup>1</sup> All unattributed figures are by the author.

<sup>2</sup> UK: Blackpatch, Buckenham Toft, Church Hill, Cissbury, Den of Boddam, Durrington, Easton

excavations undertaken at 11 of these extraction sites<sup>3</sup>. In contrast, the number of axe quarries may be as high as 34 (Vin Davis pers comm; Clough 1988), but not all stone sources have been located. Consequently, this chapter focusses upon those quarries which have been positively identified and excavated, consisting of 51 excavations carried out at 9 quarries<sup>4</sup> in the UK and Ireland.

The chronology of the flint mines and axe quarries spans the entire Neolithic Period, and certain sites remained in use after the introduction of the first metalwork around 2450 cal BC (cf. Needham et al. 2010). The flint mines on the South Downs were one of the earliest site-types of the period, currently appearing to pre-date the construction of most causewayed enclosures and long barrows (Whittle et al. 2011, 261; 853). The dates from Easton Down (Wiltshire) and Hambledon Hill (Dorset), alongside those from the Den of Boddam in north-east Scotland, demonstrate that flint extraction continued in the centuries spanning 3000 BC, or the Middle Neolithic. Amongst the Early Neolithic axe quarries the earliest sites are Graiglwyd in Gwynedd (North Wales) and Lambay Island lying off the east coast of Ireland. The only dates available for Tievebulliagh (Antrim) relate to a phase of woodland clearance which *might* correlate with episodes of extraction and parallel those from Lambay Island. The exploitation of the Mynydd Rhiw quarries (Gwynedd) occurs during the second half of the Early Neolithic and overlaps with Creag na Caillich (Perthshire) which is exploited intermittently into the Early Bronze Age when it is abandoned. During the Late Neolithic both the Den of Boddam and Hambledon Hill flint mines remained in use, and were joined by Grime's Graves – all of which overlap chronologically with Creag na Caillich. However, when extraction comes to an end at these four sites around 2100-2000 cal BC, after a gap of several centuries mining resumed at Grime's Graves where the 'primitive pits' were dug during the Middle Urn/Arreton Phase of the Early Bronze Age, and continued in use until roughly the transition into the Middle Bronze Age when mining finally came to an end (Healy et al. 2014, 55-58; Needham et al. 2010).

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Down, Grime's Graves, Harrow Hill, Long Down, Martin's Clump, Nore Down, Skelmuir Hill, Stoke Down; **Ireland**: Ballygalley Hill, Goodland, Black Mountain (taken from Barber et al. 1999; Case 1973; Bell & Bennett 1923).

<sup>3</sup> Ballygalley Hill, Blackpatch, Church Hill, Cissbury, Den of Boddam, Durrington, Easton Down, Goodland, Grime's Graves, Harrow Hill, Stoke Down.

<sup>4</sup> **UK**: Creag na Caillich [Killin], Graiglwyd, Langdale, Mynydd Rhiw, Le Pinnacle, Shetland [North Roe]; **Ireland**: Lambay Island, Rathlin Island, Tievebulliagh.

### **1:3 The need for this thesis: the limited uses of anthropological comparison in interpreting prehistoric mines and quarries**

Traditionally, prehistoric mines and quarries have been studied from technological perspectives, the scale of the workings, quantification of products, or the chronology of activity (e.g. Edmonds 1995). Extraction sites are often beset by economic determinism, couched in terms such as *'flint-axe factories and mines'* which participated in *'an industrial system ... of long-range communications between the factories and their buyers'* (Piggott 1954, 36), creating an *'axe trade'* complete with its associated *'middle-men'* (Houlder 1961, 136-139). Such paradigms often fail to look beyond the market economy and address the equally important issue of social context. The oft-overlooked question is what stimulated extraction: was it economic imperatives, cultural values, ideologies/cosmologies, or a complex matrix of these elements combining the *'sacred and profane'*? In many cases the answer was - at least in part - functional: the winning of raw material for artefacts or structures (as will be outlined in Chapter 2). Ethnographic and historical records will be explored in detail in Chapters 3 and 4, to explore the contexts of functional or economic considerations which are often obscured or embedded in ideological beliefs. This is particularly true where mining was (and is) ritualised because the raw material has a deep cultural significance and underpins social conventions, as can still be seen at the Native American pipestone quarries in Minnesota, where long-term extraction has occurred to produce ritual tobacco pipes (Scott *et al.* 2006). Similar cultural imperatives underpin much Aboriginal Australian's procurement, where ritualised journeys of 1000+ kilometres are undertaken to important quarries for particular stones or minerals which are considered to embody the essence of Ancestral Beings of the Dreamtime (Gould 1977, 164). In contrast, male competition underpins some axe-making in Papua New Guinea, illustrating other motivations (Pétrequin & Pétrequin 2011). In the Medieval Wieliczka salt mines in Poland, the galleries and tunnels are decorated with religious iconography, creating deliberate links between this dangerous subterranean industry and a metaphysical support mechanism. The *'knockers'*, mythological beings associated with post-Medieval Cornish tin mines, or the *'demons of ferocious aspect'*, Germanic dwarves or Greek *'cabalos'* recorded by Georgius

Agricola in the 16<sup>th</sup>-century (Agricola 1556, 217), demonstrate evidence of ritualised or mythologised dimensions even within historical European extraction.

Interpretations of Neolithic extraction sites have traditionally been problematic, generally failing to consider, or even recognise, the empirical evidence of non-functional activities. Yet many assemblages found in flint mines such as Harrow Hill (Curwen & Curwen 1926) and Grime's Graves (Greenwell 1870) defy functional explanations. This evidence comprises knapping debris and broken or unfinished axeheads in unlit, subterranean workings which clearly do not represent *in situ* flint knapping in a dark environment lacking definitive evidence for artificial light. Chalk 'lamps' found deep in many mines have not yet been proven to be lamps at all, and the lack of soot on gallery ceilings suggests that there was little need for light. It is even possible, as will be explored in Chapter 3 and 6, that taboos may have prevented the use of lighting. Carved chalk objects which are either decorative or symbolic in nature and clearly not part of a mining tool kit are often discovered in underground workings, as is pottery (both complete vessels and fragments). Hearths are found on many shaft floors, but were not positioned to provide light into the galleries and do not appear to be associated with cooking. As outlined in Chapter 3, the ethnography reveals accounts of ritual purification by smoke in 61 different communities, in 37 cases associated with the deposition of votive offerings as part of extraction ceremonialism (e.g. North America, New Guinea). The weight of ethnographic evidence demonstrates that cosmological or ritual motives can underpin extraction activity in many pre-industrial societies. For example, 120 cases record the use of artefacts sourced from special locations to underpin social networks, or demonstrate status or wealth. Prestige and status often rely upon storied associations, as can be seen in the extravagant potlatch ceremonies amongst Northwest Coast Native Americans (Boas & Hunt 1921; Mauss 1988; Godelier 1999), or the 'kula' system of Melanesia which is designed to increase renown and prestige through ritualised actions and gift exchange (Malinowski 1922; Godelier 1999). It is precisely these aspects of the social context of extraction site materiality that this PhD seeks to explore to broaden the debate surrounding the role(s) and cultural values of prehistoric extraction sites and their end-products.



Figure 1:2. A tobacco pipe blank returned to the Pipestone Quarries (Minnesota) for symbolic renewal.

An interesting example of ritualised procurement of an iconic raw material provided the stimulus for this PhD research. In May 1998 the author was invited by the U.S. National Park Service to participate in fieldwork at the Native American quarries at Pipestone National Monument in Minnesota (cf. Scott *et al.* 2006). This provided an opportunity to witness pipestone quarrying by members of the Lakota (Sioux) Nation who sought pipestone to craft ceremonial tobacco pipes and other symbolic artefacts. The Lakota began the process of quarrying with a ritual purification in sweat lodges near the quarries, followed by prayers and the purification of hand tools. Votive offerings were left near the quarries in return for the pipestone. Once the pipestone had been quarried, purification of the quarrymen and their tools took place again. At the workshop the carving of the pipes was carefully organised, and broken blanks and debitage was curated and returned to the quarries for renewal purposes (Figure 1:2). This ritualised quarrying came as a revelation to the author who was engaged in a national survey of the Neolithic flint mines in England at that time (Barber *et al.* 1999). It was clear that this traditional ethnographic reality, its practises and, more importantly, the material record it left behind, provided evidence reminiscent of

the English Neolithic flint mines. In particular, the deposition of broken or unfinished axeheads found underground appeared to be a direct parallel for the Lakota renewal deposits at Pipestone, and might help to explain the practises behind some of the assemblage patterning in the English mines. The author attempted to use this and a small sample of other Native American ethnography to tentatively interpret the depositional history of Shaft 27 at Cissbury (Topping 2005) and analyse the motives behind this sequence, arguably with some success (Meurkens 2005). A second paper (Topping 2011) sketched some of the data and trends from the English flint mines, but was incomplete and at a much more superficial level than that of the present study. Consequently, the totality of the flint mine data remained to be assessed, analysed and interpreted, alongside a comparable review of axe quarries. It is the aim of this thesis to fill this research void and provide a new model of Neolithic stone extraction practises and their social setting.

One of the major issues associated with traditional interpretations of prehistoric extraction sites during the 1980s and 1990s, from both the functionalist and ritualised perspectives, has been an over-reliance upon a limited range of ethnography – primarily easily-accessible studies from Papua New Guinea (e.g. Chappell 1966; Cranstone 1971; Burton 1984) and Australia (e.g. Allchin 1957). This has led to the development of archaeological theories which have a strictly limited empirical and statistical basis, which do not go far enough to assess how representative the drawn analogies are. Restricted data sets can miss the full range of cultural diversity evident even within a single region or country, which a wider review of the ethnography would have demonstrated. Consequently, there are major concerns about the strength of current comparisons drawn between these ethnographic models and the archaeological record. In addition, the fact that the same sources are regularly re-used creates a self-fulfilling model which makes it imperative to use ethnographic parallels with caution. Therefore, one aim of the present research was to test traditional models by collecting and analysing a far wider range of ethnography from the Americas, Africa, Australasia, the Pacific and Europe. These data sets have then been analysed to record the degree of commonality of themes and trends and identify the motivations underpinning the practise of extraction. This has created a large and

testable baseline data set of extraction practises and their material expressions, which will be statistically robust. A second aim of this PhD research is to collect a similar data set from equivalent global archaeological contexts to provide an overview of the structures and material patterning surviving in the archaeological record. The resulting ethnographic and archaeological trend data has then been compared and interrogated to develop a more holistic interpretative framework to enhance the understanding of prehistoric mines and quarries in the UK. The results of this research should have applications globally.

Following the present chapter, Chapter 2 will review previous research to outline the history of the study of extraction sites. Chapter 3 will describe and analyse the ethnography of extraction, and create a trend analysis of the data. Chapter 4 will review the archaeological evidence from a selection of global studies to describe the various forms of extraction and associated evidence to identify trend data. Chapter 5 explores the topographic, geological and archaeological settings of well-documented UK extraction sites. Chapter 6 will discuss and analyse the archaeological data from the UK extraction sites against the new interpretive framework to provide a probability analysis. Finally, Chapter 7 draws all of the strands of evidence together to present a new model for the interpretation of prehistoric extraction which is statistically robust, and presents a nuanced social context for the mines and quarries.

To complement the large-scale ethnographic and archaeological analyses, during this PhD research field visits and fieldwork were undertaken at the variscite mines at Gavà (near Barcelona), the North Roe quarries (Shetland), the jadeitite quarries at Mont Viso (Italy), the dolerite quarries at Sélédin (Plussulien, Brittany), the fibrolite quarries at Plouguin (Brittany), the Mill Creek and Kaolin Quarries (Illinois), the Crescent Hills quarries (Missouri), the quarries at Creag na Caillich (Perthshire), and the Langdale and Scafell Pike quarries (Cumbria); the artefact store of the National Museum of Scotland in Edinburgh and the archive at the Great North Museum (Newcastle) were visited, alongside Carnac Museum (Brittany). Previous fieldwork also informed this research, particularly at Grime's Graves (Norfolk) and the South Downs flint mines (Sussex), the quarries at Graiglwyd (Gwynedd), Mynydd Rhiw quarries (Gwynedd), Krzemionki flint mines (Poland), the Pipestone Quarries (Minnesota), and Flint Ridge quarries (Ohio);



previous archival research and museum visits drawn upon in this thesis include Devizes Museum (Wiltshire), Salisbury Museum (Wiltshire), Lewes Museum (Sussex), Worthing Museum (Sussex), Brighton Museum (Sussex), Old House Museum, Thetford (Norfolk), Norwich Castle Museum (Norfolk), the State Archaeological Museum in Warsaw (Poland). This fieldwork collected data and dimensions from a range of extraction sites such as the Pipestone Quarries (where the author undertook the first ever analytical topographic surveys, for example), and provided a photographic record for use in this thesis.

#### **1:4 Research questions, aims and objectives**

The overarching aim of this PhD research is to explore the motivations behind the use of extraction sites and identify their social context in wider Neolithic society. This research has contributed three major outputs: (1) a new statistically robust re-interpretation of prehistoric extraction sites, (2) a revision to our understanding of their role in wider Neolithic society, and (3) an interpretive framework for charactering the research and heritage values of extraction sites for academic, management and conservation purposes.

The ethnography has been collated to assess the recorded evidence for the presence/absence of: mythological association with the raw material source; ownership or restricted access to the source; contextual information; the presence/absence of ritualised extraction; sex/age of quarriers; special artefacts; the circulation of the quarry products; ceremonial after-use of sites; the presence of rock art; and the presence of burials. Parallel strands of archaeological data have been collected, including: landscape context of source; raw material/context; presence/absence of non-functional assemblages at extraction sites; age/sex of skeletal material from sites; evidence of craft specialisation; elaborate reduction sequences for lithics; artefacts used/unused; circulation of artefacts; after-use of sites; rock art; and the presence/absence of burials or body parts. The analysis of the two parallel data sets identified common elements of material patterning, highlighted the similarities and diversities, and demonstrated the potential for re-imagining the practise of extraction as a pivotal agent in defining the trajectory of the adoption of Neolithic practises in the UK.

As referred to above, the restricted range of traditional interpretive models designed to explain the social context of prehistoric extraction sites is constrained by a general lack of new research into the motivations underlying extraction practise and their social trajectories. Consequently, interpretation has become grounded and self-perpetuating. It is the overriding aim of this PhD research to test these models with new research, challenge inadequate hypotheses, and replace them with a more informed and nuanced interpretive model which will better contextualise prehistoric extraction sites and the practises and meanings which surrounded them (Chapters 3-7).

<b>Aims</b>	<b>Objectives</b>
<p><b>1 <i>Create a new interpretive framework to characterise prehistoric extraction sites</i></b></p> <p>[This will be achieved by fulfilling objectives B-E]</p>	<p>A: Review and analyse the literature on extraction sites and identify knowledge gaps;</p> <p>B: Collate and analyse ethnographic data;</p> <p>C: Collate and analyse global archaeological data;</p> <p>D: Develop a new interpretive framework;</p>
<p><b>2 <i>Produce a re-interpretation of the social context of prehistoric extraction sites during the Neolithic period in the UK</i></b></p> <p>[This will be fulfilled by completing objectives A-F]</p>	<p>E: Collate and analyse UK archaeological data within the new interpretive framework;</p> <p>F: Re-interpret the social context of extraction sites and their products within wider Neolithic society.</p>

Table 1:1. Aims and Objectives of this PhD research

The PhD asked and answered the following fundamental questions:

- *What motivations, practises and material patterning occur in the global sample of ethnography?*
- *To establish whether there is a relationship between the materiality of the ethnographic record and the material patterning in the global archaeological record?*
- *How do these various material patterns compare and contrast with that from the flint mines and axe quarries of the UK?*
- *What was the spatial relationship between Neolithic extraction sites in the UK and contemporary settlements and how might this have influenced the use and perception of extraction sites?*
- *Why was stone/flint extracted rather than gathered from surface deposits?*
- *Why were specific places chosen for extraction?*
- *Were craft specialists involved?*
- *What products were crafted from the raw material?*
- *What was the cultural and/or functional value of these products?*
- *How were the products circulated and over what distances?*
- *And, how was the extraction site product finally deposited?*

The present study has reviewed the evidence from the flint mines on the chalklands of southern Britain alongside the axe quarries of the uplands of the west and north. The timeframe of this study is primarily c.4,100-1,950BC, or what is traditionally considered the Neolithic period to the end of the Chalcolithic/Early Bronze Age transition (Needham et al. 2010, 363-373).

Overall, the main aim of this research is to develop a robust and testable hypothesis which will become a valuable contribution to the study of prehistoric extraction sites and their role in the wider prehistoric record. As Ian Kinnes (1985, 125) observed: *'... stone axes are the most visible and resilient part of the archaeological record. Whatever the circumstances of their deposition, relative quantities are an index of settlement density and their sources an indication of broader cultural and economic contacts. They are potentially the most sound basis for the quantification of Neolithic studies'*. The data collected for this thesis

will inform future research into extraction sites and the use of their products in mundane functional contexts and ritual/ceremonial spheres.

New perspectives have been generated in the course of this thesis by the considered analysis of wide ranging, searchable ethnographic and archaeological data sets which have provided material indicators from non-industrialised extraction, and produced robust statistics to identify common trends, similarities and diversity. The patterning evident in these two data sets has then been compared with the archaeological record in the UK. Where direct material correlations occur, it is possible to infer from the ethnography that similar social factors may have lain behind the patterning in the archaeological record. Such an approach provides a test of the sustainability of the status quo of current models which rest upon a few ethnographic hot-spots (e.g. New Guinea) when assessed against an exhaustive review of available comparators. The strength of the new interpretative framework lies in the closeness of the correlations between the ethnography and the archaeological record, which suggests the materiality of the archaeological record may have been produced by similar practises to those documented by ethnography. Although it would be naïve to expect to identify every motivation or practise behind the use of extraction sites to create a metanarrative for prehistoric society, it is possible to construct a meaningful social narrative which identifies the generalities, and some of the details, to develop a greater understanding of what Lewis-Williams and Pearce (2005, 9) characterised as *'the universal foundations of diversity'*. The use of robust, quantifiable ethnographic data to underpin interpretations - and restrict bias as far as possible – has led to a novel 'deconstruction' of current archaeological models by an ethnographic paradigm.

At present the role of prehistoric extraction sites, particularly of the Neolithic period, is often characterised using empirical data on mines, quarries and axeheads, some piecemeal use of analogy and the application of various kinds of interpretive frameworks. Such a situation is arguably inevitable considering the previous lack of wide-ranging, empirically-based, comparative models in recent literature. Although a number of publications have presented useful corpora of data (e.g. Schild & Sulgostowska 1997; Weisgerber 1999; Davis & Edmonds 2011), this is generally descriptive, of an archaeological nature, and rarely

reviews ethnography. Consequently, the danger of the present paradigm is that interpretation of extraction sites *can* become self-perpetuating with few fresh insights. To address this issue this PhD has assembled and analysed large anthropological and archaeological data sets on a scale not previously attempted.

The present research has successfully demonstrated that new insights can be gained from the careful use of ethnography and its application to archaeological research questions often considered beyond resolution. The thesis has demonstrated that there is a high probability that many extraction sites were considered special places, which were exploited by prescribed practises that were probably deeply meaningful to their users. The products of these special sites were often widely distributed. The ethnography would suggest that the sites were storied locations which had to be treated with respect through ritualised practises, and their products were objectified and carried embedded narratives into society (Bourdieu 1990).

This thesis offers a new perspective on prehistoric extraction and its social context which is founded upon an innovative theoretical model solidly grounded in empirical data. It provides a testable theoretical framework which will allow future research to review its robustness and use its findings to critique interpretations (*cf.* Popper 2002). The baseline data facilitates a review of the central questions concerning functionality, ritualisation, and the role of extraction sites in society. The fact that the data set is populated with empirical evidence ensures that it can be tested, or falsified, by others. Indeed, future data can be added to build or modify theories as necessary.

In essence this research has produced the following:

1. a synthesis of a large sample of readily available world-wide empirical ethnographic data;
2. a synthesis of a large sample of readily available archaeological data from global contexts;
3. a distillation of the patterns emerging from the ethnographic and archaeological data, world-wide, to identify trends in the social, political and cultural significance of mines and quarries;

4. examined the detailed evidence from 130 UK and Irish excavations at flint mines and axe quarries;
5. evaluated the closeness of fit between the material patterning in the ethnography, world-wide archaeological data and UK excavations;
6. drafted a new theoretical model to explain the social context of Neolithic extraction practises.

This research has explored how meaning was created on different levels by materiality and practise, and how symbolism, metaphors and metonyms may be inferred from the archaeological record, particularly through the identification of non-functional evidence. The question of *otherworldliness* in relation to extraction sites and their products has been examined, and, informed by ethnography, explains why certain sites and artefacts may have been perceived as extraordinary and separate from mundane reality.

In addition, the results emerging from this research have the potential to inform conservation and management strategies through an enhanced understanding of the context of prehistoric extraction, and influence the legislation surrounding these sites. Such applied research should also inform the presentation of these sites to the public, which are our earliest 'industrial' monuments.

## **Chapter 2. Previous research into Prehistoric extraction sites in the UK: a history and critical evaluation**

### **2:1 Introduction**

This chapter will review the study of prehistoric extraction sites in the UK from the mid-nineteenth century, and the first recognition of the existence of prehistoric mines and quarries, through to the present. The chapter will end with an analysis of the nature of the current debate.

### **2:2 Studies of extraction sites: 1850s to 1945**

Despite a burgeoning mid-19<sup>th</sup> century interest in *pre*-history following the works of Lyell (1863) and Lubbock (1865), who both tried to demonstrate the antiquity of man before recorded history through a study of objects, it was left to early excavators to provide the evidence for the existence of prehistoric mines and quarries. Amongst the earliest published accounts are those of Pettigrew (1853) and Manning (1855; 1872) concerning Grime's Graves flint mines in Norfolk, which were largely inconclusive, and failed to correctly identify the character of the site. On the South Downs, Colonel Lane Fox (later known as General Pitt Rivers) led excavations at Cissbury hillfort in the curious depressions scattered about the downland summit between September 1867 and January 1868. He was drawn to the large quantities of knapped flint which littered the ground surface here, and directed his research into clarifying the relationship between the surface lithics and the builders of the hillfort (Lane Fox 1869b, 54). Although it is clear that Lane Fox was primarily attempting to understand the construction sequence of the hillfort and its palimpsest (Bowden 1991, 70-71), he misinterpreted the chalk rubble fill of the shallow 'depressions' as bedrock, thus failing to discover the true depth and nature of the underlying flint mines. However, he did postulate from the lithic assemblages recovered from the thirty depressions he excavated that they were probably dug *'for the purpose of obtaining flints'* (Lane Fox 1869b, 73) - although he had claimed in an earlier

paper that they could represent '*rude huts*' (Lane Fox 1869a). Consequently, at the end of this initial campaign, confusion remained surrounding the character of the Cissbury 'depressions', and a mistaken assumption that the earthworks represented shallow surface quarries and not the elaborate 6.0m-9.5m deep galleried shafts discovered by later excavations.



Figure 2:1. Grime's Graves, Norfolk, site of Canon Greenwell's 1868-1870 excavation campaign. His excavated mine lies centre left, covered by a modern concrete cap. (Photo © English Heritage: NMR 15758-2; TL 8189-50; taken 29<sup>th</sup> August 1997).

During the latter part of Lane Fox's project, he was assisted by Canon William Greenwell, a prolific excavator of barrows (cf. Kinnes & Longworth 1985).



Although it is unclear whether Greenwell suspected the true nature of the under-excavated Cissbury 'depressions', he afterwards moved on to another site defined by a large number of similar depressions at Grime's Graves, Norfolk, excavating here between 1868-1870 (Figure 2:1). Greenwell employed gunflint miners from nearby Brandon to undertake his excavations, and was able to categorically demonstrate that the depressions at Grime's Graves were indeed deep flint mines comprising galleried shafts some 13m deep. From the evidence of a stone axehead recovered from one of the galleries (subsequently found to have originated in Cornwall), he was able to prove that the flint mines were of Neolithic date; he also discovered that the preferred tool of the Neolithic miners was the antler pick. This was the first time in the UK that the existence of flint mines had been demonstrated. Despite this being the first published account of the discovery of flint mining in the UK, Greenwell did not attempt any form of detailed contextualisation of the site beyond a descriptive account – not an unusual situation for a late Victorian Antiquary (Greenwell 1870). Of interest to the present research, Greenwell also discovered a number of hearths in the shaft fill, small bone tools, carved chalk objects, pottery, and the skull of a wading bird was found in a gallery, all of which were not functional parts of the mining process, but which only received cursory description.

Following Greenwell's success at Grime's Graves, Lane Fox returned to Cissbury and this time deliberately excavated through the chalk rubble in the depressions and discovered deep flint mines with galleries (Lane Fox 1876). Lane Fox was also able to demonstrate the relative stratigraphic relationship between the mines and the overlying hillfort (Figure 2:2; Barber et al. 1999, 9), producing an informative plan and cross-sections depicting the mines truncated by the hillfort ramparts. He also commissioned a 3-D wooden model which could be dismantled to reveal the mines beneath the fort defences (Bowden 1991, 80, Fig 20). As with Greenwell's excavations, Lane Fox did not progress beyond descriptive reportage, following later Antiquarian trends for classification and quantification to bolster the emerging Three Age System model rather than seeking explanation of the social context of extraction. This was curious considering contemporary debates in the wider scientific community concerning evolution led by Darwin, Lyell's (1863) geological research which provided

evidence for *'the Antiquity of Man'*, and Lubbock's (1865) definition of the 'Stone Age' based upon technology as an indicator of social evolution. It would appear that at this early stage of 'scientific' excavation the main concern was data collection.



Figure 2:2. Colonel Lane Fox's 1875 excavations at Cissbury, showing the truncated remains of a flint mine in the floor of the hillfort ditch, thus demonstrating for the first time the stratigraphic position of the flint mines in relation to the hillfort. (© Sussex Archaeological Society)

During the early 20<sup>th</sup>-century, the study of extraction sites was erratic. Knowles (1903; 1906) brought Tievebullagh, Antrim, to the notice of the archaeological community, providing descriptions of the quarries, on and off-site workshops, and the lithic assemblages. A brief flurry of pre-war research was stimulated by the misguided claim of Smith (1912) that flint mining at Grime's Graves and Cissbury was not Neolithic in date but Palaeolithic, based upon what he saw as typological similarities in the lithics and totally ignoring the contextual evidence discovered by Greenwell and Lane Fox. Smith's hypothesis led the Prehistoric Society of East

Anglia to excavate two flint mines at Grime's Graves in 1914-1915, Pit 1 (Figure 2:3) and Pit 2, in an attempt to solve this controversy (Clarke 1915). These excavations set new standards for the recovery of evidence and the precision of recording, and although the report is largely descriptive, it does provide a wealth of information about the structure of the mines, the depositional sequence, and the assemblages. Importantly, the report failed to provide any evidence to support Smith's Palaeolithic hypothesis.



Figure 2:3. The Prehistoric Society of East Anglia's excavations at Pit 1 in 1914 (© The British Museum).

Following the First World War archaeological research once again focussed on prehistoric extraction sites. In the USA fieldwork by Holmes (1919) produced a corpus of extraction site surveys from the Americas, many of which underpin

modern research today (e.g. Cobb 2000). In the UK, Hazzeldine Warren (1921;1922) began his excavations at the axe quarries at Graiglwyd, which demonstrated that 'Floors', or knapping sites, also existed at these quarries, one of which (Floor B; Figure 2:4) produced an unusual incised plaque. However, technology and extraction process continued to dominate most interpretations of extraction sites at this time.



Figure 2:4. Hazzeldine Warren excavating at Graiglwyd in 1919-1921. This view probably shows one of his trenches on Floor B, which was overlain by a fieldwall. (Photo © Ivor Davies & RCAHMW)

A more wide-ranging approach was adopted by Kendrick (1925), who attempted to define and characterise an 'Axe Age', typified by the eponymous artefact as an icon for the 'age'. In this publication he described some of the contexts in which axeheads had been discovered, regarding them as emblematic of the period, and used them to define cultures associated with various site types. He also explored the curious notion of an '*Eochalcic Episode*'<sup>5</sup> which he postulated may have

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<sup>5</sup> 'Eochalcic – Descriptive term for a great and uniform cultural advance immediately preceding and partly including the first use of copper and bronze in Great Britain: the dawn of the metal era' (Kendrick 1925, xi-xii).

occurred at the end of the Mesolithic period when certain places, such as the UK, might have been uninhabited because of a lack of distinctive material culture. This would span the chronological gap between the last foragers and the first farmers, and the use of stone axeheads thus became part of a general renaissance which included the first metalwork elsewhere (*ibid.*, 158-174). Despite apparently compressing the UK Neolithic and Chalcolithic/Early Bronze Age into a single uniform period seen as the beginning of the metal era, it is interesting to note Kendrick's use of the axe as one of the defining objects of this new period.

On the South Downs and 'Wessex' the inter-war years saw a flurry of activity at flint mines, although occasionally this was fraught with factionalism (Barber et al. 1999, 11-12). The Curwen's fieldwork at Harrow Hill (Curwen & Curwen 1926) provided much information about the structure, assemblage contexts, and incised art which significantly added to the national corpus, and provided parallels for the chronologically later Pit 2 at Grime's Graves (*cf.* Clarke 1915). At Easton Down excavations explored a mine complex ranged around the head of a coomb which was partly masked by a later 'Celtic' field system with evidence of a putative later settlement (Stone 1931a; 1931b; 1933). Arguably the greatest contribution to research, however, was made by John Pull (Figure 2:5), an amateur archaeologist who undertook excavations at Blackpatch (Pull 1932), Church Hill and Cissbury. His Blackpatch publication, although aimed at a general audience, was a comprehensive account of his excavations which provided a well-rounded review of the assemblages, mine structures, descriptions of the burial mounds and even a discussion of the process of patination on flint implements. However, the 'county establishment' ignored the target audience and treated the book as the final academic report and were overtly critical of the book, leading to a schism between Pull and the local archaeological societies (Barber et al. 1999, 11-12). Ironically, Curwen, one of the mainstays of the 'establishment', published his own general account of Sussex archaeology five years later (Curwen 1937), but without the rancour surrounding Pull's publication. This situation, and Pull's untimely death in 1961, prevented the full publication of his work. His archive included a wealth of information recorded in detail – for the standards of the time – which sadly languished, unpublished, in Worthing Museum until a summary

was finally published some 50 years later (Russell 2001) following an unpublished MA study undertaken in 1968 (Pye 1968).

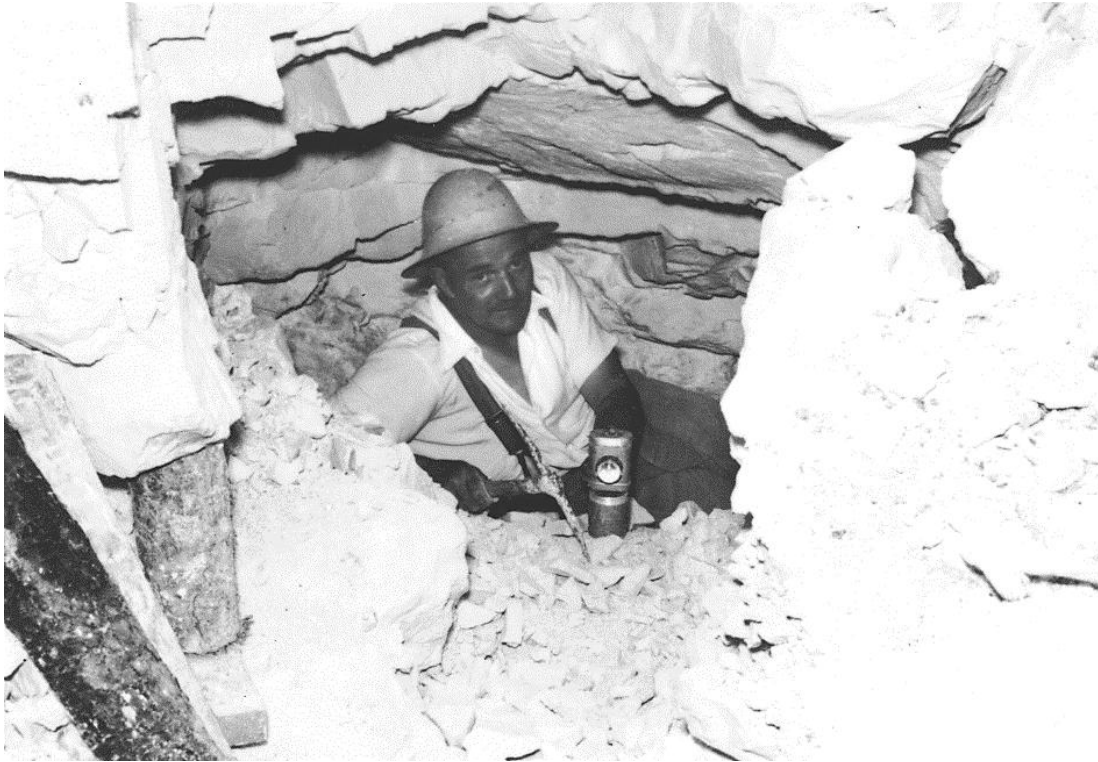


Figure 2:5. John Pull excavating at Cissbury (© Mrs M Suckling).

The inter-war years were also notable for renewed activity at Grime's Graves in Norfolk, particularly by Leslie Armstrong (Figure 2:6) who had been inspired by Smith's Palaeolithic hypothesis. Consequently, Armstrong led excavations to provide proof for a Palaeolithic date most years until the outbreak of war in 1939 (Armstrong 1921; 1927; 1934a; 1934b). In 1921 Armstrong (1921) published a paper on '*chalk crust engravings*' which he claimed as Palaeolithic art, which was greeted sceptically at the time, and have since been shown definitively to be mis-identifications of non-existent images (Varndell 2005). Roughly a decade later Clark and Piggott (1933) demonstrated convincingly – *again* - that flint mining was indeed Neolithic in date, but Armstrong continued to ignore this and excavated new sites at Grime's Graves to search for Palaeolithic evidence. Arguably his most contentious discovery was the crudely carved chalk 'Goddess' found in Pit 15 in 1939, forming part of a 'ritual group' of carved chalk objects which was both unique in the Neolithic archaeological record and unlike other European Palaeolithic figurines. Controversy surrounded the discovery of the

'Goddess', and most evidence suggests a modern forgery planted by someone who wished to lend weight to the Palaeolithic claim (see Longworth *et al.* 1991, 103-106; Varndell 2012). This final episode has cast a shadow over much of Armstrong's work at Grime's Graves, despite the fact that he did discover useful evidence of the scale and structure of the mines, the activity areas or 'floors', and the presence of Middle Bronze Age activity. Overall, the general research paradigm during this period continued to focus upon chronology, technology and processes, with little consideration of social context.



Figure 2:6. Leslie Armstrong (centre) excavating at Grime's Graves (© The British Museum).

### **2:3 Studies of extraction sites: 1945-2000**

During the post-War years the study of lithics, and to an extent extraction sites, finally became fully integrated into the reconstruction of a specific period with the publication of Stuart Piggott's (1954) *Neolithic Cultures of the British Isles*.

Although culture-historic in approach, this seminal publication foregrounded lithics as a defining feature of a primary Neolithic 'Windmill Hill Culture' and a 'Secondary Neolithic'. Piggott provided an overview of the 'Flint-Axe Factories and Mines' (ibid., 36-46) during the earlier part of his Neolithic chronology, which collated the published sources although he still couched his interpretation in economic terms, sketching the impact of market forces upon a putative group of full-time specialist miners and knappers. However, Piggott did break from economic models to briefly describe the '*ritual deposit at Grimes Graves*' found in Pit 15 (ibid., 42), curiously focussing upon the so-called chalk 'Goddess' figurine ('*a grotesquely fat and pregnant woman 4 ¼ inches high*') which he must have been personally sceptical about (cf. Clark & Piggott 1933). His description of the full 'ritual' assemblage, which included various other *bona fide* chalk carvings, and with some degree of prescience, refers to a '*shrine of an Earth Goddess ... represent[ing] an appeal to the chthonic powers for more abundant flint*' (ibid., 42). This may be the first reference in the literature to non-economic forces being part of flint mining, which is surprising considering the previous discovery of the phalarope skull in Greenwell's pit, carved chalk objects from Grime's Graves, the incised art in the South Downs flint mines, and the incised plaque discovered on Floor B at Graiglwyd (see above). Evidence of non-mining artefacts in extraction sites certainly existed at this time, albeit un-interpreted. However, what may have stimulated this paradigm shift was the simultaneous publication of Clark's excavations at the Mesolithic site of Star Carr where the author followed ethnography by discussing non-functional practises such as hunting magic (Clark 1954), although it is unclear what role ethnography played in Piggott's interpretation. Sadly these new models did not stimulate further research into the role of ritualisation in Neolithic extraction until some considerable time afterwards.

Piggott described the presence of stone tools in various contexts during his Windmill Hill Culture period (ibid., 75-80). However, it was during his 'Secondary Neolithic Cultures', or the Late Neolithic period, that he placed activity at the '*axe-factories of igneous stones*', particularly at Tievebulliagh (Antrim), Graiglwyd (Gwynedd), Great Langdale (Cumbria) and a series of unlocated sources in Cornwall (ibid., 287-301). Piggott's descriptive review of the Late Neolithic mostly deals with tool typologies, but he did divert his focus to the 'engraved plaque'



discovered on Floor B at Graiglwyd, which had been treated with caution by commentators; Piggott re-examined the piece and accepted its authenticity (*ibid.*, 290-292; Fig 46 on p294). This plaque featured a pattern of incised lines delineating triangles with cross-hatched infill, and has similarities with motifs of Grooved Ware tradition (*cf.* Cleal & MacSween 1999) and Passage Grave art of the Irish Sea zone (*cf.* Shee Twohig 1981). Unfortunately, Piggott failed to suggest why this piece of portable, mobiliary art should be present at these upland axe quarries, and what practises or ideologies may have lain behind its deposition.

Major projects returned to Grime's Graves in 1971-1972, when excavations were undertaken to answer both research objectives and provide visitor access to a new mine (Mercer 1981). Useful information was discovered about the assemblages, including a pair of rare internally-decorated Grooved Ware bowls, and a greatly enhanced understanding of the practise of flint knapping and tool typology. Detailed artefact analysis produced the revelation that axeheads were not the main implement produced at Grime's Graves, as points and scrapers were more numerous – at least as on-site survivals. A separate concurrent project was undertaken by the British Museum, which involved non-invasive survey, the excavation of a number of pits and knapping areas, and the re-excavation of five mines including Greenwell's Pit (Clutton-Brock 1984; Longworth & Rigby 1988; Longworth *et al.* 1991; Legge 1992; Longworth & Varndell 1996; Longworth *et al.* 2012). The re-excavation was undertaken by the Dutch Prehistoric Flintmines Working Group, whose detailed recording of the scale and structure of the mines and pits, and insights into mining procedures, provided a wealth of information in the British Museum references cited above. Consequently, Grime's Graves became and remains the most comprehensively researched flint mine complex in the UK.

Building upon the first report of the Sub-Committee of the South-Western Group of Museums and Art Galleries, which described the petrological analysis of stone axeheads discovered in the southwest peninsular (Keiller *et al.* 1941), a more detailed national review of axehead sourcing was presented in the first volume of *Stone Axe Studies* published in 1979 (Clough & Cummins 1979). This publication provided regional overviews of axe finds, typologies, studies of the

Langdale/Scafell quarries, and papers describing Breton and LBK Pottery associated axeheads from Europe. The volume was rounded off with two ethnographic papers, one on Melanesia and the other on Aboriginal Australia, demonstrating that some research – albeit in a limited way – was beginning to consider alternative evidence from compatible disciplines to aid interpretations. However, the over-riding stance remained one of descriptive reportage, the development of typologies, and a strictly superficial review of extraction sites. The question of materiality, social networks and how they both interacted with extraction sites was little discussed. A follow up volume (Clough & Cummins 1988) presented further regional petrological studies, alongside typologies and gazetteers. Recently, a recent third volume (Davis & Edmonds 2011) comprising the proceedings of an international conference held in York in 2007, included research on lithics and a number of extraction sites and artefact biographies.

During the 1980s, and following the lead of ‘New Archaeology’ in 1970s America, a number of theoretical initiatives in the UK sought to introduce a more rigorous application of theory to Neolithic research. Much of this was led by Richard Bradley and his students from Reading University (e.g. Bradley & Gardiner 1984), amongst others, who sought ‘*a greater concern with explanation*’ (Bradley 1978, 181) rather than adhering to the traditional descriptive reportage. This initiative led to a series of publications, influenced by post-processual approaches, which attempted to place the study of lithics into a social context (e.g. Edmonds 1990; 1993a; 1993b; 1995; 1999; Brown 1991; 1995; Bradley & Edmonds 1993; Edmonds & Richards 1998), and were influential in shaping theoretical advances in the contextualisation of lithics. Such an agenda has helped to constructively broaden the debate beyond functionalism, and using ethnography to consider meaning and symbolism, began to explore questions such as the demographics and identities of those involved in extraction and tool manufacture (e.g. Gero 1991), craft specialisation (e.g. Spielmann 2002) and processes of deposition and discard (e.g. Richards & Thomas 1984).

Coinciding with these theoretical advances, detailed fieldwork occurred at two upland axe quarries, the first was at Langdale in Cumbria, the source of Group VI [Epidotized intermediate tuff] axeheads (Bradley & Edmonds 1988; 1993), and

the second was at Creag na Caillich near Killin in Perthshire (Edmonds et al. 1992), which was the source of Group XXIV [Calc-silicate hornfels] axeheads.

The Langdale project was designed to study the effects of the production and distribution of stone axeheads upon Neolithic society, particularly as their discovery at ceremonial sites, burials, Fenland enclosures, in pits and in riverine/wetland deposits, all suggested that they had a range of emblematic uses beyond their functional utility as tools. The fact that axeheads are found in structured deposits at these various site-types suggested that they played a role in non-functional practises, lending weight to the suggestion that they were not always used as functional tools (e.g. Kenney 2008; Lynch & Musson 2001). This project discovered that the quarries were utilised over a lengthy period of time for the large scale production of axeheads. A detailed analysis of the lithics demonstrated changes in the reduction sequence of axehead production over time. In the earliest phases of quarrying the raw material was removed in blocks to low-lying workshops where knapping took place. However, during the later phases all stages of axehead production were undertaken at the quarries, which produced 'increased efficiency' and reduced wastage – if such production values were important to the Neolithic quarry teams.

In contrast, the excavations at Creag na Caillich suggested that the quarries were comparatively small-scale compared to Langdale, and that they had been used during the later Neolithic period to produce large bifacial roughouts. All stages of the reduction sequence were undertaken at 'workshop' areas, unlike Langdale where tasks could be carried out at separate locations. Interestingly, the quarries appear to have witnessed a secondary phase of exploitation when perforated maceheads were produced during the Chalcolithic/Early Bronze Age at a time when the first metalwork traditions were being established.

In the main Langdale publication, Bradley and Edmonds (1993) identified a key temporal tipping point around 3300BC, when collective burials were eclipsed by individual burial, certain enclosures become fortified, and there was a noticeable expansion of long-distance exchange networks which circulated some artefacts far beyond their points of origin. This coincided with an increasing emphasis upon ground and polished lithics and personal ornamentation featuring jet and

amber alongside traditional materials such as antler and bone. It was argued that these cultural changes in southern England heralded the appearance of large settlements close to the flint mines, reversing the situation occurring in the Early Neolithic period when the mines were generally separated from contemporary settlement. It was hypothesised that this reflects a desire to exert control over the flint sources. However, this was a time when the South Downs flint mines had been abandoned, according to recent radiocarbon analysis (Barber *et al.* 1999, 67-71; Whittle *et al.* 2011, 253-262), and the Late Neolithic mines at Grime's Graves in East Anglia have not as yet produced evidence of contemporary settlement on-site (Topping 2011b). Consequently the evidence from the flint mines does not support this model. However, Bradley and Edmonds did open the debate to concepts such as rites of passage being integrated into the use of extraction sites, and the potential significance of long-distance journeys to quarries.

The fieldwork at both Creag na Caillich and Langdale have not detected any contemporary on-site settlements which might be associated with the quarry users, although in the case of Creag na Caillich the Cleaven Dyke (now recognised as a cursus monument), alongside burial and ceremonial monuments, have begun to sketch the broader landscape setting of axe quarrying in Tayside (Barclay & Maxwell 1998). Similarly at Langdale, the evidence for contemporary settlements at the quarries and on the adjacent valley floors remains elusive, particularly as climatic constraints and the need for seasonal exploitation (as at most upland quarries) will have impacted exploitation, and clearly limited access to the sources to certain times of the year. Consequently, this provides further circumstantial evidence to suggest that upland quarry users travelled from a distance. As at Creag na Caillich, the quarries at Langdale appear to have been located at peripheral, or culturally liminal, locations based upon the current lack of settlement evidence. However, Langdale is topographically-linked by a network of valleys which provide routes to the east and south, passing by putative Neolithic enclosures on Carrock Fell (Pearson & Topping 2002) and the complex of henges at Penrith (Topping 1992), where excavations have discovered a Langdale axehead, suggesting these Late Neolithic enclosures may have played a role in the distribution of Cumbrian axeheads.

Following on from his fieldwork at Langdale and Creag na Caillich, Edmonds (1995) drew together a lot of his previous research in his book 'Stone Tools and Society' in which he modelled aspects of the social context of axehead procurement, manufacture and use. Using sub-headings such as 'The gift of stones' (paralleling the title of the 1989 Jim Crace novel of the same name about Grime's Graves), he explored issues such as the creation of identity, display, axehead deposition in various site-types and regional traditions, stating that *'there is little to be gained from maintaining a rigid distinction between the functional and symbolic properties of artefacts such as axes'* (ibid., 58). He also examined the evidence for ritualised extraction practises in a sample of sites, and described the emergence of social competition and the demise of stone procurement and use during the Early Bronze Age. This was an influential book which introduced the emerging research into the social contextualisation of stone implements during the Neolithic – Early Bronze Age to a wider audience.

In 1996 a study of stone axeheads by Pitts produced a gazetteer of axehead caches and those found in burials in Britain. Pitts observed that the question of context was regularly disregarded, and suggested that the greatest research potential lay with deliberately deposited axeheads (1996, 339). The underground caching of axehead roughouts was identified as a common practise, possibly to retain moisture to enhance knapping qualities of the raw material, but roughly 20% more finished axeheads were cached. Pitts' research found that axeheads were generally recovered singly in human burials<sup>6</sup> *'and only one grave has as many as four'* (Pitts 1996, 345). Such statistics provide a useful framework for the study of these iconic implements from these two contexts, suggesting arguably that caches of finished axeheads and burial assemblages had similar social weighting whereas caches of unfinished axeheads being less numerous lends credence to the notion that they were considered a temporary phenomenon as part of tool production.

By the mid-1990s, following on from the research of Bradley on prestige goods (e.g. Bradley 1984; 1990), the meanings of axes, and the settings and

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<sup>6</sup> Pitts lists 21 human burials with axeheads, with a further 18 doubtful or unconfirmed burials. In contrast he lists 30 caches of unfinished axeheads of all types (3 doubtful or unconfirmed), and 34 caches of finished axeheads of all types (9 doubtful or unconfirmed).

accessibility of extraction sites was beginning to be considered, mostly focused upon Langdale and Creag na Caillich. Although much consideration was given to the contexts and materiality of lithics, only superficial discussion of sources occurred – or their role in society (e.g. Thomas 1996; Whittle 1996). However, as a preamble to the International Flint Symposium held in Warsaw in 1995, a special edition of *Archaeologia Polona* was devoted to the theme of flint mining. This volume included an important paper by Whittle (1995) in which he discussed the failings of the current materialist approaches towards extraction sites, and presented a new model inspired by anthropological theory to explain symbolism and axehead use as a method of mediation and social renewal through gift giving. Critically, he described the practise of exploiting storied stone sources, referencing Australian ethnography, and how mythologisation alongside metaphoric and metonymic concepts might objectify these lithics. This paper has subsequently influenced the work of many scholars who have embraced the potential anthropological theory can bring to the study of extraction sites and their products (e.g. Cooney 2000 & 2015; Edmonds 2012; Topping 2005).

The publication of the International Flint Symposium proceedings included a number of papers which considered the social role and symbolism of flint mines (see Field 1997; De Grooth 1997; Migal 1997; Topping 1997; Voytek 1997). Unlike previous studies, these papers were arguably more grounded in ethnography than earlier publications, and sought to take the understanding of social context beyond the formulaic. However, the ethnography being drawn upon was generally very limited in range, including theoretical anthropological model-building, the inevitable accessible Papua New Guinea sources, and a small amount of Native American ethnography which reflected the origin of the author (Voytek). Consequently, an understanding of the full complexity of the ethnographic data surrounding the use and meanings of extraction sites which a wider reading of the ethnographic literature could provide, still lay in the future.

In 1998 de Grooth published a significant paper which attempted to use ethnography to develop a series of complex models for raw material acquisition, lithic production and exchange, although the author was forced to admit that *‘these models do not serve as an easy-to-use manual’* and that in certain cases the ethnography *‘would be so complicated as to be virtually unintelligible in*

*archaeological terms*' (de Grooth 1998, 357-358). The paper usefully cautioned against the impacts of excavation bias on model building, and observed that her *'models confirm that well-founded interpretations of flint procurement systems cannot be based on the study of a single settlement or extraction point, but must integrate data from different types of sites'* (ibid., 358), a stance which mirrors the approach of the present thesis by reviewing the evidence for the social context of extraction sites. In a final prescient observation, de Grooth states that *'we will have to think very carefully about the social context of distribution, considering the possibility that objects changed their meaning after passing from one context to another. Moreover, we must find ways to arrive at an understanding of the symbolic connotations of the act of digging deep holes into the earth itself'* (ibid., 366).

The late 1990s also saw Cooney and Mandal (1998) present the preliminary results of the Irish Stone Axe Project which sought to identify the sources of Neolithic axeheads found in Ireland. One of the key discoveries was the large number of Cumbrian Group VI axeheads that had crossed the Irish Sea, which complemented the Irish Group IX axeheads that had travelled in the opposite direction, indicating the cultural value these implements had to communities in both countries. Cooney (1998) also explored the ethos behind the use of extraction sites and the cultural significance of axeheads and quarries, following the lead of Whittle (1995), and being one of the first to explore the question of the role axeheads played in the creation of identity. Another significant publication was the first national survey of Neolithic flint mines in England (Barber *et al.* 1999), which assessed all extraction site records and demonstrated that there were as few as ten *bona fide* mines (although others may await discovery). The landscape context was discussed, new radiocarbon dates were used to revise their chronology which highlighted that they were some of the earliest features in the Neolithic landscape, and a discussion of ritualised mining practise was presented. However, this project did not comprehensively examine the assemblages from the mines in any detail, nor contemporary settlement data, consequently it was unable to holistically position the flint mines into the emerging theories surrounding ritualisation and social context.

Thomas' (1999) review of the Neolithic of southern England was influenced by ethnographic theory, and discussed the links between enclosures and *ad hoc* flint extraction, highlighting the symbolic significance of '*placing objects into the ground*' (1999, 224), and providing a useful deconstruction of the 'Neolithic economy'. Unfortunately there was little reference to flint mines or axe quarries and their role in society.

#### **2:4 Studies of extraction sites: 2000-present**

The new century opened with Cooney's (2000) holistic study of the Neolithic landscape of Ireland where axe quarries were foregrounded, contrasted with contemporary sites in the UK, and interpreted using a range of ethnography to explore the social context of these sites and their products, particularly in regard to ritualisation, spirituality, depositional practises and further developing the model for the creation of identity in stone (*ibid.*, 190-211).

Russell's (2000) study of Neolithic flint mines in Britain which included the novel suggestion of cannibalism as an explanation of the presence of body parts in the mines, but did not present significantly different data to Barber et al. (1999). However, a more useful publication was his summary of the unpublished John Pull archive held in Worthing Museum, which provided much unpublished contextual information illustrated by Pull's own plans and photographs, and demonstrated the major contribution Pull had made to flint mine studies (Russell 2001).

In 2004, Ray published a paper exploring the question of the materiality of stone axes, using as his starting point the 1922 study by Malinowski of the *kula* exchange system of Melanesia, and applying it to the Neolithic axes in the UK and how they may have been conceptualised, exchanged and deposited. He particularly examined the movements and meanings of axeheads around and across the Irish Sea, and the issue of artefact biography and how the social meaning of these implements may have been constructed.

Bradley, writing in 2005, reviewed the evidence provided by recent excavations at axe quarries and the national survey of flint mines to reiterate his view that



caution is needed when reviewing the evidence of ritual at these sites. Although Bradley acknowledges that '*certain activities at flint mines [and axe quarries] were carried out with a greater degree of formality than might once have been anticipated*', he suggests that such formality simply defines extraction practise as being '*ritualised*', and the precise cultural status of the extraction sites remains problematic (Bradley 2005, 104).



Figure 2:7. Samuel Calvin's photograph of the Pipestone Quarries in Minnesota, taken at the beginning of the twentieth-century, showing Native Americans quarrying with hand tools in the traditional manner (© The Calvin Photographic Collection, Department of Geoscience, University of Iowa).

In 2005 the publication of conference proceedings presented a series of archaeological and ethnographic case studies focussed upon mines and quarries using traditional technologies from both the Old and New Worlds (Topping & Lynott 2005). Interesting mythology from the Great Lakes was discussed, linking access to the sources of copper with the 'underwater Manitou' who protected the raw material and had to be placated before quarrying could begin (Clark & Martin 2005). The Minnesota pipestone quarries were examined (Scott & Thiessen 2005), alongside island-based quarries on Lambay off the coast of Ireland (Cooney 2005). One paper took as a guide Native American ethnography

(Figure 2:7) to construct an interpretive framework to attempt a reconstruction of the sequence of extraction, deposition and abandonment in Shaft 27 at Cissbury in Sussex (Topping 2005). This appears to have been relatively successful in that the patterning of the cultural assemblages in the archaeological record do find parallels with the ethnographic evidence, but prior to the current thesis this approach has only been applied to this one shaft out of many dozens that have been excavated (cf. Wheeler 2008, 160), although the generalities of the model do appear to fit a sample of European mines (Wheeler 2011, 310-314). The aim of the present thesis is to review, strengthen and further develop this model, and test its applicability across a wide range of extraction sites.

In 2007, Cooney reconsidered movement during the Mesolithic-Neolithic transition, especially focussing upon the Irish Sea and its impact upon communities and the ways it influenced social networks through the materiality of stone implements. Bradley (2007) also began to examine the role of extraction sites in their wider social setting, giving them greater prominence than in pre-1990s literature, reinforcing the roles that symbolism and ritualisation played in the exploitation of these sources. This position was strengthened by Thomas (2008) who documented the significance of mining and ground and polished axeheads during the transition from the Mesolithic to the Neolithic, as had Cooney (2007). Conneller (2008) also lent weight to this proposition when discussing lithic technology and the *chaîne opératoire* from ethnographic perspectives, arguing for the cultural significance of extraction sites which embody a sense of 'place', reiterating the point made by Bradley (2000, 88) concerning '*pieces of places*'. Needham (2008) expanded this debate by discussing a model for the possible social valorisation of axeheads, the meanings behind distribution patterns, and models for exchange and/or trade.

One of the most profoundly important publications appeared in 2011 - *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*, which has redefined our understanding of the chronology of the Early Neolithic period in parts of the UK and Ireland (Whittle *et al.* 2011). The detailed Bayesian remodelling of the radiocarbon chronologies from the Southeast, for example, demonstrates that the earliest monuments were houses and flint mines, appearing well *before* enclosures or other forms of monument were built. The

consequences of this are wide-reaching. Traditional interpretations view the introduction of the Neolithic as a result of migration, or indigenous innovation, or a mix of both, which introduced/adopted the new technologies of pottery manufacture, ground and polished stone axeheads, and cereal cultivation – even if the latter was initially small-scale in nature. Overall, the Gathering Time chronology demonstrates that *‘Flint mining emerges as one of the potentially earliest Neolithic innovations in south-east England’* (p261), an observation rarely previously considered. Consequently, we can now rethink the traditional ‘first farmers’ model (*contra* Ammerman and Cavalli-Sforza [1971, 674]: *‘early farming and Neolithic are virtually equivalent’*), and recognise that whatever the cultural origin of the Early Neolithic communities in southern England, they were clearly more motivated to exploit increasingly different or exotic types of stone than primarily driven to grow cereals – although some cereals were indeed grown. In the final chapter summarising the evidence for social change, the authors suggest that there was *‘some kind of initial colonisation’* alongside *‘the digging of deep flint mines in Sussex ... following established traditions ... which go back in central Europe to the LBK in the sixth millennium cal BC’* (853). If flint mining is now demonstrably a very early feature of the Neolithic sequence in the UK, it suggests that stone extraction was a fundamental part of Neolithisation, and one which had an established European cultural heritage (see also Sheridan & Pétrequin 2014).

The following year saw the publication of another ground-breaking publication focussing upon Alpine jadeitite axeheads which originated in quarries high in the Italian Alps (Figure 2:8), and were distributed across most of Europe during the 5<sup>th</sup>-4<sup>th</sup> millennia BC, even reaching as far afield as northern Scotland and Ireland (Pétrequin et al. 2012). This project not only produced a detailed chronology of the evolution of axehead forms and a detailed explanation of their contexts, but the use of non-invasive science (p-XRF technology) employed by the team was also able to identify specific sources for individual axeheads. This has provided data to allow research to produce a finely nuanced biography of individual axeheads, and begin to sketch the practises that lay behind them from procurement to deposition, much of this informed by the ethno-archaeological fieldwork of the authors in New Guinea (included in Chapter 3 evaluation).



Figure 2:8. Mont Viso, in the northern Italian Alps, site of jadeitite axe quarries.

Julian Thomas published a new review of the Early Neolithic period in the UK in 2013. He examined the arrival of the Alpine jadeitite axeheads around 4500-4000 BC, and how they might carry a biography which created affiliations with societies across the Channel. There was a discussion of the Alpine quarry sites and workshops, and how they were used seasonally. Using ethnography as a steer, Thomas followed Pétrequin in suggesting the axeheads did not remain in use very long, and that *[d]estruction or deposition ... [was] used to regulate the numbers of objects in circulation, while ... providing an opportunity for display, conspicuous consumption, and ... prestige'* (Thomas 2013, 275). Thomas saw the emergence of flint mines during the late 5<sup>th</sup> millennium in Europe as indicative of craft specialists with access to redistribution networks. By the time the practise had transferred to the UK it was adapted to include 'indigenous' features such as the use of antler picks in contrast to the European use of flint picks (ibid., 377). Flint mines are viewed as 'foundational' to the emergence of the Neolithic, generally remote sites from which extraction underpinned exchange – but they only emphasised one aspect of Neolithic life, the production and circulation of

tools, especially axeheads which were then used to create and transform identities. Thomas rehearsed the emerging evidence for ritualised extraction, but provides little discussion of the axe quarries in the UK (ibid., 377-384).

In 2015 Cooney published a paper exploring the use and context of Neolithic flint and stone axes in Europe which drew together many of the emerging themes, and critiqued them against recent anthropological models. The paper followed a broadly biographical approach to the study of axeheads from extraction to deposition, reviewed implement petrology and the significance of colour. Long-distance axe movements were noted, especially jadeitite which it was suggested may have played a key role in the process of Neolithization. Quarrying and production was probably ritualised, with symbolism linking the extraction sites and their products to ancestral powers, particularly those in special places such as Langdale or the island quarries. Axeheads are seen as material metaphors and metonyms with layered meanings, some of which may have validated identity, and over-sized axeheads were clearly special implements. The life-cycle of an axehead came to an end when it was returned to the earth for its final deposition. This paper encapsulated many of the strands explored by various authors, including the author's own fieldwork at a number of sites such as Lambay Island, and developed models which this PhD research can test against its data sets.

## **2:5 Conclusion**

Overall, Gathering Time and Project Jade, combined with recent excavations at axe quarries and the national survey of flint mines, place research in an interesting position to begin to comprehensively model the social context of extraction. However, there has still been little research into the detailed topographic and cultural settings of extraction sites, especially axe quarries, to clarify their relationships to, and associations with, other contemporary sites. Few authors have considered the totality of the assemblage data from all extraction sites in any real detail, and what that contextual information might indicate concerning the use of the Neolithic extraction sites. In addition, little wide-ranging ethnographic research has been undertaken to broaden the debate

beyond the few traditional, oft-quoted sources (e.g. Allchin 1957; Burton 1984; Chappell 1966; Cranstone 1971; Strathern 1969).

The debate surrounding the functionality and social context of stone extraction has been rehearsed since at least the mid-1980s, with varying degrees of success (e.g. Erickson 1984; Edmonds 1987; de Grooth 1991), research often being constrained by a widely-held perception that there were few applicable ethnographic parallels. Consequently, functionalist and empiricist approaches have resorted to economic or technological interpretations.

Many previous studies of prehistoric extraction have been descriptive, and generally functionalist in approach, primarily concerned with discovery, technical aspects of extraction, or the analysis of lithic assemblages. Such approaches have led to a theoretical framework focussed upon the 'organisation of technology' (Cobb 2000, 78), as we saw with the work of Lane Fox (1869b) and Greenwell (1870) in the nineteenth century, and the research of Kendrick (1925) and the Curwen's (Curwen & Curwen 1926) during the twentieth century. The mine/quarry was often of secondary concern, with the lithic artefacts taking primacy. Influential amongst later approaches has been the ethno-archaeological work of Binford (1979; 1980; 1983) which has influenced models such as Torrence's concerning settlement mobility and artefact manufacture, use and curation. This theoretical model (Torrence 1989b) suggested a shift from '*formal*', high-quality tools made for specific purposes and generally associated with a mobile lifeway, to '*expedient*' tools made on an *ad hoc* basis which reflect a cultural shift towards greater '*efficiency*' and a more sedentary lifestyle associated with agriculture. In the latter scenario, more time was expended upon cultivation, processing and food storage than upon the manufacture of stone tools. However, such models rarely consider the role or influence of the extraction site in the *chaîne opératoire* of these implements, nor the underlying practises or ideologies which led to the choice of extraction site and the crafting of the artefacts.

This situation poses some interpretive problems, particularly with the 'expediency' model. This has arisen because many Neolithic sources were located in areas where more accessible surface material was often available, either eroded

downslope from the upland quarries, or from outcrops or glacial erratics and other secondary deposits of toolstone. In addition, coastal areas with suitable geology regularly produce substantial quantities of toolstone, such as the beach flint eroded from the chalk cliffs at Sheringham, Norfolk. Consequently one still has to pose the fundamental question of *why* Neolithic communities chose to utilise obscure sources of raw material? Particularly as these are frequently in very dangerous or difficult places, which then require great investments in time and effort to extract the stones, craft them into particular tools, and then often distribute them over great distances.

In the UK the functionalist approach to lithic procurement has led many researchers to explore the use of extraction sites in terms of market forces, trade and exchange. This situation has been recognised by others: *'Axe sources, both of flint and other stone ... have often been characterised as "axe factories" or even industrial sites, serving essentially practical, material needs. Like the Neolithic phenomenon as a whole, the perceived tendency is towards intensification and expansion ...'* (Whittle 1995, 149). Bradley (2005, 103) has observed that *'this is a topic which has created some confusion, for prehistorians sometimes write about it using terms that are more appropriate to the modern economy'*. Such a materialist approach is epitomised by the economic determinism of Torrence (e.g. 1986) whose models are derived from a limited range of ethnography and a heavy reliance upon the post-medieval gunflint industry, all superimposed upon Bronze Age Greek obsidian production and exchange on the island of Melos (Figure 2:9). Such models reflect more about recent westernised market forces and consumerism than the prehistoric cultures being studied. Despite such an economic focus in model building, during the 1980s and 1990s post-processual research began to explore the social contexts of prehistoric archaeology (e.g. Bradley & Gardiner 1984; Edmonds 1990 & 1995; Bradley & Edmonds 1993), although in the case of extraction sites with mixed results, as Edmonds observed when he noted that *[s]timulating though these studies have been, we are still some way from capturing the character of axe production and circulation'* (Edmonds 1995, 51).



Figure 2:9. Obsidian blades and cores from the Melos Quarries, now in Heraklion Museum.

The past 30 years has seen a growing recognition of the part played by materiality, artefact biography, social context and landscape symbolism. As Conneller (2008, 169) has observed, *'raw material is important not just as an indicator of trade or mobility; it also embodies a place, and many of the places from which material was procured appear to have been especially important to prehistoric people'*. The difficulty with this recognition is that there continues to be a reliance on a limited range of ethnography which restricts the development of robust interpretive models. In addition, there is a notable lack of detailed analysis of the landscape setting or scale of extraction sites. This has been hindered by the fact that few papers provide anything other than small-scale site plans which clearly do not show any real detail of the workings (e.g. Houlder 1961) - some reports do not even include a site plan (e.g. Salisbury 1961). It is salutary to discover that despite some 50+ years of fieldwork at Great Langdale in Cumbria, for example, only a small scale map of the axe quarries, geology and lithic scatters has been published with descriptions and photographs of five



quarry types with a number of plans provided on (now mostly unreadable) microfiche (Claris & Quartermaine 1989). No individual quarries are recorded at large-scale (e.g. 1:500 or greater), although clearly site preservation is a major concern<sup>7</sup>. Indeed, more recent fieldwork at Great Langdale relies upon photographic recording of quarry sites, the only plans depicting excavation trenches without the quarry detail or contextual setting (e.g. Bradley & Edmonds 1993, 109-110; 113). The Cumbrian Historic Environment Record does not currently hold *any* surveys of individual quarries, despite the recognition of over 700 extraction sites recorded in the Great Langdale / Scafell / Glaramara complex (J Hodgson, *pers. comm.*). This is quite an incredible situation.

However, recent research at the Neolithic quarries at Langdale, Cumbria (Bradley and Edmonds 1993), Graiglwyd, Gwynedd (Williams and Davidson 1998; 2002), Mynydd Rhiw, Gwynedd (Burrow 2011), and the flint mines at the Den of Boddam (Saville 2005), has begun to refocus research upon the extraction sites.

Nevertheless, the social context of extraction is not always directly addressed. Considering that there are currently seventeen recognised flint mines in the UK and Ireland (Barber *et al.* 1999), and more than twenty-five sources of toolstone scattered throughout the country (Clough & Cummins 1979), the current projects reflect only a small sample of the original resource exploited during the Neolithic period, consequently much remains to be considered. Landscape research at Mynydd Rhiw in Gwynydd, for example, has discovered quarries alongside other multi-period earthworks which demonstrate the constraints imposed by the geology and the impact of later cairns and boundaries (Burrow 2011, 250). Similarly, fieldwork at Graiglwyd, Gwynydd, has also provided a detailed contextual plan of certain quarry sites in their topographic setting (Williams *et al.* 2011, 273), so this issue is beginning to be addressed. The next steps must be to assess and synthesize what little contextual recording exists (see Chapter 5), and develop a robust and holistic approach to analogy and model-building, which enhances our understanding of the archaeological record from extraction site to product and through to deposition, as will begin in Chapter 3.

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<sup>7</sup> Clearly the conservation and preservation of these fragile sites must remain paramount. There is a danger that publication of detailed plans could trigger disturbance to sites, as has happened in many places around Langdale. Any published plans need to be anonymised to protect the integrity of the extraction sites.

This research will next review the ethnographic data for extraction sites, identifying themes and trends and their material manifestations, which can then be used to predict and interpret probable social motivations underlying the material patterning in the prehistoric archaeological record, and develop a more informed and nuanced interpretive framework.

## Chapter 3. The Ethnography of Extraction

*'For the archaeologist who is concerned with all phases of lithic technology, particularly production, the ethnographic documentation is very incomplete. When we consider the wealth of information available on the varieties of human experience, the information on the activities associated with quarries and workshops have to be ranked among the most abysmal. Early explorers apparently took little notice of lithic procurement and production practises. Generally, observations were restricted to village life or observations made along the route of travel. Lithic quarries were infrequently visited.'* (Ericson 1984, 2).

### 3:1 Introduction

This chapter will review the ethnographic evidence for the practise of extraction, its social setting, and the use and distribution of its products at a global scale. The environmental context is considered of lesser importance than the motivations and practises which lay behind extraction - how groups extracted the raw material, and why. This data will be used to identify common trends, thus creating high-level transferrable data based upon material evidence which can be applied to the interpretation of the archaeological record.

The chapter will discuss extraction as practised by a range of indigenous communities drawn from Africa, Australia, Europe, New Guinea, the Pacific and the Americas; the ethnography has been collated from accessible English-language texts. The intention is to describe, contextualise and analyse the forms of extraction to produce a set of robust statistics which will present a near-global perspective on extraction practise. These statistics will provide a more reliable interpretative steer to underpin the archaeological analysis of extraction practises in the prehistoric past than has previously been possible through a more limited use of ethnographic data (e.g. Edmonds 1995, 2012; Torrence 1984, 1986). As Torrence (1986, 1-2) has pointed out, the solution to the potential divergence between interpretation and archaeological reality can be bridged by *'research conducted in the present where the relationship between behaviour and its*

*material correlates can be observed directly*, i.e. through the filter of ethnography.

### **3:2 Research Methodology**

The over-arching aim of this research is to gain an understanding of the probable motivations behind prehistoric extraction through the use of ethnographic analogy and how it may have impacted on contemporary society. There are constraints in that not every case study has recorded all of the attributes under study; consequently these results (like the archaeological record) has a bias, whether because certain practises were simply not observed or recorded, or they did not happen. However, by analysing a larger data set, the emerging evidence has the capacity to identify strong trends in practises by aggregating many fields of data to produce a *probability analysis* with a global perspective<sup>8</sup>.

The research strategy has been influenced by the author's specialist knowledge built over some twenty-five years involvement investigating Neolithic extraction sites around the UK, surveys of others in Europe, and fieldwork in the US. Participation in various conferences (International Flint Symposium; UISPP events; Prehistoric Society; Neolithic Studies Group) and with specialist study groups (Implement Petrology Group; Prehistoric Quarries and Early Mines Interest Group of the Society for American Archaeology) has built a comprehensive knowledge of relevant material.

During the present study various internet search engines<sup>9</sup> were used to discover new evidence, alongside search facilities in e-journals such as the *Journal of the Polynesian Society* and *Antiquity*, providing a wide range of culturally diverse data as can be seen from the range of sources in the Bibliography.

This thesis is based upon the presumption that an interpretive steer can be gained by developing a model from ethnographic analogy which is based upon

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<sup>8</sup> It should be noted that some ethnographic units are recorded more than once in the data set, e.g. the Lakota/Dakota, Inka, Tiwi and Wano, so some slight repetition does occur, but each record includes differences in detail, which taken together provides a more complete overview of practises.

<sup>9</sup> E.g. Google Scholar, Google images, individual e-journal search engines.

the structures within, and social contexts of, the material patterning of practises related to extraction and its products. To create this model, 168 ethnographic case studies were collected and analysed to produce high-level trend data and identify material patterning<sup>10</sup>. The present study sits alongside Middle Range Theory (cf. Schiffer 1988) in an attempt to position this interpretive model between high-level unifying theories and the empirical data comprising the archaeological record as a framework to identify *probable* social motivations behind archaeological formation processes. This research has constructed a near global level ethno-archaeological model of extraction practises to build upon Binford's (1962; 1979; 1980; 1983) methodologies, and create a reliable interpretive framework to enhance understanding (Hodder 1982a & 1982b; Bourdieu 1990; Godelier 1999). The model has incorporated appropriate social and anthropological theories to explain the content, variability, spatial patterning and social context of the archaeological record (e.g. Gero 1989 & 1991; Gosden & Marshall 1999). This collected data also have the capacity to be tested and falsified (Popper 2002; Schiffer 1988).

This thesis has used several analytical strategies: (i) the collection of a near global sample of ethnographic (Chapter 3) and archaeological (Chapter 4) data to identify trends in material patterning and practise; (ii) a robust analysis of this published data; (iii) model-building and testing; and (iv) application of the model to the Neolithic extraction sites of the UK to develop a new or more robust understanding of extraction practise (cf. Schiffer 1983). As has been observed by Fogelin and Schiffer (2015, 818) '*... ethnographic and archaeological accounts can supply hints as to possible patterns*' in the social context of formation processes.

Modelling the social context of extraction practise will use a 'flow model' approach (cf. Schiffer 1972; Fogelin & Schiffer 2015) to sketch the various stages of extraction practise and its outcomes from source identification to exploitation, to product preparation, product use, possible product modification to final deposition of the product. In addition, the model has the potential to identify why and how extraction site products were objectified, how they carry narratives

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<sup>10</sup> This data is presented in appendices at the end of the thesis.

which reflect practises, the ways in which they can structure social networks (Hodder 1982b; 2012), and how they can influence change in society (Rathje 1979; Marshall 2008). The ethnography has provided information on the contexts of ritualisation within extraction practise and product manufacturing and their outcomes in society (cf. Bell 1997; Spielmann 2002; Insoll 2004 & 2011).

Although this thesis has not reviewed *all* available ethnography, it has accessed a far larger sample than the norm, which offers a more nuanced understanding of traditional practises from a range of socio-technological contexts. For example, New Guinea has a rich ethnography recording various forms of extraction, but unfortunately, much of the richness of this record is often missed or ignored by archaeologists who favour a small number of easily accessible ethnographic sources (e.g. Burton 1984; Chappell 1966; McBryde 1984) which inevitably restricts interpretations. As Hampton (1997, 79) has observed, the contiguous communities inhabiting the New Guinea highlands, although superficially similar, [do] *have significant differences*' (ibid., 79) including a complex series of language groups, different materialities and cultural milieus. Critically, it is the role of this materiality, and in particular that of stone tools and other significant artefacts, which is central to the '*material and ideological reproduction of these communities of forest farmers*' (Pétrequin & Pétrequin 2012, 27) – an observation which may be pertinent to Neolithic Europe.

The present ethnographic analysis has focussed upon a series of high-level themes which emerged from the literature review:

- 3:3:1 Raw material type
- 3:3:2 Storied/mythologised sources
- 3:3:3 Ownership or restricted access to sites
- 3:3:4 Seasonal use of the resource
- 3:3:5 Age/sex demographic of the extraction site workers
- 3:3:6 Evidence for ritualised extraction
- 3:3:7 Evidence for ritualised reduction
- 3:3:8 Extraction site artefact/product typology
- 3:3:9 Extraction site artefact/product functionality
- 3:3:10 The involvement of craft specialists in artefact production

- 3:3:11 Distribution of extraction site products
- 3:3:12 Evidence for the ceremonial after-use of extraction sites
- 3:3:13 The presence of rock art/graffiti/idols at extraction sites
- 3:3:14 Burials at extraction sites

Not all of the attributes listed above are documented by every ethnographic record; consequently the number of records can be variable and is listed as a sub-set of the total in brackets in the tables below [e.g. 120 of 168]. In addition, some ethnography records a definite absence. Overall, the sub-sets are calculated to assess and contextualise presence, e.g. 3:1:2 Storied/mythologised sources: 129 [of 168] records refer to this attribute, but 9 record a definite absence, consequently only 120 records are used to model trends (e.g. 120 of 168). Where such attribute absence is recorded as a definite characteristic it is listed in the sectional texts and in Table 3:1 below to help qualify and quantify the overall social context of each attribute.

### **3:3 Statistical analysis of the ethnography of extraction taken from 168 case studies**

#### **3:3:1 *Raw material type***

The ethnography records a range of raw materials being exploited: stone (primarily for tool manufacture), minerals such as ochre and clay (personal adornment, body processing, artefact production), to metal ores (variety of products). Despite the differences in the end-use of products, meaningful trends do occur in the practises of extraction and their aftermath (Table 3:1 below).

Attributes	% & No. of studies recording attribute [n=168]	% & No. of studies recording absence of attribute [n=168]	% & No. of studies providing no data [n=168]
Raw material type	n/a	n/a	n/a
Storied/mythologised source	71% [120]	5% [9]	24% [39]
Ownership/restricted access	45% [75]	18% [31]	37% [62]
Seasonal use of the resource:	44% [74]	4% [8]	51% [86]
Permanently settled	4% [8]	44% [74]	51% [86]
Age/sex demographic of the extraction site workers:			
Adult men	55% [92]	14% [24]	31% [52]
Women	1% [2]	68% [114]	
Men, women & children	13% [22]	56% [94]	
Evidence for ritualised extraction	40% [67]	4% [6]	56% [95]
Evidence for ritualised reduction	40% [68]	6% [9]	54% [91]
Extraction site artefact/product typology	n/a	n/a	n/a
Extraction site artefact/product functionality:			
Functional/ritual	65% [110]	0	7% [12]
Functional	17% [29]	0	
Ritual	8% [14]	0	
Wealth objects	3% [3]	0	
Involvement of craft specialists in product manufacturing	70% [118]	4% [6]	26% [44]
Distribution of extraction site products:			
Supra-regional 200+km	64% [107]	0	12% [22]
Regional 100-200km	17% [28]	0	
Local >100km	7% [11]	0	
Evidence for the ceremonial use of extraction sites	33% [55]	2% [3]	65% [110]
The presence of rock art/graffiti/idols at extraction sites	27% [46]	0	73% [122]
The presence of burials at extraction sites	18% [30]	0	82% [138]

Table 3:1. Extraction practises across all raw material types.

If this data is broken down by raw material type, i.e. stone, metals and minerals, the patterning remains broadly similar in emphasis – if not intensity – across most trends (Table 3:2). Many sites have storied associations, particularly stone and metal, but metal sources are more likely to be owned, and only a small percentage of any type of site will be permanently settled. Seasonal use is more prevalent with stone sources. The age/sex demographic of extraction site workers is male dominated at stone sources, whereas metals and minerals have a greater gender mix in the composition of the work teams. In terms of extraction



practises, ritualised procedures occur at roughly half of the stone and mineral sources, which may be associated with storied locations and lithologies, whereas metals may reflect different cultural perceptions of the raw material and the functionality of the end-product. Product distributions are predominantly supra-regional, especially metals and minerals, which suggests that extraction – often from storied locations – adds a significance to the biography of the product, increasing its cultural value beyond more mundane materials. The after-use of many extraction sites is also noteworthy, and adds to the creation of place and the objectification of the products.

<b>Trends/attributes</b>	<b>Stone [n=124 of 168]</b>	<b>Metals [n=29 of 168]</b>	<b>Minerals [n=15 of 168]</b>
Mythologised source	73% [n=91]	83% [n=24]	40% [n=6]
Ownership of source	39% [n=48]	83% [n=24]	40% [n=6]
Seasonal use/permanent occupation of sites	54% [n=67] 6% [n=7] sites permanently occupied	17% [n=5] 0 sites permanently occupied	20% [n=3] 7% [n=1] site permanently occupied
Age/sex demography of extraction workers	68% [n=85] male  <1% [n=1] female	14% [n=4] male 69% [n=20] male/female/children 0 female	40% [n=6] male 33% [n=5] male/female/children 7% [n=1] female
Ritualised extraction	46% [n=57]	28% [n=8]	47% [n=7]
Ritualised reduction	39% [n=48]	69% [n=20]	53% [n=8]
Artefacts ritual/functional	67% [n=83] ritual/functional 6% [n=7] ritual 20% [n=16] functional	83% [n=24] ritual/functional 3% [n=1] ritual 14% [n=4] functional	73% [n=11] ritual/functional 0 ritual 20% [n=3] functional
Craft specialists	64% [n=79] male 3% [n=4] female  33% [n=41] unspecified	66% [n=19] male 7% [n=2] male/female/children 17% [n=5] unspecified	53% [n=8] unspecified
Product distribution	60% [n=75] 200+km 20% [n=25] 100-200km 8% [n=10] >100km	97% [n=28] 200+km 3% [n=1] 100-200km 0 >100km	80% [n=12] 200+km 7% [n=1] 100-200km 7% [n=1] >100km
Ceremonial use of extraction sites	31% [n=39]	52% [n=15]	7% [n=1]
Rock art/graffiti/idols	35% [n=44]	3% [n=1]	7% [n=1]
Burials	24% [n=30]	0	0

Table 3.2. Extraction practises by raw material type.

One important variable is the fact that not all toolstone was quarried, and many records exist of the *ad hoc* use of expedient surface stone sources for everyday functional tools such as scrapers (e.g. Allchin 1957).

Of interest in Table 3:2 is the variation between stone and metal extraction and that of minerals. In the case of minerals, it would appear that overall fewer sources were storied or owned. However, extraction teams were generally male or mixed gender, and ritualised extraction was practised in roughly half of the examples. Mineral use was destined for ritual or functional purposes and product distribution was predominantly long-distance, all of which broadly mirrors the patterning in stone and metals. Conversely, mineral sites have much less use as ceremonial arenas, little use of rock art, and no burials, suggesting overall the raw material source was viewed differently to stone and metals but the practise and product trajectories were similar.

The following sections and tables present the range of associated features for each ethnographic theme, thus creating a typical character profile for each recorded attribute or practise.

### **3:3:2 *Storied/mythologised sources***

Many extraction sites appear to have storied or ideological associations which incorporate mythology, cosmology and/or community history, often as part of a system of legitimacy over resource ownership or exploitation, or as an explanation of the origin of the raw material, which can then feed into processes of product objectification (Bourdieu 1990; Godelier 1999; Gosden & Marshall 1999; Kopytoff 1986). These associations can operate at a variety of scales, either as part of an embodied entity such as a deified earth [e.g. Inka], or as a symbolic material given to a community by an ancestor or spirit after appropriate supplication [e.g. Lakota / Dakota; Dani; Wano; Aboriginal Australians]. The present ethnographic data set records 71% [120 of 168] of communities with storied extraction sites, compared to 5% [9 of 168] who view their raw material source as simply mundane; 24% [39 of 168] of case studies provided no data.

The ethnographic record does not always document the topographic settings of storied sites or the nature of the raw material, but where this data exists, many appear to be locally prominent or distinctive landforms, or comprise unusual or atypical deposits which are generally visibly different from adjacent features in terms of scale, shape, texture or colouration (e.g. Inka; Dani; Lakota/Dakota; Aboriginal Australians). It is the extraordinary character of storied deposits, combined with their distinctiveness or culturally important settings, which sets them apart from the norm. The inherent 'otherness' or setting of these raw materials has stimulated storied associations, and led to the identification of a material seen as being a part of a social narrative linked to the cosmology of the community. This association embeds a biography into these raw materials through these storied associations (and often ritualised extraction), which can then be used to underpin and maintain social networks, identity, status, and fulfil obligations.

The nature and scale of storied materials is variable, and ranges from the global with the earth as an engendered entity to specific mountains, exposed rock strata, individual boulders, nodules or cobbles, down to fine minerals. The global scale is most readily associated with the Inka, who viewed the earth as a female entity, Pachamama, but the mountains which hosted many of the storied raw materials were considered Apu, or male 'lords', thus constructing an engendered male – female dichotomy which replicated human fertility. These storied raw materials were often exploited via caves or mines, which were considered portals to the underworld and had to be treated reverentially through the use of idols, offerings, rock art and ritualised practises (Dean 2010). In the Ozarks, Native Americans also considered caves and rock shelters as origin places and entrances to the underworld, and many of these storied locations were exploited for flint clay extraction for use in the production of ceremonial objects, especially figurines (Emmerson & Hughes 2000).

Mountains can reveal unusual surface deposits such as the northern Californian volcanic obsidian flows, whose glass-like deposits are starkly different to the underlying country rock of their surroundings, and have led to many Native American communities viewing them as containing '*atishwin*', a transferrable supernatural power (Robinson 2004). Exposures of different raw material can

also be seen on the Plains, where the pipestone in Minnesota broke the ground surface in the foreground of a locally-prominent cliff face, and became mythologised by many Plains tribes (Hughes & Stewart 1997). The Hidatsa targeted the higher buttes west of the Missouri to quarry for their toolstone, which were storied places associated with ceremonialism surrounding the springtime Big Bird ceremony (Bowers 1992).

On a smaller physical scale storied sites can comprise individual boulders, such as those of nephrite used by the Maori who believe that they are the fossilised bodies of fish which travelled with the first Maori settlers (Field 2012). Smaller still, river cobbles form the storied sources of many New Guinea highland communities, who believe that this toolstone is the remains of the bodies of supernatural beings, or significant ancestors, and has to be treated reverentially by ritual specialists to successfully 'free' the material. At the Yeineri quarries, for example, the storied locations along the Kembe River comprise boulders and outcrops which are controlled by the spirit Elogor who has to be appeased before quarrying can begin (Hampton 1997, 695). Similarly, at the Ngilipitji quarry in Arnhem Land, Aboriginal Australians view the quartzite nodules as supernatural 'eggs' and part of the Dreamtime pantheon and subject to due deference and ritualised practises (Brumm 2011).

Minerals can also be storied. The Wilgie Mia quarries, exploited by Aboriginal Australians, are linked to Dreamtime cosmology with the ochre believed to be the liver and gall of an ancestor known as Mondong (Flood 1995). This ochre was exchanged widely because of this significant storied association.

Consequently, in terms of storied associations, raw materials are generally visually distinctive in nature, differing from the norm. Storied associations appear to operate on two levels, firstly that which is linked directly to an omnipresent entity and represents part of that entity's body, or secondly, it is a material which is curated by an ancestor or spirit who needs to be appeased to gain access and allow successful extraction and product manufacture. In the case of the latter, some sites may not be considered 'sacred', but their associations with spirits or ancestors (e.g. the Yeineri quarries, see above; Hampton 1997, 695) still defines them as storied locations.

<b>Storied/mythologised source [n=168]</b>	<b>71%</b>	<b>120</b>
<b>Attributes</b>	<b>% of key attributes in data sub-set [n=120]</b>	<b>No. of records in data sub-set [n=120]</b>
Raw material type	n/a	n/a
<b>Storied/mythologised source</b>		
Ownership/restricted access	50%	60
Seasonal use of the resource	54%	65
Permanently settled	5%	6
Age/sex demographic of the extraction site workers:		
Adult men	62%	75
Women	1.5%	2
Men, women & children	12%	15
Evidence for ritualised extraction	52%	62
Evidence for ritualised reduction	48%	58
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	71%	85
Functional	10%	12
Ritual	5%	6
Wealth/status objects	1.5%	2
Involvement of craft specialists in product manufacturing	74%	89
Distribution of extraction site products:		
Supra-regional 200+km	76%	91
Regional 100-200km	12%	15
Local >100km	12%	14
Evidence for the ceremonial use of extraction sites	44%	53
The presence of rock art/graffiti/idols at extraction sites	37%	44
The presence of burials at extraction sites	25%	30

Table 3:3. The evidence from storied/mythologised sites.

