

The social context of Neolithic flint and stone extraction in Britain and Ireland

Peter TOPPING

Abstract

This research analysed 168 ethnographic studies and 223 global archaeological projects, and was then used to interpret 79 flint mine and 51 axe quarry excavations in Britain and Ireland. This suggests 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, demonstrate 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 domestic settings, confirming 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 setting, composition, structures and assemblages.

Keywords: anthropology, probability analysis, ritualised extraction, social context.

Résumé

Cette recherche analyse 168 études ethnographiques et 223 projets archéologiques à l'échelle mondiale, et a ensuite été utilisée pour interpréter 79 fouilles de minière à silex et 51 fouilles de carrières de production de haches de pierre en Grande-Bretagne et en Irlande. Elle suggère que de nombreux sites d'extraction étaient des endroits spéciaux, délibérément éloignés des habitats. Ces sites relèvent de pratiques communes et les assemblages y ont fait l'objet de dépôts soignés ce qui reflète des compétences techniques et des pratiques ritualisées, mais aussi une exclusivité – les sites étaient probablement contrôlés par des clans ou des spécialistes techniques. Les analyses précédentes, en particulier des haches en pierre, démontrent que de nombreux produits issus des sites d'extraction ont circulé sur de longues distances, n'étaient pas souvent utilisés et ont fait l'objet de dépôts dans des contextes archéologiques non domestiques. À l'inverse, les artefacts taillés à partir de matières premières ramassées de manière opportuniste en surface sont généralement découverts en contexte domestique, ce qui confirme la nature particulière des sites d'extraction et des produits qui en sont issus.

Dans l'ensemble, cette analyse de probabilité ethnographique, statistiquement robuste, fournit une base plus fiable pour modéliser le contexte social des sites d'extraction grâce à une analyse détaillée de leur environnement, de leur composition, de leurs structures et de leurs assemblages.

Mots-clés : anthropologie, analyse de probabilité, extraction ritualisée, contexte social.

1. INTRODUCTION

Prehistoric mines, quarries and their products have often been studied from economic and technological perspectives. Since the 1980s the potential role of ritualisation has been suggested, but is reliant upon a

small number of ethnographic analogues which do not encompass the cultural variety even within a single region. The present research has overcome this by using a far larger sample of data than previously attempted, offering a more nuanced understanding of traditional practices. As Hampton (1997, p. 79) has observed, the

contiguous communities inhabiting the New Guinea highlands, for example, although superficially similar, '[do] have significant differences' (HAMPTON, 1997, p. 79), including different language groups, different materialities and different social networks. Critically, it is materiality, and particularly stone tools, which is central to the 'ideological reproduction of these communities of forest farmers' (PÉTREQUIN & PÉTREQUIN, 2012, p. 27) – a scenario pertinent to Neolithic Europe.

This research presumes that an interpretive steer can be gained by developing a model from ethnographic analogy based upon the structures within, and social contexts of, the material patterning of practices related to extraction and its products (cf. LEVI-STRAUSS, 1983). To create this model, 168 ethnographic studies were analysed to produce trend data and identify material patterning, which was then tested against 223 global archaeological studies. This research has constructed a near global ethno-archaeological model of extraction practices (TOPPING, 2017) to build upon Binford's (1983) methodologies, and create a reliable interpretive bridge between analogy and archaeological data, particularly where materiality represents metaphorical associations (HODDER, 1982; BOURDIEU, 1990; GODELIER, 1999; FOGELIN & SCHIFFER, 2015). The model uses appropriate social and anthropological theories to explain the content, variability, spatial patterning and context of the archaeological record to enhance understanding of wider social contexts (e.g. GERO, 1989, 1991; GOSDEN & MARSHALL, 1999).

The model uses a 'flow model' approach (cf. SCHIFFER, 1972; FOGELIN & SCHIFFER, 2015), similar to a *chaîne opératoire*, to sketch staged extraction from source identification to exploitation, product manufacture, and product use to final deposition. In addition, the model has the potential to identify why and how extraction site products were objectified to carry narratives, and the ways in which they can structure social networks (HODDER, 1982, 2012) and influence change in society (RATHJE, 1979; MARSHALL, 2008). The ethnography has provided robust information on the contexts of ritualisation within extraction practice and its outcome in society.

2. THE ETHNOGRAPHY OF EXTRACTION

2.1. Storied sources

Many ethnographic extraction sites have storied or ideological associations which incorporate mythology, cosmology and/or community history to legitimise ownership or exploitation, or as explanation of the origin of the raw material. This can underscore objectification and social renewal (BOURDIEU, 1990; GODELIER, 1999; GOSDEN & MARSHALL, 1999; KOPYTOFF, 1986). The ethnography shows that 93 % of sites have storied associations.

Ethnography does not always record the topography of storied sites or the nature of the raw material, but where this data exists, many are locally prominent or distinctive landforms, or comprise unusual deposits visually different from their surroundings in shape, texture or colouration. The extraordinary nature of storied deposits differentiates them from the norm. These differences stimulated storied associations, linking social narratives to cosmology. Such processes objectify raw materials through storied associations (often combined with ritualised extraction), which can then be used to maintain social networks, identity and status.

