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# Re-working the Past: Evidence for Late Neolithic and Early Bronze Age Flint Extraction at the Early Neolithic Mines of Sussex

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This paper will summarise evidence for Late Neolithic and Early Bronze Age flint extraction at the Southern English mines, beginning with a brief synopsis of their chronology and followed by a summary of mine lithics. It is argued that understanding later mining is equally important as examining its beginning, because the Neolithic is framed by the pursuit of flint from deep mines with significant episodes of extraction at its beginning and end. A focus is maintained on the flint mines located in the county of Sussex because these are the best researched of the English mines. This research represents a limited study of the Late Neolithic/Early Bronze Age activity at the Early Neolithic mines, because it is far from exhaustive. Nonetheless, this paper will attempt to define the Late Neolithic and Bronze Age flint working activity at the mines and will question if this activity is associated with new episodes of shaft-mining or informal methods of extraction, such as quarrying or surface collection of earlier mine waste.

KEY-WORDS: mining, axes, lithics, Late Neolithic, Early Bronze Age, Sussex

## INTRODUCTION

In total, there are eleven confirmed flint mines (Fig. 1) in England dating to the Neolithic period *c.* 4000–2200 calBC, all are located on chalk geology in the south and southeast of the island (Barber *et al.*, 1999). An additional mine is also located in the northeast of Scotland at the Den of Boddam, which is dated to the Late Neolithic period, *c.* 3300–2900 calBC (Saville 1995).

In England, the largest group of mines, seven in total, are found along the southern coast in the county of Sussex and are all dated to the Early Neolithic period, *c.* 4000–3300 calBC. These southern mines comprise two regional groups. The first,

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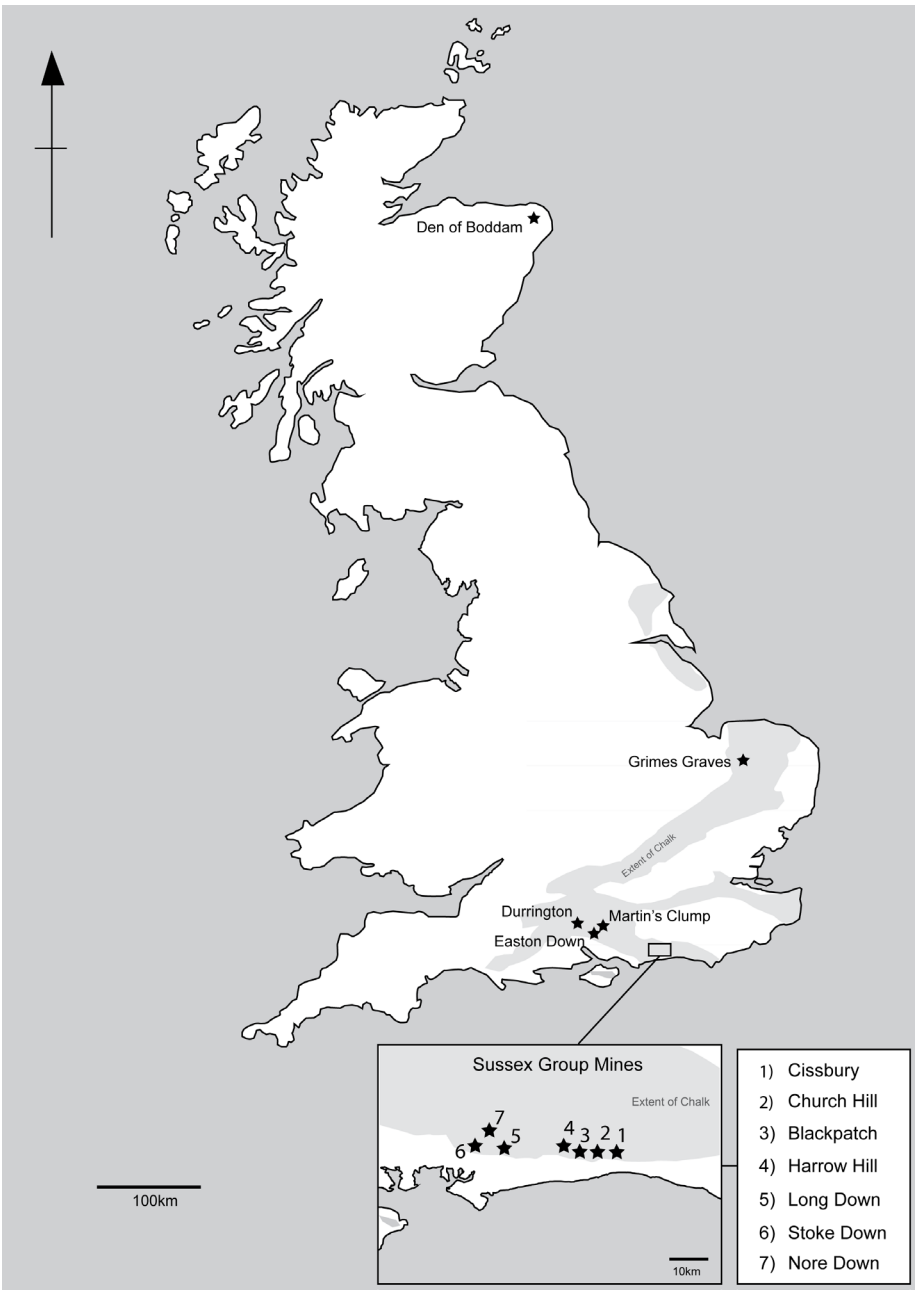