One of the recurrent features of cosmological links with raw material sources is that they are often a female engendered entity, such as ‘Pachamama’<sup>11</sup>, the Earth Mother of the Inka (Dean 2010, 36-39; 68). This female-gendered principle provides a ‘global-scale’ platform for many cosmologies, which is manifested on a local scale by focussing upon specific landscape features for separate and/or complementary embodiment. In cases where ancestral or supernatural figures are recorded, female characters also appear to predominate. For example, at the Pipestone Quarries in Minnesota, Buffalo Calf Woman is credited with providing the red pipestone for the Plains tribes which institutionalised smoking rituals (Hall

<sup>11</sup> Conversely, although Pachamama was a female entity, the Inka considered the mountains (Apu) as masculine.

1997, 77-85; Matthiessen 1989, 432). In New Guinea the Una, who operate the Langda quarries, revere a mythical woman known as Alim Yongnum who “*gives birth’ to the stones in the Ey River and controls their availability*’ (Stout 2002, 704), and Murbilik Kue, a male spirit, who owns the toolstone (Hampton 1997, 747-756). The Wano (New Guinea) invoke the Mother of Axes to assist in freeing the toolstone from the parent rockface (Pétrequin & Pétrequin 2011; 2012). Consequently, a female-engendered cosmology can be viewed as the ideological affirmation of female fecundity and its role in the provision of valuable resources, in this case toolstone, metal ores and important minerals, which are often delivered by ritualised practises. The counterpoint to such female engenderment of sources is that it is generally adult men who form extraction teams (62% [75 of 120]) and then create objects which carry a biography, transforming a female-derived substance (e.g. toolstone/pipestone) into a symbol of male power.

If we consider the evidence for storied sites against other themes (generally from smaller data sets, see Tables below), slightly different emphases occur, although they still follow the general trends outlined in Table 3:3 above: 79% [59 of 75] of owned sites are storied; 88% [65 of 74] of seasonally-used sites are storied; 93% [62 of 67] of sites practicing ritualised extraction are storied; 82% [97 of 118] of sites involving craft specialists are storied; 96% [53 of 55] of sites with pre- or post-extraction ceremonial activity are storied; 96% [44 of 46] of sites associated with rock art are storied; and 100% [30 of 30] of sites associated with burials are storied (see also 3.2 below).

Consequently, if Neolithic mines and quarries were storied locations, we would expect to see evidence of seasonality, ritualised extraction – mostly by men - craft specialists, functional tool production, supra-regional product distribution, some evidence of ceremonialism, certain sites with rock art or graffiti, and rare burials, all found at extraction sites which are often locally different in terms of topography or the character of the deposit.

### ***Selected ethnographic case studies:***

The Red Pipestone Quarry, Minnesota, is imbued with a far-reaching ideological significance to many Plains communities who believe the Great Spirit and/or Buffalo Calf Woman created the pipestone or bequeathed the sacred pipe and

smoking rituals to the Plains tribes (Figure 3.1; cf. Hall 1997, 77-85). Symbolically, the red pipestone holistically embodies the Native American life experience, a fact epitomised by an 1836 encounter between George Catlin and Plains tribes when he was told '*You see (holding a red pipe to the side of his naked arm) that this pipe is a part of our flesh. The red men are a part of the red stone*' (Matthiessen 1989, 432). Consequently, the pipestone quarries centre indigenous ideologies firmly in this point in the landscape, and create physical links between the Plains communities and the spiritworld by objectifying the raw material.

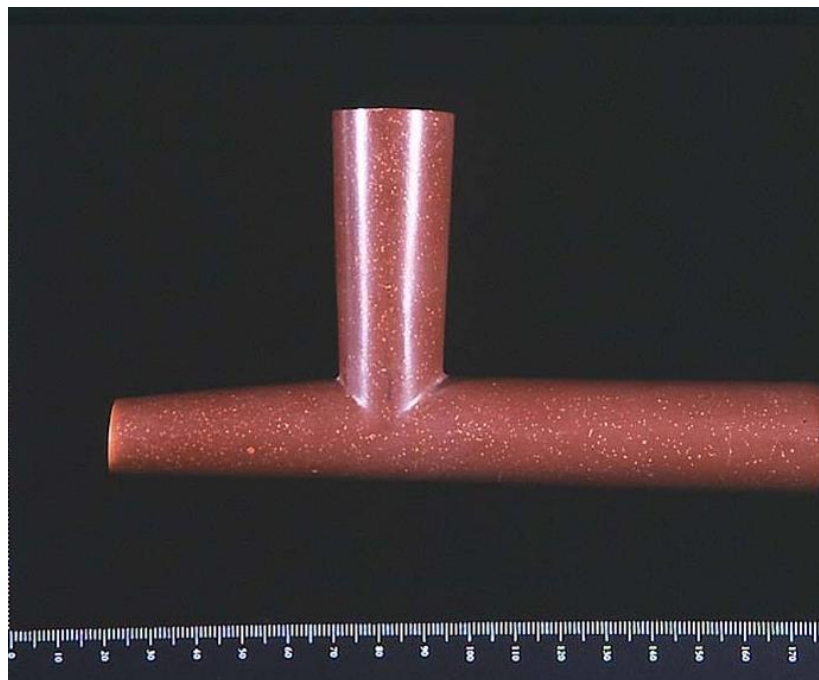


Figure 3:1. A Plains-type tobacco pipe made from Minnesota pipestone.

The Hidatsa of the Midwestern Plains practised ritualised flint procurement and tool production, both activities controlled by sacred bundle keepers. The raw material was sourced from the higher buttes and uplands to the west of the Missouri, and procurement was initiated by the springtime Big Bird ceremony (Bowers 1992, 166; 370). Consequently, to the Hidatsa flint became embodied through its extraction context linked to tribal ceremonialism, and an enhanced cultural value embedded by ritualised reduction.

The Ojibwe of the Great Lakes held traditional beliefs surrounding *Mishebeshu*, the Underwater Manitou, who was believed to control food availability and access

to copper: *'It gave copper to the Indians, who cut the metal from the being's horns as it raised them above the surface of the water ... Those who attempted to take the copper without offering proper payment met severe punishment from the Underwater Manitou. It was a creature to inspire terror and awe, as well as reverence'* (Vecsey 1983, 74-75, quoted in Clark & Martin 2005, 118-119). For the Ojibwe offerings to the Underwater Manitou were an essential preliminary to copper procurement, which ensured success and maintained a balance with the supernatural world.

In California many extraction sites were believed to be special places, embodied with *'atiswin'*, a transferrable supernatural power which could be manipulated by following the correct protocols (Robinson 2004, 97).

*'In the South American Andes, in the fifteenth and early sixteenth centuries, the Inka (Inca) framed, carved, sat on, built with, revered, fed, clothed, and talked to certain rocks'* (Dean 2010, 1). In Inka cosmology many topographic features were kratophanic, places where humans could interact directly with powerful numina. These *waka* could be natural landforms, man-made structures, or a combination of both - Andean spirits rarely inhabited representational statuary. The Inka believed that supernatural essence was transubstantial and independent of form, consequently the materiality of stone was also considered transubstantial and represented a living entity whose animacy has simply been 'paused' for a period of time. The Inka relationship with stone was aniconic, which considered lithic forms and materials as endowed with meaning, and such anicons could embody entities, ideas or actions. Consequently, stone as a substance could be both sacred and profane, and was capable of actively participating in the natural environment and on the cultural stage. The embodiment of landscape features did not include all rocks. However, the cosmology was selective and only rocks deemed to be special and beyond the ordinary were revered. It was the *potential* animacy of a rock or landform rather than any superficial appearance that created significance to the Inka. These *waka* became foci for ritual activity and received offerings, which included llamas or even children, and were used to legitimise claims to an area. Interestingly, the special nature of rock as a medium for embodiment allowed it to transfer an essence to different places by simply removing a piece of the original to the new



location as a portable metonym. Indeed, in Inka stories soil and rock are metaphors for flesh and bone, consequently much of the landscape was considered parts of a procreative 'body' (ibid., 1-22; 62; 75; 177).

Landscape features were important to the Inka. Mountains, for example, were considered sacred, and believed to be *Apu* (lords) who were powerful, male entities that watched over communities and controlled weather patterns. In contrast, other Andean cultures personified the rugged highlands as *Mama Quqa* (Mother Rock), and certain powerful rocks could be engendered as female. Although female gendering is common overall, this example demonstrates that contemporary, adjacent communities can adopt different gender schemes for the cultural landscape. Caves were believed to be portals to the underworld or the supernatural, places where worlds converged. Caves and crevices were considered feminine origin places from where the ancestors first emerged to populate the world. Rock art was used to decorate these trans-dimensional portals to symbolise transition and orchestrate encounters with the supernatural (ibid., 27-34; 55-61; 73; 95).

Inka quarries were considered sacred and the raw material became a metonym of their point of origin. Oral histories recounted stories of certain 'weary' or 'tired' quarried building stones which refused to cooperate with Inka builders, so were abandoned. An analysis of these legends suggests that the 'tired' stones were deliberately abandoned at the end of a construction project to create a memorial to the quarry, and provide a focus for rituals and offerings (Dean 2010, 50-54).

The Inka gold and silver mines were believed to lie at an interface with the spiritworld, excavated into the flanks of animate mountains. Preliminary rituals were conducted before mining could take place to petition the mountain to surrender its mineral wealth. The focus of these rituals was the '*huaca*', an idol which embodied the spiritual essence of the mountain. The *huaca* was crafted from a block of stone which comprised the metals and minerals being sought. The late 16<sup>th</sup>-century Spanish ethnography records that these idols were petitioned and prayed to, toasted with appropriate drinks, and encouraged to release the metals. Cosmologically, the metal mines occurred at the conjunction of the Inka Upper and Lower Worlds, which meant that extraction became a

direct engagement with the spirits of the mountain, facilitated by the ritualisation of the mining process (Saunders 2004, 126). In parallel, subterranean tunnels and passageways – often adorned with graffiti - were also constructed by the Inka to enable communication with the innerworld of the Ancestors and Pachamama (Dean 2010, 90-91).

Brumm (2011, 92) states that *'The evidence from [Australian] Aboriginal myths, whilst incomplete, seems to hint at the importance of stone axes in the creation of the Kulin landscape by powerful Ancestral Beings'*. Indeed, it is hard to escape the conclusion that the sourcing and production of stone axeheads and minerals in Aboriginal Australia played a pivotal role in maintaining Dreamtime beliefs (Taçon 2004). On a metaphysical level, procured stones and minerals are associated with the body parts/emissions which emanated from Ancestral Beings as they journeyed across the continent (Boivin 2004, 7). Similarly, supernatural forces at the Ngilipitji blade quarry, Arnhem Land, encourage quartzite to grow in the ground *'like a living thing'* and this *'pregnancy'* leads to the birth of *'baby stones'* or *'eggs'* of toolstone (Brumm 2011, 92).

In areas of northern Australia, implements of embodied toolstone is considered charged with a powerful Ancestral potency (Brumm 2004, 147). A variation of this can be seen at the Wilgie Mia ochre mine, Western Australia, where the ochre represents the place where a great kangaroo was slain by an Ancestor known as Mondong (Flood 1995, 271-273). Here the red ochre symbolises the blood of the kangaroo, its liver became yellow ochre, and its gall turned into green ochre deposits. The final leap of the kangaroo took it beyond Wilgie Mia to an adjacent hill known as Little Wilgie, which also appears to have been mined for ochre. The embodied ochre from these mines was highly valued for rituals, particularly red ochre, and lengthy expeditions were undertaken to procure it.

The western and central desert Aboriginal communities travelled great distances to procure Dreamtime-associated raw materials: *'some quarries occur at or near sacred sites – that is, totemic 'dreaming' places. People who believe themselves to be descended patrilineally from the particular totemic being at one of these sites will make special trips to the quarry to secure stone there. A man places a high value on stone from a site of his dreamtime totem. Stone like this is often*

*transported over long distance (as much as 500km) and is given to distant kinsmen of the same patrilineage ... [b]ecause of his patrilineal relationship to the site, a man sees the stone as part of his own being ...'* (Gould 1977, 164). As Brumm (2010, 179) has observed regarding the Mount William axeheads [a] *detailed consideration of the ethnohistorical evidence highlights the embeddedness of axe technology in cultural perceptions of landscape and the belief systems of Aboriginal people'*, and the interrelatedness between communities and their cultural landscape. Consequently certain stones and minerals are an integral part of 'being' Aboriginal, and a material representation of their Dreamtime identity.

One of the most potent myths associated with axehead production in southeastern Australia was fear of the 'Falling Sky', which centred on the belief that the sky was a great dome, held in place by timber props located in the Australian Alps which were maintained by a community of songmakers (Brumm 2010; 2011). During the early 19<sup>th</sup>-century the songmakers claimed the props were rotting, consequently they needed axes to cut new timbers and prevent the sky from falling. Although some communities panicked, it led to a general acceptance that axeheads had to be periodically gifted to the songmakers in times of crisis. Consequently, the *'large scale production of stone axes and/or the flow of axes across the landscape in south-eastern Australia may often have been motivated by religious concerns rather than the perceived social or economic benefits derived'* (Brumm 2011, 94). Conversely, it has been suggested that the Falling Sky incident was the ideological manipulation of stone resources by certain Alpine clans which allowed them to accumulate power and influence (ibid, 94). The fact that the Alpine clans had few toolstone resources, suggests this may have been a ploy to circumvent traditional exchange networks.

In the industrialised West the Neolithic flint mines on the summit of Harrow Hill, Sussex, had supernatural associations, as they were thought to be the final home of fairies in England. However, the fairies eventually left the hill when *'unbelieving archaeologists'* began to excavate the flint mines during the 1920s (Evans 1934). The nearby flint mines at Cissbury were also believed to have links with fairyfolk.

The Dani and other highland communities of the New Guinea highlands believe that the Ancestors emerged from caves or crevices; consequently they are considered sacred and used for ritual observations (Hampton 1997, 54-55). The origin myth describes how the first Ancestor was created from earth and rock: *'Rock is hard and is for man. Earth (or soil) is soft and adds flexibility'* (ibid., 55), therefore stone artefacts have an added potency through this association with origin myths. The wider cultural landscape is believed to be animate, which although not conscious, is inhabited by Ancestral (derived from humans) and non-Ancestral (mythical) ghosts and spirits, in essence an embodied landscape of the seen and unseen. Accordingly, highlanders are wary and placate the omni-present ghosts and spirits to prevent malevolent actions, particularly by ritual practises undertaken by the Big Man and pig festivals held in honour of the spirit world (ibid., 52-59). Unusual rock formations are one of the most potent locations inhabited by the supernatural entities, many of which are decorated with pictographs that are ritually re-activated every 4-5 years in ceremonies which involve rites of passage (ibid., 75).

Ideologically, stone artefacts used by New Guinea highland communities are believed to pre-exist within the toolstone strata which is derived from the bodies of mythological beings and significant ancestors, as described by origin myths. This knowledge is manipulated by ritual specialists who 'free' the axeheads from the toolstone. In the Yeleme massif fire-setting is used to free the toolstone which is believed to be the fossilised remains of the Primordial Giant who had emerged from a cave at the beginning of the world but was killed by the Wano and eaten. It is the supernatural power and ceremonialism of the ritual specialists who make the axeheads emerge from the bedrock. If, however, fire-setting fails, the quarry face is rubbed with pig fat to solicit the assistance of the Mother of Axes. The Una tribe also appeal to several female spirits for help to release adzeheads (Pétrequin & Pétrequin 2011, 339-340; 2012, 32). The involvement of female deities in many cultural contexts (e.g. North America, New Guinea) is a recurrent theme in the ethnography of extraction, creating male and female elements, with the male role often being fulfilled by the quarry teams and the female role being implicit in the ideologies linked to the extraction sites – the practise of extraction therefore arguably mirroring human procreation.

Amongst the Maori the green nephrite sources were linked to origin myths and considered sacred. These nephrite boulders are believed to be the fossilised bodies of fish which journeyed to New Zealand with the first Maori settlers. When crafted into meres (axeheads/adzeheads), some nephrite artefacts were considered embodied and used in ritual roles by the community (Field 2012, 58).

### **3:3:3 Ownership, or restricted access to extraction sites**

The ethnographic data records 45% [75 of 168] of sites have some form of ownership, ranging from individuals (e.g. village headman, New Guinea) to clans (Aboriginal Australia) or tribal groups (e.g. Lakota/Dakota). Ownership can be characterised in descending order as: unspecified ownership = 29 examples; tribal ownership = 22; clan = 15; village = 4; an elder = 3; and an individual = 2. Clearly of the specified data, corporate, group or village ownership is most prevalent.

Occasionally owned sites were/are permanently occupied (e.g. Mt William, Australia; Yeineri, New Guinea), but more often were 1-5 days march from the communities (e.g. North America, Australia, highland New Guinea). In all cases of owned sites access is restricted and procurement has to be negotiated and paid for. As Childs and Killick have observed *[t]echnology is not a monolithic force that is somehow separate from people, but is the product of complex ideology, careful social negotiations and manipulations, and the vagaries of local resources'* (Childs & Killick 1993, 333). Ownership is documented in all regions of the data set.

In contrast, extraction sites which are openly accessible are documented in 18% [31 of 168] of cases, predominantly amongst Plains peoples in North America (Lakota/Dakota, Mandan, Cheyenne, Sac and Fox, Pawnee, Kiowa, Ponca), but also Navajo in the American Southwest, the Western Dani and Wano in New Guinea, and the Mata'are of the Cook Islands.

The ethnography also records that 3% [5 of 168] of communities had no direct access to quarries and used imports, and 34% [57 of 168] of records provided no data (these two totals are combined in Table 3:1).

<b>Ownership/restricted access [n=168]</b>	<b>45%</b>	<b>75</b>
<b>Attribute</b>	<b>% of key attributes in data sub-set [n=75]</b>	<b>No. of records in data sub-set [n=75]</b>
Raw material type	n/a	n/a
Storied/mythologised source	79%	59
<b>Ownership/restricted access</b>		
Seasonal use of the resource	36%	27
Permanently settled	11%	8
Age/sex demographic of the extraction site workers:		
Adult men	63%	47
Women	0	0
Men, women & children	21%	16
Evidence for ritualised extraction	31%	23
Evidence for ritualised reduction	35%	26
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	60%	45
Functional	25%	19
Ritual	4%	5
Wealth/status objects	1%	1
Involvement of craft specialists in product manufacturing	76%	57
Distribution of extraction site products:		
Supra-regional 200+km	75%	56
Regional 100-200km	17%	13
Local >100km	7%	5
Evidence for the ceremonial use of extraction sites	21%	16
The presence of rock art/graffiti/idols at extraction sites	8%	6
The presence of burials at extraction sites	5%	4

Table 3:4. The evidence of ownership.

Most of the ethnography describes the control of resources by elders or hereditary officers, where cooperation and negotiation are used to licence access, generally in a trans-egalitarian social network. Established elites appear to be subservient to clan elders or ritual specialists concerning authority over extraction sites, but this authority does not often extend to wider powers over their communities.

Consequently, if Neolithic mines and quarries were owned, we could expect evidence of seasonality or permanent settlement, ritualised extraction, craft

specialists, functional tool production, supra-regional product distribution, some evidence of ceremonialism, a few sites with rock art or graffiti, rare burials, all at extraction sites located at topographically-distinctive landforms. However, this range of attributes could equally apply to sites not under ownership as Tables 3:3 and 3:4 demonstrate. The strongest archaeologically-visible evidence for ownership would be for topographically-distinctive settings coupled to 200+km product distributions.

***Selected ethnographic case studies:***

Native American sites have a range of ownership contexts. For example the Clear Lake (California) obsidian source was considered open access (Bryan 1950, 34). In contrast, the Pipestone Quarries (Minnesota) have a complex history of ownership. Although the Lakota (Sioux) claimed possession during the 19<sup>th</sup>-century, the Omaha, Mandan, the Sac and Fox all claimed previous ownership (Hughes 1995, 17). George Catlin recorded in the 1830s that *'tribes have visited this place freely in former times; and that it has once been held and owned in common, as neutral ground, amongst the different tribes who met here to renew their pipes'* (Matthiessen 1989, 435). It is possible that the shift from open access to tribal ownership was stimulated by contact with westernised concepts of land ownership.

The Mount William axe quarries, Australia, were located in the Kulin clan territory and were managed by a hereditary senior male clan head known as a *Ngurungaetas* who was positioned at the epicentre of axehead-manufacturing and distribution networks. The *Ngurungaetas* were normally reputed songmakers who communicated religious knowledge and were part of the political hierarchy. The *Ngurungaetas* had free passage through distant clan territories and their role meant that *[t]hese powerful and influential figures controlled the religious knowledge for the quarry and, hence, ultimately determined its significance to others'* (Brumm 2011, 94). The *Ngurungaetas* had the status and authority to embed biographies into the Mount William axeheads to enhance their power and desirability.

One of the last *Ngurungaetas* was Billibellary who held clan authorisation to live alone at the quarry; his nephew Bunggerim covered his absences (Howitt 1904). Neighbouring Kulin clan members who wished to obtain toolstone from Mount William had to follow strict conventions and meet Billibellary to exchange gifts for greenstone (Howitt 1904, 312). Aboriginal quarry custodians could face disgrace or death if they neglected their duties to protect sacred quarries; their responsibilities included complete control over access (Boivin 2004, 11).

Wilgie Mia ochre mine was in the custodianship of elders, who were the only miners allowed to enter all parts of the supernaturally-charged mine. Non-initiates could not enter certain areas (Flood 1995, 271-273).

In the New Guinea highlands the cycle of intra and inter-tribal warfare, which occurred every 6-9 years, could prevent access to quarries (cf. Diamond 2012, 119-128). During times of peace, however, many communities might access certain non-owned quarries, such as those on the Yeleme massif. Overall *'individual expeditions are episodic and take place at irregular intervals'* (Pétrequin & Pétrequin 2011, 342-343).

The Yeineri quarries in the New Guinea highlands lie near the interface with the lowland Dismal Swamp. The quarries lie in the territory of the Wano, who control access and have an on-site settlement which is subdivided into residential kinship segments, which provide the quarry work groups. Some 240 adults plus children inhabit the settlement, and it was larger when quarrying was more regular pre-contact. The Yeineri ('Source-of-the-Axe-Rock-River') clan are the controlling group, some of whom are related, and only relatives participate in group decision making in consensus with the most influential Big Man in an egalitarian system. Each work group independently quarried raw material and had direct ownership over all products, tool production, and distribution. Interestingly, the implements produced at this quarry are considered profane, even the outsized Ye-Yao blades. The hardness and colour of the stone are key criteria in establishing value. Distant relatives can be given permission to quarry for personal use or trade, but they must have their products inspected by quarry leaders. In addition, on rare occasions members of other tribes such as the Dani, Damal and Moni



were given permission to quarry under certain restrictions regarding the inspection of the quarried stone and roughouts by the Wano quarry leaders (Hampton 1997, 686-698; 723-724).

The Tagime quarries, New Guinea, ranged along a 3-4km stretch of the Tagime River, exploit river cobbles. These quarries serve a number of hamlets along the river. Unlike the example of the Yeineri quarries (above), Tagime has unrestricted access for the tribe, but non-tribal members were prohibited from collecting raw material. Apprentices exist at Tagime (generally related adolescent males) and are provided with on-site training (Hampton 1997, 725-732; 741).

The Langda quarries, New Guinea, are scattered along a 17km stretch of the Ey River drainage. The quarrying rights are owned by 11 hamlets of the Una tribe who each exploit their own section of the river for the manufacture of adzeheads and knives. In contrast, small quantities of stone for outsized ceremonial blades is sourced from hillside outcrops in Una territory. The Una hamlets have a typical New Guinean socio-political system centred upon a Big Man, and no one Big Man has ever had control over all contiguous quarry zones. The quarrying rights to each stretch of the river are owned by a single hereditary head quarryman within each quarry hamlet<sup>12</sup>, whose rights are passed down through patrilineal inheritance, and the roles of head quarryman and local Big Man can reside in a single individual. Quarrying rights only allow the head quarryman to take stone from the riverside nearest his hamlet and not the full width of the river, a situation necessitated by quarry hamlets which face one another on opposite banks. The head quarryman determines who has access, and occasionally grants permission to outsiders under supervision; in such cases the outsiders to provide food for the quarry work group. Similar traditions exist at the Sela quarries (Hampton 1997, 750-755).

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<sup>12</sup> Those hamlets in Una territory which do not have access to a quarry are forced to trade with the hamlets that do.

### 3:3:4 Seasonal use

Journeys to extraction sites could be ritualised as a controlling mechanism for the acquisition of raw materials, and often followed traditional routes through significant embodied landscapes. Returning with raw material was proof that the journey had been successfully completed. Socially, such raw materials acquired by ritualised journeys often fulfilled ceremonial obligations, underpinned social networks, and were used for initiations or rites of passage (cf. Boivin 2004, 10).

<b>Seasonal use of the resource [n=168]</b>	<b>44%</b>	<b>74</b>
<b>Attribute</b>	<b>% of key attributes in data sub-set [n=74]</b>	<b>No. of records in data sub-set [n=74]</b>
Raw material type	n/a	n/a
Storied/mythologised source	88%	65
Ownership/restricted access	36%	27
<b>Seasonal use of the resource</b>		
Permanently settled	11%	8
Age/sex demographic of the extraction site workers:		
Adult men	70%	52
Women	1%	1
Men, women & children	3%	2
Evidence for ritualised extraction	70%	52
Evidence for ritualised reduction	47%	35
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	82%	61
Functional	11%	8
Ritual	5%	4
Wealth/status objects	0	0
Involvement of craft specialists in product manufacturing	76%	56
Distribution of extraction site products:		
Supra-regional 200+km	70%	52
Regional 100-200km	13%	10
Local >100km	7%	5
Evidence for the ceremonial use of extraction sites	49%	36
The presence of rock art/graffiti/idols at extraction sites	49%	36
The presence of burials at extraction sites	32%	24

Table 3:5. The evidence for seasonal use / permanently settled sites.

In some cases, for example North America and New Guinea, climatic conditions determined when extraction could take place, and seasonality became a pragmatic response in 44% [74 of 168] of cases. However, in contrast, 5% [8 of

168] of sites are permanently settled by controlling clans (e.g. highland New Guinea) or quarry custodians (e.g. Australia). 0.5% [1 of 168] of the ethnography recorded a community with no direct access to a site who used imported products, and 50.5% [85 of 168] of the ethnography provided no data.

If Neolithic extraction sites were used seasonally, the data above suggests strongly that they would be storied locations, be used mostly by men, practise ritualised extraction, involve craft specialists, produce functional tools, have supra-regional product distribution, evidence of ceremonialism, and a few sites will feature rock art, graffiti and rare burials (see Chapter 4:3:10).

### ***Selected ethnographic case studies:***

During procurement treks to obsidian sources Wintu[n] groups in California fasted for the duration of the round trip to the quarries, creating a 'semi-religious' experience as part of extraction practise (Dubois 1935; Robinson 2004, 97).

Amongst Aboriginal Australians long-distance expeditions were undertaken to the Wilgie Mia ochre mine to procure ochre for ceremonial puposes (Flood 1995, 271-273). Even at a regional level, the Dieri tribe from Cooper's Creek collected ochre from the Flinders Range quarries which involved a journey of some 500km annually, the return trek carrying individual loads of 30 kilos (Taçon 2004, 34).

In New Guinea certain quarry expeditions were led by warrior 'entrepreneurs' whose motivation appears to be the rapid accumulation of wealth and power (Pétrequin & Pétrequin 2011, 342). The scale of seasonal movements ranges from the Wano of Yeineri who live 1 day's march from amphibolite schist quarries, and knap their roughouts on-site; whereas the Dani live 4-5 day's march from these quarries but take raw material back to their settlements to manufacture artefacts (Pétrequin & Pétrequin 2011, 338). Although the Wano live on-site at some Yeineri quarries, they also continuously prospect for new sources of stone in favourable areas within a radius of 2-3 days walk. If the prospection is successful and good quality toolstone is discovered, then Elogor, spirit owner of the land, is left offerings of food at 'special places' (Hampton 1997, 696).

The Yeineri complex comprises 9 quarries ranged along 15km of the Ye River drainage, with the lowest at Diarindo located at 645m ASL and the highest at Awigowi lying at 1,500m ASL. The hub of the complex is the eponymous Yeineri hilltop settlement which controls access and initiates quarry expeditions. The settlement lies only c.200m from its two closest quarries, three others are 3-6 hours walk away, and the remainder between 2-7 days walk. The most distant source, the Biganme quarry, is a 7 day trek from Yeineri beyond the Ye River drainage; this quarry may have been an obsidian source, which considering the lack of obsidian implements in circulation, may have been removed from profane use and reserved purely for sacred purposes. Expeditions by the Wano to the Yeineri quarry complex are stimulated by the needs of the quarryman or his relations, and the exchange value of implements. The economic base of the Wano means that they are stone rich but pig poor, whereas their neighbours the Dani are potato and pig rich but stone poor, creating the perfect symbiotic relationship between tool producers and forest farmers (Hampton 1997, 715-718).

Demand often initiates extraction at the Tagime quarries, either to meet functional requirements, or for ritual or ceremonial purposes. Interestingly, regardless of the demand, extreme weather, particularly unpredictable flash floods, can reveal new sources and prompt expedient quarrying along the Tagime River. The Tagime expect 1-3 flash floods each year, which will lead to foraging for suitable boulders. Indeed, Tagime quarry workers are often proactive and undertake prospection as a year-round activity (Hampton 1997, 741; 746). Similar practises occur at the Langda quarries where activity is also triggered by flash floods. However, between flood-triggered events, the head quarryman oversees quarrying to meet local demand and requests from outsiders. Quarrying and tool manufacturing are weather-dependant and rarely take place during the rainy season between June and October (Hampton 1997, 756).

*'The timing of the expeditions is entirely regulated by social demands, ... the regularity of ceremonial exchanges between partner villages, undertaken to pay funerary compensation at the end of a war (blood payments), for the re-establishment of peace, or for new marriage alliances'* (Pétrequin & Pétrequin 2011, 340). It is during social events that axehead roughouts were exchanged,

and in return producers received wealth and prestige objects such as pigs, marine shells and new wives. Such transactions were pivotal in building or maintaining kinship links, alliances and exchange partnerships.

On South Island, New Zealand, the Maori from the Poutini Coast undertook sea journeys every 20-30 years to the greenstone sources at Anita Bay on the north coast of North Island, a sea-crossing of several hundred kilometres (Coutts 1971, 65).

### **3:3:5 Age/sex demographic of extraction site workers**

The age/sex demographic of extraction site workers is predominantly adult male (in North America, Australia (Figure 3.2), Europe, New Guinea), with mixed gender teams involving children at a minority of sites (in Africa, New Guinea, New Zealand), and a very small percentage of female-only enterprises (in Africa, Australia). Certain of the male teams and most of the mixed gender teams feature children in support roles, usually as (male) apprentices.

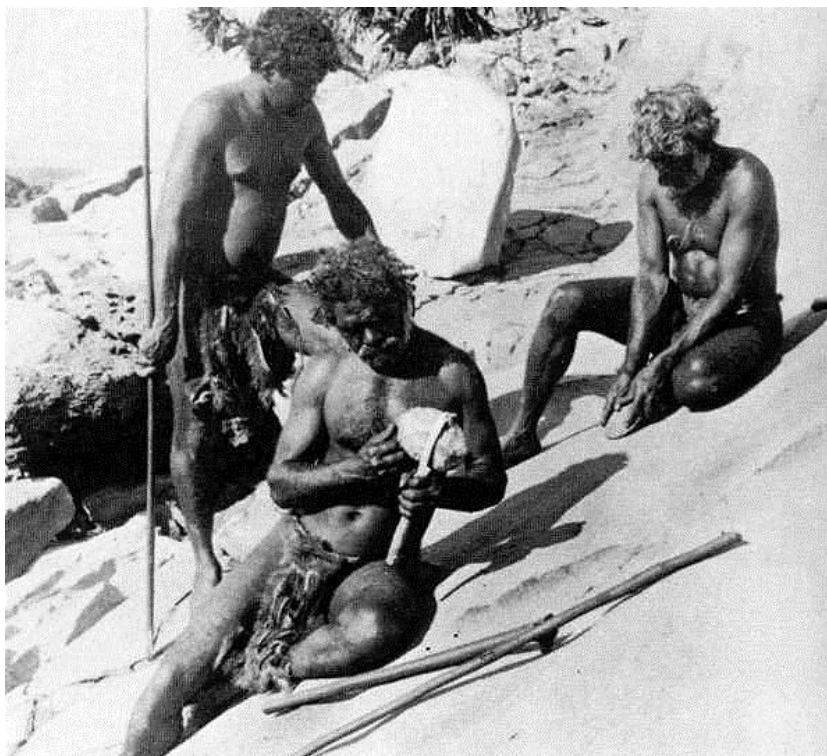


Figure 3:2. Aboriginal Australians crafting axeheads at a quarry site (© Don's Maps).

The ethnography records 131 [of 168] studies where the age and sex of the extraction site workers is documented. Of these 82% [108 of 131] were male single sex teams, 16% [21 of 131] involved mixed gender teams and children, and 1.5% [2 of 131] were female single sex teams. 37 [22% of 168] studies provided no data.

The rare ethnography which records females in lead roles, or comprising single sex teams, occur in Africa amongst the Konso where stone procurement and tool manufacture is considered a female activity (Arthur 2010); and in Tasmania, Tiwi women of Mount Rowland formed single sex teams who mined ochre (Plomley 1966). Consequently, although these are exceptional cases, women do demonstrably undertake quarrying and mining in certain social contexts.

Age and gender roles are important aspects of the composition of extraction groups: male only groups generally practise ritualised extraction and produce heavily-objectified implements which are extensively distributed; mixed age/sex groups, often involving children, are less likely to practise ritualised extraction and products frequently have a potential ritual/functional duality and are also extensively distributed; and finally, female groups can use ritual practises and some products are extensively distributed (e.g. ochre; Plomley 1966).

The determination of the age/sex demographic of work groups in Neolithic extraction sites is problematic as the archaeological evidence comprises formal burials, casual interments, or body parts, which are difficult to confidently contextualise socially. Does the skeletal data represent workers or non-workers? This point will be returned to in Chapter 6 and 7.

### ***Selected ethnographic case studies:***

In the New Guinea highlands quarry workers are predominantly men. The role of women is largely restricted to supporting tasks such as food preparation on-site or at a distance, and assisting with the transport of stone and roughouts. Although there are no clear taboos preventing participation in extraction, women rarely participate in quarrying and actively remain at a distance from the quarry and tool production areas (Hampton 1997, 715-718; 806). At the Tagime quarries apprentices observe tool grinding processes and provide support roles

(Hampton 1997, 741). Families are allowed to accompany the quarrymen to the Langda riverine quarries, where they fulfil support roles (Hampton 1997, 755).

Amongst quarries in the Yeineri complex, work groups comprise 5-10 men who spend up to 3 days to procure sufficient stone to produce 10-15 Ye-yao blades. Although these quarries are generally not considered sacred, women rarely visit them but stay in off-site bivouacs with the food cache. In general, quarry expeditions are organised by the quarry leaders and the local Big Man, and each group comprises 5-12 men which have to participate in ritual performances before and after each expedition to ensure success and appease the spiritworld (Hampton 1997, 698-718).

### **3:3:6 Evidence for ritualised extraction**

40% [67 of 168] of the ethnography documents ritualised extraction practises. The greatest concentration occurs in North America [32], followed by New Guinea [16], Australia [14], Europe [3] and South America [2], which demonstrates that this phenomenon was not geographically-restricted. Conversely, the ethnography recorded 4% [6 of 168] of cases where ritualisation was definitely not practised. 56% [95 of 168] provided no data.

Many of the North American data relate to the pipestone quarries, Minnesota, by the Lakota/Dakota. However, the Mandan, Hidatsa, Athna, Dena'ina, Yakutat, Oglala, Cheyenne, Sac and Fox, Pawnee, Kiowa, Ponca and Navajo all practised ritualised extraction in the Midwest, Plains, Northwest and Southwest. In New Guinea, ritualised extraction occurred amongst highland tribes such as the Tungei, Kawelka, Tipuka, Palke, Tumulke, Okimeni-Kisingambka, Make, Wano, Western Dani, Una, Kimyal, Dani and Ormu, demonstrating widespread practises. In Australia the Yolngu, Jawoyn, Wardaman, Nunggubuyu, Tiwi, Ngawayil, Kakadu, Warramungu, Yir Yoront, Wiradjuri and Gunwinggu peoples use ritualised extraction. Taken together, this evidence demonstrates that the practise of ritualised extraction occurs in many distant places and unrelated cultural contexts and is not an isolated response, it is a mechanism which

connects resource procurement directly to the cosmology and ideologies of indigenous communities, centring people in a place.

If Neolithic extraction sites followed ritualised practises, we would expect them to be storied locations, used mostly by men, incorporate placed deposits in the workings, involve craft specialists, produce functional/ritual objects, have supra-regional product distribution, evidence of ceremonialism, and some sites will feature rock art, graffiti and rare burials.

<b>Evidence for ritualised extraction [n=168]</b>	<b>40%</b>	<b>67</b>
<b>Attribute</b>	<b>% of key attributes in data sub-set [n=67]</b>	<b>No. of records in data sub-set [n=67]</b>
Raw material type	n/a	n/a
Storied/mythologised source	93%	62
Ownership/restricted access	34%	23
Seasonal use of the resource	78%	52
Permanently settled	0	0
Age/sex demographic of the extraction site workers:		
Adult men	73%	49
Women	0	0
Men, women & children	0	0
<b>Evidence for ritualised extraction</b>		
Evidence for ritualised reduction	52%	35
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	79%	53
Functional	10%	7
Ritual	3%	2
Wealth/status objects	0	0
Involvement of craft specialists in product manufacturing	71%	48
Distribution of extraction site products:		
Supra-regional 200+km	76%	51
Regional 100-200km	13%	9
Local >100km	9%	6
Evidence for the ceremonial use of extraction sites	55%	37
The presence of rock art/graffiti/idols at extraction sites	58%	38
The presence of burials at extraction sites	37%	25

Table 3:6. The context of ritualised extraction.

***Selected ethnographic case studies:***

Mining and entering the earth is considered fraught with supernatural dangers by the Diné (Navajo) of the American Southwest, who follow traditional lore and



*'treat the land and each other with respect ... The Diné become sick upon entering mines that burrow beneath the earth's surface unless they say prayers for protection'* (McPherson 1992, 42).

Extraction at the Pipestone Quarries, Minnesota, is highly ritualised and traditionally begins with purification rituals lasting three days, involving a sweat lodge (Figure 3.3), prayers and pipe smoking. Offerings are placed near the quarry pit, or the nearby Three Maidens - a group of large erratics decorated with rock art and believed to be the residence of the quarry guardian spirits (Winchell 1983, 15-18; Holmes 1983, 31; Scott & Thiessen 148-149). Quarrying is then undertaken using hand tools which have been purified by 'smudging' with sage smoke and prayers (Holmes 1983, 21-27; Hughes 1995, 44-45). At the end of quarrying further purification rituals occur at a sweat lodge (Hughes 1995, 44-45). Traditional taboos prevented groups performing subsistence tasks near the quarries, nor could they camp within 3.2km (2 miles) of the quarries to maintain the sanctity of the location (Hughes & Stewart 1997, 9).



Figure 3:3. A sweat lodge at the Pipestone Quarries, Minnesota, recorded in 1998.

In California many Native American communities consider obsidian to be toxic; consequently extraction and handling followed prescribed practises to counteract negative power. An example of such practises may be an animistic cache comprising abalone shells and the upper mandible of a raven's beak discovered in a remote Chumash microblade quarry (Robinson 2004, 97).

In the Andes certain potters annually sacrificed children to the deities who controlled the clay mines, sealing them alive within deep shaft tombs (Boivin 2004, 6).

Ritualised extraction at Wilgie Mia ochre mine, Australia, focussed upon the Ancestral Being known as Mondong (see 3:1:2 above) who slew a kangaroo on this spot, and continues to protect these mines. Certain areas of the mine workings were marked by small stone cairns to signal that only initiates could pass. Tradition stipulated that mining tools had to remain in the workings, and when leaving the miners had to retreat backwards while dusting away any footprints so that Mondong could not track and kill them (Flood 1995, 271-273).

Ritualised extraction was not confined to traditional societies but can be found in westernised contexts amongst the 18<sup>th</sup> and 19<sup>th</sup>-century tin mines of Cornwall where mythical 'knockers' inhabited the deepest workings and had to be appeased to ensure success and safety. Although the knockers were generally considered benevolent, they demanded respect and expected food offerings or tallow to be left for them in the remote parts of the mines or dire consequences could ensue (Bottrell 1873, 186).

At Ormu, New Guinea, a large sacred hammerstone is believed to be an oracle and has the power to authorise new quarry workings (Pétrequin & Pétrequin 2011, 340). However, at the Yeineri quarries, operated by the Wano tribe, the quarrymen conduct rituals to placate a powerful, omnipresent spirit called Elogor who owns the land and is given offerings of tobacco or foodstuffs to ensure success and safety. Curiously, although this ritual activity focusses upon the deity who owns the land, the quarry users do not view the extraction sites as sacred (Hampton 1997, 695). The work groups have to perform rituals both before and after quarry expeditions (*ibid.*, 715-718). Similarly, at the Tagime quarries, the toolmakers conduct rituals within their clan groups at both the

beginning and end of quarrying to propitiate the spirits and to ensure high quality stones are discovered (Hampton 1997, 726-732).

The Una, who own the Langda quarries, New Guinea, provide offerings and prayers to spirits associated with quarrying. Much of this ceremonialism revolves around the use of ancestral skulls which are curated in the men's house. These skulls are believed to possess 'great spirit power' and have the ability to mediate with the spirits to provide good toolstone. Traditionally, a shaman from each quarry hamlet conducts the rituals to seek permission to quarry. Vegetable offerings, and occasionally a pig, are provided for a female spirit called Alim Yongnum who owns the land surrounding the river, and to a male spirit known as Murbilik Kue who owns the toolstone. Prayers are also repeated to appeal for good weather. At the outset of quarrying the head quarryman, who is also the quarry owner, bathes in the Ey River during which he will quietly murmur incantations to the spirits. The gendering of the land and the toolstone as female and male respectively, again links extraction to human reproduction.

A further element of Langda quarry ritualisation draws upon sacrificial pig rituals which provide sanctified pig fat for quarrying. This fat is used to anoint selected boulders to beautify them and appease the spirits who inhabit them. At the end of the quarrying boulders are rubbed and 'blessed' as part of renewal rites to ensure good quality toolstone during the next expedition.

The ritual cycle at Langda included a major ceremony known as Yowali, occurring roughly every 5 years, when prayers were offered to the Ancestral skulls for permission to quarry and for a steer to the best toolstone (Hampton 1997, 755-756; 780; 799-803).

The Tungei, New Guinea, attribute their quarrying success to ritual purity and the use of the correct axehead-making magic (Boivin 2004, 11-12).

### **3:3:7 Evidence for ritualised reduction**

The ritualised reduction of material from extraction sites is recorded by 40% [68 of 168] of studies, 6% [9 of 168] record non-ritualised practises, and 54% [91 of

168] produced no data. Ritualised reduction is generally part of a process which seeks to appease supernatural forces during manufacturing. In part this also embeds a biography into the object, as is exemplified by the Sabarl axehead with its 'richly layered iconography' which incorporates human physiology and reproduction (Battaglia 1990, 133-134).

<b>Evidence for ritualised reduction [n=168]</b>	<b>40%</b>	<b>68</b>
<b>Attributes</b>	<b>% of key attributes in data sub-set [n=68]</b>	<b>No. of records in data sub-set [n=68]</b>
Raw material type	n/a	n/a
Storied/mythologised source	85%	58
Ownership/restricted access	38%	26
Seasonal use of the resource	51%	35
Permanently settled	3%	2
Age/sex demographic of the extraction site workers:		
Adult men	60%	41
Women	0	0
Men, women & children	24%	16
Evidence for ritualised extraction	51%	35
<b>Evidence for ritualised reduction</b>		
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	79%	54
Functional	14%	10
Ritual	6%	4
Wealth/status objects	0	0
Involvement of craft specialists in product manufacturing	98%	67
Distribution of extraction site products:		
Supra-regional 200+km	76%	52
Regional 100-200km	3%	2
Local >100km	12%	8
Evidence for the ceremonial use of extraction sites	60%	41
The presence of rock art/graffiti/idols at extraction sites	37%	25
The presence of burials at extraction sites	37%	25

Table 3:7. Ritualised reduction.

The symbolism of ritualised reduction can operate on different levels. In Africa for example, '*complicated technologies are made comprehensible by analogy to other natural or social processes. Metallurgy in Africa is explained by analogy to human physiology and to theories of social structure and social process*' (Childs & Killick 1993, 325). Consequently, ritualised reduction forms part of a continuum of renewal ceremonialism to maintain social networks. In the ritualised

manufacture of tools *'the modification of stone ... can sometimes be seen not so much as a creative activity, but instead as a release of entities already residing in the stone'* (Boivin 2004, 5), a process which can be harnessed to manipulate supernatural powers for specific needs or for ceremonial purposes (cf. Brumm 2004, 157).

Again, as with craft specialists, archaeologically the practise of ritualised reduction may be difficult to identify without material evidence of ideological practises, although features such as the specialised storage of materials and juxtaposed non-functional objects, both seen in the ethnography, may be potential archaeological indicators.

### ***Selected ethnographic case studies:***

Following ritualised extraction at the Pipestone Quarries, Minnesota (see 3:3:6 above), raw material is taken to workshops where preforms are crafted into tribal types of pipe, thus embodying identity into a portable artefact (Murray 1983, 84-85; Murray 1993, 5-11). If breakages occur during manufacturing, the fragments are returned to the quarry as an act of renewal; general debitage is treated similarly. The crafting of a pipe can take roughly 8 days, and each pipe was purchased directly from the craft specialist (Hughes 1995, 90).

Hidatsa flint knappers of the Midwestern Plains lived alone because of the ritualised nature of their activities, which were sanctioned by the keeper of the sacred arrow bundle. Knapping was undertaken in secret in a closed earthlodge by the light from the central hearth, and the flint was stored in covered cache pits around the perimeter of the earthlodge to maintain moisture and maximise workability. The solitary practise of knapping occurred because the Hidatsa believed that if the process was observed the flint would not fracture correctly (Bowers 1992, 166). Even on the west coast, the Maidu tribe of California followed ritualised knapping practises to ensure success (Robinson 2004, 97).

The Wano, New Guinea, undertake ritual acts at various stages of axehead production to appease Elogor and other spirits so that they will provide favourable conditions for axehead manufacturing, and to maintain equilibrium in the spirit

world (Hampton 1997, 695). Similar rituals occur at both the Tagime and Langda quarries to appease the spiritworld (Hampton 1997, 732; 755-756).

In Indonesia stone beaters for use in bark-cloth production are solely manufactured by the To Onda'e tribe, who are quarry specialists and tool makers who barter their products with lowland cloth producing communities. The To Onda'e quarry serpentinite using axes, and the shaped beater is scored with grooves before being 'cooked' in water containing plants with 'soul-stuff' to infuse strength into the implement. Following this the beater is rubbed with wax while warm to make it smooth and shiny (Kennedy 1934, 237). On Hawai'i axe-makers similarly placed blanks into a container holding a special liquid squeezed from the juices of plants which were thought to soften the toolstone. Following this roughouts were produced by flaking and grinding (Malo 1951, 51-52).

Moriori adze-makers (Chatham Islands) alleviated the '*laborious and tedious*' nature of grinding by singing a song which included an appeal for assistance to Hine-tchu-wai-wanga, the goddess traditionally associated with adze production (Smith 1892, 81).

### **3:3:8 Extraction site product typology**

Extraction site products have a range of uses from mundane functionality to esoteric ceremonialism (see 3:3:9 below). The predominant tool type is the axehead or adzehead, which occurs in 46% [77 of 168] of cases in North America, Australia, New Guinea, New Zealand and the Pacific. They can range from extravagant, over-sized, non-functional Ye-yao blades of New Guinea which can signify wealth, power, identity and social status, to relatively small work tools. The minor tool types comprise blades, knives and projectile points, but only represent 17% [29 of 168] of the finished products from the extraction sites. Of the total, 62 studies provided no data.

### 3:3:9 Extraction site artefact/product functionality

Extraction site artefact/product functionality: Functional/ritual; Ritual; Wealth/status objects [n=168]	76%	127
Attributes	% of key attributes in data sub-set [n=125]	No. of records in data sub-set [n=125]
Raw material type	n/a	n/a
Storied/mythologised source	91%	114
Ownership/restricted access	42%	53
Seasonal use of the resource	54%	68
Permanently settled	2%	2
Age/sex demographic of the extraction site workers:		
Adult men	53%	66
Women	1%	1
Men, women & children	17%	21
Evidence for ritualised extraction	46%	57
Evidence for ritualised reduction	50%	63
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual [n=117 of 168]	}	
Ritual [n=7 of 168]		
Wealth/status objects [n=3 of 168]		
[n=127]		
Involvement of craft specialists in product manufacturing	66%	83
Distribution of extraction site products:		
Supra-regional 200+km	72%	90
Regional 100-200km	14%	18
Local >100km	8%	10
Evidence for the ceremonial use of extraction sites	42%	53
The presence of rock art/graffiti/idols at extraction sites	31%	39
The presence of burials at extraction sites	20%	25

Table 3:8. Ritual and wealth objects.

A total of 156 [93% of 168] ethnographic studies record the functionality of extraction site products. This includes 76% [117 of 156] where products have a deliberate ambiguity, spanning both functional and ritual spheres. Originating as functional items, these objects have the potential to be transformed into sacred objects by ritual actions at an unspecified time in the future to meet particular needs or obligations. Consequently they have the inherent possibility of following divergent biographical paths which could lead them into different social uses than

their mundane appearance might suggest<sup>13</sup>. The remainder of the sub-set records only 4% [7 of 156] of sites producing purely ritual objects for ceremonial purposes, and 2% [3 of 156] produce purely wealth or status objects<sup>14</sup>, most of which define the social position of the owner. These categories of objects, because of their overlapping social roles, are considered together (Table 3:8). Sites which produce only functional items comprise 19% [29 of 156] of the data sub-set (Table 3:9 below). 8% [12 of 168] of the ethnography provided no data.

<b>Extraction site artefact/product functionality: Functional [n=168]</b>	<b>19%</b>	<b>29</b>
<b>Attributes</b>	<b>% of key attributes in data sub-set [n=29]</b>	<b>No. of records in data sub-set [n=29]</b>
Raw material type	n/a	n/a
Storied/mythologised source	41%	12
Ownership/restricted access	55%	16
Seasonal use of the resource	17%	5
Permanently settled	21%	6
Age/sex demographic of the extraction site workers:		
Adult men	55%	16
Women	3%	1
Men, women & children	0	0
Evidence for ritualised extraction	17%	5
Evidence for ritualised reduction	17%	5
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality: Functional		
Involvement of craft specialists in product manufacturing	76%	22
Distribution of extraction site products:		
Supra-regional 200+km	41%	12
Regional 100-200km	24%	7
Local >100km	7%	2
Evidence for the ceremonial use of extraction sites	3%	1
The presence of rock art/graffiti/idols at extraction sites	0	0
The presence of burials at extraction sites	0	0

Table 3:9. Functional objects.

<sup>13</sup> This category of objects can be reconfigured through ritual into symbols of wealth, for sacred purposes, or to fulfil social obligations, depending upon the circumstances of the object biography and the transaction being initiated. It is noteworthy that this category is by far the largest, and could have major implications for the interpretation of archaeological deposits.

<sup>14</sup> The ethnography does not always clarify precisely the differences between the wealth and status roles of objects, particularly how they relate to political power, and how this may work alongside sacred power and knowledge. This sub-set comprises wealth objects with overlapping ritual roles. The key difference with this sub-set is that these objects originated as wealth objects and did not have the ambiguity of the largest sub-set.



Archaeological indicators of functionality will include evidence/absence of wear, assemblage context and juxtaposition with other objects, and depositional practises such as hoards/caches discovered in features or structures. As a general rule, the absence of wear on an object must indicate careful curation and use in low-impact practises which may signify its engagement in non-functional uses.

***Selected ethnographic case studies:***

The Hidatsa crafted ceremonial flint knives for use in hunting rituals and increase totemism which were deposited at two locations, firstly a turtle effigy built on the northern bank of the Missouri, and secondly a snake effigy constructed from glacial boulders west of Independence. The ceremonies at the turtle effigy included '*offerings to the turtle ... Some left ... the flint knife ... for the flint was a sign of the big birds who go with the turtle and the other gods in the Missouri and the creeks around*' (Bowers 1992, 370). These ceremonial knives were produced by ritually-sanctioned knappers during significant spring ceremonies (see 3:3:10).

The Cheyenne curated four Sacred Arrows in a special medicine bundle which was the '*supreme tribal fetish*', believed to have been given to the Cheyenne by the mythological hero Sweet Medicine (Hoebel 1960, 7). These embodied artefacts are believed to hold power over the buffalo, people, and particularly enemies of the tribe. They also played a key role in renewal ceremonies. Similar empowered artefacts occur among the Ho-Chunk (Winnebago) tribe, who curate Seven Sacred Stones believed to have been given to the tribe by '*little people*', and are used in rituals. The Seven Sacred Stones were associated with a serpentine motif, and were recently rediscovered buried at the foot of a rock art panel which included a serpentine motif. The cache of seven projectile points had been placed in a large clamshell (Stanley 1999).

Arguably the most iconic Plains artefact is the tobacco pipe, pivotal to smoking rituals. The design of many pipes reflects tribal identity: disk pipes are typical of Iowa, Oto and Osage; elbow pipes are associated with northern and eastern Plains tribes; the micmac pipe is linked with the Blackfoot, Cree, Chippewa and Ojibwe; the Sioux pipe was found amongst the Dakota; and the Sioux variant pipe was common amongst the Mandan and Arikara (Murray 1983, 84-85;

Murray 1993, 5-11). The ritualisation of pipe smoking was/is a central element of tribal ceremonialism, ensuring that the pipe became an empowered artefact, reflecting tribal identity and practise.



Figure 3:4. Tchamajillas excavated at the Salmon Ruins Chacoan Great House, New Mexico.

The Puebloan 'tchamajillas' (slate and siltstone hoes; Figure 3.4) appear superficially to be functional tools but are embedded in Hopi ceremonialism, particularly the snake dance where they form part of the altar equipment: [a] *long pile of stone implements, regularly arranged, were placed at the back of the altar, and almost upon the green corn-stalks. These were all of green stone and slate, and ... were all agricultural implements, such as hoes, trowles [sic], etc'*. When this record was made in 1881 Bourke noted that such 'agricultural implements' had long since gone out of use and were restricted to 'religious ceremonies' (Bourke 1984, 125; 178-179). These implements are generally owned by clans within Puebloan communities. Puebloan Indians also believe that white flint

arrowheads can bestow the power of clairvoyancy on the owner, and that obsidian was an elixir capable of defeating diseases (Gunnerson 1998, 242-243).

Greenstone axeheads from the Mount William quarry, Australia, appear to have been preferred to similar quality axeheads from elsewhere, demonstrating their symbolic value for many Aboriginal communities in south-eastern Australia. Oral traditions link the quarry to Kulin tribal mythology. The quarry owner, or custodian, was a song-maker who conducted communications between the Ancestors, the Dreamtime, and his own community (McBryde 1979; 1984). Stone axeheads were generally empowered as masculine and age related icons, normally belonging to older men, who could lend these implements to younger men or women as a mechanism to maintain status and power (Boivin 2004, 9). In addition, stone axeheads had roles in burial ceremonies, the construction of sacred Bora Ring enclosures, in increase ceremonialism, and as totemic symbols (Brumm 2004, 150).

Robinson, writing between 1829-1834, describes the functionality of stone tools on Tasmania as being '*for ... dissecting food, affording relief to the afflicted body, modelling the destructive weapon, stripping the forest animal of its fur, etc*', which records the role certain stone implements had in traditional medicine (Plomley 1966, 190).

In New Guinea many communities have sacred power objects which originated as mundane, every-day, functional items but which have been withdrawn from secular use and transformed into sacred paraphernalia by ritual practises to manipulate supernatural forces (Hampton 1997, 279). Consequently the 'functional' appearance of an object can be deceptive. In certain areas ceremonial axeheads share the same characteristics as everyday work axes, particularly those originating from the Abiamp quarry (Chappell 1987, 79-81), thus axehead morphology is not always an accurate indicator of the meaning of an axehead (Figure 3:5). This is illustrated by the over-sized Ye-yao blades which emerge from a quarry initially for profane use, but the owner can choose to convert the implement into a sacred power object. The ritualisation of objects is believed to be a practise inherited from the Ancestors (Hampton 1997, 468-469).



Figure 3:5. A New Guinea axe with elaborate woven hafting in Manchester Museum.

The criteria for transformation can be social or political necessity, or indeed the rarity of the raw material. Transformations occur at significant events which create biography and social value. In fact *[t]he exchange of ownership by public display and presentation of the display-exchange stones [Ye-yao] not only fuels the economy by the repayment of debts and the establishment of new obligations, but it appeases the ghosts and ancestral and other spirits of the unseen world that are observing and listening to the proceedings. The many formal displays of these stone items of wealth before distribution also establish social prestige – when both humans and ghosts/spirits are alerted to the donor’s identification by loud pronouncements by ceremonial leaders’*. The transformative rituals seek to domicile ancestors or powerful spirits within the blades, who can

then be manipulated by ceremonies to maintain social order. The ancestral spirits are drawn from within the individual's patrilineage, with powerful leaders in life being most favoured. Although the highlanders have female ghosts and spirits, only male spirits are installed into the sacred objects. Taboos prevent sacred axeheads from being identified, discussed or functionally used (Hampton 1997, 468-476; 542-544).

Amongst highland communities sacred objects are owned by individual adult men but curated and worshipped within small socio-religious groups comprising 6-11 men drawn from a patrilineage. All adult men belong to a men's group, and each individual owns at least one sacred stone with supernatural powers which provides the focus for personal Ancestor worship, for defence against malevolent spirits, and also sun worship. Taboos prevent all females and uninitiated boys from participating in the use of sacred objects (Hampton 1997, 478-479; 542). Consequently, embodied New Guinea axeheads are considered sentient 'Ancestral Beings', which are treated with respect to placate and manipulate their powers, and repeated rituals feed, beautify and worship the implements to revitalise their spirit power (Hampton 1997, 545). In addition, certain types of artefact have specific symbolic roles. The Dani use stone chisels from the Yeineri quarries as representations of slain warriors in war ceremonies, and in their healer's kits; the same stone tools are used in the Baliem Gorge to protect healer's equipment from malevolent spirits (Hampton 1997, 617).

Conversely, the hereditary chiefs of the Sentani, New Guinea, use special axeheads in public ceremonies which are crafted from highly polished rare stones. These axeheads are carefully curated to avoid dulling the polish, and are packed in organic cases. Some are covered in latex to enhance their sheen, and are not hafted but simply held in the hand as symbols of status and power. It is object biography which enhances social value and restricts circulation and use to the local power elites (Pétrequin & Pétrequin 2011, 343-344).

The Kimyal, Yali and Una of highland New Guinea use 'power stones' to stimulate, maintain or augment significant events such as harvests or the creation of new garden plots. These can include small Yeineri and Tagime-style adze blades and stone knives, which are never used as functional tools, and can be

planted amongst crops to stimulate growth. Other stones are placed beside domestic hearths where they were prayed to for success with the potato crop, or can be carried to help the owner discover good toolstone. These stones also protect the individual against aggression, or when placed strategically within the domestic house they could ward off adverse weather and protect the house. The tools were designated for these special uses by six head quarrymen and the local Big Men from the Langda area. (Hampton 1997, 649-684).

New Guinea axeheads and adzeheads signify that owners have undertaken initiation into adult male society (Pétrequin & Pétrequin 2011, 343), and different methods of hafting identify regional affiliation (cf. Sillitoe 1988). When the axeheads and adzeheads are combined with other paraphernalia (i.e. shells, exotic feathers and hunting bows) the total assemblage signals both status and identity (Pétrequin & Pétrequin 2011, 343). Strathern (1969, 321) has observed that the unusually long, thin Mount Hagen ceremonial axeheads were *'deliberately fashioned as objects of beauty'* and mounted in elaborately carved hafts; in contrast and paralleling the findings of Vial (1941), Strathern also discovered that bride-price axeheads were predominantly oversized with less emphasis upon surface finish; despite this they were acceptable as wealth or status objects.

New Guinea practises of funerary compensation or marriage payments demonstrate that axeheads (and pigs) can symbolically represent a human life. In terms of wealth and status, a group of axeheads can become the property of a dominant lineage, rather than an individual, and are consequently curated in a special house within the village. Such axeheads are considered sacred objects created by Ancestral Beings which are inalienable, underpinning legitimisation (Pétrequin & Pétrequin 2011, 344). Certain ancestral axeheads were viewed as living entities which could fly during the night but could be attracted from the sky with pig fat (Pétrequin & Pétrequin 1993).

The most potent and valuable New Guinea artefacts are the oversized, non-functional 'Ye-yao' axe blades, some of which are 90cm in length and used in ceremonies, during ritual exchanges, and in social networks. These blades are

crafted from greenschist or amphibolitic schist, which emits a green glow in the dark, and is quarried from secret locations at Awigobi (the 'River of the Night'), believed to be the route used by the ancestors when searching for the luminous Ye-yao. Some communities believe the Ye-yao are splinters from Yeli, the Sacred Tree which grew at the beginning of the world. These highly-charged objects are carefully crafted and polished, dressed in miniature tree-kangaroo fur skirts and draped with pendants to transform them into 'women' of stone. In addition to their ceremonial value, certain Ye-yao are considered so powerful that they rarely enter the social arena and are kept strictly secret (Pétrequin & Pétrequin 2011, 344-346; Hampton 1997, 468-469).

The Ye-yao are graded by characteristics:

1. The longest are the most valuable
2. Their width is less important
3. Rock type and colour preferences exist
4. Adornment with miniature clothing, etc., does not enhance a stone's trade value
5. Multiple items traded together can increase a stone's trade value

In the Grand Valley a large Ye-yao of 70+cm in length may be worth a large pig – blade production being roughly equivalent to timescales involved in pig farming. Ye-yao blades are used in funerary displays, payments, war indemnity payments, bride-wealth transfers, for trade, and for transformation into ritual objects. While circulating as profane objects, blades can be stored openly in the men's house, and when not displayed they are wrapped in bark coverings. Ye-yao can be carried to ceremonies by women – or when being traded. Some men restrict trade of these implements to affinal groups, and consider them primarily reserved for ritual or ceremonial uses (Hampton 1997, 453-455).

The Maori believe that nephrite is 'ensouled', and individual objects are engendered and have an identity as animate objects with a role in the community (Brumm 2004, 146). Maori nephrite artefacts also embody histories, and create 'documents' which provide evidence of legitimacy (Field 2012). The Maori selectively use raw materials, and in some communities obsidian was reserved

for cutting tools, whereas basalt was used for adze manufacturing (Jones 1984, 251).

On the island of Malaita, Solomon Islands, flaked chert adzes are associated with ancestor worship, and priests and community leaders carry the implements for status and legitimacy, and traditional curers use them to draw pain from the body. The stone adzeheads also play a ritual role because of their '*magical efficacy*', as they are believed to have been created during storms where they are believed to be the '*teeth of the thunderbolt*' and responsible for striking down men and trees. 'Thunderbolt' adzeheads are driven into the ground by the force of the storm, where they 'cool' and eventually rise to the surface to be discovered by men, who must treat them with respect as magical objects and not use them for mundane tasks. In pre 19<sup>th</sup>-century contexts warriors considered these artefacts as sacred weapons which would make the bearer invincible (Ross 1970, 416).

### **3:3:10      *The involvement of craft specialists***

Craft specialists operate at a variety of locations, many begin preliminary reduction at the extraction site with final finishing off-site (e.g. New Guinea, Australia), whereas others remove the unaltered raw material to off-site workshops (e.g. Pipestone Quarries).

The ethnography records craft specialists in 70% [118 of 168] of studies, 4% [6 of 168] record they were not present, and 26% [44 of 168] of ethnography provided no data. 95 studies record the age/sex demographic, 94% [89 of 95] were male, 4% [4 of 95] involved mixed gender specialists, and 2% [2 of 95] were female. Consequently, as with extraction teams the individuals involved are predominantly male. Occasionally children would be involved, generally in support roles or as apprentices, as attested in New Guinea and Africa, for example.



<b>Involvement of craft specialists in product manufacturing [n=168]</b>	<b>70%</b>	<b>118</b>
<b>Attributes</b>	<b>% of key attributes in data sub-set [n=118]</b>	<b>No. of records in data sub-set [n=118]</b>
Raw material type	n/a	n/a
Storied/mythologised source	82%	97
Ownership/restricted access	51%	61
Seasonal use of the resource	49%	58
Permanently settled	7%	8
Age/sex demographic of the extraction site workers:		
Adult men	66%	78
Women	2%	2
Men, women & children	17%	20
Evidence for ritualised extraction	39%	47
Evidence for ritualised reduction	55%	66
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	70%	83
Functional	22%	26
Ritual	4%	5
Wealth/status objects	2%	2
<b>Involvement of craft specialists in product manufacturing</b>		
Distribution of extraction site products:		
Supra-regional 200+km	70%	83
Regional 100-200km	16%	19
Local >100km	9%	11
Evidence for the ceremonial use of extraction sites	36%	43
The presence of rock art/graffiti/idols at extraction sites	25%	30
The presence of burials at extraction sites	24%	29

Table 3:10. Craft specialists.

The identification of craft specialists at Neolithic extraction sites is difficult, and often inferred from subjective assessments of technical expertise. In terms of the ethnographic material culture, relatively mundane objects such as scrapers can be manufactured by recognised craft specialists, but may not exhibit great production skill – unlike certain over-sized ceremonial axeheads. Yet both groups of objects were produced by craft specialists who have normally served apprenticeships. Consequently, archaeology may comment upon levels of expertise, but without recourse to direct witness evidence it is difficult to confidently identify inputs by craft specialists.

### ***Selected ethnographic case studies:***

A rare example of female craft specialists has been recorded amongst Konso women in Ethiopia, who quarry stone and are skilled knappers who have undergone lengthy apprenticeships. These female knappers are dependent upon tool making for their livelihood. Culturally, tool production is considered a feminine task whereas men build things or farm. The Konso '*women procure high-quality stone from long distance, produce formal tools with skill, and use their tools efficiently*' (Arthur 2010, 228). Consequently, in rare cases such as this and the Tiwi women in Tasmania, it is females who complete the *chaîne opératoire*, not men (Brumm 2004; Plomley 1966).

The Hidatsa of the Midwestern Plains, purchase the rights and training to become a flint knapper from the sacred bundle keeper, an elder who had purchased the rights from his elders. Flint knapping was one of several skills controlled by bundle keepers, and tight sanctions prevented anyone from using any which had not been purchased. Such controls restricted specialist knowledge to the elders, whose control over the rights ensured that they would receive payments during old age from the younger generation (Bowers 1992, 120). The Mandan flint knappers had similar conventions to the Hidatsa, and knapping rights had to be purchased from the keeper of the Snowy Owl bundle<sup>15</sup> (Bowers 1950, 283-285). Amongst the Cheyenne flint knappers were generally older men who could gain great prestige from their work (Grinnell 1923, 178).

At the Pipestone Quarries in Minnesota, the tobacco pipes were traditionally manufactured by craft specialists who had been sanctioned by the tribe or had obtained supernatural permission during a vision quest (DeCory & DeCory 1989, 18).

Knappers at the Njillipidji quarry in Arnhem Land were clan members with traditional and exclusive rights to the quarry through ancestral links. Their principal product was the flint spear head, which once crafted was wrapped in paperbark and promptly passed in to the ceremonial exchange network; tradition

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<sup>15</sup> This medicine bundle contained a complete arrow-making kit, the wings and claws from a snowy owl, skins, herbs, feathers, a pipe, a bow, a lance, a buffalo robe and assorted pigments.

prevented the knappers from using the spear heads themselves (Torrence 1986, 52-53).

Many axehead producers of the New Guinea highlands only manufacture roughouts, and the consumer grinds and polishes the object at off-site locations (Pétrequin & Pétrequin 2011, 343), a practise also found amongst the Maori (cf. Field 2012). Consequently, craft specialists in these cases are only involved in the preliminary stages of implement manufacture.

In New Guinea craft specialists only exist amongst communities who exploit the harder, non-laminar rocks, such as Langda, Sela and Suntamon. However, craft specialisation is not a full-time activity and even the best adzehead makers in Langda are also forest farmers *and* participate in tribal warfare (Pétrequin & Pétrequin 2011, 338-339). At the Yeineri quarries all roughouts are taken to the settlements for reduction, grinding and polishing, and as no local sources of sandstone occur, imported grinders are used. Informants reported that it could take between 1.5-3.0 years to produce the required shape and polish on a typical 25-40cm long axe blade (Hampton 1997, 715-718). The Tagime quarry toolmakers regard themselves as expert grinders who fashion water-rounded cobbles sourced from the Tagi River. Occasionally some flaking is needed to complete the preform, followed by 5 weeks of grinding and shaping. However, in the case of the oversized blades more than one grinder could be involved in the production of the artefact (Hampton 1997, 733-734; 744).

Craft specialists are recorded amongst several Polynesian societies. In the Hawai'ian archipelago axehead makers were highly esteemed as their products enabled tree clearance and facilitated farming (Malo 1951, 51), as were the Samoan adzehead makers (Green 1974, 254). Conversely, in the Cook Islands, adze manufacturing was undertaken by a mundane group of 'artisans' who were paid for their labours but appear to have gained little prestige (Cleghorn 1984, 400). However, amongst the Maori craft specialism was more embedded in society - *'It is worthy of special note ... that Maori life occupations were to some extent specialised, and the knowledge descended from father to son. So that in a tribe ... there might be a family whose hereditary skill and knowledge constituted them makers of axes and implements to the clan'* (Best 1912, 21). Clearly the

hereditary transference of stone working craft skills amongst the Maori involved male-dominated patrilineal apprenticeships.

### 3:3:11 *Distribution of extraction site products*

87% [146 of 168] of ethnography documents the scale of the distribution of extraction site products (22 records provided no data). 64% [107 of 168] relate to distances of 200+km from source, 17% [28 of 168] to 100-200km, and 7% [11 of 168] are found within 100km of the extraction site. Such patterns demonstrate the cultural values placed on products which clearly equate with distances travelled - the majority being transported far beyond the extraction site. Ethnographically, the greater the distance travelled by an object the more valuable it appears to be, but such movements have to be linked to object biography and/or the recognisability of the raw material.

Distance [n=168]		Storied sites	Owned sites	Ritualised extraction	Ceremonial after-use	Rock art / graffiti / idols	Human burials
<b>200+km</b> 64% [n=107]		85% [n=91 of 107]	50% [n=54 of 107]	48% [n=51 of 107]	49% [n=52 of 107]	41% [n=44 of 107]	27% [n=29 of 107]
<b>100-200km</b> 17% [n=28]		50% [n=14 of 28]	61% [n=17 of 28]	32% [n=9 of 28]	0	0	0
<b>&gt;100km</b> 7% [n=11]		73% [n=8 of 11]	55% [n=6 of 11]	55% [n=6 of 11]	9% [n=1 of 11]	0	0
<b>No data</b> 12% [n=22]							

Table 3:11. Product distributions by distance against potentially archaeologically-visible characteristics.

If one considers the general context of these distributions against six archaeologically-visible characteristics as defined by this thesis (Table 3:11), the patterning demonstrates that only the supra-regional distribution (200+km) presents all six, lending weight to the observation that the greatest distances travelled were by the most valued products which emerged from ritualised

practises at storied locations. This data also illustrates the fact that ritualised extraction was important at all levels of product distributions, and generally over half of all sites were in some form of ownership.

*'Unlike settlements, quarries are unique because ... these sites are likely to have been the only component of the exchange system which had a link to every other locality where the stone was made, used and discarded'* (Torrence 1986, 91).

However, spatial parameters, political situations and functionality all impact upon distribution patterns irrespective of the exchange/trade network. 'Down-the-line' systems (cf. Renfrew 1975; 1993) are common, although ethnography often sketches socio-political situations which can be difficult to identify in the archaeological record (cf. Godelier 1999). One of the most common phenomena associated with down-the-line exchange is a decrease in abundance with increasing distance from the point of origin, which may be the impact of consumers periodically retaining traded goods during onward transit, thus decreasing product availability over greater distances (Chappell 1987, 72-73). However, the ethnographic data presented above could suggest that this is too simplistic a model, and the supra-regional movement of objects may be the most prevalent, which may also be recorded in the archaeological record as with the Group VI axeheads (Clough & Cummins 1988; Cooney & Mandal 1998) or Alpine jadeitite axeheads (Pétrequin et al. 2012a) for example.

In archaeological terms, implement petrology has helped to identify the points of origin of many stone axeheads, which identifies those implements which were transported the greatest distances, and by implication may have had the most value to users. Once archaeology is able to accurately source all stone and flint implements it will allow interpretations to focus upon the finer detail of the social context of object distributions which the ethnography can now provide.

### ***Selected ethnographic case studies:***

The petrology of greenstone axeheads has enhanced the understanding of stone tool distributions patterns in Australia. Ethnography has documented examples of selected quarries used preferentially which fed into long-distance exchange. This is epitomised by Mount William greenstone axeheads, the majority of which are

found in areas which possess alternative quality toolstone – yet Mount William products travelled 300+ km further than more locally-sourced axeheads as a result of their greater cultural value (Brumm 2011, 87). Large-scale meetings of Aboriginal groups facilitated the exchange of Mount William greenstone axeheads for spears, sandstone and possum-skin cloaks. The lack of variation in the size of Mount William axeheads, despite distance from the quarry, demonstrates that they were highly valued artefacts and retained for special uses (McBryde 1979; 1984)

It was not just toolstone that was highly prized amongst Aboriginal communities. At Wilgie Mia ochre mine, the red ochre was linked with Ancestral Beings from the Dreamtime and was so important for rituals that communities travelled great distances to procure this pigment. This highly valued substance was distributed across the whole of southern Australia (Flood 1995, 271-273).

Pacific ethnography records trade networks spanning great distances, all facilitated by seaborne travel. For example, two Polynesian networks distributed fine-grained basalt adzeheads over distances of up to c.4000km. A western network was focussed upon quarries located on Tutuila Island, Samoa, whereas an eastern network centred upon the Eiao quarries on the northwest Marquesas Islands (Weisler 2008, 540).

The central highland New Guinea trade and exchange networks operate on both secular and ceremonial/spiritual levels. Trade normally occurred between male members of a single patrilineage, with a smaller number of transactions between unrelated male friends. There are no professional traders. Typical distances for trading transactions was between kinsmen separated by 35km to 45km. In secular, profane transactions, those trading conduct business in private and without ceremony, the focus being upon material benefit rather than socio-political gain. In contrast ceremonial exchange underpins rituals and various economic aspects of cultural interaction and is traditionally an open-ended transaction which has no closure through the use of inalienable objects which embed indebtedness between individuals to transform status and prestige rather than affect material gain. These transactions generally occur between relatives,

and are instigated by the Big Man<sup>16</sup> who conducts the proceedings in public with appropriate ceremony. In general the highlands exchange system continually traded objects onwards so that extraction site products were in a continuous state of re-circulation within the network. The 'customary' value of the object was set by the producers before the product left the extraction site, and it was this value which was used during transactions<sup>17</sup> (Hampton 1997, 804-806; 808; 824).

A major feature of secular toolstone distribution is/was symbiotic exchange between axehead producers and those without access to raw material. The materials exchanged were generally those not readily available to the other community. Consequently highlanders traded birds of paradise, decorated woven bags, pigs, tobacco, vegetables and axeheads to lowlanders who provided laurel wood bows, marine shells, sago palm flour, pottery and dog's teeth (Pétrequin & Pétrequin 2011, 342). However, warfare can disrupt exchange networks and in certain areas could only be stopped with the payment of large numbers of oversized Ye-yao axe blades (Hampton 1997, 468-469); conversely peaceful conditions in combination with sedentary forest farming, inter-group marriage, the development of long term contacts, cross-cultural fertilisation, alliance-building, and social competition, all create conditions conducive to the distribution of extraction site products (op cit., 343). Trade goods moved in a series of chain-like stages from producers to consumers, which can allow products to circumvent enemy territories. Normally quarry workers rarely travel beyond the first two stages of a trading network because of enemy threat (Hampton 1997, 806; 816).

In highland New Guinea two mutually exclusive distributions of functional ground stone tools have developed. In Grand Valley and the West Region distinctive axeheads, adzeheads, knives and chisels are manufactured and traded

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<sup>16</sup> The social position of the Big Man is gained from a combination of military skill, wealth, the size of his household, political charisma, the ability to manipulate the spirit world, and general ingenuity (Hampton 1997, 834).

<sup>17</sup> An interesting phenomenon recorded in the ethnographic literature (White & Modjeska 1978, 28-29) is the diminution in size of some axeheads passing through exchange networks as they are successively sharpened or re-worked, resulting in increasingly smaller tools over time and distance. However, Chappell's (1987) study suggests that this is not necessarily the case in archaeology.

throughout the area by the Yeineri and Tagime quarries. By contrast different styles of adzeheads and knives are produced by the Langda-Sela quarries for the adjacent Yali and East Region. These two separate distributions correlate with language boundaries which are reflected in the types of stone tools, but curiously not in other materials traded across the cultural boundary (Hampton 1997, 421; 743). It may be that stylistically stone tools embody cultural identity in a way that other objects do not, particularly subsistence resources, thus their circulation is culturally restricted whereas subsistence resources are more widely exchanged. The scale of movement within the exchange networks suggests that most was undertaken between individuals or contiguous groups over short distances (Chappell 1987, 88-89).

A review of two New Guinea communities, the Hagen<sup>18</sup> and the Wiru<sup>19</sup>, is informative (see Table 3:12 below). These two communities are separated by distance, with the intervening area inhabited by two communities, the Kaul and the Imbonggu. The Hagen and Wiru also have different degrees of access to raw materials – particularly toolstone (cf. Chappell 1966; Strathern 1969). Both communities follow slightly differing subsistence regimes but occupy quite different environmental settings; critically, the Hagen have greater access to 'luxury' items such as shells and participate in a more extensive trade network than the toolstone-poor Wiru.

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<sup>18</sup> The Hagen inhabit part of the western Highlands close to several axe quarries.

<sup>19</sup> The Wiru are located in the southern Highlands some 65km (40 Miles) south of Hagen territory at the interface between the uplands and lowland swamps.



<b>HAGEN</b> [highland forest dwellers]	Socio-economic and cultural filters	<b>WIRU</b> [lowland grassland dwellers]
Subsistence: Pigs; Sweet potato Variables: taro; yam; banana; sugar cane; beans	<p style="text-align: center;">Spatial and cultural separation by intervening Kauli and Imbonggu communities</p> <ul style="list-style-type: none"> <li>• Indirect trade links between Hagen and Wiru</li> <li>• Distance from, and access to, high quality raw materials</li> </ul>	Subsistence: Pigs; Sweet potato Variables: taro; yam; banana; sugar cane; beans
Segmentary group structure, especially clans; Women banned from participation in exchanges and rarely dance; Stone axes solely a male tool		Formerly segmentary group structure, now village dwellers with village as active unit; Only males display stone axes; Both males and females use work axes
Ceremonial exchange determines prowess: Axes = bridewealth, compensation and funeral payments, gifts to ritual specialists		Ceremonial exchange determines prowess: Axes = bridewealth, exchange with maternal kin, funeral payments, gifts to ritual specialists
Exchange items: pigs, shells, plumes, stone axes, salt, oil		Exchange items: pigs, shells, plumes, stone axes, salt, sugar cane
Public transactions = shells and pigs		Public transactions = sugar cane and cooked vegetables
Primary exchange items = salt, oil, shells		Primary exchange items = pigs, foodstuffs, sugar cane
Hagen produced stone axes as wealth or ceremonial objects, not just for subsistence tasks; participated in extensive multi-directional trade networks		Wiru in poor trading position, produced no major commodity, did not have access to high quality raw materials; were not middlemen; restricted trade network
Near quarries in Jimi, Wahgi, and Chimbu valleys		Distant from quarries; only poor quality toolstone found locally
Axes LARGE [13cm-15cm] Axes circulate as wealth objects; Classify axes into <u>c.15</u> types; Good quality axes plentiful  STONE AXES, ALL PURPOSE TOOL		Axes SMALL [5cm-7.5cm] Axes circulate as wealth objects; Classify axes into <u>2</u> types; Good quality axes few, thus wooden replicas used NO LONGER USE STONE AXES (STEEL NOW USED)
Flake tools have no exchange value; Flake tools simple, no secondary retouch; Raw material widespread; NO LONGER USE FLAKE TOOLS		Flake tools have no exchange value; Flake tools simple, no secondary retouch; Raw material widespread FLAKES = ALL PURPOSE TOOLS
Ceremonial and work axes manufactured by Hagen Ceremonial axes worn on special occasions Ceremonial axes could be used in warfare	No axe types manufactured by Wiru  Ceremonial axes held during dances Ceremonial axes <i>not</i> used in warfare	

Table 3:12. The social context of axehead production and use in the New Guinea Highlands / Lowlands interface (data extrapolated from Strathern 1969 and Chappell 1966).

The Hagen have accessible toolstone resources and are recognised expert quarrymen and axe-makers. Their use of stone implements – particularly oversized axeheads - encompasses the everyday functional requirements of forest dwellers alongside the needs of ceremonial life which maintains personal and

group identities. For the Hagen, stone axes are exclusively a male tool and only men are involved in their trade. In contrast, the Wiru have no direct access to high-quality toolstone and are reliant upon poor-quality local material which restricts their tool technology to flake tool production, and unlike the Hagen they no longer use stone axes, preferring those of steel which are used by both men and women. Consequently, the Wiru are reliant upon trade for what are invariably smaller axeheads, but like the Hagen their stone axeheads are used for display and restricted to male use. Interestingly, the Wiru overcome their lack of access to high quality axeheads by crafting wooden replicas for ceremonial use.

Overall, these two subtly contrasting, indirectly linked, communities illustrate the ways culture and materiality can be modified over relatively short distances, even between culturally similar groups. Access to resources is a major constraint on materiality and thus traditions, which impacts upon the ideologies of each group. Such a model of trade and resource access, and the effects of distance and cultural filters such as intervening communities, could have an important bearing upon the interpretation of the distribution of extraction site products during the Neolithic in the UK, and suggests that we should expect differences, even if only subtle differences, in the use and meaning of extraction site products once they have travelled beyond contiguous communities. The difficulty, as always, is to identify contemporary cultural boundaries in the archaeological record. Such a cultural phenomenon may undermine models which propose major pan-European social structures founded upon apparently consistent materiality (e.g. Pétrequin et al 2012c).

### **3:3:12      *Evidence for the ceremonial use of extraction sites***

Certain extraction sites have a secondary role as a venue for rituals or cyclical ceremonies, generally linked to social renewal and rites of passage. At the Pipestone Quarries, Minnesota, ritual is focussed upon a location associated with guardian spirits of the quarries, and burial mounds occur at the site. A sundance circle and sweat lodges provide settings for ceremonialism, with the quarries as a

backdrop (Hughes 1995; Hughes & Stewart 1997; Scott, Thiessen, Richner & Stadler 2006).

The ethnography records 33% [55 of 168] of sites are used for pre or post-extraction ceremonial events. The greatest number occur in North America [25], associated with the Lakota/Dakota Nations, the Mandan, Cheyenne, Sac and Fox, Pawnee, Kiowa and Ponca peoples. Africa has the second highest number [15], mostly associated with communities of metal workers, and Australia provides evidence of 12 communities. 2% [3 of 168] of cases record sites which were specifically not used for ceremonial purposes, and 65% [110 of 168] provided no data.

<b>Evidence for the ceremonial use of extraction sites [n=168]</b>	<b>33%</b>	<b>55</b>
<b>Attribute</b>	<b>% of key attributes in data sub-set [n=55]</b>	<b>No. of records in data sub-set [n=55]</b>
Raw material type	n/a	n/a
Storied/mythologised source	96%	53
Ownership/restricted access	29%	16
Seasonal use of the resource	67%	37
Permanently settled	0	0
Age/sex demographic of the extraction site workers:		
Adult males	47%	26
Women	0	0
Men, women & children	27%	15
Evidence for ritualised extraction	67%	37
Involvement of craft specialists in product manufacturing	79%	43
Evidence for ritualised reduction	74%	41
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	93%	51
Functional	2%	1
Ritual	4%	2
Wealth/status objects	0	0
Distribution of extraction site products:		
Supra-regional 200+km	94%	52
Regional 100-200km	0	0
Local >100km	2%	1
<b>Evidence for the ceremonial use of extraction sites</b>		
The presence of rock art/graffiti/idols at extraction sites	67%	37
The presence of burials at extraction sites	45%	25

Table 3:13. Ceremonial use.

In archaeological terms evidence of pre- or post-extraction ceremonialism will be manifested by hearths, structures and assemblages in the immediate environs of the site, or in the abandonment sequence. Rock art or graffiti is likely.

### 3:3:13 *The presence of rock art, graffiti, or idols at extraction sites*

Rock art, graffiti or the use of idols is recorded in 27% [46 of 168] of the ethnography. North America documents 26 records, Australia 19 and South America 1. 73% [122 of 168] of ethnography provided no data, making it difficult to know how representative the 46 cases are of any wider trend.