Storied materials range in scale from the earth as an engendered entity to specific mountains, exposed rock strata, individual boulders, nodules/cobbles to fine minerals. The global scale is seen with the Incas, who viewed the earth as a female entity, Pachamama, but the mountains which contained storied raw materials were male 'lords' (Apu), thus constructing an engendered male – female dichotomy replicating human fertility. These storied raw materials were exploited in caves or mines, which were considered portals to the underworld, and were treated reverentially with idols, offerings, rock art and ritualised practices (DEAN, 2010). Native Americans in the Ozarks also considered caves and rock shelters as origin places and entrances to the underworld, and were exploited for flint clays to produce ceremonial objects, especially figurines (EMMERSON & HUGHES, 2000). Exposures of different raw materials were exploited on the Plains too, such as Minnesota pipestone where surface exposures

were quarried in the foreground of a prominent cliff and became mythologised by many tribes (HUGHES & STEWART, 1997).

Storied sites can be individual boulders, such as those of nephrite, considered by the Maori to be fossilised fish which arrived with their first settlers (FIELD, 2012). Smaller still, river cobbles used by many New Guinea communities are associated with supernatural beings or significant ancestors, and can only be processed by ritual specialists. At the Yeineri quarries, Kembe River sources are controlled by the spirit Elogor who has to be appeased before quarrying (HAMPTON, 1997, p. 695). Similarly at the Ngilipitji quarry in Arnhem Land, Aboriginal Australians view quartzite nodules as supernatural Dreamtime 'eggs' which require respectful treatment (BRUMM, 2011).

Fine minerals can also be storied. The Wilgie Mia quarries are part of the Aboriginal Australian Dreamtime where the ochre is believed to be the liver and gall of an ancestor known as Mondong (FLOOD, 1995).

Overall, storied raw materials are generally visually distinctive. Storied associations operate on two levels: (1) those linked to an omnipresent entity and represent that entity's body (e.g. Incas); or (2) a material curated by an ancestor/spirit who has to be appeased to gain access (e.g. Lakota; Dani; Aboriginal Australians). In the latter case, some sites are not considered 'sacred', *per se*, but their link with spirits/ancestors defines them as storied locations (e.g. Yeineri quarries; HAMPTON, 1997, p. 95).

A recurrent theme of storied sites is a correlation between the raw material and a female engendered entity. This female-gendered principle provides a global platform for many ideologies, often manifested by focussing upon specific landscape features for embodiment. Where ancestral or supernatural figures are recorded, female characters also predominate. Consequently, a female-engendered cosmology can be viewed as the ideological affirmation of female fertility and its role in resource provision. The counterpoint to such female engenderment of the raw material is that it is generally adult

male extraction teams that create objects which carry a biography, transforming a female-derived material into a symbol of masculine power.

The ethnography suggests that if Neolithic sites were storied locations, they would often see seasonal use, ritualised extraction, craft specialists, supra-regional product distribution (200+ km), some ceremonialism, some rock art/graffiti, and rare burials.

2.2. Ownership, or restricted access

The ethnography records 68 % of sites are owned by individuals, clans or tribal groups. Ownership is characterised as: unspecified = 29 examples; tribal = 22; clan = 15; village = 4; an elder = 3; an individual = 2. Occasionally owned sites are permanently occupied, but most are 1-5 days march from the community.

2.3. Age/sex demographic of extraction site users

The age/sex demographic of site users is predominantly adult male (82 %), followed by mixed gender teams with children (16 %), and a few female-only enterprises (2 %). Children feature in support roles, usually as apprentices. The rare female teams occur among the Konso (Africa) where procurement and tool manufacture is considered a female activity (ARTHUR, 2010), and among the Tiwi (Tasmania) where women mined ochre (PLOMLEY, 1966). Consequently, women do undertake extraction in certain exceptional social contexts (GERO, 1991).

2.4. The evidence for ritualised extraction

Ethnography records ritualised extraction in 92 % of cases. The greatest concentration occurs in North America [32], followed by New Guinea [16], Australia [14], Europe [3] and South America [2], demonstrating that this phenomenon was not geographically-restricted. Ritualised extraction occurs in many distant places and unrelated cultural contexts and is not an isolated response, rather it is a mechanism which connects resource procurement to a cosmology or ideology, centring people in a place.

Ethnography describes preliminary purification rites, prescribed extraction practices, generally on-site artefact production, and often post-extraction renewal rites. These practices leave clear material traces in the archaeological record, and this ethnographic evidence is compared with the archaeological data in Figure 1.

These six indicators of ritualised extraction practices are considered to be the most archaeologically visible, which can deliver a more nuanced interpretation of prehistoric extraction. One of the strongest correlations is between storied locations and the 200+ km distribution of products.

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

Fig. 1 – A comparison of the material evidence of ritualised extraction recorded by ethnography and archaeology.

2.5. Distribution of extraction site products

The distribution of extraction products is a key indicator of ritualised practices and recoverable by archaeology. Ethnography records 64 % of products travel 200+ km from source, 17 % between 100-200 km, and 7 % are found within 100 km of the extraction site. Such patterns demonstrate that cultural value equates with distances transported, and the majority of products move far beyond extraction sites.

If we consider product distributions against six archaeologically-visible features (Fig. 2), the patterning shows that only supra-regional distribution (200+ km) is associated with all six, and again illustrates that the most valued products travelled the greatest distances, often from storied locations. In addition, ritualised extraction was important at all scales of product distribution.