**Fig. 1.** Location of British flint mines. Graphic elaboration: J. Bączkowski.

larger, Worthing Group includes the mine complexes at Blackpatch, Church Hill, Cissbury and Harrow Hill. The Chichester Group includes the complexes at Long Down, Nore Down and Stoke Down. Outside of Sussex, there are two flint mines, Easton Down, Wiltshire and Martin's Clump, Hampshire, which are located close to each other on Salisbury Plain. Several undated shallow pits have also been discovered in Wiltshire at Durrington, which may represent a small mine complex (Booth and Stone 1952). Lastly, Grime's Graves, the largest and best known British mine complex, is located in the east of England, close to Thetford, Norfolk.

The southern British flint mines are characterised by deep mine workings composed of mineshafts, up to 12 m deep, joining a subterranean gallery system from which raw flint was extracted from seams located (Barber *et al.*, 1999) within the chalk bedrock of the Cretaceous system (145–66 Mya). Typically, the main product of the mines was bi-facially worked axeheads. Away from the flint mines, axeheads were often transformed by intensive polishing into prestige items that were exchanged and occasionally placed as votive deposits in pits or natural places, such as wetlands (Edmonds 1995; Holgate 2019).

The research history of the British mines is long and there is little to be gained from detailing it here (see Barber *et al.*, 1999). In summary, the first excavation of a flint mine was carried out at Grimes Graves in 1868 by Canon William Greenwell (Greenwell 1870), followed in the mid-1870s by Augustus Lane Fox Pitt Rivers (Lane Fox 1876) who opened a mineshaft at Cissbury. Fieldwork carried on throughout the 20th century, including further investigations of Grimes Graves (Armstrong 1934) and in Sussex on Church Hill, Blackpatch and Cissbury, all directed by John Pull (see Russell 2001), as well as at Harrow Hill by Dr Eliot Cecil Curwen (Curwen and Curwen 1926). In the mid-20th century, small-scale archaeological excavations were undertaken at Stoke Down (Wade 1922), at Long Down (Salisbury 1961), and at Easton Down and Martin's Clump (Stone 1931; 1933). The last sizable excavations were carried out across the 1970s and 1980s, including Grimes Graves by Roger Mercer (Mercer 1981) and Harrow Hill by Gale Sieveking (McNabb *et al.*, 1996). Lastly, in the mid-1980s, Robin Holgate undertook small-scale fieldwork on Harrow Hill and Long Down (Bączkowski and Holgate 2017).

## A BRIEF CHRONOLOGY OF BRITISH FLINT MINING

Initial attempts to date the mines drew on contemporary knowledge of lithic typologies, specifically, Reginald Smith, Keeper of British and Medieval Antiquities at the British Museum, argued that the mines were Palaeolithic in date (Smith 1912).

The debate was largely resolved in 1933 with the publication of "The Age of British Flint Mines" (Clark and Piggott 1933), which compared artefacts from mines with those recovered from Neolithic monuments, such as causewayed enclosures. Doubt still persisted amongst some archaeologists (Armstrong 1934), and it was not until the 1950s that the mines were fully accepted as Neolithic.

*Early Neolithic Radiocarbon dates*

The majority of radiocarbon dates from British flint mines have been obtained from material recovered from their excavation, including assemblages of red deer (*Cervus elaphus*) antler picks and animal bone, which were fashioned into implements for use in mining including picks, punches and shovels.

To date, a total of 50 radiocarbon dates have to date been obtained for the British mines via various research programs (Burleigh *et al*., 1969, Burleigh 1975; Bowman *et al*., 1990; McNabb *et al*., 1996; Barber *et al*., 1999; Ambers and Bowman 2003; Bączkowski and Holgate 2017; Edinborough *et al*., 2019; Teather 2019). Collectively, these dates show that mining commenced close to the start of the 4th millennium BC at the southern mines (Barber *et al*., 1999), shortly after the transition from the Mesolithic to the Neolithic at 4000 calBC (Collard *et al*., 2009; Whittle *et al*., 2011). This Early Neolithic extraction does not appear to have continued for more than 200–300 years at the majority of mines, although exceptions to this chronology include Cissbury where mining appears to have continued into the 37th century BC (Teather 2019).