<b>The presence of rock art/graffiti/idols at extraction sites [n=168]</b>	<b>27%</b>	<b>46</b>
<b>Attributes</b>	<b>% of key attributes in data sub-set [n=46]</b>	<b>No. of records in data sub-set [n=46]</b>
Raw material type	n/a	n/a
Storied/mythologised source	96%	44
Ownership/restricted access	13%	6
Seasonal use of the resource	78%	36
Permanently settled	0	0
Age/sex demographic of the extraction site workers:		
Adult males	63%	29
Women	0	0
Men, women & children	0	0
Evidence for ritualised extraction	85%	39
Evidence for ritualised reduction	54%	25
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	78%	36
Functional	0	0
Ritual	6%	3
Wealth/status objects	0	0
Involvement of craft specialists in product manufacturing	65%	30
Distribution of extraction site products:		
Supra-regional 200+km	98%	45
Regional 100-200km	0	0
Local >100km	0	0
Evidence for the ceremonial use of extraction sites	80%	37
<b>The presence of rock art/graffiti/idols at extraction sites</b>		
The presence of burials at extraction sites	65%	30

Table 3:14. Rock art, graffiti and idols.

The strongest associations of sites featuring rock art, graffiti and idols is seasonal use, an all-male workgroup, ritualised extraction, and extensive (200+km) product distribution.

***Selected ethnographic case studies:***

The Pipestone Quarries, Minnesota, feature rock art panels on a group of glacial erratics known as the Three Maidens (Figure 3.6), believed to be the residence of the guardian spirits of the quarries. Offerings are left beside the rock art at the beginning and end of each quarrying season, as recorded by George Catlin in the 1830s, *'humbly propitiating the guardian spirits of the place, by sacrifices of tobacco, entreating for permission to take away a small piece of the red stone for a pipe'* (Matthiessen 1989, 430). The rock art comprises anthropomorphs, animals, and geometric/abstract shapes; the predominant motifs are human figures and turtles (Winchell 1983, 15-18; Holmes 1919, 264).

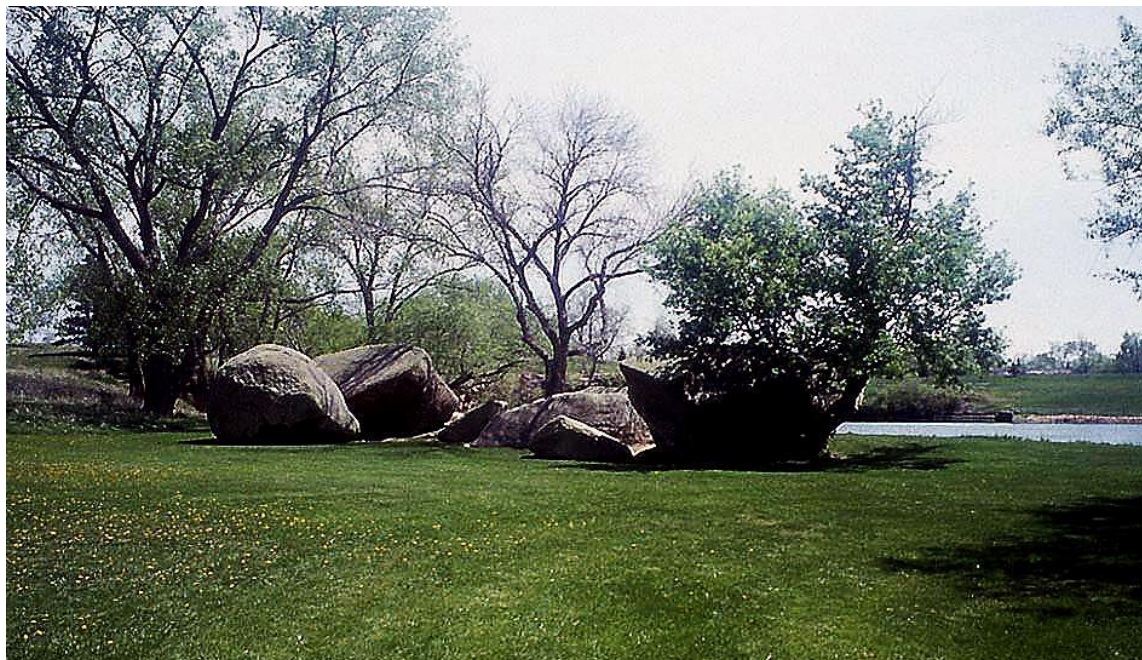


Figure 3:6. The Three Maidens, Pipestone Quarry, Minnesota in 1998.

**3:3:14      *The presence of burials at extraction sites***

Formalised burials are recorded in 18% [30 of 168] of ethnographic accounts (North America = 25; Australia = 5). In North America the Pipestone Quarries are

the major record, where various Plains communities buried their dead in small earthen mounds adjacent to the quarries, graphically depicted by George Catlin in 1836-37 (Figure 3:7; cf. Pratt & Troccoli 2013, 150-151) and recorded by more recent archaeology (Scott et al. 2006). In Australia a number of Aboriginal communities interred burials at extraction sites including the Yolngu, Yir Yoront, Mimi, Mara-larr-mirri and Gurrka-larr-mirri. 82% [138 of 168] provided no data. The small number of cases here limit the potential for identifying broader traditions,

<b>The presence of burials at extraction sites [n=168]</b>	<b>18%</b>	<b>30</b>
<b>Attributes</b>	<b>% of key attributes in data sub-set [n=30]</b>	<b>No. of records in data sub-set [n=30]</b>
Raw material type	n/a	n/a
Storied/mythologised source	100%	30
Ownership/restricted access	13%	4
Seasonal use of the resource	80%	24
Permanently settled	0	0
Age/sex demographic of the extraction site workers:		
Adult males	97%	29
Women	0	0
Men, women & children	0	0
Evidence for ritualised extraction	83%	25
Evidence for ritualised reduction	83%	25
Extraction site artefact/product typology	n/a	n/a
Extraction site artefact/product functionality:		
Functional/ritual	76%	23
Functional	0	0
Ritual	7%	2
Wealth/status objects	0	0
Involvement of craft specialists in product manufacturing	97%	29
Distribution of extraction site products:		
Supra-regional 200+km	97%	29
Regional 100-200km	0	0
Local >100km	0	0
Evidence for the ceremonial use of extraction sites	83%	25
The presence of rock art/graffiti/idols at extraction sites	100%	30
<b>The presence of burials at extraction sites</b>		

Table 3:15. Burials.

In archaeological terms, extraction sites which feature burials could indicate storied locations, seasonal use, adult male workgroups, ritualised extraction, involvement of craft specialists to produce functional/ritual products, have

extensive product distributions (200+km), evidence for the ceremonial use of sites, and feature rock art/graffiti.



Figure 3:7. George Catlin's painting of the Pipestone Quarries in south-western Minnesota (painted 1836-1837; from Pratt & Troccoli 2013, 151). A burial mound lies centre left, and the Three Maidens (home of the guardian spirits of the quarry) are at centre right.

### **3:4 Implications for the archaeological record**

Several trends are apparent in the ethnography (Tables 3:1 & 3:2). The strongest evidence of ritualisation occurs at the stone and metal producing sites where roughly twice as many are storied locations than those producing minerals. Ownership is twice as likely at metal sites than stone or mineral sites. Seasonality is far more common at stone extraction sites than other resources. Stone extraction is male dominated, but mineral extraction is less male dominated with mixed age/gender groups, and metal procurement is predominantly by mixed age/gender teams.

If the ethnographic trends and practises synthesised from the 168 studies are recast to ignore the records which provided no data (and therefore, arguably, may have presented results as positive or negative), it may be that one can establish a truer picture of the social importance and emphasis placed on each attribute or practise by the global communities studied. However, this recasting can only work for themes where a definite absence was also recorded as the results would otherwise create a 100% bias towards presence. Consequently product functionality, extraction team demographics, product distributions, graffiti etc., and the presence of burials cannot be modelled in this way. In descending order of commonality the recast themes are:

- 93% [120 of 129] of studies record storied associations with the raw material [120 present; 9 negative; 39 no data]
- 95% [118 of 124] record craft specialists [118 present; 6 absent; 44 no data]
- 68% [75 of 111] provided evidence of ownership [75 present; 31 not owned; 5 communities no access to sites; 57 no data]
- 89% [74 of 83] recorded seasonality [74 present; 8 permanently inhabited sites; 1 no access to sites; 85 no data]
- 88% [68 of 77] documented ritualised reduction [68 present; 9 absent; 91 no data]
- 92% [67 of 73] record ritualised extraction [67 present; 6 absent; 95 no data]
- 95% [55 of 58] record ceremonial use of sites [55 present; 3 absent; 110 no data]

This suite of data demonstrates that extraction practise was multi-faceted in these global examples, and the strongest trends are those which are both common and have high percentages. Storied location is the strongest trend and the most common element with a high percentage, closely followed by craft specialists, the ceremonial use of sites and ritualised extraction. These components of extraction clearly formed the foundation for practises at many sites.



The remaining themes are modelled upon the complete 168 study data, and show the following trends:

- 70% [117] of extraction site products had a potential ritual/functional duality; 17% [29] were purely functional; 4% [7] were purely ritual; 2% [3] were wealth/status objects; 7% [12] provided no data
- 64% [108] recorded male-only extraction teams; 13% [21] featured mixed age/gender teams; 1% [2] recorded female-only teams; 22% [37] provided no data
- 64% [107] of extraction site products are distributed 200+km from source; 17% [28] 100-200km; 7% [11] <100km; 12% [22] provided no data
- 27% [46] recorded rock art/graffiti/idols; 73% [122] provided no data
- 18% [30] record burials; 82% [138] provided no data

If the full data set of 168 studies is analysed to identify common juxtapositions, two of the commonest trends are storied locations and supra-regional product distribution (200+km), which registers in 56% [94 of 168] of all studies. In terms of the social context of extraction in these examples, the ethnography records that extraction teams are predominantly men, but the land and raw material is often gendered as female. The ethnography suggests that the men involved are often specialists brought together as relatives or clan/kinship affiliates; many undergo apprenticeships or initiations. Political power and status may rest upon access to, or ownership of, the sacred power embodied in extraction site products; these objects may originally be produced for functional use but can be transformed into sacred or wealth/status objects at a later time. There is some connection between certain products and bodily symbolism (e.g. Battaglia 1990; Hall 1997). Extraction practises are repeatedly intertwined, forming an integral part of social networks which were pivotal in the creation of identity, status and power. This interconnectedness is demonstrated by Table 3:16 below concerning storied sites, where the recorded absence and data voids are shown alongside the attributes of storied extraction sites, which demonstrates that certain attributes such as ceremonialism and rock art may be under-represented in the data set simply because the records contain neither positive nor negative evidence.

<b>Storied/mythologised source [n=168]</b>	<b>[n=120]</b>		
<b>Attributes</b>	<b>% &amp; No. of studies recording attribute</b>	<b>No. of studies recording absence of attribute</b>	<b>No. of studies providing no data</b>
Raw material type	n/a		
Storied/mythologised source	71% [120]	5% [9]	24% [39]
Ownership/restricted access	50% [60]	22% [27]	28% [33]
Seasonal use of the resource	54% [65]	5% [6]	41% [49]
Permanently settled	5% [6]	54% [65]	41% [49]
Age/sex demographic of the extraction site workers:			
Adult men	62% [75]	13% [15]	
Women	1.5% [2]	73.5% [88]	25% [30]
Men, women & children	12% [15]	63% [75]	
Evidence for ritualised extraction	52% [62]	5% [6]	43% [52]
Evidence for ritualised reduction	48% [58]	33% [39]	19% [23]
Extraction site artefact/product typology	n/a	n/a	n/a
Extraction site artefact/product functionality:			
Functional/ritual	71% [85]	20% [24]	
Functional	10% [12]	81% [97]	9% [11]
Ritual	5% [6]	86% [103]	
Wealth/status objects	1.5% [2]	87.5% [107]	
Involvement of craft specialists in product manufacturing	74% [89]	7% [8]	19% [23]
Distribution of extraction site products:			
Supra-regional 200+km	76% [91]	18% [22]	
Regional 100-200km	12% [15]	82% [98]	6% [7]
Local >100km	12% [14]	82% [99]	
Evidence for the ceremonial use of extraction sites	44% [53]	3% [3]	53% [64]
The presence of rock art/graffiti/idols at extraction sites	37% [44]	0	63% [76]
The presence of burials at extraction sites	25% [30]	0	75% [90]

Table 3:16. The recast data from storied/mythologised sites, highlighting recorded absence and data voids.

Such entangled ethnographic practises clearly bear some interesting parallels with the material evidence from the archaeological record at extraction sites in the UK, such as the Langdale/Scafell Complex or Graiglwyd. Considering the strong evidence for storied locations - often associated with locally-prominent landforms - and other common features such as ritualised extraction, rock art and extensive product distributions, when considered together these co-present material factors can now be used to infer the likelihood of storied associations in the archaeological record, and examine the broader social context of extraction

sites in the UK with greater confidence than previously when using much smaller data sets. The detailed exploration of the social context of Neolithic extraction sites will form the basis of the following chapters.

## Chapter 4. The Archaeology of Extraction

### 4:1 Introduction

The objective of this chapter is to identify and analyse trends in assemblage patterning within an archaeological sample and to compare it with those emerging from the aggregated ethnography detailed in Chapter 3. This chapter follows the ethnographic review of the previous chapter by assessing a sample of global archaeological sites to investigate the extent of parallel patterning between the two data sets. If there is a good agreement between the two then the ethnographic data will form an interpretive lens through which to view the possible social context of the archaeological data. The archaeological sample has been taken from Africa, the Americas, Asia, Australia, Europe, the Middle East, New Zealand, and the Pacific.

Although there are clear differences between the environmental settings of many of the ethnographic and archaeological case studies, by creating probability statistics through relational analogy and aggregating traits, robust trend data can emerge and be applied to the interpretation of the archaeological evidence to develop more nuanced understandings of prehistoric extraction informed by the practises of traditional societies.

### 4:2 Research Methodology

This chapter will undertake a comparative analysis of the ethnographic and archaeological data collected by this thesis. The data from the ethnographic reports and archaeological sites has been analysed using Excel Spreadsheets. In the case of the archaeological data analysed in this chapter, one spreadsheet documented the flint mines and another axe quarries. The 14 fields of archaeological evidence recorded and analysed broadly parallel those documented in the ethnographic case studies examined in Chapter 3. The structure of the fields follows a 'flow model' approach (Schiffer 1972; Fogelin & Schiffer 2015) which broadly mirrors the *chaîne opératoire* of extraction sites and lithic production. This is designed to discover common material patterns in the

two data sets in a staged, contextual way, highlighting commonalities and differences in practise from extraction, to product manufacture, use and discard.

The archaeological fields are listed in Table 4:1 below, grouped alongside their broadly analogous ethnographic themes or practises. Inevitably not every excavation report has discovered or recorded all attributes, particularly those of earlier Antiquarians, so excavation bias is present. Consequently, for the purposes of this chapter, the analysis has relied upon only the definite recorded presence of each attribute at each site to create a robustly accurate record. No presumption of presence has been applied.

One major consideration is the fact that ethnography demonstrates that certain archaeological correlates may have more than one meaning, or functional interpretation, which can introduce an element of ambiguity. For example, animal remains in archaeological sites could indicate seasonal use (if migratory species), evidence of feasting or subsistence activities. Alternatively, the ethnography provides records where the careful placing of animal remains in workings, or within backfill events, can represent aspects of ritualised practises designed to embed ideologies through ceremonialism during the extraction cycle.

The archaeological data set of 223<sup>20</sup> studies was collected in the same way as the ethnographic data in the previous chapter<sup>21</sup>. As had been the case with the ethnographic data, the collection of archaeological reports was restricted by time, source accessibility and to English texts. Generally site data was accepted if it recorded four or more fields, but some were accepted with less to broaden the range of evidence. Inevitably, the literature does not always record all of the strands of evidence, contexts, attributes or traits which are being researched by this thesis, due to taphonomic processes or excavation bias. Nevertheless, the archaeological data provides a substantial body of aggregated evidence which can be analysed to produce robust probability statistics and detect trends in the archaeological data which can be compared with the ethnography.

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<sup>20</sup> The data set comprises 9 case studies from Africa; 54 from the USA; 15 from South America; 3 from Asia; 3 from Australia; 62 from Europe; 7 from Ireland; 1 from the Middle East; 1 from New Zealand; 7 from the Pacific; and 61 from the UK. The UK data mirrors that of the other sets comprising a random collection of multi-period flint, stone, copper, quartz and gunflint reports, which generally differs from the period-specific and more detailed data of Neolithic flint and stone extraction analysed later in the thesis.

<sup>21</sup> The global archaeological data set is included on a CD in the back cover of the thesis.

<b>HIGH LEVEL ETHNOGRAPHIC THEMES BY % [n=168]</b>	<b>LIST OF POTENTIAL ARCHAEOLOGICAL CORRELATES</b>
Mythic or storied associations with the raw material source [71%]	Locally prominent or unusual topographic setting
Evidence of ownership or restricted access to the raw material source [45%]	Settlement evidence at the extraction site
Seasonal use of source [44%]	Stabilised horizons and/or hearths in shaft fills; Animal remains, articulated, in workings; Animal remains, disarticulated, in workings
Age-sex demographic of those using the extraction site [55% = adult male only; 13% mixed gender & children; 1% female only]	Human burials in workings; Human body parts in workings
Evidence of ritualised extraction [40%]	Extraction tools abandoned in workings; Imported extraction tools in/at workings; Hearths in situ on shaft floors/galleries; Charcoal deposits in workings; Non-functional objects in workings [e.g. carved objects, pottery]; Placed deposits in workings; Structures in workings [e.g. chalk platforms, shrines, pits]; Animal remains, articulated, in workings; Animal remains, disarticulated, in workings; Stabilised horizons and/or hearths in shaft fills; Debitage and/or lithics in post-extraction contexts [e.g. galleries, shafts, floors]; Human burials in workings; Human body parts in workings
Ritualised reduction [40%]	Knapping tools in/at workings; Debitage and/or lithics, in situ, in or adjacent to workings; Debitage and/or lithics in post-extraction contexts [e.g. shafts, floors];
Artefacts: ritual v functional use [65% ritual/functional duality; 17% functional; 8% ritual; 3% wealth/status objects]	Useful life of implements; Maximum distribution of site products
Craft specialists involved in implement production both on-site and off-site [70%]	Knapping tools in/at workings
Circulation of extraction site products [64% 200-400+km; 17% 100-200km; 7% <100km]	Maximum distribution of site products
Ceremonial after-use of extraction sites [33%]	Rock art / graffiti / polished axe marks in workings; Rock art / graffiti near workings [>5km]
Presence of rock art or graffiti at extraction sites [27.5%]	Rock art / graffiti / polished axe marks in workings; Rock art / graffiti near workings [>5km]
Burials at extraction sites [18%]	Human burials in workings; Human body parts in workings

Table 4:1. High level ethnographic themes and practises shown alongside equivalent archaeological features and assemblages (Based upon Topping 2011, 274, with additions).

### 4:3 Statistical Analysis of the Archaeological Record

#### 4:3:1 *Topographically-distinctive landscape settings*

The ethnographic data set analysed in Chapter 3 recorded that 71% [120 of 168] of extraction sites are storied locations, of which many (where data has been recorded) are anchored upon distinctive or unusually shaped landforms where origin myths, etc., can be given tangibility, creating a physical interface with ideologies to legitimise status, identity and maintain social networks. This is recorded from informants in the ethnographic data, and inferred from the archaeological record on the basis that the locations chosen for extraction were locally-prominent landforms. For example, Pike of Stickle (UK), Tievebulliagh (Northern Ireland) (Figure 4:1) and Creag na Caillich (UK) are all bell-shaped mountains; Harrow Hill (UK) and Cissbury (UK) are amongst the highest points on the chalk downland; Rijkholt (Netherlands), Sélèdin (France) (Figure 4:2), Mill Creek and Kaolin (Illinois) are all ranged along the summits of valley scarps. Consequently, such locations could potentially indicate the presence of embodied locations when compared to those in less dramatic settings.



Figure 4:1. Tievebulliagh, Antrim, site of the Group IX porcellanite axe quarries (© Dave Field).

Prominently-positioned, dramatic, or isolated extraction can also be seen at Valle Sbernia (Italy) or Rijckholt (Netherlands) on steep valley sides, the ridges of Flint Ridge (Ohio), crests or mountain/mesa summits such as Scafell Pike (UK), Casa Montero (Spain), Alibates (Texas), and Obsidian Cliffs (Wyoming), volcanoes as at Manau Kea (Hawai'i), caves such as Wyandotte (Indiana) and Mammoth (Kentucky), lake settings such as Isle Royale (Great Lakes), and islands such as Lambay (Ireland), Rathlin (Ireland), Heligoland (Netherlands), Shetland (UK), and Henderson Island (Pacific). Most of these sites also provided secondary deposits of detached raw material downslope in more *accessible* locations, yet regardless of this accessibility, such expedient sources were frequently ignored (as evidenced by a lack of extraction) in favour of the more challenging deposits which clearly had a greater significance to those exploiting them, irrespective of logistical costs and increased danger. An extreme example of such an acute logistical investment is provided by the 3<sup>rd</sup> Unnamed Cave in Tennessee where Native Americans crawled through a kilometre of underground tunnels to quarry chert in a 'dark zone' cave chamber decorated with rock art (Simek et al. 1998). Indeed, a survey of the Tennessee caves in the Appalachian Plateau discovered that 1.5% had evidence for mining, and caves in general were used as ritual arenas during the Archaic, Woodland and Mississippian periods (Simek pers. comm.).

The wider landscape setting of some mines is informative. At Jablines (France; Bostyn & Lançon 1992; Bostyn & Lançon 1995, 310), Serbonnes (France; de Labriffe & Sidéra 1995a, 317), Pâlis (France; de Labriffe & Sidéra 1995b, 322), Villemaur-sur-Vanne "Le Grand Bois Marot" (France; de Labriffe et al. 1995a, 332), Villemaur-sur-Vanne "Les Orlets" (France; de Labriffe et al. 1995b, 345) and Miskolc-Avas Hill (Hungary; Simán 1995, 380), for example, extensive fieldwork in the hinterland of these extraction sites has failed to discover any evidence of contemporary settlements. Ethnographic analogues would suggest that these extraction sites may have been protected by taboos which prevented settlement in the environs of the mines because of ideological concerns about the sacred nature of these locations (e.g.s Pipestone, Minnesota; certain highland New Guinea quarries).





Figure 4:2. The quarry at Sélédin, Plussulien, source of the Breton Dolerite A axeheads.

A recurrent trend amongst extraction sites is their liminality, lying at a distance from settlements. As with the ethnography, the implication of this archaeological observation must be the potential for the identification of sites which were special, possibly carrying embodied narratives or supernatural associations. In contrast, utilised expedient raw material sources often lie closer to settlements and were generally used for producing everyday tools, as has been observed on the coastal plain below the South Downs flint mines where the analysis of Neolithic flint assemblages has discovered that mined flint was generally reserved for axehead production (Gardiner 1990; Holgate 1995).

The archaeological data records 64% [142 of 223] of extraction sites located upon unusual and/or locally-prominent landforms – in contrast to 71% of ethnographic records of sites with storied associations<sup>22</sup>. The potential social

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<sup>22</sup> Interestingly, the non-storied sites produce many of the same tool types as the storied, the difference being their mundane functionality compared to the symbolic values placed on storied products.

context of these sites is presented in Tables 4:2 and 4:3 below, where the data sets are compared. As with the ethnography, excavation bias prevents 100% representation across the various fields. In addition, raw material type has been ignored in all tables in favour of assessing extraction practise and social context. Similarly, although ethnography generally records the age and sex demographic of extraction teams, archaeology cannot be that specific and has to rely upon human skeletal material from the workings which may not necessarily represent extraction workers.

The ethnographic data suggests that the characteristics of storied extraction sites comprise 50% with restricted access or ownership, over half are exploited seasonally, over half practise ritualised extraction, 74% involve craft specialists, slightly under half practise ritualised reduction, similar percentages of ritual and functional artefacts are produced, the circulation of storied extraction site products is overwhelmingly supra-regional (200+km), almost half of the extraction sites host post-extraction ceremonialism, over a third feature graffiti and/or rock art, and a quarter contain human burials or body parts.



Figure 4:3. A broken jadeitite axehead fragment discovered at Castle Douglas, Dumfries and Galloway, now curated in the National Museum of Scotland.

<b>ETHNOGRAPHY [n=168]</b> <b>Mythico-religious associations 71%</b> [n=120 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Prominent/unusual topography 64%</b> [n=142 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source			Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>50%</b> [n=60 of 120]	<b>11%</b> [n=15 of 142]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>54%</b> [n=65 of 120]	<b>18%</b> [n=26 of 142]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>52%</b> [n=62 of 120]	<b>39%</b> [n=56 of 142]	Evidence for ritualised extraction
Ritualised reduction	<b>48%</b> [n=58 of 120]	<b>25%</b> [n=35 of 142]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 7%</b> [n=8 of 120] <b>F/R = 81%</b> [n=95 of 120]	<b>R/W = 7%</b> [n=10 of 142] <b>F/R = 42%</b> [n=60 of 142]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>74%</b> [n=89 of 120]	<b>43%</b> [n=61 of 142]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 12%</b> [n=14 of 120] <b>R = 12%</b> [n=15 of 120] <b>SR = 76%</b> [n=91 of 120]	<b>L = 6%</b> [n=9 of 142] <b>R = 20%</b> [n=29 of 142] <b>SR = 41%</b> [n=58 of 142]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>44%</b> [n=53 of 120]	<b>30%</b> [n=42 of 142]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>37%</b> [n=44 of 120]	<b>18%</b> [n=25 of 142]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>25%</b> [n=30 of 120]	<b>24%</b> [n=34 of 142]	Presence of burials / body parts

Table 4:2. The comparative analysis of the archaeological and ethnographic traits recorded at extraction sites in relation to mythologised or storied sources and/or prominent topographic locations.

In the archaeological record 39% of sites provide evidence of ritualised extraction, taken here as the deposition of items not functionally associated with

extraction such as hearths, non-extraction artefacts (e.g. pottery, carved chalk objects, etc), graffiti and human remains. One of the key ethnographic observations is that storied sites invariably have a supra-regional product distribution, a pattern well attested in archaeology where, for example, axeheads of jadeitite originating from the Italian Alps (Figure 4:3), Groups VI and IX axeheads from Langdale (UK) and Tievebulliagh (Ireland) respectively, or obsidian bifaces from the American Rockies, were all extensively distributed. Similarly, the presence of rock art and human burials is recorded in similar ratios in both disciplines, which suggests sites such as the Langdale Pikes, Creag na Caillich and many of the English flint mines may originally have been storied locations with a deep cultural significance.

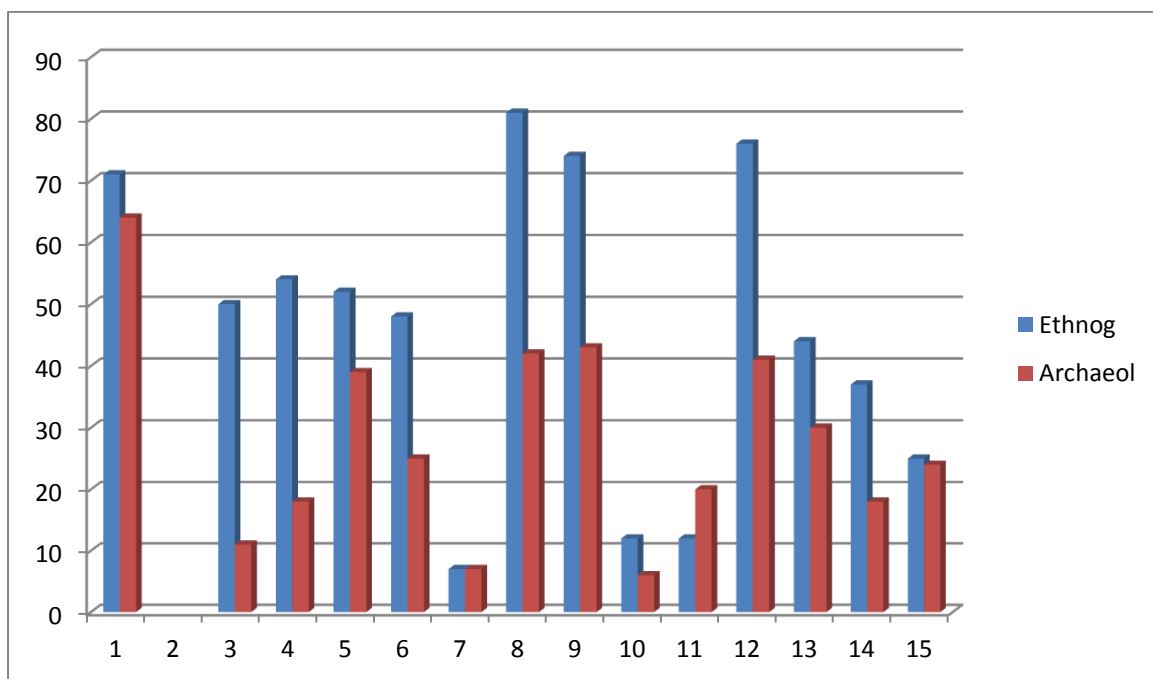


Table 4:3. Storied / prominent landscape settings

Key: **1 = Storied / prominent settings**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### **4:3:2 Evidence for restricted access to extraction sites**

The ethnography records that 45% of extraction sites had some form of ownership or restricted access, which can be difficult to identify archaeologically without documentary evidence. However, some material evidence does exist, such as shrines used by elite-sponsored craft specialists scattered amongst the Manau Kea quarries, Hawai'i (McCoy et al. 2011), and rare small-scale, permanent settlements inhabited by quarry custodians on Mount William in Australia (McBride 1984; Brumm 2011). Therefore these types of evidence can be seen as potential indicators of ownership or access restrictions at extraction sites.

Ethnography suggests that another possible indicator is rock art, which can be used to signpost a culturally important site or location, indicate ownership claims, and signpost access taboos. Archaeologically, rock art is carefully positioned in and around important cave extraction sites in Africa, Australia, the USA and South America (e.g. Brady & Rissolo 2006; Crothers 2012; Flood 1997; Robbins et al. 1996; Simek et al. 1998), it is juxtaposed with upland and mountain extraction sites such as the previously mentioned Manau Kea (McCoy et al. 2011), Krumlovský les in the Czech Republic (Oliva 2010) (Figure 4.4), Graig Lwyd (Warren 1921), Creag na Caillich (see Chapter 5) and Langdale (Beckensall 2002). Changing motifs on panels at the Pipestone Quarries in Minnesota may reflect temporal changes in tribal ownership of the quarries (Hughes 1995, 17; see also Chapter 3). Pipestone also provides an important contrast with Mount William in that taboos restrict any settlement within c.3.2km of the quarries, despite changing ownership and access arrangements, thus the presence/absence of settlement as an indicator of proprietorial rights can be ambiguous in ethnographic terms.

More widely, places circumscribed by taboos and similar restrictions may be marked in other archaeologically-visible ways. At certain Aboriginal Australian quarries small menhir-like vertical stones, generally waist high, are positioned adjacent to quarries to signpost their presence and warn away women whose presence was taboo. The quarries on the Beorgs of Uyea in Shetland, feature

similar small vertical stones scattered amongst the quarries which may be associated with Neolithic extraction (observed during fieldwork; June 2013).



Figure 4:4. One of the flint mine hollows at Krumlovský les, Czech Republic.

A comparative analysis of the ethnographic and archaeological data (see Table 4:4 below) illustrates a number of reasonably close correlations and similar patterning. There is a strong correlation between storied sites documented by ethnography and those in prominent locations recorded by archaeology (79% v 83% respectively). Close correlations exist with evidence for seasonal use of sites, ritualised extraction, the presence of craft specialists, artefact usage (functional v ceremonial) and the circulation of extraction site products. The strong association of storied sites in ethnography with locally-prominent archaeological sites is underpinned by the correspondingly long-distance distributions of products from both. This reinforces the archaeological view that certain extraction sites such as the Alpine jadeitite sources, the obsidian sources in the Rockies, or Langdale, for example, had a deep and widespread social significance as sources of embodied artefacts whose cultural value ensured widespread distribution. Ethnographically, the quarry custodian at the Aboriginal

Australian Mount William was central in managing the extraction, valourisation and distribution of axeheads across vast tracts of south-eastern Australia (Brumm 2011). Consequently ownership and restricted access may be part of an overarching mechanism which ensured that certain tool types had an embedded social value and significant distribution network.

<b>ETHNOGRAPHY [n=168]</b> <b>Ownership/restricted access 45%</b> [n=75 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Restricted access interpreted 8%</b> [n=18 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>79%</b> [n=59 of 75]	<b>83%</b> [n=15 of 18]	Locally prominent or unusual topographic setting
<b>Ownership / restricted access to extraction site</b>			<b>Evidence for restricted access to extraction site</b>
Seasonal use / expeditions to extraction site	<b>36%</b> [n=27 of 75]	<b>44%</b> [n=8 of 18]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>31%</b> [n=23 of 75]	<b>44%</b> [n=8 of 18]	Evidence for ritualised extraction
Ritualised reduction	<b>35%</b> [n=26 of 75]	<b>22%</b> [n=4 of 18]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 8%</b> [n=6 of 75] <b>F/R = 85%</b> [n=64 of 75]	<b>R/W = 11%</b> [n=2 of 18] <b>F/R = 55%</b> [n=10 of 18]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>76%</b> [n=57 of 75]	<b>67%</b> [n=12 of 18]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 7%</b> [n=5 of 75] <b>R = 17%</b> [n=13 of 75] <b>SR = 75%</b> [n=56 of 75]	<b>L = 6%</b> [n=1 of 18] <b>R = 17%</b> [n=3 of 18] <b>SR = 56%</b> [n=10 of 18]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>21%</b> [n=16 of 75]	<b>39%</b> [n=7 of 18]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>8%</b> [n=6 of 75]	<b>28%</b> [n=5 of 18]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>5%</b> [n=4 of 75]	<b>39%</b> [n=7 of 18]	Presence of burials / body parts

Table 4:4. The comparative analysis of ownership or restricted access.

To summarise, candidate archaeological indicators of ownership or access restrictions could include:

- The presence of shrines
- The presence of small-scale settlement for craft specialists or a site custodian
- The use of novel structural features (e.g. vertical lithic uprights, Aboriginal Australia, Beorgs of Uyea, Shetland)

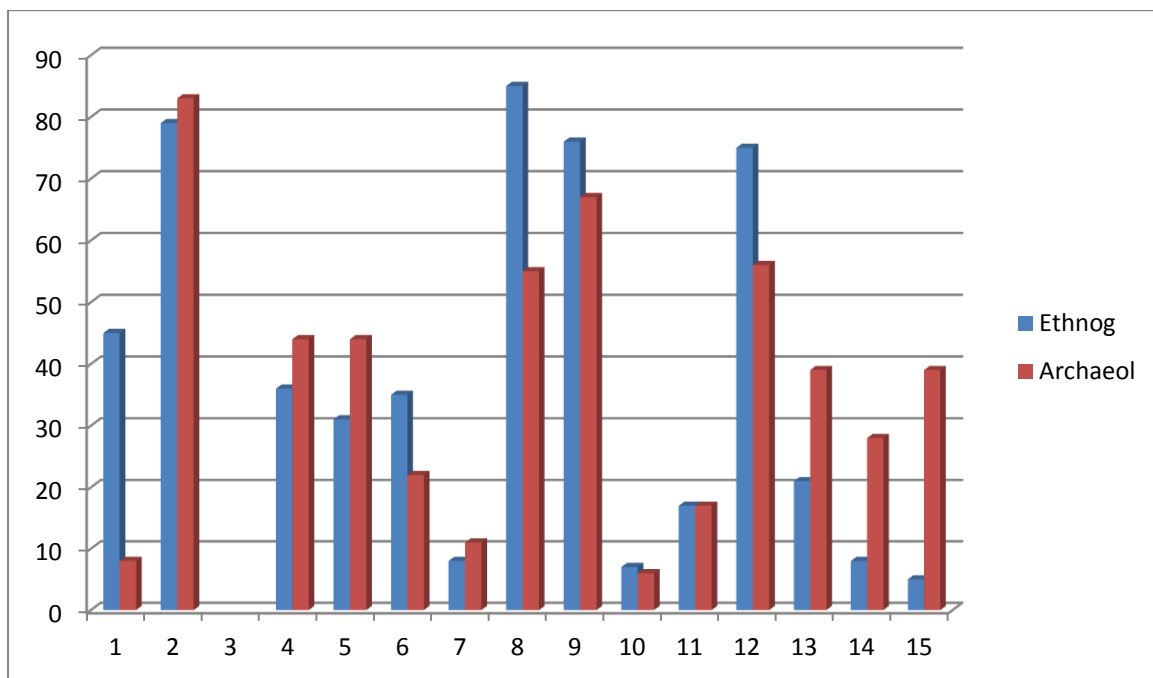


Table 4.5. Ownership / restricted access

Key: **1 = Ownership / restricted access**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### **4:3:3 Evidence for the seasonal use of extraction sites**

The ethnography records 44% of extraction sites were used seasonally. While seasonal use can be difficult to identify archaeologically, circumstantial evidence from 13% of sites could indicate seasonality, such as the remains of over-wintering bat roosts and migrant bird species discovered in the mines at Grime's



Graves, which demonstrate not only a period of inactivity during the winter months but a resumption of extraction in the springtime (Topping 2011b). In addition, topography and climatic constraints can restrict activity. At high altitude sites such as the jadeitite sources on Mont Viso in the Italian Alps (Figure 4:5), the obsidian sources in the Rockies, and even the modest summits of the Lakeland Fells such as Scafell Pike/Langdale, the summits are all snow-covered during the winter and spring periods. Indeed, the Alpine sources may have only been accessible during the summer period (P Pétrequin, pers comm). Similarly, raw material sources on islands such as Rathlin, Henderson or Heligoland, may also have been affected by seasonality, particularly during equinoctial and winter periods when sea conditions could become increasingly perilous. Consequently, many extraction sites by nature of their environmental niche may have been subject to some degree of enforced inaccessibility as a result of topographic setting and local micro-climate.



Figure 4:5. The Mont Viso range, location of Alpine jadeitite quarries.

<b>ETHNOGRAPHY [n=168]</b> <b>Seasonality 44%</b> [n=74 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Seasonal Use interpreted 13%</b> [n=30 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>88%</b> [n=65 of 74]	<b>87%</b> [n=26 of 30]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>36%</b> [n=27 of 74]	<b>27%</b> [n=8 of 30]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site			Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>70%</b> [n=52 of 74]	<b>30%</b> [n=9 of 30]	Evidence for ritualised extraction
Ritualised reduction	<b>47%</b> [n=35 of 74]	<b>17%</b> [n=5 of 30]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 5%</b> [n=4 of 74] <b>F/R = 93%</b> [n=69 of 74]	<b>R/W = 3%</b> [n=1 of 30] <b>F/R = 50%</b> [n=15 of 30]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>76%</b> [n=56 of 74]	<b>50%</b> [n=15 of 30]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 7%</b> [n=5 of 74] <b>R = 13%</b> [n=10 of 74] <b>SR = 70%</b> [n=52 of 74]	<b>L = 3%</b> [n=1 of 30] <b>R = 17%</b> [n=5 of 30] <b>SR = 47%</b> [n=14 of 30]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>49%</b> [n=36 of 74]	<b>20%</b> [n=6 of 30]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>49%</b> [n=36 of 74]	<b>13%</b> [n=4 of 30]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>32%</b> [n=24 of 74]	<b>27%</b> [n=8 of 30]	Presence of burials / body parts

Table 4:6. The comparative analysis of the evidence for the seasonal use of extraction sites.

The comparative analysis of the ethnographic and archaeological data (Table 4:6), does not produce many strong comparators, which may reflect excavation or observational bias. One of the closest correlations occurs between ethnographic sites used seasonally which have storied associations, and those

archaeological sites in locally-prominent locations where the present author suggests seasonality is presumed (88% v 87%). The remaining traits are more variable, although there are similar patterns in the weighting of the evidence between ritual and functional products at seasonal sites, and distribution patterns. The after-use of sites is suggested by the presence of burials or human body parts at roughly 30% of sites in both data sets, although in the case of archaeology it is unclear whether this reflects ceremonialism, ritualised closure or expedient events.

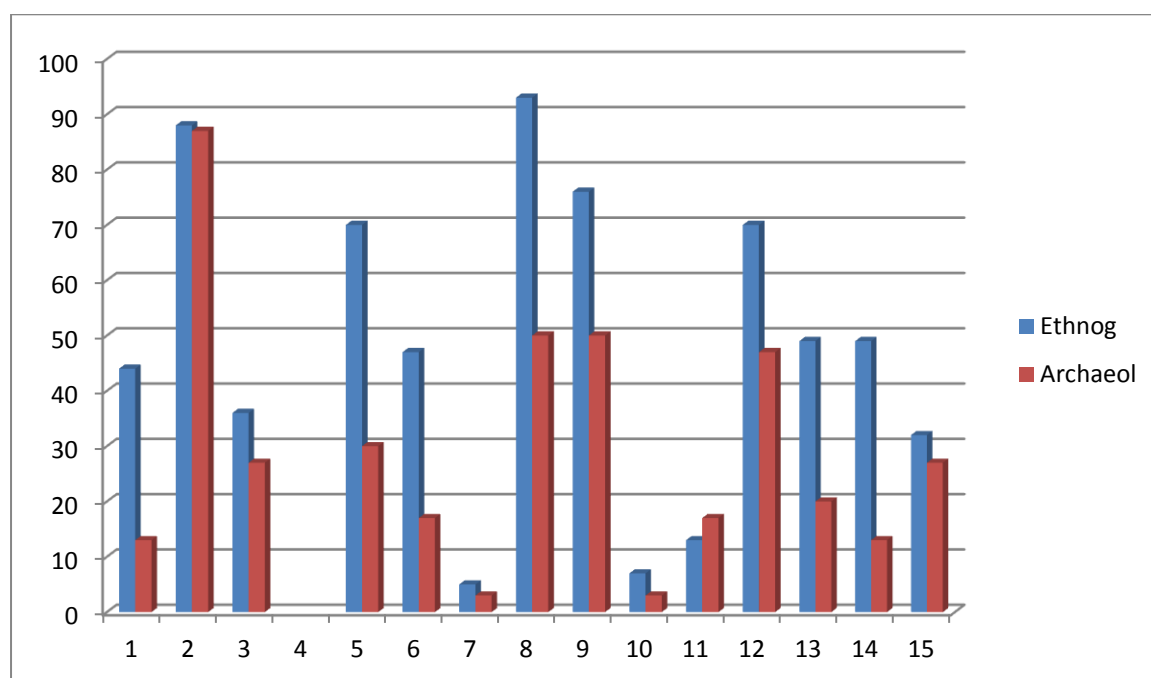


Table 4:7. Seasonality

Key: **1 = Seasonality**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

In summary, potential seasonal indicators would appear to be:

- Storied locations and/or locally-prominent topographic settings
- The presence of rock art/graffiti
- The presence of burial deposits or human body parts

#### **4:3:4 *The age/sex demographic of extraction site workers***

Ethnography has the benefit of dealing with living communities whose activities can be studied first hand, unlike prehistoric archaeology which has to view material evidence from a distance of numerous generations. Ethnography often records the sex, and sometimes the age, of extraction workers, but archaeology can only record the sex and age of the human remains found at extraction sites, and these may or not may not derive from extraction teams. Consequently, understanding the demographic of extraction site workers is enormously difficult, relying upon the interpretation of human remains recovered from the workings, or those that can be directly linked to the extraction process off-site. This ambiguity of the archaeological human remains creates a conundrum: the remains could represent the burial of a site worker, or represent the expedient re-use of the workings for an interment. As a result of this lack of clarity, this thesis will rely upon the burial record (4:3:11 below) to sketch the definitive evidence for those buried at extraction sites, whether as workers or not.

#### **4:3:5 *The evidence for ritualised extraction***

The practise of ritualised extraction is well documented in ethnography, generally as a component of ideologies surrounding a storied raw material source. Such practises occur amongst the Plains Tribes, communities of the Northwest Coast and American Southwest, various Aboriginal Australian communities, early historic miners in Europe, and a number of societies in New Guinea, for example.

40% (67 of 168) of the ethnography records ritualised extraction practises, and of these examples 94% (63 of 67) occur at storied sites, which may imply that ethnography may have missed such practises in other places. However, although the 40% comprises less than half of the total data, in 71% (120 of 168), or nearly twice as many studies, there is evidence of embodied or storied extraction sites, suggesting that cosmology and ritualisation interacted on several different levels at any given place<sup>23</sup>. Consequently, the ethnography suggests a

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<sup>23</sup> The 31% of ethnography not recording ritualised practises at storied sites does not include any great detail of ritual activity. Consequently, such activity may have occurred but has left no

high probability of a storied association occurring at a minimum of some three-quarters of all extraction sites, and that at roughly half (or potentially more) there may have been ritualised practises.

<b>Ethnographic events</b>	<b>Ethnographic evidence</b>	<b>Possible archaeological correlates</b>
<b>Purification rituals</b>	Sweat lodges; hearths; use of substances to purify people and tools	Hearths in or near workings; charcoal in workings
<b>Pre- and post-extraction offerings or rituals</b>	Rock art; curated animal remains; human sacrifices; food stuffs; feasting; consultation of ancestral remains	Rock art near or on-site; placed deposits; pottery; curated animal remains; human remains
<b>Ritualised extraction</b>	Extraction tools kept on-site; special tools; substances used to anoint workfaces	Tools left on-site; tool caches; unusual or non-local tools; structures (e.g. chalk platforms, 'caves')
<b>Rites of renewal</b>	Broken artefacts and production debris returned to site; debitage left on-site; human remains	Broken artefacts and debitage in workings; human remains; structured deposits in backfill of extraction site

Table 4:8. A comparative analysis of ritualised extraction practises.

Ethnography documents practises associated with preliminary purification rites, prescribed extraction practises, on-site artefact production, and often post-extraction renewal rites. Such practises clearly have the potential for leaving behind material evidence in the archaeological record. For example, those practises which deposit artefacts which are unrelated to extraction both adjacent to, and within, the sites, often comprising pottery, carved objects, human remains, animal body parts, broken tools and debitage. This ethnographic evidence is compared with the archaeological data and summarised in Table 4:8 above (based upon Topping 2011, 274, Table 14.1, with amendments).

The European archaeological record, for example, includes a number of sites which have produced evidence paralleling the material patterning of ritualised extraction in the ethnographic literature. At Stránská Skála (Czech Republic), a chert extraction site, amongst a large lithic assemblage lay a pot containing imported blades (Svoboda 1995, 280), possibly referencing other stone sources or an act of renewal. At Krumlovský les (Czech Republic), a Late Lengyel footed

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imprint or gone unreported.

bowl was surrounded by charcoal and carefully placed in the upper fills of a shaft (Oliva 2006, 165), clearly referencing the mine. Similar contexts were recorded in France at Villemaur-sur-Vanne “Les Orlets” where a near complete Michelberg pot was discovered in the upper fills of an abandoned shaft – but one which had never been exploited (de Labriffe et al. 1995b, 343). Here the nearest Michelberg settlement lay 30+km away (ibid., 343-5), reinforcing the notion that many sites were protected by taboos as special places preventing miners living on-site. Does the fact that this shaft had not been worked suggest it was excavated for ideological reasons and not extraction, and was then symbolically abandoned and referenced with the pot as part of renewal ceremonies mirroring those at the mines?

At Sümeg-Mogyorósdomb, Hungary, antler tools abandoned in the mines were discovered decorated with incised geometric motifs (Bácskay 1995, 389-90), suggesting another potential element of ritualisation.



Figure 4:6. Pottery vessel discovered within the flint mines at Defensola ‘A’, Italy (from di Lernia et al. 1995).

The mining complex at Defensola “A”, Italy, produced a rich assemblage of mining tools, decorated pottery at key locations in the galleries (particularly

entrances to adjoining tunnels), limestone 'lamps', charcoal and faunal remains, and geometric graffiti (Figure 4:6) (di Lernia et al. 1995, 428; di Lernia et al. 1991). Clearly a range of secondary activities occurred here which was not directly related to mining *per se*, but which involved the curation and deposition of assemblages at important locations within the mines during extraction or at abandonment.

The presence of hearths in the English flint mines has been recognised as significant for some time (cf. Barber et al. 1999); their occurrence in European mines is also recorded. For example, a hearth was discovered on the basal silts of Shaft 5 at Tušimice, Czech Republic, (Lech & Mateiciucová 1995a, 274), and another in Shaft 28 at Wierzbica "Zełe", Poland, (Lech & Lech 1999, 472-7). At the latter site Shafts 28 and 19 produced sequences of hearths (alongside worked flint and mining debris) from varying depths within the shaft fills, demonstrating the repetitious nature of depositional patterning in parts of Europe, and the continuing importance of fire in referencing the mines. In Shaft 1 at Polany Kolonie II, Poland, a hearth was discovered on the floor of the shaft, with a second on top of a dump of backfill, followed by a third hearth comprising *older* material re-deposited in the shaft from elsewhere (demonstrated by <sup>14</sup>C dates), all then superseded by a final hearth lit higher in the shaft (Schild 1995b, 484). This sequence emphasises the importance of fire as part of the abandonment process at certain European mines, including redeposited hearths from off-site contexts. A simpler sequence was recorded in Shaft 1 at Polany II, Poland, where a small hearth was lit on basal deposits and associated with flint nodules, arguably for renewal purposes, which was followed by a final hearth surrounded by nodules and worked flints placed upon the upper fills (Herbich & Lech 1995, 503).

Shaft fills regularly feature deposits of debitage, artefacts (complete and broken), and pottery, as can be seen at Bečov, Czech Republic (Lech & Mateiciucová 1995b, 277), and Tomaszów, Poland (Schild 1995a, 461), where large assemblages were recovered, particularly from the uppermost fills of shafts, possibly associated with abandonment events. In Belarus, at Krasnaselsky, knapping took place in half-filled shafts (Charniauský 1995, 266), thus deliberately placing debitage into abandoned mines, arguably for renewal purposes.

At Jablines, France, sherds of Cerny Culture pottery was interpreted as residual evidence of an earlier phase of mining (Bostyn & Lanchon 1995, 309). However, such deposits might equally have been a deliberate act to commemorate the ancestral past in the present through the deposition of artefacts, rather than being a residual deposit, as may have occurred at Shaft 1 at Polany Kolonie II (see above). Such practises of secondary deposition may have underpinned claims of legitimisation.

The presence of animal remains occurs at Serbonnes, France, where cattle bones were recovered from certain shafts but without adjacent settlement evidence (de Labriffe & Sidéra 1995, 317), which argues against casual discard, and suggests these deposits were linked to mining, either as placed deposits or evidence of feasting associated with mining. Similar evidence was recorded at Sümeg-Mogyorósdomb, Hungary, where the remains of domesticated species (goat, cattle) were found in the mines alongside red deer, horse, aurochs, roe deer (Bácskay 1995, 390), perhaps implying elaborate feasting.

The comparative analysis of the ethnographic and archaeological records shows a strong concordance between the ethnographic evidence and the intuitive archaeological data for ritualised extraction, 40% v 41% respectively. The ethnography demonstrates that the social context of ritualised extraction generally occurs at storied sources, involves craft specialists, embeds artefact biographies, has a widespread distribution of artefacts, and a notable use of sites for ceremonies and to a lesser extent burials. Most of these attributes can be retrieved by archaeology, as Tables 4:9 and 4:10 show, which suggests that ritualised extraction practises were designed to source, manufacture and distribute artefacts through appropriate social networks to maintain traditions, underscore alliance building, kinship networks, house societies, and play important roles in ceremonialism.



<b>ETHNOGRAPHY [n=168]</b> <b>Ritualised extraction 40%</b> [n=67 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Interpreted ritualised extraction 41%</b> [n=92 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>93%</b> [n=62 of 67]	<b>61%</b> [n=56 of 92]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>34%</b> [n=23 of 67]	<b>9%</b> [n=8 of 92]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>78%</b> [n=52 of 67]	<b>10%</b> [n=9 of 92]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
<b>Ritualised extraction</b>			<b>Evidence for ritualised extraction</b>
Ritualised reduction	<b>52%</b> [n=35 of 67]	<b>43%</b> [n=40 of 92]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 3%</b> [n=2 of 67] <b>F/R = 90%</b> [n=60 of 67]	<b>R/W = 5%</b> [n=5 of 92] <b>F/R = 51%</b> [n=51 of 92]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>71%</b> [n=48 of 67]	<b>54%</b> [n=50 of 92]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 9%</b> [n=6 of 67] <b>R = 13%</b> [n=9 of 67]  <b>SR = 76%</b> [n=51 of 67]	<b>L = 2%</b> [=2 of 92] <b>R = 24%</b> [n=22 of 92] <b>SR = 35%</b> [n=32 of 92]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>55%</b> [n=37 of 67]	<b>58%</b> [n=53 of 92]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>58%</b> [n=38 of 67]	<b>27%</b> [n=25 of 92]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>37%</b> [n=25 of 67]	<b>33%</b> [n=30 of 92]	Presence of burials / body parts

Table 4:9. A comparative analysis of the evidence for ritualised extraction.

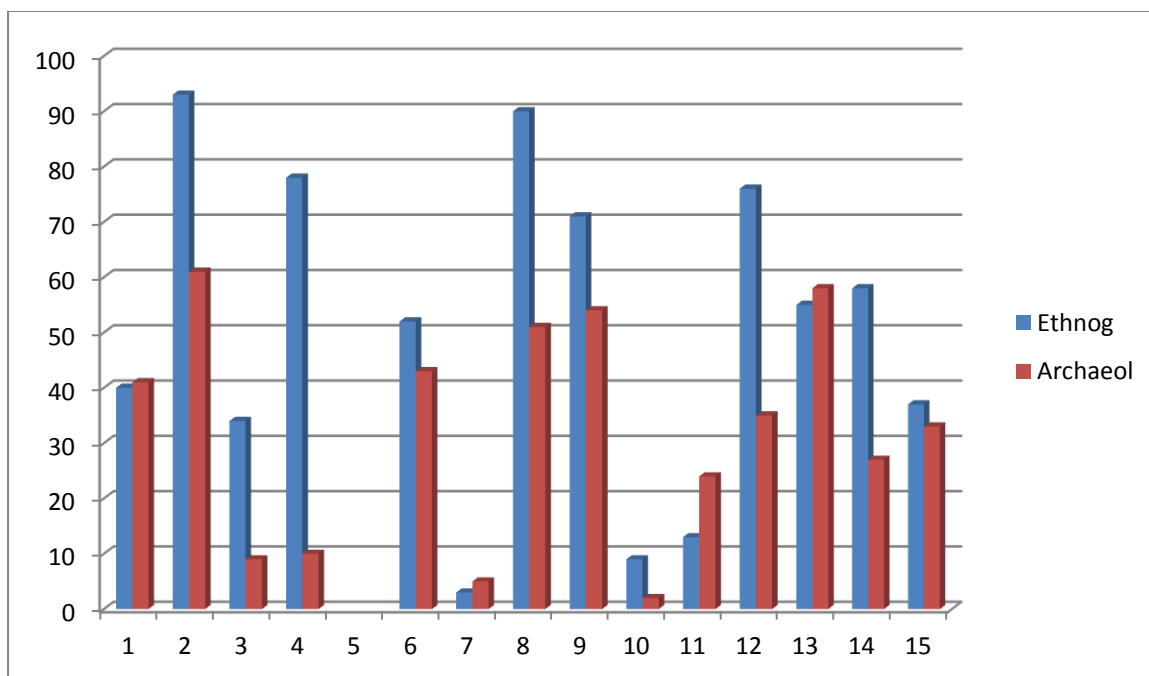


Table 4:10. Ritualised extraction

Key: **1 = Ritualised extraction**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### 4:3:6 *Extraction site product functionality*

The interpretation of artefact functionality can be problematic. The question of use has to acknowledge the possibility that functionality can be transformed as artefacts accumulate a biography over time, which can lead to the transference from one social category to another, reconfiguring and reobjectifying them into items designed to fulfil alternative requirements such as compensatory payments, convey ideologies, histories, or designate wealth and status (e.g. Chappell 1987, 79-81). Clearly there is little ambiguity with certain artefact types, such as oversized axeheads in New Guinea (Vial 1941; Hampton 1997) which may parallel Neolithic axeheads of Alpine jadeitite (Pétrequin et al. 2012a). These axeheads are too large for practical use and ethnographically were circulated as a means of

demonstrating wealth and status, as among Australian Aboriginal communities (cf. Boivin 2004; Brumm 2004).

<b>ETHNOGRAPHY</b> [n=168] <b>Functional use 17%</b> [n=29 of 168]		<b>ARCHAEOLOGY</b> [n=223] <b>Interpreted functional use 11%</b> [n=26 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>41%</b> [n=12 of 29]	<b>65%</b> [n=17 of 26]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>55%</b> [n=16 of 29]	<b>8%</b> [n=2 of 26]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>17%</b> [n=5 of 29]	<b>15%</b> [n=4 of 26]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>17%</b> [n=5 of 29]	<b>38%</b> [n=10 of 26]	Evidence for ritualised extraction
Ritualised reduction	<b>17%</b> [n=5 of 29]	<b>23%</b> [n=6 of 26]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
<b>Artefacts: Functional use</b>		<b>Artefacts: Functional use</b>	
Craft specialist artefact production	<b>76%</b> [n=22 of 29]	<b>38%</b> [n=10 of 26]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 7%</b> [n=2 of 29] <b>R = 24%</b> [n=7 of 29] <b>SR = 41%</b> [n=12 of 29]	<b>L = 0</b> <b>R = 46%</b> [n=12 of 26] <b>SR = 38%</b> [n=10 of 26]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>3%</b> [n=1 of 29]	<b>23%</b> [n=6 of 26]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>0</b>	<b>12%</b> [n=3 of 26]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>0</b>	<b>15%</b> [n=4 of 26]	Presence of burials / body parts

Table 4:11. The comparative analysis of functional extraction site products.

The comparative analysis of artefacts accredited with functional use (Table 4:11) records 17% by ethnography compared to 11% by archaeology. Axeheads are a primary indicator of product functionality in archaeology, and non-functionality may be indicated by use-wear patterns at deposition. The ethnography suggests that fewer extraction sites were storied than that implied by archaeology, the evidence for ritualised extraction appears to be twice as strong in archaeology, yet craft specialists are nearly twice as prevalent in the ethnography. Artefact circulation shows a strong emphasis on non-local distributions, but the big

differences are with on-site ceremonialism, rock art/graffiti and human burials, all of which are more strongly represented in the archaeological record. Such discrepancies may represent different cultural practises over time.

<b>ETHNOGRAPHY [n=168]</b> <b>Functional / Ritual use 70%</b> [n=117 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Interpreted functional / ritual use 27%</b> [n=61 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>91%</b> [n=107 of 117]	<b>74%</b> [n=45 of 61]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>41%</b> [n=48 of 117]	<b>13%</b> [n=8 of 61]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>55%</b> [n=64 of 117]	<b>18%</b> [n=11 of 61]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>47%</b> [n=55 of 117]	<b>66%</b> [n=40 of 61]	Evidence for ritualised extraction
Ritualised reduction	<b>54%</b> [n=63 of 117]	<b>46%</b> [n=28 of 61]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
<b>Artefacts: Functional/Ritual use</b>			<b>Artefacts: Functional/Ritual use</b>
Craft specialist artefact production	<b>70%</b> [n=83 of 117]	<b>65%</b> [n=39 of 61]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 7%</b> [n=8 of 117] <b>R = 15%</b> [n=18 of 117] <b>SR = 71%</b> [n=83 of 117]	<b>L = 3%</b> [n=2 of 61] <b>R = 20%</b> [n=12 of 61] <b>SR = 64%</b> [n=39 of 61]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>44%</b> [n=51 of 117]	<b>46%</b> [n=28 of 61]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>31%</b> [n=36 of 117]	<b>23%</b> [n=14 of 61]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>20%</b> [n=23 of 117]	<b>34%</b> [n=21 of 61]	Presence of burials / body parts

Table 4:12. The comparative analysis of the evidence for dual-use extraction site products.

As suggested above, the use of an artefact can be obscured by its apparent 'functional' typology, which can mask complex social trajectories which can

transform mundane objects by ritual action into ceremonial items (Chappell 1987, 79-81). Again, it is the interpretation of context which is the key, especially if deposition is sufficiently distinctive to accurately allow categorisation into sacred or profane practises. However, it is arguable as to whether archaeology as a discipline is capable of identifying the finer nuances of some ethnographically-recorded trajectories such as marriage (bride wealth) or compensatory payments (e.g. from death during warfare), much of which might be mistakenly interpreted as evidence of wealth or status in the archaeological record.

Although there is inevitably a subjective element in the identification of dual-purpose artefacts (sacred/profane) produced at extraction sites, there is some concordance between the two sets of data (Table 4:12). The ethnography records a 70% presence of dual-purpose artefacts compared to 27% in the archaeological record, differences which can be explained by the nature of the evidence used by the two disciplines. The extraction and production processes show similar emphases with 70+% of artefacts originating from storied or locally-prominent sites, with roughly half using raw material from ritualised extraction. There is a close concordance with the evidence for craft specialists and ritualised reduction. The distribution of dual-purpose artefacts shows very similar trends in both ethnography and archaeology, with lowest scores for local networks and the greatest for supra-regional networks, again demonstrating the cultural value of many extraction site products. Interestingly, both disciplines record sites which produce(d) dual-purpose artefacts have close correlations with ceremonialism, rock art, and burials. Consequently, these factors may indicate dual-purpose artefact production.

The final broad category is that of purely ritual objects, either objectified by ceremonialism or created as wealth objects (Table 4:13). This category records the smallest percentages, with ethnography at 5% compared to 6% inferred by archaeology. However, it should be stressed that the majority of ethnography primarily records the production of functional items, the creation of specialised ritual/wealth objects is less frequently noted.

The trends apparent in archaeology suggests that over 70% of these objects originated from locally-prominent sites (87% ethnography), and in 36% of cases

ritualised extraction appears to have been practised (25% ethnography). The circulation of these high-value artefacts shows similar low ratios for local distributions, an unknown correlation at the regional level, and over 50% in both disciplines were distributed through supra-regional network(s). In addition, around a quarter of sites appear linked to ceremonialism in both disciplines.

<b>ETHNOGRAPHY [n=168]</b> <b>Ritual / Wealth Objects 5%</b> [n=8 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Ritual / Wealth Objects 6%</b> [n=14 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>87%</b> [n=7 of 8]	<b>71%</b> [n=10 of 14]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>62%</b> [n=5 of 8]	<b>14%</b> [n=2 of 14]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>50%</b> [n=4 of 8]	<b>7%</b> [n=1 of 14]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>25%</b> [n=2 of 8]	<b>36%</b> [n=5 of 14]	Evidence for ritualised extraction
Ritualised reduction	0	<b>50%</b> [n=7 of 14]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
<b>Artefacts: Ritual use / Wealth Objects</b>			<b>Artefacts: Ritual use / Wealth Objects</b>
Craft specialist artefact production	0	<b>57%</b> [n=8 of 14]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 12%</b> [n=1 of 8] <b>R = 0</b> <b>SR = 87%</b> [n=7 of 8]	<b>L = 14%</b> [n=2 of 14] <b>R = 14%</b> [n=2 of 14] <b>SR = 57%</b> [n=8 of 14]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>25%</b> [n=2 of 8]	<b>29%</b> [n=4 of 14]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>37%</b> [n=3 of 8]	<b>21%</b> [n=3 of 14]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>25%</b> [n=2 of 8]	<b>7%</b> [n=1 of 14]	Presence of burials / body parts

Table 4:13. The comparative analysis of the evidence for ritual/wealth objects.

#### **4:3:7 Evidence for craft specialist artefact production**

The involvement of craft specialists in the *chaîne opératoire* is recorded in 70% of the ethnography, and inferred in 43% of archaeological examples (Figure 4:7).

Clearly this disparity may reflect methodological differences between the

disciplines and the quality of evidence. Of concern is the fact that ethnography is able to record direct observational data, whereas archaeology may only be recognising some of the more obvious examples of craft specialist involvement. In addition, proficiency in craft technology is relative. Individuals can be considered craft specialists by their community even when they are involved in the production of mundane, everyday tools which are not status or wealth related. Consequently the identification of craft specialists in the archaeological record is problematic. It remains salutary that ethnography records almost twice as many examples of craft specialists as archaeology. Perhaps raising awareness of this issue may lead to a finer nuancing of archaeological interpretive frameworks in the future.

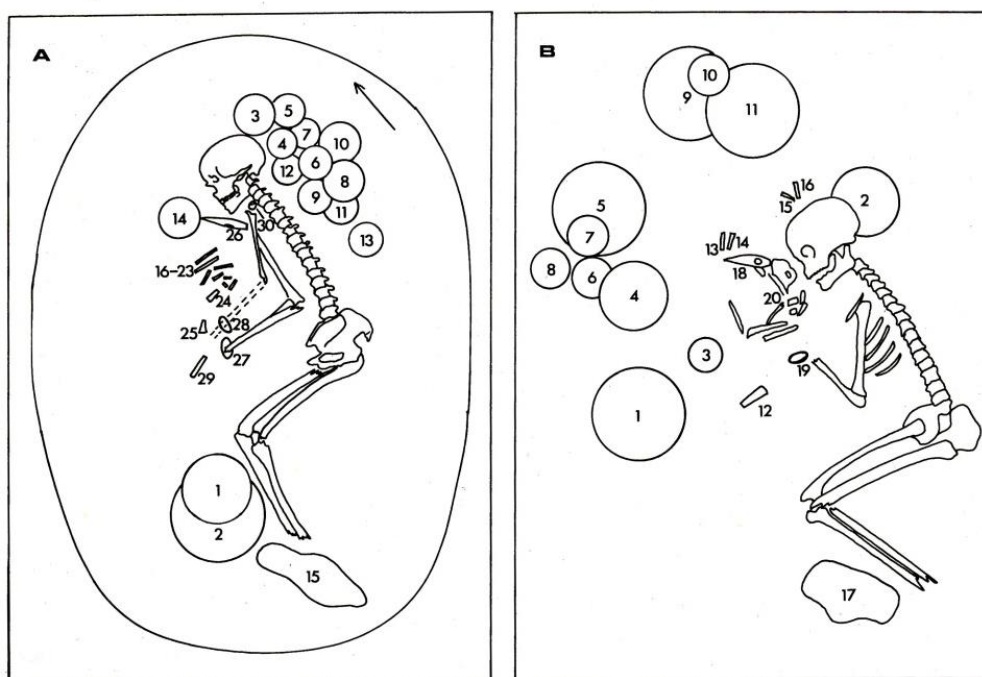


Abb. 239: Vel'ké Raškovce, Kr. Trebisov, Grab 1. (1—14 Keramik; 15 Silexknollen; 16—23 Silexklingen; 24 Kernstein; 25 Beil; 26 Kupferaxt; 27—28 Kupferarmringe; 29 Kupfermeißel; 30 Goldanhänger).  
 B: Vel'ké Raškovce, Kr. Trebisov, Grab 37. (1—11 Keramik; 12 Beil; 13—16 Silexklingen; 17 Silexknollen; 18 Kupferaxt; 19 Kupferarmring; 20 Knochen eines jungen Schafes oder einer Ziege). (nach J. Vizdál 19777).

Figure 4:7. The burials of two putative flint workers, interred with knapping tools and flint nodules. Discovered at Vel'ké Raškovce, Kr. Trebisov, Slovakia (from Lichardus-Itten 1999).

In terms of the ethnographic data set, 82% of storied sites provide evidence of craft specialists involved in the *chaîne opératoire*. This roughly parallels the archaeological examples where 64% of locally-prominent sites have well-crafted products. Both ethnography and the archaeological record suggest similar ratios

of functional to ceremonial/symbolic artefact production, and a supra-regional distribution of artefacts (200+km from source).

<b>ETHNOGRAPHY [n=168]</b> <b>Craft specialist involvement 70%</b> [n=118 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Craft specialists interpreted 43%</b> [n=95 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>82%</b> [n=97 of 118]	<b>64%</b> [n=61 of 95]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>51%</b> [n=61 of 118]	<b>13%</b> [n=12 of 95]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>49%</b> [n=58 of 118]	<b>16%</b> [n=15 of 95]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>39%</b> [n=47 of 118]	<b>53%</b> [n=50 of 95]	Evidence for ritualised extraction
Ritualised reduction	<b>55%</b> [n=66 of 118]	<b>38%</b> [n=36 of 95]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 6%</b> [n=7 of 118] <b>F/R = 92%</b> [n=109 of 118]	<b>R/W = 8%</b> [n=8 of 95] <b>F/R = 53%</b> [n=50 of 95]	Artefacts: Ritual/Functional use
<b>Craft specialist artefact production</b>			<b>Evidence for craft specialist artefact production</b>
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 9%</b> [n=11 of 118] <b>R = 16%</b> [n=19 of 118] <b>SR = 70%</b> [n=83 of 118]	<b>L = 4%</b> [n=4 of 95] <b>R = 22%</b> [n=21 of 95] <b>SR = 49%</b> [n=47 of 95]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>36%</b> [n=43 of 118]	<b>38%</b> [n=36 of 95]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>25%</b> [n=30 of 118]	<b>24%</b> [n=23 of 95]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>24%</b> [n=29 of 118]	<b>29%</b> [n=28 of 95]	Presence of burials / body parts

Table 4:14. The comparative analysis of evidence for the involvement of craft specialists.



Several European mining complexes appear to provide evidence of craft specialisation. In Poland, for example, at Krzemionki the banded flint was mainly used for axehead production, whereas at Świeciechów-Lasek (Balcer 1995, 209) and Tomaszów I (Schild 1995a, 462) the flint was used for blades, or ‘*massive backed blades*’ at Wierbica “Zełe” (Lech & Lech 1995, 475). At Valkenburg aan de Geul, Netherlands, axeheads also predominate (Brounen 1995, 451-2), whereas at Rijckholt, Netherlands, 14,217 flint picks were recovered within the mines (Felder et al. 1998, 47). In France axeheads are the main product at Jablines (Bostyn & Lanchon 1995, 312), Fampoux (Vallin & Masson 1995, 312), Villemaur-sur-Vanne “Le Grand Bois Marot” (de Labriffe et al. 1995a, 325) and Villemaur-sur-Vanne “Les Orlets” (de Labriffe et al. 1995b, 338).

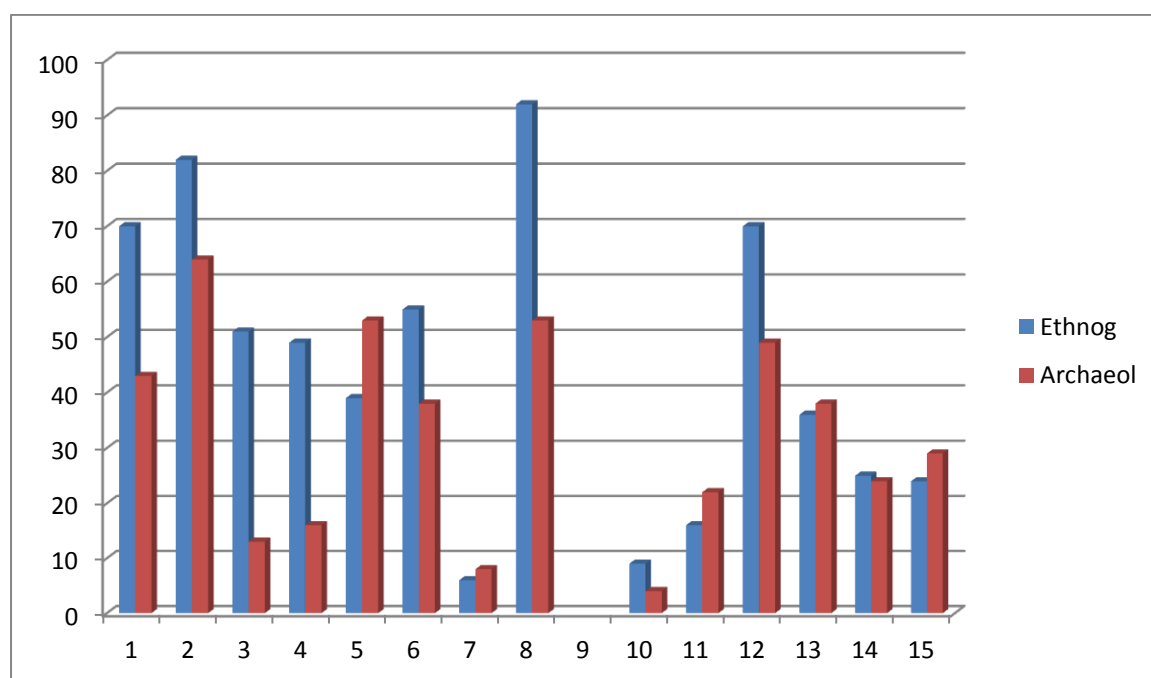


Table 4:15. Craft specialists

Key: **1 = Craft specialists**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

Conversely, at Villemaur-sur-Vanne “Le Grand Bois Marot”, France, the excavators have suggested that the mines were used by non-specialists as evidenced by large numbers of discarded roughouts and few finished axeheads – although finished axeheads have been recovered by surface collection (de Labriffe et al. 1995a, 328-30). This may indicate that finished pieces were crafted on the surface, and unwanted roughouts were simply discarded. That ritualised activities occurred at this site is suggested by the discovery of a ground and polished axehead from Chipping Floor 1 which had been deliberately burnt (de Labriffe et al. 1995a, 329).

Consequently, drawing the strands of evidence together, locally-prominent extraction sites with rock art or graffiti, burials or body parts, a preponderance of functional tool types, and long-distance product distribution, may all indicate the presence of craft specialists.

#### **4:3:8 *The distribution of extraction site products***

The local distribution of extraction site products (<100km from source), shows a close correlation between the ethnography and the archaeological record with only a 1% difference between data sets (Tables 4:16 and 4:17). The extraction sites which served these local networks show a strong correlation between storied sources recorded by ethnography, and those in locally-prominent settings recorded by archaeology. This suggests storied locations may have played a significant role in prehistory, although the data demonstrates that greater numbers of products went into regional and supra-regional distribution networks. Various differences of emphasis exist between the attributes recorded by both disciplines, which may reflect temporal and spatial changes, but the greatest influence may be the small size of the data sample which could have distorted the results. This again highlights the traditional interpretive problem noted in Chapter 2 concerning the use of small data sets to create interpretive models.

<b>ETHNOGRAPHY [n=168]</b> <b>Circulation [&lt;100km] 6%</b> [n=11 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Circulation [&lt;100km] 5%</b> [n=12 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>73%</b> [n=8 of 11]	<b>75%</b> [n=9 of 12]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>45%</b> [n=5 of 11]	<b>8%</b> [n=1 of 12]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>45%</b> [n=5 of 11]	<b>8%</b> [n=1 of 12]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>55%</b> [n=6 of 11]	<b>17%</b> [n=2 of 12]	Evidence for ritualised extraction
Ritualised reduction	<b>73%</b> [n=8 of 11]	<b>25%</b> [n=3 of 12]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 36%</b> [n=4 of 11] <b>F/R = 63%</b> [n=7 of 11]	<b>R/W = 17%</b> [n=2 of 12] <b>F/R = 17%</b> [n=2 of 12]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>100%</b> [n=11 of 11]	<b>33%</b> [n=4 of 12]	Evidence for craft specialist artefact production
<b>Circulation of artefacts: Local</b>			<b>Circulation of artefacts: Local</b>
Ceremonial use of extraction sites	<b>9%</b> [n=1 of 11]	<b>17%</b> [n=2 of 12]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>0</b>	<b>0</b>	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>0</b>	<b>0</b>	Presence of burials / body parts

Table 4:16. A comparative analysis of the distribution of extraction site products: <100km.

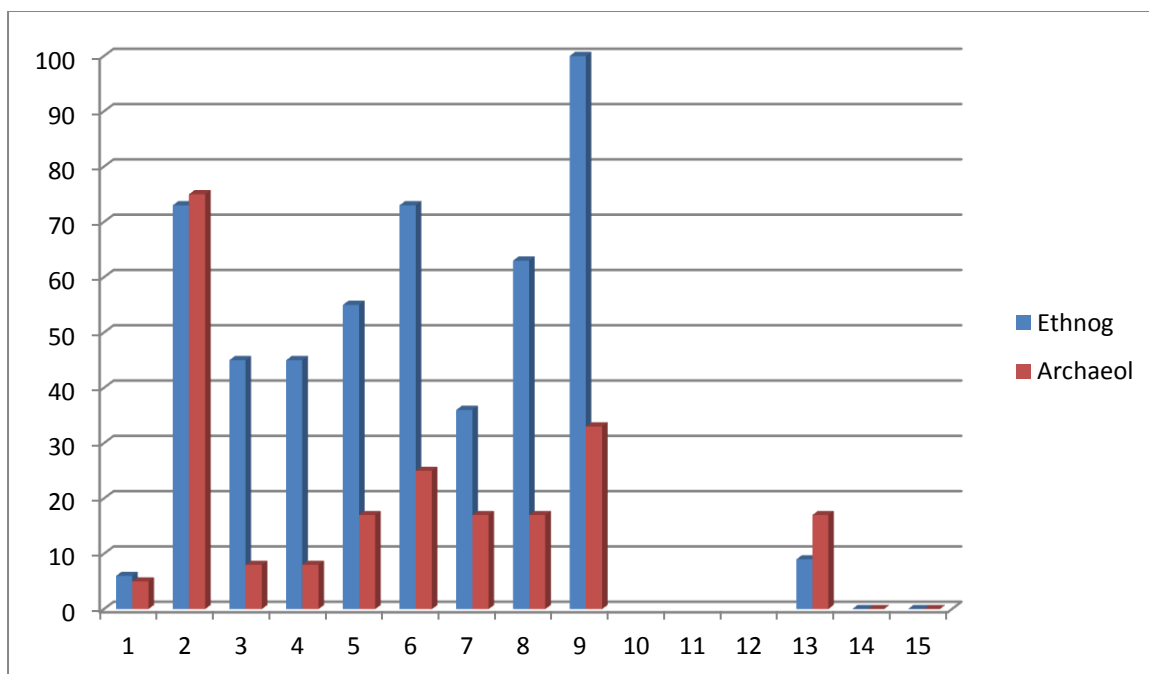


Table 4:17. Local product distribution [<100km]

Key: **1 = Local product distribution [<100km]**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

The ethnography records almost half of extraction sites have some form of restricted access and were only used seasonally, whereas less than 10% of archaeological cases have inferred such practises. 55% of ethnography records locally-distributed (<100km) objects which had originated from ritualised extraction, which compares to a modest 17% inferred in the archaeological record. These attributes might be inferred at certain European archaeological sites such as Stránská Skála, Czech Republic (Svoboda 1995), and Wierzbica “Zełe”, Poland (Lech & Lech 1995), which appear to have targeted local requirements.

<b>ETHNOGRAPHY [n=168]</b> <b>Circulation [100-200km] 17%</b> [n=28 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Circulation [100-200km] 19%</b> [n=43 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>50%</b> [n=14 of 28]	<b>67%</b> [n=29 of 43]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>46%</b> [n=13 of 28]	<b>7%</b> [n=3 of 43]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>36%</b> [n=10 of 28]	<b>12%</b> [n=5 of 43]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>32%</b> [n=9 of 28]	<b>49%</b> [n=21 of 43]	Evidence for ritualised extraction
Ritualised reduction	<b>14%</b> [n=4 of 28]	<b>35%</b> [n=15 of 43]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 0</b> <b>F/R = 89%</b> [n=25 of 28]	<b>R/W = 5%</b> [n=2 of 43] <b>F/R = 56%</b> [n=24 of 43]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>46%</b> [n=13 of 28]	<b>44%</b> [n=19 of 43]	Evidence for craft specialist artefact production
<b>Circulation of artefacts: Regional</b>			<b>Circulation of artefacts: Regional</b>
Ceremonial use of extraction sites	<b>0</b>	<b>42%</b> [n=18 of 43]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>0</b>	<b>16%</b> [n=7 of 43]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>0</b>	<b>28%</b> [n=12 of 43]	Presence of burials / body parts

Table 4:18. A comparative analysis of the distribution of extraction site products: 100-200km.

Extraction sites which operate(d) as part of a regional network (100-200km from source) (Table 4:18), show differences with those operating at a local level. Fewer ethnographic studies record regional networks, yet conversely, artefact distribution is well documented in archaeology through petrological analysis. Consequently, some confidence can be placed on both data sets which suggests that the archaeological record has provided evidence for a greater number of regionally-focused sites, perhaps identifying information beyond the

ethnographer's reach? However, the social context of extraction differs in that ethnography records more evidence of restricted access and seasonality than archaeology, although similar emphases are placed upon ritualisation and the inputs of craft specialists. The apparent divergence between percentages of ritual objects may be misleading in that ethnography records the existence of artefacts which can emerge as purely functional pieces, but through ritual transformation can become ceremonial, wealth or status objects (cf. Chapter 3, section 3:3:9). Consequently, in this instance ethnography may be under-representing reality regarding the circulation of ritualised artefacts in regionalised networks.

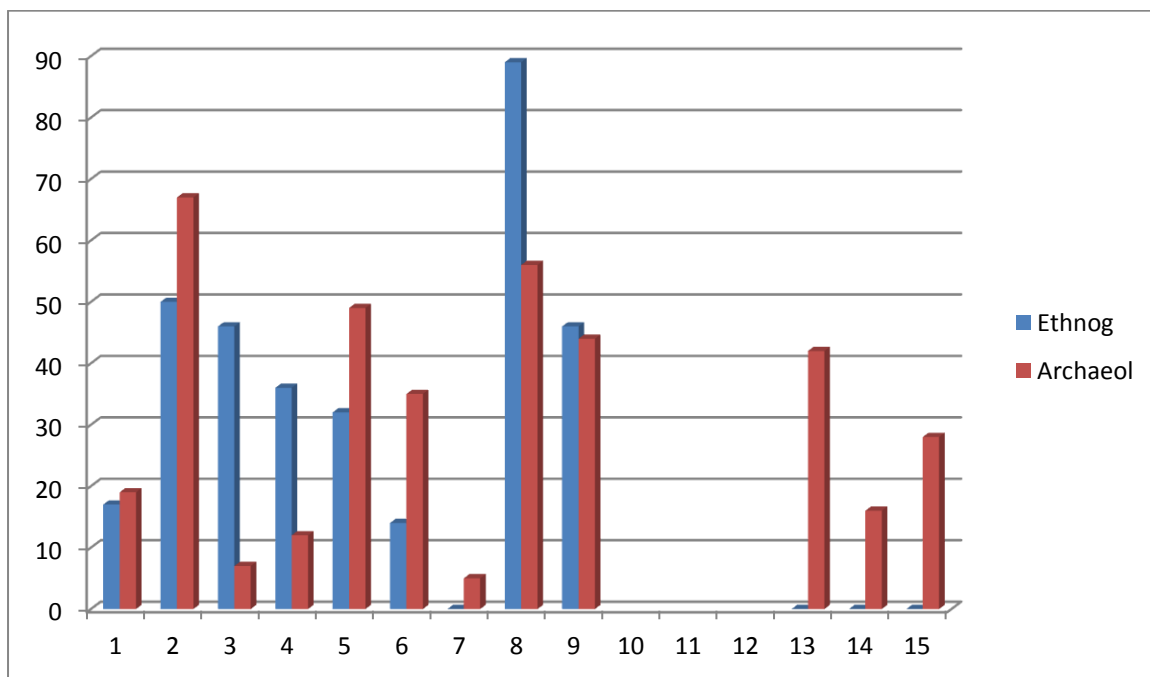


Table 4:19. Regional product distribution [100-200km]

Key: 1 = **Regional product distribution [100-200km]**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

The archaeological record shows reasonably pronounced trends for the after-use of sites in terms of ceremonialism, decoration with rock art or graffiti, and the

interment of burials or body parts. Ethnography does not record such patterning, therefore the data sets may simply be divergent and illustrate separate trends in secondary practises where the evidence suggests it was greater in the past.

Extraction sites associated with supra-regional networks produce objects which are distributed 200+km from the source. This category is the most numerous in both data sets, accounting for 64% of ethnographic examples and 60% in archaeological. The key observation is that over half of all sites recorded by both disciplines appear to distribute products at a supra-regional level, which demonstrates a cultural and 'economic' importance. The presence of robust distributional data from petrological analysis gives the archaeological data a solid foundation and validity. Interestingly, the different scales of distribution recorded by both disciplines show similar ratios overall, with local sites being fewest in number, followed by regional sites, and finally the substantially greater number of supra-regional sites. This observation demonstrates the relative cultural importance of the extraction sites in this final category, underscored by the fact that their products are distributed the most extensively of all. The fact that the majority of extraction site products fall into this category suggests that archaeological interpretation should acknowledge the probability that archaeological artefacts that entered long-distance networks were objectified and carried narratives to far-flung communities.

Examples of European sites which have extensive distribution patterns include Rijckholt – St Geertruid (de Grooth 1998; 2005), Netherlands, Jablines (Bostyn & Lanchon 1992; 1995), Grand Pressigny (Millet-Richard 2006) and Sélédin (Le Roux 1971; 1979) (Figure 4.8) in France, Krzemionki (Borkowski 1995) in Poland (Figure 4.9), and the Italian jadeitite axeheads from the Alpine sources (Pétrequin et al. 2012a). North American examples include Knife River (Ahler 1986), Burlington and Flint Ridge (DeRegnaucourt & Georgiady 1998), and Obsidian Cliff Plateau (Davis et al., 1995). Each of these sites produced distinctive types of toolstone.