3. THE ARCHAEOLOGY OF EXTRACTION

The ethnographic model derived from 168 case studies was tested against 223 near-global archaeological sites. This analysis was designed to discover common material patterns in the two data sets in a staged, contextual way across extraction, product manufacture, use and discard. The archaeological data showed many correlations with the ethnography, allowing a more cogent modelling of the social context of extraction.

The analysis of the ethno-archaeological model illustrated the following common trends:

1. Distinctive locations
2. Restricted access
3. Ritualised extraction
4. Ceremonialism/burials
5. Rock art/graffiti
6. Supra-regional product distribution

<i>Distance</i> [n = 168]	<i>Storied sites</i>	<i>Owned sites</i>	<i>Ritualised extraction</i>	<i>Ceremonial use</i>	<i>Rock art/ graffiti/ idols</i>	<i>Human burials</i>
200 + km 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]
100-200 km 17 % [n = 28]	50 % [n = 14 of 28]	61 % [n = 17 of 28]	32 % [n = 9 of 28]	0	0	0
>100 km 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
No date 12 % [n = 22]						

Fig. 2 – Ethnographic product distributions against archaeologically recoverable features.

3.1. The landscape setting of extraction sites

When the model is applied to the landscape setting of extraction sites, several observations emerge which the model would suggest implies they were probably storied locations practising ritualised procurement. Firstly, location was clearly important, with distinctive landforms being preferred (Fig. 3), irrespective of raw material quality. Additionally, visually different raw materials



Fig. 3 – The distinctive dome-shaped summit of the Pike of Stickle axe quarries in Langdale, Cumbria.
Photo © P. Topping.

were deliberately targeted, such as Langdale Tuff, Riebeckite Felsite, or coloured flints. The model would suggest these were storied locations.

Specific raw material was important: Blackpatch and Harrow Hill mines were deliberately located upon inferior quality flint, despite better deposits nearby (BARBER *et al.*, 1999, p. 24). Clearly here it was the *location* of extraction that was important rather than toolstone quality, a situation paralleled at the Langdale axe quarries where '[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, p. 127).

Despite prominent locations, however, the presence of woodland affected visibility (ALLEN & GARDINER, 2012). Although only a minority of sites have provided data, the upland quarries at Creag na Caillich and Langdale/Scafell, the South Downs mines and Grime's Graves (Fig. 4), all produced evidence of woodland. The upland quarries were probably near the treeline, and the mines appear to have been in woodland clearings. Consequently, despite often prominent locations, many sites were hidden by woodland and barely visible (cf. FONTIJN, 2007), which may imply exclusivity, a



Fig. 4 – Grime's Graves flint mines.
Photo © P. Topping.

fact supported by evidence of ritualised practices at these sites. In addition to the woodland at Grime's Graves, periglacial stripes surrounding the mines may have also influenced cultural perceptions of the site (Fig. 5).

Rock art/graffiti is an integral part of ritualised extraction for many cultures, and is present at roughly 30 % of archaeological sites. The lack of permanent settlement at archaeological sites would be explained by the model as evidence of taboos preventing domestic activity near extraction, adding to the impression of exclusivity. In addition, long-distance product distributions in almost every archaeological case would suggest evidence of storied locations practising ritualised extraction.

Taken together, the high percentage of sites in prominent locations, or comprising distinctive deposits, provides a strong parallel with the cross-cultural ethnographic trends, and implies that the majority of archaeological sites were also storied.

3.2. Evidence for seasonal extraction

Seasonality can be both a deliberate act and a practical constraint imposed by location and climate. Ethnography documents seasonality in 89 % of cases. The archaeological record has evidence suggesting seasonality or temporary abandonment, comprising wind-blown



Fig. 5 – The periglacial stripes at Grime's Graves flint mines, defined by different vegetation.
Photo © P. Topping.

silts in the workings, stabilised and compacted horizons in backfill, and hearths, debitage, placed deposits, and animal remains on stabilised layers. Circumstantial evidence such as bat skeletons in galleries at Grime's Graves (Pit 1 & Pit 2), proves these sites were open during the winter hibernation period (TOPPING, 2011).

Amongst the British and Irish sites, natural silts, stabilised horizons and assemblages are recorded in 53 % of mines and 33 % of quarries.

3.3. The practice of stone extraction

Ethnography records ritualised practices in 92 % of cases, and of those 94 % were storied locations. The presence of storied associations demonstrates that ideologies and ritualisation were entangled. At times ritualised practices can become obscured. For example, 'functional' deposits of extraction tools left *in situ* at most sites may be material evidence indicating taboos preventing removal (as recorded at the Aboriginal Wilgie Mia mines), rather than simply casual discard.

The ethnography identifies broad trends in ritualised extraction, which are sequential, and follow a *chaîne opératoire* (Fig. 1):

1. Ritualised preparations
2. Ritualised extraction
3. Renewal rites
4. Ritualised closing ceremonies
5. Occasional human burials

The archaeological record contains similar material patterning.

3.4. Ritualised preparations

Ritualised extraction often begins with purification rituals, including prayers, offerings, and rock art/graffiti in or near the sites. Purification uses smoke/steam, prayers at hearths, sweat lodges or burning herbs. The archaeological record contains material evidence suggesting purification activities.