There is an absence of deep mining throughout the Middle Neolithic in England, the exception being a small and shallow mine complex located north-west of the Durrington Walls Henge in Wiltshire (Booth and Stone 1952). The Den of Boddam in Scotland is also dated to the Middle Neolithic and comprises of hundreds of 'bell-pits', so-named because they are generally wider at their base than top (Saville 1995). Deep mines were probably not developed at the Den of Boddam due to the unstable character of the gravel geology.

The next and final phase of extraction began in the Late Neolithic *c*. 2900–2200 calBC and continued into the Early Bronze Age *c*. 2200–1600 calBC. At present the only deep mine dating to these periods is Grimes Graves where mining began in the Late Neolithic, *c*. 2660 calBC, and continued until *c*. 2200 calBC, with a second phase of simpler pit extraction lasting between *c*. 2000–1800 calBC, in the Early Bronze Age period (Healy *et al*., 2014).

At present, the only Bronze Age radiocarbon dates obtained directly from a flint mine in Southern England are from Shaft 4 on Church Hill (Figs. 2 and 3: Teather 2019: 43–46). The material dated from Shaft 4 includes a wooden bowl dated to

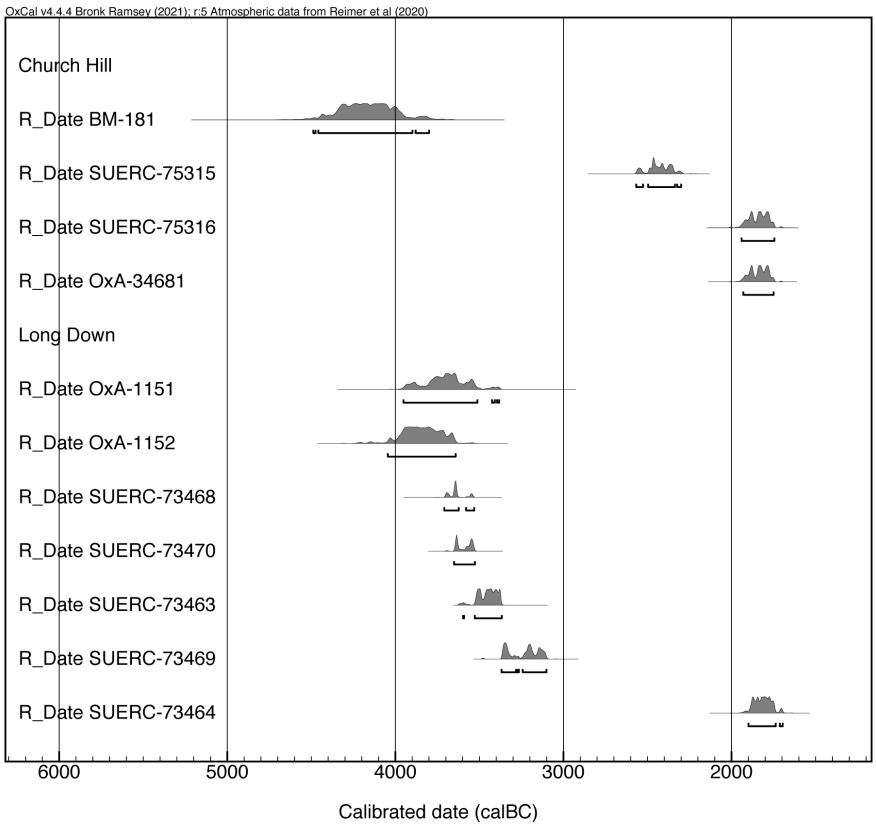


**Fig. 2.** Church Hill and Long Down calibrated radiocarbon dates.

1937–1751 calBC (95% probability, SUERC–75316, 3521 ±34 BP), and a pig mandible dated to 2526–2307 calBC (95% probability, SUERC–75315, 3940 ±34 BP). A third radiocarbon date was obtained from the bone of a field vole (*Microtus agrestis*) contained within an owl pellet found in a gallery associated with Shaft 4, dated to 2132–1921 calBC (95% probability, OxA-34681, 3639±29 BP). These artefacts may relate to a later re-cut and extraction from an earlier mineshaft (Barber 2005: 103–106), as an antler pick from another gallery associated with Shaft 4 excavated by Pull indicates an Early Neolithic date of 4490–3810 calBC (95% probability, BM-181, 5340±150 BP; Barber *et al.*, 1999: 81).