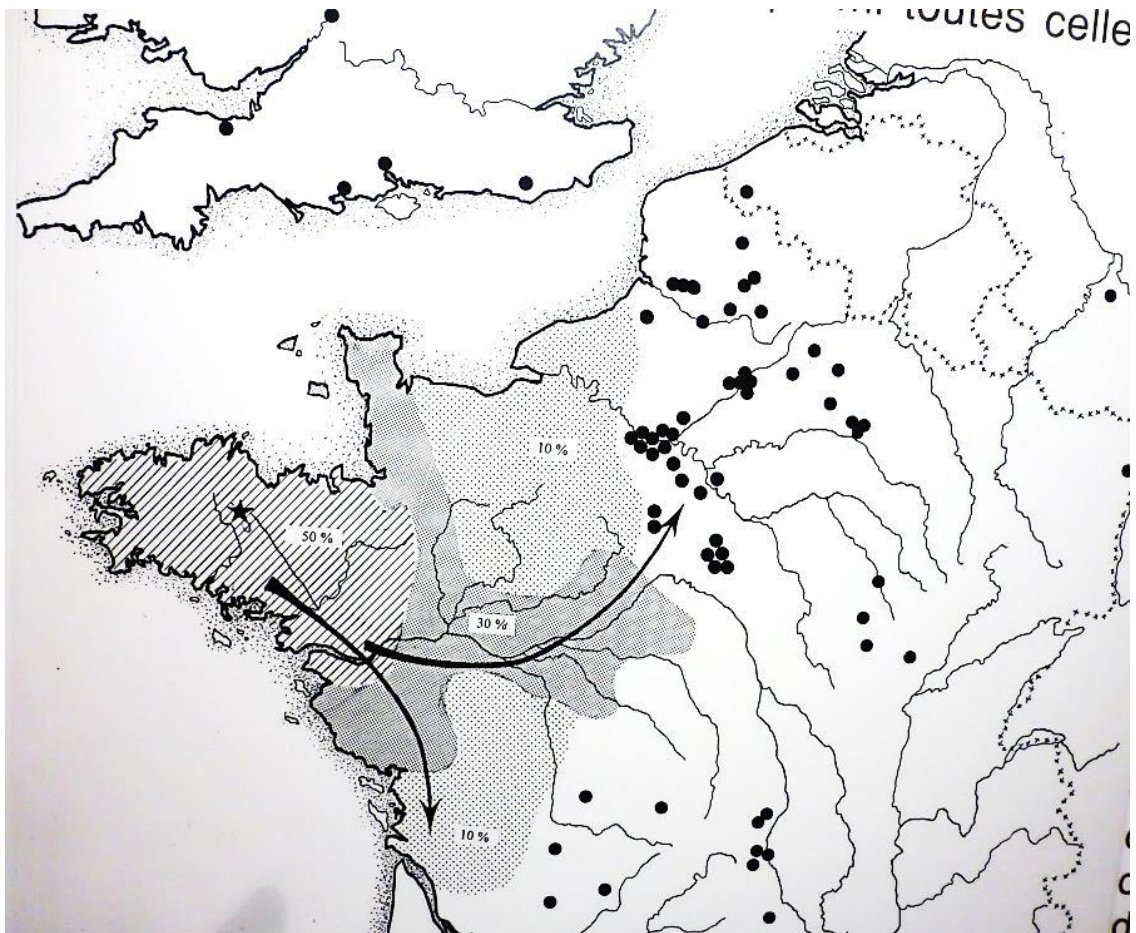
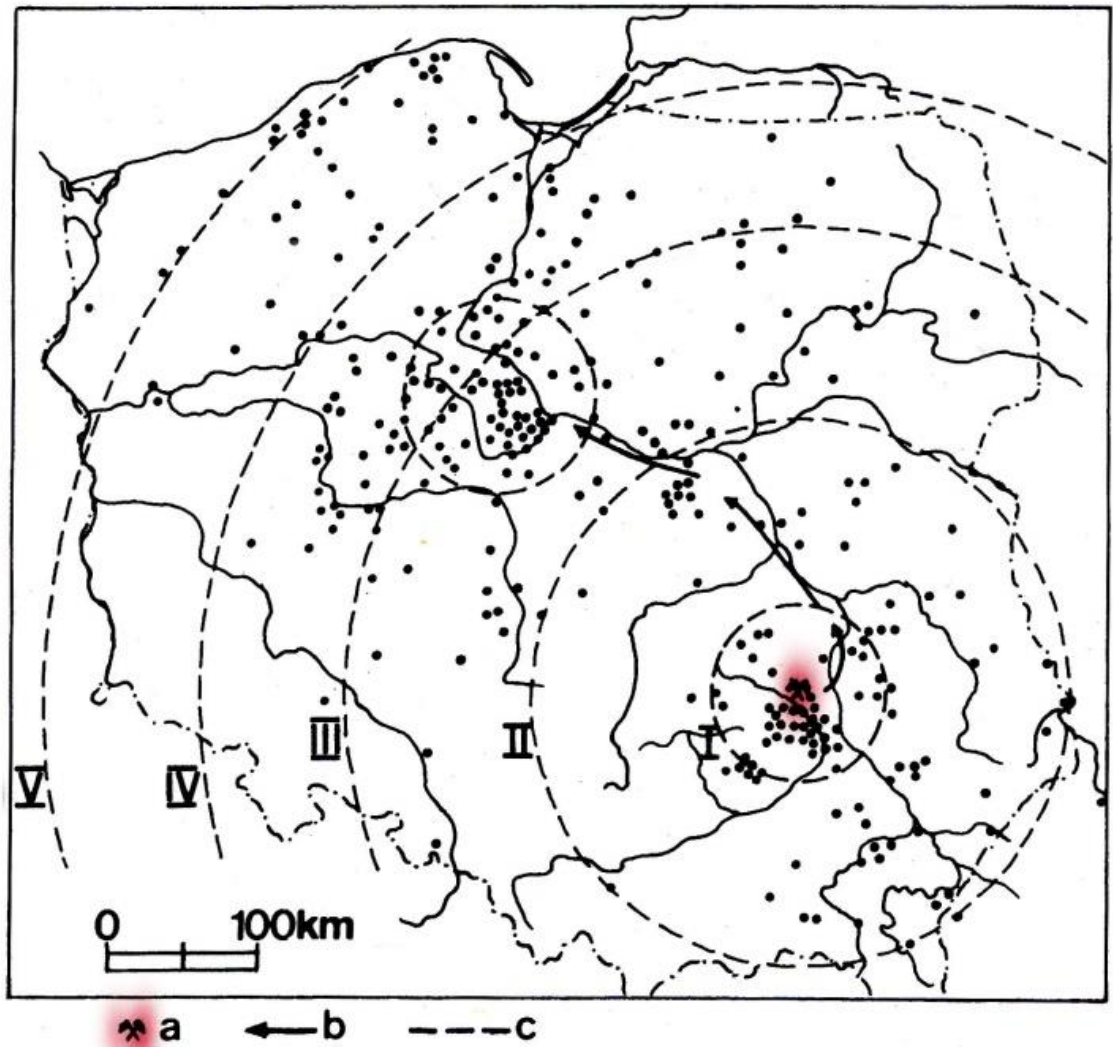


Figure 4:8. The distribution of the Sélédin, Plussulien, Dolerite 'A' axeheads (from a display in Plussulien Museum).

Both data sets record a high percentage of sites demonstrating, or suggesting, links to storied locations. The ethnography suggests that archaeology needs to give more credence to restricted access and seasonality. Both data sets record relatively high percentages for ritualised extraction, evidence for the inputs of craft specialists, and processes of ritualised reduction sequences. Despite such evidence, both data sets record the production of functional/ritual artefacts far exceeding that of ritual/wealth objects. However, some consideration is needed of the possibility for the later transformation of dual-functional products in to status/ritual/wealth objects which may be hidden by the apparent functionality of the original products, especially considering the storied source, ritualised extraction and ceremonial uses of many sites in both data sets (see 4:3:6).





**16. Distribution of banded flint artifacts in the Globular Amphorae Culture province in Poland: a — mines; b — principal direction of artifacts distribution; c — circles of artifacts distribution.**

Figure 4:9. The distribution of Banded Flint axeheads from Krzemionki, Poland (from Borkowski et al. nd, 19).

<b>ETHNOGRAPHY [n=168]</b> <b>Circulation [200+km] 64%</b> [n=107 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Circulation [200+km] 60%</b> [n=85 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>85%</b> [n=91 of 107]	<b>68%</b> [n=58 of 85]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>50%</b> [n=54 of 107]	<b>12%</b> [n=10 of 85]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>53%</b> [n=57 of 107]	<b>15%</b> [n=13 of 85]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>48%</b> [n=51 of 107]	<b>38%</b> [n=32 of 85]	Evidence for ritualised extraction
Ritualised reduction	<b>49%</b> [n=52 of 107]	<b>25%</b> [n=21 of 85]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 6%</b> [n=6 of 107] <b>F/R = 90%</b> [n=96 of 107]	<b>R/W = 9%</b> [n=8 of 85] <b>F/R = 58%</b> [n=49 of 85]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>78%</b> [n=83 of 107]	<b>55%</b> [n=47 of 85]	Evidence for craft specialist artefact production
<b>Circulation of artefacts: Supra-Regional</b>			<b>Circulation of artefacts: Supra-Regional</b>
Ceremonial use of extraction sites	<b>49%</b> [n=52 of 107]	<b>29%</b> [n=25 of 85]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>41%</b> [n=44 of 107]	<b>19%</b> [n=16 of 85]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>27%</b> [n=29 of 107]	<b>21%</b> [n=18 of 85]	Presence of burials / body parts

Table 4:20. A comparative analysis of the distribution of extraction site products: 200+km.

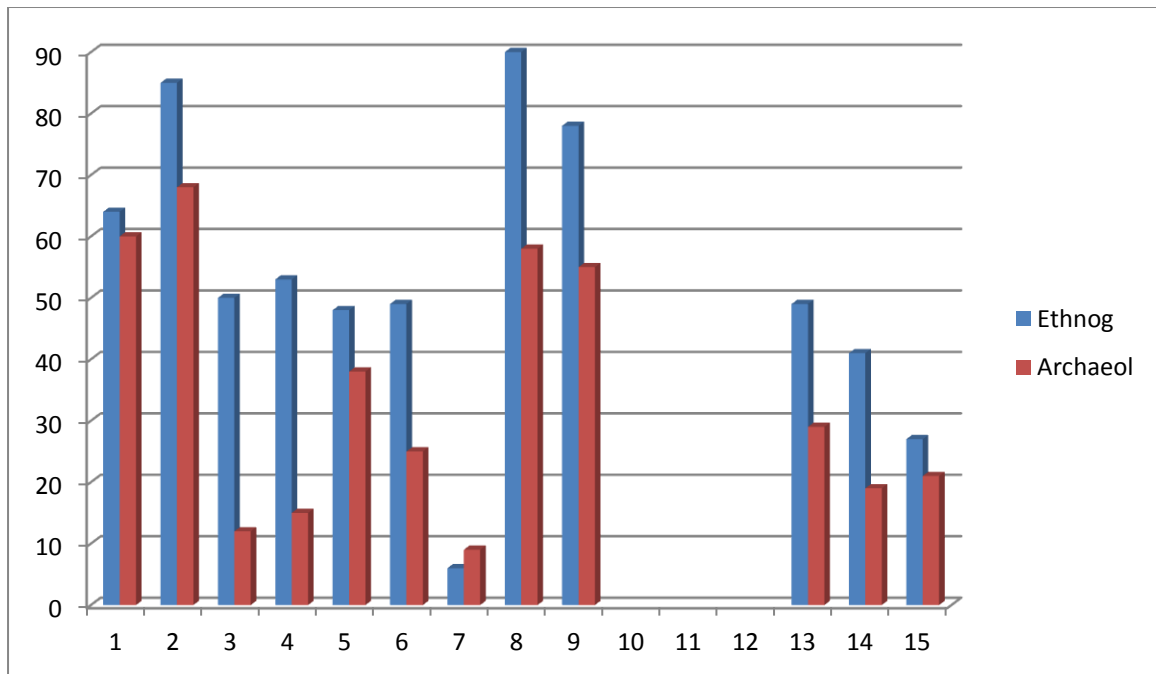


Table 4:21. Supra-regional product distribution [200+km]

Key: **1 = Supra-regional product distribution [200+km]**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### **4:3:9 Pre- and post-extraction activities at extraction sites**

The ethnography records that in roughly one third of studies some form of ceremonialism was embedded in extraction practise, which is performed before and/or after procurement. Such ceremonialism is generally part of the process of ritualised extraction (see sections 4:3:5, 4:3:6, 4:3:7, 4:3:8 & 4:3:9). Preliminary ceremonialism is generally designed to appease the supernatural owners of the site, when offerings or services are made in return for the raw material (e.g. Hampton 1997; Dean 2010; Stout 2002; Clark & Martin 2005). Post-extraction ceremonialism is normally linked to rites of renewal, and the reaffirmation of social networks such as kinship links, alliance building and the maintenance of group identities (e.g. Gould 1977; Brumm 2010; Hall 1997; Hughes & Stewart 1997).

<b>ETHNOGRAPHY [n=168]</b> <b>Pre/post-extraction activities 33%</b> [n=55 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Interpreted pre/post-extraction</b> <b>activities 30%</b> [n=66 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>96%</b> [n=53 of 55]	<b>64%</b> [n=42 of 66]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>29%</b> [n=16 of 55]	<b>11%</b> [n=7 of 66]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>67%</b> [n=37 of 55]	<b>9%</b> [n=6 of 66]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>67%</b> [n=37 of 55]	<b>79%</b> [n=52 of 66]	Evidence for ritualised extraction
Ritualised reduction	<b>74%</b> [n=41 of 55]	<b>41%</b> [n=27 of 66]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R = 4%</b> [n=2 of 55] <b>F/R = 95%</b> [n=52 of 55]	<b>R = 6%</b> [n=4 of 66] <b>F/R = 51%</b> [n=34 of 66]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>78%</b> [n=43 of 55]	<b>54%</b> [n=36 of 66]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 2%</b> [n=1 of 55] <b>R = 0</b>  <b>SR = 94%</b> [n=52 of 55]	<b>L = 3%</b> [n=2 of 66] <b>R = 27%</b> [n=18 of 66] <b>SR = 38%</b> [n=25 of 66]	Circulation of artefacts: Local / Regional / Supra-Regional
<b>Ceremonial use of extraction sites</b>			<b>Ceremonial use of extraction sites</b>
Rock art/graffiti at extraction sites	<b>67%</b> [n=37 of 55]	<b>32%</b> [n=21 of 66]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>45%</b> [n=25 of 55]	<b>48%</b> [n=32 of 66]	Presence of burials / body parts

Table 4:22. The comparative analysis of data for pre/post extraction ceremonialism at extraction sites using averaged statistics based upon a sub-set of the full data assemblage.

A comparison of the data sets shows that both have similar emphases for most attributes, demonstrating that archaeology is recognising appropriate comparators which can now be used to add detail to a more nuanced

interpretation of the social context of extraction, and sketch the potential outputs and outcomes of such behavioural patterning. Secondary deposition which is demonstrably not connected with extraction (e.g. later burials) has been excluded from this analysis.

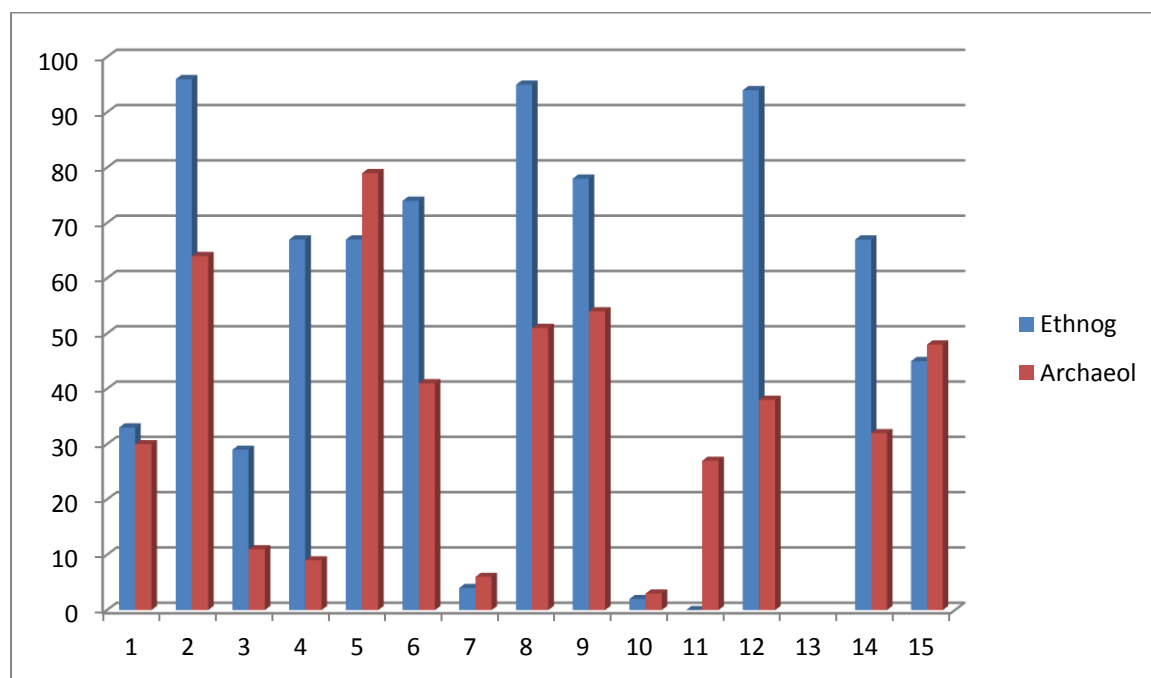


Table 4:23. Ceremonialism at sites

Key: **1 = Ceremonial use of sites**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### 4:3:10. *The use of rock art, graffiti or idols at or near extraction sites*

The use of rock art (petroglyphs/pictographs), graffiti and idols to sign-post an extraction site is recorded in roughly one-third of ethnographic cases (27%; 46 of 168), compared to roughly one sixth by archaeology (13%; 29 of 223). This contrast may partly be due to fieldwork bias and preservation, or that archaeological studies have not considered this evidence part of ritualised practises at extraction sites. The discovery of the Copt Howe rock art on the valley floor below the Great Langdale axe quarries is a case in point, or the

panels in the valley below Creag na Caillich, both of which may be signposting the quarries (see Chapter 5). Yet ethnographically roughly 30% of sites (see Chapter 3:1:13) record the use of art at extraction sites, particularly at places such as the Pipestone Quarries in Minnesota (e.g. Winchell 1983; Holmes 1919) or the 3<sup>rd</sup> Unnamed Cave in Tennessee (Simek et al. 1998), and in South America, where idols are used by several cultures (e.g. Dean 2010).



Figure 4:10. Charcoal pictograph of a possible human figure drawn upon a chalk pillar in the flint mines at Krzemionki, Poland.

Archaeologically, rock art is comparatively rare in continental Europe. At Defensola “A”, Italy, for example, the mines contained three areas of geometrical graffiti, with a fourth scratched onto a limestone block discovered outside the mines (di Lernia et al. 1995, 428). The graffiti at Defensola “A” suggests that art added a further level of complexity to ritualised extraction practises here, inscribing the workings with meaningful images and clearly sign-posting the cultural value of this location.

At Krzemionki, Poland, a series of four charcoal pictographs have been recorded in the underground workings depicting (Figures 4:10 & 4:11):

1. a ‘bull’s head’ (Figure 4:11a)

2. 'bull's horns' (4:11b)
3. a 'pair of human feet' (4:11d)
4. and a possible human figure interpreted as a man, or a woman giving birth (4:11e) (Babel 1999, 594)

The presence of anthropomorphic or representational art at Krzemionki is unusual and relatively rare as a phenomenon in Europe<sup>24</sup>, and may have been designed to heighten mythological or ancestral links, or indicate legitimacy for the users of the mines.

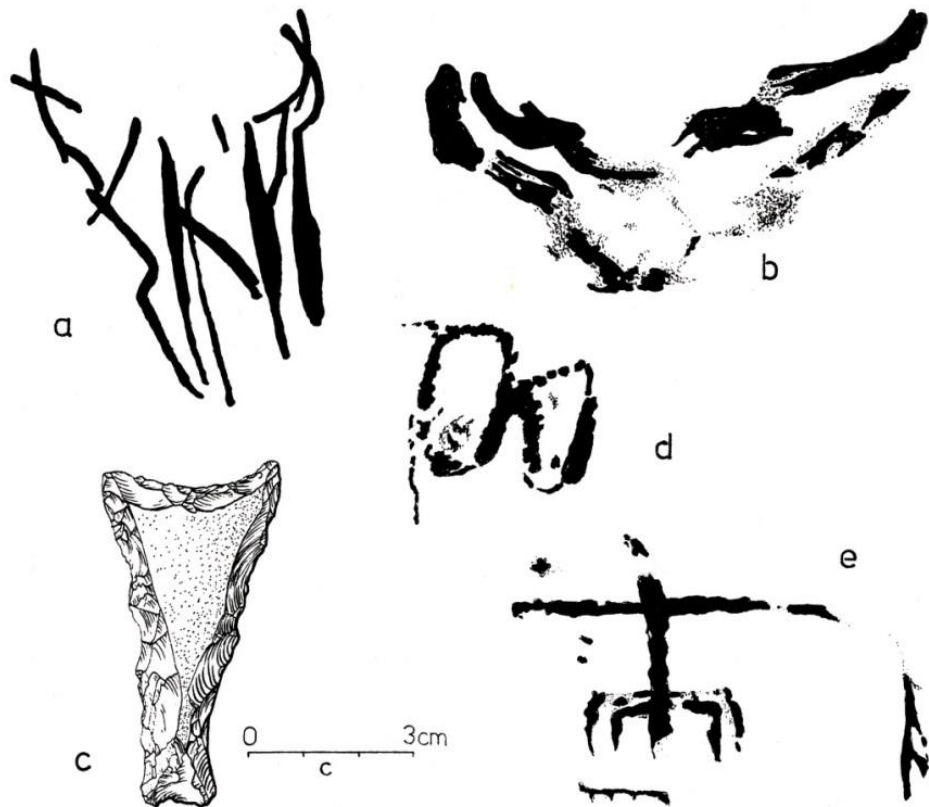


Figure 4:11. The Krzemionki graffiti (from Babel 1999).

Both ethnography and archaeology illustrate a number of correlations between the data sets, particularly with potentially storied sites, the use of ritualised extraction, the involvement of craft specialists, a dominance for supra-regional product circulation, pre and post-extraction ceremonialism, and the presence of burials or body parts, all creating a package of practises which can include rock art and idols (Figure 4.12). Seasonality in the ethnographic data is very high,

<sup>24</sup> See recently rediscovered graffiti from Cissbury, UK, which may feature representational art <http://www.antiquity.ac.uk/projgall/teather347> [accessed 16/03/2016]

considering the overall scarcity of this attribute. Consequently, rock art/idols not only sign-post sites, but form part of a suite of practises which create social significance for these places.



Figure 4:12. A rare example of a Neolithic idol discovered in the variscite mines at Gavà, near Barcelona. Disarticulated burials were also found underground, accompanied by grave goods (Casas & Majó 2009; Bosch & Gómez 2009).



<b>ETHNOGRAPHY [n=168]</b> <b>Rock art, graffiti and statuary 27%</b> [n=46 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Rock art, graffiti and statuary 13%</b> [n=29 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>96%</b> [n=44 of 46]	<b>86%</b> [n=25 of 29]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>13%</b> [n=6 of 46]	<b>24%</b> [n=7 of 29]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>78%</b> [n=36 of 46]	<b>14%</b> [n=4 of 29]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>85%</b> [n=39 of 46]	<b>86%</b> [n=25 of 29]	Evidence for ritualised extraction
Ritualised reduction	<b>54%</b> [n=25 of 46]	<b>48%</b> [n=14 of 29]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 6%</b> [n=3 of 46] <b>F/R = 78%</b> [n=36 of 46]	<b>R/W = 10%</b> [n=3 of 29] <b>F/R = 58%</b> [n=17 of 29]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>65%</b> [n=30 of 46]	<b>79%</b> [n=23 of 29]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 0</b>  <b>R = 0</b>  <b>SR = 98%</b> [n=45 of 46]	<b>L = 0</b>  <b>R = 24%</b> [n=7 of 29] <b>SR = 48%</b> [n=14 of 29]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>80%</b> [n=37 of 46]	<b>69%</b> [n=20 of 29]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites			Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>65%</b> [n=30 of 46]	<b>59%</b> [n=17 of 29]	Presence of burials / body parts

Table 4:24. A comparative analysis of the evidence for the use of art or statuary at extraction sites using averaged statistics based upon a sub-set of the full data assemblage.

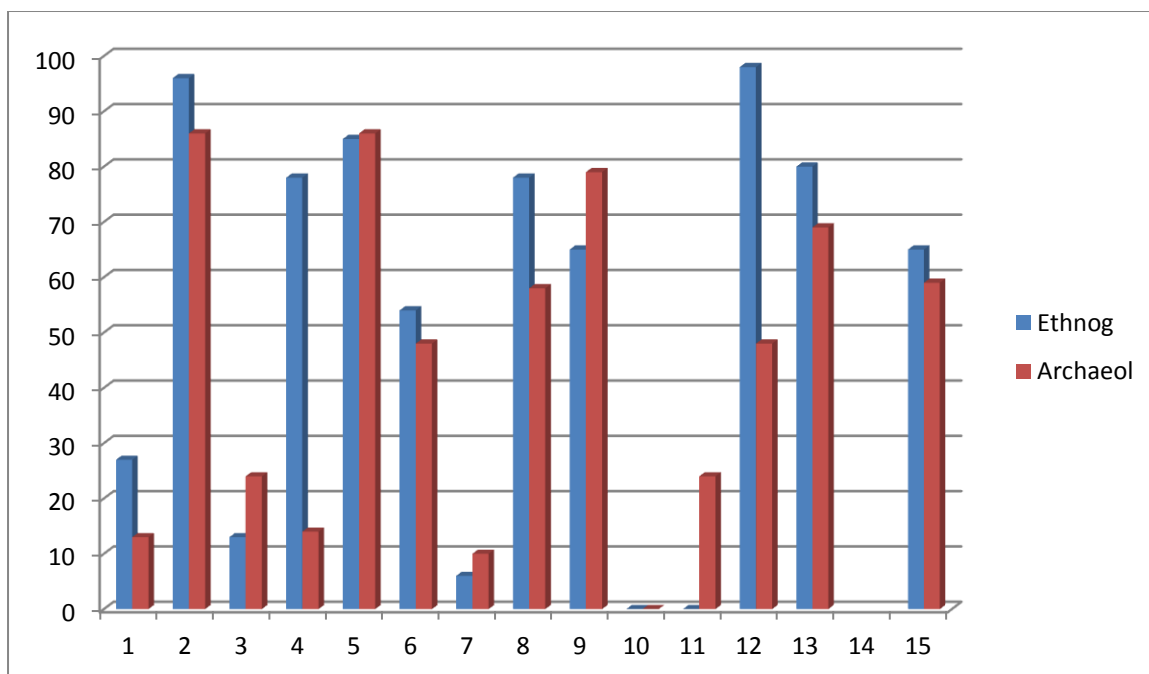


Table 4:25. Rock art, graffiti and statuary

Key: **1 = Rock art, graffiti and statuary**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### **4:3:11      *The presence of burials / body parts at extraction sites***

Human burials or body parts have been found in 19% [43 of 223] of excavations, and in 18% of the ethnography [30 of 168]. Although the interment of burials or body parts occurs in roughly twenty percent of extraction sites in both disciplines, this can be problematic as the precise motivation for deposition in the archaeological record can be ambiguous. Do the burials represent the remains of miners, or individuals who had an association with extraction, a significant ancestor, or simply a random person without any links to the site. The presence of site-related artefacts may be an unreliable indicator as they could be residual, or represent the material renegotiation of the status of the deceased at the time of death, who may not have even been associated with extraction. In addition, difficulties exist with the reliability of some evidence, as has been demonstrated

recently by the case of the radiocarbon dating of Skull #1 found buried in a small pit at the end of a gallery at Rijckholt, traditionally interpreted as Neolithic because of its context, which has now been shown to date to the post-Medieval period (de Grooth et al. 2011).

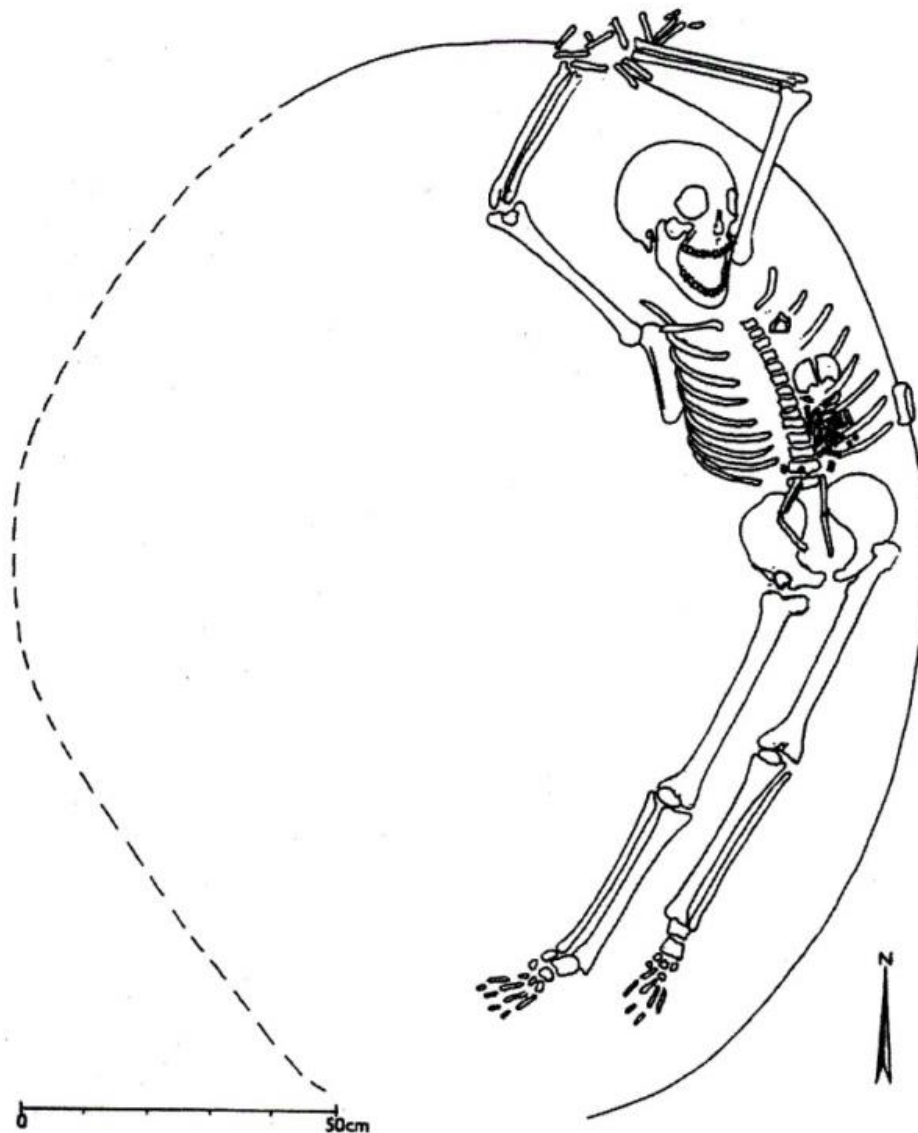


Figure 4:13. The burial of a female and infant from Shaft 5 at Krumlovský les, Czech Republic, dating from the Eneolithic Lengyel Culture (from Oliva 2006).

The European archaeological record has provided evidence of burials or body parts from Austria, Belgium, Belarus, the Czech Republic, France, Hungary, Italy and the Netherlands, but this practise may have been more widespread than current distributions reflect. The European evidence comprises formal and casual burials and the deposition of body parts, primarily skulls or long bones.

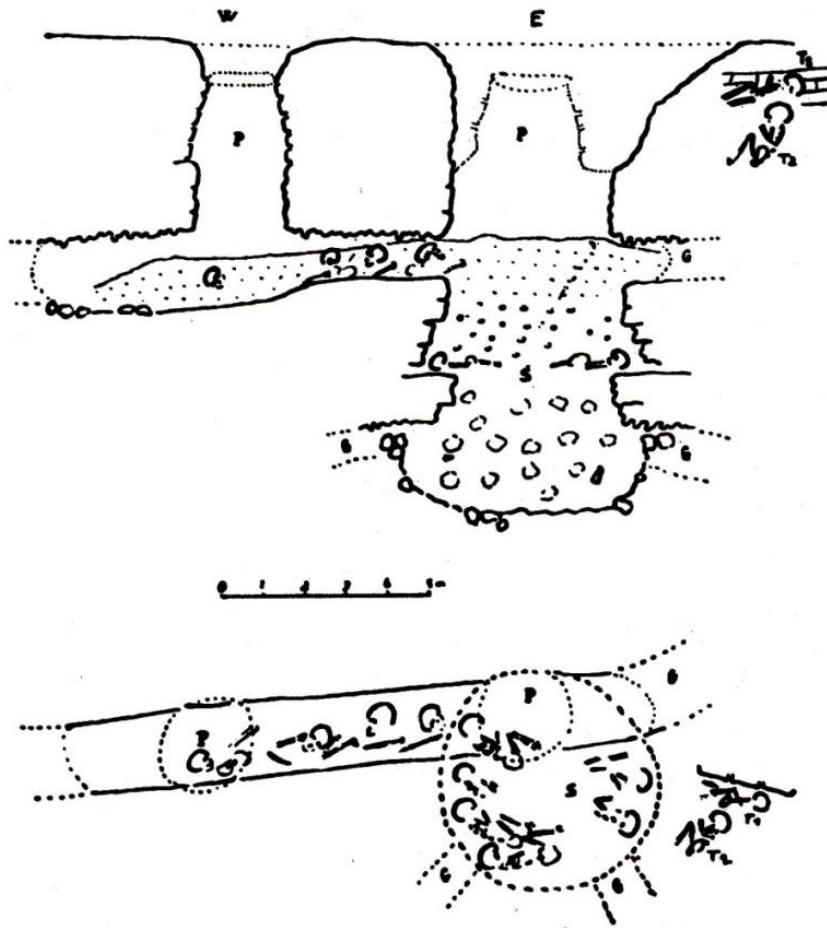


Figure 4:14. The multiple interments at Salinelles, France (from Dijkman 1999).

At Villemaur-sur-Vanne “Les Orlets”, France, a putative Chalcolithic child’s burial was discovered in a shaft entrance, lying on it’s right side and accompanied by a necklace of teeth and antler (de Labriffe et al. 1995b, 345). One of the shafts at Krasnaselsky, Belarus, contained a Corded Ware Culture ‘miner’s burial’ with a large bone needle and a decorated pot (Charniausky 1995, 269). Shaft 5 at Krumlovský les, Czech Republic, contained the articulated skeletons of two females; the lower interment (Figure 4:13) was discovered at a depth of 7.0m and appears to have been casually thrown into the partly backfilled shaft and had the head of a new-born infant placed upon her chest with the body across her pelvis (Oliva 2006, 165-6; 2010). Multiple burials can be seen at Chamber A at Valle Sbernia, Italy, where lying upon the backfill ‘were found about ten [articulated] skeletons (of adults of both sexes and children) lying in a circle around the furnishings, a flint blade and late Eneolithic ceramics’ (Sisto 1995, 435). Another example was recorded at Salinelles, France (Figure 4:14), where some twelve

crouched or disarticulated skeletons were discovered scattered through the middle fills of a shaft and within a gallery leading to an adjoining shaft (Dijkman 1999, 478-9). Interestingly, both shafts appeared to have been purposefully closed by stone slabs following the burials, thus creating a sealed chamber.

Clearly the formal burials are referencing the mines, and possibly commemorating familial or kinship links to extraction practises; renewal and fertility rites may also be represented by human interment. The two female skeletons discovered at Krumlovský les offer the possibility of different contexts of deposition, evidenced by the lower burial and the fact that the child's skull was detached from its body and the configuration of the adult female skeleton suggests it had been thrown into the mines rather than carefully placed. This might imply that they may have been murdered or sacrificed as part of abandonment rituals, which may have been associated with renewal or fertility ceremonialism.

Body parts also occur at certain European sites. At Rijckholt, Netherlands, body parts were recorded at workshops on the slopes of a re-entrant 200m from the mines, comprising a skull (female), fragments of a mandible, a right femur, with references to two other skulls (Felder et al. 1998, 54-57). The context of these body parts suggests a strong link with the mines, either through referencing, association and/or renewal or fertility rites. The presence of body parts may also represent excarnation practises amongst the mining community, which created physical links between the significant dead and the mines. Veneration of the dead, ancestral links to the mines, kinship and alliance building will all have been symbolically woven into these interments. The body parts absent from the mines may have remained at the home settlements to forge a bilateral symmetry with the extraction sites.

At the Pipestone quarries, Minnesota (Scott et al. 2006), and Blackpatch, UK (Pull Archive, Worthing Museum), for example, certain contemporary burial mounds have been constructed on-site which monumentalise and juxtapose the dead. This suggests both ritual observance and veneration of significant individuals, embedding them into the charged arena of the extraction site, and creating direct associations with the raw material to physically confirm legitimacy.

<b>ETHNOGRAPHY</b> [n=168] Burials / body parts 18% [n=30 of 168]		<b>ARCHAEOLOGY</b> [n=223] Burials / body parts 19% [n=43 of 223]	
Raw material	n/a	n/a	Raw material
Mythical / spiritual associations with source	<b>100%</b> [n=30 of 30]	<b>79%</b> [n=34 of 43]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>13%</b> [n=4 of 30]	<b>19%</b> [n=8 of 43]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>80%</b> [n=24 of 30]	<b>19%</b> [n=8 of 43]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>83%</b> [n=25 of 30]	<b>67%</b> [n=29 of 43]	Evidence for ritualised extraction
Ritualised reduction	<b>83%</b> [n=25 of 30]	<b>40%</b> [n=17 of 43]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 7%</b> [n=2 of 30] <b>F/R = 76%</b> [n=23 of 30]	<b>R/W = 2%</b> [n=1 of 43] <b>F/R = 58%</b> [n=25 of 43]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>97%</b> [n=29 of 30]	<b>65%</b> [n=28 of 43]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 0</b>  <b>R = 0</b>  <b>SR = 97%</b> [n=29 of 30]	<b>L = 0</b>  <b>R = 28%</b> [n=12 of 43] <b>SR = 42%</b> [n=18 of 43]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>83%</b> [n=25 of 30]	<b>74%</b> [n=32 of 43]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>100%</b> [n=30 of 30]	<b>40%</b> [n=17 of 43]	Rock art/graffiti at extraction sites
Presence of burials / body parts			Presence of burials / body parts

Table 4:26. The presence of burials or body parts at extraction sites.

Other burials off-site are also recorded (not included in the data sets here), often interpreted as miners or flint knappers. At Michałowice, Wojw, Kraków, a crouched inhumation of a 'flint knapper' was accompanied by flint implements, a punch and an anvil stone (Lech 1999, 272). The graves of two Chalcolithic 'flint miners' from the Tiszapolgár-kultur were discovered at Veľké Raškovce, Kr. Trebišov, Slovakia (Figure 4:7). Both graves featured crouched inhumations

lying on their right sides, accompanied by ceramics, flint tools, copper artefacts and a single flint nodule roughly the length of a femur placed near the feet (Lichardus-Itten 1999, 281). Both graves exhibited similar body positioning and an interesting juxtaposition of artefacts of the old and new technologies.

There is a strong correlation between the percentages of sites associated with human remains recorded by both disciplines, 18% in ethnography compared to 19% in archaeology. This may suggest that archaeological extraction sites were included in wider traditions of ritualised interment, but that these were comparatively rare events at storied and ritualised mines and quarries.

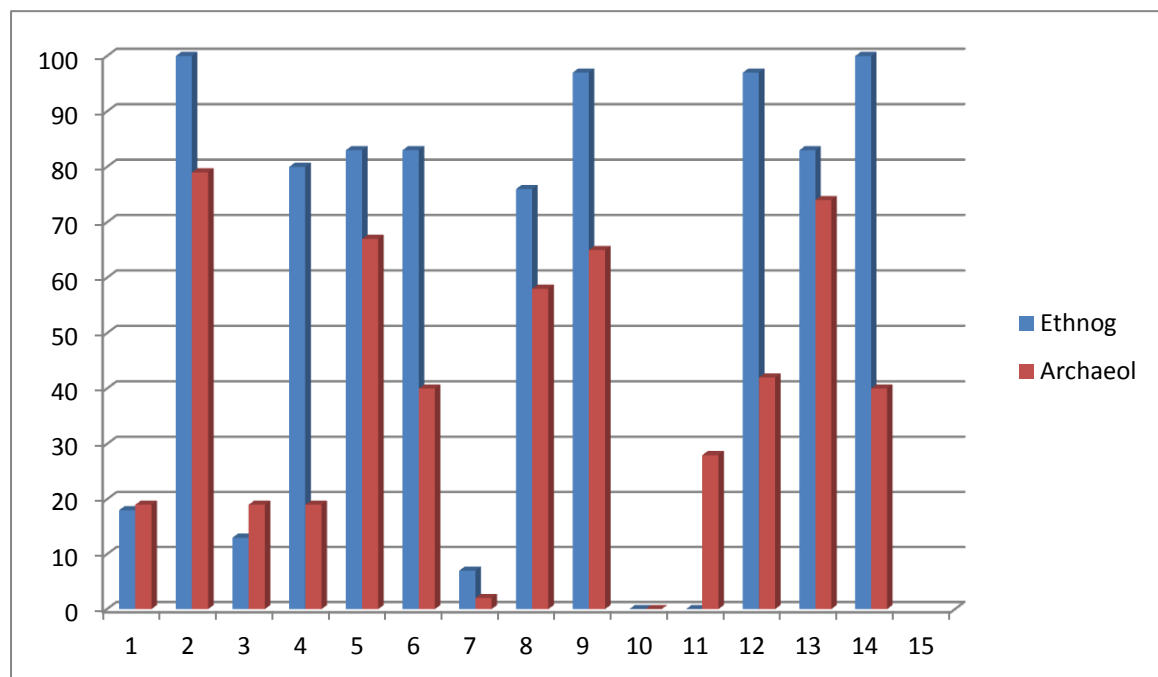


Table 4:27. Burials / body parts

Key: **1 = Burials / body parts**; 2 = Storied / prominent settings; 3 = Ownership / restricted access; 4 = Seasonality; 5 = Ritualised extraction; 6 = Ritualised reduction; 7 = Ritual / wealth objects; 8 = Functional / ritual objects; 9 = Craft specialists; 10 = Local product distribution [<100km]; 11 = Regional product distribution [100-200km]; 12 = Supra-regional product distribution [200+km]; 13 = Ceremonial use; 14 = Rock art / graffiti; 15 = On-site burials.

#### **4:3:12      *An overview by raw material type***

##### *Stone*

The use of stone is arguably one of humankind's oldest technologies, and consequently would be expected to have developed a strong cultural identity over the millennia. In comparing the ethnographic and archaeological records of stone extraction, certain strong trends are apparent. One of the strongest parallels appears to be that over 60% of sites recorded by both disciplines have potentially storied locations, allied with ritualised extraction in 40+% of cases. Amongst the ethnography, all examples recorded inputs from craft specialists, whereas the more intuitive interpretations of the archaeological record recognised only 40%, highlighting an area which needs to be addressed by more detailed analysis. Interestingly, both disciplines record only a minority of tools being crafted for ritual/ceremonial purposes compared to those destined for more functional uses. Similar ratios are recorded for the varying scales of product distribution by both disciplines, suggesting that petrological analysis has been pivotal in enhancing the interpretation of archaeological artefact distributions to a level which mirrors that of the well-documented ethnography. A final parallel is provided by the evidence for pre- and post-extraction ceremonialism which appears identical in both disciplines.



<b>ETHNOGRAPHY [n=168]</b> <b>Stone 74%</b> [n=124 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Stone 90%</b> [n=201 of 223]	
Raw material	Stone	Stone	Raw material
Mythical / spiritual associations with source	<b>73%</b> [n=91 of 124]	<b>63%</b> [n=127 of 201]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>39%</b> [n=48 of 124]	<b>8%</b> [n=17 of 201]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>54%</b> [n=67 of 124]	<b>12%</b> [n=25 of 201]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>46%</b> [n=57 of 124]	<b>42%</b> [n=85 of 201]	Evidence for ritualised extraction
Ritualised reduction	<b>39%</b> [n=48 of 124]	<b>22%</b> [n=45 of 201]	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 6%</b> [n=7 of 124] <b>F/R = 83%</b> [n=103 of 124]	<b>R/W = 6%</b> [n=13 of 201] <b>F/R = 41%</b> [n=83 of 201]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>100%</b> [n=124 of 124]	<b>40%</b> [n=81 of 201]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 8%</b> [n=10 of 124] <b>R = 20%</b> [n=25 of 124] <b>SR = 60%</b> [n=75 of 124]	<b>L = 6%</b> [n=12 of 201] <b>R = 19%</b> [n=39 of 201] <b>SR = 41%</b> [n=82 of 201]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>31%</b> [n=39 of 124]	<b>31%</b> [n=63 of 201]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>35%</b> [n=44 of 124]	<b>14%</b> [n=28 of 201]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>24%</b> [n=30 of 124]	<b>21%</b> [n=43 of 201]	Presence of burials / body parts

Table 4:28. The comparative analysis of raw materials: stone.

### *Metals*

The exploitation and processing of metalliferous ores is technically more complex than that of lithic materials, and although its heritage is comparatively shorter

chronologically, its richness of practise is particularly noteworthy, especially in African ethnography (e.g. Childs & Killick 1993).

<b>ETHNOGRAPHY</b> [n=168] <b>Metals 17%</b> [n=29 of 168]		<b>ARCHAEOLOGY</b> [n=223] <b>Metals 7%</b> [n=15 of 223]	
Raw material	Metals	Metals	Raw material
Mythical / spiritual associations with source	<b>83%</b> [n=24 of 29]	<b>73%</b> [n=11 of 15]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>83%</b> [n=24 of 29]	<b>13%</b> [n=2 of 15]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>17%</b> [n=5 of 29]	<b>33%</b> [n=5 of 15]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>28%</b> [n=8 of 29]	<b>20%</b> [n=3 of 15]	Evidence for ritualised extraction
Ritualised reduction	<b>69%</b> [n=20 of 29]	0	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/W = 3%</b> [n=1 of 29] <b>F/R = 97%</b> [n=28 of 29]	<b>R/W = 7%</b> [n=1 of 15] <b>F/R = 13%</b> [n=2 of 15]	Artefacts: Ritual/Functional use
Craft specialist artefact production	<b>90%</b> [n=26 of 29]	<b>53%</b> [n=8 of 15]	Evidence for craft specialist artefact production
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 0</b>  <b>R = 3%</b> [n=1 of 29] <b>SR = 97%</b> [n=28 of 29]	<b>L = 0</b>  <b>R = 27%</b> [n=4 of 15] <b>SR = 7%</b> [n=1 of 15]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>52%</b> [n=15 of 29]	0	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>3%</b> [n=1 of 29]	0	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>0</b>	0	Presence of burials / body parts

Table 4:29. The comparative analysis of raw material types: metals.

The strongest correlations occur with storied locations. The fact that 28% of ethnographic sites use ritualised extraction compared to 20% suggested by archaeology, might imply that such practises occurred at roughly one third of all sites. There is a discrepancy between the evidence of craft specialists recorded by ethnography and that suggested by archaeology (90% v 53% respectively).

Similarly there is a significant difference in product distribution with an overwhelming supra-regional distribution in ethnography (97%) compared to a predominantly regional distribution suggested by archaeology (27%). Such a discrepancy may result from the fact that not all products have been scientifically-sourced in archaeology compared to the first-hand observation of ethnography. The difficulties of sourcing of metal artefacts, which can include recycled ores, present challenges for the analysis of distribution patterns. Interestingly, both disciplines suggest less than 10% of metal objects were produced for ritual or ceremonial purposes, despite the fact that over half of the ethnography records the ceremonial or ritual after-use of sites, which suggests aspects of ritualisation may be missing from current archaeological interpretations.

### *Minerals*

The exploitation of minerals has been a multi-faceted practise. The principal substances sought have been ochre, gypsum and salt, sought for a variety of uses ranging from painting, body adornment, rock art, and consumption/food preservation, yet curiously the ritual aspects of procurement are often underplayed in archaeological interpretations (see Table 4:30 below).

The strongest correlations between the data sets occur with site location, which are often storied, or presumed to be. Around half the sites appear to practise ritualised extraction for culturally-important minerals, which are then generally distributed to supra-regional distances (i.e. 200+km). Curiously, there is more evidence for pre- and post-extraction ceremonialism recorded by archaeology than ethnography, arguably suggesting an interpretive bias.

<b>ETHNOGRAPHY [n=168]</b> <b>Minerals 9%</b> [n=15 of 168]		<b>ARCHAEOLOGY [n=223]</b> <b>Minerals 3%</b> [n=7 of 223]	
<b>Raw material</b>	<b>Minerals</b>	<b>Minerals</b>	<b>Raw material</b>
Mythical / spiritual associations with source	<b>40%</b> [n=6 of 15]	<b>57%</b> [n=4 of 7]	Locally prominent or unusual topographic setting
Ownership / restricted access to extraction site	<b>40%</b> [n=6 of 15]	<b>14%</b> [n=1 of 7]	Evidence for restricted access to extraction site
Seasonal use / expeditions to extraction site	<b>20%</b> [n=3 of 15]	<b>14%</b> [n=1 of 7]	Evidence for the seasonal use of the extraction site
Age-sex of miners / quarriers	n/a	n/a	Age-sex of miners / quarriers
Ritualised extraction	<b>47%</b> [n=7 of 15]	<b>71%</b> [n=5 of 7]	Evidence for ritualised extraction
Craft specialist artefact production	<b>53%</b> [n=8 of 15]	<b>43%</b> [n=3 of 7]	Evidence for craft specialist artefact production
Ritualised reduction	<b>53%</b> [n=8 of 15]	0	Elaborate reduction
Special artefacts	n/a	n/a	Special artefacts
Artefacts: Ritual/Functional use [R/W = Ritual and/or Wealth Objects; F/R = Functional and/or Ritual artefacts]	<b>R/F = 73%</b> [n=11 of 15] <b>F = 20%</b> [n=3 of 15]	<b>R = 0</b>  <b>F = 43%</b> [n=3 of 7]	Artefacts: Ritual/Functional use
Circulation of artefacts: Local / Regional / Supra-Regional	<b>L = 7%</b> [n=1 of 15] <b>R = 7%</b> [n=1 of 15] <b>SR = 80%</b> [n=12 of 15]	<b>L = 0</b>  <b>R = 0</b>  <b>SR = 43%</b> [n=3 of 7]	Circulation of artefacts: Local / Regional / Supra-Regional
Ceremonial use of extraction sites	<b>7%</b> [n=1 of 15]	<b>29%</b> [n=2 of 7]	Ceremonial use of extraction sites
Rock art/graffiti at extraction sites	<b>7%</b> [n=1 of 15]	<b>43%</b> [n=3 of 7]	Rock art/graffiti at extraction sites
Presence of burials / body parts	<b>0</b>	<b>29%</b> [n=2 of 7]	Presence of burials / body parts

Table 4:30. The comparative analysis of raw material types: minerals.

#### 4:4 Implications for the interpretation of the Neolithic extraction sites of the UK.

The preceding discussion has ranged over a wide variety of ethnographic and archaeological evidence to identify a series of common trends which may be present at prehistoric extraction sites, and using ethnography as a steer, it is possible to begin to develop an interpretive framework to take the debate beyond the traditional emphasis on functionality. The key ethnographic indicators which

can provide evidence of socially significant extraction sites, most of which are interlinked, are as follows:

1. **Topographic location.** Ethnography documents the fact that many sites are storied locations anchored upon locally-prominent landforms (when recorded), and the observation that archaeological sites are often located in distinctive topographic settings suggests that similar conventions may have occurred in the archaeological past. Such sites are usually used seasonally (often for practical reasons), involved ritualised extraction, and craft specialists participated in the *chaîne opératoire* to produce primarily functional tools which are distributed 200+km from the source. These sites are often flagged with rock art or graffiti, and some are used for pre- and post-extraction ceremonialism.
2. **Restricted access.** This level of evidence is often difficult to identify archaeologically. However, shrines can indicate craft specialists who may control access to the resource, or small, on-site settlement can signify the presence of site custodians on the Aboriginal Australian model. Such evidence can be associated with rock art, and product distribution of 200+km.
3. **Ritualised extraction.** The practise of ritualised extraction is well documented in ethnography in 93% of cases where it is recorded the sites were storied: archaeological indicators would appear to be non-functional assemblages in the workings, the secondary deposition of debitage in unlit subterranean workings, human remains and body parts, animal remains, sequences of hearths in shaft fills, all indicative of complex extraction practises. Where such evidence exists, it is often associated with potentially storied locations, craft specialists who produce mostly functional tools, and pre- and post-extraction ceremonialism involving rock art, graffiti and burials.
4. **Pre- and post-extraction ceremonialism/burials.** This generally comprises rock art, graffiti, human burials or body parts, and animal remains. Where this occurs it is generally associated with storied locations where ritualised extraction is practised, and where craft

specialists are part of the *chaîne opératoire* producing primarily functional tools.

5. **Rock art, graffiti and the use of idols.** Rock art can often signpost an extraction site and graffiti can adorn the workings, both media designed to impart messages. In terms of the context of such inscribed sites, the art normally occurs at storied locations practicing ritualised extraction, with craft specialists producing functional tools which are generally circulated 200+km from source, and have evidence for pre- and post-extraction ceremonialism.
6. **Supra-regional product distribution.** Products or artefacts which are generally distributed 200+km from source have normally been produced at storied sites using ritualised extraction, with inputs by craft specialists, and evidence of pre- and post-extraction ceremonialism.

These six indicators of ritualised extraction practises at storied sites are considered to be the most archaeologically visible, but also those which can deliver a more nuanced interpretation of the context of prehistoric extraction sites which has been statistically validated. It should be noted that one of the strongest and most recurrent correlation is between locally prominent locations and the 200+km distribution of products.

#### **4:5 Revision of the preliminary interpretive framework.**

To test the validity of comparing the archaeological data with the ethnography, each of the six thematic ethnographic indicators of storied/ritualised sites listed above (4:4) has been reassessed for its archaeological visibility and the most robust retained. Each surviving thematic indicator has then had related ethnographic indicators grouped within their over-arching theme to create a comprehensive range of material indicators with archaeological visibility. Finally, each of the five ethnographic themes has had its likely archaeological material analogues grouped together on a contextual basis (Table 4:31). In archaeological terms, it may be sufficient for three or more broad thematic indicators to be present to characterise a more nuanced social context of extraction sites.

<b>REVISED ETHNOGRAPHIC THEMES</b> [n=168]	<b>POTENTIAL ARCHAEOLOGICAL ANALOGUES</b> [n=223] [Note: some fields can be indicative of more than one theme]
<b>MYTHOLOGISED/STORIED EXTRACTION SITES</b> Mythic or ideological associations with the raw material source [71%] Burials at extraction sites [18%]	Locally-prominent or unusual topographic setting; Human burials in workings; Human body parts in workings
<b>OWNERSHIP</b> Evidence of ownership or restricted access to the raw material source [45%]	Settlement evidence at the extraction site
<b>SEASONAL USE OF SITES</b> Seasonal use of source [44%]	Stabilised horizons and/or hearths in shaft fills; Animal remains, articulated, in workings; Animal remains, disarticulated, in workings Wild animal remains in workings indicative of winter roosts/accidental incorporation while workings left open (e.g. bats, small mammals)
<b>RITUALISED EXTRACTION</b> Evidence of ritualised extraction [40%] Ritualised reduction [40%] Ceremonial after-use of extraction sites [33%] Presence of rock art or graffiti at extraction sites [27%]	Extraction tools abandoned in workings; Imported extraction tools in/at workings; Debitage and/or lithics in subterranean contexts; Hearths on shaft floors/galleries; Charcoal deposits in workings; Non-functional objects in workings [e.g. carved chalk objects, pottery]; Placed deposits in workings; Structures in workings [e.g. chalk platforms, shrines, pits]; Animal remains, articulated, in workings; Animal remains, disarticulated, in workings; Stabilised horizons and/or hearths in shaft fills; Debitage and/or lithics in post-extraction contexts; Knapping tools in/at workings; Human burials in workings; Human body parts in workings; Rock art / graffiti / polished axe marks in workings; Rock art / graffiti near workings [<5km]
<b>FUNCTIONALITY OF PRODUCTS</b> Artefacts: ritual v functional use [65% ritual/functional duality; 17% functional; 8% ritual; 3% wealth objects]; Circulation of extraction site products [64% 200-400+km; 17% 100-200km; 7% <100km]	Maximum distribution of site products

Table 4:31. The revised interpretive framework for storied/ritualised extraction sites (Based upon Topping 2011, 274, with additions and revisions).

These broad ethnographic themes now form the basic framework for analysing the contextual and material patterning of prehistoric extraction sites to characterise the nature of their social context. The following chapter will begin to focus in upon extraction sites by considering their wider landscape setting and what this can indicate about social perceptions.

## Chapter 5. The landscape setting of extraction sites

The purpose of this chapter is to describe and analyse the landscape settings of prehistoric extraction sites in Britain against the interpretive framework developed in Chapters 3 and 4 to identify the associations and relationships between these sites and contemporary features, and what it can reveal about the social context of the mines and quarries. A more detailed analysis of excavated sequences, structures and assemblage data from individual extraction sites will occur in Chapter 6.

Each extraction site in this Chapter has been chosen because it has been identified, investigated and proven to be the source of a particular group of products. Unlike certain sources such as Groups XVIII focussed upon an as yet unidentified site, or sites, on the Whin Sill(s), or Group II derived from somewhere '*near St Ives*' (Clough & Cummins 1979, 127), the sites chosen here are not ambiguous. Despite the lack of precision in sourcing flint (Craddock et al. 2012), the sites have been proven by excavation. Each case study has been deliberately chosen to provide a geographical spread across Britain to investigate whether regional trends or different responses to raw materials exist.

By definition, extraction sites comprise operational arenas where lithic procurement was undertaken, whether on a relatively expedient basis as in the case of surface quarries, or as a more formalised and technical practise conforming to certain common procedures as in the flint mines. In the UK the geographical distribution of extraction sites is diametrically opposed, reflecting the underlying geology (Figure 5:1). The majority of flint mines are located upon the Cretaceous flint-bearing chalks of the south and east of the UK<sup>25</sup> and the northeast of Ireland, with two outliers in the northeast of Scotland upon secondary deposits of glacially-derived gravel tills containing nodular flint (Den of Boddam and Skelmuir Hill) - the latter unusually in the uplands. Conversely, the axe quarries chosen for this study are situated in more montane environments targeting the igneous rocks of Shetland, the Scottish highlands, Cumbria, north Wales, southwest Wales, and the Welsh Border. Other major toolstone sources

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<sup>25</sup> Curiously none have been recognised to date on the chalklands of Yorkshire.



exist in northern England, Yorkshire, the east Midlands and the southwest peninsular but their precise location is as yet unidentified (Clough & Cummins 1979; 1988).

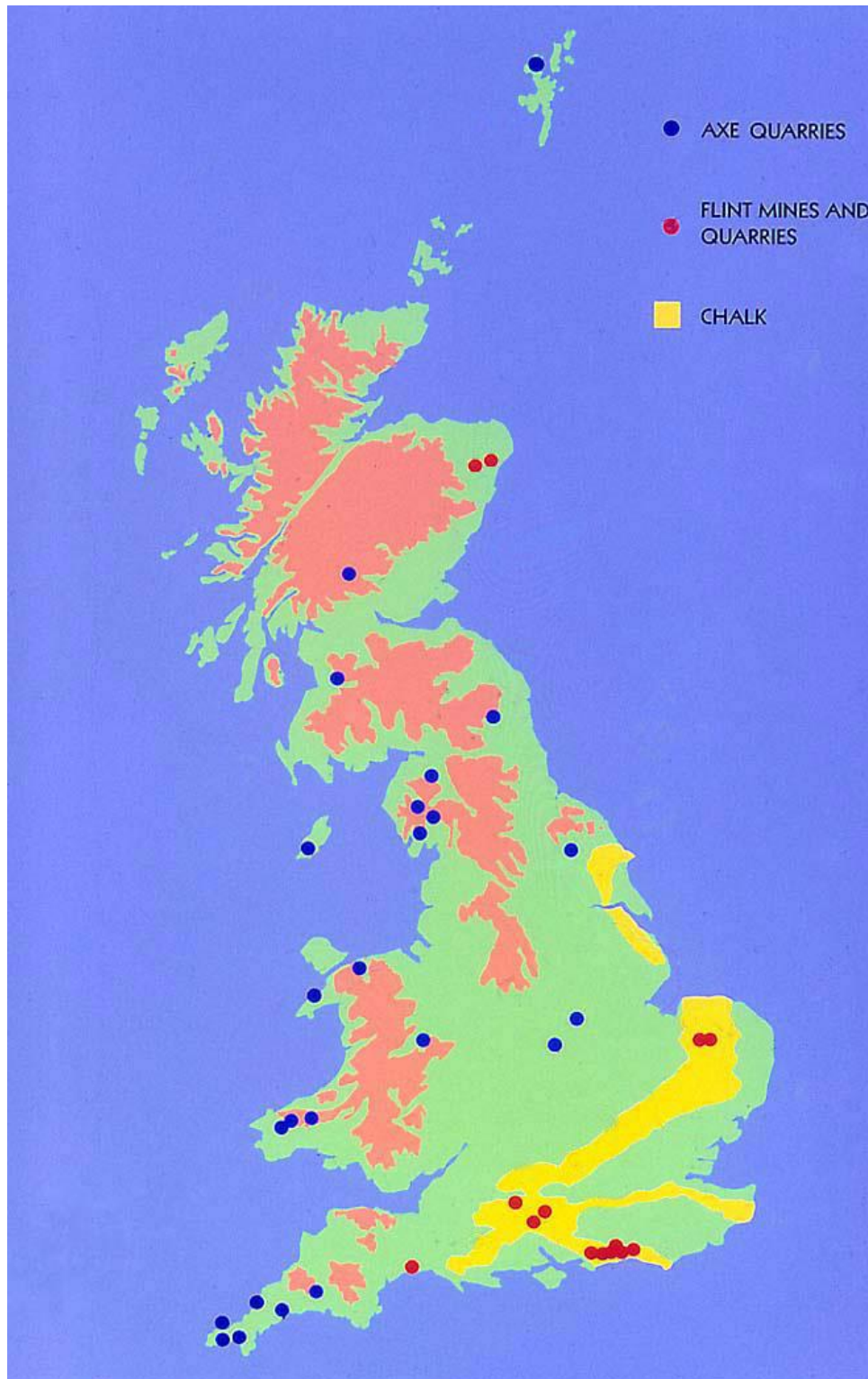


Figure 5:1. The general distribution of axe quarries and flint mines in Britain (© Trevor Pearson & Lucy Topping).

This Chapter will describe and analyse the following attributes from the interpretive framework to characterise the landscape setting of each site:

1. **Landscape setting:** an unusual or distinctive landform or geological exposure can become storied, embodying cultural narratives and creating a social importance to a place;
2. **Settlement:** whether domestic settlement occurred at the extraction site;
3. **Product distribution:** the analysis of cross-cultural ethnographic data in Chapter 3 suggest that although storied sites can produce product distributions within 100km of the source, the greatest distributions occur 100+km, and emerged with the potential to be transformed from functional to ritual objects;
4. **Rock art/graffiti/idols:** the use of on-site and off-site art to flag and create messages concerning site importance;
5. **Burials:** the evidence for interments within, at, or surrounding sites will be examined to investigate the importance of human remains to the practise of extraction;
6. **Raw material:** to explore whether differences of landscape settings and associations exist between the mines and quarries.

The Chapter will proceed from north to south, and follow the lithology from stone to flint extraction, then a conclusion will draw together the emerging trends concerning the landscape setting of these sites and what this high-level data may suggest about their social context.

### **5:1 North Roe, Shetland [Group XXII]**

The Shetland archipelago is the most northerly point of the British Isles, and the axe quarries on North Roe, Mainland, link it to the tradition of island extraction sites such as Le Pinnacle on Jersey (Patton 1993, 24-26), the Irish sites on Lambay and Rathlin Islands (Cooney *et al.* 2012), Heligoland with its red flint (Beuker 2005, 278-279), or the obsidian sources on Sardinia (Costa 2007), for example. The rugged topography of the Shetlands has been influenced by a north-south fault-line that continues southwards to the Great Glen, with glacially-

scoured rolling hills, shallow lochs and valleys. The quarries lie in North Roe (Figure 5:2), northwest Mainland, an area dominated by Ronas Hill (450m OD), the highest point on Shetland. The eastern edge of the high ground is bounded by a range of hills (Beorgs of Housetter; Beorgs of Skelberry) and to the west by the sea. The northern boundary is formed by the Beorgs of Uyea (174m OD) where some quarries are located. North Roe is almost severed from Mainland by the fjord-like Ronas Voe, Colla Firth and Quey Firth.



Figure 5:2. A Felsite dyke and quarry scoop at Grut Wells, Shetland.

The North Roe sub-arctic land mass is characterised as Late Devonian to possibly Early Carboniferous, and forms part of the Northmaven Pluton. The country-rock is red Granophyric Granite cut by a series of dykes (e.g. Figure 5:3); those in the north are Riebeckite Felsite, whereas in the south they are quartz-dolerite, felsic and semifelsic rocks, dolerite, basalt and 'unspecified basic' dykes (British Geological Survey; Scotland, Sheet 129, Northmaven [Bedrock]). A preliminary survey of these dykes by Phemister (1952) recorded a concentration in the south straddling Ronas Hill where there is a notable swarm; others appear to be truncated by the Ronas Voe or the coastal margins. In the north fewer and

shorter dykes occur, and the central area has few dykes. Visually, these granite uplands are characterised by stark, red granite blockfields penetrated by the dark stones of the intrusive linear dykes snaking across the landscape.

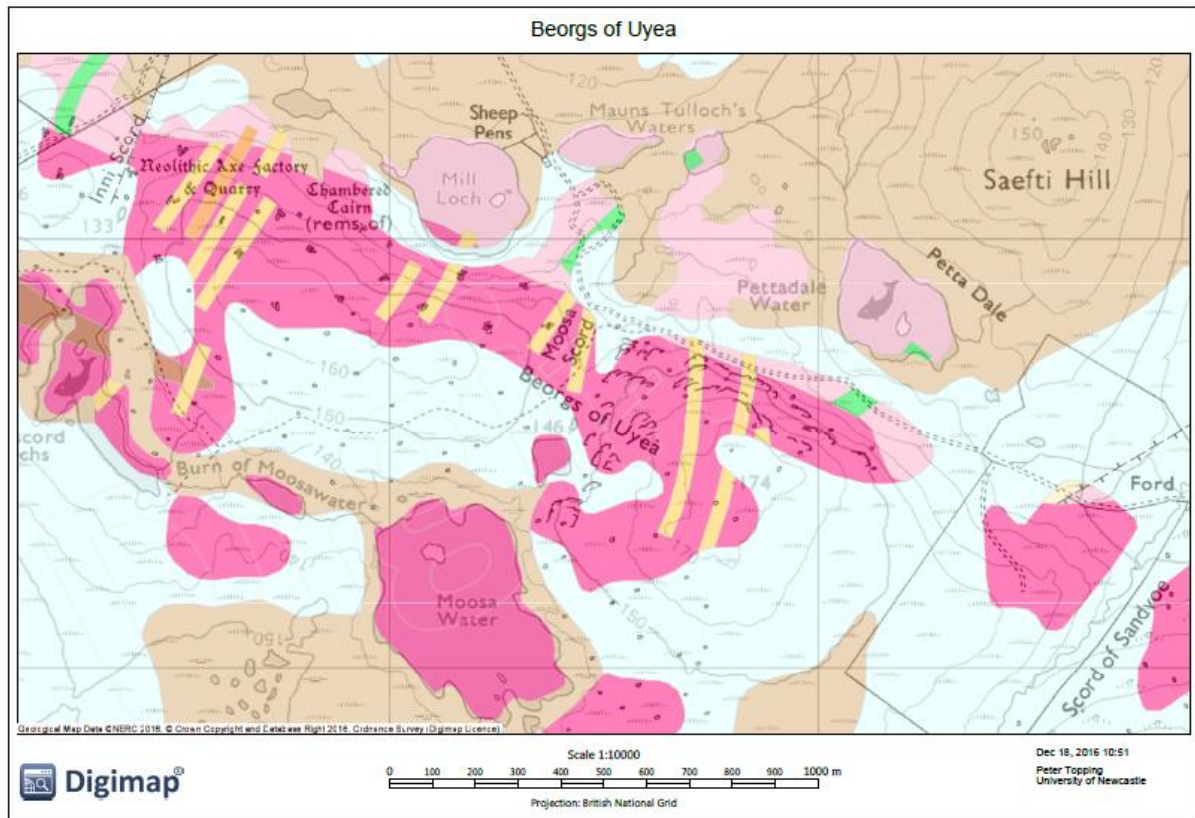


Figure 5:3. The geology of the Beorgs of Uyea showing the location of felsite dykes embedded in the granite countryrock.

The Shetland Neolithic settlement record is problematic in that morphology is not always an accurate guide to chronology. Building in stone had early beginnings on the archipelago as a pragmatic response to the limited availability of woodland resources, which is characterised as ‘*open birch/hazel woods*’ with few [*c*]losed canopy woods’ (Tipping 1994, 23). As in Orkney, inhabitants of Shetland were forced to construct in stone, although in the case of Shetland often without the benefit of easily fractured sandstone flags (cf. Childe 1931). Consequently, many house plans are similar across quite diverse periods. For example, the Neolithic houses 1, 2 and 3 at Scord of Brouster (Figure 5:4) feature internal radial stone uprights or recesses built into the body of the house walls (Whittle et al. 1986, 5-37), which parallel the ground plans of Iron Age wheelhouses and the Bronze

Age structures at Jarlshof (Hamilton 1956). Consequently, ground plans and structural features are not chronologically diagnostic. However, excavated assemblages are distinctive (cf. Calder 1956) – as, of course, is scientific dating.



Figure 5:4. A round-house at the Scord of Brouster Neolithic settlement, Shetland.

The house sites and settlements reviewed here were inhabited by axe using – or axehead *curating* - groups, spanning the Neolithic period (e.g. Modesty) to the Early Bronze Age (e.g. Ness of Gruting and Jarlshof; Sheridan 2012). The archaeological record demonstrates that axeheads and Shetland knives, and by implication quarrying, played a significant role in the cultural life of these island communities for a considerable time, although the possibility that some artefacts were curated as heirlooms has to be considered. However, the presence of full size and miniature battle-axes at House 1, Ness of Gruting (Sheridan 2012, 17-18) and Stanydale (Calder 1950), demonstrates that some quarrying took place during the Early Bronze Age. The Neolithic/Early Bronze Age houses of Shetland are generally located adjacent to the coastline, or within 1-2 km of the sea; it is notable that no contemporary settlements or field systems have been discovered in the uplands of North Roe near the quarries.



Figure 5:5. Part of the hoard from Modesty, Shetland, now curated in the National Museum of Scotland.

The recently dated hoard from Modesty, near Bridge of Walls, included 13 polished Shetland knives<sup>26</sup> and 9 felsite axeheads (Figure 5:5), found buried beneath a substantial charcoal deposit, which raises the possibility that this site represents the burnt remains of a timber house (Sheridan 2012 & pers. comm.). If so, then the Neolithic settlement record of Shetland may be artificially biased towards stone-built structures, and potentially under-represent timber buildings – with implications for settlement density and population demographics. The stone-built houses generally occur in open settlements juxtaposed with irregular fields and clearance cairns, as at Scord of Brouster (Whittle 1986, 3-4), Pinhoulland (ibid., 54; Mahler 2012) and Stanydale (Calder 1956, 372). In some cases these settlements feature lynched fields, as at Ness of Gruting (Calder 1956, 351 & 374), implying a considerable period of cultivation and soil movement. At Islesburgh a typical settlement complex lies on the northern side of a small voe, comprising a heel-shaped chambered cairn (HU 334 685; Henshall 1963, 165 &

<sup>26</sup> Shetland knives are large ovoid, thinly ground implements often considered to be for flensing purposes, or ceremonial deposition, as can be seen by the hoard of 19 discovered on Stourbrough Hill and now curated in the Shetland Museum (Figure 5:7).

405; Calder 1963, 45-47) roughly 300m west of an ovoid, stone house with thick recessed walls; test excavations discovered a fragment of steatite bowl and two roughout axeheads (Calder 1963, 71-73). The house was enclosed by a U-shaped enclosure wall open towards the voe which enclosed an area of 0.3ha (0.75 acres). A second slightly built enclosure lies roughly 23m west, with a sub-circular plan and a diameter of 39.6m. This configuration of sites is replicated at Mangaster Voe (HU 333 698), but in this case a group of three stone-built houses (at least one is heel-shaped) lie adjacent to the remains of a cairn and an enclosure. One recurrent feature is the location of houses on poorer land with the fields and enclosures placed on better quality soils. Many settlements and field systems lie on south-facing land and are integrated with, or overlooked by, chambered cairns (e.g. Islesburgh, Scord of Brouster and Stanydale), demonstrating a carefully structured landscape.



Figure 5:6. The small heel-shaped cairn at Islesburgh, North Roe, Shetland.

The chambered cairns of Shetland have a primarily westerly distribution on Mainland, with a southerly aspect preferred (Figure 5:6). On Unst the opposite is true with an easterly distribution, and the two cairns on Fetlar lie in the north of the island (Henshall 1963, opp 137). However, in relation to the extraction sites in North Roe, the highest point in the archipelago, Ronas Hill, is topped by a

passage grave with a rectangular chamber in a circular cairn (Henshall 1963, 172-173), which may be one of the earliest in the island sequence on morphological grounds, possibly constructed c.3700 cal BC (Sheridan 2012, 29). This tomb is located amongst a concentration of felsite dykes, including a swarm, but no evidence of domestic settlement exists. Similarly, a heavily-disturbed tomb on the north-facing slopes of the Beorgs of Uyea (HU 328 900 [see Figure 5:8]; Scott & Calder 1952; Henshall 1963, 156-157), survives as a short passage and small rectilinear chamber but without a cairn<sup>27</sup>. This site lies c.130m west of the ‘working gallery’ recorded by Scott and Calder (see below), which is located within a major area of felsite extraction and roughout production. Considered together, the Shetland practise of positioning tombs within quarry zones, combined with a notable lack of settlement, suggests deliberate structuring of the landscape to keep stone extraction separate from domestic activity on these dramatic granite-strewn hills.

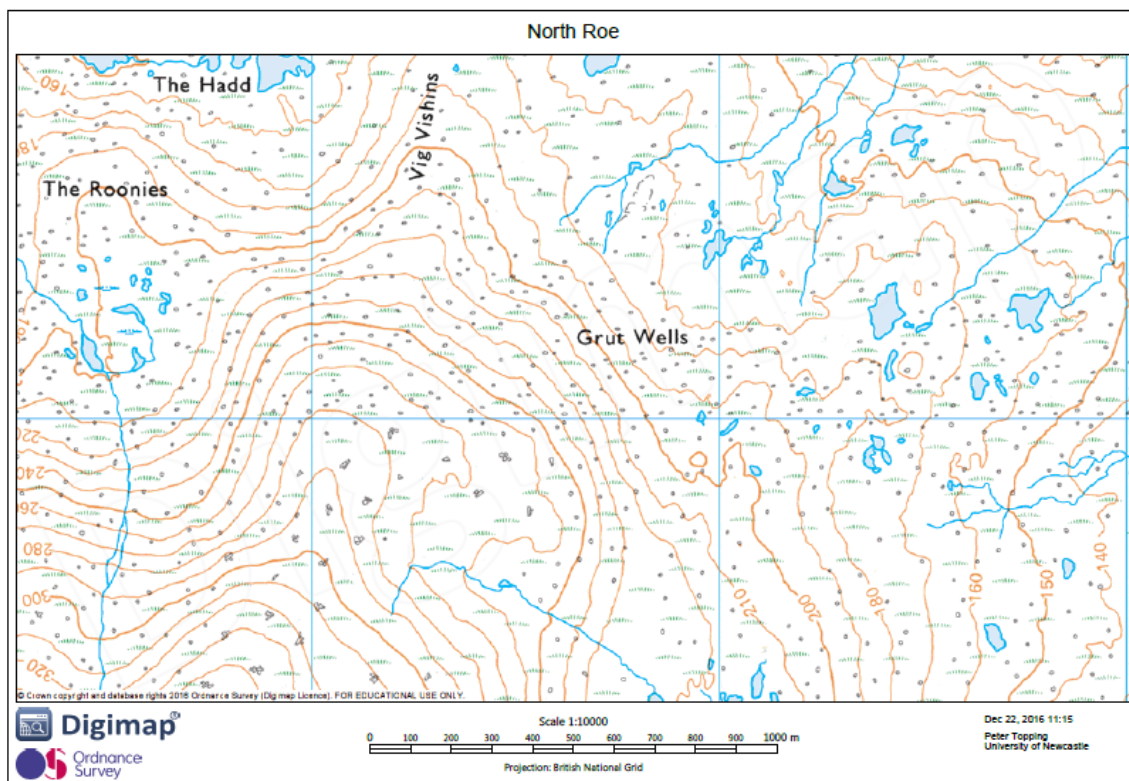


Figure 5:7. The environs of the Grut Wells quarries.

<sup>27</sup> A small cairn-like chamber was discovered by Gabriel Cooney at Grut Wells in 2013, near quarry activity on dykes in the central part of North Roe [see Figure 5:7]. This too has no overlying cairn.



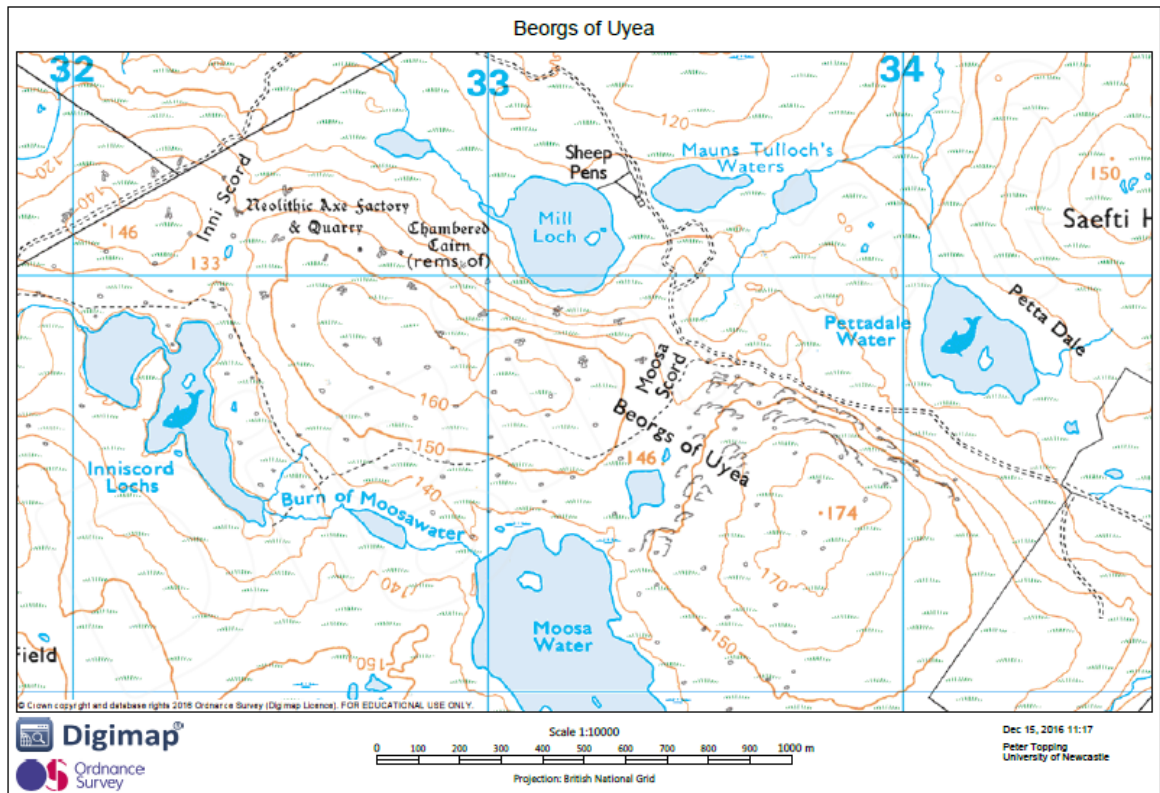


Figure 5:8. The landscape setting of the quarries on the Beorgs of Uyea.

As observed above, the North Roe felsite quarries lie on granite uplands beyond the apparent limits of settlement. Those in the north on the Beorgs of Uyea (HU 326 902) lie amongst a red granite blockfield and focus upon dark grey felsite dykes cascading downslope in sinuous, linear deposits of brick-sized or smaller cobbles. Quarrying occurs on north-facing slopes at 145m OD, overlooking a group of small lochs and the coastline 2km to the north. Abutting one of the more prominent felsite dykes is an unusual roofed 'working gallery' (Figure 5:9; Scott & Calder 1952). This is positioned on the western side of the dyke which has been exposed in a trench, the trench then revetted with stone walling and roofed over at ground level to create a chamber almost 3.0m in length and up to 1.15m in width and 1.13m in height. It was noted that the dyke exposed in the gallery was *'spalled and undercut ... [and] the splinters of the porphyritic rock ... littered the floor to a depth varying from 4 to 6 ins. [10 to 15 cms], [and] had all the appearance of waste flakes chipped off in the process of the manufacture of stone tools'* (ibid., 176). Within the gallery an anvil/polissoir, eight hammerstones, cores, flakes and a *'disc of schist'* were recorded (ibid., 177).

The gallery had no formal entrance, and the excavators suggested that access would have been through the roof. This structure appears to have been a deliberately sealed chamber abutting the dyke, which might parallel the small Grut Wells chamber mentioned above (Footnote 27). The Beorgs of Uyea quarries also feature a felsite boulder with flaking scars which has been masked by a curving low stone wall, effectively hiding extraction from view again.



Figure 5:9. The Beorgs of Uyea working gallery constructed abutting a felsite dyke.

These quarry structures may represent a local tradition whereby extraction sites were monumentalised but deliberately hidden from view, in the same way as mortuary houses were hidden beneath long barrows, suggesting that some stone procurement was an exclusive practise. In addition, interspersed amongst the quarries and workshops are a series of small vertical stones standing up to 0.7m high, which are reminiscent of the markers erected by some Aboriginal Australian communities to signpost quarry locations and warn off women. The Shetland examples require further research, but may form part of the stone row continuum found in parts of northern Scotland, particularly Caithness, Sutherland and Shetland – but unusually not Orkney (Myatt 1988; Burl 1993, 123-131) – which

often focus upon *'a cairn or a cist, even a low natural hummock resembling a heather-covered burial-mound'* (Burl *ibid.*, 127). The presence of the putative passage grave lends weight to this suggestion. Taken together, the hidden workings, putative tomb and vertical stone markers, all suggest that the Beorgs of Uyea – and the North Roe quarries - was a special place. The emphasis on hiding certain quarries from general view implies social restrictions surrounding access and extraction - a point emphasised by the lack of domestic settlement adjacent to the quarries.



Figure 5:10. The Stourbrough Hill hoard of Shetland Knives, comprising 19 implements found on the summit of the eponymous hill. A further 22 hoards of Shetland knives are known from the archipelago. The Stourbrough Hill hoard is now curated by Shetland Museum, Kirkwall.

The major products of the Shetland quarries are axeheads and Shetland knives. The distribution of quarry products demonstrates that the majority of Group XXII felsite axeheads remained on the archipelago (Sheridan 2011, 30). In addition, there is a dichotomy in that the axeheads, some over-sized, existed on islands where there was a dearth of evidence for woodland, suggesting that Shetland

axeheads were non-utilitarian in nature. In addition, as Sheridan (*ibid.*) has observed, Shetland Neolithic society followed its own insular course and did not subscribe to practises such as conspicuous consumption or grandiose monument building as seen on Orkney, although the presence of two Group IX porcellanite axeheads discovered at unlocated sites on Shetland (Clough & Cummins 1988, 240, SHE 3; Ritchie 1992, 216) does suggest the possibility of off-island contacts with the Irish Sea/western Scotland diaspora. The identification of a putative 'felsite' axehead from Curragh Mollagh, Isle of Man (Clough & Cummins 1988, 222; SC 401 962), if confirmed, lends weight to the Irish Sea/western Scotland/northern isles model of interaction.

The Shetland extraction sites show interesting correlations with the interpretive framework derived from the analysis of cross-cultural patterns in the anthropological and archaeological data discussed in Chapters 3 and 4. The sites are located in distinctive settings of red granite scored by dark felsite dykes, some of the workings are hidden, burial monuments appear to have been integrated within the quarried areas, and significantly there is little evidence of adjacent settlement. The quarries may have been marked by low megaliths. Consequently, these trends demonstrate that the sites were liminal to settled areas, some were hidden, and burial monuments were integrated within the extraction zones. Taken together, this suggests that these sites were storied locations embodied by supernatural and ancestral presences, taboos prevented settlement on-site, and the depositional histories of the products implies that they were produced by ritualised practises for ceremonial purposes, or as statements of status and/or wealth.

## **5:2 Creag na Caillich, Killin, Perthshire [Group XXIV]**

The summit of Creag na Caillich (NN 562 376) is the southern terminal of a range of four mountains forming a southeast-facing corrie overlooking Loch Tay and the confluence of two rivers which empty into the loch at Killin. From the south, the summit of Creag na Caillich has a distinctive half-dome shape which peaks at 916m OD (Figure 5:11), shelving on the south to a peat-covered saddle at c.660m OD before descending gradually to Glen Lochay and Loch Tay. The

topography of Creag na Caillich contrasts noticeably with the other summits in the range, having a more glacially rounded profile and not the jagged irregularity of its neighbours.



Figure 5:11. The distinctive glacially-rounded, half-dome summit of Creag na Caillich in the centre, contrasting with its more rugged neighbours.

The geology is formed by the Dalridian metamorphic assemblage beginning with low-lying Loch Tay Limestone followed by phyllites, schists and bands of quartzite (Figure 5:12). Between approximately 720-770m OD can be found *'bands of grey-green indurated rock of very fine grain'* (Ritchie 1968, 126), or Calc-silicate Hornfels, which is the source of Group XXIV axeheads, formed by contact metamorphism between schists and underlying appinite (Edmonds *et al.* 1992, 81).