3.5. Hearths/charcoal deposits

Ethnography records the purification of individuals and extraction tools at hearths. Archaeologically, hearths occur in 29 % of mines and 10 % of quarries, with smaller charcoal deposits at 29 % of mines and 30 % of quarries. Examples occur on the floors of Shaft 5 at Blackpatch (RUSSELL, 2001), the Cave Pit at Cissbury (PARK HARRISON, 1877), Pit B49 at Easton Down (STONE, 1933), Pit 21 and Shaft III at Harrow

Hill (CURWEN & CURWEN, 1926; HOLLEYMAN, 1937), Pit 1, Pit 2 (Fig. 6), Pit 15 and the 1971 Shaft at Grime's Graves (MERCER, 1981) - none appear to have been used for lighting, cooking or hardening antler picks. A group of hearths was discovered on Floor B at Graiglwyd within the quarry workings (HAZZLEDINE WARREN, 1921), and another was found at Ballygalley Hill upslope from the quarries (COLLINS, 1978). The contexts of these hearths and the lack of domestic activity suggest they were part of extraction practice.

3.6. Offerings

Ritualised extraction was enhanced by accompanying paraphernalia. Archaeological evidence of non-functional material comprises carved chalk objects, pottery, re-deposited debitage and lithics, graffiti, and structures (e.g. chalk platforms). This evidence, alongside preparations at hearths, suggests the deposition of offerings. Examples include a 'shell deposit' and carved chalk object from Shaft 2, Gallery III, Blackpatch (RUSSELL, 2001); a carved chalk ball

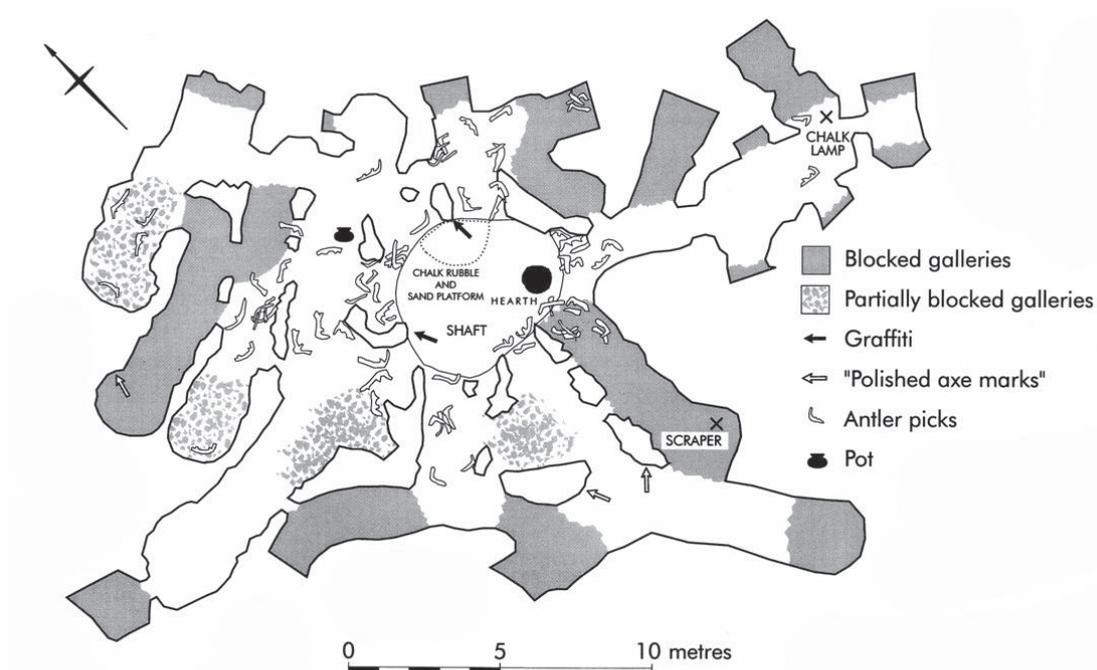


Fig. 6 - Pit 2, Grime's Graves, showing the distribution of assemblages within the mine. Plan © T. Pearson (after CLARKE, 1915).

from Gallery I and chalk objects and animal bones from the fill of Shaft 7, Blackpatch (PULL, 1932); two ox skulls and other animal remains and four carved chalk objects from Tindall's 1874 Shaft, Cissbury (WILLETT, 1880); a dog skull discovered in Pit B1(A), Easton Down (STONE, 1931); and carved chalk objects and Grooved Ware from Pit 1, Grime's Graves (CLARKE, 1915). The carved chalk objects are clearly not extraction tools, and comprise balls, phalli and inscribed blocks, paralleling ethnographic offerings (Fig. 7).

These assemblages target 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 (MERCER, 1981), or graffiti above entrances at Harrow Hill, Cissbury and Grime's Graves (BARBER *et al.*, 1999). The shaft floors thus became a structured arena where hearths, graffiti and placed deposits created a demarcated stage where objects transmitted messages to trigger appropriate actions to maintain cosmological order during extraction.

Evidence for offerings also exists at quarries, including two axehead roughouts placed on a deposit of silt and debitage in the South Scree 'Cave', Langdale (FELL, 1951); the schist disc amongst debitage in the Working Gallery, Beorgs of Uyea, Shetland (SCOTT & CALDER, 1952); and pit deposits buried beneath cairns at Lambay Island (COONEY, 2005).