Elsewhere, a set of radiocarbon dates obtained from the Long Down mines are of interest (Bączkowski and Holgate 2018; Figs. 2 and Table 1). Of the seven dates,

**Table 1.** Church Hill and Long Down catalogue of radiocarbon dates.

| SITE | Lab Code | 14C AGE | 14C STD | MATERIAL | CONTEXT | REFERENCE |
|---|---|---|---|---|---|---|
| Church Hill | BM-181 | 5340 | ±150 | Antler (*Cervus elaphus*) | Unknown gallery | Teather 2019; Edinborough *et al.*, 2019 |
| Church Hill | SUERC-75315 | 3940 | ±34 | Tooth (*Sus scrofa*) | Shaft 4, Layer 4, 4ft. | Teather 2019; Edinborough *et al.*, 2019 |
| Church Hill | SUERC-75316 | 3521 | ±34 | Wood (*Populus*) | Shaft 4, Layer 6 | Teather 2019; Edinborough *et al.*, 2019 |
| Church Hill | OxA-34681 | 3639 | ±29 | Microtus agrestis | Shaft 4 Galleries | Teather 2019; Edinborough *et al.*, 2019 |
| Long Down | OxA-1151 | 4900 | ±100 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by R. Holgate | Barber *et al.*, 1999; Bączkowski and Holgate 2017 |
| Long Down | OxA-1152 | 5050 | ±29 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by R. Holgate | Barber *et al.*, 1999; Bączkowski and Holgate 2017 |
| Long Down | SUERC-73468 | 4863 | ±32 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by J. Salisbury | Bączkowski and Holgate 2018; Edinborough *et al.*, 2019 |
| Long Down | SUERC-73470 | 4828 | ±32 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by J. Salisbury | Bączkowski and Holgate 2018; Edinborough *et al.*, 2019 |
| Long Down | SUERC-73463 | 4681 | ±32 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by J. Salisbury | Bączkowski and Holgate 2018; Edinborough *et al.*, 2019 |
| Long Down | SUERC-73469 | 4544 | ±32 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by J. Salisbury | Bączkowski and Holgate 2018; Edinborough *et al.*, 2019 |
| Long Down | SUERC-73464 | 3493 | ±32 | Antler (?*Cervus elaphus*) | Unknown shaft excavated by J. Salisbury | Bączkowski and Holgate 2018; Edinborough *et al.*, 2019 |

obtained from red deer antler pick fragments from the upper fill of a mineshafts excavated by Salisbury in the 1950s (Salisbury 1961), five are Early Neolithic and date to *c.* 3710–3368 calBC (95% probability). Of the other dates, one is later Early Neolithic or early Middle Neolithic, *c*. 3369–3102 calBC (95% probability, UERC-73469, 4544±32 BP), and the other is Early Bronze Age, *c*. 1900–1695 calBC (95% probability, SUERC–73464, 3493±32 BP). Middle Neolithic activity on Long Down is also supported by the presence of Peterborough Ware pottery (Drewett 1983), although the nature of this activity is uncertain, whilst the Early Bronze Age date could be associated with flint working based on the recycling of previous mine waste, as discussed in detail below.

## THE EVIDENCE AND CHARACTER OF LATER ACTIVITY AT THE SOUTHERN BRITISH MINES

This paper will now outline and review evidence of Late Neolithic/Early Bronze Age flint working and other evidence, including possible extraction features. This review is not intended to be a comprehensive study of all the flint mining material, due to the size and dispersed nature of the archives held across multiple British museums. Instead, this paper focuses on the results of research carried out for this author's PhD (Bączkowski 2021). This research was based on the comparative study of assemblages and analysis, including the recording of weight, type and percentages, of more than 40.000 lithics recovered from the mines on Cissbury, Harrow Hill, Stoke Down and Long Down. Walkover surveys were also undertaken at Harrow Hill and Long Down.

The objective of this research was to characterise flint working activities at the mines through the examination of the lithic assemblages. Whilst the majority of the examined lithics, as detailed below, were Early Neolithic in date and associated with bi-facial axehead production, a smaller amount were not and are dated to the Late Neolithic/Early Bronze Age. As surprisingly little research has been carried out on the later lithics from the mines, it was decided to study these in detail and question their relationship with the Early Neolithic deep mines, as well as examining how they might provide information on the social and cultural practices taking place within the vicinity of the mines.

Developing narratives on the later activity at the mines is also important for understanding the wider social and cultural changes that were taking place in Late Neolithic/Early Bronze Age communities across the British Isles (Pearson 2009; Allen *et al.*, 2012. Pearson *et al.*, 2019). This is notable, as the mines were being revisited

when the worldview of communities in both southern England and East Anglia were being transformed by the arrival of The Beaker people and a transition to bronze (Healy 2012; Pearson *et al*., 2019).