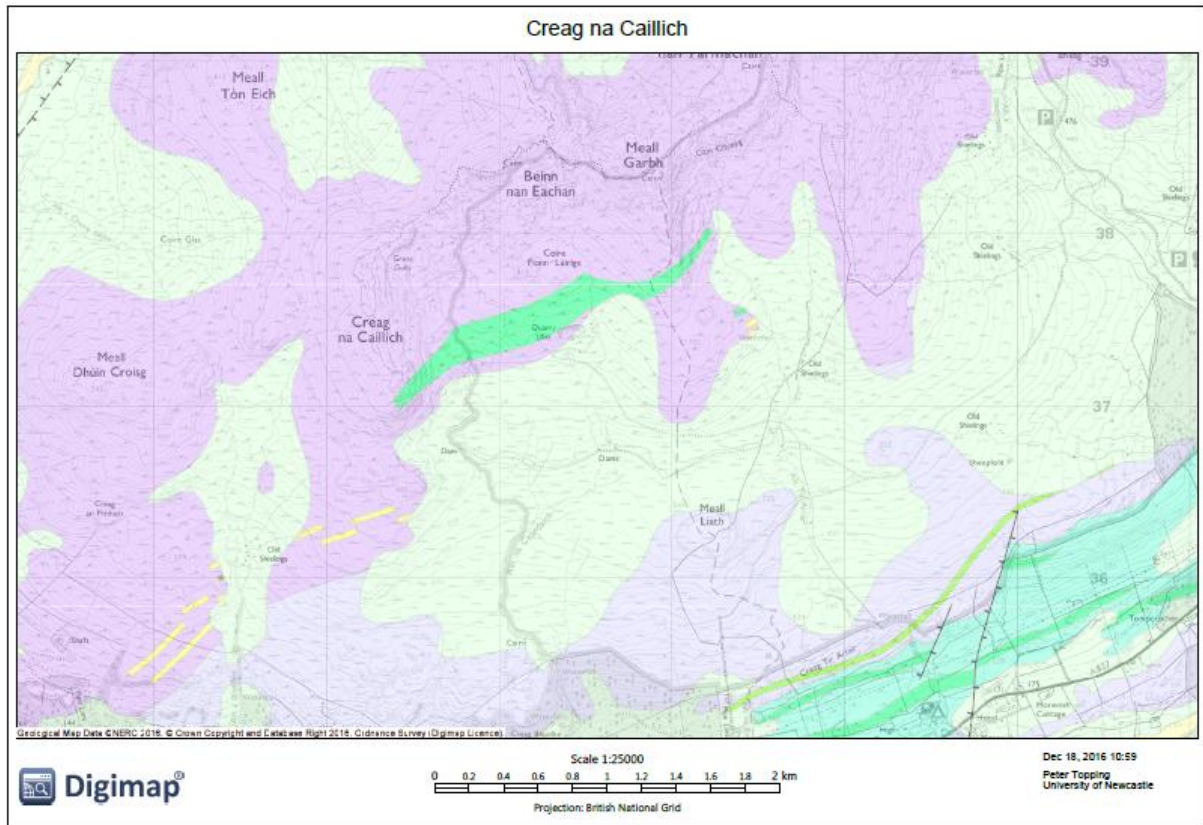


Figure 5:12. The general geological context of the Creag na Caillich quarries.

The environment during the first phase of quarrying, c.3350 cal BC, witnessed some declines in elm and birch, possibly indicating selective felling, although quarrying was the only activity recorded at this time (Figures 5:13 and 5:14). The Elm Decline impacted at c.3300 cal BC and appears to have been anthropogenic. Following this there was some limited birch regeneration and the introduction of pastoral herbs c.2650 cal BC, until a less-intensive secondary phase of quarrying occurred c.2300-1800 cal BC, which had no impacts upon woodland or vegetation. The quarries appear to have been close to the contemporary tree-line, therefore they may have been hidden from view (Tipping et al. 1993).



Figure 5:13. The jagged quarry face of the Eastern Quarry (Site 1), Creag na Caillich.

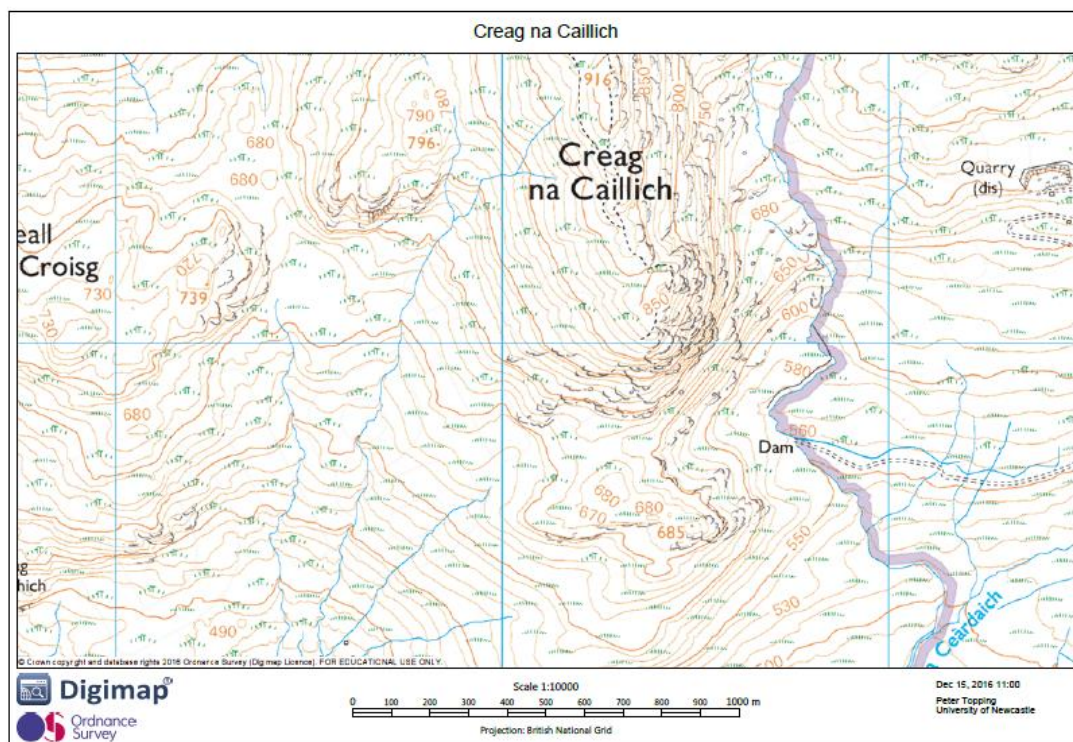


Figure 5:14. The topographic setting of the Creag na Caillich quarries.

A cluster of rock art sites are located in the general environs of Creag na Caillich on valley floors and lower hill slopes, particularly 2.5km to the southwest at the confluence of the Allt Dhùin Croisg and the River Lochay (centred NN 53 36), and 5km to the southeast ranged along the Allt a' Mhoirneas (centred NN 616 367) directly overlooking Loch Tay (Figure 5:15). The rock art panels primarily feature simple cup-marked motifs with rare cup-and-ring combinations and form part of a series found on both sides of Loch Tay (Morris 1981, 53-68). A recent survey of upper Strath Tay concluded that the more complex rock art panels may have delimited settlement boundaries, and also discovered evidence of a local quartz lithic tradition probably responsible for expedient functional tools (Bradley 1997; Barclay & Maxwell 1998, 4).

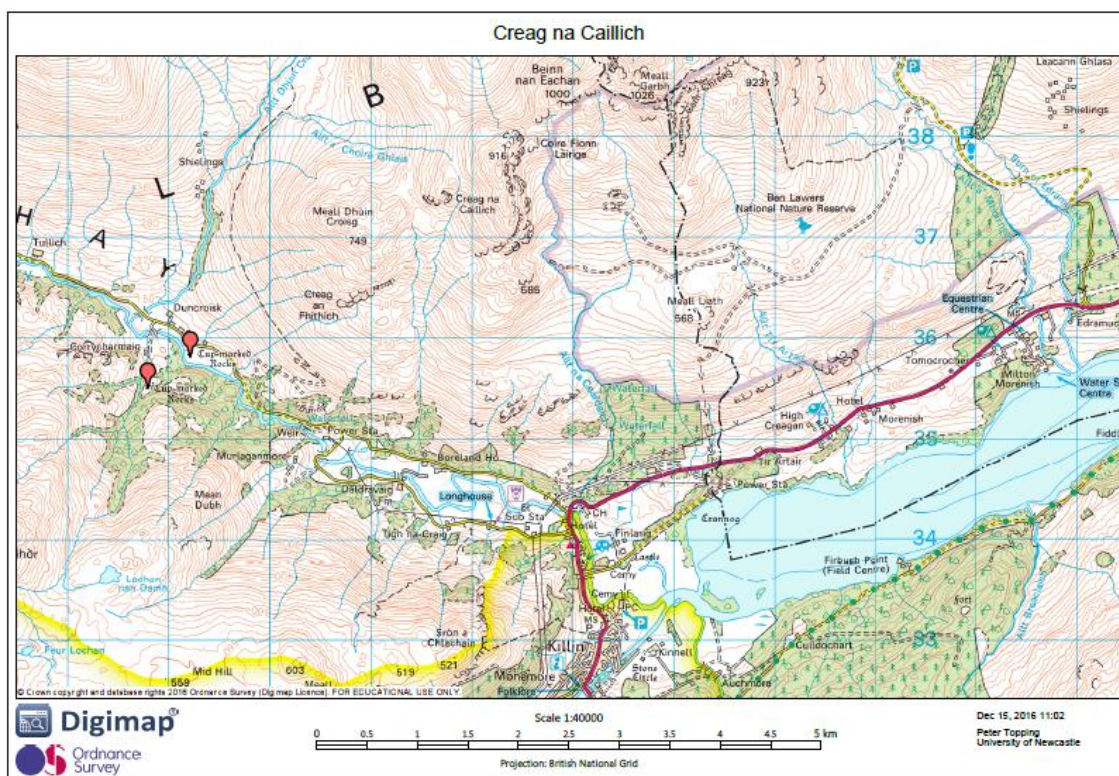


Figure 5:15. The wider landscape setting of the Creag na Caillich quarries. The rock art sites are identified with pin icons.

Megalithic monuments are also found in the area. A chambered tomb lies on the valley floor at Craggan 15.5km to the south at the western end of Loch Earn (NN 5745 2188; cf. Henshall 1972, 479); Kindrochat long cairn lies 16km southeast near the eastern end of Loch Earn (NN 7230 2300; Henshall 1972, 472-475);



Edinchip chambered long cairn is 2km southwest of the western end of Loch Earn (NN 575 218; Davidson & Henshall 1983); Fortingall long cairn is located near the eastern end of Loch Tay some 17km to the east-north-east (NN 7297 4658; Henshall 1972, 478); and the Pitnacree earlier Neolithic round mound is roughly 19km to the E of Loch Tay (NN 928 533; Coles & Simpson 1965).



Figure 5:16. The complex stone circle at Croft Moraig, Tayside.

Standing stones are scattered across valley floors at Glen Dochart (NN 5630 3158) 2.6km south of the quarries, and at Tir Artair (NN 5885 3473) 3km distant near the west end of Loch Tay. The eastern approach to Loch Tay is terminated by the complex stone circle at Croft Moraig (Figure 5:16; Piggott & Simpson 1971), which is part of the series of lithic monuments (i.e. standing stones, long cairns, stone circles) ranged along the length of Strath Tay for a distance of 20+km (Coles & Simpson 1965, 35, Fig 1; 48-49).

In the lower lying eastern areas of Tayside lie more substantial Neolithic monuments, such as the henges at North Mains (Barclay 1983) and Balfarg (Mercer 1981b; Mercer *et al.* 1988), the Cleaven Dyke cursus (RCAHMS 1994a;

Barclay & Maxwell 1998) and various chambered cairns (Henshall 1972; RCAHMS 1994b). Less permanent structures are represented by the palisaded enclosure at Douglasmuir (Kendrick 1995), the long mortuary enclosure at Inchtuthill (Barclay & Maxwell 1991), and the Grooved Ware associated, timber-built mortuary structure at Balfarg Riding School (Barclay & Russell-White 1993) adjacent to Balfarg henge. This zone of more substantial monument building to the east of the Strathtay uplands illustrates a structured landscape with the more tractable soils witnessing the construction of major monuments, whereas the challenging uplands presented fewer settlement opportunities and witnessed a smaller footprint on the landscape typified by megalith constructions or the inscription of rock art.

At the southern end of Glen Ogle an axehead of *'greenish mottled quartzite'* 15.5cm in length (Figure 5:17) was *'said to have been found in a cist at Lochearnhead, Perthshire'* (NN 58 23) and was acquired by the Society of Antiquaries of Scotland in 1887 (PSAS 21 (1887), 288-289; Smith 1963, 167). Analysis by Project Jade discovered that this axehead was probably sourced from the Mont Beigua region of the Italian Alps (Pétrequin *et al.* 2008), and was discovered only 14km south of the Creag na Caillich quarries which were themselves producing *'grey-green indurated rock of very fine grain'* (Ritchie 1968, 126). This juxtaposition hints at some form of link, symbolic or otherwise, between the jadeitite axehead and the Perthshire raw material, whether as part of local procurement practises, or as an 'object-sign' of status and/or prestige linked to the interment(s) in the cist (Pétrequin *et al.* 2012a). The presence of an exotic Italian axehead in Perthshire, which may have been an heirloom at the time of deposition, demonstrates that Neolithic groups in Tayside had access to extensive exchange networks, and were cognizant of widespread pan-European cultural traditions, irrespective of whether these artefacts had the same symbolic meanings in all regions.



Figure 5:17. The jadeitite axehead discovered at Lochearnhead, now curated by the National Museum of Scotland.

The Neolithic cultural landscape of upper Strath Tay was primarily articulated along valley floors and loch-side locations. Although little evidence of domestic settlement has been recovered, the ephemeral nature of timber-built structures may explain this bias in distributions. The fortuitous excavation of a Late Neolithic site at the Haugh of Grandtully, located upon a river terrace, comprised a series of pits and scoops containing Impressed Ware pottery and a small lithic assemblage; two pits were radiocarbon dated (Pit 15, 4080±190BP & Pit 40, 3920±100BP; Simpson & Coles 1990). The excavations did not discover structural remains, but this may be an issue of survival or sampling bias. Consequently, considering the range of sites scattered along the straths, and the Haugh of Grandtully evidence, all suggests that some form of settlement might be expected, even if transient in nature, interspersed amongst the monumentalised and structured landscape.

Overall, the Neolithic landscape decreases in complexity from east to west. The structured eastern areas of Tayside host substantial monuments, sometimes inter-connected, which display a greater investment in settlement and the creation of identity than appears to be the case in the uplands of Strath Tay to the west where the focus is on smaller monuments. A final marginal zone exists above the valley floors where the highland wildscape is entered, a liminal area of high ground on the skyline. The Neolithic settlement record of Tayside and Upper Strath Tay can therefore be sub-divided into three general zones, ranging from the monument complex in the east, to a dispersed settlement record in the western straths, above which lay an unsettled, liminal zone of dramatic topography and mountain summits – and the site of stone extraction.

The Creag na Caillich quarries are located roughly 166m below the mountain summit, between 720m-750m OD on steep south-facing, craggy slopes overlooking Loch Tay. The quarries are approached across poorly-drained, broken, glacially-sculpted ground cut by many streams. The outcrops of hornfels are signposted downslope by small 'screes' of eroding material no more than 1.5m wide, comprising fragmented pale green brash with occasional struck flakes. These 'screes' are up to 50m in length, although moorland vegetation may mask their true extent. The Eastern Quarry (Figure 5:13) is characterised by a protruding, upwardly oblique sill of tabular hornfels jutting out from a steep hillslope [46°-56°], creating precarious extraction conditions. The tabular hornfels has a 'layered' appearance, each 'layer' being roughly 0.4m thick. Geological studies suggest a lack of homogeneity in the parent material, resulting in inconsistent knapping qualities (Edmonds *et al.* 1992, 81). The quarry face is scarred with concoidal fractures on the lower edges of the strata, suggesting an upward-swinging motion to detach blocks or large flakes. A number of hammerstones were noted in the immediate vicinity of the quarry. A second quarry lies some 70m west of the first, on slightly lower-lying and more level ground surviving as a large crescentic scarp. Excavations here found only poor-quality hornfels (*ibid.*, 92-94). A workshop area which produced roughouts lay on a saddle below the crags between 650m-670m OD (*ibid.*, 83-88; 94-102; 106-107). This workshop produced no evidence of the final stages of reduction, suggesting axeheads were completed off-site.

The excavators interpreted the quarries as small-scale extraction events occurring on an intermittent basis *'for the production of roughouts for large bifacial artefacts'* (ibid., 106). In addition, they considered that the quarry output did not extend *'beyond the horizons of the local system ... reflect[ing] the production of axes for local use in an area which was relatively poor in raw materials'* – although certain axeheads clearly did travel considerable distances from the source (ibid., 108).

The identification and distribution of Creag na Caillich Group XXIV axeheads is limited to 30 confirmed examples, comprising 29 axeheads and 1 adze (Ritchie 1968; Ritchie & Scott 1988). The distribution lies primarily in northeast Scotland (0-200km) with isolated finds from eastern Scotland (80-160km) and eastern England; the two most southerly examples come from Buckinghamshire (Clough & Cummins 1988, 185; 283). Clearly these outliers from Buckinghamshire suggest that Creag na Caillich axeheads were valued objects which led to their movement of c.350 miles (563 km) from source. The fact that many similar axeheads await petrological analysis, suggests that the full distribution of this Group remains to be established.

The Creag na Caillich quarries are located on a distinctive half-dome shaped mountain overlooking Loch Tay, which may originally have been on or near the tree-line. This would have restricted its visibility from the valley floors, and created an element of exclusivity beyond the recognised areas of lower-lying Neolithic activity. Rock art on the adjacent valley floors may have signposted the quarries, and integrated them into the wider landscape of burial monuments and megaliths. No on-site settlement has been discovered. Product distribution suggests primarily a regional focus, but occasionally achieving supra-regional distances. Taken together, the topographic setting could be interpreted as a storied location which was enhanced by carefully positioned rock art and other monuments which embedded a cultural significance into the area. The distribution of products, which could range up to supra-regional distances, together with a storied location, implies that ritualised extraction practises and craft specialists were also involved in the chaîne opératoire. This combination of factors in regard to the cross-cultural trends identified in Chapters 3 and 4 would suggest Creag na Caillich fits the criteria of a mythologised site.

### 5:3 Langdale/Scafell, Cumbria [Groups VI & XI]



Figure 5:18. Pike of Stickle and South Scree, Langdale.

The topography of the southwest Lakeland fells was created from the eroding Ordovician Period volcanoes of the Borrowdale Volcanic Group. These peaks and craters have produced a landscape of dramatic variation, with prominent dome-shaped summits such as Pike of Stickle standing 709m OD (Figure 5:18), contrasting with the rugged massif of Scafell Pike towering over the surrounding valleys at 978m OD. Many of these summits are skyline features from considerable distances. Steep-sided valleys such as Langdale follow sinuous east-west courses into the mountains, joining high altitude routes via watershed passes. The Wasdale Valley approaches the massif from the southwest, creating alternative routes to the raw material.

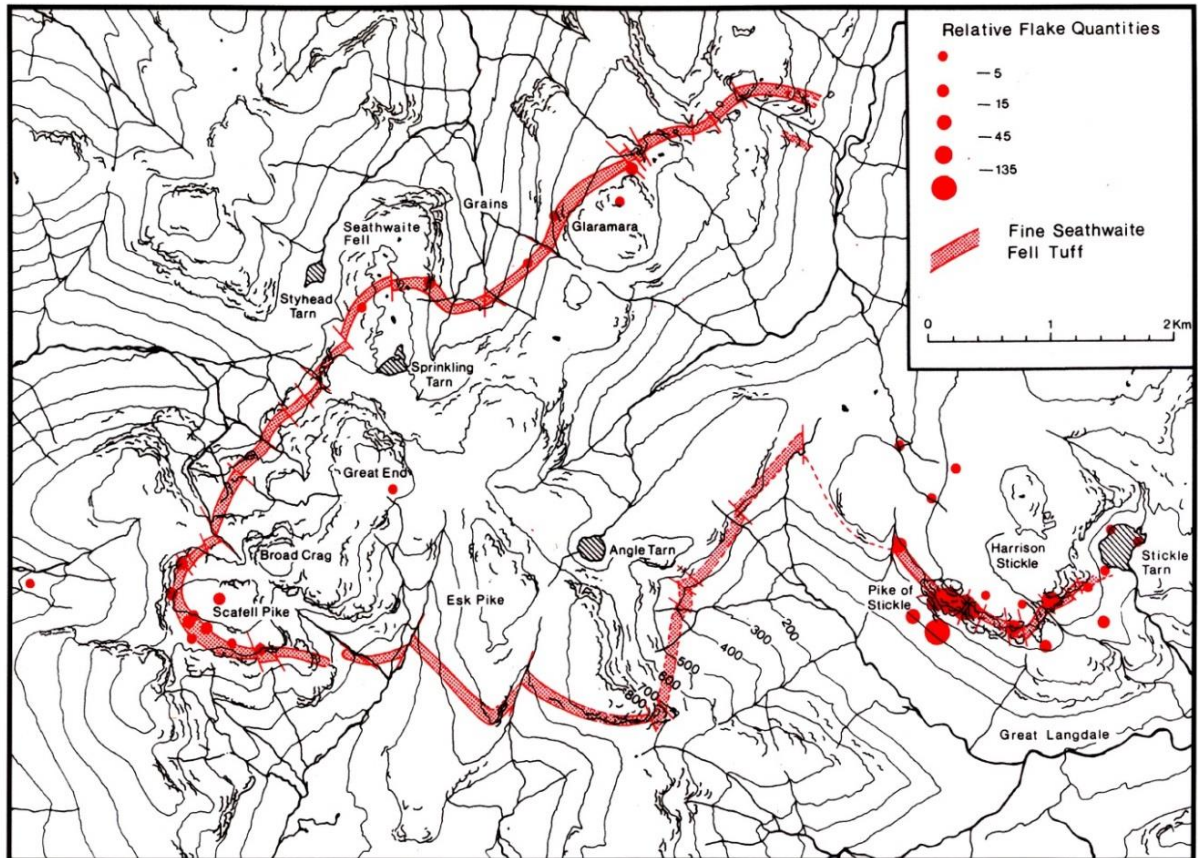


Figure 5:19. The geology of the Langdale/Scafell axe quarries, highlighting the location of the targeted Seathwaite Tuff deposit (from Claris & Quatermaine 1989, 4).

The toolstone targeted in the Langdale/Scafell area is an Epidotized Intermediate Tuff (Borrowdale Volcanic Series; Figures 5:19 and 5:20). The quarries were first noted by Bunch and Fell (1949), following the observation that ‘*an important stone axe factory must have existed in the immediate area of Great Langdale*’, particularly after the earlier discovery of a ‘*small working floor*’ on Mart Crag Moor by Professor Watson (Keiller *et al.* 1941, 58-60). Bunch and Fell recorded one of the major complexes at Pike of Stickle in detail, documenting features such as the South Scree. Subsequent mapping of the tuff deposits has discovered that the raw material extends in an erratic horseshoe from Stickle Tarn up the Langdale Valley, around Angle Tarn and Esk Pike skirting the western flanks of Scafell Pike, Great End and Seathwaite Fell, follows the western slopes of Glaramara, until it peters out in the Langstrath Valley (Claris & Quatermaine 1989). Overall, the tuff follows an erratic course over some 19 contiguous square kilometres, making it one of the most extensive raw material sources in the UK.

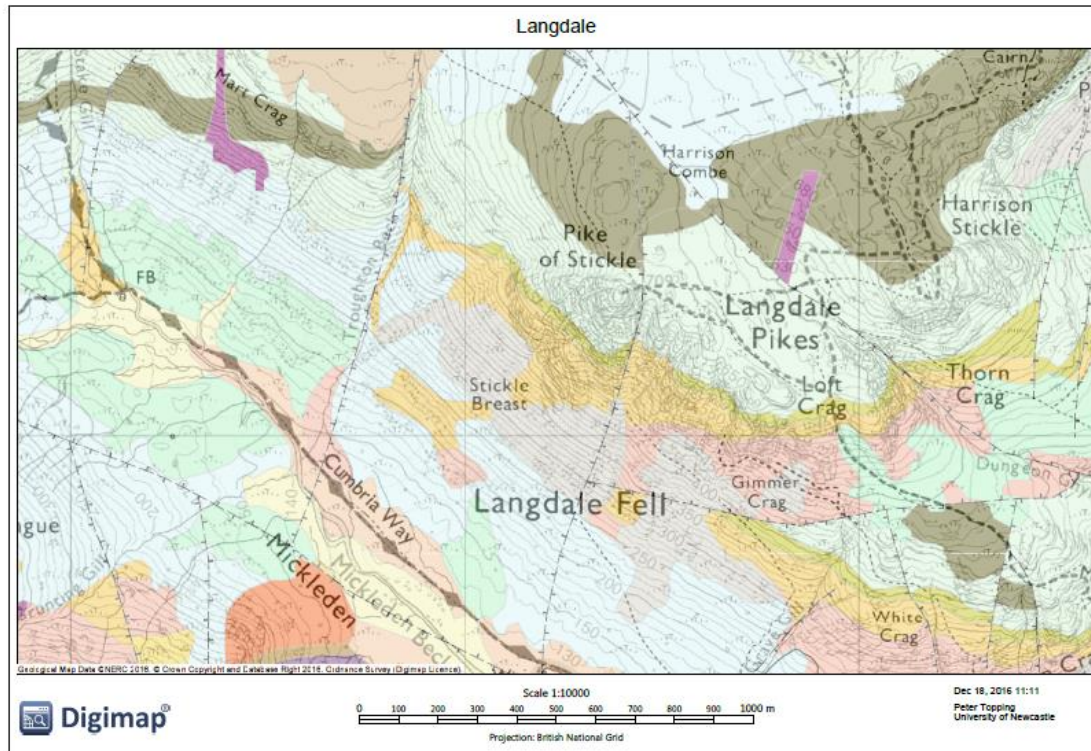


Figure 5:20. The geological context of the main Langdale quarries which range around Pike of Stickle from Thorn Crag to Troughon Beck.

Recent fieldwork has now identified over 700 quarries exploiting this type of stone (inf. the late V Davis), with outlying sites being recognised beyond the core areas on the summit of Fairfield, 10km east-north-east of the Langdale Valley. Here four areas of axe working occurred around outcropping tuff, which petrology identified as a *'fine-grained silicified rhyolitic tuff'* with similarities to the rare Group XI raw material (Davis & Quartermaine 2007). In contrast, an unconfirmed Group VI source at Raise Beck some 2km west of Fairfield suggests the possibility that other sources lie beyond the main deposits (ibid.).

Another variety of toolstone, Carrock Fell Gabbro, has been confirmed on the south-east flanks of Carrock Fell (north-east of Langdale) at White Crag, and classified as Group XXXIV (Fell & Davis 1988); to date seven axeheads have been sourced to this site (Davis *et al.* 2007). The source lies downslope from an enigmatic, undated multiple-entrance enclosure, and close to a major east-west route through the Lake District (Pearson & Topping 2002), which terminated – or passed through – the henge complex at Penrith which had associations with axehead finds (Burl 1976; Topping 1992).



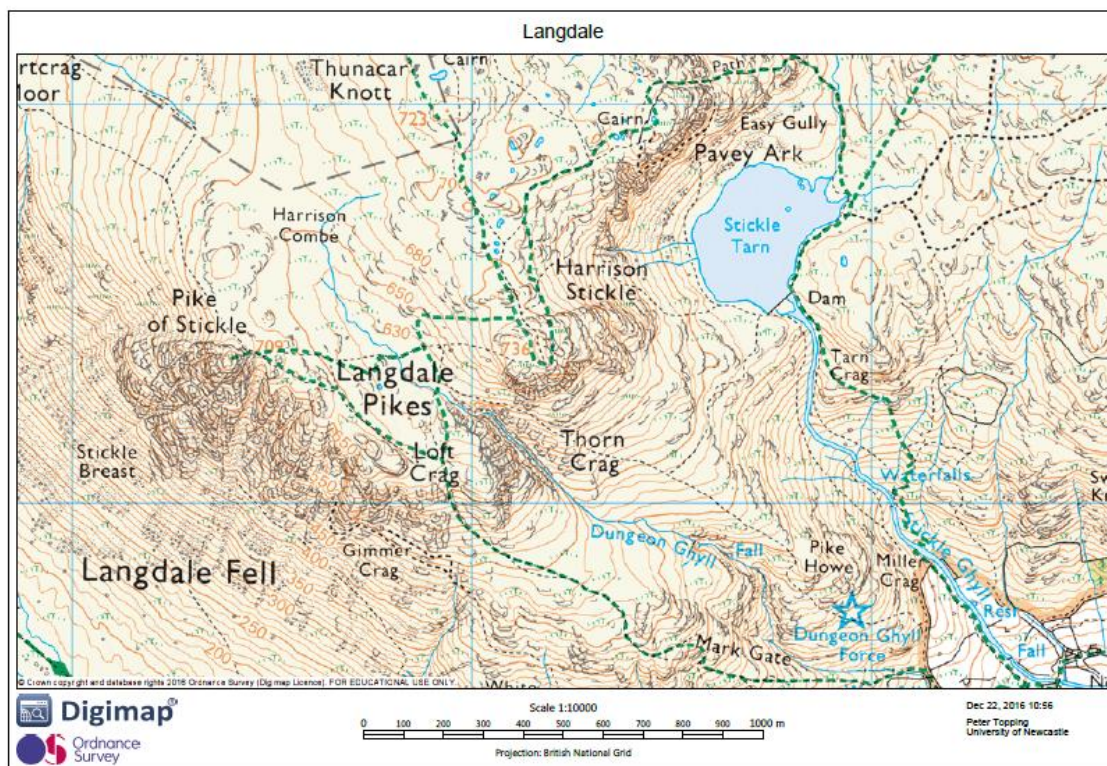


Figure 5:21. The topographic setting of the Pike of Stickle quarries.

The environmental context of the Langdale/Scafell quarries is difficult to reconstruct with precision through a lack of securely dated and juxtaposed evidence (Figures 5:21 and 5:24). However, some general trends are apparent. Pre-Elm Decline impacts upon the wildscape are recorded at Blea Tarn (190m OD), for example, some 2.5km south-east of the Langdale Pikes on the southern side of the valley (Pennington 1970; 1975). Here, the pollen data provided no evidence of widespread disturbance to the woodland canopy before c.3200BC, and systematic (short-lived clearings) only occurred a ‘few centuries’ later, after which the forest regenerated until more permanent clearings were established after c.2700BC (Pennington & Tutin 1964; Pennington in Clough 1973). At Angle Tarn, at the head of the Langdale Valley, the pollen evidence suggests a similar scenario (Pennington in Clough 1973). These localised impacts appear to have led eventually to the *‘widespread destruction of upland forest and by coastal clearances for agriculture on a scale sufficient to bring about permanent change in both vegetation and soils’* (Pennington 1975, 85). Unfortunately, there is little consensus concerning the altitude of a tree-line and whether it lay below, near, or

above the quarries. Nor is there a definitive date for the Elm Decline<sup>28</sup>. However, considering the general chronological span of quarrying in the Langdale Valley during the first half of the Neolithic period, it is safe to presume that the woodland canopy would have been close to the workings, and had partly if not wholly hidden them, even if only when viewed from the valley floors. Consequently, these quarries were visually and spatially liminal - and probably concealed by trees.



Figure 5:22. A typical quarry on the south-west face of Pike of Stickle.

The regional Neolithic settlement context of the Langdale/Scafell complex is sparse. However, one of the most significant discoveries is the rock art panel found on a prominent boulder at Copt Howe on the valley floor, roughly 3-4km east of the axe quarries (Beckensall 2002, 37-47), which is positioned similarly to those below Creag na Caillich, arguably signposting the extraction sites. Some settlement activity has emerged beyond the quarries, particularly at Ehenside Tarn on the Cumbrian coast, characterised by a series of hearths and brushwood

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<sup>28</sup> c.3800BC (Bradley & Edmonds 1993); c.3200-3000BC (Pennington in Clough 1973); 3390-3150BC (Institute of Terrestrial Ecology).

platforms which produced an assemblage of Early Neolithic ceramics and evidence of Group VI axeheads production (Figure 5:23; Darbishire 1874; Manby 2007). Such sites clearly follow the tradition of Late Mesolithic activity at nearby Eskmeals (Bonsall *et al.* 1989), but with the addition of ceramics and axehead finds.



Figure 5:23. One of the Group VI axeheads from Ehenside Tarn with its wooden haft, now curated in the British Museum.

A more tangible presence is provided by the discovery of a causewayed enclosure on Green How on the northern periphery of the Skiddaw Massif, roughly 25kms north of the Langdale quarries which morphologically resembles a Neolithic causewayed enclosure but is as yet undated (Horne *et al.* 2002). A second putative Neolithic enclosure on Carrock Fell (see above) lies on the northern edge of Skiddaw Massif (Pearson & Topping 2002). This stone-built enclosure encompasses 1.94ha, features nine wide entrance breaks, and is significantly larger than Cumbrian hillforts which range from 0.06ha to 1.02ha and have far fewer entrance breaks. Although undated, this enclosure lies above a recognised Neolithic quarry. Other examples exist such as the enclosure on Howe Robin on Crosby Ravensworth Fell above the Eden Valley (Brown 2002). Here a shelving limestone pavement has been modified to create an enclosure of

4.55ha, with parts of the perimeter defined by segmented ditches reminiscent of Neolithic structures. A final enclosure at Skelmore Heads, near Barrow-in-Furness, produced a hoard of four stone axeheads, and is located adjacent to a long cairn (Brown 1996).

A number of long cairns are scattered around the periphery of the Central Fells. A western group comprises Sampson's Bratful, Skelmore Heads and Haverbrack, and an eastern series is ranged along the eastern side of the Eden Valley at Raiset Pike and Trainford Brow, clearly monumentalising a major Cumbrian routeway. A number of putative or destroyed sites occur on both sides of the Central Fells (Masters 1984). Henges, or hengiform enclosures, occur near Penrith, on the Eden Valley-trans Pennine routeways (Topping 1992), with early stone circles such as Long Meg extending the network towards the Tyne Gap and the east coast (Burl 1976, 55-97). Consequently, the monument record of Cumbria, as seen in Shetland and Perthshire, suggests a zoned landscape, with different forms of monument ranged around – and looking towards - the high ground and the raw material sources, but with no evidence for settlements near the quarries.

The principal product of these quarries is the large, broad-butted axeheads, which also include over-sized Cumbrian Club types, some of which have slight button butts reminiscent of Breton axeheads. The distribution of Group VI axeheads is arguably the most extensive and numerous of all axe quarries in the UK, with a distribution ranging from Shetland in the north (Sheridan 2012, 11), throughout mainland UK, the Isle of Man, and Ireland (Clough & Cummins 1988; Cooney & Mandal 1998). The related Group XI axeheads are much fewer in number, and restricted to the upper Thames, South Wales and Cumbria (Clough & Cummins 1988).

The Langdale/Scafell Complex is primarily focussed upon the half-dome shaped summit of Pike of Stickle and England's highest mountain of Scafell Pike, demonstrating again a fixation with the selection of locally-prominent topographic features. The quarries clearly lie beyond any recognised settlement zones, they are flagged by rock art on the valley floor in Langdale, and burial and ceremonial monuments are ranged around them – but at a distance. Such attributes would

suggest that this quarry complex was storied, with taboos preventing settlement, and the large-scale, extensive distribution of products implies ritualised practises which have created embodied axeheads with a widespread social value.

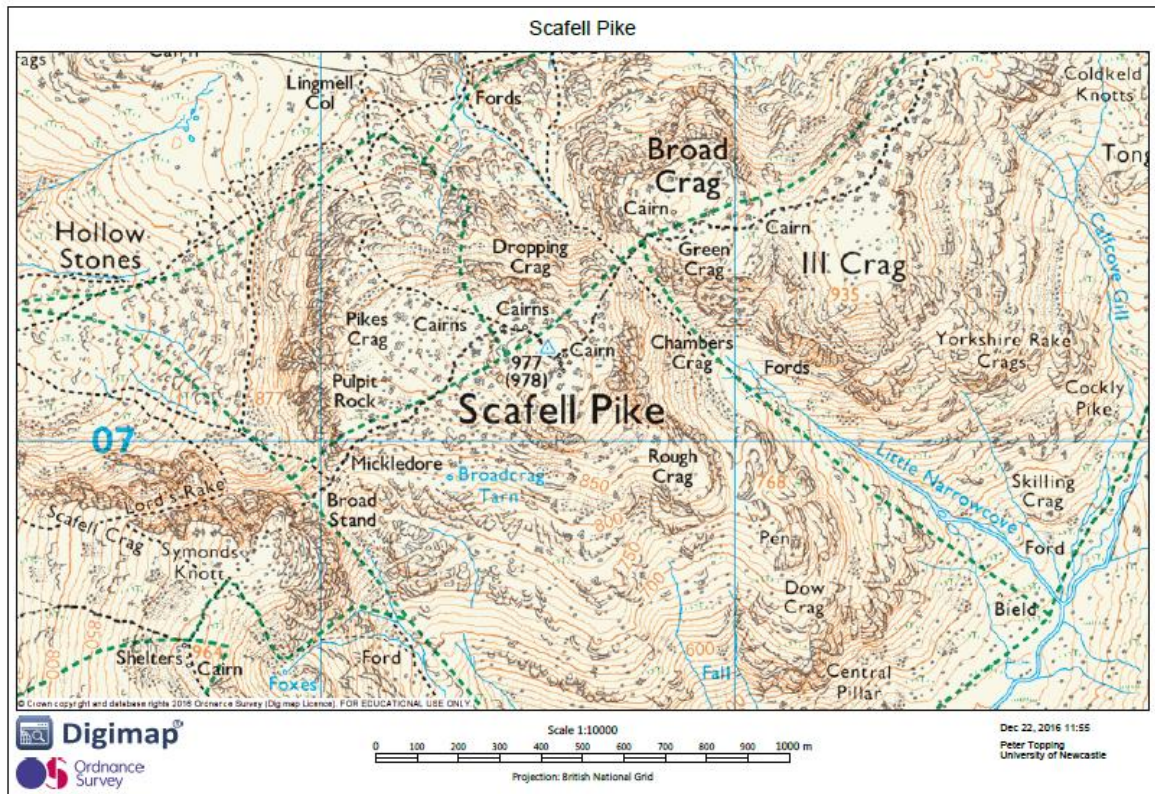


Figure 5:24. The topographic setting of the Scafell Pike quarries.

#### 5:4 Graiglwyd, Gwynedd [Group VII]

The prominent igneous intrusion at Penmaenmawr (SH 71 75) forms part of the northern fringe of the Yr Wyddfa (Snowdonia) massif, overlooking the narrow coastal plain, the Irish Sea, the Menai Straits and Môn (Anglesey) to the west (Figure 5:26). The Yr Wyddfa massif rises in height to the south and west. Much of the Penmaenmawr intrusion has been quarried, reducing its height from 472m OD to 345m OD; only parts of the eastern and southern periphery remain intact. Early maps suggest the intrusion had a distinctive dome-shaped profile, and despite the quarrying it remains a visually prominent landform from the coastal plain and Môn.



Figure 5:25. The lower outcrop at Graiglwyd, site of Hazeldine Warren's excavations.

The raw material at Graiglwyd is Augite Granophyre (Clough 1988, 7), a fine-grained, pale grey rock which is readily knapped (Williams & Davidson 1998, 5). The strata producing this material occurs in a deposit some 50-100m wide, lying around the eastern and southern periphery of the intrusion, although similar rocks and evidence of axe-making can be found on the north-west slopes of nearby Dinas (SH 700 738) and Garreg Fawr (SH 692 731) (Williams & Davidson 1998, 3-5). Recent evidence recorded scree exploitation on the western slopes of Graiglwyd outcrop (ibid., 5), demonstrating a range of procurement strategies.

The radiocarbon chronology from the quarries, and various adjacent sites associated with quarry products, has shown that extraction occurred throughout the Neolithic period. On the coastal plain the gravel ridge of Llandegai/Parc Bryn Cegin, south-east of Bangor, hosted activity from the Early Neolithic onwards. Here a timber structure and contemporary pit containing Graiglwyd lithics lay adjacent to House B1, suggesting a small farming settlement (Lynch & Musson 2001; Williams et al. 2011). The megalithic tombs of the Llyn Peninsula favour a predominantly riverine and coastal distribution, framing the Yr Wyddfa massif (Cummings 2004), suggesting activity zoning with settlements and tombs on the

lower ground surrounding the quarries in the uplands. Land-use changed substantially around 3200 cal BC following the apparent abandonment of the farming settlement(s), and the construction of two early henge monuments, a short cursus, and a number of later Neolithic pits which also contained Graiglwyd lithics and demonstrated the deliberate destruction of Graiglwyd polished axeheads (Williams et al. 2011).

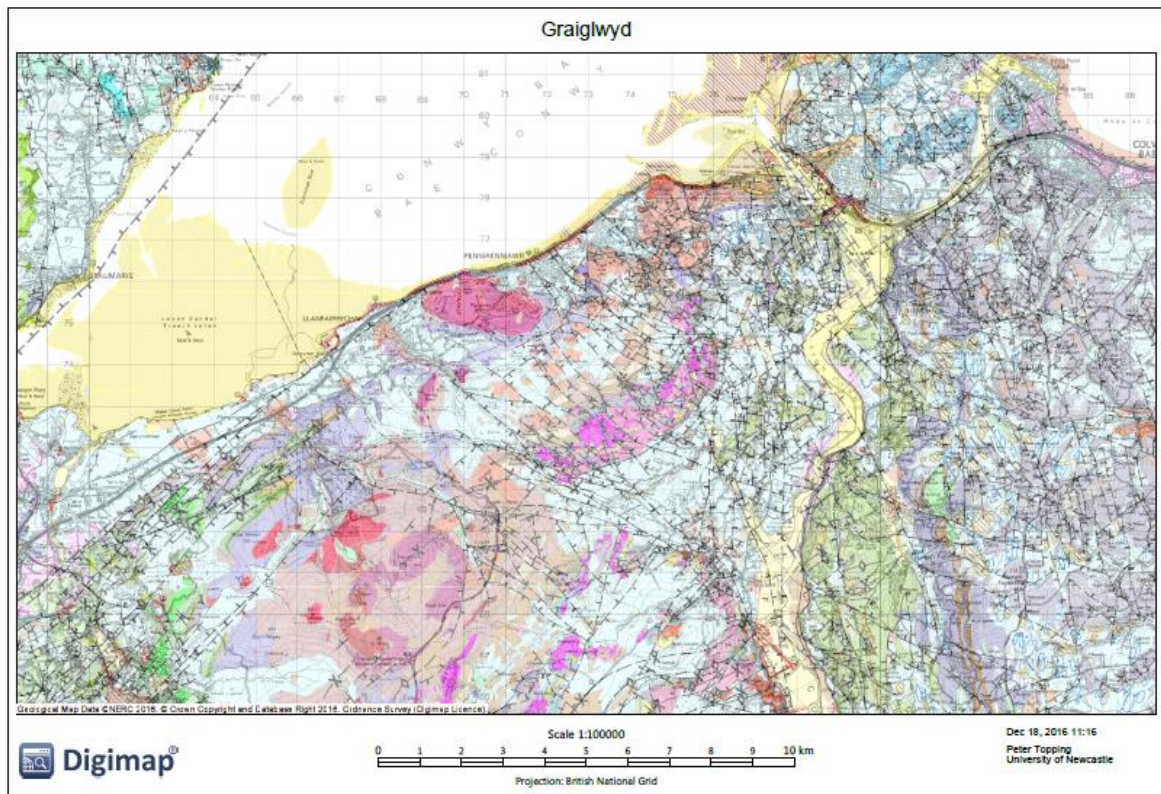


Figure 5:26. The geological setting of the Graiglwyed quarries.

The coastal plain adjacent to Graiglwyd is largely devoid of tombs, the nearest, Maen-Y-Bardd (SH 741 718), lies 3km south-east on slopes overlooking the Afon Conwy valley. A second, Lletty'r Filiast (SH 772 829), is located on Great Orme's Head 7km to the north-east (Lynch 1969a). Clearly this void on the coastal plain might reflect impacts by post-medieval land use, or simply define a gap in distribution.

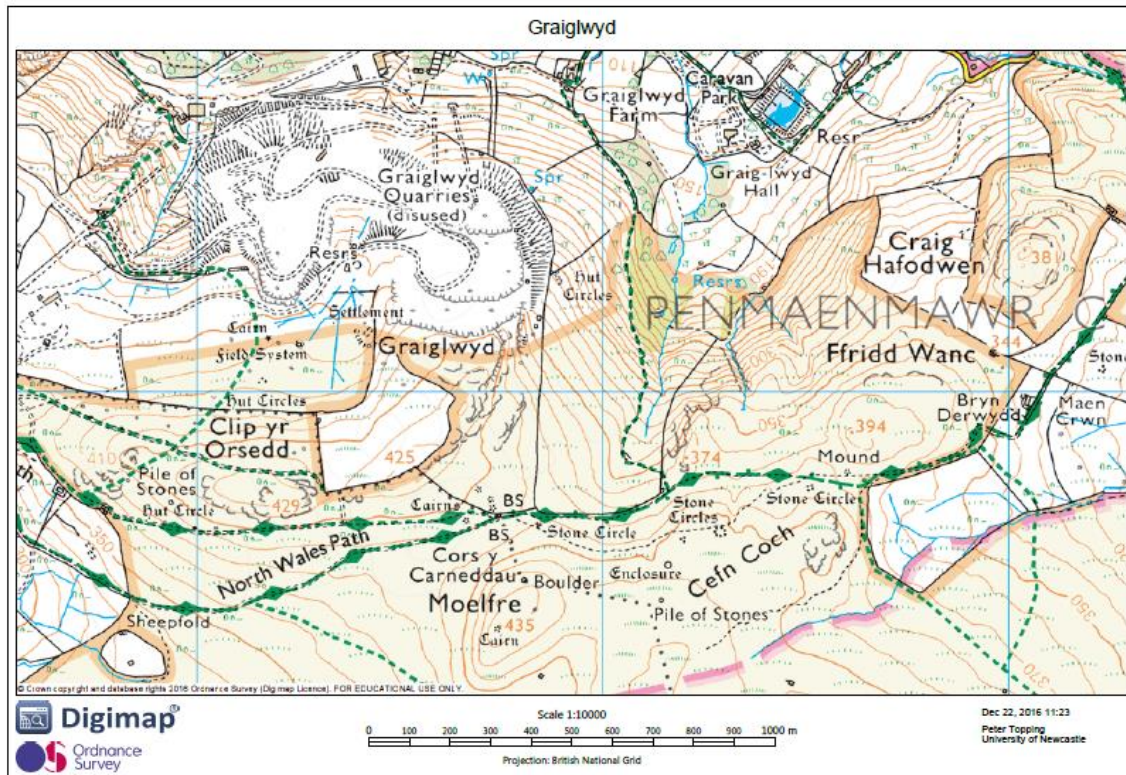


Figure 5:27. The topographic setting of the Graiglwyd quarries showing the series of stone circles and cairns lying immediately to the south.

The nearby island of Môn (Anglesey) has a coastal or riverine distribution of c.29 megalithic tombs which have produced assemblages including Graiglwyd axeheads (Lynch 1970, 72-80; Cummings 2004). At the tomb of Bryn yr Hen Bobl, two scrapers crafted from reworked Graiglwyd axeheads were discovered amongst the assemblage, alongside a roughout positioned in the forecourt. Graiglwyd debitage was recovered from many parts of the site, and four polished axeheads made from a local Môn dolerite were also recorded (Hemp 1935; Lynch 1969b, 166). The recent discovery of three Early Neolithic houses at Llanfaethlu, near Holyhead Bay, juxtaposed with Middle Neolithic pits, with both features containing Graiglwyd lithics, is beginning to provide a view of island settlement (Rees & Jones 2016). Despite the geographical separation by the Menai Straits, Graiglwyd axeheads featured in depositional practises in both areas.

At Graiglwyd extraction was focussed on the eastern outcrops where the toolstone is most workable. At Site F, Trench E, for example, evidence indicates



the outcrop had been quarried using fracture plains to prise apart the raw material (Figure 5:28). The Trench E quarry contained flaking debris and a roughout, with a 'finely-flaked axe' positioned vertically in a crevice (Williams & Davidson 1998, 19). Alongside outcrop quarrying, shallow hollows evidence scree exploitation (ibid., 19). 'Working floors' were discovered on both the outcrop summit and at its foot, providing evidence of on-site axehead production. Three cairns were recorded on, and to the west, of the Site F outcrop, containing axe-making debitage in all three, whether residual or primary deposits. In the case of Cairn 67, a compact layer of debitage, including a roughout axehead, returned a date from unidentified charcoal at the beginning of the Neolithic (5330±90 BP [SWAN-142]; 4350-3990 cal BC; ibid., 19). The purpose of the cairns is unclear as burial deposits were not encountered, and the primacy of the axe-flaking debitage may be illusory. However, if the cairns were contemporary with the extraction, they may represent a deliberate act of monumentalisation at the quarries, designed to impart visual messages concerning the importance of place and emphasise taboos. The incorporation of debitage into formalised monuments may also represent an act of atonement for the quarrying as part of renewal practises.



Figure 5:28. Graiglwyd, Site F, Trench E: Quarry with the location of the flaked axehead shown by the uppermost arrow, the roughout by the lower, both buried beneath quarry debris and debitage.

Excavations demonstrate that axehead production, if not finishing, occurred on-site and was not just a practise at lowland sites such as Llandegai/Parc Bryn Cegin. However, it was at the lowland sites where certain axeheads went through deliberate destruction as part of structured pit deposits.



Figure 5:29. A typical Group VII axehead discovered in the 1993 excavations (cf. Williams & Davidson 1998).

The typical product of the Graiglwyd quarries was the pointed-butt axehead (Figure 5:29), although adzeheads and chisels were also produced (Hazzeldine Warren 1919). Although this region is comparatively isolated by its topography, the extensive distribution of Group VII axeheads throughout southern Britain demonstrates long-distance exchange mechanisms, and the proximity of the Irish Sea suggests other routes for Graiglwyd products. The distribution of Group VII axeheads is extensive, although largely limited to southern Britain, outliers occur at Ballacosnahan, Isle of Man (SC 257 821), and Cairnpapple, West Lothian (NS 987 717); the majority are found from Yorkshire/Lancashire in the north to Kent in the south-east and Dorset in the south-west (Clough & Cummings 1988, 271).

The Graiglwyd quarries are located on a prominent mountain summit, overlooking the settlements of the coastal plain. Megalithic tombs encircle and frame the quarries, and small on-site cairns of debitage appear to monumentalise extraction. On-site workshops suggest the presence of craft specialists, there is no on-site settlement evidence, and the supra-regional distribution of products once again imply the production of embodied artefacts by ritualised extraction which were highly valued and carried social narratives across southern Britain.

## 5:5 East Anglian Flint Mines

The Late Neolithic/Early Bronze Age flint mines at Grime's Graves [TL 8175 8980] are located on Breckland heaths at 25m OD (Figure 5:30), near the south-eastern edge of the Fenland Basin in an area with dense lithics concentrations from the earlier Neolithic onwards (Hall & Coles 1994, 38-64). This extensive mine complex lies on an interfluvium between the rivers Wissey and Little Ouse, and a shallow relict valley defines its northern boundary (Linford *et al.* 2009, 2-3). The mines lie on a low spur-like promontory, with periglacial stripes to the north and east (Figure 5:33), comprising parallel chalk ridges up to 10m wide and 0.5m high with intervening fissures filled with sand. These stripes support distinctive plant communities creating a striking impression of linear bands scored across the landscape in a similar manner to those subsequently noted at the broadly contemporary site of Stonehenge (Parker Pearson 2012, 243-244). Such glacially-derived vegetation patterning may be a recurrent feature of later Neolithic sites located on chalkland geologies.

The geology at Grime's Graves is characterised by the 'Brandon Flint Series', which comprises 8m-15m of chalk, marl and flint seams located at the junction of the Upper and Middle Chalk (Figure 5:31). The flint seams are generally known by the names given by Brandon gunflint miners during the eighteenth and nineteenth centuries, such as 'Topstone or Toppings', 'Wallstone', and 'Floorstone' (the principal seam targeted by Neolithic miners). An unstable deposit of Devensian Cover Sand overlies the chalk, and ranges up to 3.0m in thickness. The shelving chalk geology is deepest in the south, forcing the Neolithic miners to dig shafts up to 13m deep in this area, whereas in the north and west only relatively shallow shafts and pits between 3m-6m deep were necessary. The deeper mines have subterranean galleries, but the shallow pits do not, although some have niches to exploit upper flint deposits. The local soils of the Worlington Series are well drained and vary from alkaline to highly acidic.

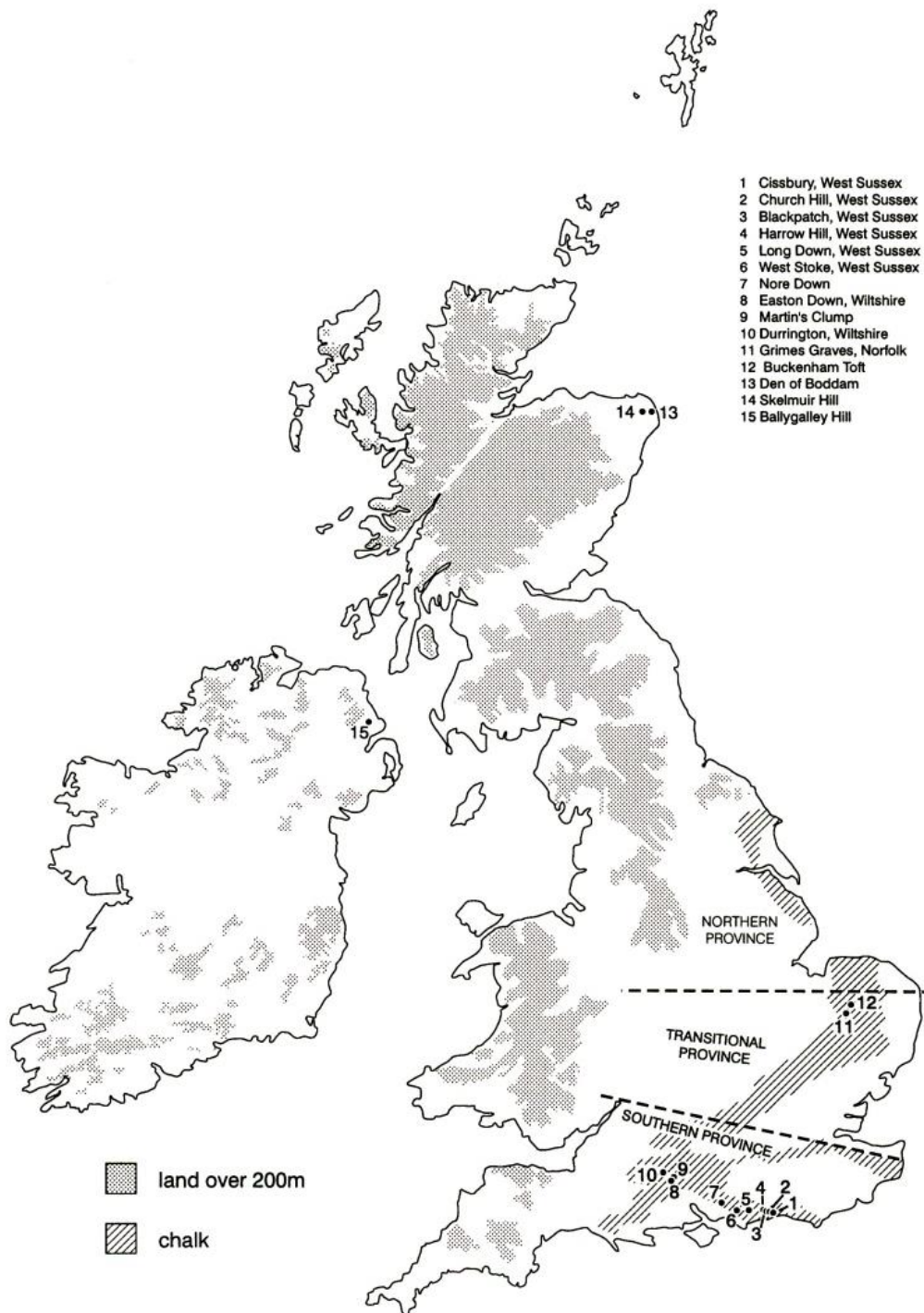


Figure 5:30. The distribution of flint mines in the UK and Ireland (from Barber et al. 1999).

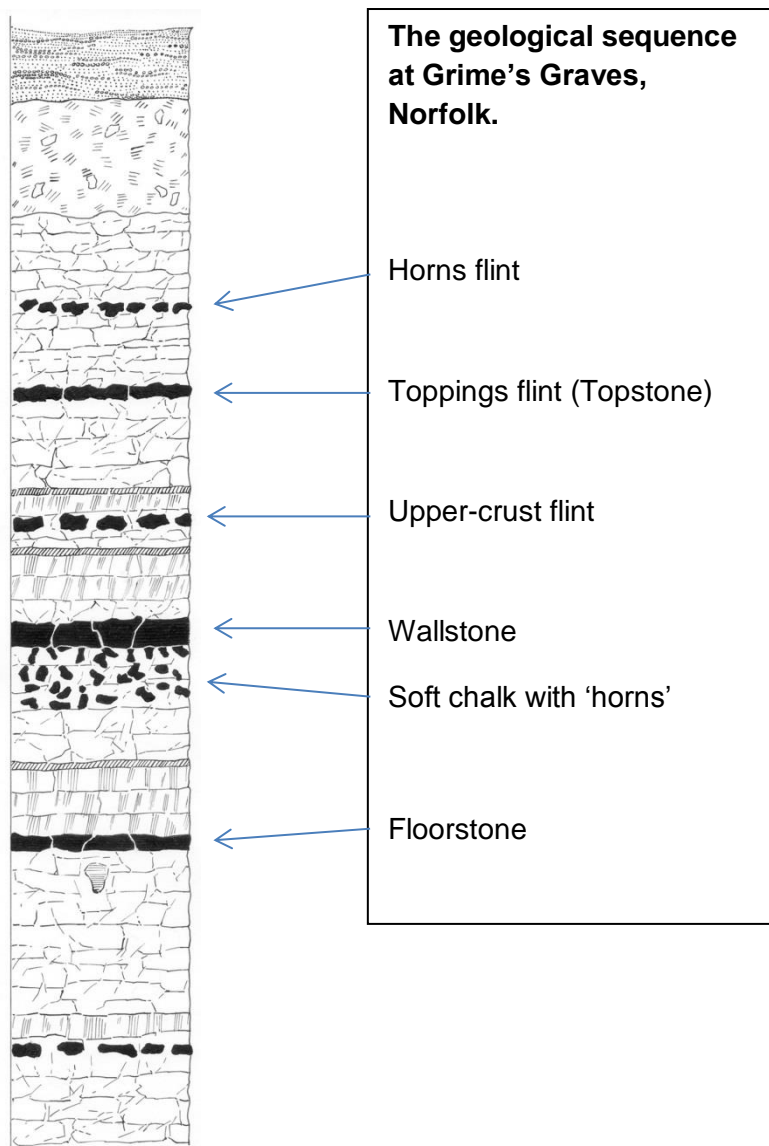


Figure 5:31. The geological sequence at Grime's Graves (drawing © Judith Dobie).

The palaeoenvironmental data suggests that Grime's Graves (Figure 5:32) was mantled by dense, deciduous woodland into the Neolithic period, broken only by natural clearings. The elm decline caused some disruption to the woodland canopy, followed by regeneration, until herbs appeared later in the period. However, it was not until the beginning of the Iron Age (c.800–500 BC) that there was any noticeable clearance of trees and the development of heathland (F Healy pers comm.; Murphy 1984; Healy 1984). Consequently, these flint mines, like those on the South Downs, were set amongst woodland, which must have acted as a visual barrier and added an ambience to the mine complex.



Figure 5:32. Grime's Graves from the south. Periglacial stripes can be seen in the centre top, and top right of the aerial photograph. Greenwell's Pit is concrete-capped, bottom right (© Historic England; TL15757-07; 29 July 1997).

Traces of Neolithic activity are scattered throughout Breckland and the eastern Fen Edge, with sites favouring riverine and south-facing elevated positions. The Fen Basin lies 12km west of Grime's Graves, and can be accessed by the Little Ouse valley 1.5km to the south, or along the River Wissey 4km to the north, providing both regional routes and entry to the North Sea coast. Flint scatters are common, but more formalised settlement is glimpsed at Kilverstone, near Thetford, where 28 pit groups contained Mildenhall Ware vessels in complex depositional sequences including craft and subsistence activities, suggesting *'occupation was repeated and persistent but not continuous'* (Garrow *et al.* 2005,

156). Mobility clearly remained part of Neolithic life in the Brecklands, if Kilverstone is a reliable indicator. Earlier excavations at Hurst Fen, near Mildenhall (Clark 1960), also discovered pit groups which may have had similar sequences to those at Kilverstone. At Hurst Fen, the lithic assemblage included six axeheads, four of which were flint (one possibly originating from the Norfolk mines) and two Group VI axeheads from Langdale (ibid., 224-225). The site also provided evidence of ground tool recycling. The scale and activity at Hurst Fen suggests a Kilverstone-like level of occupation, whether intermittent or not, and the presence of Langdale lithics demonstrates a connection to long-distance networks. Overall, Neolithic settlement in the Brecklands and Fen Edge suggests a distinct clustering of sites on the eastern periphery of the Fen Basin, contrasting with a more dispersed pattern across the Brecklands (Healy 1984; Hall & Coles 1994). However, given the length of the Neolithic and the lack of chronological precision for dating certain sites, it is possible that this region was sparsely settled.

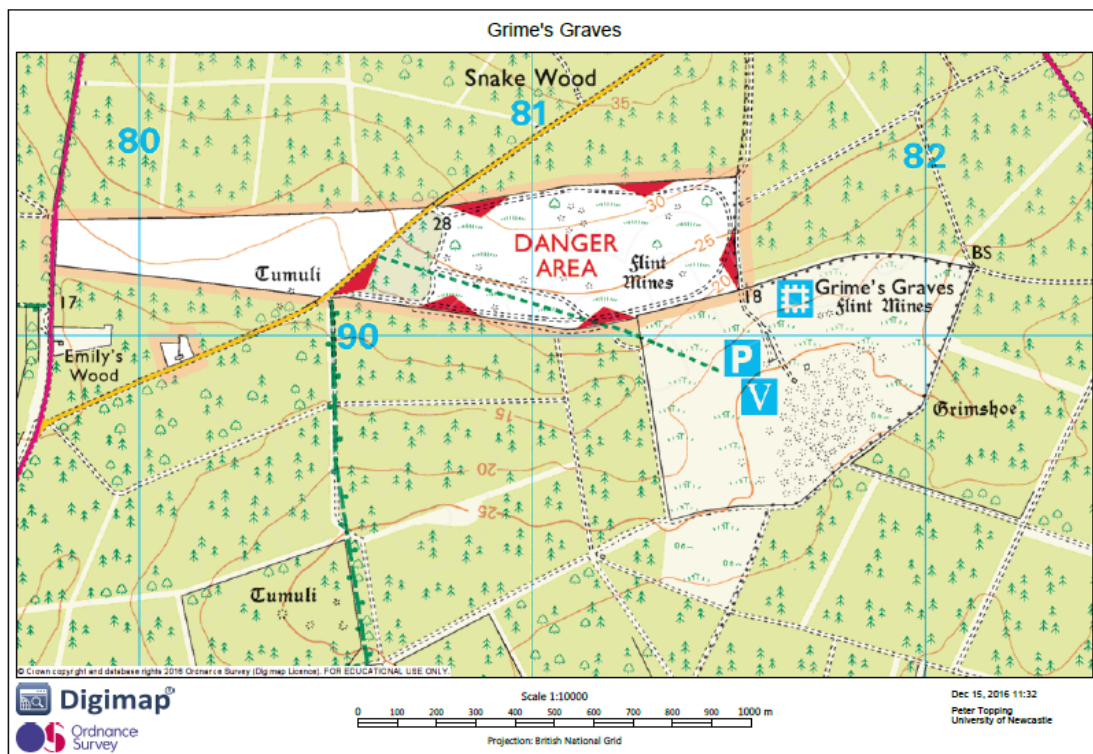


Figure 5:33. The topographic setting of the flint mines at Grime's Graves.

The surviving earthworks at Grime's Graves cover an area of 7.6ha and comprise 433 mines and pits originating in the Late Neolithic and Early Bronze Age periods





Excavations have found no evidence for contemporary settlement on-site, which the framework would suggest was the result of social constraints. Although there are interpretive difficulties with product distributions, that fact that two Cornish stone axeheads were discovered on-site suggests that Grime's Graves was part of a long-distance exchange network. Consequently, the framework would interpret this data as a storied location which produced culturally valorised or embodied products by ritualised practises, which were transported over long-distances.

### 5:6 South Downs/Wessex Flint Mines



Figure 5:35. Harrow Hill flint mines, Sussex (© Historic England; TQ 0809-24; 18 January 2004; NMR 23311-33).

The South Downs flint mines are located on the downland escarpment overlooking the coastal plain or downland, and favour false-crested or tilted positions. Church Hill, Long Down and Cissbury, for example, are situated upon false crests above steep slopes and close to deposits of Clay-with-flints, which may have first alerted Neolithic groups to flint in these areas. The eastern group

of flint mines (Harrow Hill [Figure 5:35], Blackpatch, Church Hill, Cissbury [Figure 5:38]) are intervisible, although woodland may have masked their presence during the earlier Neolithic (Barber et al. 1999, 55; Allen & Gardiner 2012, 100). The western group of Long Down, Nore Down, and Stoke Down, are more dispersed and not intervisible and may also have been hidden by woodland (Allen & Gardiner *ibid.*). The Wessex group of mines (Martin's Clump, Easton Down, Durrington) are also not intervisible.

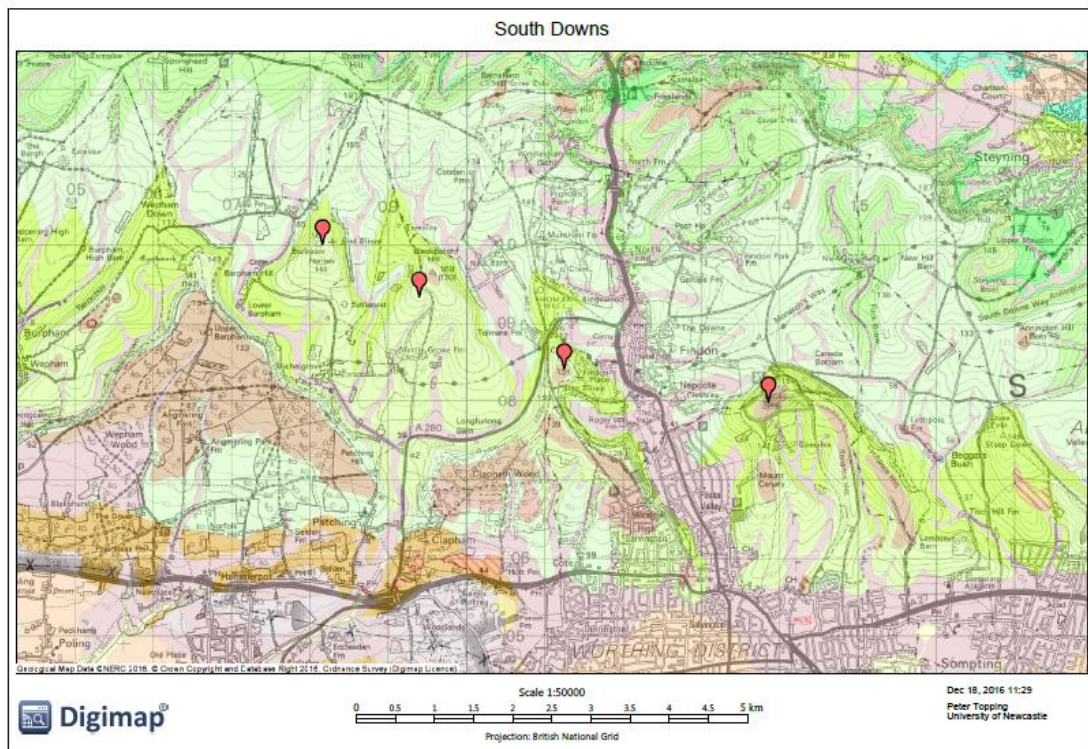


Figure 5:36. The geological settings of the South Downs flint mines on (left to right) Harrow Hill, Blackpatch, Church Hill and Cissbury.

The South Downs flint mines are located on Sussex White Chalk, with some downland topped by deposits of Clay-with-flints. These summit deposits are more resistant to erosion than the underlying Sussex White Chalk, and this may have led to undercutting to reveal the flint deposits. Eroded nodules will have accumulated on downland slopes, indicating the presence of upslope flint deposits to Neolithic prospectors. Geologically, Cissbury (Figure 5:36) and Church Hill exploit the first and second seams of the Peacehaven Beds, whereas Blackpatch and Harrow Hill target the inferior Rottingdean and Old Nore Marls (Mortimore 1986, 23; Barber et al. 1999, 24). The observation that poor-quality

flint was extracted at Blackpatch and Harrow Hill when better material was available locally, suggests that non-functional motivations may have informed choices (Figure 5:37). The Wessex flint mines, conversely, were not located upon Clay-with-flints but exploited shallow or surface flint deposits.

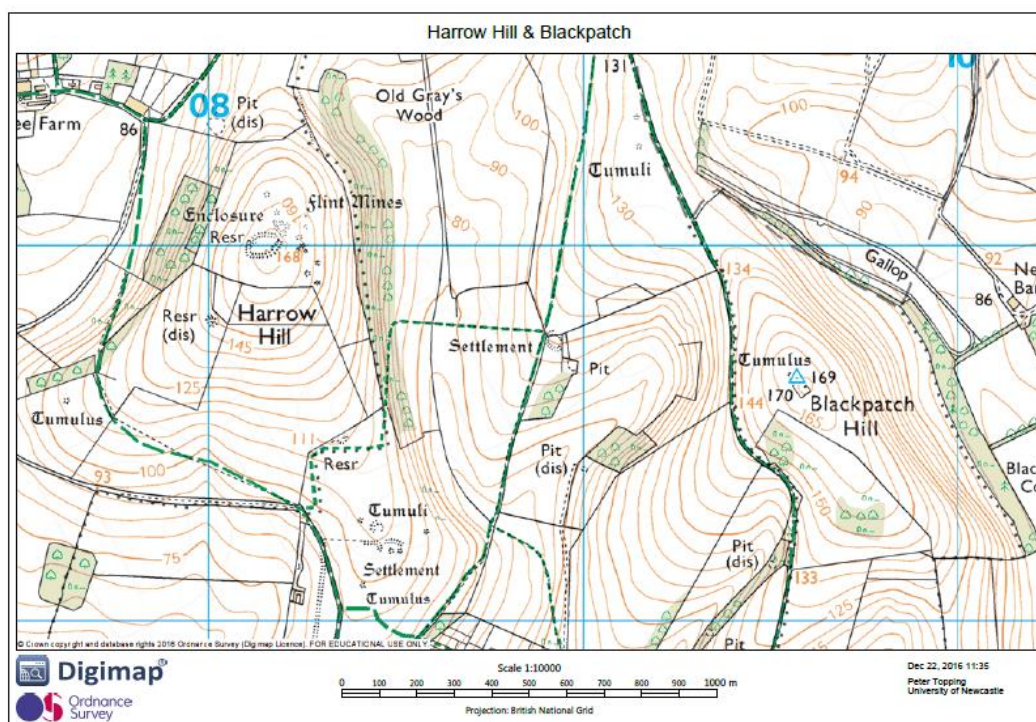


Figure 5:37. The topographic setting of Harrow Hill and Blackpatch flint mines.

The contemporary environmental setting of the mines clearly determines visibility and impact, which is problematic as most reconstructions rely upon outdated interpretations. Nevertheless, recent reanalysis of molluscan evidence suggests ancient beech woodland at Stoke Down, Sussex, and Easton Down, Wiltshire, and shade-loving species from Harrow Hill, Sussex, all imply that mining occurred in wooded environments. In addition, complementary evidence from long barrows and causewayed enclosures on the South Downs demonstrates that they were constructed in recently opened or short-lived woodland clearings (Allen & Gardiner 2012, 96-100). The *Gathering Time* chronology (Whittle et al. 2011b) indicates that these two site-types were constructed roughly 10 generations after the first mines were sunk, therefore the mines must have been dug in woodland, perhaps following the discovery of nodules in tree-throw hollows (Allen & Gardiner 2012, 100). Recent environmental research demonstrates that postglacial woodland was widespread across the South Downs during the Early

Neolithic. Consequently, and despite locally-prominent settings of the South Downs mines, woodland must have masked the location of the mines, providing exclusivity to these hidden, secretive places. In Wessex, the picture is less clear, but woodland is suggested at Easton Down, and natural clearings only appear to have occurred where Late Neolithic monument complexes developed (e.g. Dorchester, Stonehenge), arguably suggesting woodland canopies similar to the South Downs (*ibid.*, 101-102).

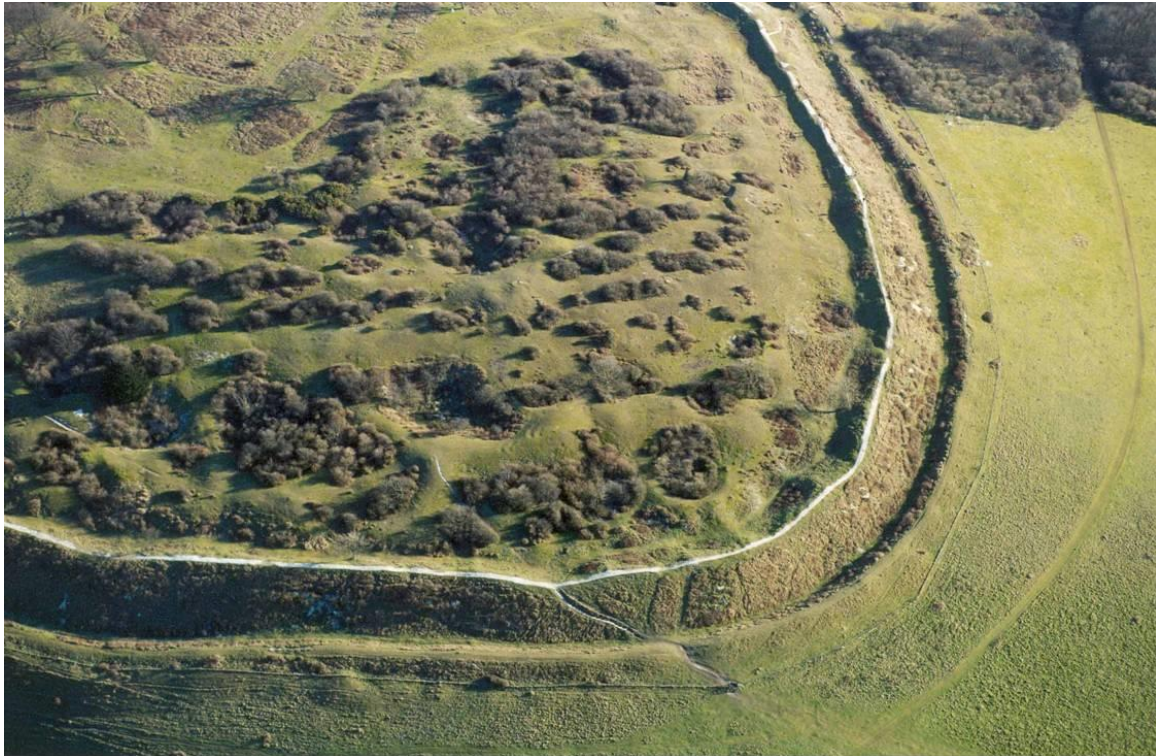


Figure 5:38. The Cissbury flint mines truncated by the ramparts of Cissbury Rings (© Historic England; TQ 1307-41; 18 January 2004).

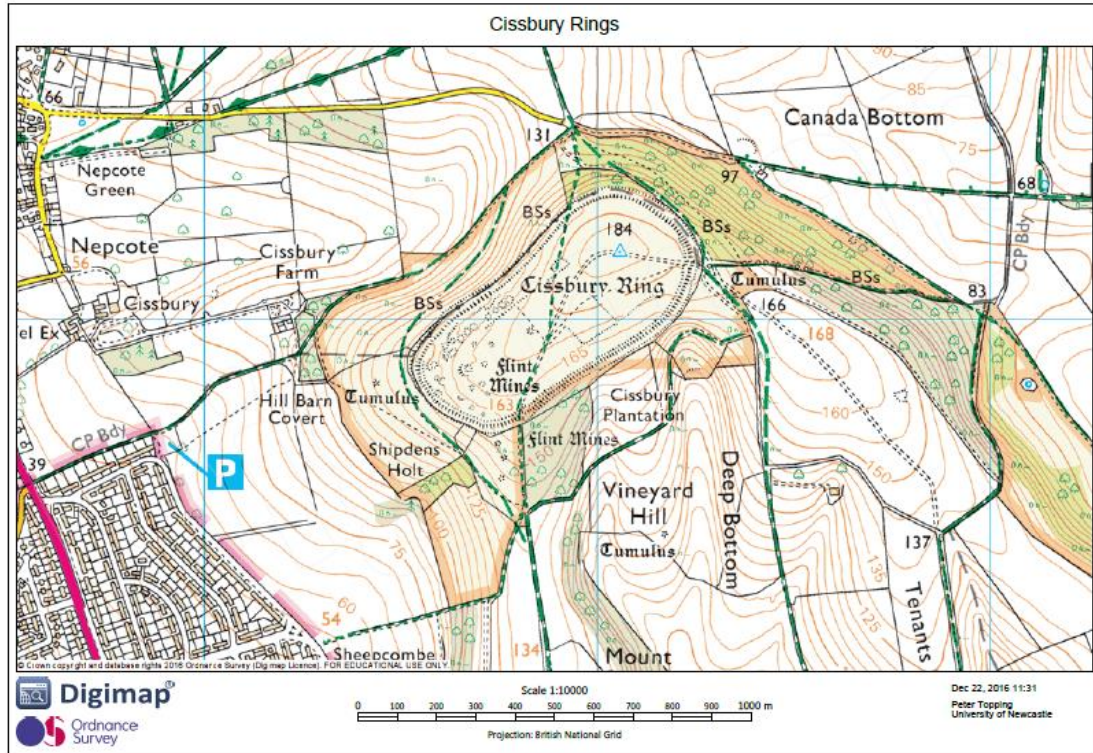


Figure 5:39. The topographic setting of the Cissbury flint mines.

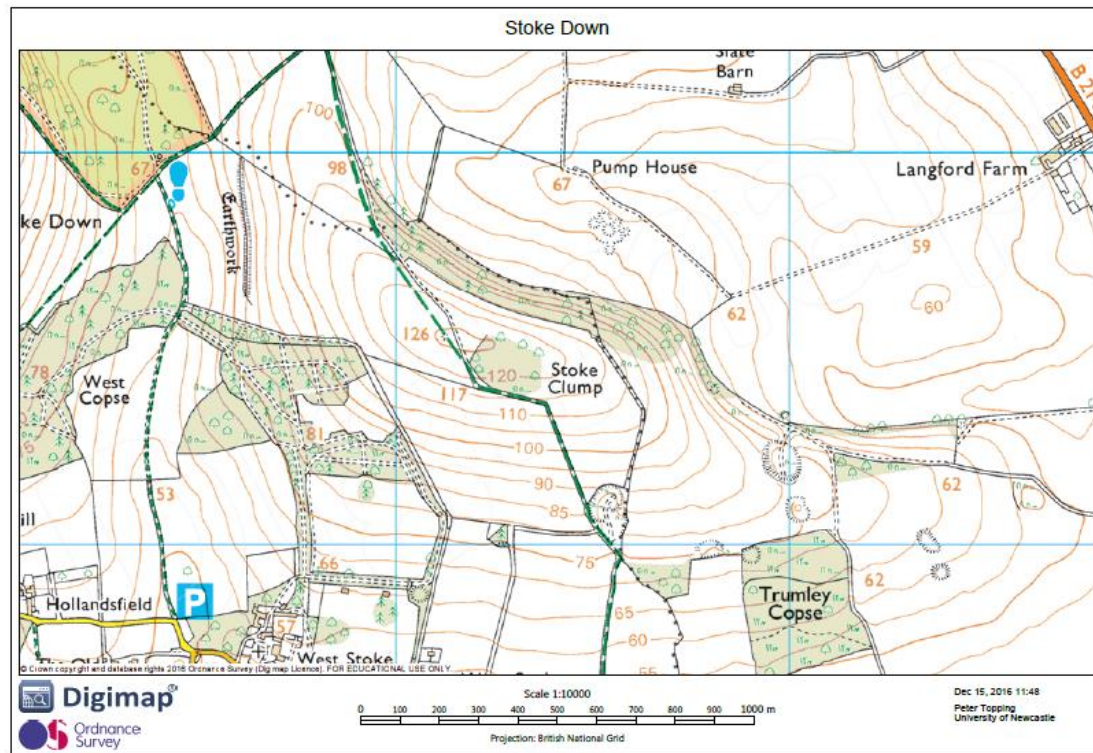


Figure 5:40. The topographic setting of the Stoke Down flint mines.

The South Downs flint mines have not produced evidence of permanent occupation, although the Durrington shafts do overlook the pre-henge settlement at Durrington Walls, if it were contemporary (see below). The mines at Blackpatch included a number of contemporary barrows scattered amongst the mines (Pull 1932; Russell 2001). The mines at Cissbury (Figure 5:39), Church Hill, Blackpatch and Harrow Hill form a discrete cluster lying between the Rivers Adur and Arun (Figure 5:36), a downland zone devoid of any other contemporary Neolithic monument (Topping 2005, 84). Adjacent areas of low-lying coastal plain have produced lithic assemblages which suggest that mined flint was reserved for specific tool types, particularly axeheads which were often carefully curated, often unused or deposited in hoards (Gardiner 1990; Holgate 1995). Such use and depositional practises would appear to confirm the special nature of these flint mines and their products.

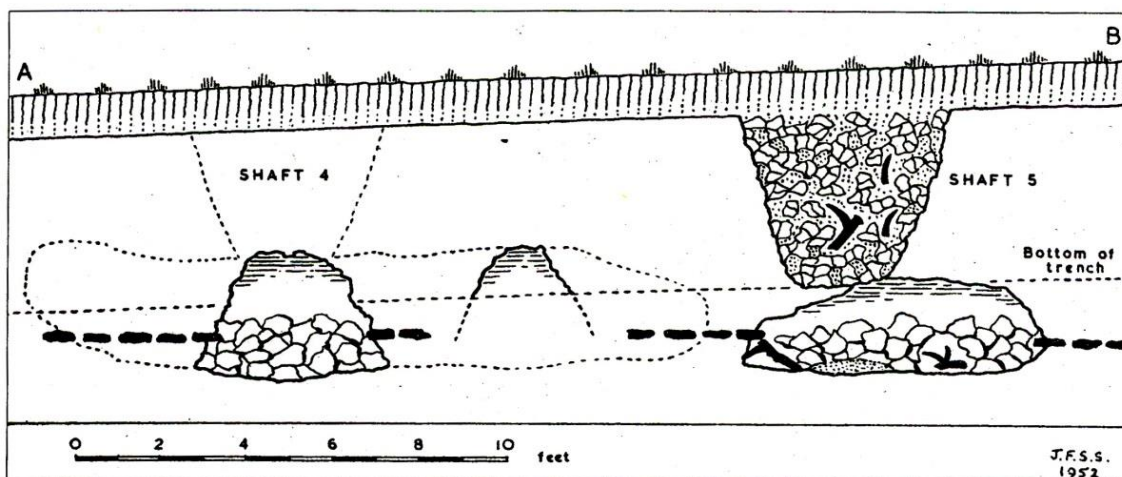


Figure 5:41. The small Durrington flint mines (from Booth & Stone 1952).

In contrast, the western South Downs mines (Long Down, Stoke Down [Figure 5:40], Nore Down) are all located west of the River Arun along the downland ridge, but here the mines are intermixed with potentially later causewayed enclosures (Oswald et al. 2001, 117-118) and long barrows (Kinnes 1992, Fig 6), suggesting less exclusivity and a greater range of activities emerging in this part of the downland. Further to the west, the Wessex group also feature broadly contemporary monuments nearby: at Martin's Clump a long barrow was constructed 150m to the south, and the Durrington shafts (Figure 5:41) were positioned on a crest overlooking the pre-henge settlement at Durrington less

than a kilometre to the south (Barber et al. 1999, 57; Parker Pearson 2012). Further analysis is clearly needed at Durrington to determine the precise chronological relationship of the shafts to the settlement and henge.

The South Downs and Wessex mines produced a range of implements. The main product was the axehead, but cores, scrapers and minor tool types figure prominently (Gardiner 2001). The distribution of South Downs flint mine products is hampered by the same problems described above regarding sourcing, although the presence of imported flint axeheads at southwestern enclosures such as Carn Brea and Helman Tor (Mercer 1981c & 1997) suggest that the South Downs or Wessex mines may have had a role in supplying implements to these well-connected sites (Group VI axeheads were also found at Carn Brea).



Figure 5:42. The Harrow Hill flint mines from the northeast.

These mines share many common characteristics: they are mostly on downland slopes, with only Harrow Hill on a summit (Figure 5:42). However, the emerging environmental context suggests that they were probably comparatively hidden in woodland, without associated on-site settlements. The locally-prominent setting of all sites would suggest that they may have been storied, and were probably

special places as implied by the lack of ‘polluting’ settlement. At Blackpatch small burial mounds were constructed from mining waste, embedding an ancestral presence at the site, and further developing the cultural value of these mines. The probability that their products were involved in long-distance movements adds further to the likelihood that these were all ritualised arenas servicing the specialised needs of communities across southern Britain – and possibly beyond.

## **5:7 Comparisons and conclusions**

If the interpretive framework presented in Chapters 3 and 4 is applied to the landscape settings of the extraction sites several themes emerge (Table 5:1), where their co-existence suggests that they were probably mythologised extraction sites practising ritualised procurement. Firstly, location was clearly important, with summits or false-crests being preferred, irrespective of raw material type or quality. The framework would suggest these were storied locations in the majority of cases. The issue of toolstone quality is epitomised at Blackpatch and Harrow Hill which were located upon inferior toolstone despite better quality deposits nearby. Clearly in these examples it was the precise location of extraction that was paramount rather than toolstone quality (Barber et al. 1999, 73; Topping 2005, 84). This is paralleled at the Langdale axe quarries where it was discovered *[t]he larger, more conspicuous outcrops were preferred to those which were easier to reach, even when more accessible sites had equally suitable raw material’* (Bradley & Ford 1986, 127).