Fig. 7 – Carved chalk objects from the Cissbury flint mines. Photo © D. Field.

3.7. Rites of renewal

Ethnography documents the return of debitage and rejected artefacts to sites as part of renewal rituals. At archaeological sites this can be inferred from debitage or artefacts discovered in dark, subterranean workings with no evidence of artificial light where tool production clearly did not take place, as at Blackpatch, Cissbury, Den of Boddam, Durrington, Goodland, Grime's Graves, Harrow Hill, and Stoke Down. Renewal would also explain the 300+ axehead roughouts recovered by excavations at Grime's Graves (Gillian Varndell pers. comm.), or the cache of axeheads in Shaft III at Harrow Hill, where 33 'in various stages of manufacture' were discovered (HOLLEYMAN, 1936). The quarries have fewer such deposits, but they do occur at Site 95 (BRADLEY & EDMONDS, 1993), and South Scree 'Cave' (FELL, 1951), both in Langdale.

3.8. Human remains

Human remains are rare at archaeological sites, although excavation bias and taphonomy need consideration; the human remains discussed here are from the mines. Ethnography records burials in 18 % of cases, particularly in Australia and North America. Amongst the Neolithic mines, burials occur at 12 % of sites: 'Barrow' 2, Blackpatch, a small pit contained an adult male inhumation, a chalk object near the skull, and an unrelated skull fragment in the upper fill (PULL, 1932); 'Barrow' 3, Blackpatch, a small pit held two successive inhumations accompanied by lithics and animal bones beneath a 'barrow' of reconfigured mine debris (BARBER, 2005); the Skeleton Shaft at Cissbury, contained a female skeleton positioned head down, 0.76 m above the shaft floor, alongside animal bones (LANE FOX, 1876); Shaft VI, Cissbury, an adult male skeleton lay mid-way down the shaft surrounded by chalk blocks, lithics and a carved chalk object (PARK HARRISON, 1878); in Shaft 27, Cissbury, an adult female skeleton was discovered on the lower shaft fills with two chalk objects and a 'fossil-like worm' (TOPPING, 2005); and in Pit 2, Grime's Graves, a disarticulated skeleton lay mid-way down the shaft, juxtaposed with animal bones and lithics and below a series of hearths (CLARKE, 1915).

Body parts occur at 10 % of archaeological sites. Examples include: Shaft 4, Blackpatch, where an adult's femur and child's mandible were found (RUSSELL, 2001); Shaft 6, Church Hill, a fibula was discovered (RUSSELL, 2001); Pit 1, Grime's Graves, the shaft contained a human skull wedged between chalk blocks 5 cm above an ox bone (CLARKE, 1915); and the lower fills of Pit 3, Grime's Graves, produced a pick made from human bone from Early Bronze Age workings (LONGWORTH & VARDELL, 1996).

Overall, the human remains suggest formal or casual burials designed to link the dead to the raw material, as suggested by ethnography. Burials and body parts are predominantly found in the lower half of shafts, or beneath mounds of mine debris. However, by the Early Bronze Age at Grime's Graves burials are absent, suggesting a shift in practice, although a human femur was used as a pick in Pit 3 (LEGGE, 1992; LONGWORTH & VARDELL, 1996), demonstrating the deliberate use of human remains as extraction tools. This occurred during a period when metalworking was first introduced, and society moved away from communal beliefs to greater individualism and social inequality.

If the predominantly female remains recovered from the mines represent site workers, then unlike the male teams of ethnography, the archaeological sites suggest that mixed gender teams, possibly with children (e.g. child's mandible, Shaft 4, Blackpatch), operated on the South Downs; at Grime's Graves and the upland quarries it is less clear. The presence of human remains parallel practices recorded at causewayed enclosures, long barrows and henges.

3.9. Graffiti/rock art

Graffiti/rock art is a feature at 14 % of mines and 2 % of quarries. Ethnography suggests this may be part of ritualised preparations to legitimise procurement, satisfy cosmological concerns, and provide an arena for offerings.

This art targets access routes, observation points, and creates cultural or ideological boundaries. In the mines it occurs above gallery entrances at entry points to the deeper workings,

and rock art panels on valley floors provide views to the upland quarries. In addition, portable art such as inscribed chalk blocks at the mines, and a stone plaque from Graiglwyd axe quarry (HAZZELDINE WARREN, 1921), hint at a role for portable art in extraction practice.

3.10. Site abandonment

Site abandonment often follows episodic sequences of backfilling, paralleling trends in ethnography where 33 % of cases documented post-extraction ceremonialism. The archaeological evidence of backfilling events comprises stabilised surfaces, natural silts and assemblages. Such evidence occurs at 53 % of mines and 33 % of quarries, suggesting prescribed abandonment practices, and is seen 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 chronology of staged backfilling spans the Neolithic and Early Bronze Age, indicating a long-lived tradition.