*Late Neolithic to Early Bronze Age flintwork*

The majority of the lithics recovered from the mines and their immediate environs are Early Neolithic and are almost exclusively associated with bi-facial axehead production (Bączkowski 2021). Research carried out for this author's PhD of almost 40,000 lithics recovered from the mines on Church Hill, Harrow Hill, Stoke Down and Long Down (Fig. 3), indicated that 73% of the assemblages comprised of waste from bi-facial axehead production, which is almost certainly Early Neolithic in date. In total 26% of the examined assemblages cannot be directly associated with bi-facial axehead production and is not clearly Early Neolithic in date. The analysis of the Late Neolithic/Early Bronze lithics present in the Early Neolithic mine assemblages, as discussed next, reveal the form and character of this flint working.

*The Long Down flintwork assemblage*

As with other Sussex flint mines, the main product on Long Down were bi-facial axeheads, along with smaller amounts of single-piece sickles and long blades, which are all clearly Early Neolithic in date. The most obvious non-Early Neolithic lithics present in the Long Down assemblage are ovate and discoidal forms (Fig. 4), which are typically Late Neolithic/Early Bronze Age in date (Butler 2005). Similar forms were also produced at Grimes Graves where they were interpreted as blanks for discoidal knives (Saville 1981; Gardiner 1988), which are confidently dated to the Late Neolithic/Early Bronze Age (Healy *et al*., 2014).

Several of the ovate examples in the Long Down assemblage appear to have been formed on the flint working waste from Early Neolithic mining, because they contain later flake removals that have removed the earlier white patinated surface, exposing the non-patinated dark blue to black colour of the raw flint. This white patination takes many millennia to form and is due to contact between the raw flint and highly calcareous deposits and is common in Early Neolithic flintwork. Therefore, it is likely the Long Down ovates demonstrate the recycling of mine waste from Early Neolithic spoil-heaps during the Late Neolithic/Early Bronze Age periods. The radiocarbon dates give some limited indication for the dating of this activity, as outlined above.

*The Stoke Down flintwork assemblage*

The Stoke Down struck flint assemblage was recovered by Major Wade in the 1920s, who excavated three mineshafts up to 3.6 m in depth (Wade 1922). Although it

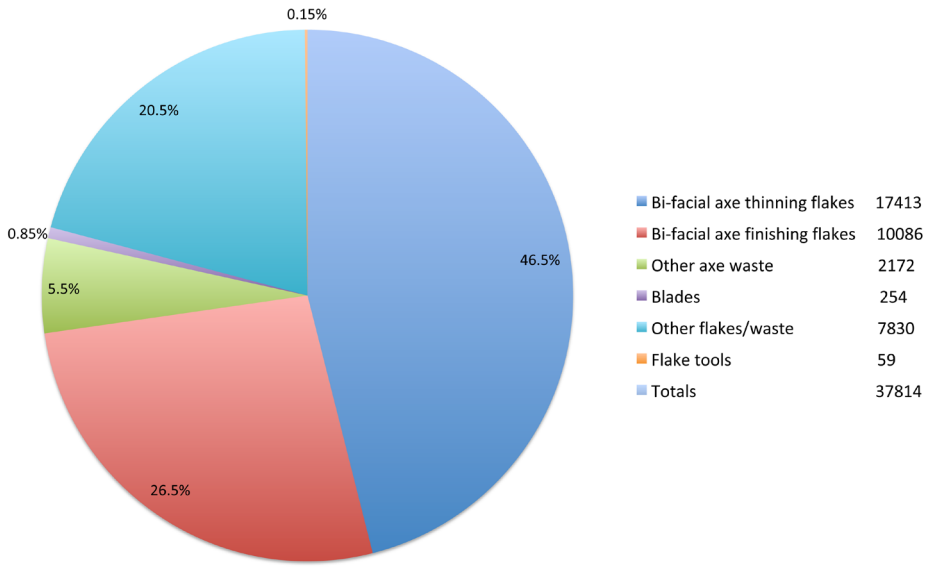


**Fig. 3.** Combined flintwork totals from Church Hill, Harrow Hill and Long Down (source: Holgate 1989; Bączkowski and Holgate 2017).

was only possible to examine part of the Stoke Down assemblage, the findings of its analysis echoed those of other researchers, who had highlighted that it was not typical for an assumed Early Neolithic flint mine (Healy 2011). Analysis of the Stoke Down material comes with a caveat, in that it only contains select pieces with little debitage, unlike the Long Down and Harrow Hill assemblages both recovered by Holgate who also collected debitage (Bączkowski and Holgate 2017). Nonetheless, the Stoke Down assemblage is of note as it is an oddity for Sussex mine assemblages because it contains a notable amount of later flintwork dated to the Late Neolithic/Early Bronze Age periods.

Included in the assemblage are pieces that are characteristic of Late Neolithic/Early Bronze Age technologies (Fig. 5). These pieces include probable discoidal knife blanks and flaked knives, an assemblage that is similar to types being produced at Grimes Graves (Saville 1981). A finely worked knife is typical of Late Neolithic flint working. It has argued that such knives were often specially produced to be polished and subsequently deposited in pits or burials, echoing the treatment of Early Neolithic bi-facial axeheads and indicating they may have had meaning beyond domestic tools (Edmonds 1995: 102–103; Gardiner 2008).