Despite prominent locations, however, the presence of woodland and vegetation impacted visibility (Allen & Gardiner 2012). Although only a minority of sites have provided environmental data, the upland quarries at Creag na Caillich and Langdale/Scafell, the South Downs mines and Grime’s Graves, all produced evidence of woodland settings. The upland quarries were probably near the treeline, but may have been masked by scrub or high-altitude tree species, and the mines appear to have been in woodland clearings. Consequently, despite the fact that most extraction sites were located in locally-prominent positions, woodland will have hidden them, which suggests an element of social exclusivity



in extraction practises, something the evidence for ritualised practises strongly implies (Chapter 6). In addition to the woodland setting at Grime's Graves, the periglacial stripes may have been a phenomenon which enhanced cultural perceptions of these mines, and helped to create an ambience around the site.

The use of rock art or graffiti is shown to be an integral part of ritualised extraction for many cultures, and is well-represented at roughly one third of all archaeological sites. The interpretive framework would suggest that in the Neolithic examples this art was used to both signpost sites and form locations for offerings and religious observance. Similarly, almost 40% of all sites had some form of association, or juxtaposition, of burial monuments or upstanding megaliths, which would suggest the deliberate monumentalising of extraction to commemorate the practise, or a significant ancestor. All of these elements enhanced the layers of social and cultural meaning embedded into these sites.

The lack of settlement evidence from extraction sites in the UK could be explained from the ethnographic data as evidence of taboos preventing domestic activity near the extraction, as at Pipestone and several New Guinea quarries, for example. This further constraint adds weight to the observation of exclusivity, prescribed practises and a heightened social importance attached to these sites.

The final strand of evidence is product distributions, which in almost every case appears to be linked to sites which the interpretive framework would suggest are mostly storied locations practising extraction and producing embodied products which could transmit cultural narratives – often over long-distances.

Context/Trend	Sites	% of sites displaying trend
<b>Axe quarries<sup>29</sup></b>		
① quarries located on/near skyline	Langdale/Scafell/Glaramara; Creag na Caillich; Graiglwyd; Shetland; Mynydd Rhiw; Hyssington; Fairfield; Carrock Fell	100% [8 of 8]
② quarries located on distinctively shaped landforms	Langdale/Scafell/Glaramara; ?Graiglwyd; Creag na Caillich; Hyssington; Fairfield	63% [5 of 8]
③ quarries occur in isolation beyond the limits of permanent settlement	Langdale/Scafell/Glaramara; Creag na Caillich; Graiglwyd; Shetland; Mynydd Rhiw; Hyssington; Fairfield; Carrock Fell	100% [8 of 8]
④ quarries are monumentalised with broadly contemporary tombs, barrows, cairns or standing stones	Shetland; ?Graiglwyd; Mynydd Rhiw	38% [3 of 8]
⑤ quarries associated with, or near to, rock art/graffiti	Hyssington; Langdale/Scafell/Glaramara; Creag na Caillich	38% [3 of 8]
⑥ quarry products have limited distribution [<160km]	Mynydd Rhiw; Shetland	25% [2 of 8]
⑦ quarry products have extensive distribution [>160km]	Langdale/Scafell/Glaramara; Graiglwyd; Creag na Caillich; Hyssington; Fairfield; Carrock Fell	75% [6 of 8]
<b>Flint mines<sup>30</sup></b>		
① mines located on/near skyline	Blackpatch; Harrow Hill; Cissbury; Church Hill; Stoke Down; Long Down; Martin's Clump; Durrington Walls; Skelmuir Hill	64% [9 of 14]
② mines located on distinctively shaped landforms	Grime's Graves; Cissbury; Harrow Hill; Church Hill; Blackpatch; Skelmuir Hill	43% [6 of 14]
③ mines occur in isolation beyond the limits of permanent settlement	Blackpatch; Church Hill; Cissbury; Easton Down; Grime's Graves; Harrow Hill; Long Down; Martin's Clump; Stoke Down; Nore Down; Buckenham Toft; Den of Boddam; Skelmuir Hill	93% [13 of 14]
④ mines are monumentalised with broadly contemporary tombs, barrows, cairns or standing stones	Blackpatch; Long Down; Stoke Down; Martin's Clump; Skelmuir Hill	36% [5 of 14]
⑤ mines associated with, or near to, rock art/graffiti	Cissbury; Harrow Hill; Grime's Graves; Church Hill	29% [4 of 14]
⑥ mine products have limited distribution [<160km]	?	?
⑦ mine products have extensive distribution [>160km]	?	?

Table 5.1. Topographic settings of proven Neolithic extraction sites.

Taken together, the high percentages of flint mines and axe quarries situated in locally-prominent settings provide a strong parallel with the cross-cultural trends

<sup>29</sup> The 8 axe quarry complexes used in this analysis are those which have been demonstrated to be the source of raw material for specific groups of axeheads: Carrock Fell (Grp XXXIV; cf. Davis et al. 2007); Creag na Caillich (Grp XXIV); Fairfield (Grp XI; cf. Davis & Quartermaine 2007); Graiglwyd (Grp VII); Langdale/Scafell/Glaramara (Grp VI); Mynydd Rhiw (Grp XXI); Shetland (Grp XXII); and the putative quarry at Hyssington (Grp XII; Jones & Burrow 2011).

<sup>30</sup> The flint mines total 14 sites and comprise those ratified by Barber *et al.* 1999: Blackpatch, Church Hill, Cissbury, Durrington, Easton Down, Grime's Graves, Harrow Hill, Long Down, Martin's Clump, Stoke Down; the putative mines at Nore Down and Buckenham Toft; and the two Scottish sites of Den of Boddam and Skelmuir Hill (cf. Saville 2005 for the latter two sites).

identified in the review of ethnographic data, and suggests the probability that the majority of these archaeological extraction sites were in mythologised or storied locations. This is lent weight by the similar percentages of sites associated with human remains in the two data sets, the strong parallels regarding rock art/graffiti, and the correlation of supra-regional product distribution, all combining to provide robust indicators of storied extraction sites. In addition, the fact that surface deposits of raw material, accessible erratics and/or lower-lying scree exist at almost all extraction sites, demonstrates that Neolithic and Early Bronze Age groups generally avoided 'least effort' or expedient sources in preference for those more difficult to attain – because they were culturally more important for certain objects. This useful geological indicator can therefore also identify mythologised extraction sites. Consequently, when viewed in combination, these various strands of evidence all suggest that some 70-90+% of stone extraction sites were probably storied locations, which pragmatically did not need to be exploited as alternative – and more accessible - sources of similar raw material was available locally. This demonstrates that other motivations lay behind the practise of stone extraction in these particular places. Indeed, it may have been the act of extraction itself, undertaken at a culturally significant location, which might have been of equal ideological importance to the community as the value of the raw material and any subsequent products. Added to this, the extraction sites were located in liminal places beyond the limits of domestic settlements, often journeyed to through structured, monumentalised landscapes of rock art, burial mounds and ceremonial constructions. They lay at a cosmological interface between the sacred and profane, where living communities could connect with the supernatural and secure implements which could maintain social networks, define status and wealth, and create identity.

This chapter has demonstrated how each extraction site compares against the interpretive framework developed in Chapters 3 and 4 in respect to landscape setting, settlement evidence, product distribution, rock art/graffiti, and burials. Chapter 6 will focus in upon the site structures and assemblages to review the archaeological evidence for storied sites, ownership, seasonality, ritualised extraction and the functionality of products.

## **Chapter 6. Arenas of extraction: site structures and assemblages**

So far this thesis has reviewed the history of research into British Neolithic mines, the ethnography and archaeology of extraction, and the landscape settings and associations of Neolithic extraction sites. This data has usefully provided a number of general themes and trends from a wide variety of social contexts. To investigate the data from individual extraction sites, the present chapter will now review the structures and assemblages from the British mine and quarry complexes, with occasional reference to Irish material.

This chapter will review the headline characteristics of cross-cultural trends which emerged from the analyses in Chapters 3 and 4. It will follow on from Chapter 5 which reviewed the landscape settings of extraction sites by analysing and interpreting the archaeological evidence for seasonal use, extraction practises, human remains, the use of rock art/graffiti, site abandonment, and product functionality; these aspects were deemed to have the potential for visibility in the archaeological record. The chapter will then present a summary of extraction site data.

The archaeological data in this chapter comprises 79 excavations at flint mines and 51 excavations at axe quarries in the UK and Ireland. This will be used to produce a probability analysis of practises and their social context to inform our understanding of Neolithic and Early Bronze Age extraction sites, based upon robust statistics.

### **6:1 Assessing the presence of themes derived from the ethnography of stone extraction**

The analysis of the cross-cultural ethnographic data has identified a suite of factors or practises relating to the exploitation of extraction sites and their products (Chapter 3). The major ethnographic themes emerging from the 168 case studies can be summarised, in descending order of importance, as:

- 71% [120] record mythologised or storied extraction sites
- 70% [118] involve craft specialists in on- or off-site production
- 65% [117] of products have functional/ritual duality; 17% [29] were purely functional; 8% [14] were purely ritual; and 3% [3] were wealth objects
- 64% [107] of products distributed 200+km; 17% [28] 100-200km; and 7% [11] <100km
- 55% [92] record male-only extraction teams; 13% [22] record mixed gender/age teams comprising men, women and children; and 1% [2] record female only teams
- 45% [75] of extraction sites are in some form of ownership
- 44% [74] of sites are used seasonally
- 40% [67] record ritualised extraction practises; 4% [6] document its absence
- 40% [68] record ritualised reduction of the raw material
- 33% [55] record ceremonial use of extraction sites; 2% [3] record it does not happen
- 27% [46] record rock art, graffiti or the use of idols
- 18% [30] document on-site burials

This aggregated ethnographic data demonstrates a strong correlation between topographically-distinctive mines and quarries and ritualised extraction practises, craft specialists, and widespread product distributions (200+km). Where one or more of these themes are present the framework would infer the presence of the other inter-linked traits (see Chapter 3). Unfortunately, not all trends are visible in the archaeological record, consequently, only those with material evidence which parallels the cross-cultural ethnographic data have been analysed (see Chapter 4).

## **6:2 Evidence for seasonal extraction**

Seasonality can be both a deliberate act and a practical constraint imposed by the vagaries of location, time and climate. The ethnography documents a 44% (74 of 168) occurrence of seasonal working, 4% (8 of 168) where it was not

practised, and 51% (86 of 168) where there is no data (Chapter 3:3:4). Of the seasonally-used sites, 89% (66 of 74) were storied locations. For many, pragmatic reasons dictated when sites could be exploited. In the archaeological record, it is possible to recognise periods of stasis at extraction sites which can be read as indications of seasonality and/or temporary abandonment. These comprise natural wind-blown silts within the workings, stabilised and compacted horizons within the backfill of the sites, and the residue of events (e.g. hearths, deposits of debitage, placed deposits, and animal remains placed upon stabilised layers). Indirect evidence also exists, such as the bat skeletons in certain galleries at Grime's Graves (Pit 1, galleries 1 & 8; Pit 2, galleries 1, 3, 5 & 6; Clarke 1915, 55, 58 & 90), suggesting these sites remained open during the winter hibernation period (October to March) which allowed these animals access to the deeper workings, and were deserted which encouraged roosting (Topping 2011b)<sup>31</sup>. The lack of bats in the South Downs mines may simply reflect excavation bias.

It is possible that circumstantial evidence such as the presence of migratory species, such as the phalarope skull discovered in Greenwell's Pit, Grime's Graves, could also indicate seasonality, especially as only the skull was deliberately curated, demonstrating special practises in the deposition of this migrant species (Topping 2011b). Although it is not clear what time of year the skull was deposited, it would appear to be associated with abandonment activities in that particular gallery. Another 'possible' bird bone was recorded in Shaft 27 at Cissbury (Pull Archive, Worthing Museum), which may hint at similar practises, and potentially create links between the mines and practises evident at long barrows where migrant bird species were deposited in mortuary assemblages (Field 2006b, 131-132).

The presence of migratory species at extraction sites offers the possibility that they were idealised and embedded in ideologies. The apparent disappearance of migrants in the autumn might have defied rational explanation to the extraction site users, and come to symbolise species that had otherworldly links because of their unexplained disappearance. Consequently, when species such as the

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<sup>31</sup> Indeed, bats still roost at Grime's Graves today in Greenwell's Pit, Pit 1 and Pit 15.

phalaropes reappeared in the spring, they may have been viewed as supernatural messengers whose reappearance triggered expeditions to the mines and quarries in much the same way as the Big Bird ceremony with its links to migrating raptors triggered Hidatsa quarry expeditions<sup>32</sup>.

At Graiglwyd, Trenches 3 and 5 provided evidence of sequential workings, some cutting through redeposited scree, which suggests lengthy periods of abandonment if not seasonality (Williams & Davidson 1998). Similarly at Langdale excavations at Pike of Stickle Site 98 recorded a clear sequence of quarrying events and axehead production which may have been undertaken over successive seasons (Bradley & Edmonds 1988; 1993). Excavations at Lambay Island discovered a number of pits, one of which contained a complex series of deposits all sealed by a low cairn, alongside stone settings, suggesting episodic or seasonal activity (Cooney 2000; 2005). However, the stratigraphic sequences recorded at some of the shallower flint workings such as the pits at Blackpatch which range from 0.60m-1.37m in depth, are of a scale which suggests a single extraction event with no need to return (Barrows 2, 3 & 4 [Pull 1932 & Pull Archive at Worthing Museum; Russell 2001]; these shallow pits were misidentified as burial mounds by the excavator).

Amongst the UK archaeological data sets, natural silts, stabilised horizons and deposits/features are recorded in 53% (42 of 79) of the flint mines and 33% (17 of 51) of axe quarries. These range from primary deposits of fine silt containing scapulae, antler picks and debitage at Easton Down Pit B49 - which still allowed access to the niches (Stone 1933). More formalised structures exist, such as the chalk platform in the 1971 Shaft, Grime's Graves, which held a pair of internally-decorated Grooved Ware bowls and was positioned to allow access to the galleries and be seen by visitors; it was eventually buried by natural silts suggesting that the shaft base had remained open (Mercer 1981).

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<sup>32</sup> The author is grateful to Professor John Kelly for discussions of Osage ideologies and their possible similarities with Mississippian iconography, particularly the example of hibernating frogs and their material manifestations at Cahokia.

### 6:3 The practise of stone extraction

The ethnography records evidence of ritualised practises in 40% (67 of 168) of the data, and this occurred at storied locations in 92.5% (62 of 67) of studies. As observed above (4:3:5), the overall data records an incidence of 71% (120 of 168) for embodied or storied extraction sites, demonstrating that ideologies and ritualisation were entangled. As a result, the ethnography suggests that storied associations occurred at roughly three-quarters of extraction sites, and at as many as half of them there was little residual material surviving in the archaeological record. Indeed, ritual observance may have been purely behavioural, and need not have been linked to any form of material deposition. This could explain the apparent differences in the scale of the evidence between the mines and quarries (6:3:2). In addition, ritualised practises can be obscured. For example, the fact that 'functional' deposits such as extraction tools were left *in situ* after use at most sites, may actually be a material observance of ritualised practise, indicating that taboos had prevented their removal - as was documented at the Wilgie Mia mines in Aboriginal Australia, amongst others (Flood 1995, 271-273; Taçon 2004, 32). The material remains of extraction clearly have to be treated with caution in connection with potential ritual practises, but the interpretive framework does now offer a more robust steer as to the rich variety of probable social contexts which lay behind many previously interpreted 'functional' deposits in the mines and quarries.

The ethnographic data identifies broad trends in ritualised extraction, which are often staged and sequential. The stages which the practise passes through include:

1. Ritualised preparations; offerings; prayers; rock art/graffiti;
2. Ritualised extraction following prescribed conventions;
3. Renewal rituals and offerings;
4. Ritualised closing ceremonies;
5. Occasional human burials.

The archaeological record provides material evidence which fits the temporal and spatial patterning of this ethnographic data and now forms the basis of the interpretive framework.



### **6:3:1 *Ritualised preparations***

Ritualised extraction begins with careful preparations, comprising purification rituals, offerings, prayers, and the creation of rock art/graffiti in significant locations adjacent to the extraction sites. To summarise the ethnographic trends identified in Chapter 3 and identify their appropriate archaeological correlates (see Chapters 3 and 4), preparatory behaviours often include purification by smoke and steam, the placing of offerings accompanied by prayers within or adjacent to the workings which may occur at rock art panels, and the deliberate slaughter of animals as offerings.

Material evidence discovered at archaeological extraction sites does appear to indicate such preparatory behaviours. However, the nature of the archaeological record does not always allow the recovery of subtle nuances of actions and contexts to be precisely differentiated, consequently preparatory offerings cannot always be distinguished from those which may be linked to renewal rituals, and thus they must be treated as a part of a general practise, although potentially focussed upon different outcomes ranging from propitiation to renewal. The identification of non-functional assemblages such as the carved chalk objects in Blackpatch Shaft 7, the carved chalk objects and animal remains in Tindall's 1874 Shaft at Cissbury, carved chalk objects, pottery and animal remains in Pit 2 Grime's Graves, or the elaborate pit groups at Lambay Island, all suggest that offerings were repeatedly located in similar contexts at extraction sites.

### **6:3:2 *Hearths***

The ethnography records purification of individuals and extraction tools as often associated with hearths or charcoal deposits<sup>33</sup>. Hearths are present in 29% (23 of 79) of flint mines and 10% (5 of 51) of axe quarries, and charcoal deposits at 29% (23 of 79) of flint mines and 30% (15 of 51) of axe quarries.

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<sup>33</sup> Fire-setting at axe quarries is a major consideration, but without the associated evidence of scorched quarry faces other explanations need to be sought. The fact that hearths in flint mines were not linked to fire-setting could argue that it can only be proven at axe quarries where fire-damaged quarry faces (mostly non-Langdale sites) can be demonstrated.

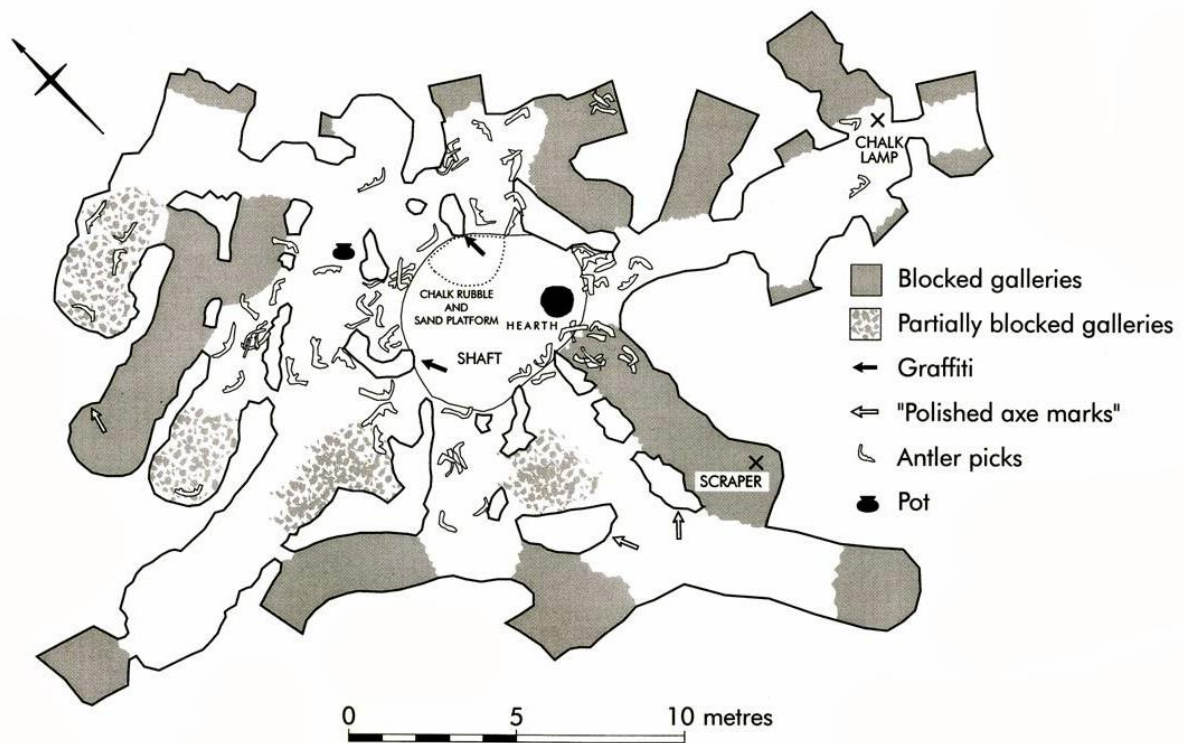


Figure 6:1. Pit 2, Grime's Graves, showing the distribution of abandoned antler picks, artefacts, graffiti, hearth and chalk platform discovered on the shaft floor (illustration by Trevor Pearson, from Topping 1997, 129).

Hearths were discovered on the shaft floors of Shaft 5 at Blackpatch, the Cave Pit at Cissbury, Pit B49 at Easton Down, Pit 21 and Shaft III at Harrow Hill, Pit 1, Pit 2 (Figure 6:1), Pit 15 and the 1971 Shaft at Grime's Graves, which do not appear to have been used for lighting, cooking or hardening antler picks (Figure 6:2). A group of hearths was discovered on Floor B at Graiglwyd, integrated within the quarry workings, and a hearth found at the axehead production site at Thunacar Knott, Langdale, were not associated with mundane tasks. Similarly, a non-domestic hearth was found at Ballygalley Hill abutting a debitage deposit immediately upslope from the quarried, outcropping flint strata. Site 98, Pike of Stickle, produced a *'considerable quantity of charcoal'* against the quarry face which was taken by the excavators as evidence of fire-setting. Similarly, the cave-like Site 95, Pike of Stickle, produced substantial deposits of charcoal, which again was interpreted as fire-setting. The site at Le Pinnacle, Jersey, had a series of nearby hearths and midden deposits which were ranged around

outcropping raw material at the foot of a coastal stack which may represent feasting as part of the preparation cycle – but without settlement evidence (Patton 1991 & 2001). A hearth was laid near the Lambay Island quarries as part of the closing of the Phase 1 pits before they were buried beneath a dump of quarry debris. The contexts of these various hearths and their lack of associated settlement structures or midden debris demonstrates that they were integrated into extraction practise, directly or indirectly, rather than being subsistence related. The provision of fire, heat, light and smoke, probably from the burning of specially chosen materials, suggests that this formed deliberate acts performed in or close to sites during the extraction process.

### **6:3:3 *Deposits of charcoal***

Small deposits of charcoal were discovered in the galleries of Shaft V and the Cave Pit at Cissbury, Greenwell's Pit, the 1971 Shaft and Pit 15 at Grime's Graves (which do not appear to have been the remains of torches as no definitive soot residues were discovered on the gallery ceilings) may be the remains of floral or vegetable material<sup>34</sup>. Unspecified deposits of charcoal were discovered at the base of the Large Pit at Cissbury. Small deposits of charcoal were also discovered in the workings at Creag na Caillich, which were not considered to be evidence of fire-setting, alongside deposits of charcoal at Stake Beck (Langdale) and in Trench 1 at Mynydd Rhiw. At Graiglwyd Site F, Test Pit I, a thin layer of charcoal was discovered juxtaposed with small amounts of debitage. Overall, such small deposits may represent the burning of herbs or similar substances to produce smoke or scented air in and around the workings to create a particular ambience during extraction.

### **6:3:4 *Offerings***

In tandem with preparatory activities linked to hearths, or the deliberate burning of small amounts of organic materials, the archaeological record also provides

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<sup>34</sup> '*soot stains on roof fragments*' were discovered in the 1971 Shaft, which suggested to the excavator the use of torches in these galleries (Mercer 1976, 107).

material evidence of offerings, which ethnography would suggest were accompanied by prayers. At Shaft 2, Blackpatch, Gallery III produced a '*shell deposit*' and a carved chalk object; Shaft 5, Blackpatch, included both charcoal and fragments of pig bones in the galleries and shaft; Shaft 7, Blackpatch, produced an unfinished carved chalk ball from Gallery I and other chalk objects and animal bones from the shaft fill; Chipping Floor 2, Blackpatch, featured a hearth juxtaposed with ox, pig, sheep and human bones and pottery fragments (also an intrusive cremation deposit); the shallow pit known as Barrow 2, Blackpatch included a carved chalk object placed near a human skull near the base of the workings; the shallow pit labelled Barrow 4, Blackpatch, produced an ox tooth and lithics beside a disarticulated adult male inhumation; Tindall's 1874 Shaft, Cissbury, produced two ox skulls, and a faunal assemblage comprising ox, stag, otter, wild boar and roe deer, and four carved chalk objects from basal deposits; a carved chalk cup was discovered at the bottom of the Large Pit, Cissbury; the Skeleton Shaft, Cissbury, produced a female skeleton possibly thrown head first down the shaft who came to rest upon silts, alongside the remains of four pigs, ox, goat, fox, roe deer, shrew, mice, voles, toads and snails<sup>35</sup>; a quartzite fragment was found in Gallery E in the Cave Pit, Cissbury; Pit B1(A), Easton Down, contained a dog skull mid-way down this shallow pit; at Goodland, Antrim, the workings included a large number of pits, some containing randomly-collected pottery sherds and lithics sourced from settlement sites and redeposited there; Greenwell's Pit, Grime's Graves, contained a dog skeleton in Gallery II, and the skull of a phalarope lying between two antler picks and a Cornish greenstone axehead in another gallery; Pit 1, Grime's Graves, produced carved chalk objects and Grooved Ware from the shaft base and its galleries; Pit 2, Grime's Graves, contained a chalk 'lamp' at the end of Gallery 5; Pit 4, Grime's Graves, contained a chalk 'cup' on the basal silts; Pit 15, Grime's Graves, produced a contentious group of carved chalk objects on the shaft floor; the 1971 Shaft, Grime's Graves, contained a carved chalk object lying beside a chalk platform upon which held two internally decorated Grooved Ware bowls; Pit 21, Harrow Hill, contained a portable chalk block scratched with seven parallel lines placed next to a hearth and a deposit of debitage. Many of these carved chalk

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<sup>35</sup> Some of these smaller species were clearly accidental intrusions.

objects are clearly non-functional, and include balls, phalli and inscribed blocks, all of which would happily fit the ethnography and the interpretive model as offerings. The small cup-shaped chalk 'lamps' when tested have provided no evidence of oils or fats, and experiments have shown that they have a short burn time (Tanimoto et al. 2011), which combined with the lack of soot-staining in the galleries, all implies they are better considered part of ritualised depositional practises.

Evidence for offerings also exists at axe quarries: Floor B, Graiglwyd, produced 'a few scraps of [unidentified] bone'; Site F, Test Pit E, Graiglwyd, contained two roughouts placed in the corner of the quarry; Site F, test Pit C, Graiglwyd, sampled a chipping floor which contained a quartz nodule; the South Scree 'Cave', Langdale, contained two axehead roughouts placed on top of a deposit of silt and debitage; the Working Gallery, Beorgs of Uyea, Shetland, contained a schist disc of 6.3cms diameter; a series of pits at Lambay Island contained assemblages comprising pottery, debitage, hammerstones and rubbers, the pits were sealed by low cairns and a hearth, then all was buried beneath a cairn of quarry debris with an axehead hoard and jasper pendants juxtaposed.

### **6:3:5 *Rites of renewal***

Certain deposits can be read as rites of renewal, following the ethnography from locations such as the Pipestone Quarries where waste material and broken or rejected artefacts were returned to the quarry as part of renewal rituals. At the archaeological sites in the UK this can be inferred with deposits of debitage in dark, subterranean workings which were not lit artificially and were locations where knapping or tool production clearly could not have taken place. The list of such contexts comprises: Shaft 2, Blackpatch, with debitage in Galleries V and VII; Shaft 5, Blackpatch, with debitage and 'waste' nodules in the galleries and niches; Willett's 1874 Shaft, Cissbury, contained lithics on the shaft floor; at the Cave Pit, Cissbury, two axehead roughouts and a quartzite fragment were found in Gallery E, and Gallery F produced debitage; Shaft 24, Cissbury, contained two flint knives in the West Gallery; Shaft 27, Cissbury, had lithics on the shaft floor, Gallery 1 produced a flint knife, Gallery 2 flakes, blades and a knife, the North

Gallery flakes, nodules, a core, an endscraper and a blade; Pit 46, Den of Boddam, contained a substantial deposit of debitage and rejected cobbles; Shaft 5, Durrington, had a petit tranchet derivative arrowhead on the floor of the South Gallery; at Goodland, Antrim, some pit deposits comprised lithics and debitage which may have originated off-site; Greenwell's Pit, Grime's Graves, produced roughout axeheads and a Cornish greenstone axehead from its galleries; Pit 1, Grime's Graves, had a pile of nodules in Gallery 1; Pit 2, Grime's Graves, contained lithics and a roughout axehead on the shaft floor; Pit 15, Grime's Graves, had a pile of flint nodules positioned at the entrance to Gallery 7; debitage was found on the floor of the 1971 Shaft, Grime's Graves; Pit 21, Harrow Hill, produced debitage on the shaft floor and in Galleries 1 and 2; an uncertain number of roughout axeheads were discovered on the floor of Shaft III, Harrow Hill; at Shaft 1, Stoke Down, lithics were recovered from the shaft floor.

The axe quarries have similar deposits, although in many cases they are not from dark, subterranean contexts and the assemblages may be expedient. The East Quarry (Site 1), Creag na Caillich, contained a compact deposit of debitage >25cms thick with small charcoal deposits beneath flakes and further small quantities of charcoal; the West Quarry (Site 2), Creag na Caillich, produced a sequence of debitage deposits juxtaposed with charcoal and isolated flakes; Floor B, Graiglwyd, comprised a massive deposit of debitage and a sequence of hearths commingled with scree slope exploitation; Trench 3, Graiglwyd, produced flakes from all contexts, and four axehead roughouts from secondary quarrying; Trench 5, Graiglwyd, contained debitage from tertiary workings; Site F, Test Pit E, Graiglwyd, discovered debitage in a quarry sealing two well-finished axehead roughouts placed carefully in one corner; Site F, Test Pit G, Graiglwyd, recovered flakes and debitage in a quarry; Site F, Trench M / Mound 3077, Graiglwyd, lay on the outcrop summit and was constructed of debitage with a vestigial kerb and no evidence of human remains or charcoal; Site F, Trenches J and R / Mound 3078, Graiglwyd, comprised weathered debitage heaped into a cairn and encircled with stone blocks; Site F, Trench K and Test Pit P / Mound 3079, Graiglwyd, consisted of debitage and quarried blocks with two axehead roughouts but no kerb; Site F, Pit 550e/570n, Graiglwyd, recovered a deposit of debitage with a single broken axehead roughout; Site F, Cairn 65, Graiglwyd,

comprised a cairn sealing a pit containing an upright ?anvil stone in a fill of debitage, charcoal flecks and coarse sherds; Site F, Cairn 67, Graiglwyd, produced debitage and an axe roughout sealed beneath a stone cairn; South Scree Cave, Pike of Stickle, contained two axe roughouts placed upon a deposit of debitage; Dungeon Ghyll Quarries, Langdale, produced debitage from the Phase 2 workings; Site 98, Pike of Stickle, had an alternating sequence of debitage, charcoal and quarry debris adjacent to the quarry face; Site 95, Pike of Stickle, 'cave' extraction contained successive tips of debitage, silts and charcoal; Site B, Mynydd Rhiw, comprised a quarry scoop filled with debitage and lithics with some evidence of Neolithic hearths; Site G, Mynydd Rhiw, produced debitage in a quarry; Trench 1, Mynydd Rhiw, contained quarry debris and small amounts of charcoal; Trench 2, Mynydd Rhiw, comprised a deposit of debitage in the quarry scoop; Working Gallery, Beorgs of Uyea (Shetland), contained a deposit of debitage and lithics; Tievebulliagh had numerous roughouts and other lithics abandoned amongst quarry debris; Lambay Island had pits near the quarries which contained debitage, hammerstones, rubbers and sherds of bowl pottery.

### **6:3:6 Tools found in workings**

Another facet of extraction practise which ethnography demonstrates *can* be ritualised, is the practise of deliberately abandoning extraction tools within the workings to satisfy ritual convention (e.g. at the Aboriginal Australian mine of Wilgie Mia [Flood 1995, 271-273]). Although the archaeological data is constrained by biases, as is ethnography, 65% (52 of 79) of flint mines and 27% (14 of 51) of axe quarries contained assemblages of extraction tools in the workings. Such evidence was recorded at flint extraction sites at Ballygalley Hill, Black Mountain, Blackpatch, Church Hill, Cissbury, Den of Boddam, Durrington, Easton Down, Goodland, Grime's Graves (Figure 6:2), Harrow Hill and Stoke Down. Amongst the axe quarries tools remained in workings at Beorgs of Uyea, Creag na Caillich, Graiglwyd, Lambay Island, Langdale, Le Pinnacle, Mynydd Rhiw and Tievebulliagh.



Figure 6:2. Antler picks abandoned in a side chamber of Greenwell's Pit, Grime's Graves.

Although expediency or casual discard could be cited to explain this depositional patterning, the juxtaposition of other apparently ritualised practises and deposits suggests that functionality need not be the sole explanation. For example, on the shaft floor of Pit 15, Grime's Graves, a chalk platform held 7 antler picks (Longworth & Varndell 1996, 51); in contrast at Shaft V, Cissbury, a chalk platform lying against the western side of the shaft wall held 3 antler tines. These examples appear deliberate and not casual discard, suggesting that some extraction tools were curated in prescribed ways, as epitomised by the placed deposit in Greenwell's Pit of two inward-facing antler picks associated with a bird skull and Cornish axehead (Figure 6:7). Interestingly, the Early Bronze Age pits at Grime's Graves not only demonstrated a change of tool use from antler picks to bone picks, but surprisingly produced a bone pick made from a human femur in Pit 3 (Legge 1992, 69-70), and other potential human bone implements were recorded in Pit 3A (Longworth & Varndell 1996, 91-95). Clearly this evidence provides a less than subtle take on an 'embodied' artefact, but lends weight to the



potential objectification of extraction tools and a route by which the remains of particular human actors were embedded within the process of extraction (cf. Bourdieu 1990). Overall, the evidence for the abandonment of extraction tools within workings does seem to fit into a suite of deliberate acts illustrated by assemblage patterning, and suggests that tool deposition followed conventions of extraction practise.

### **6:3:7 *Imported extraction tools***

Archaeologically, a further aspect of extraction practise is the recognition that many extraction tools were brought from off-site locations, which may provide circumstantial evidence of the general direction of travel of the quarry users. As mentioned above, different types of imported hammerstones of granite and tuff have been recognised at quarries in Langdale (Bradley & Suthren 1990), which could not only indicate quarry use by different groups (and possibly indicate ownership), but could also illustrate access routes. Although the tuff hammerstones may be local, the closest granite source would appear to be Wasdale Head, 8km west of the Pike of Stickle quarries, which could imply a westerly route. Alternatively, mid-Eskdale sources would imply a south-westerly route to the Langdale quarries. Taken together, this directionality suggests that *one* of the main routes used by those exploiting the quarries was west to east, possibly from the Cumbrian coast and sites such as Ehenside Tarn (Darbishire 1874), or alternatively settlements dispersed amongst the valleys (Evans 2004). Similar patterns of imported hammerstones was discovered at Graiglwyd, in this case imported rounded pebbles or cobbles, perhaps derived from riverine or coastal deposits (Williams & Davidson 1998, 12-16). At Mynydd Rhiw alongside local dolerite hammerstones were imported beach cobbles (Houlder 1961), possibly from the bay at Hell's Mouth 2km to the south-east – which may also indicate a coastal route by these quarry users. The Working Gallery at the Beorgs of Uyea, Shetland, produced a number of hammerstones, including 7 granite water-rolled cobbles (Scott & Calder 1952), again demonstrating the use of off-site riverine or coastal materials – the nearest coastline is roughly 2km distant. The selection of off-site hammerstones may represent a deliberate

integration of culturally-significant materials into extraction practise, which embodied social narratives or signifiers as a means of sedimenting group identity into quarrying.

At the flint mines the sourcing of extraction tools is problematic as techniques such as isotopic analysis has not been applied to identifying the point of origin of antler picks. However, deer biology provides indirect evidence of likely resource management. The red deer sheds antlers between March and May, and the study of picks from Grime's Graves revealed that 80+% were shed compared to <20% sourced from hunted stags, demonstrating that the majority of extraction tools were expediently collected (Clutton-Brock 1984, 13 & 16). This may have been facilitated by stags shedding their antlers in the same place each year (Clason 1981, 122), introducing a degree of predictability for collection strategies. However, territorial behaviour is a major constraint, particularly as each stag inhabits a territory of roughly 10 hectares of mature forest, so the population can be very dispersed. If the assemblages collected at Grime's Graves are an approximate guide to the quantities of antler picks needed for flint extraction, then excavations have suggested that an average of 140+ antler picks were used during the working life of each mine (Topping 2011b). Consequently, to collect sufficient antlers the miners would have had to forage over a *minimum* area of seven square kilometres, or 1,400 hectares (allowing for two antlers per 10ha) of forest. Consequently, the logistics of antler procurement must have been a considerable time-commitment, and another reason why extraction was tied to seasonal activities to enable shed antlers to be collected at the appropriate time of year. The fact that many antler picks were abandoned underground could also be tied to rites of renewal, in this case related to extraction tools.

Grime's Graves provides one further example of the use of off-site tools by the presence of a Cornish greenstone axehead discovered in Greenwell's Pit '*in the first gallery, 4 feet from the entrance*', which may have been used to produce the rare concave axe marks on the walls of this gallery (Greenwell 1870). Further concave axe marks were recorded in 6 galleries in Pit 1, and in Pit 2 (Clarke 1915), suggesting that polished axeheads were being used to deliberately mark shaft and gallery walls rather than being used for extraction. A second Cornish axehead found amongst the assemblage on Floor 15 (Peake 1917),

demonstrates a further peripheral role for these off-site artefacts in Late Neolithic extraction practises.

### 6:3:8 *Built structures*

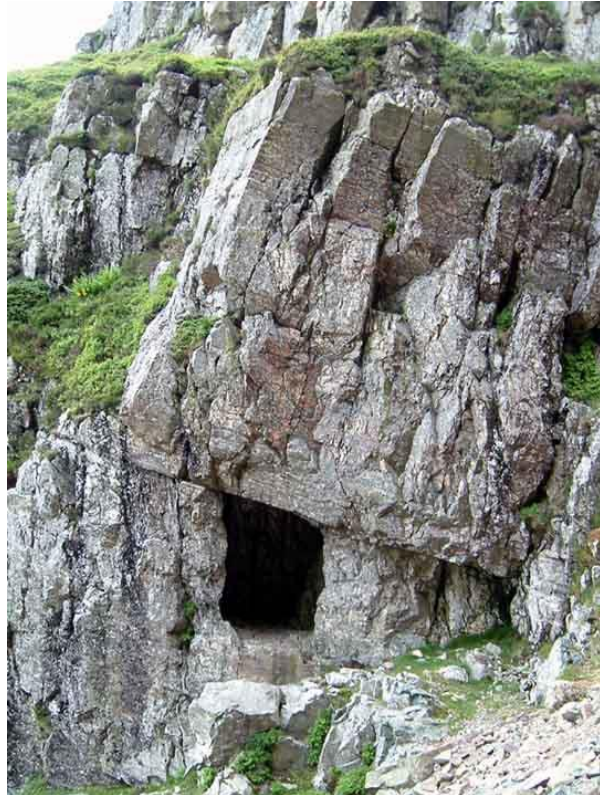


Figure 6:3. The South Scree 'Cave', Pike of Stickle, Langdale (Modern Antiquarian website).

Structures were constructed in 10% (8 of 79) of the flint mines and at 10% (5 of 51) of the quarries. Some are reminiscent of the small cairns found underground in the Wilgie Mia Aboriginal Australian mines, which demarcate boundaries to areas which may not be entered by non-initiates (Flood 1995, 271-273). In Blackpatch Shaft 1 a putative chalk platform lay in the centre of the shaft floor; an artificial 'cave' was constructed around Gallery F in the Cave Pit, Cissbury; in Shaft V, Cissbury, a chalk platform abutted the western wall of the shaft floor which held 3 antler tines; at Goodland 171 pits were discovered, containing quarry debris, debitage, lithics and pottery, some covered by low cairns; at Pit 1, Grime's Graves, a chalk platform was juxtaposed with hearths, extraction tools, lithics and Grooved Ware; in Pit 2, Grime's Graves, a platform lay close to the

entrance to Gallery 6; in Pit 15, Grime's Graves, an 'ogive-shaped' platform of mined flint lay in the north-western part of the shaft floor, on lay 7 antler picks; and in the 1971 Shaft, Grime's Graves, a hearth lay beneath a platform constructed of flint and chalk blocks on the shaft floor, upon which were placed two Grooved Ware bowls and debitage, and a small burnt area overlay part of the platform. All of these structures are located upon the shaft floors, or at gallery entrances, all key access points to the deepest areas of underground extraction, and in places which would signpost or trigger responses by visitors.

At the axe quarries structural expression was different. At Graiglwyd, Mound 3077 lay on the summit of the outcrop and was constructed of axe-making debitage; Mound 3078, Graiglwyd, was also built of axe-making debitage and lay 15m west of the outcrop; Mound 3079, Graiglwyd, was built of axe-making debitage and lithics and was situated near Mound 3078; Cairn 65, Graiglwyd, covered a pit containing a putative anvil and axe-making debris; Cairn 67, Graiglwyd, was constructed over a spread of debitage and an axehead roughout; at Lambay Island pit deposits were ultimately sealed beneath a low cairn of quarry debris, alongside placed deposits; at Langdale the South Scree Cave appears to have been purposefully dug to contain the placed deposits outlined above (Figure 6:3); also at Langdale, Site 95 was another artificial cave containing placed deposits and charcoal; on Shetland the Beorgs of Uyea Working Gallery is a built structure abutting the felsite; the quarries on Midfield and the Beorgs of Uyea in Shetland have walled structures abutting felsite boulders and small standing stones. Clearly there is a range of built structures at the axe quarries which appear to have monumentalised the extraction sites and aspects of their practise, but also arguably monumentalised rites of renewal, particularly the mounds of debitage. In addition to these examples, the middens facing the site at Le Pinnacle may also be a material expression of other stages of extraction practise.

### **6:3:9 *Human remains***

Human skeletal material is found in a small number of sites, although excavation bias and taphonomic processes have impacted upon the sample. This is

particularly true at axe quarries where the upland soils tend to be acidic and not sympathetic to bone preservation. Consequently, the human remains discussed here originate from the chalkland flint mines. The ethnography records formalised burials in 18% (30 of 168) of studies, particularly in Aboriginal Australia and North America. Amongst the flint mines in the UK and Ireland, burials have been discovered at 12% (9 of 79) of the mines. At 'Barrow' 2, Blackpatch, a small pit contained an extended adult male inhumation with a 'serrated lump of chalk' near the skull, an unrelated skull fragment was found in the upper fill, and an intrusive Saxon burial completed the sequence; at 'Barrow' 3, Blackpatch, a small niche pit, there were two successive crouched inhumations accompanied by lithics and animal bones found near the centre of a 'barrow' comprising reconfigured mining waste with an intrusive unaccompanied cremation scattered throughout the mounded material; at 'Barrow' 4, Blackpatch, a small pit held a disarticulated adult male inhumation accompanied by lithics and an ox tooth; at Blackpatch 'Barrow' 12, a remodelled waste dump covered a primary unaccompanied inhumation followed by a secondary adult male inhumation with carved chalk objects and lithics, a third disarticulated burial was scattered throughout the mounded material, and the upper fills produced three Saxon interments; in Shaft 1, Church Hill, a secondary cremation was placed in the upper fills and accompanied by lithics, a bone tool and sherds of Beaker and Collared Urn; the Skeleton Shaft, Cissbury, contained a female skeleton positioned head down, near-vertically 0.76m above the shaft floor, and juxtaposed with animal bones; at Shaft VI, Cissbury, a crouched adult male skeleton surrounded by a setting of chalk blocks and nodules was accompanied by lithics and a carved chalk object, and lay roughly mid-way down the shaft (Figure 6:4); in Shaft 27, Cissbury, an adult female skeleton was discovered on the lower fills of the shaft with 'charcoal' in her right hand and accompanied by 2 chalk objects and a 'fossil-like worm'; and in Pit 2, Grime's Graves, mid-way down the shaft lay a disarticulated skeleton lying below a sequence of two hearths and juxtaposed with animal bones and lithics.

### **6:3:10      *Human body parts***

In addition to formal or semi-formal burials, there are instances of body part deposition in 10% (8 of 79) of sites. At Shaft 4, Blackpatch, a child's mandible and an adult femur were discovered in the upper fills of the shaft; the L-shaped Chipping Floor 2, Blackpatch, saw tool production followed by the setting of two hearths at each end of the floor, the western juxtaposed with human and animal bones, an intrusive cremation appears to be associated with Beaker sherds; 'Barrow' 2, Blackpatch, contained a secondary skull fragment in the upper fills of the reconfigured waste dump above an extended inhumation; 'Barrow' 12, Blackpatch, another remodelled waste dump, contained a tertiary disarticulated inhumation above a sequence of two crouched inhumations; Shaft 6, Church Hill, a single human fibula was discovered on or close to the floor of the shaft; Chipping Floor 4, Church Hill, included a hearth which was associated with unspecified human bone; Pit 1, Grime's Graves, the middle shaft fills contained a human skull wedged between chalk blocks 5cms above an ox bone; and Pit 3, Grime's Graves, produced a pick made from human bone from the lower fills.

The presence and context of human remains at the flint mines suggests that they represent formal or semi-formal burials deliberately creating associations between the dead and the raw material source in similar ways recorded by ethnography, such as the Yolngu (Morphy 1995) and Mara-larr-mirri (Taçon 1991) Australian Aboriginal communities, or various Plains Tribes (Hughes 1995) who buried significant individuals who were associated with extraction at these sites<sup>36</sup>. Both the burials and the body parts are predominantly from contexts in the lower to middle fills of the shafts, or buried beneath re-modelled mine waste dumps which have been converted into *ersatz* burial mounds. However, the Late Neolithic – Early Bronze Age pits at Grime's Graves have an absence of burials, suggesting a shift in extraction practises. In contrast, we now see a human femur being used as a bone pick in Pit 3, and two further possible examples from Pit 3A, all suggesting a move away from veneration of the dead to possibly subjugation through the dismemberment of human remains for use as extraction tools. Such extreme treatment may not be out of place during this major period

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<sup>36</sup> The interpretive issue with the archaeological remains is identifying the linkage to the extraction site and whether the remains represented status, wealth or identity.

of flux when technology was changing, and cultural dynamics are reconfigured from a communal focus to one of individualism and growing expressions of social inequality.



Figure 6:4. Shaft VI, Cissbury, male interment surrounded by chalk blocks with a flint axehead near the knees (© Sussex Archaeological Society).

If the human remains and body parts recovered from the flint mines are representative of those who worked these sites, then unlike the predominantly male-orientated teams of ethnography, the archaeological record suggests that mixed gender teams, possibly with children, operated on the South Downs. The picture is less clear at Grime's Graves and the axe quarries.

### **6:3:11      *Graffiti/rock art***

A further element of extraction practise is the small body of graffiti or rock art at the sites, creating a visual signifier at key points in the site, or landscape setting of the sites. Such uses include graffiti at gallery entrances in flint mines, and rock art panels in valley floor locations below certain axe quarries. The ethnography

suggests that part of the preparatory repertoire included the creation of rock art to provide evidence of legitimisation and satisfy ideological concerns, and provide an arena for offerings. The Inka, for example, dug tunnels to communicate with the earth (Pachamama), and graffiti was used to identify special places of transition where the surface world met the supernatural innerworld (Dean 2010, 90-91). The ethnography records rock art/graffiti in 27% (46 of 168) of cases, predominantly in the Americas and Australia.

Amongst the extraction sites of the UK and Ireland 14% (11 of 79) of flint mines provide evidence of rock art/graffiti in subterranean contexts compared to 2% (1 of 51) of axe quarries. However, if rock art/graffiti within a radius of 5km of the sites is considered, then the flint mines provide little evidence of above-ground signage compared to the axe quarries where 61% (31 of 51) are situated within 5km of rock art panels - generally on lower-lying valley floor locations, suggesting they waymarked or restricted movement around the uplands. Conversely, the lack of signage around the flint mines may reflect the inherited practises from their place of origin<sup>37</sup>, implying they were more exclusive than the quarries, an observation arguably borne out between the Rivers Arun and Adur in Sussex, where the mines appear to be the only significant evidence of Early Neolithic activity in this block of chalk downland.

Amongst the flint mines Shaft 4, Church Hill, had a putative graffito above a gallery entrance; Willett's 1874 Shaft, Cissbury, had a lattice-like graffito in the East Gallery; No. 2 Escarp Shaft, Cissbury, had two lattice graffiti above gallery entrances; the Cave Pit, Cissbury, contained two graffiti above the entrances to the East-south-east Gallery and Gallery B; Shaft VI, Cissbury, had a graffito above a gallery entrance; Greenwell's Pit, Grime's Graves, had polished axe marks on certain gallery walls; Pit 1, Grime's Graves, had polished axe marks in Galleries 2, 6, 7, 11, 12, and 13; Pit 2, Grime's Graves, contained two graffiti, the 'Sundial' above the Gallery 6 entrance and the 'Tally Marks' between Galleries 4 and 7 (Figure 6:5), polished axe marks were recorded in Galleries 1-2, 5, and 11; Pit 21, Harrow Hill, had 7 graffiti near gallery entrances and scratched upon chalk

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<sup>37</sup> A lack of exposed rock surfaces on the chalk downland could also have restricted the use of art.



blocks; and Shaft 13, Harrow Hill, graffiti was placed near the entrances to Gallery 13-III and Shaft 13G.

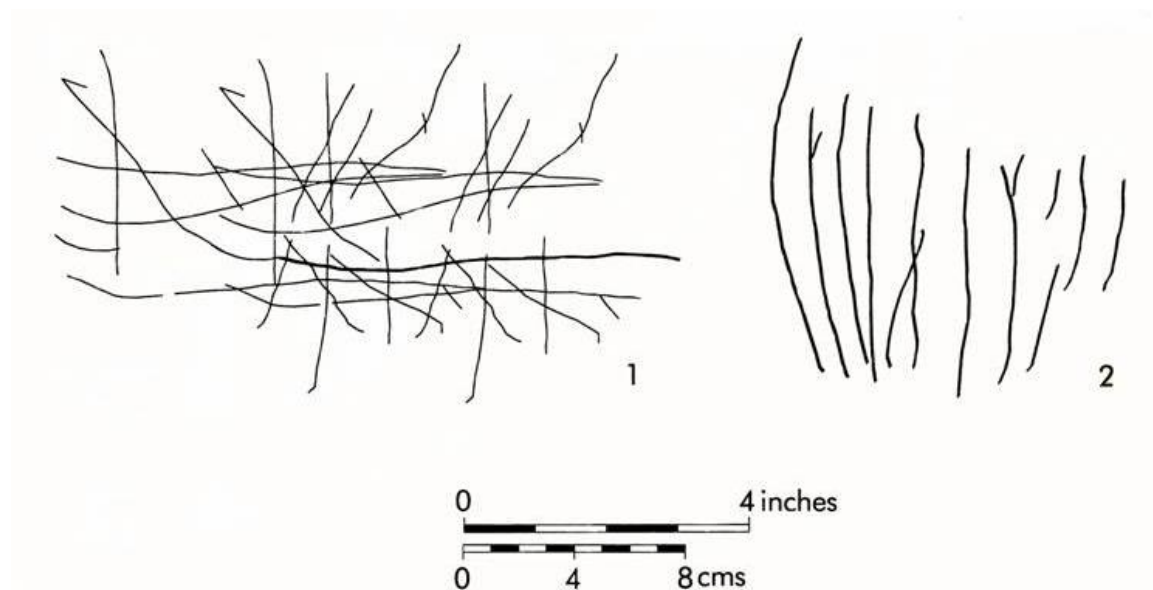


Figure 6:5. Pit 2 graffiti, Grime's Graves; 1 = 'Tally Marks' found on buttress between galleries 4 and 7; 2 = 'Sundial' discovered at the gallery 6 entrance (illustration Trevor Pearson from Topping 1997, 130).

The axe quarries generally use rock art/graffiti in different ways to the flint mines. Floor B at Graiglwyd produced the only recorded example of on-site art found to date at an axe quarry, comprising a stone plaque inscribed with geometric designs reminiscent of Grooved Ware and Passage Grave motifs (Hazzeldine Warren 1921, 194). Its portability and context close to hearths and discarded roughouts mirrors the context of portable art in flint mines (e.g. Pit 21, Harrow Hill). However, the use of rock art in the quarry environs (within 5km of the sites) occurs at sites such as Creag na Caillich and Langdale (Figure 6:6), where rock art panels have been created in valley floor locations within view to the quarries, clearly producing cultural messages and visual links along the major routeways to the sites (see Chapter 5).



Figure 6:6. The Chapel Stile rock art panel, Langdale. Motifs are located on the lower parts of the boulder.

Overall, the use of rock art/graffiti at or near extraction sites would appear to identify access routes and create message points flagging cultural or ideological boundaries concerning access. Such psychological boundaries may also be represented by the graffiti in the flint mines, which is generally placed above gallery entrances at the base of the shaft, clearly signing the entry points to the main subterranean workings. The role of portable art in the form of inscribed chalk blocks at the mines, and the stone plaque from Graiglwyd, all hint at the use of portable signs, which could also have been used to provide material links between sites and the home settlements.

### **6:3:12      *Site abandonment and rites of renewal***

The abandonment of extraction sites in many cases appears to follow a sequence of staged and episodic backfilling, which may be paralleling trends in the ethnography where 33% (55 of 168) of studies documented post-extraction

ceremonialism at extraction sites. In comparison, archaeological evidence of backfilling events consists of stabilised surfaces, especially silts, which are often overlain by hearths and the deposition of debitage, lithics, pottery, extraction tools, animal remains and rare human remains or body parts, all within the confines of the extraction arena. These contexts and assemblages occur at 53% (42 of 79) of the mines and 33% (17 of 51) of the quarries, demonstrating that these sites followed prescribed abandonment practises which incorporated all of the material elements used during extraction. This evidence exists at the mines at Blackpatch, Church Hill, Cissbury, Easton Down, Harrow Hill, Goodland, Grime's Graves and Stoke Down, and the quarries at Creag na Caillich, Graiglwyd, Lambay Island, Langdale and Mynydd Rhiw. The chronological range of these mines and quarries demonstrates that staged backfilling occurred throughout the Neolithic period and into the Early Bronze Age, demonstrating that this was a long-lived tradition and firmly integrated into the practise of extraction.

Examples of such practises include Shaft 7, Blackpatch, where the lower fills incorporated carved chalk objects. A third of the way up the shaft lay a *'large floor occupying the whole bore of the pit ... [comprising] bushels of flakes and fine splinters in places piled 4ins [10.1cm] thick. Along the shaft wall on the northern edge of this floor was a huge pile of raw flint nodules ... [A]nimal bones, principally ribs of oxen, were littered about on this floor ...'* (Pull 1932, 49). This horizon was then eventually buried by a deposit of medium to large chalk blocks. However, when the shaft had been backfilled to approximately two-thirds, a deposit of cremated human bone was discovered, which appeared to have been burnt elsewhere, and a flint axehead, flint knife and scraper, and *'a curious charm of worked chalk'*<sup>38</sup> lay adjacent to the cremation (ibid., 58). This final staged event was buried by another deposit of chalk mining debris. Shaft 7 clearly demonstrates episodic backfilling in a staged sequence with events taking place on the exposed surfaces. At Blackpatch the epitome of closure ceremonies took place in the uppermost fills of Shaft 1, comprising a large deposit of debitage and charcoal, ox and pig bones, and a *'central pile'* of 12-15 lower sheep mandibles surrounded by burnt stones, *'an ovate and a beautifully finished celt'* and a red quartzite hammerstone (ibid., 40; Pull Archive, Worthing Museum). Clearly such

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<sup>38</sup> A poorly fashioned ball.

a carefully constructed assemblage is not casual discard, and must represent ceremonialism incorporating feasting, offerings and aspects of renewal rites at the mine's closure.

At Church Hill a number of mines also demonstrated staged backfilling. At Shaft 1, a tilted deposit of chalk silt demonstrates that this mine was backfilled to roughly a third of its depth before it was temporarily abandoned, a depth of silt then accumulated before a sequence of chalk debris and clay deposits accompanied by antler picks, lithics and a carved chalk object were deposited. Eventually, the upper stratigraphy was completed by a substantial secondary deposit of chalk silt with a cremation and a mixed assemblage of Beaker, Collared Urn and Grooved Ware sherds, a range of lithics, all sealed beneath another deposit of clay on which was scattered debitage, lithics and the bones and teeth of two oxen. Some of the latter may represent redeposited material (Barber 2005, 102-103), although the possibility of an as yet unrecorded phase of Late Neolithic mining could be represented (Russel 2001, 93). Interestingly, at Shaft 4 the first recognised stabilised surface also occurred after the shaft was roughly one third backfilled, and was also covered by a deposit of chalk silt before 12 further deposits – some including assemblages – gradually filled the shaft. It may be that this is an indication of behavioural patterning, and here at Church Hill the staged abandonment of a mine began when it was one third backfilled? A further example at Shaft 6 saw the episodic backfilling of 11 deposits of alternating chalk debris and debitage, rounded off by a deposit of debitage (Chipping Floor 13) on the uppermost surface of a substantial chalk silt, suggesting that re-deposition of debitage formed a major part of closure activities at certain mines, hinting at renewal rites.

At Cissbury, Willett's 1874 Shaft had a sequence of at least 6 deposits in the shaft (Willett 1880). As was noted at Church Hill, once roughly one third of the shaft was filled a large deposit of '*moist red loam*' occurred which included charcoal fragments buried by chalk blocks before an even larger dump of moist red loam was deposited which included debitage, lithics, antler picks and charcoal. Another deposit of chalk rubble with lithics, '*bone*' (unidentified) and charcoal completed the sequence, again demonstrating staged procedures. At the Cave Pit (Park Harrison 1877) the cultural deposits were placed on surfaces

beginning at a depth of 1.2m above the shaft floor, once again when the shaft was roughly one third backfilled. Comingled with the chalk backfill above this level was debitage, axehead roughouts, lithics, charcoal and antler picks, all once again referencing the practise of extraction. At Shaft VI (ibid.), shaft stratigraphy represents at least 13 separate depositional events, alternating between chalk rubble with comingled lithics and materials such as debitage, *‘four masses of iron pyrites’*, a hearth with an ox bone and lithics, and mid-way down the shaft a crouched inhumation (see above) with further deposits of lithics and animal bones above. Sequences of hearths, debitage and lithics, interspersed with animal bones, also characterised the staged fills of Shaft 24 (Pull Archive, Worthing Museum). However, arguably the most elaborate sequence at Cissbury was recorded in Shaft 27 (ibid.; Russell 2001, 178-189; Topping 2005), which produced a near complete ox skeleton and pig bones from fills beginning again at roughly one third depth and part of a sequence of at least 12 separate deposits below the turf. However, in this case a female skeleton was also discovered some 1m below this level, juxtaposed with carved chalk objects and charcoal. The uppermost fills comprised almost totally of silts, but still inter-mixed with axehead roughouts, lithics and animal bones, suggesting the prescribed backfilling events had halted when the shaft was half filled, but that secondary activities occurred as the shaft slowly filled with wind-blown material.

At Pit B1, Easton Down (Stone 1931), separate deposits of chalk rubble contained scapulae, antler picks, rakes, tines, animal bones, lithics and axehead roughouts, clearly again referencing extraction practises. A large deposit of chalk silt filled the top of the shaft, containing lithics, animal bones, tines and an axehead roughout, all partly overlain by Chipping Floor 1. Pit B1(A), a small prospecting pit only 1.8m deep, contained debitage, lithics and axeheads on the floor, but it was then left open allowing silts to accumulate containing flakes, lithics, an axehead roughout, a broken axehead, antler tines and a dog skull. This suggests that natural backfilling was interspersed with depositional activities which carefully choreographed the various assemblages in the pit. The presence of a curated dog skull hints at symbolism, possibly group totemism, perhaps paralleling the dog skeleton found in Greenwell’s Pit at Grime’s Graves (see below). In Pit B49, a possible two-phase pit was sequentially backfilled with

chalk blocks and extraction tools to a depth of around one third, then a silt layer developed containing 5 ox scapulae, 3 broken antler picks, charcoal and debitage. This was buried beneath chalk rubble to a depth of two thirds, when another larger deposit of silt accumulated, containing molluscs, coarse pottery, 5 axehead roughouts, a broken antler pick and a possible flint pick. The uppermost fill comprised turf, topsoil, nodules and Romano-British sherds. Again, at Easton Down the sequences and assemblages are clearly referencing extraction practise through placed deposits of digging tools and cultural material in a series of staged events to close the pit.

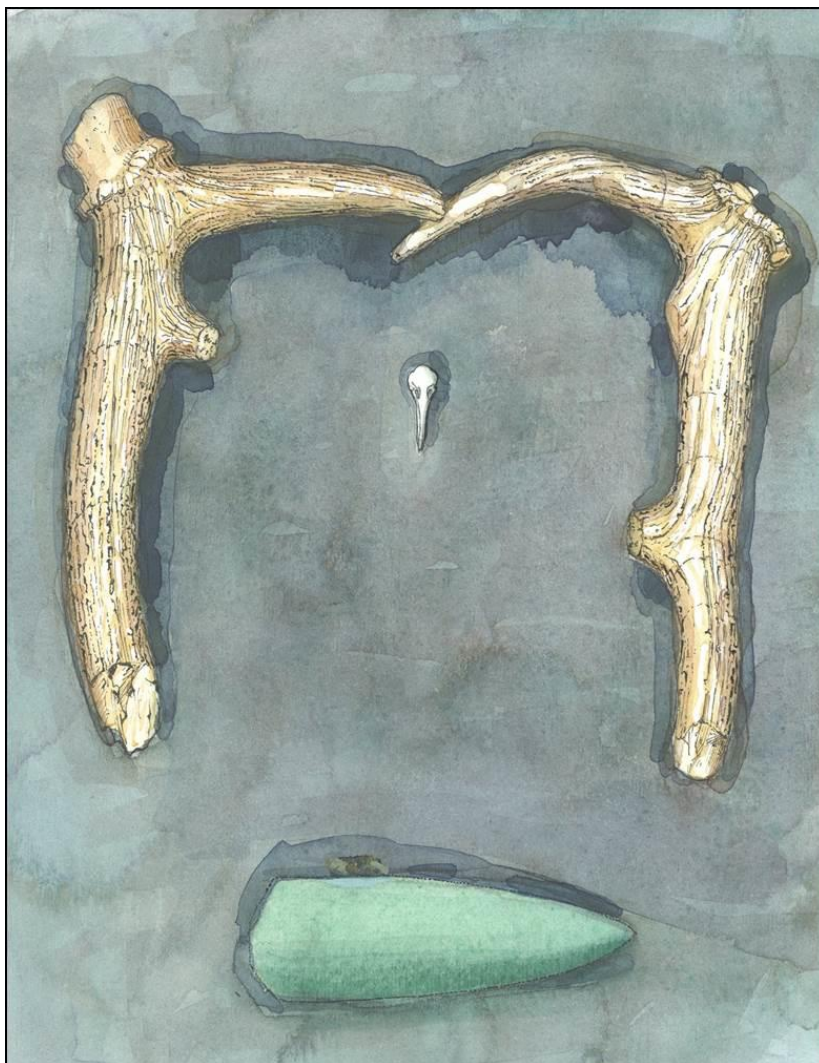


Figure 6:7. A reconstruction of the antler picks, phalarope skull and Cornish stone axehead assemblage found in a gallery of Greenwell's Pit (© English Heritage; illustration by Judith Dobie).

At Goodland, Antrim (Case 1973), the site was characterised by a U-shaped, ditched enclosure which was quickly backfilled, and had outcropping flint nodules on its south-east perimeter. Between the ditch lay a series of grouped pits, 171 in total, which had been rapidly filled with nodules, debitage, sherds and lithics, and some covered by low cairns. In this case closing activities differed from the mines as surface extraction was practised at Goodland. However, the use of pit deposition on-site may be a miniature skuemorph of shaft depositional practises witnessed in the mines, and ties Goodland into the same continuum of practise. Similar features were discovered at the quarries on Lambay Island (Cooney 2005; 2007), suggesting the possibility of an indigenous Irish practise at surface quarries.

At Greenwell's Pit, Grime's Graves, abandonment activities began in the galleries with a placed deposit of the phalarope skull, antler picks and Cornish axehead in one gallery (Figure 6:7), and the skeleton of a dog in another, which triggered the backfilling of the shaft with a sequence of dumps of chalk debris with mining tools, carved chalk objects, hearths, '*numerous*' animal bones, dumps of debitage and two deposits of wind-blown silts, together totalling at least 7 distinct horizons in the 12m deep shaft (Greenwell 1870; Longworth & Varndell 1996). In Pit 1 (Figure 6:8; Clarke 1915) the shaft was initially filled with a tilted dump of chalk rubble incorporating extraction tools, lithics, debitage and Grooved Ware, all capped by a deposit of '*fine*' chalk rubble which had stabilised, and was followed by a substantial deposit of wind-blown silts with lithics, nodules and antler picks, demonstrating a hiatus in backfilling. Following this, a series of chalk deposits featured hearths, a human skull wedged between two blocks of chalk mid-way down the shaft (6:6:9 & 6:6:10), debitage, hammerstones, and assorted animal bones, demonstrating at least 10 separate abandonment events. Pit 2 had a similar sequence and assemblages, but in this case the human skull was replaced by a disarticulated skeleton found half way down the shaft. Pit 12 (Armstrong 1932; Longworth & Varndell 1996), had only a modest primary dump of chalk rubble, followed by chipping floors alternating with dumps of chalk and boulder clay, with some of the uppermost floors (B and C) associated with Peterborough Ware sherds. The presence of substantial chipping floors throughout the sequence of 19 layers/deposits demonstrates the integration of

tool production alongside references to extraction during the staged abandonment sequence. In the shaft fill of Pit 15 (Longworth & Varndell 1996) lay a series of 5 chipping floors and a '*number of hearths and smaller fires*' (ibid., 51), suggesting another example of alternating, staged backfilling events and tool production. These examples contrast markedly with the newly recognised Early Bronze Age pits (Healy et al. 2014) such as Pit 3 (Armstrong 1923), where a human bone pick was recovered in the lower fills of chalk rubble, and there is little of the richness of artefact deposition in these sites, demonstrating that after a break in extraction at Grime's Graves of a number of centuries, backfilling practises had clearly changed significantly. The fact that shallow pit extraction was now practised, demonstrates not only a technical shift – and perhaps resource depletion - but from the perspective of a created arena for the potential enactment of ceremonialism, such pits were comparatively open to daylight and offered few opportunities for subterranean, hidden activities and assemblage deposition. The hiatus between Late Neolithic mining and Early Bronze Age activities clearly saw a cultural transformation away from ritualised practises, to a more mundane approach to flint extraction involving fewer material elements in the repertoire.

On the South Downs at Harrow Hill, Pit 21 (Curwen & Curwen 1926) had alternating bands of fine, medium and coarse chalk rubble juxtaposed with charcoal deposits, debitage and lithics, once again producing a material reference to extraction and its products. Similarly in Shaft III (Holleyman 1937), although the shaft stratigraphy is not described, an assemblage of 33 axeheads was recovered, including one broken example with one part found at the base of the shaft and the other at the top (ibid., 242-243), which are probably referencing the raw material with the rejected tools forming part of renewal rites.

At Stoke Down (Wade 1923; Barber & Dyer 2005), Shaft 1's fills comprised at least 6 layers/deposits incorporating lithics, unworked nodules and extraction tools, producing again the standard material references to extraction. The concept of renewal appears to have been taken to extremes in the case of Shaft 2, which had a depth of 2.89m. Here a substantial amount of flint was discovered in the shaft fill, arguably more than the site had produced, suggesting an off-site origin (Barber & Dyer 2005, 47), which implies deliberate curation for deposition



in this shaft, probably for renewal purposes – or conspicuous consumption? Interestingly, a greensand saddle quern was found at a depth of 2.13m, perhaps paralleling practises witnessed at certain causewayed enclosures, such as Windmill Hill and Etton, creating a link between the mines and wider repertoires of practise.

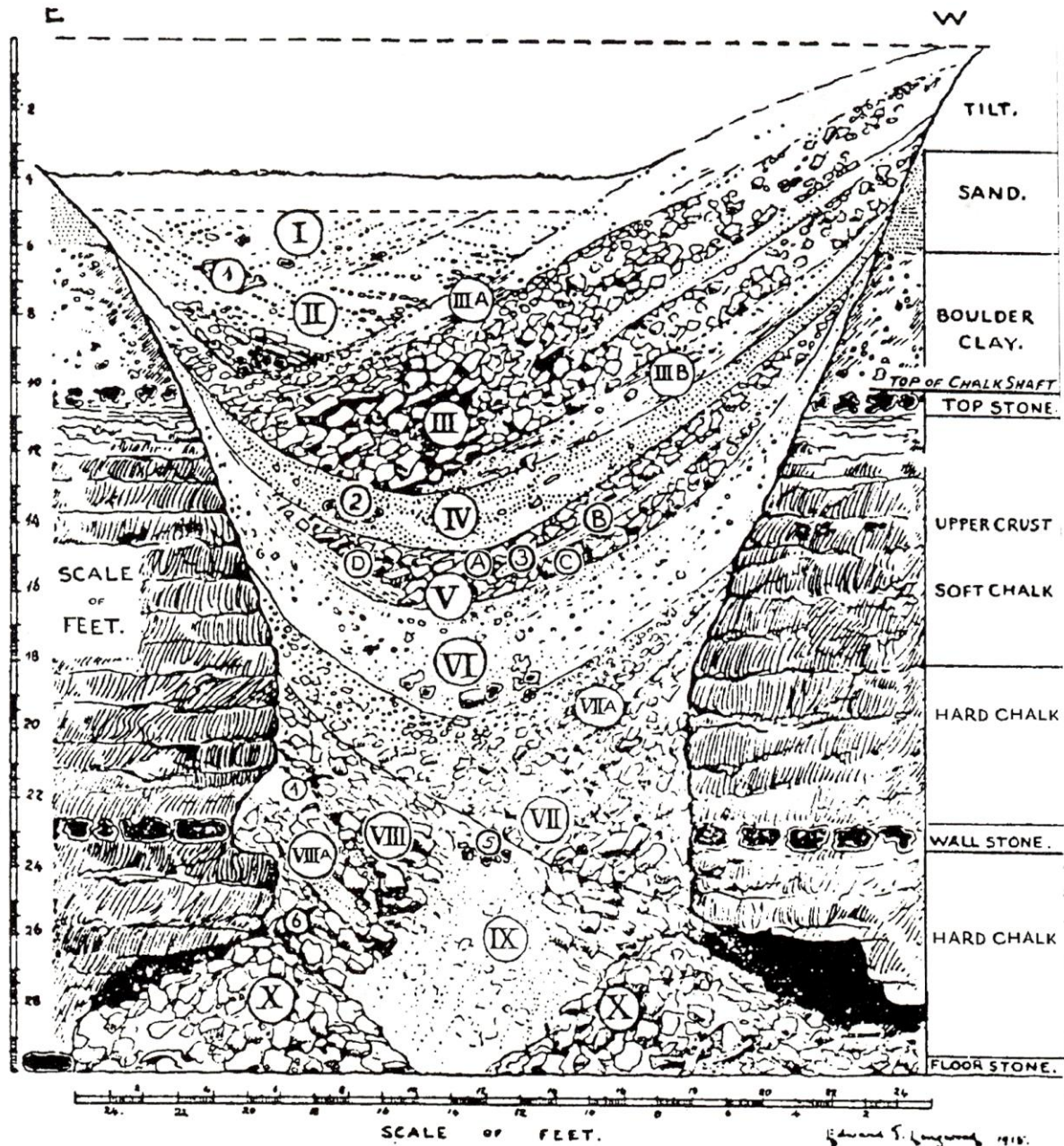


Figure 6:8. Pit 1, Grime's Graves, cross section and deposits (from Clarke 1915).

The axe quarries have similar stratigraphic sequences, focussing upon quarry waste, debitage and extraction tools. At the East Quarry (Site 1), Creag na

Caillich (Edmonds et al. 1992), the primary backfill consisted of quarry debris with small deposits of charcoal, sealed by compacted debitage and charcoal >25cms thick, followed by a humic soil incorporating flakes, quarry debris, charcoal and a granite hammerstone. The West Quarry (Site 2) had an almost identical stratigraphic sequence, suggesting again a focus upon the deliberate return of quarry debris to the point of origin, depositing dumps of debitage – possibly from the nearby chipping floors – and activities which generated small quantities of charcoal. In general, these deposits are similar to those found in the mines.

At Graiglwyd, Floor B (Hazzeldine Warren 1921), an area of scree exploitation developed a 'floor' of 'cubical blocks of stone' (ibid., 170) upon which was sited a large hearth >6.1m in diameter, with other smaller hearths positioned elsewhere on the floor. Huge quantities of debitage, flakes and 'imperfect axes' were discovered, including 400+ broken roughouts, 'some 1,100 specimens ... [belonging] ... to the axe and adze group' were collected overall, alongside a decorated stone plaque (ibid., 194; see 6:6:11). A 'few [unidentified] scraps of bone about the size of a finger nail' were found (ibid., 195). Taken together, the Graiglwyd sequence details the retention of scree-working debris on-site, the use of hearths, the presence of bones suggesting offerings or feasting, and the deliberate deposition of axeheads in various stages of manufacture at their place of origin. Trench 3 (Williams & Davidson 1998) produced evidence of flake deposits and 4 axehead roughouts within a sequence of quarrying episodes amongst the scree slopes which implies renewal activities at the source. In Trench 5 (ibid.) below the outcropping scree, a secondary phase of quarrying produced quantities of quarry debris and debitage, suggesting the re-deposition of raw material and debitage in the original quarry for renewal purposes rather than pragmatically allowing it to accumulate into a waste dump.

Arguably the most elaborate sequences occur at Lambay Island (Cooney 1998; 2000; 2004; 2005; 2011) where shallow scoops containing pottery, lithics and axehead roughouts are located within 3m of the quarry face, juxtaposed with pits containing debitage, hammerstones and grinders, which were sealed by small stone settings – with a hearth located in a central position – then all buried under a mound of quarry waste and beach gravel 8m in diameter and standing 1m high. This sequence clearly references the practise of extraction by returning the tools

to the earth, the use of fire, and the final monumentalisation of these activities by a cairn of quarry debris, sedimenting extraction practise into the cultural landscape.

The quarries scattered amongst the Langdale Pikes provide a range of evidence. The South Scree Cave (Fell 1951), which appears to have been a natural fissure quarried to produce a cave-like feature on the side of Top Buttress, contained a basal deposit of compacted silts and debitage >53cms in depth. Lying on the surface of this deposit was two axehead roughouts, suggesting a structured deposit of chipping debris topped-off with two of the quarry products in an act of renewal set in a shrine-like structure: a parallel practise is common in New Guinea (Hampton 1997). The Dungeon Ghyll quarries (Bradley & Edmonds 1988; 1993) saw an initial phase of working, followed by a period of abandonment; the secondary phase of extraction was accompanied by the deliberate deposition of debitage and hammerstones within the workings, rather than expediently dumped downslope. Consequently, again extraction tools and manufacturing debris were carefully curated on-site and returned to their point of origin. Site 95, Pike of Stickle (*ibid.*), was another cave-like quarry with episodic working involving deposits of charcoal, some substantial, culminating in a sequence of dumps of flakes and hammerstones, purposefully returning extraction tools and debitage back to the earth.

At Site B, Mynydd Rhiw (Houlder 1961), a quarry contained drift deposits with hammerstones, and in the upper levels later Neolithic and Bronze Age hearths were recorded (Burrow 2011). This example illustrates abandonment without deliberate backfilling, with quarry waste remaining heaped around the workings. However, extraction tools were placed in the workings, perhaps reflecting localised practise. Recent excavations in Trenches 1 and 2 (*ibid.*) produced quarry debris, charcoal deposits, debitage and hammerstones, assemblages referencing the processes of extraction and tool production.

<b>Archaeological data</b>	<b>Flint mines</b>	<b>Axe quarries</b>
Debitage and/or lithics in workings	41% [32 of 79]	43% [22 of 51]
Debitage and/or lithics in post-extraction contexts (shaft fills; floors)	71% [56]	82% [42]
Stabilised horizons/silts/hearths in site fills	53% [42]	33% [17]
Extraction tools in workings	65% [52]	27% [14]
Imported extraction tools in/at workings (e.g. hammerstones)	10% [8]	20% [10]
Knapping tools in/at workings	19% [15]	35% [18]
Hearths in workings	29% [23]	10 [5]
Charcoal deposits in workings	29% [23]	30% [15]
Non-functional objects in workings (e.g. carved chalk objects; pottery)	31% [24]	8% [4]
Placed deposits in workings	38% [30]	10% [5]
Structures in workings (e.g. chalk platforms; shrines; pits)	10% [8]	10% [5]
Animal remains, articulated, in workings	4% [3]	0
Animal remains, disarticulated, in workings	43% [34]	4% [2]
Human burials in workings	12% [9]	0
Human body parts in workings	10% [8]	0
Rock art/graffiti/polished axe marks in/at workings	14% [11]	2% [1]
Rock art/graffiti/polished axe marks in/near workings (<5km)	80% [63]	61% [31]
Settlement evidence at workings	1% [1]	0
Product distribution 200+km from source	?	86% [44]

Table 6:1. A comparison between the evidence of probable ritualised extraction practises at the flint mines and the axe quarries. Fields with 40+% parallel the ethnographic data and are highlighted.

### **6:3:13      *A summary of the evidence for ritualised extraction practises***

To summarise these various strands of evidence, the data suggests that the materiality in the archaeological record strongly parallels the ethnographic data, and this demonstrates that ritualised extraction practises (to varying degrees) probably occurred at most, if not all, of the sites listed above – and arguably at others (Table 6:1). Preparatory activities appear to be evidenced by hearths and charcoal deposits at both the flint mines and axe quarries, in contexts which cannot easily be explained as purely mundane, subsistence or functionally-related features. The evidence of extraction tools in extraction and post-extraction contexts, structures, placed deposits and rock art/graffiti, all demonstrate practises which recur at most sites. In addition, the on-site deposition of production waste and broken or rejected implements mirrors the rites of renewal practised at a number of ethnographic sites. Finally, the often

elaborate and episodic nature of backfilling at many sites, alongside the presence of rare formal burials and/or body part placement, suggests the strong probability that abandonment was a structured and formalised series of events which was both commemorative and deferential in nature. It is noteworthy that all of these core elements of a ritualised extraction practise are represented at both the flint mines and axe quarries.

#### **6:4 After extraction: the biographies and deposition of extraction site products**

The functionality of extraction site products can be glimpsed from indirect or circumstantial evidence. The ethnography suggests that the condition of the artefact, its depositional context, and the distance it has travelled from its source, indicates the social value of the item - and indirectly the cultural perception of the extraction site itself. In addition, final deposition may have been the primary causal mechanism for the sourcing and creation of the artefact. The ethnography demonstrates that many items are created for specific purposes, purposes which underpinned social networks and ideologies. However, a major archaeological constraint is the fact that only a sample of stone axeheads have been petrologically analysed, and flint at present cannot be sourced with any real degree of precision beyond a 'regional' attribution (Craddock et al. 2012). Consequently, there are limitations to the interpretation of distribution patterns for many stone tools, thus affecting a comprehensive understanding of social values.

During the Neolithic Period the predominant product of many extraction sites was the axehead, although by the Late Neolithic at Grime's Graves axeheads were eclipsed by points (G Varndell pers. comm.; Topping 2011b, 39). The axehead was both a functional tool and a cultural icon, arguably symbolising control over nature (Whittle 1995, 252) as part of a melange of social roles (Cooney 1998 & 2015). As Morgan (2005; quoted in Pauketat 2013, 1) has observed, '[b]elief happens in and through things and what people do with them'. The potency of the axe as an emblematic symbol is demonstrated by the fact that a number were even crafted from soft, non-utilitarian materials and deposited in a variety of contexts. For example, two axeheads were manufactured from chalk and

deposited at Woodhenge (Figure 6:9; Cunnington 1929, 112-113; pl. 22, 1-2), an axehead of silty mudstone was found at Fomart Knowe in Northumberland (Clough & Cummins 1988, 229, #95), and at the Orkney-Cromarty tomb of Calf of Eday South-East, a broken sandstone axehead was discovered on the floor of the chamber (Calder 1938, 204), and an assemblage comprising a broken sandstone axehead and a complete sandstone axehead roughout were found in the lower passage of the tomb at Huntersquoy on Eday (ibid.). These examples illustrate a variety of contexts, geographically widespread around the UK, which suggest that skeuomorphs also possessed the social significance associated with axeheads of harder igneous rocks or flint. It was the axehead as icon that mattered, which created a mnemonic, an objectified item designed to prompt actions and deliver consequences in networks of exchange and social interaction (Bourdieu 1990; Godelier 1999). Such agency embodied in an extraction site product may have reflected the status of its point of origin, which ethnography suggests (71% of cases) was probably a storied location, creating the potential to embed cultural narratives in objects (Miller 2010, 53). The extraction site product thus became a material manifestation of 'being', part of the process of maintaining and renewing social norms, which transcended other artefacts made from more mundane, expedient materials. Consequently, extraction site products were often treated in particular ways.

The special nature of certain axeheads was established from the earliest stages of the Neolithic. At the Sweet Track, Somerset Levels, an imported and unused Alpine jadeitite axehead had been placed near an unused flint axehead attributed to the South Downs mines (Coles & Coles 1986, 59-60; Craddock et al. 1983, sample 362). The timber-built Sweet Track provides a dendrochronological *terminus post quem* for the two axeheads of 3807 or 3806 cal BC, establishing a date for the axehead as an objectified artefact, the fact that the South Downs mines were active, and providing a 'snapshot' of depositional practises in wetland areas – part of the riverine and bog deposit continuum (Bradley 1990).



Figure 6:9. Chalk axeheads from Woodhenge, now curated in Devizes Museum.

Such special treatment of axeheads can also be seen during the Early Neolithic in mortuary practises (Fowler 2003) and at causewayed enclosures (Edmonds 1993b; 1993c), for example. Saville's detailed analysis of axehead use and deposition at the enclosures has shown they can be cached, complete and intact, but far more often they are discovered fragmentary and/or burnt; some are reworked (Saville 2002, 98-99), which may be tied to ritual practises designed to transform the functionality of the implement (Chapter 3:3:9). Clearly the axehead at causewayed enclosures was an integral part of a range of practises, some of which resulted in the destruction of these implements and final deposition at the enclosure. It would appear that these axeheads had been created as material 'actors' for specific social engagements, establishing a relational entanglement between people, material culture and a social arena defined by the enclosure (cf. Hodder 2012).

Similar practises existed in Sweden. At Svartskylle, Early Neolithic axeheads, scrapers and blades were burnt and left in four deposits on a prominent hilltop. At Kverrestad, fire-damaged lithics and decorated pottery were deposited in pits, the assemblage comprising 100+ axeheads, tanged arrowheads, projectile points and debitage. Other examples include Svågertorp, where six burnt axeheads and a chisel were placed in a pit; and Strandby where 100+ burnt axeheads, chisels and scrapers were discovered (Larsson 2006, 400-408). This demonstrates the deliberate destruction of specific artefacts in other European contexts, possibly for transformative purposes to create symbolic connotations (ibid., 408). In addition, axehead hoards also occurred in many European countries such as the Netherlands, where imported over-sized flint axeheads were placed in wetlands, but periodically removed and replaced, demonstrating repetitive use despite the context (Wentink 2008; van Gijn 2010). In certain cultural contexts the positioning of the axehead was also prescribed, and in the TRB axeheads could be juxtaposed in at least eight different spatial arrangements (Rech 1979). These few examples illustrate something of the range of non-functional, cultural interactions with axeheads which are documented in various European contexts.

In the UK, the Early Neolithic enclosure of Carn Brea in Cornwall is of interest here. This hilltop enclosure produced at least 6 polished flint axeheads, all broken and many burnt (Saville 1981, 138-140), demonstrating particular – and non-functional - treatment of these implements. In addition, 45 other stone axeheads and axehead fragments were also discovered, mostly of Cornish origin (Smith 1981, 153). However, it is the flint axeheads which are of note, as their nearest possible source may have been the Wessex or South Downs mines, so they had probably travelled some distance to Carn Brea. Interestingly, the Late Neolithic flint mines at Grime's Graves in Norfolk produced two Cornish stone axeheads, one in Greenwell's Pit, the other on Floor 15 (Clough & Cummins 1988, 177, Norfolk 47 & 48), which illustrates long-distance exchange networks existed between Norfolk and Cornwall. The chemical analysis of flint assemblages by Craddock et al. (2012, 147) suggests that roughly half of the implements tested in East Anglia were from south-western sources (South



Downs and Wessex), so a north-east/south-west movement of artefacts is well documented.

The treatment and deposition of axeheads was not consistent, however, and it was not until the Late Neolithic that axeheads became a common feature of grave assemblages, particularly non-functional 'prestige' implements (Hayfield & Manby 1996, 238). Indeed, Kinnes (1992, 108) has observed that *[f]rom all sources the surviving [mortuary] assemblage for the insular early Neolithic is distinctively utilitarian, with the possible exception of labour-intensive polished flint and stone axes ... [which later] occur ... in the rich inventories of single graves beneath northern round barrows [during] the later third millennium ...*.

The earliest manifestations of this trend was linked to the appearance of the 'macehead complex', which saw the introduction of Seamer-type flint axeheads and Duggleby-style adzes during the Mid to Late Neolithic, alongside Mortlake pottery, plano-convex knives and antler maces (Kinnes 1979; Manby et al. 2003). A typical example can be seen at the multi-phase barrow at Whitegrounds in Yorkshire, where a secondary burial in a round barrow was associated with a Seamer axehead, a flint blade, a jet slider, a pig's humerus and a calf mandible (Brewster 1984).