Abandonment at mines was generally episodic, following the sequential backfilling of the galleries, and progressed in stages up the shaft. Each abandonment event was often accompanied by cultural objects, human and animal bones, and/or hearths (Fig. 8). For example, Shaft 27, Cissbury, a minimum of 12 deposits filled the shaft (TOPPING, 2005); the 1971 Shaft, Grime's Graves, comprised at least 6 backfilling events, interspersed with c. 13 phases of stasis represented by natural silts (MERCER, 1981). These sequences prove that some mines remained open as arenas for post-extraction ceremonialism, mirroring ethnographic practices designed to appease cosmological concerns.

To summarise, this evidence suggests that the archaeological record strongly parallels the ethnography, and implies that ritualised extraction probably occurred at most, if not all, sites mentioned above. The analysis found that the commonest themes at the mines are: distinctive locations; debitage/lithics in the workings; stabilised horizons and hearths in the workings; tools abandoned in workings; and

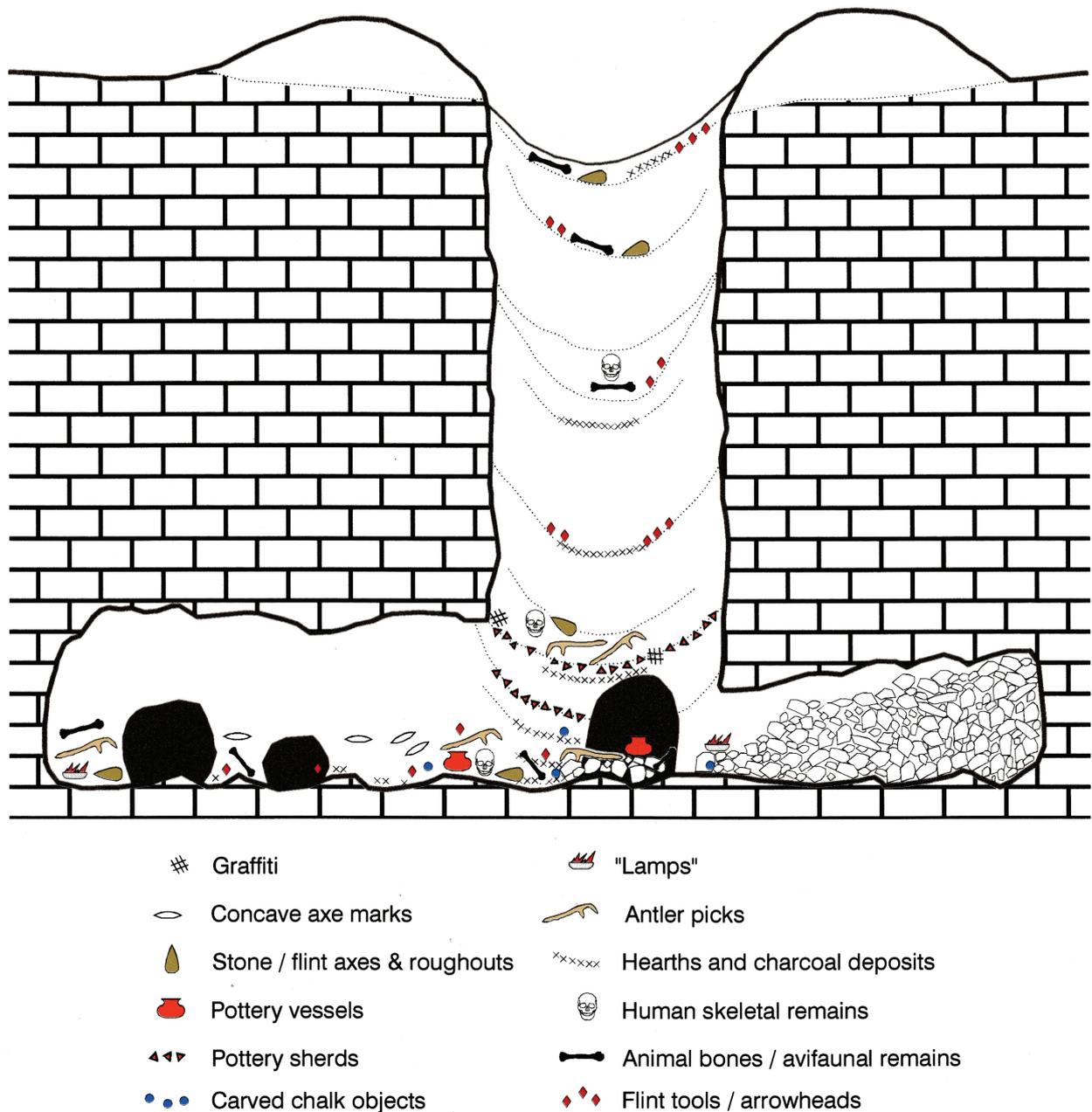


Fig. 8 – The spatial and temporal distribution of assemblages in the British flint mines.
Diagram © P. Topping & T. Pearson.

deposits of disarticulated animal remains. At the quarries the commonest themes are: distinctive locations; debitage/lithics in workings; rock art/graffiti within 5 km of the site; and supra-regional product distribution (200+ km). These comparators would suggest that where most, or all, occur, then we can infer storied locations practising ritualised extraction to produce valued products for extensive distribution.