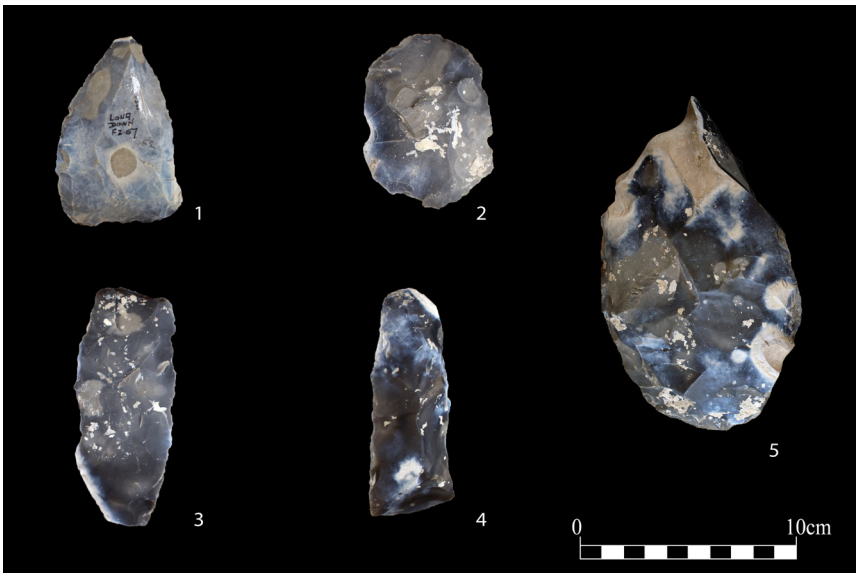


**Fig. 4.** Select pieces from the Long Down flintwork assemblage. Key: 1 – Flaked knife; 2 – Discoidal knife; 3-4 – Small picks; 5 – Ovate blank. Photo: J. Bączkowski.


**Fig. 5.** Select pieces from the Stoke Down flintwork assemblage. Key: 1 – Discoidal knife; 2-3 – Flaked knives; 4 – Ovate knife; 5 – Ovate blank. Photo: J. Bączkowski.

A number of both core and flake axehead roughouts are also present in the Stoke Down assemblages, which are much finer than the typically robust Early Neolithic axehead roughouts collected from the mines. One previously documented axehead (Wade 1922), not currently present in the assemblage is a waisted axehead, a distinctive form of Middle to Late Neolithic axehead typified by an outward flared cutting end (Field 2011; Healy 2011). Notably, in the Middle Neolithic, such waisted axes were placed within funerary deposits in round barrows (Gibson and Bayliss 2010; Gibson *et al.*, 2011). In the Late Neolithic period, waisted axes were also produced at the Grimes Graves mines (Craddock and Cowell 2004), possibly as prestige items for export.

Finally, a number of flake cores are present in the assemblage. The cores tend to be large and reasonably crude with single faces and only limited evidence of platform preparation. The cores are mixed in date with several characteristic of the Early Neolithic and others more typical of the Late Neolithic.

Currently, there are no radiocarbon dates for the Stoke Down mines and therefore further comment on the chronology of extraction at the site is difficult. The character of the assemblage, with both Early Neolithic/Late Neolithic pieces, may infer that the mining on Stoke Down began in the Early Neolithic but that flint working and possible mining activity was also undertaken in the Late Neolithic and Early Bronze Age periods. This later period of flint working and possible extraction activity at Stoke Down is contemporary with mining at Grimes Graves (Healy *et al.*, 2014).

*Other Sussex mine flint work assemblages*

Aside from Long Down and Stoke Down, the lithic assemblages from the other Sussex flint mines are widely distributed between many museums and institutes, especially those from Cissbury, Church Hill and Blackpatch. Assessment of the Harrow Hill assemblage recovered by Holgate (Bączkowski and Holgate 2017) recorded a number of scrapers, knives and ovates more typical of a Late Neolithic/Early Bronze Age date. There was also some evidence of earlier flakes from bi-facial axe production being recycled in the later periods (Bączkowski and Holgate 2017). However, it is unclear if there was any renewed deep mining on Harrow Hill beyond the recycling of earlier material that was probably quarried from old spoil heaps.

Much of the lithic assemblage from Church Hill is missing and the archives held by museums, including Worthing Museum and Art Gallery, contain only selected pieces such as complete axeheads and also axehead-roughouts (Russell 2001). The radiocarbon dates from Church Hill indicate that extraction and production of lithics occurred during the Late Neolithic and Early Bronze Age, *c.* 2900–1600 calBC, some 700–800 years after mining stopped.