The henge monuments of the later Neolithic provide a further setting for axehead deposition, again linking extraction site products to communal monuments, and arguably providing an insight into distribution networks. At the Mayborough henge at Eamont Bridge in Cumbria, one of a group of up to three henges (Topping 1992), a broken polished axehead of Lakeland Tuff found in c.1876 at the entrance to the henge (TCWAAS 1877), creating a connection between the site and the quarries. The importance of the Mayburgh henge lies in its unusual form – a large embanked enclosure constructed of river cobbles without an inner ditch and reminiscent of the Boyne Valley type in Ireland. Recently another example of an Irish-style henge has been discovered at Catterick (Bradley 2007, 134-136). These two unusual henges lie at opposite ends of a major routeway across the Pennines, and may have been integral in the distribution of axeheads from the Langdale/Scafell Complex. That these henges should be of an Irish type may not be coincidental, and may be a reflection of the strong cultural connections across the Irish Sea during the later Neolithic, epitomised by the

movements of both Irish Group IX axeheads and those of Cumbrian Group VI crossing the sea in opposite directions (Clough & Cummins 1988; Cooney & Mandal 1998). Less than 10km south of Catterick lie the Thornborough henges, a roughly linear group of six sites following the course of the River Ure towards its confluence with the River Swale, which extends the cross-Pennine route towards the Yorkshire Wolds where large numbers of Group VI axeheads have been found (Harding 2003, 97). In addition, an area of bog located immediately north of these henges has produced a number of Group VI axeheads, reaffirming the strong links between henges and axehead movement, and illustrating local wetland deposition (ibid.).

Clearly henges played an important role in the distribution of axeheads during the later Neolithic. However, this was not just a north British phenomenon. Axehead deposition can also be seen at Avebury (Smith 1965, 110-120), for example, where axeheads from various sources were discovered in a range of ditch contexts, suggesting some continuity from the placed deposits of the Early Neolithic causewayed enclosures? Overall, communal monuments appear to have played pivotal roles in the distribution of extraction site products, either as the first point of exchange, or through social networking activities.

Using the ethnography as a steer, the depositional contexts of extraction site products can be examined to identify the context of procurement and manufacturing, followed by the use-life of the artefact, and therefore something of the social context of the extraction site itself. The ethnographic trend would suggest that artefacts which have a demonstrably widespread distribution probably originated at a storied location via ritualised extraction, and the artefact was probably an embodied object which was designed to carry a narrative and had a recognised cultural value. As such these artefacts became material actors which were emblematic of social obligations, whether the maintenance of kinship links, networking between groups and communities, social renewal, power relations, debt repayments or wealth creation. The extraction site products played a multi-dimensional role in what was probably a multi-layered cosmos. As Edmonds (1993b, 83) has observed, *[p]ut simply, the periodic procurement and exchange of axes in specified contexts may have had important consequences for the significance accorded to those that were made and used more widely*.

## 6:5 Stone extraction during the Neolithic and Early Bronze Age

The detailed probability analysis of the structures and assemblages discovered in flint mines and axe quarries focussed upon 21 fields of empirical evidence<sup>39</sup>.

This has provided an extremely detailed picture of assemblage patterning drawn from every published excavation report. The perennial issues of excavation bias, taphonomic process and survival have been addressed by collating a large body of evidence to bridge the voids in the archaeological record. This data was then analysed to identify the commonest trends and patterning in the archaeological record to contrast with those of the interpretive framework to produce a detailed national analysis not previously possible. In total the archaeological data comprises 79 excavations undertaken at 11 different flint mine complexes<sup>40</sup>, and 51 excavations at 9 different axe quarries<sup>41</sup> in the UK and Ireland.

ARCHAEOLOGICAL EVIDENCE	ETHNOGRAPHIC THEMES
Topographically-distinctive location; widespread product distribution; presence of non-mining assemblages in workings	<b>Mythologised/storied extraction sites</b>
General lack of settlement evidence, rare buildings; widespread product distribution	<b>Ownership</b>
Evidence for temporary abandonment	<b>Seasonal use of extraction sites</b>
Presence of non-mining assemblages in workings; non-mining structures in the workings; animal remains; human burials / body parts; evidence for temporary abandonment; widespread product distribution	<b>Ritualised extraction</b>
Ritualised extraction; widespread product distribution; limited product distribution	<b>Functional end-use of extraction site products</b>

Table 6:2. The aggregated archaeological / cross-cultural ethnographic data.

The archaeological data can be analysed in a variety of ways to provide different perspectives on the character of extraction practise, both geographically and over

<sup>39</sup> These fields were: topographically-distinctive location; accessibility; debitage/lithics in workings; debitage/lithics in post-extraction contexts; stabilised horizons/hearths in post-extraction contexts; tools in workings; imported [exotic] tools in workings; knapping tools in workings; hearths in workings; charcoal deposits in workings; non-extraction objects in workings; placed deposits in workings; structures in workings; animal remains, articulated; animal remains, disarticulated; human burials; human body parts; rock art/graffiti in workings; rock art/graffiti within 5km of workings; settlement evidence at workings; distribution of products (the latter problematic concerning flint sourcing).

<sup>40</sup> Ballygalley Hill, Blackpatch, Church Hill, Cissbury, Den of Boddam, Durrington, Easton Down, Goodland, Grime's Graves, Harrow Hill, Stoke Down.

<sup>41</sup> Creag na Caillich, Graiglwyd, Lambay Island, Langdale, Mynydd Rhiw, Le Pinnacle, Rathlin Island, Shetland, Tievebulliagh.

time (Table 6:2). The analysis demonstrates that the 6 commonest fields recorded at the flint mines are: topographically-distinctive location; debitage/lithics in the workings; debitage/lithics in post-extraction contexts; stabilised horizons and hearths in shafts/pits and/or on shaft/pit fills; tools abandoned in workings; and deposits of disarticulated animal remains. At the axe quarries the 5 commonest fields comprise: locational preferences; debitage/lithics in workings; debitage/lithics in post-extraction contexts; rock art or graffiti within 5km of the site<sup>42</sup>; and supra-regional distribution of products (200+km)<sup>43</sup>. In terms of the interpretive framework, these comparators would suggest that where most, or all, of these indicators occur, then the inference would be that these extraction sites were probably storied locations which practised ritualised procurement and produced highly valued products.

The data indicates that 19 flint mines exhibit the 6 commonest fields and are located in four different complexes – Blackpatch, Church Hill, Cissbury and Grime’s Graves. Their geographical distribution ranges from the South Downs to East Anglia. Chronologically, the Sussex flint mines date from the earliest stage of the Neolithic in southern England, beginning in *4145-3805 cal BC* [95% probability] or *4020-3855 cal BC* [68% probability] (Bayliss et al. 2011, 789, Fig. 14.129). In East Anglia, however, the mines are associated with Late Neolithic/Early Bronze Age activity, beginning *2665-2605 cal BC* [95% probability] before the first appearance of metalwork, and ending *1510-1405 cal BC* [95% probability] (Healy et al. 2014, 55-58) during the transition to the Middle Bronze Age when Arretton metalwork and Wessex 2 burials were current (Needham et al. 2010).

### **6:5:1 *The chronology of extraction in the UK***

This chronology demonstrates an important observation - that a prescribed extraction practise already existed before the appearance of the first Neolithic activity in southern England. This pre-existing knowledge, whether imported by

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<sup>42</sup> The density of rock art is far lower around the axe quarries than in other upland areas which do not have quarries, suggesting a different level of messaging between the two areas.

<sup>43</sup> The commonest data fields all scored a presence of over 40% - the percentage marker of ritualised practises in the ethnographic data.

individuals or transmitted by cultural contact, drew heavily upon learned technical expertise – deep shaft flint mining was not an *ad hoc* or expedient event, it required geological knowledge to prospect for flint strata, and technical skill to understand the stresses of chalk to allow safe subterranean mining, for example (the late P Felder pers. comm.). In addition to technical knowledge, certain material practises were also repeatedly followed as part of extraction, particularly the deposition of assemblages in specific locations within the mines. This implies that extraction practises had been developed previously, elsewhere, and it was part of a shared cosmology which had been transplanted, or transmitted, into the UK from adjacent areas of continental Europe as a component part of ‘being’ Neolithic (Sheridan 2007 & 2010; Whittle et al. 2011). One of the potential points of origin for an emergent flint mining tradition in the UK is the Paris Basin. Here flint mining not only developed roughly 4-500 years earlier than in the UK and Ireland (thus allowing a lengthy gestation for a traditional practise to develop and become culturally embedded), *but* the Paris Basin flint mines were also one of the first types of site to appear in that landscape, thus paralleling the sequence in the UK (Giligny 2011; Giligny et al. 2011; Giligny et al. 2012, 1150-1155), and they share similar depositional practises (Wheeler 2008 & 2011).

Neolithic practises may have first entered southern England via several routes, including the Thames Estuary. Here novel burial rites were introduced, such as the inhumation from Yabsley Street, Blackwall, accompanied by plain carinated bowl pottery (Coles et al. 2008), and early ‘houses’ like the White Horse Stone structure (Hayden & Stafford 2006), all of which appear to have rapidly led to more permanent constructions like the Coldrum Stones megalithic burial monument built during 3960-3880 *cal BC* [68% probability] (Wysocki et al. 2013). These various Neolithic practises overlap chronologically with the appearance of flint mines on the Sussex chalk downlands, and demonstrate an emergent ‘package’ of shared practises and beliefs which had similarities in depositional patterning at various types of site (Table 6:3).

<sup>14</sup> C dates	FLINT MINES										AXE QUARRIES						
	Harrow Hill	Church Hill	Martin's Clump	Blackpatch	Cissbury	Long Down	Easton Down	Den of Boddam	Hambledon Hill	Grime's Graves	Graiglwyd	Lambay Island	Tievebulliagh	Langdale	Mynydd Rhiw	Shetland	Creag na Caillich
4300																	
4200																	
4100																	
<b>4000</b>																	
3900																	
3800																	
3700																	
3600																	
3500																	
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<b>3000</b>																	
2900																	
2800																	
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2200																	
2100																	
<b>2000</b>																	
1900																	
1800																	
1700																	
1600																	
1500																	
1400																	
1300																	
1200																	
1100																	

Table 6:3. The relative chronology of UK and Irish extraction sites based upon crude <sup>14</sup>C dates.

Within this regional context of emergent Neolithic practises - probably resulting from a combination of population movement and indigenous change - the flint

mines on the South Downs, and possibly the less securely dated Wessex group, appear to be some of the first constructions in a cultural landscape dominated by mobility, with shifting mixed farming regimes providing low-level cereal production, and a continued exploitation of wild resources (Schulting 2008; Field 2008; Thomas 2013; Thorpe 2015). It would take another one or two centuries before other permanent monuments such as long barrows or causewayed enclosures began to anchor communities to other places, but for different cultural and social imperatives (Whittle et al. 2011b; Bayliss et al. 2011). Consequently, it was the early flint mines which physically dominated the landscapes from on or near downland crests, although the white scars were masked by woodland (Barber et al. 1999, 53-55; Allen & Gardiner 2012). At around the same time, c.4,000-3,900 cal BC, the Graiglwyd axe quarries in Gwynedd may have been exploited (Williams & Davidson 1998, 18-19). This first pioneering phase of stone extraction on the South Downs and Graiglwyd, which was closely followed by Lambay Island (Cooney 2005) and possibly Tievebulliagh (Mallory 1990), all have one thing in common – they are all close to, or visible from, the sea. This could indicate that coastal movements facilitated some of the initial prospection for stone sources during this earliest phase of the Neolithic. In addition, the temporal pattern of these developments may be more complex than suggested here - it is possible that Neolithic practises began earlier in Ireland (Cooney 2007), and the transition to the Neolithic need not have first emerged via the Thames Estuary but by coastal movements skirting the southern UK and the Irish Sea (Sheridan 2010). Whichever the route, currently the earliest dates for stone procurement still occur on the South Downs and in Gwynedd.

### **6:5:2 *The flint mines*** (see Table 6:3)<sup>44</sup>

The 19 flint mines with the 6 commonest features or assemblages suggesting ritualised extraction, in ranked order (greatest number first), comprise: Pit 2, Grime's Graves (Figure 6:10); Greenwell's Pit, Grime's Graves; Shaft 27, Cissbury; The Cave Pit, Cissbury; 1971 Shaft, Grime's Graves; Pit 15, Grime's

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<sup>44</sup> All of the subsequent archaeological references to specific site data can be retrieved from the accompanying appendices at the end of the thesis.

Graves; Willet's 1873 Shaft, Cissbury; Shaft V, Cissbury; Shaft 24, Cissbury; The Large Pit, Cissbury; Shaft 4, Blackpatch; The Skeleton Shaft, Cissbury; No2 Escarp Shaft, Cissbury; Pit 7, Grime's Graves; Shaft 3, Blackpatch; Shaft 3A, Blackpatch; Shaft 8, Blackpatch; Shaft 3, Church Hill; No 1 Escarp Shaft, Cissbury. The 6 attributes in this group of mines spans the complete Neolithic period, and importantly demonstrates how geographically-widespread the practise of extraction had been, before it diminished during the Early Bronze Age.

The flint mine that has the largest number of features and greatest variety in its assemblage patterning is Pit 2 at Grime's Graves which contained 16 [80%] of the 21 fields of evidence<sup>45</sup>, closely followed by Greenwell's Pit and Pit 1 also at Grime's Graves which both had 15. This suggests that extraction practise continued to develop over time, and may have reached its apogee at Grime's Graves, building upon earlier practises evident at the South Downs mines.



Figure 6:10. Grime's Graves (May 2004).

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<sup>45</sup> The final field 'product distribution' is problematic, as discussed previously (cf. Craddock et al. 2012).



Overall the data strengthens the observation suggested above that a prescribed practise of flint extraction, defined by a distinctive set of attributes including storied sources, ritualised practises and highly-valued products, was already established and adopted before the first mines were sunk at the pioneering stage of the Neolithic in the UK. This is underlined by the geographical distribution of early mines which contained the 6 commonest attributes, consisting of Blackpatch, Church Hill, Cissbury (all South Downs). The South Downs mines remain the earliest in the UK, and would appear to be broadly contemporary with Goodland in Antrim which produced plain carinated bowls of Ballymarlagh Style (Collins 1978), demonstrating once again early preferences for raw material sources close to the sea.

Amongst the early mines none have produced evidence of experimentation, the development of mining skills, or subterranean accidents suggesting poor techniques<sup>46</sup>. The people who sunk the first flint mines clearly used a pre-learned, expert level of technical knowledge and followed a traditional practise. This suggests the presence of specialists or some form of technical elite amongst the Neolithic communities who could pass on their skills to successive generations (*cf.* de Grooth 1997 & 1998). The fact that later mines at Grime's Graves also displayed such technical competency demonstrates a continuity of practise into the Late Neolithic period in other parts of the UK, which arguably peaked at Pit 2 with the greatest number of ritualised attributes. In contrast, the final stages of Early Bronze Age mining at Grime's Graves (after a break of several centuries) is accompanied by the least number of attributes (e.g. the 'Primitive Pits' and Pit 15D; Healy et al. 2014, 57-58) and a shift from galleried deep shaft extraction to largely shallow pits with occasional niches, suggesting that by the time metalworking traditions were firmly established the practise of stone extraction had become more expedient and involved fewer formalised practises.

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<sup>46</sup> John Pull originally thought that the female skeleton recorded in Shaft 27 at Cissbury had been killed by a collapsed chalk arch, but the placing of artefacts around the body parallel practises evident in formal burials such as that in Shaft VI at Cissbury, suggesting that the Shaft 27 skeleton was also a deliberate burial (Topping 2005, 76-77).

### **6:5:3 *The axe quarries*** (see Table 6:3)

There are 9 axe quarries which display the 5 commonest attributes suggesting ritualised practises: Pike of Stickle Site 98, Creag na Caillich Site 1, Graiglwyd Site F Test Pit E, Pike of Stickle Site 95, Creag na Caillich Site 2, Graiglwyd Floor B, Pike of Stickle South Scree Cave, Graiglwyd Trench 3, and Graiglwyd Trench 5. The geographical distribution and temporality of these complexes again demonstrates that the commonest features of extraction practise were current throughout the Early Neolithic to Early Bronze Age periods and the working-life of these quarries, paralleling the situation found in the flint mines.

As with the flint mines, it would appear that a prescribed practise of stone quarrying existed from the earliest Neolithic, particularly at Graiglwyd, Lambay Island, and possibly Tievebulliagh, closely followed chronologically by the Langdale sites, Mynydd Rhiw and probably the Shetland quarries<sup>47</sup>. In parallel with flint extraction, these complexes are either on the coast, or visible from it, with the obvious exception of the land-locked Langdale sites<sup>48</sup>, again suggesting that Early Neolithic prospection and stone procurement may have been undertaken via coastal routes. In the case of the axe quarries the earliest sites are ranged around the Irish Sea - contrasting with the flint mines which overlook the Channel coastline, arguably indirectly indicating two of the routes of Neolithisation.

The current chronology suggests that many upland axe quarries were beginning to fade from use around the Middle Neolithic (c.3000BC) during a time of major social transformations<sup>49</sup>. The South Downs flint mines were also abandoned around this time, new burial rites were introduced, new pottery styles emerged (Impressed Ware, Peterborough Ware and Grooved Ware), major ceremonial sites and complexes were constructed (e.g. Brodgar on Orkney, Stonehenge/Durrington Walls, Avebury, and cursus monuments) or restructured (e.g. Fornham All Saints, Suffolk), and some of the last causewayed enclosures

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<sup>47</sup> The Shetland axe quarries, currently only dated by association with a single <sup>14</sup>C date linked to a hoard of 13 felsite axes found at a distance from the quarries, which would place their deposition at 3500-3110 cal BC (Sheridan 2012, 12-14) and provide a rough indication of quarry use.

<sup>48</sup> Although as yet strictly undated, the Scafell Pike surface quarries are intervisible with the coast, the Irish Sea, and the Isle of Man, so would fit this pattern.

<sup>49</sup> Shetland, Langdale, Mynydd Rhiw, Lambay Island and probably Graiglwyd all faded from use around c.3000BC, but Creag na Caillich and possibly Tievebulliagh continued beyond that date.

appear to have been deliberately attacked (e.g. Hambledon Hill and Crickley Hill). Only the Creag na Caillich quarries appear to have regained a momentum and witnessed a second phase of exploitation during the Late Neolithic-Early Bronze Age transition, thus overlapping with the late Neolithic flint mines at Grime's Graves, the surface quarries at Hambledon Hill, the Easton Down mines, and probably the Den of Boddam pits.

Taken together, the evidence examined above suggests that there is a robust range of data amongst the assemblages to suggest that ritualised extraction practises took place at many sites, and to varying degrees, with the greatest levels of ritualisation occurring during the Neolithic period. The sites which recorded strong evidence for probable ritualisation include the mines at Ballygalley Hill, Blackpatch, Cissbury, Church Hill, Grime's Graves and Harrow Hill, and the quarries at Creag na Caillich, Graiglwyd, Lambay Island, Langdale, Le Pinnacle and Shetland (Beorgs of Uyea). This demonstrates that ritualised practises were widespread at extraction sites, which must have enhanced social perceptions not only of the sites but also their products. Using the framework as a guide, at least 56% [6 of 11] of the flint mines and 67% [6 of 9] of axe quarries probably followed highly ritualised extraction practises.

The analysis of the collated archaeological data can also be ranked to illustrate which sites provide the greater evidence for ritualised extraction practises by the numbers of fields of evidence present at each site (Table 6:3 below). This data is ranked highest to lowest, and illustrates an interesting pattern when the chronology of the sites is taken into account. This suggests that some of the most heavily ritualised sites appeared amongst the earliest mines of the Early Neolithic period at Cissbury and Blackpatch on the South Downs, which were broadly contemporary with the axe quarries on Lambay Island and Graiglwyd. These sites were followed around the Middle Neolithic by the quarries at Langdale and the ongoing use of Graiglwyd. However, by the Late Neolithic period Grime's Graves produced three mines (Pit 1; Pit 2; Greenwell's Pit) which all exhibited the maximum number of probable ritual elements, suggesting a final flourish of ritualised practises at this time. Eventually, during the Early Bronze Age mining phase at Grime's Graves (Healy et al. 2014), which occurred several centuries after the end of the previous Late Neolithic mining, ritualised deposits

diminished significantly, suggesting the end of ritualisation during the transition from the Early Bronze Age to the Middle Bronze Age, at the time when metalworking had become widespread and well established and the Wessex 2 traditions were morphing into Deverel-Rimbury (Needham et al. 2010).

<b>Flint mines [n=79 excavations]</b>		<b>Axe quarries [n=51 excavations]</b>	
	<b>%</b>		<b>%</b>
Grime's Graves Pit 2	80% [16]		
Grime's Graves Greenwell's Pit	75% [15]		
Grime's Graves Pit 1	75% [15]		
Cissbury Shaft 27	65% [13]		
Cissbury Cave Pit	60% [12]		
Blackpatch Shaft 1	60% [12]	Lambay Island Eagle's Nest	60% [12]
Cissbury Shaft VI	55% [11]		
Cissbury Willet's Shaft	55% [11]		
Goodland	55% [11]		
Grime's Graves 1971 Shaft	55% [11]		
Grime's Graves Pit 15	50% [10]		
		Langdale Pike of Stickle Site 98	50% [10]
Blackpatch Shaft 2	50% [10]		
Blackpatch Chipping Floor 2	50% [10]		
Cissbury Willet's Shaft	45% [9]		
Cissbury Shaft V	45% [9]	Le Pinnacle	45% [9]
Cissbury Pull Shaft 24	45% [9]		
Harrow Hill Pit No21	45% [9]		
Blackpatch Shaft 5	45% [9]		
Church Hill Shaft No1	45% [9]		
Cissbury Large Pit	40% [8]		
		Langdale Pike of Stickle Site 95	40% [8]
Cissbury Tindall's Shaft	40% [8]		
		Shetland Beorgs of Uyea Gallery	40% [8]
Ballygalley Hill	40% [8]	Creag na Caillich East Quarry Site 1	40% [8]
Church Hill Shaft No4	40% [8]	Graiglwyd Site F Test Pit E	40% [8]
Church Hill Shaft No5A	40% [8]	Mynydd Rhiw Site B	40% [8]
Harrow Hill Shaft 13	40% [8]	Graiglwyd Site F Test Pit I	40% [8]
		Graiglwyd Site F Cairn 65	35% [7]
Blackpatch Shaft 7	35% [7]		
Church Hill Shaft No6	35% [7]		
Easton Down Pit B49	35% [7]		
Blackpatch Barrow No1 (dump of Shaft 3)	35% [7]	Creag na Caillich West Quarry Site 2	35% [7]
		Graiglwyd Site F Test Pit S	30% [6]
Church Hill Chipping Floors Nos 1-11	30% [6]		
		Langdale South Scree Cave	30% [6]
		Graiglwyd Floor B	30% [6]
Harrow Hill Shaft III	30% [6]	Langdale Thunacar Knott	30% [6]

		Mynydd Rhiw Trench 1	30% [6]
Grime's Graves Pit 12	30% [6]	Graiglwyd Site F Cairn 67	30% [6]
Church Hill Chipping Floor No14 (cut by Shafts Nos6 & 7)	30% [6]		
Stoke Down Shaft No2	30% [6]		
Black Mountain	30% [6]	Graiglwyd Site F Mound 3079	30% [6]
Blackpatch Barrow No3	30% [6]		
Blackpatch Barrow No12	30% [6]		
Church Hill Pit C (IA/Med?)	30% [6]		
Easton Down Pit B1 & Floor B1	30% [6]		
Easton Down Pit B1(A) & Floor B2	30% [6]		
Grime's Graves Pit 3	30% [6]		
Blackpatch Shaft 4	25% [5]		
		Shetland Beorgs of Uyea / Midfield	25% [5]
		Tievebulliagh [Discovery]	25% [5]
Cissbury Skeleton Shaft	25% [5]		
Easton Down B67	25% [5]	Langdale Harrison Stickle	25% [5]
Grime's Graves Pit 8	25% [5]		
		Graiglwyd Trench 3	25% [5]
		Graiglwyd Trench 5	25% [5]
Church Hill Chipping Floor No12	25% [5]		
Church Hill Shaft No7	25% [5]		
Grime's Graves Pit 9	25% [5]		
Grime's Graves Pit 10	25% [5]		
Grime's Graves Pit 14	25% [5]		
Stoke Down Shaft No3	25% [5]		
Blackpatch Chipping Floor 4	25% [5]	Creag na Caillich East Working Floor Site 3	25% [5]
Blackpatch Barrow No2	25% [5]	Creag na Caillich West Working Floor Site 4	25% [5]
Blackpatch Barrow No4	25% [5]	Langdale Dungeon Ghyll	25% [5]
Grime's Graves Pit 4	25% [5]		
Grime's Graves Pit 5	25% [5]		
Stoke Down Shaft No1	25% [5]		
Cissbury No2 Escarp Shaft	20% [4]		
Grime's Graves Pit 7	20% [4]		
		Mynydd Rhiw Site G	20% [4]
		Langdale Stake Beck	20% [4]
Blackpatch Shaft 6	20% [4]	Graiglwyd Site F Test Pit C	20% [4]
Grime's Graves Pit 11	20% [4]	Mynydd Rhiw Trench 2	20% [4]
Blackpatch Chipping Floor 1	20% [4]		
Church Hill Pit A	20% [4]		
Durrington Shaft 5	20% [4]		
Blackpatch Chipping Floor 3	20% [4]		
		Rathlin Island	15% [3]
Blackpatch Shaft 3A	15% [3]		
Blackpatch Shaft 8	15% [3]		
Church Hill Shaft No3	15% [3]		
Blackpatch Shaft 3	15% [3]		
Church Hill Shaft No2	15% [3]		
Church Hill Chipping Floor No13	15% [3]		
Cissbury No1 Escarp Shaft	15% [3]		
		Graiglwyd Site F Mound 3077	15% [3]

		Graiglwyd Site F Mound 3078	15% [3]
		Graiglwyd Site F Test Pit N	15% [3]
		Graiglwyd Site F Test Pit Q	15% [3]
		Graiglwyd Site F Test Pits B & F	15% [3]
		Graiglwyd Site F Test Pit 550e/570n	15% [3]
Grime's Graves Pit 6	15% [3]		
Easton Down B19	15% [3]		
Easton Down B45	15% [3]		
		Langdale Loft Crag Site DS87	15% [3]
Den of Boddam	15% [3]		
Church Hill Pit B (?IA)	15% [3]	Graiglwyd Site F Test Pit G	15% [3]
		Graiglwyd Site F Test Pit H	15% [3]
		Tievebulliagh Trench 1	15% [3]
		Tievebulliagh Trench 2	15% [3]
		Tievebulliagh Trench 6	15% [3]
		Tievebulliagh Trenches 4a & 4b	10% [2]
Church Hill Chipping Floor No15	10% [2]		
Stoke Down Pit D1	10% [2]		
		Tievebulliagh Trench 3	10% [2]
		Tievebulliagh Trench 5	10% [2]
		Graiglwyd Site F Test Pit L	10% [2]
		Graiglwyd Site F Test Pit O	10% [2]
		Tievebulliagh Trench 7	10% [2]
		Tievebulliagh Trench 8	10% [2]
		Tievebulliagh Trench 9	10% [2]

Table 6:3. The relative percentages of 21 potentially ritualised practises recorded at the Neolithic and Early Bronze Age extraction sites, ranked highest to lowest, with the number of attributes shown in brackets [n of 21].

The final chapter of this thesis will summarise the overall findings of this research and re-evaluate the social role(s) of extraction sites and their products during the Neolithic and Early Bronze Age periods in the UK.

## **Chapter 7. Conclusion: The Social Context of Prehistoric Extraction Sites**

This thesis has now reviewed and analysed the Neolithic extraction sites of the UK from a macro to micro level against archaeologically-visible trends identified by the interpretive framework. This has ranged in scale from landscape settings down to individual sites and their assemblages in Chapters 5 and 6, all designed to build a new model of extraction practises and their social context founded upon robust statistics. This was achieved in Chapter 5 by investigating the landscape settings of extraction sites, their settlement associations, product distributions, the presence of rock art/graffiti, the presence of burials, and the differences between practises at sites exploiting flint and stone. In Chapter 6 individual sites were analysed for the possibility of storied locations, evidence of ownership, seasonal use, ritualised extraction, and the functionality of products.

The present chapter will now draw together the strands of evidence to offer a new, more robust model of extraction practises during the Neolithic period in the UK.

### **7:1 Conclusions on archaeological and anthropological trends in stone extraction.**

This thesis has explored the issue of the social context of prehistoric extraction sites in the UK by combining a thorough analysis of the archaeological evidence for Neolithic mines and quarries with a comprehensive analysis of anthropological trends and world-wide archaeology. Previous studies have made use of a reasonable quantity of empirical data on flint mines, axe quarries and axeheads, with some piecemeal use of analogy, and interpretive frameworks of various kinds have been applied, but none have drawn together the quantity of comparative ethnographic and archaeological data collected by this PhD.

This thesis has been founded upon the premise that the materiality of ethnographic extraction practises can be used to create an interpretive framework which can be applied to the material patterning surviving in the archaeological record (cf. Bourdieu 1990; Godelier 1999). The framework has used analogy as a bridge between the empirical data in the archaeological record and high-level unifying theories (cf. Schiffer 1988), with a steer from ethno-archaeological methodologies (Binford 1962, 1979, 1980, 1983; Hodder 1982a, 1982b). The model also acknowledges the inherent biases in the ethnography (as with archaeology), particularly data voids and the recognition that ‘traditional’ societies are rarely static in terms of structure, status, wealth and ideology (Spriggs 2008). The model has followed a ‘flow model’ approach to track the stages of extraction practises and their social outcomes (cf. Schiffer 1972; Fogelin & Schiffer 2015; Rathje 1979; Marshall 2008; Bell 1997; Spielmann 2002; Insoll 2004 & 2011). The data in this PhD has the capacity to be tested and falsified (Popper 2002; Schiffer 1988).

The aims of this thesis have been to:

1. Create a new interpretive framework to characterise prehistoric extraction sites;
2. Produce a reinterpretation of the social context of prehistoric extraction sites during the Neolithic Period in the UK.

These two aims were met by a literature review (Chapter 2) which assessed previous studies and identified gaps in knowledge, and the state of current interpretations. These knowledge gaps and interpretive models then influenced the ethnographic data collection (Chapter 3) of 168 case studies used to construct the first layer of the interpretive framework, and provide global detail of the social contexts of extraction practises, their outputs and outcomes for society. In Chapter 4, a global review of 223 archaeological reports was collected and analysed to establish common trends in material patterning. This identified archaeological evidence that could be explained by the same material trends in the ethnography, in particular a set of signatures for special, storied sites with ritualised practises. Chapters 5 and 6 then sought archaeological evidence for



the same factors in the British Neolithic to Early Bronze Age record. Chapter 5 began the detailed analysis of the UK extraction sites by analysing their landscape settings using the interpretive framework, with some reference to the Irish material. This established the contemporary environs of each excavated site studied, characterising the environment, the range of monuments and their relationships and associations with the extraction sites, which established the topographical-distinctiveness of the sites, their liminality in relation to nearest settlements, ceremonial and burial monuments, and the long-distance distribution of certain types of stone axeheads. Chapter 6 then used the interpretive framework to review in detail each published excavation (79 flint mines; 51 axe quarries) and analysed the processes and structures used by the extraction teams, and the contexts of assemblage deposition against the themes of the framework. This analysis found strong correlations between ethnographic themes and archaeological data for storied sites, the seasonal use of sites, ritualised extraction, access to the source, and product distributions, all of which now provide a more nuanced view of extraction practises.

The key finding of this thesis is the research value of more fully engaging with the richness and variety of ethnography as an aid to interpreting the archaeological record. Using small samples of ethnographic data does not produce a statistically robust interpretive model, rather it leads to hypothesis building premised upon assumption and guess work, creating a self-fulfilling circularity of empty citations of previous research (Smith 2015, 20-21). The research value of large ethnographic data sets for trend analysis can be seen with the 168 studies reviewed by this thesis. This has demonstrated that the functionalist approaches common before the late 1980s are not borne out by the ethnographic trends identified by the interpretive framework. However, the more recent uses of selected anthropological data to argue for the ritualisation of extraction practises and to construct object biographies (e.g. Whittle 1995, Cooney 1998, Bradley 2005, and Edmonds 2012), for example, have been confirmed by this study in a way that more arbitrary uses of ethnography could not do.

As noted earlier, biases in the ethnographic record can be constructively avoided by aggregating data, although records still remain which have not accounted for the presence or absence of an attribute. If one disregards these ambiguous

records (which arguably could have provided negative or positive returns), and models the aggregated data of the more complete records for positive attributes set against negative attributes, potentially a more realistically weighted picture of extraction practises can emerge. Consequently, a recasting of the percentages forming the bulk of Chapter 3<sup>50</sup> now provides an enhanced weighting to the trends which can be modelled in this way:

- 95% [55 of 58] record ceremonial use of sites [55 present; 3 absent (110 no data)]
- 95% [118 of 124] record craft specialists [118 present; 6 absent (44 no data)]
- 93% [120 of 129] of studies record storied associations with the raw material [120 present; 9 negative (39 no data)]
- 92% [67 of 73] record ritualised extraction [67 present; 6 absent (95 no data)]
- 89% [74 of 83] recorded seasonality [74 present; 8 permanently inhabited sites; 1 no access to sites (85 no data)]
- 88% [68 of 77] documented ritualised reduction [68 present; 9 absent (91 no data)]
- 68% [75 of 111] provided evidence of ownership [75 present; 31 not owned; 5 communities no access to sites (57 no data)]

This aggregated ethnographic data confirms that aspects of ritualisation played a fundamental part in extraction practises in the majority of these global societies. These headline trends demonstrate that ritualised extraction was practised on a seasonal/expedient basis at storied locations – many of which were owned, involved craft specialists who practised ritualised reduction, and extraction was surrounded by ceremonialism. The key observation here is that much of the materiality of these ethnographic practises can be paralleled, contextually, in the archaeological record, and this informed the construction of the interpretive framework.

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<sup>50</sup> The ethnographic biases (particularly the voids) mean that the percentages presented in the bulk of Chapter 3 are likely to be *minimum* percentages, thus the social realities may be far greater than sketched there, as these recast percentages demonstrate.

This ethnographic data builds upon the work of Bradley (2005), Edmonds (2012), Cooney (1998), Whittle (1995) and others, to provide a more detailed perspective of how storied contexts may have emerged in the archaeological record as part of the process of constructing a cultural landscape and creating legitimacy for the community. Such processes are fundamental to constructing identity, and often involve social negotiation drawing upon the status and wealth of significant individuals, and between the living and the supernatural. The fact that many Neolithic extraction sites in Britain and Ireland (see Chapter 5) can now be viewed as lying well beyond the limits of settlements and ceremonial monuments, with only a few significant burials on-site, suggests exclusivity and probably restricted access, with control by tribes, clans or a technical elite. The useful research of Allen and Gardiner (2012) demonstrating the likelihood that many sites were relatively hidden amongst woodland, adds to the notion of the liminality of extraction. The final clinching observation which must demonstrate that the sites were indeed special places is the fact that at nearly all quarries and mines more accessible, expedient sources of raw material were available, but they were ignored in favour of those which could be won from more significant – but difficult – locations (Chapters 5 & 6). Consequently, it is now difficult to disagree with Brady and Rissolo (2006, 483), who have suggested that it is no longer the case that the suggestion of ritualised extraction needs to be justified, but conversely, a case has to be made for simple non-ritualised, functional extraction at prehistoric mines and quarries! As Fogelin and Schiffer (2015, 824) have observed in relation to the life histories of objects ‘... *we are coming closer to constructing in detail a society’s ceremonial world - a world that included people, animate and inanimate objects and supernatural entities*’.

The ethnography has provided some useful analogies concerning the cosmology of certain extraction sites. One of the recurrent themes is the presence of female deities in many cosmologies (e.g. North America, New Guinea), creating male (quarry teams) and female (deities) roles associated with the extraction sites, suggesting that stone procurement symbolically mirrored human procreation. Consequently, a female-engendered cosmology may have become an ideological affirmation of female fecundity and its role in providing valuable resources such as toolstone. Conversely, it is often male extraction teams (55% [92 of 168]) who

work the female engendered sources and create objects which transform a female-derived substance (e.g. toolstone) into a symbol of male power.

The ethnography also illustrates age and gender roles in extraction practises: male-only groups generally practise ritualised extraction and produce objectified implements which are extensively distributed; mixed age/sex groups with children, are less likely to practise ritualised extraction and products frequently have a potential ritual/functional duality, but are still extensively distributed; and finally, female-only groups can use ritualised practises and some products are extensively distributed (e.g. ochre; Plomley 1966). Of interest in this case is the fact that the small amount of human skeletal remains from the Neolithic flint mines is predominantly female, and children are also represented, which may argue for mixed sex/age groups and against male-only teams in the archaeological record. Consequently, the demographics emerging from the skeletal evidence suggest that Neolithic extraction teams may have differed in emphasis from those identified in the ethnography captured in Chapter 3.

The majority of ethnography records that extraction sites produced implements which have particular values for the community, and often emerge initially as profane tools, but with the capacity to be transformed by rituals into sacred artefacts at specific points in time to fulfil ceremonial needs or social obligations (65% [110 of 168]). It is this multiplicity of potential trajectories, combined with the wide range of depositional practises from wetlands to pit deposits to deposition in communal monuments, which undermines the model of a standardised, pan-European meaning for jadeitite axeheads (Pétrequin et al. 2012c) and other types. Regionalised models offer greater opportunity to explore themes such as the creation of group identity and ideology.

The ethnography collected for this thesis identifies that certain objects can convey sacredness but *not* wealth, a key finding which may be borne out archaeologically by the fact that only rarely are multiple axeheads found in graves as demonstrations of 'wealth'. Archaeological indicators will include evidence/absence of wear, assemblage context and juxtaposition with other objects, and depositional practises such as hoards/caches discovered in features or structures. The absence of wear on an object must indicate careful curation

and non-functional uses, and when considered against the quantities of objects this may identify social roles: single or small numbers indicate symbolic, ritual objects which define sacredness or the ceremonial status of the individual, whereas multiple objects may create statements of wealth. However, it is not always clear from the ethnography what differences exist between the wealth and status roles of objects, how they relate to political power, and how this may interact with sacred power and knowledge. There is also some ambiguity in that some wealth objects can also have roles in ritual, but in these cases the objects originated as wealth objects.

One of the key linkages identified by the thesis is the strong correlation between the long-distance movement (200+km) of extraction site products and ritualised extraction in the ethnography in 64% [107 of 168] of cases, which compares with 60% [85 of 223] in the global archaeological data for long-distance movement of products coupled to ritualised extraction. This adds an element of security to the interpretation of product outcomes from ritualised extraction practises.

## **7:2 Conclusions on the social and cultural context of stone extraction in Neolithic Britain.**

The analysis presented in this thesis implies that many extraction sites were viewed as special places (Chapters 5 and 6), and the ethnography suggests that they were used in particular, ritualised ways (Chapter 3). Ethnography records ritualisation of even mundane activities in many traditional societies, and the structures and non-functional deposits in many Neolithic extraction sites suggests similar practises may have occurred as part of 'being' Neolithic (Chapter 4). Stone procurement often targeted dangerous and difficult sources; consequently the practise must have been entangled with checks, controls and rituals designed to counter the inherent dangers, ensure success, and maintain the status of the loci, the miners and their products. In addition, the fact that final deposition of many extraction site products was in non-domestic contexts compared to those from expedient sources, demonstrates that these objects were clearly entangled within a web of communal procedure, transaction and social performance. As Edmonds (1993b, 72) has noted, if the Early Neolithic did not witness a

*'wholesale economic transformation'* with woodland clearance and widespread agriculture, then other explanations for the sudden appearance and proliferation of flint and stone axeheads is needed. Consequently, it is difficult to escape the conclusion that the axehead became a widespread *leitmotif* during the earliest Neolithic in the UK.

Most mines and quarries produced raw material for axehead production. Such iconic artefacts may have had a multiplicity of meanings, ranging from *'a religious symbol, an item of exchange [to] a functional tool'* (Cooney 1998, 108), and as Whittle (1995, 251) has observed, *'[w]e should not ... assume fixed or inherent values for things'*. The fact that so many stone axeheads originating from extraction sites were widely distributed throughout the UK and Ireland, and were often deposited broken or burnt, or buried in hoards - unused, demonstrates that they had a deep cultural significance beyond that of functional tools (cf. Needham 2008, 318-319). The earliest mines on the South Downs, arguably following traditions transplanted from the Paris Basin and the Low Countries (Giligny et al. 2012; Wheeler 2008 & 2011; de Grooth 1997 & 1998), conform to this trend. Analysis of the depositional patterns of axeheads from the adjacent coastal plain confirms that the majority were unused and carefully curated (Gardiner 1990). The later Norfolk flint mines provide a similar scenario, but with a greater focus on points, scrapers and discoidal knives rather than axeheads.

The extensive distributions of many stone axehead types demonstrate that they too had a deeply embedded cultural value, and a currency which may have transcended flint. Stone extraction was a dangerous pursuit with both physical and metaphysical challenges, but successful procurement objectified the raw material, becoming as Bradley (2000, 88) has suggested *'pieces of places'*, resonant with symbolic power. The dangers are readily illustrated at the precipitous, exposed quarries on Top Buttress on Pike of Stickle, Langdale, for example, the source of the *recognisable* green tuff which was used to transmit cultural narratives across the UK and over the sea to Ireland. Similarly, the steep slopes of Creag na Caillich ensured stone extraction was a precipitous pursuit, and off-shore sources such as Lambay Island produced their own dangers associated with sea travel. Such dangers required mediation with natural and supernatural forces.

The material evidence of ritualised extraction can be seen in most flint mines, and follows patterns of deposition (Figure 7:1). Human remains, for example, are found only in the fills of shafts and not within galleries; contemporary pottery is only found in the shaft fills at Grime's Graves and the Irish surface quarries at Ballygalley Hill and Goodland; hearths were only located on shaft floors or in shaft fills; axeheads and debitage have been recovered from a range of contexts; and rare graffiti is only found within the mines, normally above gallery entrances. Such deposits are reflecting the ritualised materiality of extraction, its preparation, and aspects of renewal ceremonialism.

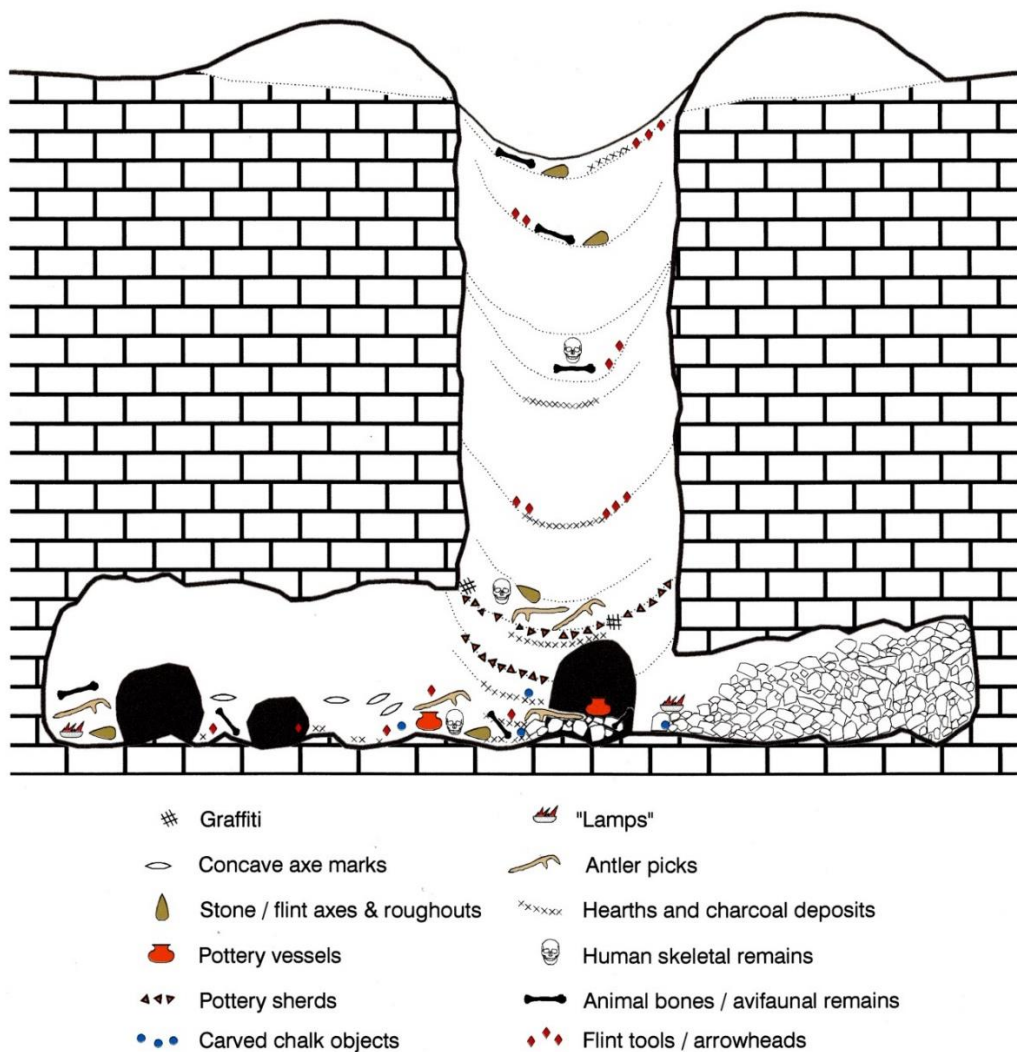


Figure 7:1. The spatial and temporal distribution of assemblages in the UK flint mines (© Pete Topping & Trevor Pearson).

The presence of hearths on shaft floors, or smaller charcoal deposits in galleries, suggests that fire, heat, light and smoke played an increasingly important role in

the extraction process during the Neolithic. Ethnography suggests that the ritualised purification of Neolithic miners and their tools at a hearth may have preceded extraction, particularly as shaft floor hearths were positioned without regard to providing light or heat to the galleries, nor apparently used for cooking. The small deposits of unidentified charcoal in certain galleries in Greenwell's Pit and Pit 15, Grime's Graves, may be a Late Neolithic manifestation of purification by smoke, particularly as these deposits remained intact and had not been disturbed by the passage of miners, suggesting they were part of abandonment ceremonialism.

Ritualisation was enhanced at flint mines by accompanying paraphernalia, such as carved chalk objects, pottery, re-deposited debitage and lithics, graffiti, and the regular presence of chalk platforms occasionally displaying grouped antler picks, all illustrating a range of non-functional activities juxtaposed with mining. In addition, both flint - and rarely stone - axeheads are found within many mine shafts. Ethnography suggests such deposition often represents the return of rejects, or even tools, back to the source to stimulate symbolic renewal of the raw material. This would explain the 300+ axehead roughouts recovered by excavations at Grime's Graves (inf. G Varndell), or the cache of axeheads in Shaft III at Harrow Hill, where 33 '*in various stages of manufacture*' were discovered. One of these was broken, the cutting edge found '*just beneath the turf and the butt end 8ft [2.4m] down [the shaft]*' (Holleyman 1937). The different contexts suggests that the uppermost fragment remained in circulation longer, but had eventually been returned to the same mine as the first fragment, perhaps their point of origin, as part of symbolic renewal.

Bird remains are rare discoveries in flint mines. In Greenwell's Pit the skull of a phalarope, a shorebird, was placed between a pair of antler picks and an imported Cornish greenstone axehead at the distant end of a gallery (Topping 2011b). The structured arrangement of this assemblage demonstrates that it was not casual discard. Such deposits placed underground could have created a tangible cosmological reference, possibly linked to fertility and renewal (cf. Whittle 1995); carved chalk phalli discovered in Greenwell's Pit and Pit 15 would lend weight to this suggestion. In Gallery III of Pit 21, Harrow Hill, '*the skull of*



*what appears to have been a mouse*' was discovered beside an antler pick, which may hint at other forms of symbolism (Holleyman 1937).

The few instances of human remains provide another aspect of extraction practise, where interments or body parts may have been designed to establish links between communities and the extraction site. At Barrow 12, Blackpatch, a contemporary burial mound was raised amongst the mines, symbolically using mine waste, which positioned the dead amongst the mines. Burials were also interred underground, as in Shaft 27, Cissbury, where a female skeleton was discovered on the basal deposits accompanied by carved chalk objects and a *'fossil like worm*' (Pull Archive, Worthing Museum). Also at Cissbury, a male burial was discovered in Shaft VI encircled by chalk blocks and juxtaposed with an axehead, chalk disk, a burnt pebble, and a group of flint implements (Park Harrison 1878). A second female skeleton was found lying head down in No1 Escarp Shaft, Cissbury (Lane Fox 1876). Disarticulated body parts also formed part of the interment repertoire at Blackpatch, Church Hill and Grime's Graves, suggesting links to the wider practise of excarnation recorded at causewayed enclosures, long barrows and henges.

Despite the small size of the overall assemblage of human skeletal material in the UK, there is a predominance of female skeletal remains, and the child's mandible from Shaft 4, Blackpatch (Pull Archive, Worthing Museum), introduces issues surrounding age and gender roles in Neolithic extraction practise. In the ethnographic record taboos banning certain sexes are often in place (generally against females), and in extremely rare examples extraction is practised by female teams (cf. Arthur 2010).

The assemblages in the flint mines emphasise entry points into the deeper workings, particularly gallery entrances, as in the 1971 Shaft, Grime's Graves, where two internally-decorated Grooved Ware bowls lay on a platform, or the graffiti above entrances at Harrow Hill, Cissbury and Grime's Graves. The shaft floors became a structured arena where hearths, graffiti and placed deposits created a demarcated stage where markers transmitted messages to trigger appropriate behaviours to maintain a cosmological equilibrium during extraction.

At abandonment the mines were generally backfilled episodically, following the sequential backfilling of the galleries as they were worked out (Longworth & Varndell 1996, 79-89) and progressing in stages up the shaft. Each abandonment event was often accompanied by cultural material, human and animal bones, and/or hearths. At Shaft 27, Cissbury, at least twelve separate deposits filled the shaft, referencing abandonment and human burial through to renewal rites (Topping 2005). At the 1971 Shaft, Grime's Graves, the shaft fill comprised at least 6 major backfilling events, interspersed with some 13 periods of stasis illustrated by deposits of natural silts (Mercer 1981). Such patterning demonstrates that certain mines remained open as an arena for post-extraction ceremonialism, paralleling ethnographic practises designed to propitiate the spiritworld and restore harmony to the natural world (e.g. Boivin 2004; Brumm 2004; Hampton 1997; Scott & Thiessen 2005; Taçon 1991).

To date, apart from Balleygalley Hill, Antrim (Collins 1978), no other flint extraction site has produced settlement evidence, although excavation bias and taphonomic processes may have impacted. Consequently, the evidence suggests that mines were located in liminal areas beyond settlement zones, and also generally distanced from other types of monument, demonstrating that they possessed a separate social significance.

Axe quarries appear to have had a more restricted range of evidence for ritualised practise, which generally suggests renewal rites and commemoration. Occasional axehead hoards or placed deposits have been discovered at Graiglwyd and Langdale. One deposit at Graiglwyd saw an axehead roughly placed in the corner of a quarry, beside a second, and buried beneath debitage, suggesting an act of renewal (Williams & Davidson 1998 & 2002). At Lambay Island (Cooney 2000; 2005; 2007), extraction occurred alongside the digging of shallow scoops and a sequence of pits which were backfilled with extraction debris, tools and broken pottery. This was followed by the construction of sequences of stone settings, a '*hearth-like feature*', artefact deposits including maceheads and axeheads, all eventually sealed beneath a '*cairn-like*' dump of quarry debris which monumentalised quarry ceremonialism in the landscape.

Hearths appear to be rare at axe quarries, as are grouped artefacts and bone remains (generally because of acidic soils in the case of the latter).

Nevertheless, some evidence does suggest ritualisation. The granite and tuff hammerstones used at Langdale were sourced off-site and were used separately in different quarries leading Bradley and Edmonds (1993, 204) to speculate that *[p]erhaps particular parts of the rock face, or even particular quarries, were the preserve of different communities*'. Expediency, ritual constraints and cosmology might also have determined which rock types should be used.

The quarries also provide little evidence of permanent settlement, although topographic and climatic constraints will have impacted. The fragmentary evidence at Thunacar Knott (Clough 1973), for example, suggests nothing more than a temporary shelter lying behind Pike of Stickle, Langdale, and used for axehead production. No other quarry has produced definitive evidence of permanent settlement to date.

Geologically, the axe quarries are located in the uplands of the north and west, whereas the flint mines are restricted to the low-lying chalk of southern and eastern England, with two outlying sites located on secondary deposits of flint gravel on the Buchan Ridge in north-east Scotland. The distribution of flint and stone axeheads is inevitably influenced by the location of the parent material: flint axeheads have a predominantly southern British distribution, and in certain areas such as Sussex, Norfolk and Kent 80% of axeheads are flint. North of Yorkshire, however, flint axeheads are far fewer, perhaps suggesting different cultural values in northern Britain where stone axeheads predominate, or a pragmatic demonstration of raw material availability. The comparatively restricted distribution of flint axeheads is further illustrated by caches of unfinished axeheads, which only occur in the south and east of the UK, emphasising that their limited distribution parallels their chalkland origins, and demonstrates their core area (Clough & Cummins 1979 & 1988; Pitts 1996).

The ethnography suggests that many of the topographically-distinctive extraction sites in the UK may have been engendered or mythologised as part of a cosmology which sought to explain the origins of the cultural landscape and humankind's place within it. At Grime's Graves, periglacial stripes score the

ground surface surrounding the mine complex on its spur, creating an unusual striped patterning in the vegetation which is aligned not only on the mines but also the direction of midwinter solstice. Similar stripes have subsequently been recognised at the broadly contemporary monument of Stonehenge, where they appear to have influenced the winter solstice alignment of the later lithic phases of the site and the Avenue (Parker Pearson 2012).

The skyline location of many mines and quarries placed them between the earth and the sky, which in a layered cosmology may have situated them at a portal between the surface, the underworld and the heavens. The isolation and visual prominence of many sites appears to have been significant, although woodland will have created visual constraints (Allen & Gardiner 2012). The viewshed of Graiglwyd makes it visible from a wide range of coastal locations, as is Mynydd Rhiw; the quarry at Le Pinnacle, Jersey, was located at the base of a prominent coastal stack. In addition, as Cooney (1998) has observed, the fact that axe quarries visibly altered the surface of the landscape created a monumentality that embedded them psychologically into the cultural landscape. As Bradley (2000, 86-87) noted, it was the *'character of the place [which] seemed at least as important as the qualities of the [raw] material'*.

The extensive distribution of certain stone axehead types confirms both the cultural importance of their sources, and emphasises the extensive nature of the networks which transported these products across the UK. The most numerous axehead type is the abundant Cumbrian Group VI axehead which were transported throughout the UK and to Ireland and the Isle of Man. In Ireland 23% of Group VI axeheads were discovered in rivers and 20% in bogs, demonstrating their value for wetland deposition – although these percentages are significantly lower than those of indigenous Irish axeheads (Cooney & Mandal 1998, 144-146). In contrast many Group IX axeheads from Antrim were distributed throughout the UK, illustrating the importance of exotic, recognisable tool types to communities on both sides of the Irish Sea (Clough & Cummins 1988; Cooney & Mandal 1998). Anglo-Irish cultural connections are also implied at the Penrith henges, where Mayburgh parallels the morphology of Irish Boyne Valley henges, along with the recently excavated example at Catterick, both forming terminals on a major cross-Pennine route (Bradley 2007, 134-135).

The axehead roughouts originating from the 700+ Group VI quarries at Langdale/Scafell were distributed along valley routes west to the coastal plain and sites such as Ehenside Tarn for finishing, and east to the Eden Valley and the henge monuments at Penrith. From Penrith dispersal was widespread: east via Stainmore, then south-east across the Pennines through Yorkshire to the Thornborough henges and onwards to the Wolds. In contrast, the two North Welsh axe quarries have distinctly different distributions: Group VII axeheads from Graiglwyd are widely distributed throughout Wales and southern Britain, conversely, the few Group XXI Mynydd Rhiw axeheads appear confined to Wales (Clough & Cummins 1988; Burrow 2011). This could suggest that Graiglwyd axeheads had the greater cultural value in Wales and beyond, whereas Mynydd Rhiw appears to have supplied only regional needs. Arguably, long-distance distribution combined with large quantities of products are defining characteristics of deeply-valued extraction sites whose products were important to society. As Godelier (1999, 169) has observed, *'it is when the object of trade ... is used to reactivate this imaginary and symbolic relationship with the origin, that it becomes sacred and acquires an even greater value for having moved in to the religious area of power ... insofar as the origins of individuals and of groups has a bearing on the places they occupy in a social and cosmic order'*. The ethnography and archaeological evidence suggest such extraction sites probably practised ritualised extraction. Conversely, the sites with a limited product distribution pattern may illustrate different social conventions, although the fact that these raw materials were still purposefully quarried, rather than expediently acquired by surface collection, may still have embedded a greater cultural resonance than found with more mundane materials.

Towards the end of Early Bronze Age mining at Grime's Graves (Healy 2014), material evidence for ritualised practises appears to diminish or disappear, mines became pits, and bone picks replaced those of antler. At the Creag na Caillich quarries, a secondary phase of production changed to perforated axeheads, and the small pits at Den of Boddam provided little evidence for ritualisation. This all happened around the time when Arreton and Acton metalworking traditions were firmly established, cremation practises in Middle and Late Urns occurred, and Wessex 2 was eclipsed by Deverel-Rimbury traditions (Needham et al. 2010),

creating conditions for social transformation and flux, and terminating the ideological needs for ritualised extraction practises.

### **7:3 Final comments: stone extraction and identity at the beginning of the Neolithic.**

Fieldwork for the thesis has discovered that many of the earliest sites were in sight of the sea (the South Downs mines; Graiglwyd; Lambay Island; Tievebulliagh), which combined with their early radiocarbon dates (cf. Chapter 6), demonstrates that they were pivotal to the process of Neolithisation, particularly as they may have been the earliest Neolithic constructions in these areas. Consequently, extraction sites were deeply involved in the creation of identity and becoming Neolithic. The location of these early sites suggests that prospection and stone procurement during the earliest colonising phases of the Neolithic may have been undertaken via coastal routes, with the axe quarries ranged around the Irish Sea and the flint mines overlooking the Channel coastline, arguably fossilising two of the routes used by those who brought the Neolithic to the UK.

The archaeological record demonstrates that diverse communities in the UK and Europe followed certain common practises as part of a general tradition of stone extraction – with some regional variations. This implies that ritualised extraction had its foundations in a pan-European cultural phenomenon which was adopted in the UK and subsequently modified to reflect and accommodate emerging local or cultural diversity (Bradley 2007, 36). It was the role of the most prolific implement which emerged from the extraction sites, the axehead, which became truly transformative in society in a variety of ways. As Allen and Gardiner (2012, 100) have observed *‘the inherent symbolism of producing from the ancient forests the very means of cutting them down’* produced a paradigm shift. Communities no longer relied upon the unpredictability of fire or natural events to clear the forests and woodland, as in the preceding Mesolithic, they now took direct control over nature and began to transform their cultural landscape with the axe. Consequently, this implement, which was emblematic of control over nature, became adopted as a symbol of control in society and was embedded in various social institutions and carefully curated, forming, as Brumm (2011) has

characterised them – *power tools*. Tools that had emerged from ritualised performances at charged, storied locations on the very edge of the cultural landscape.

#### **7:4 Suggestions for future research.**

A number of research strands have emerged during the work on this thesis which would reward further study and enhance our understanding of the roles played by extraction sites. These include:

- Research into the extraction sites of the Paris Basin, Nord Pas de Calais and the Low Countries, to determine whether they did form the springboard for the earliest mines and quarries in the UK;
- Human skeletal remains could be investigated to determine whether these individuals originated in Europe, or were indigenous actors, which would inform the hypothesis of the putative European origins of mining. In addition, certain skeletons such as the female from Shaft 27, Cissbury, or the female skeleton from the Skeleton Pit at Cissbury, need to be examined for signs of trauma and to identify the cause of death;
- Isotopic analysis of antler picks could determine their place of origin in relation to the extraction sites to examine collection strategies, and help identify the approximate location of the extraction team home settlements.

## BIBLIOGRAPHY

- Adkins, R & Jackson, R 1978. *Neolithic Stone and Flint Axes from the River Thames*. London: British Museum, Department of Prehistoric and Romano-British Antiquities, Occasional Paper No 1.
- Affolter, J, Sedlmeier, J & Zurbuchen, M 1997. New results from the study of two flint mines in the Jura Mountains of Switzerland. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 13-21.
- Agricola, G 1556. *De Re Metallica* (Translated by HC & LH Hoover, 1912). New York: Dover Publications [Reprinted 1986].
- Ahler, SA 1986. *The Knife River Flint Quarries: Excavations at Site 32DU508*. Bismarck, North Dakota: State Historical Society of North Dakota.
- Aldsworth, FG 1979. A possible Neolithic oval barrow on Nore Down, West Marden. *Sussex Archaeological Collections* 117, 251.
- Allard, P & Burnez-Lanotte, L 2006. Linearbandkeramik: blade debitage at Verlaine "Petit Paradis" (Verlaine, Hesbaye, Belgium). In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 37-54.
- Allard, P, Bostyn, F, Gilligny, F & Lech, J, eds., 2008. *Flint mining in Prehistoric Europe: Interpreting the archaeological records* (BAR International Series 1891). Oxford: Archaeopress.
- Allchin, B 1957. Australian Stone Industries, Past and Present. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 87(1), 115-136.
- Allen, MJ & Gardiner, J 2012. Not Out of the Woods Yet: some reflections on Neolithic ecological relationships with woodland. In AM Jones, J Pollard, MJ Allen & J Gardiner (eds) *Image, Memory and Monumentality*. Oxford: The Prehistoric Society. 93-107.



Ammerman, AJ & Cavalli-Sforza, LL 1971. Measuring the rate of spread of early farming in Europe. *Man* 6, 674-688.

Armstrong, AL 1921. Flint-crust engravings, and associated implements from Grime's Graves, Norfolk. *Proceedings of the Prehistoric Society of East Anglia* 3(3), 434-443.

Armstrong, AL 1927. The Grime's Graves problem in the light of recent research. *Proceedings of the Prehistoric Society of East Anglia* 5, 91-136.

Armstrong, AL 1934a. The Percy Sladen Trust excavations, Grime's Graves, Norfolk. Interim report 1927-1932. *Proceedings of the Prehistoric Society of East Anglia* 7, 57-61.

Armstrong, AL 1934b. Grime's Graves, Norfolk: report on the excavation of Pit 12. *Proceedings of the Prehistoric Society of East Anglia* 7, 382-394.

Arnold, JE & Walsh, MR 2010. *California's Ancient Past: From the Pacific to the Range of Light*. Washington: The Society for American Archaeology Press.

Arthur, KW 2010. Feminine Knowledge and Skill Reconsidered: Women and Flaked Stone Tools. *American Anthropologist* 112(2), 228-243.

Bąbel, J 1997. Teaching flint knapping skills in Neolithic mining societies. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 167-169.

Bąbel, J 1999. PL6 Krzemionki, Gemeide Bodzechów, Wojw. Kielce und Gemeinde Boria, Wojw. Tarnobrzeg. In G Weisgerber (ed) *5000 Jahre Feuersteinbergbau: Die Suche nach dem Stahl der Steinzeit*. Bochum: Deutschen Bergbau-Museum. 586-595.

Bácskay, E 1995. H2 Sümeg-Mogyorósdomb, Veszprém County: The flint mine of Sümeg-Mogyorósdomb. *Archaeologia Polona* 33, 383-395.

Balcer, B 1995. The Relationship between a settlement and the flint mines. A preliminary study of the Eneolithic workshop assemblage from Ćmielów (Southern Poland). *Archaeologia Polona* 33, 209-221.

- Ballin, T 2004. The worked quartz vein at Cnoc Dubh, Uig parish, Isle of Lewis, Western Isles. Scottish Archaeological Internet Report 11 (2004) [www.sair.org.uk].
- Ballin, T 2011a. The felsite quarry complex of Northmaven: observations from a fact-finding mission to Shetland. In A Saville (ed) *Flint and Stone in the Neolithic Period*. Oxford: Oxbow Books. 62-81.
- Ballin, T 2011b. The felsite quarries of North Roe, Shetland – An overview. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 121-130.
- Ballin, T 2012. The distribution of worked felsite – within and outwith Neolithic Shetland. In DL Mahler (ed) *The Border of Farming and the Cultural Markers*. Copenhagen: The National Museum of Denmark.
- Ballin, TB & Ward, T 2013. Burnetland Hill Chert Quarry: A Mesolithic extraction site in the Scottish Borders. *The Quarry* #9 (January 2013), 3-23.
- Bamforth, DB 2006. The Windy Ridge quartzite quarry: hunter-gatherer mining and hunter-gatherer land use on the North American Continental Divide. *World Archaeology* 38(3), 511-527.
- Barber, M 2005. Mining, Burial and Chronology: the West Sussex Flint Mines in the Late Neolithic and Early Bronze Age. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 94-109.
- Barber, M 2006. The place of flint mines within the Early Neolithic of Southern England. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 55-60.
- Barber, M, Field, D & Topping, P 1999. *The Neolithic Flint Mines of England*. Swindon: RCHME/English Heritage.
- Barber, M & Dyer, C 2005. Scouting for Shafts: Aerial Reconnaissance and the Neolithic Flint Mines at Stoke Down, West Sussex. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 30-50.

Barclay, GJ 1983. Sites of the third millennium bc to the first millennium ad at North Mains, Strathallan, Perthshire. *Proceedings of the Society of Antiquaries of Scotland* 113, 122-281.

Barclay, GJ & Maxwell, GS 1991. Excavation of a long mortuary enclosure within the Roman legionary fortress at Inchtuthill, Perthshire. *Proceedings of the Society of Antiquaries of Scotland* 121, 27-44.

Barclay, GJ & Maxwell, GS 1998. *The Cleaven Dyke and Littleour: Monuments in the Neolithic of Tayside*. Edinburgh: Society of Antiquaries of Scotland, Monograph 13.

Barclay, GJ & Russell-White, CJ 1993. Excavations in the ceremonial complex of the fourth to second millennium BC at Balfarg/Balbirnie, Glenrothes, Fife. *Proceedings of the Society of Antiquaries of Scotland* 123, 43-210.

Barnatt, J & Timberlake, S 2013. The Ecton Mines: four millennia of extracting copper. *British Archaeology* 133 (November/December 2013), 18-23.

Barrett, JC 1994. *Fragments from Antiquity: An Archaeology of Social Life in Britain, 2900-1200BC*. Oxford: Blackwell.

Bates, B 2003. *The Real Middle-Earth: Magic and Mystery in the Dark Ages*. London: Pan Books.

Battaglia, D 1990. *On the Bones of the Serpent: Person, Memory, and Materiality in Sabarl Island Society*. Chicago: The University of Chicago Press.

Bayliss, A, Healy, F, Whittle, A & Cooney, G 2011. Neolithic narratives: British and Irish enclosures in their timescapes. In A Whittle, F Healy & A Bayliss, *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*. Oxford: Oxbow Books. 682-847.

Bayman, JM & Dye, TS 2013. *Hawaii's Past in a World of Pacific Islands*. Washington: The Society for American Archaeology Press.

Beaubien, PL 1983. Notes on the archaeology of Pipestone National Monument. *The Minnesota Archaeologist* 42 (1 & 2), 37-80.

- Beaumont, PB & Boshier, AK 1974. Report on test excavations in a prehistoric pigment mine near Postmasburg, Northern Cape. *The South African Archaeological Bulletin* 29 (June 1974), 113/114, 41-59.
- Beckensall, S 2002. *Prehistoric Rock Art in Cumbria*. Stroud: Tempus.
- Bell, C 1997. *Ritual: Perspectives and Dimensions*. Oxford: Oxford University Press.
- Best, E 1912. *The Stone Implements of the Maori*. Wellington: AR Shearer.
- Beuker, J 2005. Import from all quarters: Stone axes in the northern Netherlands. In LPL Kooijmans, PW van den Broeke, H Fokkens & AL van Gijn (eds) *The Prehistory of the Netherlands, Volume I*. Amsterdam: Amsterdam University Press. 277-280.
- Bickler, SH, & Turner, M 2002. Food to Stone: Investigations at the Suloga adze manufacturing sites, Woodlark Island, Papua New Guinea. *The Journal of the Polynesian Society* 111(1), 11-44.
- Binford, LR 1962. Archaeology as Anthropology. *American Antiquity* 28(2), 217-225.
- Binford, LR 1979. Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35, 255-273.
- Binford, LR 1980. Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45, 4-20.
- Binford, LR 1983. *In Pursuit of the Past: Decoding the Archaeological Record*. London: Thames & Hudson.
- Binford, LR & O'Connell, JF 1984. An Alyawara Day: The Stone Quarry. *Journal of Anthropological Research* 40(3) (Autumn 1984), 406-432.
- Bishop, B 2012. *Grime's Graves Environs*. Unpublished PhD thesis, University of York.
- Bloch, M 1971. *Placing the Dead, Tombs, Ancestral Villages and Kinship Organisation in Madagascar*. London: Seminar Press.

- Boas, F & Hunt, G 1921. *Ethnology of the Kwakiutl*. Washington: American Bureau of Ethnology, 35<sup>th</sup> Annual Report.
- Boivin, N 2004. From veneration to exploitation: human engagement with the mineral world. In N Boivin & MA Owoc (eds), *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World*. London: UCL Press. 1-29.
- Boivin, N & Owoc, MA (eds) 2004. *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World*. London: UCL Press.
- Bonsall, C, Sutherland, D, Tipping, R & Cherry, J 1986. The Eskmeals Project 1981-5: an Interim Report. *Northern Archaeology* 7(1), 3-30.
- Booth, AStJ & Stone, JFS 1952. A trial flint mine at Durrington, Wiltshire. *Wiltshire Archaeological and Natural History Magazine* 54, 381-388.
- Borkowski, W 1995a. *Krzemionki Mining Complex: Deposit management system*. Warsaw: Państwowe Muzeum Archeologiczne Zespół Do Badań Pradziejowego Górnictwa.
- Borkowski, W 1995b. PL6 Krzemionki, Kielce Province. *Archaeologia Polona* 33, 506-524.
- Borkowski, W, Gieysztor-Szymczak, E, Migal, W & Sałaciński, S nd. *Prehistoric Flint Mining in Poland*. Warsaw: State Archaeological Museum in Warsaw.
- Bosch, J & Gómez, A 2009. Estudi de les Ceràmiques Neolítiques Procedents de les Mines 83, 84, 85 i 90 de Gavà. *Rubricatum* 4, 63-83.
- Boschian, G & Zamagni, B 2006. The area distribution of the artefacts in the flint workshop of the San Bartolomeo Rock-shelter (Abruzzo, Central-Italy). In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 301-306.
- Bostyn, F 1997. Characterization of flint production and distribution of the tabular Bartonian flint during the Early Neolithic (Villeneuve-Saint-Germain Period) in France. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 171-183.

- Bostyn, F & Lanchon, Y 1992. *Jablins, Le Haut Château (Seine-et-Marne): Une minière de silex au Néolithique*. Paris: Editions de la Maison des Sciences de l'Homme, Documents d'Archéologie Française, n° 35.
- Bostyn, F & Lanchon, Y 1995. F50 Jablins, "Le Haut-Château", Seine-et-Marne District: The Neolithic flint mine at Jablins, "le Haut-Château" (Seine-et-Marne). *Archaeologia Polona* 33, 297-310.
- Bostyn, F, Giligny, F & AL Carmine 2008. A new flint mine at Flins-sur-Seine/ Aubergenville (Yvelines, France). In P Allard, F Bostyn, F Giligny & J Lech (eds) *Flint Mining in Prehistoric Europe: Interpreting the archaeological records*. Oxford: British Archaeological Reports International Series 1891. 79-95.
- Bottrell, W 1873. *Traditions and Hearthside Stories of West Cornwall*, Volume II. Penzance: Beare and Sons.
- Bourdieu, P 1990. *The Logic of Practise*. Cambridge: Polity Press.
- Bourke, JG 1884. *Snake-Dance of the Moquis*. Tucson. University of Arizona (Originally published in 1884).
- Bowden, M 1991. *Pitt Rivers*. Cambridge: Cambridge University Press.
- Bower, B 2002. Openings to the Underworld: The ancient Maya may have dug caves with spiritual abandon. *Science News Online* [online]. Available from: <http://www.sciencenews.org/20020518/bob9.asp> [Accessed 22 May 2002].
- Bowers, AW 1950. *Mandan Social and Ceremonial Organisation*. Chicago. University of Chicago Press.
- Bowers, AW 1992. *Hidatsa Social and Ceremonial Organisation*. Lincoln. University of Nebraska Press, Bison Books.
- Bradley, R 1978. *The Prehistoric Settlement of Britain*. London: Routledge & Kegan Paul.
- Bradley, R 1984. *The Social Foundations of Prehistoric Britain*. Harlow: Longmans.

- Bradley, R 1990. *The Passage of Arms: An archaeological analysis of prehistoric hoards and votive deposits*. Cambridge: Cambridge University Press.
- Bradley, R 1997. *Rock Art and the Prehistory of Atlantic Europe: Signing the Land*. London: Routledge.
- Bradley, R 2000. *An Archaeology of Natural Places*. London: Routledge.
- Bradley, R 2005. *Ritual and Domestic Life in Prehistoric Europe*. London: Routledge.
- Bradley, R 2007. *The Prehistory of Britain and Ireland*. Cambridge: Cambridge University Press.
- Bradley, R & Edmonds M 1988. Fieldwork at Great Langdale, Cumbria, 1985-1987: preliminary report. *Antiquaries Journal* 68, 181-209.
- Bradley, R & Edmonds, M 1993. *Interpreting the axe trade: Production and exchange in Neolithic Britain*. Cambridge: Cambridge University Press.
- Bradley, R & Ford, S 1986. The siting of Neolithic stone quarries – Experimental archaeology at Great Langdale, Cumbria. *Oxford Journal of Archaeology* 5(2), 123-128.
- Bradley, R & Gardiner, J 1984. *Neolithic Studies: a Review of Some Current Research*. Oxford: British Archaeological Reports, British Series 133.
- Bradley, R, Meredith, P, Smith, J & Edmonds, M 1992. Rock Physics and the Neolithic Axe Trade in Great Britain. *Archaeometry* 34(2), 223-233.
- Bradley, R & Suthren, R 1990. Petrographic analysis of hammerstones from the Neolithic quarries at Great Langdale. *Proceedings of the Prehistoric Society* 56, 117-122.
- Brady, JE & Rissolo, D 2006. A Reappraisal of Ancient Maya Cave Mining. *Journal of Anthropological Research* 62:4 (Winter 2006), 471-490.
- Brewer-LaPorta, M, Burke, A & Field, D (eds) 2010. *Ancient Mines and Quarries: A Trans-Atlantic Perspective*. Oxford: Oxbow Books.

- Brewster, TCM 1984. *The Excavation of Whitegrounds Barrow, Burythorpe*. Malton: The East Riding Archaeological Research Committee.
- Brounen, FTS 1995. NL3 Valkenburg aan de Geul, Limburg Province: Neolithic flint extraction at Valkenburg aan de Geul. *Archaeologia Polona* 33, 445-453.
- Brown, AG 1991. Structured deposition and technological change among the flaked stone artefacts from Cranborne Chase. In J Barrett, R Bradley & M Hall (eds) *Papers on the Prehistoric Archaeology of Cranborne Chase*. Oxford: Oxbow Books. 101-133.
- Brown, AG 1995. Beyond Stone Age economics: a strategy for a contextual lithic analysis. In AJ Schofield (ed) *Lithics in Context: Suggestions for the Future Direction of Lithic Studies*. London: Lithic Studies Society, Occasional Paper 5. 27-36.
- Brown, M 1996. Skelmore Heads, Urswick, Cumbria. Swindon: Unpublished RCHME survey report.
- Brown, M 2002. The Howe Robin Story: an unusual enclosure on Crosby Ravensworth Fell. In G Varndell & P Topping (eds) *Enclosures in Neolithic Europe*. Oxford: Oxbow Books. 110-114.
- Brumm, A 2004. An axe to grind: Symbolic considerations of stone axe use in Ancient Australia. In N Boivin & MA Owoc (eds), *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World*. London: University College London Press. 143-163.
- Brumm, A 2010. 'The Falling Sky': Symbolic and Cosmological Associations of the Mt William Greenstone Axe Quarry, Central Victoria, Australia. *Cambridge Archaeological Journal* 20(2), 179-196.
- Brumm, A 2011. Power tools: Symbolic considerations of stone axe production and exchange in 19<sup>th</sup> century south-eastern Australia. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 85-97.



Bryan, K 1950. Flint quarries – the sources of tools and, at the same time, the factories of the American Indians. Cambridge, Massachusetts: *Harvard University Peabody Museum Papers XVII(3)*.

Budziszewski, J 1997. C-14 dating of shallow flint mine sites. Case study from the “Za Garnarczami” mining field in Ożarów (Central Poland). In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 49-55,

Bunch, B & Fell, C 1949. A Stone-Axe Factory at Pike of Stickle, Great Langdale, Westmorland. *Proceedings of the Prehistoric Society* 15, 1-20.

Burl, A 1976. *The Stone Circles of the British Isles*. London: Yale University Press.

Burl, A 1993. *From Carnac to Callanish: The Prehistoric Stone Rows of Britain, Ireland and Brittany*. London: Yale University Press.

Burrow, S 2011. The Mynydd Rhiw quarry site: Recent work and its implications. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 247-260.

Burton, J 1984. Quarrying in a tribal society. *World Archaeology* 16, 234-247.

Burton, J 1989. Repeng and the Salt-Makers: ‘Ecological Trade’ and Stone Axe Production in the Papua New Guinea Highlands. *Man (New Series)* 24(2), 255-272.

Calder, CST 1938. Excavations of three Neolithic chambered cairns – one with an upper and a lower chamber – in the islands of Eday and Calf of Eday in Orkney. *Proceedings of the Society of Antiquaries of Scotland* 72, 193-216.

Calder, CST 1950. Report on the excavation of a Neolithic temple at Stanydale in the parish of Sandsting, Shetland. *Proceedings of the Society of Antiquaries of Scotland* 84 (1949-50), 185-205.

Calder, CST 1956. Report on the discovery of numerous Stone Age house sites in Shetland. *Proceedings of the Society of Antiquaries of Scotland* 89 (1955-56), 340-397.

Capote, M, Castañeda, N, Consuegra, S, Criado, C & Díaz-del-Río, P 2008. Flint mining in early Neolithic Iberia: a preliminary report on 'Casa Montero' (Madrid, Spain). In P Allard, F Bostyn, F Giligny & J Lech (eds) *Flint Mining in Prehistoric Europe: Interpreting the archaeological records*. Oxford: British Archaeological Reports International Series 1891. 123-137.

Capote, M, Consuegra, S, Díaz-del-Río, P & Terradas, X, eds., 2011. *Proceedings of the 2<sup>nd</sup> International Conference of the UISPP Commission on Flint Mining in Pre- and Protohistoric Times (Madrid, 14-17 October 2009)*. Oxford: Archaeopress.

Casas, A & Majó, T 2009. Estudi Arqueoantropològic de les Restes Humanes Neolítiques de les Mines 84 I 90 de Gavà (Baix Llobregat). *Rubricatum* 4, 209-223.

Cassen, S, Boujot, C, Bella, SD, Guiavarc'h, M, Le Pennec, C, Martinez, MPP, Querré, G, Santrot, M-H & Vigier, E 2012. Dépôts Bretons, tumulus carnacéens et circulations à longue distance. In Pétrequin *et al.* 2012a. 918-995.

Catlin, G 1841. *Letters and Notes on the Manners, Customs, and Conditions of the North American Indians*, 2 volumes. (Reprinted and edited as P Matthiessen (ed) 1989, *George Catlin: North American Indians*, New York: Penguin Books).

Catlin, G 1867. Last rambles amongst the Indians of the Rocky Mountains and the Andes. New York: D Appleton. (Quoted in Holmes 1919, 295-6).

Celoria, F 1974. Preliminary List of Neolithic Axes from the London Region with Petrographic Data. *London Studies* 1, 87-92.

Chappell, J 1966. Stone Axe Factories in the Highlands of East New Guinea. *Proceedings of the Prehistoric Society* 32, 96-121.

Chappell, S 1987. *Stone Axe Morphology and Distribution in Neolithic Britain*. Oxford: British Archaeological Reports, British Series 177.

Charniausky, MM 1995. BY1 Krasnaselsky, Grodna Province; BY2 Karpautsy, Grodna Province: Ancient flint mines in Belarus. *Archaeologia Polona* 33, 263-269.

- Cheben, I & Illášová, L 1997. Radiolarite mining pits in Bolešov, Vlára Pass. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 57-61.
- Childe, VG 1931. *Skara Brae: A Pictish Village in Orkney*. London: Kegan Paul, Trench, Trubner & Co Ltd.
- Childs, ST, & Killick, D 1993. Indigenous African Metallurgy: Nature and Culture. *Annual Review of Anthropology* 22, 317-337.
- Claris, P & Quartermaine, J 1989. The Neolithic quarries and axe-factory sites of Great Langdale and Scafell Pike: a new field survey. *Proceedings of the Prehistoric Society* 55, 1-25.
- Clark, JGD 1954. Excavations at Star Carr: an Early Mesolithic site at Seamer near Scarborough Yorkshire. Cambridge: Cambridge University Press.
- Clark, JGD & Piggott, S 1933. 'The age of the British flint mines'. *Antiquity* 7, 166-183.
- Clark, CP & Martin, SR 2005. A Risky Business: Late Woodland Copper Mining on Lake Superior. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 110-122.
- Clarke, R 1935. The flint-knapping industry at Brandon. *Antiquity* 9, 38-56.
- Clarke, WG (ed) 1915. *Report on the Excavations at Grime's Graves, Weeting, Norfolk, March-May 1914*. London: Prehistoric Society of East Anglia.
- Clason, A.T. 1981. The Flintminer as a Farmer, Hunter and Antler Collector. *Third International Symposium on Flint, 24-27 Mei 1979, Maastricht*, 119-125. Maastricht: Nederlandse Geologische Vereniging.
- Clayton, L, Bickley Jr, WB & Stone, WJ 1970. Knife River Flint. *Plains Anthropologist* 15 (Nov 1970), 50(1), 282-290.
- Cleal, R & MacSween, A 1999. *Grooved Ware in Britain and Ireland*. Oxford: Oxbow Books.

- Cleghorn, PL 1984. An historical review of Polynesian stone adze studies. *The Journal of the Polynesian Society* 93(4), 399-422.
- Clough, THMcK 1973. Excavations on a Langdale axe chipping site in 1969 and 1970. *Transactions of the Cumberland & Westmorland Antiquarian & Archaeological Society, New Series*, LXXIII, 25-46.
- Clough, THMcK 1988. Introduction to the regional reports: prehistoric stone implements from the British Isles. In THMcK Clough & WA Cummins (eds) *Stone Axe Studies, Volume 2*. London: Council for British Archaeology Research Report No. 67. 1-11.
- Clough, THMcK & Cummins, WA 1979. *Stone Axe Studies*. London: Council for British Archaeology Research Report No. 23.
- Clough, THMcK & Cummins, WA (eds) 1988. *Stone Axe Studies, Volume 2*. London: Council for British Archaeology Research Report No. 67.
- Clutton-Brock, J 1984. *Excavations at Grimes Graves, Norfolk, 1972-1976, Fascicule 1: Neolithic antler picks from Grimes Graves, Norfolk, and Durrington Walls, Wiltshire: a biometrical analysis*. London: British Museum Press.
- Cobb, CR 2000. *From Quarry to Cornfield: The Political Economy of Mississippian Hoe Production*. Tuscaloosa: University of Alabama Press.
- Coles, B & Coles, J 1986. *Sweet Track to Glastonbury*. London: Thames & Hudson.
- Coles, JM & Simpson, DDA 1965. The Excavation of a Neolithic Round Barrow at Pitnacree, Perthshire, Scotland. *Proceedings of the Prehistoric Society* 31, 34-57.
- Coles, S, Ford, S & Taylor, A 2008. An early Neolithic grave and occupation, and an early Bronze Age hearth on the Thames foreshore at Yabsley Street, Blackwall, London. *Proceedings of the Prehistoric Society* 74, 215-234.
- Collet, H, Hubert, F, Robert, C & Joris, J-P 2006. The flint mines of Petit-Spiennes (province of Hainault, Belgium): an update. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 67-72.

- Conneller, C 2008. Lithic Technology and the *Chaîne Opératoire*. In J Pollard (ed) *Prehistoric Britain*. Oxford: Blackwell. 160-176.
- Cooney, G 1998. 'Breaking Stones, Making Places: the Social Landscape of Axe Production Sites'. In Gibson, A & Simpson, D (eds) *Prehistoric Ritual and Religion*. Stroud: Sutton Publishing. 108-118.
- Cooney, G 2000. *Landscapes of Neolithic Ireland*. London: Routledge.
- Cooney, G 2005. Stereo Porphyry: Quarrying and Deposition on Lambay Island, Ireland. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 14-29.
- Cooney, G 2007. Parallel worlds or multi-stranded identities? Considering the process of 'going over' in Ireland and the Irish Sea zone. In A Whittle & V Cummings (eds) *Going over: The Mesolithic-Neolithic Transition in North-West Europe*. Oxford: Oxford University Press, Proceedings of the British Academy 144. 543-566.
- Cooney, G 2014. *North Roe Survey; First season of North Roe Felsite Project*. Unpublished report.
- Cooney, G 2015. Stone and flint axes in Neolithic Europe. In C Fowler, J Harding & D Hofmann (eds) *The Oxford Handbook of Neolithic Europe*. Oxford: Oxford University Press. 515-534.
- Cooney, G & Mandal, S 1998. *The Irish Stone Axe Project, Monograph 1*. Bray: Wordwell.
- Cooney, G, Mandal, S & O'Keefe, E 2011. The Irish Stone Axe Project: Reviewing progress, future prospects. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 427-442.
- Cooney, G, Mandal, S, O'Keefe, E, Warren, G, Ballin, T & Megarry, W 2012a. Axes from islands: the role of stone axeheads from insular sources in the Neolithic of Ireland and Britain. In DL Mahler (ed) *The Border of Farming and the Cultural Markers*. Copenhagen: The National Museum of Denmark. 79-99.