3.11. The chronology of extraction

The chronology of these sites and practices (Fig. 9) spans the Early Neolithic at the South Downs and Wessex Groups of mines (WHITTLE *et al.*, 2011) to the Late Neolithic/Early Bronze Age at Grime's Graves (HEALEY *et al.*, 2014), Den of Boddam (SAVILLE, 2005) and Hambleton Hill (MERCER & HEALY, 2008). The quarries are an

earlier Neolithic phenomenon, with only Creag na Caillich exploited in the Late Neolithic/Early Bronze Age (EDMONDS *et al.*, 1992).

This chronology combined with the immediate introduction of galleried mines, proves an important point - extraction practices

¹⁴ 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	?	?	?								?						
4000				?	?	?	?					?					
3900													?	?			
3800		?		?									?				
3700		?	?										?		?		
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1200						?				?							
1100						?				?							

Fig. 9 – The relative chronology of axe quarries and flint mines based upon crude radiocarbon dates.

existed *before* the introduction of Early Neolithic activity in southern England, as demonstrated by the European radiocarbon chronology. This pre-existing knowledge drew heavily upon technical expertise from Europe – shaft and gallery mining was not an *ad hoc* activity, it required geological knowledge and technical skill. In addition, certain material practices were repeatedly followed during extraction, particularly assemblage deposition in specific locations. This shows that extraction practice followed a shared ideology brought to Britain and Ireland from adjacent areas of Europe as part of 'being' Neolithic.

Neolithic practices may have entered southern England via several routes, including the Thames Estuary. As observed, the South Downs mines, and possibly the Wessex Group, were among the first constructions in a landscape used by mobile groups with shifting mixed farming, and a reliance on wild resources. It would take another 100-300 years before communal monuments appeared (e.g. long barrows, causewayed enclosures) to anchor communities to other places for different social imperatives. The Graiglwyd, Lambay Island, Langdale and possibly Tievebulliagh quarries were exploited at roughly the same time. Most have one thing in common – they are close to, or visible from, the sea. This suggests the Neolithic transition and the introduction of mining resulted from sea travel skirting southern Britain and the Irish Sea, lent weight by the early dates from the South Downs, Graiglwyd, Langdale and Lambay Island.

One possible point of origin was the Paris Basin. Here flint mining not only appeared roughly 4-500 years earlier than in Britain and Ireland, *but* the Paris Basin flint mines were also one of the first Neolithic site types to appear in that landscape too, thus paralleling the sequence in Britain (GILIGNY, 2011; GILIGNY & BOSTYN, 2016).

The aggregated ethnography builds upon the work of Bradley, Edmonds, Cooney, Whittle and others, to provide a more nuanced perspective of extraction sites. Such documented processes are fundamental to reconstructing practices and outcomes. The fact that many extraction sites in Britain and Ireland lie beyond the limits of settlement and ceremonial monuments,

suggests exclusivity and probably restricted access - with control by tribes, clans or a technical elite. The research of Allen and Gardiner (2012) demonstrates that many sites were hidden in woodland, adding to their liminality. A final factor which suggests sites were considered special places is the fact that nearly all had more accessible sources of raw material locally but these were ignored in favour of those from more difficult but significant locations.

Ethnography has provided useful insights into the cosmology of extraction sites. A recurrent theme is the presence of female deities, creating male (quarry teams) and female (supernatural entities) roles, suggesting procurement may have symbolically mirrored human procreation. Consequently, a female-engendered cosmology may be an ideological affirmation of female fertility in relation to toolstone. Conversely, it is often male extraction teams who work the female-engendered resources and create objects which transform a female derived substance (e.g. toolstone) into a symbol of male power.

Some ethnography cites extraction site products as 'profane' tools initially, which can be ritually transformed into 'sacred' objects at

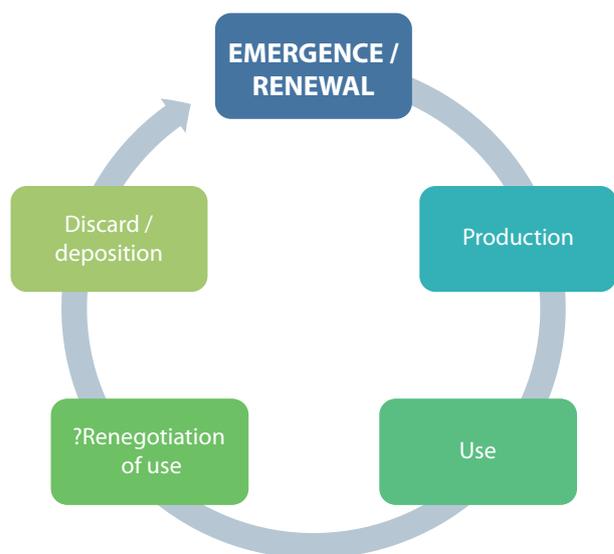


Fig. 10 – The ethnographic cycle of lithic procurement from emergence to discard, including potential conversion of use/value. Diagram © P. Topping.

certain times to fulfil ceremonial or social obligations (Fig. 10). In addition, some objects convey sacredness but *not* wealth, a key finding which may be seen archaeologically by the fact that only rarely are multiple axeheads found in graves as demonstrations of inferred 'wealth'.

A strong ethnographic correlation exists between long-distance movement (200+ km) of extraction site products and ritualised extraction in 64 % of cases, which compares with 60 % in the global archaeological data. This lends security to the interpretation of product outcomes from ritualised extraction practices.