*Evidence of Late Neolithic to Early Bronze Age extraction?*

Beyond the radiocarbon dates and lithics, there is almost no evidence of mining or quarrying features dating to the Late Neolithic or Early Bronze Age present at any of the Sussex mines. In part, this is because of excavation bias with many of the historic excavations only focusing on the deep mines, which, apart from Church Hills Shaft 4, all produce consistent Early Neolithic radiocarbon dates. Notably, it was also on Church Hill that Pull excavated a number of large pits and other features that appeared to be later than the Early Neolithic (Russell 2001: 122–129). The best example excavated by Pull was Pit A (Fig. 6), which contained Beaker period pottery and flintwork including an ovate axe, indicating that the feature dates to the Early Bronze Age (Russell 2001: 122–125). Such features could evidence later extraction on Church Hill as similar simple pits were also recorded at Grime's Graves, which date to the Early Bronze Age (Healy *et al.*, 2014).

Elsewhere in Sussex the only other non-deep mine workings were documented on Harrow Hill, where Holgate opened two adit like drift-mines just to the south of the main mine complex (Bączkowski and Holgate 2017). It was not possible to date the drift-mines and although they appeared broadly contemporary with the Early Neolithic mines (Bączkowski 2019a), this is far from conclusive.

Both Chichester group mines, Long Down and Stoke Down, may offer limited evidence of later extraction. Within the main mine complex on Long Down, several elongated hollows can be observed possibly cutting across the spoil heaps of the earlier deep mines (Fig. 7). The date of the features are unknown and they could relate to Early Neolithic deep mineshafts sunk within the congested area of the main mine complex, making them marginally later than the spoil heaps from earlier workings. Alternatively, they could represent open-cast quarries exploiting the earlier spoil heaps in the Late Neolithic or Early Bronze Age periods. Both the radiocarbon dates and lithics outlined above offer limited evidence of activities dating to these periods and the presence of later extraction features should not be ruled out on Long Down.

Lastly, the deep mines on Stoke Down are unusual for Sussex mines as they did not appear to join galleries, but were composed of single mineshafts with minimal undercutting at their bases to extract flint (Wade 1922). This alone cannot directly infer the dating for the Stoke Down mines because similar non-galleried 'pit shafts' were recorded at Easton Down (1932), which clearly date to the Early Neolithic (Edinborough *et al.*, 2019). However, along with the Late Neolithic/Early Bronze Age lithics, the presence of single mineshafts could indicate that some later extraction occurred on Stoke Down, with the Early Neolithic material being residual in the later workings. It is also worth noting that simple mineshafts and pits were recorded at

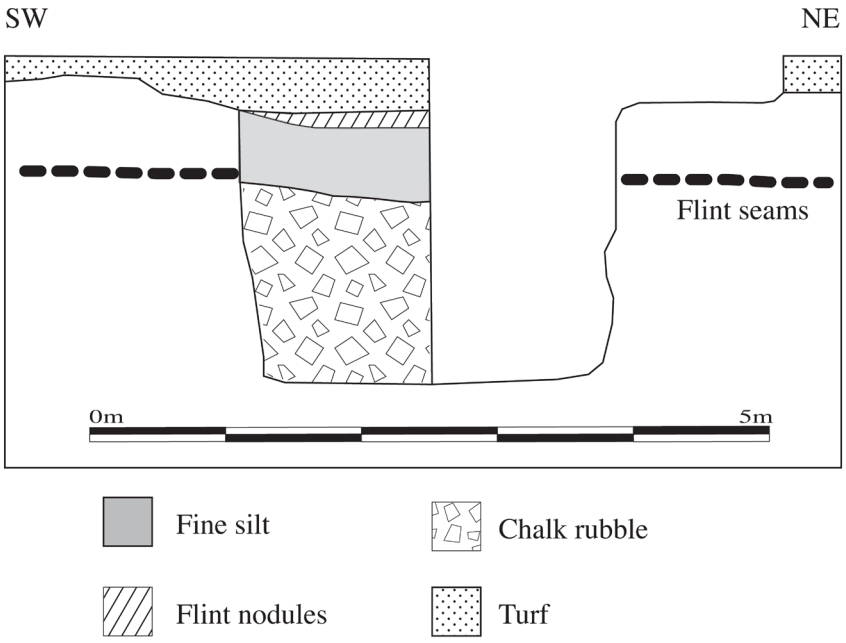


**Fig. 6.** Church Hill pit excavated by J. Pull, half section and profile. Graphic elaboration: J. Bączkowski, adapted from M. Russell 2001: Fig. 76.

Grimes Graves (Longworth *et al.*, 2012), which are later, and also contemporary with the deep galleried mines (Healy *et al.*, 2014).

## DISCUSSION

The latest radiocarbon dates show that the initial phase of Early Neolithic deep mining across southern Britain began close to 4000 calBC and lasted for some 200–400 years (Edinborough *et al.*, 2019). There follows a significant gap in mining, almost a 1000 years, before resumption of deep mining at Grimes Graves in the Late Neolithic and then the Early Bronze Age.