Cooney, G, Mandal, S, O’Keeffe, E & Warren, G 2012b. A centre of island life, axe production on Rathlin Island. In DL Mahler (ed) *The Border of Farming and the Cultural Markers*. Copenhagen: The National Museum of Denmark. 83-87.

Cooper, HK 2011. The life (lives) and times of native copper in Northwest North America. *World Archaeology* 43(2), 252-270.

Costa, LJ 2007. *L’Obsidienne: Un témoin d’échanges en Méditerranée préhistorique*. Paris: Editions Errance.

Coutts, PJF 1971. Greenstone: The Prehistoric Exploitation of Bowenite from Anita Bay, Milford Sound. *The Journal of the Polynesian Society* 80(1), 42-73.

Craddock, PT, Cowell, MR, Leese, MN & Hughes, MJ 1983. The trace element composition of polished flint axes as an indicator of source. *Archaeometry* 25, 135-163.

Crace, J 1989. *The Gift of Stones*. London: Pan Books.

Craddock, PT, Cowell, MR & Hughes, MJ 2012. The provenancing of flint axes by chemical analysis and the products of Grimes Graves mines: a reassessment. In I Longworth, G Varndell & J Lech *Excavations at Grimes Graves, Norfolk, 1972-1976: Fascicule 6*. London: British Museum Press. 145-157.

Craig, B 1990. Relic and trophy arrays as art among the Mountain-Ok, central New Guinea. In L Hanson & A Hanson (eds) *Art and Identity in Oceania*. Bathurst: Robert Brown. 196-210.

Cranstone, BAL 1971. The Tifalmin: a ‘Neolithic’ people in New Guinea. *World Archaeology* 3(2), 132-142.

Crothers, GM 2012. Early Woodland Ritual Use of Caves in Eastern North America. *American Antiquity* 77(3), 524-541.

Cummings, V 2004. The monuments of north-west Wales and their landscape settings. In V Cummings and A Whittle *Places of Special Virtue: Megaliths in the Neolithic Landscapes of Wales*. Oxford: Oxbow Books. 41-55.

Cunnington, ME 1929. *Woodhenge*. Devizes: George Simpson.

- Curwen, EC 1937. *The Archaeology of Sussex*. London: Methuen & Co.
- Curwen, E & Curwen, EC 1926. Harrow Hill flint-mine excavation 1924-5. *Sussex Archaeological Collections* 67, 103-138.
- Darbishire, RD 1874. Notes on discoveries at Ehenside Tarn, Cumberland. *Archaeologia* 44, 273-292.
- Davidson, JL & Henshall, AS 1983. A Neolithic chambered long cairn at Edinchip, Perthshire. *Proceedings of the Society of Antiquaries of Scotland* 113, 35-39.
- Davis, LB, Aaberg, SA, Schmitt, JG & Johnson, AM 1995. *The Obsidian Cliff Plateau Prehistoric Lithic Source, Yellowstone National Park, Wyoming*. Denver, Colorado. National Park Service, Rocky Mountain Region, Division of Cultural Resources, Selections Series, No. 6.
- Davis, V, Davis, A & Markham, M 2007. The sourcing and dispersal of prehistoric stone implements from Carrock Fell, Cumbria. In P Cherry (ed) *Studies in Northern Prehistory: Essays in Memory of Clare Fell*. Kendal: Cumberland & Westmorland Antiquarian & Archaeological Society. 100-114.
- Davis, V & Edmonds, M (eds) 2011. *Stone Axe Studies III*. Oxford: Oxbow Books.
- Davis, V & Quatermaine, J 2007. Widening the Horizons: Recent Discoveries of Axe Factories in the Lakeland Fells. In P Cherry (ed) *Studies in Northern Prehistory: Essays in Memory of Clare Fell*. Kendal: Cumberland & Westmorland Antiquarian & Archaeological Society. 141-151.
- Dean, C 2010. *A Culture of Stone: Inka Perspectives on Rock*. Durham & London: Duke University Press.
- DeCory, S & DeCory, J 1989. The Gift of the Sacred Pipe. *Coteau Heritage* 2:1 (April 1989), 18-19.
- Demoule, J-P (ed) 2007. *La révolution néolithique en France*. Paris: La Découverte.

- Derby, C 1989. Local Native American Craftsmen. *Coteau Heritage* 2:1 (April 1989), 15-17.
- DeRegnaucourt, T & Georgiady, J 1998. *Prehistoric Chert Types of the Midwest*. Arcanum, Ohio: Occasional Monographs Series of the Upper Miami Valley Archaeological Research Museum No. 7.
- Diamond, J 2013. *The World Until Yesterday*. London: Penguin Books.
- Díaz-del-Río, P, Consuegra, S, Castañeda, N, Capote, M, Criado, C, Bustillo, MA, & Pérez-Jiménez, JL 2006. The earliest flint mine in Iberia. *Antiquity* 80, No 307 (March 2006) [<http://antiquity.ac.uk/ProjGall/diazdelrio/index.html>].
- Dijkman, W 1999. F6 Salinelles “Vigne du Cade”, Dép. Gard. In G Weisgerber (ed) *5000 Jahre Feuersteinbergbau*. Bochum: Deutschen Bergbau-Museum Bochum, Nr. 77. 478-479.
- Dillian, CD 2002. *More Than Toolstone: Differential Utilization of Glass Mountain Obsidian*. Unpublished DPhil thesis, University of California, Berkeley.
- Dobosi, VT 2006. Lovas (Hungary) ochre mine reconsidered. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 29-36.
- Doelman, T 2008. *Time to Quarry: The Archaeology of Stone Procurement in Northwestern New South Wales, Australia*. Oxford: BAR International Series 1801.
- Dorsey, GA 1900. An Aboriginal Quartzite Quarry in Eastern Wyoming. *Field Columbian Museum Publication* 51, *Anthropological Series* II(4), 235-243.
- Dutton, A & Fasham, PJ 1994. Prehistoric copper mining on the Great Orme, Llandudno, Gwynedd. *Proceedings of the Prehistoric Society* 60, 245-286.
- Dubois, C 1935. Wintun Ethnography. *University of California Publications in American Archaeology and Ethnology* 28(5), 279-403.
- Edmonds, M 1987. Rocks and Risk: Problems with Lithic Procurement Strategies. In AG Brown & MR Edmonds (eds) *Lithic Analysis and Later British*



*Prehistory: Some problems and approaches*. Oxford: BAR British Series 162 (Reading Studies in Archaeology No2). 155-179.

Edmonds, M 1990. Description, understanding and the *chaîne opératoire*. *Archaeological Review from Cambridge* 9(1), 55-70.

Edmonds, M 1993a. Interpreting causewayed enclosures in the past and the present. In C Tilley (ed) *Interpretative Archaeology*. Oxford: Berg. 99-142.

Edmonds, M 1993b. Towards a context for production and exchange: the polished stone axe in earlier Neolithic Britain. In C Scarre & F Healy (eds) *Trade and Exchange in Prehistoric Europe*. Oxford: Oxbow Books. 69-86.

Edmonds, M 1993c. Interpreting Causewayed Enclosures in the Past and the Present. In C Tilley (ed) *Interpretative Archaeology*. Oxford: Berg. 99-142.

Edmonds, M 1995. *Stone Tools and Society*. London: Batsford.

Edmonds, M 1999. *Ancestral Geographies of the Neolithic: Landscapes, monuments and memory*. London: Routledge.

Edmonds, M 2012. Axes and Mountains: a view from the West. In P Pétrequin, S Cassen, M Errera, L Klassen, A Sheridan, & A-M Pétrequin (eds) 2012a. *JADE. Grandes haches alpines du Néolithique européen, V<sup>e</sup> au IV<sup>e</sup> millénaires av. J.-C.* Bésançon: Presses Universitaires de Franche-Comté n° 1224, Collection Les cahiers de la MSHE Ledoux n° 17, Série Dynamiques territoriales n° 6. 1194-1207.

Edmonds, M & Richards, C (eds) 1998. *Understanding the Neolithic of North-Western Europe*. Glasgow: Cruithne Press.

Edmonds, M, Sheridan, A & Tipping, R 1992. Survey and excavation at Creag na Caillich, Killin, Perthshire. *Proceedings of the Society of Antiquaries of Scotland* 122, 77-112.

Eerkens, JW, Vaughan, KJ & Grados, ML 2009. Pre-Inca mining in the Southern Nasca Region, Peru. *Antiquity* 83, 738-750.

Emerson, TE & Hughes, RE 2000. Figurines, Flint Clay Sourcing, The Ozark Highlands, and Cahokian Acquisition. *American Antiquity* 65, 79-101.

Ericson, JE 1984. Toward the analysis of lithic production systems. In JE Ericson & BA Purdy (eds.) *Prehistoric Quarries and Lithic Production*. Cambridge: Cambridge University Press. 1-9.

Ericson, JE & Purdy, BA, (eds.), 1984. *Prehistoric Quarries and Lithic Production*. Cambridge: Cambridge University Press.

Evans, AA 1934. A Countryman's Diary. *Sussex County Magazine* 8(7).

Evans, H 2004. Where is the Cumbrian Neolithic? In V Cummings & C Fowler (eds) *The Neolithic of the Irish Sea: Materiality and traditions of practise*. Oxford: Oxbow Books. 123-128.

Evans, J 1872. *The ancient stone implements, weapons and ornaments of Great Britain*. London: Longmans, Green & Co.

Evens, EDL, Grinsell, LV, Piggott, S & Wallis, FS 1962. Fourth Report of the Sub-Committee of the South-Western Group of Museums and Art Galleries on the Petrological Identification of Stone Axes. *Proceedings of the Prehistoric Society* 28, 209-266.

Evers, TM 1975. Recent Iron Age research in the Eastern Transvaal, South Africa. *The South African Archaeological Bulletin* 30 (December 1975), 119/120, 71-83.

Felder, PJ, Rademakers, PCorM & de Grooth, METh 1998. *Excavations of Prehistoric Flint Mines at Rijkholt-St. Geertruid (Limburg, The Netherlands) by the 'Prehistoric Flint Mines Working Group' of the Dutch Geological Society, Limburg Section*. Bonn: Archäologische Berichte 12.

Fell, C 1951. The Great Langdale stone-axe factory. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 50, 1-14.

Fell, C 1964. The Cumbrian Type of Polished Stone Axe and its Distribution in Britain. *Proceedings of the Prehistoric Society* 30, 39-55.

- Fell, CI & Davis, RV 1988. The Petrological identification of stone implement from Cumbria. In THMcK Clough & WA Cummins (eds) 1988. *Stone Axe Studies, Volume 2*. London: Council for British Archaeology Research Report No. 67. 71-77.
- Field, D 1997. The Worthing Flint Mine Complex. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 65-69.
- Field, D 2006a. Procurement and extraction of flint in Wessex, England. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 77-82.
- Field, D 2006b. *Earthen Long Barrows: The earliest monuments in the British Isles*. Stroud: Tempus.
- Field, D 2008. The Development of an Agricultural Countryside. In J Pollard (ed) *Prehistoric Britain*. Oxford: Blackwell. 202-224.
- Field, D 2012. Porourangi: a Maori symbol of war, peace and identity. In J Trigg (ed) *Of Things Gone But Not Forgotten: essays in archaeology for Joan Taylor*. Oxford: British Archaeological Reports, International Series 2434. 55-61.
- Fladmark, KR 1984. Mountain of Glass: Archaeology of the Mount Edziza obsidian source, British Columbia, Canada. *World Archaeology* 16(2), 139-156.
- Fladmark, KR 1985. *Glass and Ice: The Archaeology of Mt. Edziza*. Burnaby, British Columbia: Simon Fraser University, Department of Archaeology, Publication No. 14.
- Flood, J 1995. *The Archaeology of the Dreamtime* (Revised Edition). London: Collins.
- Flood, J 1997. *Rock Art of the Dreamtime*. London: Harper Collins.
- Fogelin, L & Schiffer, MB 2015. Rites of Passage and Other Rituals in the Life Histories of Objects. *Cambridge Archaeological Journal* 25(4), 815-827.

- Fontijn, D 2007. The Significance of 'Invisible' Places. *World Archaeology* 39 (1), 70-83.
- Forrest, AJ 1983. *Masters of Flint*. Lavenham: Terence Dalton.
- Fowler, C 2003. Rates of (ex)change: decay and growth, memory and the transformation of the dead in early Neolithic southern Britain. In H Williams (ed) *Archaeologies of Remembrance – Death and Memory in Past Societies*. New York: Academic/Plenum Press. 45-63.
- Fowler, C 2004. *The Archaeology of Personhood*. Abingdon: Routledge.
- Fowler, C 2013. *The Emergent Past: A Relational Realist Archaeology of Early Bronze Age Mortuary Practises*. Oxford: Oxford University Press.
- Frieman, C 2012. *Innovation and Imitation: Stone Skeuomorphs of Metal from 4<sup>th</sup>-2<sup>nd</sup> Millennia BC Northwest Europe*. Oxford: BAR Int Ser 2365.
- Gardiner, JP 1984. Lithic distributions and Neolithic settlement patterns in Central Southern England. In R Bradley & J Gardiner (eds) *Neolithic Studies: a review of current research*. Oxford: British Archaeological Reports, British Series 133, 15-40.
- Gardiner, JP 1990. Flint procurement and Neolithic axe production on the South Downs: a re-assessment. *Oxford Journal of Archaeology* 9(2), 119-140.
- Gardiner, J 2001. Catalogue of Surviving Flintwork from the Worthing Group of Mines. In M Russell *Rough Quarries, Rocks and Hills: John Pull and the Neolithic Flint Mines of Sussex*. Oxford: Oxbow Books. 202-223.
- Garrow, D, Beadsmoore, E & Knight, M 2005. Pit Clusters and the Temporality of Occupation: an Earlier Neolithic Site at Kilverstone, Thetford, Norfolk. *Proceedings of the Prehistoric Society* 71, 139-157.
- Gero, J 1989. Assessing social information in material objects: how well do lithics measure up? In R Torrence (ed) *Re-tooling: Towards a Behavioral Theory of Stone Tools*. In R Torrence (ed) *Time, Energy and Stone Tools*. Cambridge: Cambridge University Press. 92-105.

- Gero, J 1991. Genderlithics: Women's Roles in Stone Tool Production. In J Gero & M Conkey (eds) *Engendering Archaeology: Women and Prehistory*. Oxford: Blackwell. 163-193.
- van Gijn, AL 2010. *Flint in Focus: Lithic Biographies in the Neolithic and Bronze Age*. Leiden. Sidestone Press.
- Giligny, F 2011. Neolithic territories and lithic production: some examples from the Paris Basin and neighbouring regions. In A Saville (ed) *Flint and Stone in the Neolithic Period*. Oxford: Oxbow Books. 179-195.
- Giligny, F, Bostyn, F, Couderc, J, Lethrosne, H, Le Maux, N, Lo Carmine, A & Riquier, C 2011. Production and diffusion of axes in the Seine valley. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 149-166.
- Giligny, F, Bostyn, F & Le Maux, N 2012. Production et importation de haches polies dans le Bassin parisien: typologie, chronologie et influences. In P Pétrequin, S Cassen, M Errera, L Klassen, A Sheridan & A-M Pétrequin 2012a. *JADE. Grandes haches alpines du Néolithique européen, V<sup>e</sup> au IV<sup>e</sup> millénaires av. J.-C.* Bésançon: Presses Universitaires de Franche-Comté n° 1224, Collection Les cahiers de la MSHE Ledoux n° 17, Série Dynamiques territoriales n° 6. 1136-1167.
- Giot, P-R 1995. *Bretagne des Mégalithes*. Rennes: Éditions Ouest-France.
- Glenn, TA 1935. Distribution of the Graig Lwyd Axe and its Associated Cultures. *Archaeologia Cambrensis* 90, 189-218.
- Godelier, M 1999. *The Enigma of the Gift*. Oxford: Polity Press.
- Godoy, R 1985. Mining: anthropological perspectives. *Annual Review of Anthropology* 14, 199-217.
- Goldenberg, G 2006. Neolithic exploitation and manufacturing of flint in the Monti Lessini, Verona, Italy. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 83-90.
- Goodale, JC 1971. *Tiwi Wives*. Seattle. University of Washington Press.

- Gosden, C & Marshall, Y 1999. The Cultural Biography of Objects. *World Archaeology* 31(2), 169-178.
- Gould, RA 1977. Ethno-archaeology; Or, Where do Models Come From? In RVS Wright (ed) *Stone Tools as Cultural Markers*. Canberra: Australian Institute of Aboriginal Studies. 162-177.
- Gould, RA, Koster, DA & Sontz, AH 1971. The Lithic Assemblage of the Western desert Aborigines of Australia. *American Antiquity* 36(2), 149-169.
- Gould, RA & Saggars, S 1985. Lithic Procurement in Central Australia: A Closer Look at Binford's Idea of Embeddedness in Archaeology. *American Antiquity* 50(1), 117-136.
- Green, RC 1974. A Review of the Portable Artifacts from Western Samoa. In RC Green & JM Davidson (eds) *Archaeology in Western Samoa, Volume II*. Auckland: Bulletin of the Auckland Institute and Museum.
- Greenwell, W 1870. On the opening of Grime's Graves in Norfolk. *Journal of the Ethnological Society of London, New Series* 2, 419-439.
- Grinnell, GB 1923. *The Cheyenne Indians: Their History and Ways of Life*. 2 Volumes. New Haven. Yale University Press.
- Grooth, METH de 1991. Socio-economic aspects of Neolithic flint mining: a preliminary study. *Helinium* 31/32, 153-189.
- Grooth, METH de 1997. The social context of Neolithic flint mining in Europe. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 71-75.
- Grooth, M de 1998. The Flint Mines at Rijckholt-Sint Geertruid and Their Socio-economic Interpretation. In M Edmonds & C Richards (eds) *Understanding the Neolithic of North-Western Europe*. Glasgow: Cruithne Press. 351-369.
- Grooth, M de 2005. Mines in the marl: The flint extraction at Rijckholt. In LP Louwe Kooijmans, PW van den Broeke, H Fokkens & AL van Gijn (eds) *The Prehistory of the Netherlands, Volume 1*. Amsterdam: Amsterdam University Press. 243-248.

Grooth, MTh de, Lauwerier, RCGM & Schegget, ME 2011. New <sup>14</sup>C dates from the Neolithic flint mines at Rijckholt-St. Geertruid, the Netherlands. In M Capote, S Consuegra, P Díaz-del-Río & X Terradas (eds) *Proceedings of the 2<sup>nd</sup> International Conference of the UISPP Commission on Flint Mining in Pre- and Protohistoric Times (Madrid, 14-17 October 2009)*. Oxford: British Archaeological Reports, International Series 2260. 77-89.

Gunnerson, JH 1998. Mountain lions and pueblo shrines in the American southwest. In NJ Saunders (ed) *Icons of Power: Feline Symbolism in the Americas*. London: Routledge. 228-257.

Hall, D & Coles, J 1994. *Fenland Survey: An essay in landscape and persistence*. London: English Heritage.

Hall, RL 1997. *An Archaeology of the Soul*. Chicago. University of Illinois Press.

Hamilton, JRC 1956. *Excavations at Jarlshof, Shetland*. Edinburgh: Her Majesty's Stationery Office, Ministry of Works Archaeological Reports No. 1.

Hammel, A, White, C, Pfeiffer, S & Miller, D 2000. Pre-colonial mining in south Africa. *The Journal of the South African Institute of Mining and Metallurgy* (January/February 2000), 49-56.

Hampton, OW 1997. *Rock Quarries and the Manufacture, Trade, and Uses of Stone Tools and Symbolic Stones in the Central Highlands of Irian Jaya, Indonesia: Ethnoarchaeological Perspectives*. Unpublished DPhil thesis, Texas A&M University.

Harding, J 2003. *Henge Monuments of the British Isles*. Stroud: Tempus.

Harrer, H 1963. *I Come from the Stone Age*. London: Companion Book Club.

Hayden, C & Stafford, E 2006. The prehistoric landscape at Aylesford, Kent: CTRL integrated site report series. Unpublished report:  
<http://archaeologydataservice.ac.uk/archives/view/ctrl/whsisr/downloads.cfm?volume=documentation&CFID=45833&CFTOKEN=797DC47F-E891-4B25-BBCB7BDD0900A64A> [Accessed 24.Nov.2015]

Hayfield, C & Manby, TG 1996. A flint axe from Aldro, East Yorkshire. *Yorkshire Archaeological Journal* 68, 235-239.

Hazzeldine Warren, S 1919. A Stone-Axe Factory at Graig-Lwyd, Penmaenmawr. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 49 (Jul-Dec 1919), 342-365.

Hazzeldine Warren, S 1921. Excavations at the Stone-Axe Factory of Graig-Lwyd, Penmaenmawr. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 51 (Jan-Jun 1921), 165-199.

Hazzeldine Warren, S 1922. The Neolithic stone axes of Graig Lwyd, Penmaenmawr. *Archaeologia Cambrensis* 77(1), 1-32.

Healy, F 1984. Farming and Field Monuments: the Neolithic in Norfolk. In C Barringer (ed) *Aspects of East Anglian Pre-History: 20 Years after Rainbird Clarke*. Norwich: Geo Books. 77-140.

Healy, F, Bayliss, A & Whittle, A 2011. Sussex. In A Whittle, F Healy & A Bayliss, *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*. Oxford: Oxbow Books. 207-262.

Healy, F, Marshall, P, Bayliss, A, Cook, G, Bronk Ramsey, C, van der Plicht, J & Dunbar, E 2014. *Grime's Graves, Weeting-with-Broomhill, Norfolk. Radiocarbon dating and chronological modelling*. Portsmouth: English Heritage Research Report Series no. 27-2014.

Hemp, WJ 1935. The Chambered Cairn known as Bryn yr Hen Bobl, near Plâs Newydd, Anglesey. *Archaeologia* LXXXV, 253-292.

Henshall, AS 1963. *The Chambered Tombs of Scotland: Volume 1*. Edinburgh: Edinburgh University Press.

Henshall, AS 1972. *The Chambered Tombs of Scotland: Volume 2*. Edinburgh: Edinburgh University Press.

Herbich, T, & Lech, J 1995. PL5 Polany II, Radom Province. *Archaeologia Polona* 33, 488-506.



- Hester, TR & Shafer, HJ 1984. Exploitation of chert resources by the ancient Maya of northern Belize, Central America. *World Archaeology* 16(2), 157-173.
- Hodder, I 1982a. *The Present Past*. London: Batsford.
- Hodder, I 1982b. *Symbols in Action: Ethnoarchaeological Studies in Material Culture*. Cambridge: Cambridge University Press.
- Hodder, I 2012. *Entangled: An Archaeology of the Relationships between Humans and Things*. London: Wiley.
- Hoebel, EA 1960. *The Cheyenne: Indians of the Great Plains*. New York. Holt, Rinehart and Winston.
- Högberg, A 2006. A technological study of flake debitage attributes from the production of Neolithic Square-Sectioned Axes from Scania South Sweden. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 387-394.
- Holgate, R 1991. *Prehistoric Flint Mines*. Princes Risborough: Shire Archaeology.
- Holgate, R 1995. Neolithic flint mining in Britain. *Archaeologia Polona* 33, 133-161.
- Holleyman, G 1937. Harrow Hill Excavations, 1936. *Sussex Archaeological Collections* 78, 230-251.
- Holmes, WH 1890a. A Quarry Workshop of the Flaked-Stone Implement Makers in the District of Columbia. *American Anthropologist* 3:1 (January 1890), 1-26.
- Holmes, WH 1890b. Excavations in an Ancient Soapstone Quarry in the District of Columbia. *American Anthropologist* 3:4 (October 1890), 321-330.
- Holmes, WH 1891. Aboriginal Novaculite Quarries in Garland County, Arkansas. *American Anthropologist* 4:4 (October 1891), 313-316.
- Holmes, WH 1900. The Obsidian mines of Hidalgo, Mexico. *American Anthropologist* (New Series) 2:3 (July-September 1900), 405-416.

- Holmes, WH 1901. Aboriginal Copper Mines of Isle Royale, Lake Superior. *American Anthropologist* (New Series) 3:4 (October-December 1901), 684-696.
- Holmes, WH 1903. The Obsidian mines of Hidalgo, Mexico. *American Anthropologist* (New Series) 5:3 (July-September 1903), 503-507.
- Holmes, WH 1919. *Handbook of Aboriginal American Antiquities, Part 1, Introductory, The Lithic Industries*. Washington: Smithsonian Institution, Bureau of American Ethnology, Bulletin 60.
- Hoover, TH & Bruguier, LR 1989. "The Pipestone Reservation: A History". *Coteau Heritage* 2:1 (April 1989), 9-11.
- Horne, P, MacLeod, D & Oswald, A 2002. The Seventieth Causewayed Enclosure in the British Isles? In G Varndell & P Topping (eds) *Enclosures in Neolithic Europe*. Oxford: Oxbow Books. 115-120.
- Houlder, CH 1961. The Excavation of a Neolithic Stone Implement Factory on Mynydd Rhiw in Caernarvonshire. *Proceedings of the Prehistoric Society* 27, 108-143.
- Houlder, CH 1979. The Langdale and Scafell Pike axe factory sites: a field survey. In THMcK Clough & WA Cummins (eds) *Stone Axe Studies*. London: Council for British Archaeology Research Report No. 23. 87-89.
- Howitt, AW 1904. *The Native Tribes of South-East Australia*. London: Macmillan.
- Hubert, F 1999a. B2 Obourg, Gem. Und Kr. Mons, Prov. Hainaut. In G Weisgerber (ed) *5000 Jahre Feuersteinbergbau*. Bochum. Deutschen Bergbau-Museum Bochum, Nr. 77. 422-423.
- Hubert, F 1999b. B5 Strépy, Gem. La Louvière, Kr. Soignies, Prov. Hainaut. In G Weisgerber (ed) *5000 Jahre Feuersteinbergbau*. Bochum: Deutschen Bergbau-Museum Bochum, Nr. 77. 424.
- Huffman, TN 2006. Maize grindstones, *Madikwe* pottery and ochre mining in precolonial South Africa. *South African Humanities* 18(2), 51-70.

- Hughes, DT 1995. *Perceptions of the Sacred: A Review of Selected Native American Groups and Their Relationships with the Catlinite Quarries*. Omaha. Report produced for the National Park Service, Midwest Region, Omaha, Nebraska.
- Hughes, DT & Stewart, AJ 1997. *Traditional Use of Pipestone National Monument: Ethnographic Resources of Pipestone National Monument*. Omaha. Report produced for the National Park Service, Midwest Region, Omaha, Nebraska.
- Huntington, R & Metcalf, P 1979. *Celebrations of Death: The Anthropology of Mortuary Ritual*. Cambridge: Cambridge University Press.
- Insoll, T 2004. *Archaeology, Religion, Ritual*. New York: Routledge.
- Insoll, T 2011. *The Oxford Handbook of the Archaeology of Ritual and Religion*. Oxford: Oxford University Press.
- Jenkins, D n.d.. Notes on the Copper Mines on Mynydd Parys.
- Jennings, J & Glascock, MD 2002. Description and method of exploitation of the Alca obsidian source, Peru. *Latin American Antiquity* 13(1), 107-118.
- Jones, KL 1984. Polynesian Quarrying and Flaking Practises at the Samson Bay and Falls Creek Argillite Quarries, Tasman Bay, New Zealand. *World Archaeology* 16(2), 248-266.
- Jones, NW & Burrow, S 2011. A potential axe factory near Hyssington, Powys: Survey and excavation 2007-08. In V Davis & M Edmonds 2011. *Stone Axe Studies III*. Oxford: Oxbow Books. 295-307.
- Joep, EM 1952. Porcellanite axes from factories in north-east Ireland: Tievebulliagh and Rathlin. *Ulster Journal of Archaeology* 15, 31-55.
- Keiller, A, Piggott, S & Wallis, FS 1941. First Report of the Sub-Committee of the South-Western Group of Museums and Art Galleries on the Petrological Identification of Stone Axes. *Proceedings of the Prehistoric Society* 7, 50-72.
- Kendrick, TD 1925. *The Axe Age*. London: Methuen & Co.

- Kendrick, J 1995. Excavation of a Neolithic enclosure and an Iron Age settlement at Douglasmuir, Angus. *Proceedings of the Society of Antiquaries of Scotland* 125, 29-67.
- Kennedy, R 1934. Bark-cloth in Indonesia. *Journal of the Polynesian Society* 43, 229-243.
- Kenney, J 2008. Recent excavations at Parc Bryn Cegin, Llandygai, near Bangor, North Wales. *Archaeologia Cambrensis* 157, 9-142.
- Kern, A, Kowarik, K, Rausch, AW & Reschreiter, H (eds) 2009. *Kingdom of Salt: 7000 years of Hallstatt*. Wien: Natural History Museum.
- Kinghorn, G 1895. Notes on the discovery of polished stone axes and oval knives of porphyry, &c., at Modesty, near Bridge of Walls, Shetland. *Proceedings of the Society of Antiquaries of Scotland* 29 (1894-1895), 48-54.
- Kinnes, I 1979. *Round Barrows and Ring-ditches in the British Neolithic*. London: British Museum Occasional Paper 7.
- Kinnes, IA 1985. Circumstances not context: The Neolithic of Scotland as seen from outside. *Proceedings of the Society of Antiquaries of Scotland* 115, 15-57.
- Kinnes, IA 1992. *Non-Megalithic Long Barrows and Allied Structures in the British Neolithic*. London: British Museum Occasional Papers 52.
- Kinnes, IA & Longworth, IH 1985. *Catalogue of the excavated Prehistoric and Romano-British material in the Greenwell Collection*. London: British Museum Press.
- Knowles, WJ 1903. Stone Axe Factories near Cushendall, County Antrim. *The Journal of the Anthropological Institute of Great Britain and Ireland* 33 (July-December 1903), 360-366.
- Koldehoff, B & Brennan, T 2010. Exploring Mississippian Polity Interaction and Craft Specialization with Ozark Chipped-Stone Resources. *The Missouri Archaeologist* 71, 131-164.

Koldehoff, B & Wilson, GD 2010. Mississippian Celt Production and Resource Extraction in the Upper Big River Valley of St. Francois County, Missouri. *The Missouri Archaeologist* 71, 217-248.

Kolesnik, A 2006. Neolithic – Chalcolithic Flint Exploitation in Donbas (South-East of the Ukraine). In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 129-134.

Kopytoff, I 1986. The cultural biography of things: commodities as process. In A Appadurai (ed) *The social life of things*. Cambridge: Cambridge University Press. 64-91.

Körlin, G & Weisgerber, G (eds) 2006. *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum.

Królik, H, Schild, A, Tomaszewski, J & Ciepielewska, E 2006. Raw material and techno-structural patterning of Masovian occupants of the Rydno complex. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 17-28.

Labriffe, de, P-A & Sidéra, I 1995a. F52 Serbonnes “le Revers de Brossard”, Yonne District. *Archaeological Polona* 33, 313-319.

Labriffe, de, P-A & Sidéra, I 1995b. F53 Pâlis “le Buisson Gendre”, Aube District. *Archaeological Polona* 33, 319-322.

Labriffe, de, P-A Augereau, A & Sidéra, I 1995a. F54 Villemaur-sur-Vanne “le Grand Bois Marot”, Aube District. *Archaeological Polona* 33, 322-335.

Labriffe, de, P-A Augereau, A & Sidéra, I 1995b. F55 Villemaur-sur-Vanne “les Orlets”, Aube District. *Archaeological Polona* 33, 335-345.

Lane Fox, AH 1869a. An examination into the character and probable origins of the hillforts of Sussex. *Archaeologia* 42, 27-52.

Lane Fox, AH 1869b. Further remarks on the hillforts of Sussex: being an account of the excavations of the hillforts at Cissbury and Highdown. *Archaeologia* 42, 53-76.

Lane Fox, AH 1874. On the principles of classification adopted in the arrangement of his anthropological collection, now exhibited in the Bethnal Green Museum. *Journal of the Anthropological Institute* 4, 293-308.

Lane Fox, AH 1876. 'Excavations in Cissbury Camp, Sussex; being a report of the Exploration Committee of the Anthropological Institute for the year 1875'. *Journal of the Anthropological Institute of Great Britain and Ireland* 5, 357-390.

Larsson, L 2006. Flint and fire – destruction of wealth. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Montanhistorische Zeitschrift, Der Anschnitt. Beiheft 19. 403-412.

Lass, B 1994. *Hawaiian Adze Production and Distribution: Implications for the Development of Chiefdoms*. Los Angeles: University of California at Los Angeles, Institute of Archaeology Monograph 37.

Leach, M 2010. Quarry Pits and Hearth Fires: Balancing work and family in the Great Basin. *The SAA Archaeological Record* 10(2), 24-30.

Lech, J 1999. Das Grab eines Steinschmiedes aus Michalowice bei Krakau – und das Problem der Arbeitsspezialisierung unter der ersten Ackerbau treibenden Bevölkerung Mitteleuropas. In G Weisgerber (ed) *5000 Jahre Feuersteinbergbau*. Bochum: Deutschen Bergbau-Museum Bochum, Nr. 77. 271-278.

Lech, H & Lech, J 1995. PL3 Wierzbica "Zełe", Radom Province. *Archaeologia Polona* 33, 465-480.

Lech, H & Lech, J 1997. Flint mining among Bronze Age communities: A case study from Central Poland. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

91-98.

Lech, J & Mateiciucová, I 1995. CZ1 Tušimice near Kadaň, Chomutov District. *Archaeologia Polona* 33, 271-276.

Lech, J & Longworth, I 2006. The Grimes Graves flint mine site in the light of two Late Neolithic workshop assemblages: a second approach. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 413-422.

Legge, AJ 1981. The agricultural economy. In R Mercer, *Grimes Graves, Norfolk: excavations 1971-72*. London: Department of the Environment. 169-181.

Legge, AJ 1992. *Excavations at Grimes Graves, Norfolk, 1972-1976, Fascicule 4: Animals, environment and the Bronze Age economy*. London: British Museum Press.

Lernia, S di 1997. Local and mid-range exchange in the south-eastern Neolithisation process in Italy: The problem of lithic raw material distribution. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 218-223.

Lernia, S di, Fiorentino, G, & Galiberti, A 1991. “Gargano Prehistoric Flint Mines Project”: The state of research in the Neolithic mine of Defensola – Vieste (Italy). *Origini* XV, 175-198.

Lernia, S di, Fiorentino, A, Galiberti, A, & Basili, R 1995. I18 Defensola “A”, Foggia Province. *Archaeologia Polona* 33, 426-428.

Le Roux, C-T 1971. A stone axe-factory in Brittany. *Antiquity* 45, 283-288.

Le Roux, C-T 1979. Stone axes of Brittany and the Marches. In THMcK Clough & WA Cummins (eds) *Stone Axe Studies*. London: Council for British Archaeology Research Report No. 23. 49-56.

Le Roux, C-T 1998. Specialised Production, Diffusion, and Exchange during the Neolithic in Western France: the Example of Polished Stone Axes. In M

- Edmonds & C Richards (eds) *Understanding the Neolithic of North-Western Europe*. Glasgow: Cruithne Press. 370-384.
- Le Roux, C-T 2011. Une «production de masse» dès le Néolithique: les ateliers de Plussulien (Côtes-d'Armor) et les haches polies en métadolérite du «type A». *Bulletin de la Société Géologique et Minéralogique de Bretagne* (2011) D: 9, 3-33.
- Lewis-Williams, D & Pearce, D 2005. *Inside the Neolithic Mind*. London: Thames & Hudson.
- Lichardus-Itten, M 1999. Silexknollen als Beigabe in Gräbern der Frühkupferzeitlichen Tiszapolgár-Kultur. In G Weisgerber (ed) *5000 Jahre Feuersteinbergbau*. Bochum: Deutschen Bergbau-Museum Bochum, Nr. 77. 279-283.
- Linford, N, Martin, L & Holmes, J 2009. *Grimes Graves, Norfolk: Report on geophysical survey, October 2007*. Swindon: English Heritage Research Department Report Series No. 64-2009.
- Longworth, I, Ellison, A & Rigby, V 1988. *Excavations at Grimes Graves, Norfolk, 1972-1976, Fascicule 2: The Neolithic, Bronze Age and later pottery*. London: British Museum Press.
- Longworth, I, Herne, A, Varndell, G & Needham, S 1991. *Excavations at Grimes Graves, Norfolk, 1972-1976; Fascicule 3, Shaft X: Bronze Age Flint, Chalk and Metal Working*. London: British Museum Press.
- Longworth, I & Varndell, G 1996. *Excavations at Grimes Graves, Norfolk, 1972-1976, Fascicule 5: Mining in the deeper mines*. London: British Museum Press.
- Longworth, I, Varndell, G & Lech, J 2012. *Excavations at Grimes Graves, Norfolk, 1972-1976, Fascicule 6: Exploration and excavation beyond the deep mines*. London: British Museum Press.
- Looking Horse, A 1989. The Sacred Pipe. *Coteau Heritage* 2:1 (April 1989), 13-14.



- Loveday, R & Barclay, A 2010. "One of the Most Interesting Barrows Ever Examines" – Liffs Low Revisited. In J Leary, T Darvill & D Field (eds) *Round Mounds and Monumentality in the British Neolithic and Beyond*. Oxford: Oxbow Books. 108-129.
- Lovett, E 1887. Notice of the gun flint manufactory at Brandon, with reference to the bearing of its processes upon the modes of flint-working practised in prehistoric times. *Proceedings of the Society of Antiquaries of Scotland* 21, 206-12.
- Lubbock, J 1865. *Pre-historic Times, as Illustrated by Ancient Remains, and the Manners and Customs of Modern Savages*. London: Williams & Norgate.
- Lucas, G 2012. *Understanding the Archaeological Record*. Cambridge: Cambridge University Press.
- Lyell, C 1863. *The Geological Evidence of the Antiquity of Man, with Remarks on Theories of the Origin of the Species by Variation*. London: John Murray.
- Lynch, F 1969a. The Megalithic Tombs of North Wales. In *Megalithic Enquiries in the West of Britain: a Liverpool Symposium with contributions by TGE Powell, JXWP Corcoran, F Lynch & JG Scott*. Liverpool: Liverpool University Press. 107-148.
- Lynch, F 1969b. The Contents of Excavated Tombs in North Wales. In *Megalithic Enquiries in the West of Britain: a Liverpool Symposium with contributions by TGE Powell, JXWP Corcoran, F Lynch & JG Scott*. Liverpool: Liverpool University Press. 149-174.
- Lynch, F 1970. *Prehistoric Anglesey*. Llangefni: The Anglesey Antiquarian Society.
- Lynch, F & Musson, C 2001. A prehistoric and early medieval complex at Llandegai, near Bangor, North Wales. *Archaeologia Cambrensis* 150 (2004), 17-142.
- Lyon, C 1861. Letter. *Bulletin of the American Ethnographic Society* I, 39.
- Mackie, EW 1971. Creag na Caillich. *Radiocarbon* 13(2), 450-1.

- Mackie, EW 1972. Radiocarbon dates for two Mesolithic shell heaps and a Neolithic axe factory in Scotland. *Proceedings of the Prehistoric Society* 38, 412-416.
- Maggi, R, Campana, N & Negrino, F 2006. The Copper Age jasper quarry of Valle Lagorara within the longer history of the valley (Italy). In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 135-144.
- Mahler, DL 2012. Pinhoulland – a multi period site, West Mainland, Shetland. In DL Mahler (ed) *The Border of Farming and the Cultural Markers*. Copenhagen: The National Museum of Denmark. 37-52.
- Malinowski, B 1922. *Argonauts of the Western Pacific*. London: Routledge.
- Mallory, JP 1990. Trial Excavations at Tievebulliagh, Co. Antrim. *Ulster Journal of Archaeology*, 3<sup>rd</sup> Series, 53, 15-28.
- Malo, D 1951. *Hawaiian Antiquities (Moolelo Hawaii)* (Second Edition). Honolulu: BP Bishop Museum Special Publication 2.
- Man, EH 1883. On the Aboriginal Inhabitants of the Andaman Islands (Part III). *The Journal of the Anthropological Institute of Great Britain and Ireland* 12, 327-434.
- Manby, TG, King, A & Vyner, BE 2003. The Neolithic and Bronze Ages: a time of early agriculture. In TG Manby, S Moorhouse & P Ottaway (eds) *The Archaeology of Yorkshire*. Leeds: Yorkshire Archaeological Society. 35-116.
- Manby, TG 2007. Ehenside Tarn and The Neolithic Pottery of North-western England. In P Cherry (ed) *Studies in Northern Prehistory: Essays in memory of Clare Fell*. Kendal: Cumberland & Westmorland Antiquarian & Archaeological Society. 61-97.
- Manning, CR 1855. Note on Grime's Graves. *Norfolk Archaeology* 4, 356.
- Manning, CR 1872. Grime's Graves, Weeting. *Norfolk Archaeology* 7, 169-177.

Manning, P 2005. Jewish Ghosts, Knackers, Tommyknockers, and Other Sprites of Capitalism in the Cornish Mines. *Cornish Studies* (2<sup>nd</sup> Series) 13, 216-255.

Marshall, Y 2008. Archaeological possibilities for feminist theories of transition and transformation. *Feminist Theory* 9(1), 25-45.

Mason, RJ 1982. Prehistoric mining in South Africa, and Iron Age copper mines in the Dwarsberg, Transvaal. *The Journal of the South African Institute of Mining and Metallurgy* (May 1982), 134-144.

Masters, L 1984. The Neolithic Long Cairns of Cumbria and Northumberland. In R Miket & C Burgess (eds) *Between and Beyond the Walls: Essays on the Prehistory and History of North Britain in Honour of George Jobey*. Edinburgh: John Donald. 52-73.

Matthiessen, P (Ed) 1989. *George Catlin: North American Indians*. New York: Penguin Books.

Mauss, M 1988. *The Gift: Forms and Functions of Exchange in Archaic Societies*. London: Routledge.

McBryde, I 1976. Seelands and Sai Yok Pebble Tools: A Further Consideration. *Australian Archaeology* 4, 58-73.

McBryde, I 1979. Petrology and prehistory: lithic evidence for exploitation of stone resources and exchange systems in Australia. In THMcK Clough & WA Cummins *Stone Axe Studies*. London. CBA Research Report No 23, 113-126.

McBryde, I 1984. Kulin greenstone quarries: the social contexts of production and distribution for the Mount William site. *World Archaeology* 16, 267-285.

McCarthy, FD 1976. *Australian Aboriginal Stone Implements* (2<sup>nd</sup> Edition). Sydney: The Australian Museums Trust.

McCoy, PC, Weisler, MI, Zhao, J-x & Feng, Y-X 2009. <sup>230</sup>Th dates for dedicatory corals from a remote alpine desert adze quarry on Mauna Kea, Hawai'i. *Antiquity* 83, 445-457.

McCoy, MD, Ladefoged, TN, Graves, MW & Stephen, JW 2011. Strategies for constructing religious authority in ancient Hawai'i. *Antiquity* 85, 927-941.

McGraw, AJ & Valdez Jr, F 1978. *41 BX 68: A Prehistoric Quarry-Workshop in Northern Bexar County, Texas*. San Antonio, Texas: The University of Texas at San Antonio, Center for Archaeological Research, Archaeological Survey Report No. 56.

McNabb, J, Felder, PJ, Kinnes, I & Sieveking, G 1996. An archive on recent excavations at Harrow Hill, Sussex. *Sussex Archaeological Collections* 134, 21-37.

McPherson, RS 1992. *Sacred Land, Sacred View; Navajo Perceptions of the Four Corners Region*. Salt Lake City. Brigham Young University, Charles Redd Monographs in Western History No. 19.

Meltzer, DJ (ed) 1998. *Ancient Monuments of the Mississippi Valley by Ephraim G Squier and Edwin H Davis*. Washington: Smithsonian Classics of Anthropology.

Mercer, RJ 1981a. *Grimes Graves, Norfolk, Excavations 1971-72. Volumes I & II*. London: HMSO.

Mercer, RJ 1981b. The excavation of a late Neolithic henge-type enclosure at Balfarg, Markinch, Fife, Scotland, 1977-78. *Proceedings of the Society of Antiquaries of Scotland* 111, 63-171.

Mercer, RJ 1981c. Excavations at Carn Brea, Illogan, Cornwall, 1970-73. *Cornish Archaeology* 20, 1-204.

Mercer, RJ 1997. The excavation of a Neolithic enclosure complex at Helman Tor, Lostwithiel, Cornwall. *Cornish Archaeology* 36, 5-63.

Mercer, RJ, Barclay, GJ, Jordan, D & Russell-White, CJ 1988. The Neolithic henge-type enclosure at Balfarg – a re-assessment of the evidence for an

incomplete ditch circuit. *Proceedings of the Society of Antiquaries of Scotland* 118, 61-67.

Meurkens, L 2005. [http://www.palarch.nl/wp-content/meurkens I 2005 review of topping p and m lynott eds 2005 the cultural landscape of prehistoric mines published by oxbow books.pdf](http://www.palarch.nl/wp-content/meurkens%202005%20review%20of%20topping%20p%20and%20m%20lynott%20eds%202005%20the%20cultural%20landscape%20of%20prehistoric%20mines%20published%20by%20oxbow%20books.pdf) [Accessed 4 February 2013]

Meyers, JT 1970. *Chert Resources of the lower Illinois valley*. Springfield, Illinois: Illinois State Museum, Reports of Investigations No. 18, Illinois Valley Archaeological Program, Research Papers Volume 2.

Migal, W 1997. Selected aspects of specialization in mining and flint knapping. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 99-101.

Miller, D 2010. *Stuff*. Cambridge: Polity Press.

Miller, DE & Van Der Merwe, NJ 1994. Early metal working in Sub-Saharan Africa: A review of recent research. *Journal of African History* 35, 1-36.

Mills, WC 1921a. Flint Ridge. *Ohio Archaeological and Historical Publications* XXX, 90-161.

Mills, WC 1921b. Flint Ridge. *Certain Mounds and Village Sites in Ohio* 3(3), 169-239.

Millet-Richard, L-A 2006. Settlements and flint workshops in the Grand Pressigny region: hypotheses about the knappers of livres de beurre. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 423-432.

Milner, GR, Hammerstedt, SW & French, KD 2010. Chert hoes as digging tools. *Antiquity* 84, 103-113.

Morice, AG 1895. Notes on the Western Dénés. *The Transactions of the Canadian Institute* IV, 1-222. (Quoted in Holmes 1919, 318)

- Morphy, H 1995. *Landscapes and the reproduction of the Ancestral Past*. In E Hirsch and M O'Hanlon (Eds), *The Anthropology of Landscape*. Oxford. Clarendon Press. 184-209.
- Morris, RWB 1981. *The Prehistoric Rock Art of Southern Scotland (except Argyll and Galloway)*. Oxford: British Archaeological Reports, British Series 86.
- Mortimore, RN 1986. Stratigraphy of the Upper Cretaceous White Chalk of Sussex. *Proceedings of the Geological Association* 97(2), 97-139.
- Munson, PJ & Munson, CA (1990). *The Prehistoric and Early Historic Archaeology of Wyandotte Cave and Other Caves in Southern Indiana*. Indianapolis: Indiana Historical Society, Prehistoric Research Series, Vol. 7, No. 1.
- Murphy, P 1984. Prehistoric Environments and Economies. In C Barringer (ed) *Aspects of East Anglian Pre-History: 20 Years after Rainbird Clarke*. Norwich: Geo Books. 13-30.
- Murray, RA 1983. A Brief Survey of the Pipes and Smoking Customs of the Indians of the Northern Plains. *The Minnesota Archaeologist* 42 (1 & 2), 81-100.
- Murray, RA 1993. *Pipes on the Plains*. Pipestone: Pipestone Indian Shrine Association.
- Myatt, L 1988. The stone rows of northern Scotland. In CLN Ruggles (ed) *Records in Stone: Papers in memory of Alexander Thom*. Cambridge: Cambridge University Press. 275-318.
- Needham, S 2008. Exchange, Object Biographies and the Shaping of Identities, 10,000-1000 B.C.. In J Pollard (ed) *Prehistoric Britain*. Oxford: Blackwell. 310-329.
- Needham, S, Parker Pearson, M, Tyler, A, Richards, M & Jay, M 2010. A first 'Wessex 1' date from Wessex. *Antiquity* 84, 363-373.
- O'Brien, W 2004. *Ross Island: mining, metal and society in early Ireland*. Galway: National University of Ireland, Bronze Age Studies 6.

- O'Brien, W 2007. Miners and farmers: local settlement contexts for Bronze Age mining. In C Burgess, P Topping & F Lynch (eds) *Beyond Stonehenge: Essays on the Bronze Age in Honour of Colin Burgess*. Oxford: Oxbow Books. 20-30.
- Oliva, M 1997. Prehistoric chert extraction and distribution in the Krumlovský les area (Southern Moravia). In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 107-115.
- Oliva, M 2006. The Krumlovský les (Southern Moravia) exploitation area: mining techniques, chronology, symbolic meaning. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 163-172.
- Oliva, M 2010. *Prehistoric Mining in the “Krumlovský les” (Southern Moravia): Origin and Development of an Industrial-Sacred Landscape*. Brno: Moravské Zemské Muzeum.
- Oswald, A, Dyer, C & Barber, M 2001. *The Creation of Monuments: Neolithic Causewayed Enclosures in the British Isles*. Swindon: English Heritage.
- Parish, R 2010. Description of five Dover Chert Quarries in Stewart County, Tennessee. *Tennessee Archaeology* 5:1 (Summer 2010), 83-99.
- Park Harrison, J 1877a. On Marks found upon Chalk at Cissbury. *Journal of the Anthropological Institute* 6, 263-271.
- Park Harrison, J 1877b. Report on some further discoveries at Cissbury. *Journal of the Anthropological Institute* 6, 430-442.
- Park Harrison, J 1878. Additional discoveries at Cissbury. *Journal of the Anthropological Institute* 7, 412-433.
- Parker, AC 1925. The Great Algonkin Flint Mines at Coxsackie. *Researches and Transactions of the New York State Archeological Association* IV, 105-125.
- Parker, DD 1966. *The Recollections of Philander Prescott: Frontiersman of the Old Northwest 1819-1862*. Lincoln. University of Nebraska Press.

- Parker Pearson, M 2012. *Stonehenge: Exploring the greatest Stone Age mystery*. London: Simon & Schuster.
- Patton, M 1993. *Statements in Stone: Monuments and society in Neolithic Brittany*. London: Routledge.
- Pauketat, TR 2013. *An Archaeology of the Cosmos: Rethinking Agency and Religion in Ancient America*. London: Routledge.
- Peake, AE 1917. Further excavations at Grimes Graves. *Proceedings of the Prehistoric Society of East Anglia* 2(3), 409-436.
- Pearson, T 1996. *Lingheath Farm, Brandon, Suffolk (NMR No TL 78 NE 81)*. Swindon: National Monuments Record Unpublished Archive Report.
- Pearson, T & Topping, P 2002. Rethinking the Carrock Fell enclosure. In G Varndell & P Topping (eds) *Enclosures in Neolithic Europe*. Oxford: Oxbow Books. 121-127.
- Pennington, W 1970. Vegetational history in the north-west of England – a regional study. In D Walker & RG West (eds) *Studies in the Vegetational History of the British Isles*. Cambridge: Cambridge University Press. 41-80.
- Pennington, W 1975. The effect of Neolithic man on the environment of north-west England: the use of absolute pollen diagrams. In JG Evans, S Limbrey & H Cleere (eds) *The Effect of Man on the Landscape: The Highland Zone*. London: Council for British Archaeology, Research Report 11. 74-86.
- Pennington, W 1991. Palaeolimnology in the English Lakes – some questions and answers over fifty years. *Hydrobiologia* 214, 9-24.
- Pennington, W & Tutin, TG 1964. Pollen Analysis from the Deposits of Six Upland Tarns in the Lake District. *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences* 248, No746 (Dec 10, 1964), 205-244.



Pétrequin, P, Jeudy, F & Jeunesse, C 1993. Neolithic Quarries. The Exchange of Axes and Social Control in the Southern Vosges. In C Scarre & F Healy (eds) *Trade and Exchange in Prehistoric Europe*. Oxford. Oxbow Books. 45-67.

Pétrequin, P & Jeunesse, C 1995. *La Hache de Pierre: Carrières vosgiennes et échanges de lames polies pendant le Néolithique (5400-2100 av. J.-C.)*. Paris. Editions Errance.

Pétrequin, P & Pétrequin, A-M 1993. *Ecologie d'un outil: La hache de pierre en Irian Jaya (Indonesie)*. Paris: CNRS Editions.

Pétrequin, P & Pétrequin, A-M, Jeudy, F, Jeunesse, C, Monnier, L, Pelegrin, J & Praud, I 1998. From the Raw Material to the Neolithic Stone Axe. Production Processes and Social Context. In M Edmonds & C Richards (eds) *Understanding the Neolithic of North-Western Europe*. Glasgow: Cruithne Press. 277-311.

Pétrequin, P, Sheridan, A, Cassen, S, Errera, M, Gauthier, E, Klassen, L, Le Maux, N, Pailler, Y 2008. Neolithic Alpine axeheads, from the Continent to Great Britain, the Isle of Man and Ireland. In H Fokkens, BJ Coles, AL van Gijn, JP Kleijne, HH Ponjee & CG Slapp Endel (eds) *Between foraging and farming. Analecta Praehistorica Leidensia* 40. 261-279.

Pétrequin, P & Pétrequin, A-M 2011. The twentieth-century polished stone axeheads of New Guinea: why study them? In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 333-349.

Pétrequin, P & Pétrequin, A-M 2012. Les modèles ethnoarchéologiques de Nouvelle-Guinée. In Pétrequin *et al.* 2012a. 27-45.

Pétrequin, P, Cassen, S, Errera, M, Klassen, L, Sheridan, A & Pétrequin, A-M 2012a. *JADE. Grandes haches alpines du Néolithique européen, V<sup>e</sup> au IV<sup>e</sup> millénaires av. J.-C.* Bésançon: Presses Universitaires de Franche-Comté n° 1224, Collection Les cahiers de la MSHE Ledoux n° 17, Série Dynamiques territoriales n° 6.

Pétrequin, P, Cassen, S, Gauthier, E, Klassen, L, Pailler, I & Sheridan, A 2012b. Typologie, chronologie et repartition des grandes haches alpines en Europe occidentale. In Pétrequin *et al.* 2012a. 574-727.

Pétrequin, P, Cassen, S, Errera, M, Klassen, L & Sheridan, A 2012c. Des choses sacrées ... fonctions idéelles des jades alpins en Europe occidentale. In Pétrequin *et al.* 2012a. 1354-1423.

Pétrequin, P, Pétrequin, A-M, Errera, M & Prodéo, F 2012d. Prospections alpines et sources de matières premières. Historique et résultats. In Pétrequin *et al.* 2012a. 46-185.

Pettigrew, Rev ST 1853. Note on Grime's Graves. *Journal of the British Archaeological Association* 8, 77.

Phemister, J 1952. The riebeckite-bearing dikes of Shetland. *The Mineralogical Magazine and Journal of the Mineralogical Society* 29 (1950-52), 359-373.

Phillips, P 1979. Stone axes in ethnographic situations: some examples from New Guinea and the Solomon Islands. In THMcK Clough & WA Cummins *Stone Axe Studies*. London: CBA Research Report No 23, 108-112.

Phillips, WA 1900. Aboriginal Quarries and Shops at Mill Creek, Illinois. *American Anthropologist (New Series)* 2, 37-52.

Piggott, S 1954. *The Neolithic Cultures of the British Isles. A Study of the Stone-using Agricultural Communities of Britain in the Second Millennium B.C.*. Cambridge: Cambridge University Press.

Piggott, S 1962. *The West Kennet Long Barrow: Excavations 1955-56*. London: HMSO.

Piggott, S & Simpson, DDA 1971. Excavation of a stone circle at Croft Moraig, Perthshire, Scotland. *Proceedings of the Prehistoric Society* 37, 1-15.

Pitts, M 1996. The Stone Axe in Neolithic Britain. *Proceedings of the Prehistoric Society* 61, 311-371.

- Plint, RG 1962. Stone axe factory sites in the Cumbrian fells. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 62, 1-26.
- Ploeg, A 2000. Contemporary Stone Tool Technology: A Review Article. *Anthropos* 95, 228-235.
- Plomley, NJB (ed) 1966. *Friendly Mission: The Tasmanian Journals and Papers of George Augustus Robinson, 1829-1834*. Hobart: Tasmanian Historical Research Association. 904.
- Popper, K 2002. *Conjectures and Refutations: The growth of scientific knowledge*. London: Routledge.
- Powers, S 1877. Tribes of California. *Contributions to North American Ethnography* III. (Quoted in Holmes 1919, 321)
- Pratt, S & Troccoli, JC 2013. *George Catlin: American Indian Portraits*. London: National Portrait Gallery.
- Pryor, F 1998. *Etton: Excavations at a Neolithic causewayed enclosure near Maxey Cambridgeshire, 1982-7*. London: English Heritage Archaeological Report 18.
- Pull, JH 1932. *The Flint Miners of Blackpatch*. London: Williams & Norgate.
- Pye, E 1968. *The Flint Mines at Blackpatch, Church Hill and Cissbury*. Unpublished MA Thesis, University of Edinburgh.
- Rambow, D 1989. White Exploration of the "Red Stone Quarry". *Coteau Heritage* 2:1 (April 1989), 6-8.
- Ramos-Millán, A 1997. La Venta. A prehistoric flint mine in a tribal society (Iberian Southeast). In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 117-121.

- Rathje, WL 1979. Modern Material Culture Studies. In MB Schiffer (ed) *Advances in Archaeological Method and Theory 2*. New York: Academic Press. 1-37.
- Ray, K 2004. Axes, kula, and things that were 'good to think' in the Neolithic of the Irish Sea regions. In V Cummings & C Fowler (eds) *The Neolithic of the Irish Sea*. Oxford: Oxbow Books. 160-173.
- RCAHMS 1994a. *South-east Perth: an archaeological landscape*. Edinburgh: RCAHMS.
- RCAHMS 1994b. *Braes of Doune: an archaeological survey*. Edinburgh: RCAHMS.
- RCHME 1994. *Harrow Hill, West Sussex. An Earthwork Survey by The Royal Commission on the Historical Monuments of England, August 1994*. Swindon: National Monuments Record Unpublished Archive Report [TQ 01 SE 23 & 17].
- Rech, M 1979. *Studien zu Depottfunden der Trichterbecher – und Einzelgrabkultur des Nordens*. Neumünster: Offa-Bücher.
- Rees, C & Jones, M 2016. Neolithic houses on Anglesey. *British Archaeology* 147 (March April 2016), 46-51.
- Renfrew, C 1975. Trade as action at distance: questions of integration and communication. In JA Sabloff & CC Lomberg-Karlovsky (eds) *Ancient Civilisation and Trade*. Albuquerque: University of New Mexico. 3-59.
- Renfrew, C 1993. Trade beyond the material. In C Scarre & F Healy (eds) *Trade and Exchange in European Prehistory*. Oxford: Oxbow Books. 5-16.
- Richards, C & Thomas, J 1984. Ritual activity and structured deposition in Later Neolithic Wessex. In R Bradley & J Gardiner (eds) *Neolithic Studies*. Oxford: BAR British Series 133. 189-218.
- Ricq-de Bouard, M 1993. Trade in Neolithic Jadeite Axes from the Alps: New Data. In C Scarre & F Healy (eds) *Trade and Exchange in Prehistoric Europe*. Oxford: Oxbow Books. 61-67.

- Ride, D 2006. *In Defence of Landscape: An Archaeology of Porton Down*. Stroud: Tempus.
- Rind, MM 2006. New excavations in the Neolithic chert mine of Arnhofen, Stadt Abensberg, Lkr. Kelheim, Lower Bavaria. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 183-186.
- Risch, R, Boivin, N, Petraglia, M, Gómez-Gras, D, Korisettar, R & Fuller, D 2011. The prehistoric axe factory at Sanganakallu-Kupgal (Bellary District), southern India. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 189-202.
- Ritchie, PR 1968. The stone implement trade in third-millennium Scotland. In JM Coles & DDA Simpson (eds) *Studies in Ancient Europe: Essays presented to Stuart Piggott*. Leicester: Leicester University Press. 117-136.
- Ritchie, PR 1992. Stone axeheads and cushion maceheads from Orkney and Shetland: some similarities and contrasts. In N Sharples & JA Sheridan (eds) *Vessels for the Ancestors: Essays on the Neolithic of Britain and Ireland in Honour of Audrey Henshall*. Edinburgh: Edinburgh University Press. 213-220.
- Ritchie, PR & Scott, JG 1988. The Petrological identification of stone axes from Scotland. In THMcK Clough & WA Cummins (eds) *Stone Axes Studies, Volume 2*. London: Council for British Archaeology Research Report No. 67. 85-91.
- Robbins, LH, Murphy, ML, Campbell, A & Brook, GA 1996. Excavations at the Tsodilo Hills Rhino Cave. *Botswana Notes and Records* 28, 23-45.
- Robbins, LH, Murphy, ML, Campbell, A & Brook, GA 1998. Intensive Mining of Specular Hematite in the Kalahari Ca. A.D. 800-1000. *Current Anthropology* 39(1), 144-150.
- Robinson, D 2004. The Mirror of the Sun: Surface, mineral applications and interface in California rock-art. In N Boivin & MA Owoc (eds) *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World*. London: University College London Press. 91-105.

- Rolleston, G 1879. Notes on Skeleton found at Cissbury. *Journal of the Anthropological Institute* 8, 377-389.
- Root, MJ, Ahler, SA, Falk, CR, Foss, JE, Haas, H & Artz, JA 1986. *Archeological Investigations in the Knife River Flint Primary Source Area, Dunn County, North Dakota: 1982-1986 Program*. Grand Forks, North Dakota: University of North Dakota, Department of Anthropology Contribution No. 234.
- Ross, HM 1970. Stone adzes from Malaita, Solomon Islands: An ethnographic contribution to Melanesian archaeology. *Journal of the Polynesian Society* 79(4), 411-420.
- Rudebeck, E 1998. Flint Extraction, Axe Offering, and the Value of Cortex. In M Edmonds & C Richards (eds) *Understanding the Neolithic of North-Western Europe*. Glasgow: Cruithne Press. 312-350.
- Russell, M 2000. *Flint mines in Neolithic Britain*. Stroud: Tempus.
- Russell, M 2001. *Rough Quarries, Rocks and Hills: John Pull and the Flint Mines of Sussex*. Oxford: Oxbow Books.
- Salisbury, EF 1961. Prehistoric Flint Mines on Long Down, Earham, 1955-1958. *Sussex Archaeological Collections* 99, 66-73.
- Saunders, NJ 2004. The Cosmic Earth: materiality and minerology in the Americas. In N Boivin & MA Owoc (eds) *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World*. London: University College London Press. 123-141.
- Saville, A 1981. The flint and chert artefacts. In R Mercer Excavations at Carn Brea, Illogan, Cornwall, 1970-73: A Neolithic Fortified Complex of the Third Millenium bc. *Cornish Archaeology* 20, 101-152.
- Saville, A 2002. Lithic artefacts from Neolithic causewayed enclosures: character and meaning. In G Varndell & P Topping (eds) *Enclosures in Neolithic Europe*. Oxford: Oxbow Books. 91-105.

Saville, A 2005. Prehistoric Quarrying of a Secondary Flint Source: Evidence from North-East Scotland. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 1-13.

Saville, A 2006. Flint technology associated with extraction sites in north-east Scotland. In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 449-454.

Saville, A, ed., 2011. *Flint and Stone in the Neolithic Period*. Oxford: Oxbow Books.

Schibler, J, Breitenlechner, E, Deschler-Erb, S, Goldenberg, G, Hanke, K, Hiebel, G, Hüster Plogmann, H, Nicolussi, K, Marti-Grädel, E, Pichler, S, Schmidl, A, Schwarz, S, Stopp, B & Oeggl, K 2011. Miners and mining in the Late Bronze Age: a multidisciplinary study from Austria. *Antiquity* 85 (2011), 1259-1278.

Schierle, S (ed) 2001. *Maximilian Prince of Wied: Travels in the Interior of North America during the years 1832-1834*. Köln: Taschen GmbH.

Schiffer, MB 1972. Archaeological context and systemic context. *American Antiquity* 37, 156-165.

Schiffer, MB 1983. Toward the identification of formation processes. *American Antiquity* 48, 675-706.

Schiffer, MB 1988. The structure of archaeological theory. *American Antiquity* 53, 461-485.

Schild, R 1995a. PL2 Tomaszów, Radom Province. *Archaeologia Polona* 33, 455-465.

Schild, R 1995b. PL4 Polany Kolonie II, Radom Province. *Archaeologia Polona* 33, 480-488.

Schild, R, Królik, H & Tomaszewski, J 1997. A raw material economy of the Palaeolithic and Mesolithic occupants of the Rydno Complex. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 286-293.

- Schild, R & Sulgostowska, Z 1997. *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.
- Schulting, R 2008. Foodways and Social Ecologies from the Early Mesolithic to the Early Bronze Age. In J Pollard (ed) *Prehistoric Britain*. Oxford: Blackwell. 90-120.
- Scott, DD & Thiessen, TD 2005. Catlinite Extraction at Pipestone National Monument, Minnesota: Social and Technological Implications. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 140-154.
- Scott, DD, Thiessen, TD, Richner, JJ & Stadler, S 2006. *An Archeological Inventory and Overview of Pipestone National Monument, Minnesota*. Lincoln, Nebraska: United States Department of the Interior, National Park Service, Midwest Archeological Center, Occasional Studies in Anthropology No. 34.
- Scott, LG & Calder, CST 1952. Notes on a chambered cairn, and a working gallery, on the Beorgs of Uyea, Northmaven, Shetland. *Proceedings of the Society of Antiquaries of Scotland* 86 (1951-1952), 171-177.
- Seeman, MF 1985. Craft specialisation and tool kit structure: A systematic perspective on the midcontinental flint knapper. In S. C. Vehik (ed) *Lithic Resource Procurement: Proceedings from the second conference on prehistoric chert exploitation*. Southern Illinois University, Center for Archaeological Investigations, Occasional Paper No. 4, 7-36.
- Shaffer, GD 2003. Prehistoric soapstone use in northeastern Maryland. *Antiquity* 77, No 297 (September 2003), <http://antiquity.ac.uk/ProjGall/shaffer/shaffer.html>.
- Shee Twohig, E 1981. *The Megalithic Art of Western Europe*. Oxford: Clarendon Press.
- Sheridan, A 2007. From Picardie to Pickering and Pencraig Hill? New information on the 'Carinated Bowl Neolithic' in northern Britain. In A Whittle & V Cummings (eds) *Going over: the Mesolithic-Neolithic transition in north-west Europe*. Oxford: Oxford University Press for The British Academy. 441-492.



- Sheridan, A 2010. The Neolithisation of Britain and Ireland: the 'big picture'. In B Finlayson & GM Warren (eds) *Landscapes in transition*. Oxford: Oxbow Books. 89-105.
- Sheridan, A 2012. Neolithic Shetland: a view from the "mainland". In DL Mahler (ed) *The Border of Farming and the Cultural Markers*. Copenhagen: The National Museum of Denmark. 6-36.
- Sheridan, A & Pétrequin, P 2014. Constructing a Narrative for the Neolithic of Britain and Ireland: The Use of 'Hard Science' and archaeological reasoning. In A Whittle & P Bickel (eds) *Early Farmers. The view of Archaeology and Science. Proceedings of the British Academy* 198, 369-390.
- Sillitoe, P 1988. *Made in Niugini. Technology in the Highlands of Papua New Guinea*. London: British Museum Publications.
- Sillitoe, P & Hardy, K 2003. Living Lithics: ethnoarchaeology in Highland Papua New Guinea. *Antiquity* 77, 555-566.
- Simán, K 1995. H1 Miskolc-Avas Hill: Prehistoric mine on the Avas Hill at Miskolc. *Archaeologica Polona* 33, 371-382.
- Simek, JF, Franklin, JD & Sherwood, SC 1998. The Context of Early Southeastern Prehistoric Cave Art: A Report on the Archaeology of 3<sup>rd</sup> Unnamed Cave. *American Antiquity* 63(4), 663-677.
- Simek, JF, Cressler, A, Herrman, NP & Sherwood, SC 2013. Sacred landscapes of the south-eastern USA: prehistoric rock art and cave art in Tennessee. *Antiquity* 87, 430-446.
- Sisto, AMT 1995. I26 Valle Sberinia / Valle Guariglia I, Foggia Province. *Archaeologia Polona* 33, 434-436.
- Skertchley, SBJ 1879. On the Manufacture of Gun-Flints, the Methods of Excavating for Flint, the Age of Palaeolithic Man, and the Connexion between Neolithic Art and the Gun-Flint Trade. *Memoirs of the Geological Survey of England and Wales*. London. HMSO.

- Smith, I 1965. *Windmill Hill and Avebury: Excavations by Alexander Keiller 1925-1939*. Oxford: Clarendon Press.
- Smith, I 1981. Stone artefacts. In R Mercer Excavations at Carn Brea, Illogan, Cornwall, 1970-73: A Neolithic Fortified Complex of the Third Millenium bc. *Cornish Archaeology* 20, 152-160.
- Smith, ME 2015. How can archaeologists make better arguments? *The SAA Archaeological Record* (September 2015), 15(4), 18-23.
- Smith, R 1931. *The Sturge Collection: An illustrated selection of flints from Britain bequeathed in 1919 by William Allen Sturge*. London: British Museum.
- Smith, RA 1912. On the date of Grime's Graves and Cissbury flint mines. *Archaeologia* 63, 109-158.
- Smith, SP 1892. Stone implements from the Chatham Islands. *The Journal of the Polynesian Society* 1(2), 80-82.
- Smith, WC 1963. Jade Axes from Sites in the British Isles. *Proceedings of the Prehistoric Society* 29, 133-172.
- Spielmann, KA 2002. Feasting, Craft Specialization, and the Ritual Mode of Production in Small-Scale Societies. *American Anthropologist* 104(1), 195-207.
- Spriggs, M 2008. Ethnographic parallels and the denial of history. *World Archaeology* 40, 538-552.
- Stanley, JW 1976. A Preliminary Description of thin Sections of Some Neolithic Stone Axes from the London Region. *Science and Archaeology* 18, 3-11.
- Stanley, LA 1999. The Sacred Rock Petroglyph Site & the Seven Sacred Stones. *Abstracts of the 64<sup>th</sup> Annual Meeting, Chicago, Illinois*. Washington: Society for American Archaeology. 271.
- Starnini, E & Biagi, P 2006. Excavations at the Harappan Flint Quarry 862 on the Rohri Hills (Sindh, Pakistan). In G Körlin & G Weisgerber (eds) *Stone Age – Mining Age*. Bochum: Deutschen Bergbau-Museum. 195-202.

- Stone, JFS 1931a. Easton Down, Winterslow, S Wilts, Flint Mine excavation, 1930. *Wiltshire Archaeological Magazine* 45, 350-366.
- Stone, JFS 1931b. A settlement site of the Beaker period on Easton Down, Winterslow, S Wilts. *Wiltshire Archaeological Magazine* 45, 366-372.
- Stone, JFS 1933a. Excavations at Easton Down, Winterslow 1931-32. *Wiltshire Archaeological Magazine* 46, 225-242.
- Stone, JFS 1933b. A Flint Mine at Martin's Clump, Over Wallop. *Proceedings of the Hampshire Field Club and Archaeological Society* 12(2), 177-180.
- Stout, D 2002. Skill and Cognition in Stone Tool Production: An Ethnographic Case Study from Irian Jaya. *Current Anthropology* 43(5), 693-722.
- Strathern, M 1965. Axe Types and Quarries: A note on the classification of stone axe blades from the Hagen area, New Guinea. *The Journal of the Polynesian Society* 74(2), 182-191.
- Strathern, M 1969. Stone Axes and Flake Tools: Evaluations from Two New Guinea Highlands Societies. *Proceedings of the Prehistoric Society* 35, 311-329.
- Sundstrom, L 1996. Mirror of heaven: cross-cultural transference of the sacred geography of the Black Hills. *World Archaeology* 28(2), 177-189.
- Svoboda, J 1995. CZ3 Stránská Skála, Brno District. *Archaeologia Polona* 33, 278-281.
- Taçon, PSC 1991. The power of stone: symbolic aspects of stone use and tool development in western Arnhem Land, Australia. *Antiquity* 65, 192-207.
- Taçon, PSC 1999. Identifying Ancient Sacred Landscapes in Australia: From Physical to Social. In W Ashmore & AB Knapp (eds) *Archaeologies of Landscape: Contemporary Perspectives*. Oxford. Blackwell. 33-57.
- Taçon, PSC 2004. Ochre, Clay, Stone and Art: The Symbolic Importance of Minerals as Life-Force among Aboriginal Peoples of Northern and Central Australia. In N Boivin & MA Owoc (eds), *Soils, Stones and Symbols: Cultural*

*Perceptions of the Mineral World*. London: University College London Press. 31-42.

Tanimoto, S, Stacey, R, Varndell, G & Sweek, T 2011. Grimes Graves revisited: a new light on chalk 'lamps'. *British Museum Technical Research Bulletin* 5, 39-47.

Tankerslye, KB 1996. Prehistoric Mining in the Mammoth Cave System. In KC Carstens & PJ Watson (eds) *Of Caves and Shell Mounds*. Tuscaloosa: University of Alabama Press. 33-39.

*Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society*, 1<sup>st</sup> Series, 3 (1876-1877), xvi.

Teather, AM 2008. *Mining and Materiality in the British Neolithic*. Sheffield University: Unpublished PhD Thesis.

Teather, AM 2011. Interpreting hidden chalk art in southern British flint mines. *World Archaeology* 43:2, 230-251.

Thackeray, AI & Thackeray, JF 1983. Excavations at the Blinkklipkop specularite mine near Postmasburg, Northern Cape. *The South African Archaeological Bulletin* 38 (June 1983), 137, 17-25.

Thomas, J 1991. *Rethinking the Neolithic*. Cambridge: Cambridge University Press.

Thomas, J 1996. *Time, Culture and Identity: An interpretive archaeology*. London: Routledge.

Thomas, J 1999. *Understanding the Neolithic*. London: Routledge.

Thomas, J 2008. The Mesolithic-Neolithic Transition in Britain. In J Pollard (ed) *Prehistoric Britain*. Oxford: Blackwell. 58-89.

Thomas, J 2013. *The Birth of Neolithic Britain: An Interpretive Account*. Oxford: Oxford University Press.

Thomas, J 2015. House societies and founding ancestors in Early Neolithic Britain. In C Renfrew, M Boyd & I Morely (eds) *Death Rituals, Social Order and*

*the Archaeology of Immortality in the Ancient World*. Cambridge: Cambridge University Press. 138-152.

Thorpe, N 2015. The Atlantic Mesolithic – Neolithic Transition. In C Fowler, J Harding & D Hofmann (eds) *The Oxford Handbook of Neolithic Europe*. Oxford: Oxford University Press. 215-229.

Tilley, C & Thomas, J 1993. The axe and the torso: symbolic structures in the Neolithic of Brittany. In C Tilley (ed) *Interpretative archaeology*. Oxford: Berg. 225-324.

Timberlake, S & Switsur, R 1988. An archaeological investigation of early mineworkings on Copa Hill, Cwmystwyth: new evidence for prehistoric mining. *Proceedings of the Prehistoric Society* 54, 329-334.

Timberlake, S 2014. Prehistoric Copper Extraction in Britain: Ecton Hill, Staffordshire. *Proceedings of the Prehistoric Society* 80, 159-206.

Tipping, R 1994. The form and fate of Scotland's woodlands. *Proceedings of the Society of Antiquaries of Scotland* 124, 1-54.

Tipping, R, Edmonds, M & Sheridan, A 1993. Palaeo-environmental Investigations Directly Associated with a Neolithic Axe 'Quarry' on Beinn Lawers, Near Killin, Perthshire, Scotland. *New Phytologist* 123(3), 585-597.

Topping, P 1992. The Penrith henges: a survey by the Royal Commission on the Historical Monuments of England. *Proceedings of the Prehistoric Society* 58, 249-264.

Topping, P 1997. Structured deposition, symbolism and the English flint mines. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 127-132.

Topping, P 2004. The South Downs Flint Mines: Towards an ethnography of Prehistoric Flint Extraction. In J Cotton & D Field (eds) *Towards a New Stone Age: aspects of the Neolithic in South-East England*. York: Council for British Archaeology Research Report Series 137. 177-190.

Topping, P 2005. Shaft 27 Revisited: an Ethnography of Neolithic Flint Extraction. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 63-93.

Topping, P 2010. Neolithic Axe Quarries and Flint Mines: Towards an Ethnography of Prehistoric Extraction. In M Brewer-LaPorta, A Burke & D Field (eds) *Ancient Mines and Quarries: A Trans-Atlantic Perspective*. Oxford: Oxbow Books. 23-32.

Topping, P 2011a. Prehistoric extraction: further suggestions from ethnography. In A Saville (Ed) *Flint and Stone in the Neolithic Period*. Oxford: Oxbow Books, 2011, pp.271-286.

Topping, P 2011b. The evidence for the seasonal use of the English flint mines. In M Capote, S Consuegra, P Díaz-del-Río & X Terradas (eds) *Proceedings of the 2<sup>nd</sup> International Conference of the UISPP Commission on Flint Mining in Pre- and Protohistoric Times (Madrid, 14-17 October 2009)*. Oxford: British Archaeological Reports, International Series 2260. 35-43.

Topping, P 2011c. *Grime's Graves*. London: English Heritage Guidebooks.

Topping, P & Lynott, M, eds., 2005. *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books.

Torrence, R 1984. Monopoly or direct access? Industrial organisation at the Melos obsidian quarries. In JE Ericson & BA Purdy (eds) *Prehistoric quarries and lithic production*. Cambridge: Cambridge University Press. 49-64.

Torrence, R 1986. *Production and Exchange of Stone Tools*. Cambridge: Cambridge University Press.

Torrence, R, ed., 1989a. *Time, Energy and Stone Tools*. Cambridge: Cambridge University Press.

Torrence, R 1989b. Re-tooling: Towards a Behavioral Theory of Stone Tools. In R Torrence (ed) *Time, Energy and Stone Tools*. Cambridge: Cambridge University Press. 57-66.

- Torrence, R 2001. Hunter-gatherer technology: macro- and microscale approaches. In C Panter-Brick, RH Layton & P Rowley-Conwy (eds), *Hunter-Gatherers: An Interdisciplinary Perspective*: 73-98. Cambridge: Cambridge University Press.
- Tripcevich, N & Contreras, DA 2011. Quarrying evidence at the Quispisisa obsidian source, Ayacucho, Peru. *Latin American Antiquity* 22(1), 121-136.
- Tripcevich, N & Mackay, A 2011. Procurement at the Chivay obsidian source, Arequipa, Peru. *World Archaeology* 43(2), 271-297.
- Trubitt, MB 2003. *Archeological Mapping at a Novaculite Quarry Site (3GA22) in Hot Springs National Park*. Report submitted to the National Park Service under Archeological Resources Protection Act, Permit No. MWR-02-1.
- Vallin, L & Masson, B 1995. F51 Fampoux near Arras: A flint mine recently discovered at Fampoux near Arras (Northern France). *Archaeologia Polona* 33, 311-313.
- Varndell, G 2005. Seeing Things: A. L. Armstrong's Flint Crust Engravings from Grimes Graves. In P Topping & M Lynott (eds) *The Cultural Landscape of Prehistoric Mines*. Oxford: Oxbow Books. 51-62.
- Vaughan, KJ, Grados, ML, Eerkens, JW & Edwards, MJ 2007. Hematite Mining in the Ancient Americas: Mina Primavera, A 2,000 Year Old Peruvian Mine. *The Journal of the Minerals, Metals and Materials Society* 59(12) (December 2007), 16-20.
- Vecsey, C 1983. *Traditional Ojibwa religion and its historical changes*. Philadelphia: The American Philosophical Society.
- Vermeersch, PM & Paulissen, E 1997. Extensive Middle Palaeolithic chert extraction in the Qena Area (Egypt). In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 133-142.
- Vial, LG 1941. Stone axes of Mount Hagen, New Guinea. *Oceania* 11 (1940/1941), 158-163.

- Villalba, MJ, Edo, M, Blasco, A, Gimeno, D & Turiel, J-LF 1997. Can Tintorer mining complex, Gavá: The latest results. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 143-147.
- Voytek, B 1997. Some theoretical issues connected with the study of flint mining. In R Schild & Z Sulgostowska (eds) *Man and Flint*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences. 149-152.
- Waddington, C 2004. *The Joy of Flint*. Newcastle upon Tyne: Museum of Antiquities.
- Wade, AG 1923. Ancient Flint Mines at Stoke Down, Sussex. *Proceedings of the Prehistoric Society of East Anglia* 4(1), 82-91.
- Walter, R, Jacomb, C & Bowron-Muth, S 2010. Colonisation, mobility and exchange in New Zealand prehistory. *Antiquity* 84, 497-513.
- Warren, SH 1921. Excavations at the Stone-Axe Factory of Graig-Lwyd, Penmaenmawr. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 51, 165-199.
- Watson, PJ (ed) 1974. *Archaeology of the Mammoth Cave Area*. New York: Academic Press.
- Watts, I 2002. Ochre in the Middle Stone Age of Southern Africa: Ritualised display or hide preservative? *The South African Archaeological Bulletin* 57 (175), 1-14.
- Wedel, MM 1974. Le Sueur and the Dakota Sioux. In E Johnson (ed) *Aspects of Upper Great Lakes Anthropology: Papers in Honor of Lloyd A Wilford*. St Paul: Minnesota Historical Society, Minnesota Prehistoric Archaeology Series # 11, 157-190.
- Weisgerber, G 1999. *5000 Jahre Feuersteinbergbau: Die Suche nach dem Stahl der Steinzeit*. Bochum: Deutschen Bergbau-Museum.



Weisler, M 1995. Henderson Island prehistory: colonisation and extinction on a remote Polynesian island. In T Benton & T Spencer *The Pitcairn Islands: Biogeography, Ecology and Prehistory*. London: Academic Press. 377-404.

Weisler, MI 2008. Tracking ancient routes across Polynesian seascapes with basalt artefact geochemistry. In B David & J Thomas (eds) *Handbook of Landscape Archaeology*. Blue Ridge Summit, Pennsylvania: Altamira Press. 536-543.

Weisler, M 2011. A quarried landscape in the Hawaiian Islands. *World Archaeology* 43(2), 298-317.

Weisler, MI, Kirch, PV & Endicott, JM 1994. The Mata'are Basalt Source: Implications for Prehistoric Interaction Studies in the Cook Islands. *The Journal of the Polynesian Society* 103(2), 203-216.

Weisler, MI, Collins, SL, Feng, Y, Zhao, J-x, Shipton, C & Wei, X 2013. A New Major Adze Quarry from Nanakuli, O'ahu: Implications for Interaction Studies in Hawai'i. *Journal of Pacific Archaeology* 4(2), 35-57.

Weltfish, G 1965. *The Lost Universe*. New York: Basic Books.

Wentink, K 2008. Crafting axes, producing meaning. Neolithic axe depositions in the northern Netherlands. *Archaeological Dialogues* 15, 151-173.

Wheeler, P 2008. Ideology and influences behind the Neolithic flint mines of Southern Britain. In P Allard, F Bostyn, F Giligny & J Lech (eds) *Flint Mining in Prehistoric Europe: Interpreting the archaeological records*. Oxford: British Archaeological Reports, International Series 1891. 155-163.

Wheeler, P 2011. Ideology and context within the European flint-mining tradition. In A Saville (ed) *Flint and Stone in the Neolithic Period*. Oxford: Oxbow Books. 304-315.

White, JP & Modjeska, N 1978. Where do all the stone tools go? Some examples and problems in their social and spatial distribution in the Papua New Guinea Highlands. In I Hodder (ed) *The Spatial Organisation of Culture*. London: Duckworth. 25-38.

Whittle, A 1995. Gifts from the earth: symbolic dimensions of the use and production of Neolithic flint and stone axes. *Archaeologia Polona* 33, 247-259.

Whittle, A 1996. *Europe in the Neolithic: The creation of new worlds*. Cambridge: Cambridge University Press.

Whittle, A 2003. *The Archaeology of People: Dimensions of Neolithic Life*. London. Routledge.

Whittle, A, Healy, F & Bayliss, A 2011a. *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*. Oxford: Oxbow Books

Whittle, A, Bayliss, A & Healy, F 2011b. Gathering time: the social dynamics of change. In A Whittle, F Healy & A Bayliss, *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*. Oxford: Oxbow Books. 848-914.

Willet, EH 1880. On flint workings at Cissbury, Sussex. *Archaeologia* 45, 337-348.

Williams, JLIW & Davidson, A 1998. Survey and excavation at the Graig Lwyd Neolithic axe factory, Penmaenmawr. *Archaeology in Wales* 38, 3-21.

Williams, JLIW & Davidson, A 2002. Field survey at Graig Lwyd, Penmaenmawr. *Archaeology in Wales* 42, 3-16.

Williams, JL, Kenney, J & Edmonds, M 2011. Graig Lwyd (Group VII) assemblages from Parc Bryn Cegin, Llandygai, Gwynedd, Wales – analysis and interpretation. In V Davis & M Edmonds (eds) *Stone Axe Studies III*. Oxford: Oxbow Books. 261-278.

Willet, EH 1875. On flint workings at Cissbury, Sussex. *Archaeologia* 65, 337-348.

Winchell, NH 1911. *The Aborigines of Minnesota*. St Paul: The Minnesota Historical Society.

Winchell, NH 1884. Indian Pictographs at the Pipestone Quarry. *The Minnesota Archaeologist* 42 (1 & 2), 15-18. (Reprinted from Winchell, NH 1884. *The Geology of Minnesota, Vol 1*. Minneapolis: Johnson, Smith & Harrison. 556-559)

Woolworth, AR (ed) 1983. The Red Pipestone Quarry of Minnesota: Archaeological and Historical Reports. *The Minnesota Archaeologist* 42 (1 & 2).

Wysocki, M, Griffiths, S, Hedges, R, Bayliss, A, Higham, T, Fernandez-Jalvo, Y & Whittle, A 2013. Dates, Diet, and Dismemberment: Evidence from the Coldrum Megalithic Monument, Kent. *Proceedings of the Prehistoric Society* 79, 61-90.