4. CONCLUSIONS

Overall, this analysis suggests that many prehistoric extraction sites were special places used in ritualised ways. Ethnography shows ritual permeates even mundane activities in many traditional societies, and the assemblages and non-functional deposits in many Neolithic extraction sites suggest similar practices occurred during their use. Consequently extraction must have been entangled with controls and rituals designed to counter inherent dangers, ensure success, and maintain the status of the site, the miners and their products. Final deposition of many extraction site products was in non-domestic contexts in contrast to products made from expedient sources, demonstrating that extraction site objects were enmeshed in a web of procedure, transaction and social performance. As Edmonds (1993) has noted, if the Early Neolithic did not see a 'wholesale economic transformation' with extensive woodland clearance and widespread agriculture, then other explanations for the proliferation of flint and stone axeheads is needed, particularly unused examples. Consequently, it is difficult to escape the conclusion that the axehead became a widespread *leitmotif* during the earliest Neolithic in Britain and Ireland – as in Europe.

The extensive distribution of many stone axeheads throughout Britain and Ireland which were often deposited broken or burnt, or buried in hoards, demonstrates a deeper significance than functional tools. As Fontijn (2007, p. 77) observed, '[p]articuliar objects – and the ideas that

they stand for – can become a central memory paradoxically precisely because they were destroyed or removed in a specific ceremony ... [creating] remembrance by removal.'

The cultural value of Cumbrian Group VI axeheads, for example, is seen in Ireland where 23 % were discovered in rivers and 20 % in bogs, demonstrating their importance in wetland deposition - even higher percentages of indigenous Irish axeheads are found in these contexts (COONEY & MANDAL, 1998). In parallel, many Antrim Group IX axeheads were recovered from various contexts in Britain, showing the value of exotic objects to communities on both sides of the Irish Sea. Similarly, the South Downs mines follow this trend, with axeheads from the mines recorded on the adjacent coastal plain mostly unused and carefully curated (GARDINER, 1990).

The physical and metaphysical challenges of extraction objectified raw materials, making them 'pieces of places' as Bradley (2000) has suggested, resonant with symbolic power. The physical dangers are typified by the precipitous Top Buttress quarries on Pike of Stickle, Langdale, for example, or at the Creag na Caillich quarries, and off-shore sources such as Lambay and Rathlin Islands involved challenging sea travel. Such logistical difficulties required mediation with natural and supernatural forces.

Mediation is most readily seen in the patterned evidence of ritualised extraction in most mines. Human remains are found only in shaft fills and not within galleries; pottery only occurs in shaft fills at Grime's Graves and the Irish quarries at Ballygalley Hill (COLLINS, 1978) and Goodland (CASE, 1973); hearths were only placed on shaft floors or shaft fills; lithics and debitage occur in various contexts throughout the workings; and graffiti is found above gallery entrances.

Ethnography suggests that many distinctive prehistoric extraction sites may have been engendered or mythologised as a means of explaining the origins of the cultural landscape and humankind's place within it. At Grime's Graves, periglacial stripes visible on the ground surface create an unusual striped patterning around the mines. Similar stripes

found at Stonehenge (a broadly contemporary monument), influenced the winter solstice alignment of the site and Avenue.

The skyline location of many sites placed them symbolically between the earth and the sky, which in a layered cosmology may have situated them at an interface of the surface world, the underworld and the heavens. Isolation and liminality would have enhanced such locations. As Cooney (1998) has observed, the fact these sites visibly altered the landscape created a monumentality that embedded them psychologically into the cultural landscape.

Towards the end of the Early Bronze Age ritualised practices diminished at Grime's Graves, and shaft mining changed to pit extraction, and bone picks replaced antler. At the Creag na Caillich quarries, secondary extraction changed products to perforated axeheads, and the pits at Den of Boddam provide little evidence of ritualisation. This realignment of extraction practice occurred when Arreton and Acton metalworking traditions were well established, cremations in Urns took place, and Deverel-Rimbury traditions eclipsed Wessex 2, creating a period of social transformation which appears to have ended the ideological need for ritualised extraction practices.

4.1. Stone extraction and identity at the beginning of the Neolithic

This research has shown the earliest extraction sites are located near the sea, which demonstrates their pivotal role in Neolithisation as they were some of the first Neolithic constructions. Consequently, extraction sites were deeply involved in the creation of identity and becoming Neolithic. Their location suggests that prospection and stone procurement was undertaken along the coastline, with the axe quarries ranged around the Irish Sea and the flint mines overlooking the Channel, arguably fossilising two Neolithic routes to Britain and Ireland.

Archaeology records that communities in Britain, Ireland and Europe followed a general tradition of extraction – with common practices. This implies that ritualised extraction had its foundations in a pan-European social

phenomenon which was later adopted in Britain and Ireland, with some modifications reflecting an emerging cultural diversity. It was the role of the most abundant implement from the extraction sites, the axehead, which became truly transformative in society in a variety of ways. As Allen and Gardiner (2012) 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 create forest clearings 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, becoming as Brumm (2011) has characterised them – '*power tools*'. Tools that had emerged from ritualised performances at charged, storied locations on the very edges of the cultural landscape.

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Author's address:

Peter TOPPING
University of Newcastle
School of History, Classics & Archaeology
Newcastle upon Tyne, NE1 7RU
United Kingdom
topping.pete@gmail.com