Analysis of the lithics undertaken for this paper has shown the existence at all the examined Sussex mines of Late Neolithic/Early Bronze Age pieces in varying amounts, including discoidal knives, a dagger and the waisted axehead. As detailed, some of the pieces have evidence of being produced on older waste flakes from

**Fig. 7.** A Long Down quarry extracting earlier mine waste? Photo: J. Bączkowski.

bi-facial axe production but others, including the waisted axe from Stoke Down could have been produced from newly extracted flint.

There is no direct evidence of deep mines being opened in Southern England, unlike at Grimes Graves. Instead, this later flint working appears to be based on the recycling of mine waste from the Early Neolithic spoil heaps. It is also possible that the Early Neolithic mineshafts may have been re-opened, as indicated by the radiocarbon dates from Shaft 4 on Church Hill and the lithics recovered from the Stoke Down mineshafts, containing both Early Neolithic and Late Neolithic/Early Bronze Age forms. At present, without new fieldwork, it is difficult to fully understand the character of this later activity. However, this paper has shown later activity took place at the Sussex mines and by recognising the evidence new discussions and themes can be formed on the mining narrative.

The production of the lithics at the Sussex mines, which share affinities with the forms produced at Grimes Graves (Saville 1981; Bishop 2014), shows that the mines once again became the focus of flint working activity. However, there are key differences between Early Neolithic and Late Neolithic/Early Bronze Age mining. The differences are most notable in the lithics being produced, as the Early Neolithic mines are almost solely focused on the manufacture of bi-facial axeheads and occasionally single piece sickles (Bączkowski 2021). This is in contrast to the Late Neolithic/Early

Bronze Age flint working at the southern mines and Grimes Graves, where more diverse lithics were produced, including ovate and discoidal knives, arrowheads and a range of other implements (Saville 1981; Bishop 2014).

The production of discoidal forms is also recorded across Sussex and the South-east of England at many non-mining sites, including Beachy Head where they were produced in reasonably large amounts on nodules sourced from surface deposits of Clay-with-Flints (Gardiner 1988; 2008). A similar pattern is repeated in Norfolk with discoidal forms not only produced at the Grimes Graves complex, and within its wider environs (Robins 2002), but also at many other sites away from the mines (Healy 1998). Overall, it appears that the mines were therefore part of wider Late Neolithic uptake and increase in the production of discoidal and ovate forms, which appear to have been produced as 'prestige items' that were often distributed and deposited far from their original source (Edmonds 1995; Gardiner 2008).

Evidence of the production of discoidal and ovate forms at the Sussex mines therefore links them not only to Grimes Graves, but also to a European wide tradition of producing ovate, double-edged blades and daggers in the mid-third millennium (Edmonds 1995; Frieman 2014; Frieman and Erikson 2015). Across Europe, these forms were produced at specialist production sites, including Grand-Pressigny in the Massif Central, France (Mallet *et al*., 2004), but also notably from mined flint at Alborgand and Hillerslev in northern Jutland, Denmark (Becker 1959) and also at Kvarnby and Södra Sallerup, Malmö, Sweden (Berggren *et al*., 2016). The knife industry of Kvarnby and Södra Sallerup is of particular interest as there is currently no evidence of new mines being opened. Instead, and similar to the Sussex mines, the acquisition of flint was from the spoil heaps of earlier Neolithic mines (Berggren *et al*., 2016).

In Britain, the renewed interest in the mining landscape began in the Late Neolithic period and continued into the Early Bronze Age. There is no evidence of deep mining in the Middle Neolithic until Grimes Graves in the late 3rd millennium BC. The reasons for this break are unclear, but it seems likely the Early Neolithic flint mines in southern England ceased production as the demand for axeheads waned after an initial period of extensive woodland clearance was undertaken to open the landscape for newly imported agricultural practices (Woodbridge *et al*., 2012).

The chronology is similar across Continental Europe, with many deep mines dating and confined to the Younger Neolithic, *c.* 4400–3500 calBC (Kerig *et al*., 2015), such as Rijckholt-St. Geertrud, Limburg, The Netherlands (Felder *et al*., 1998) and Jablines, Seine-et-Marne, France (Bosytn and Lanchon 1992). The rate of deforestation across Europe is nuanced and regionally variant, although it is widely accepted that by the late 4th millennium BC, many areas had been cleared of trees for agriculture (Roberts *et al*., 2018). Therefore axes were not always the main products

of the Continental mines, with blades also being produced in large numbers, such as at Rijckholt (Felder *et al.*, 1998).

During the final Neolithic, *c.* 3400–2900 a second peak in mining, as seen in Britain, is also observed in Continental Europe (Kerig *et al.*, 2015), with large-scale mine complexes, such as Krzemionki (Ostrowiec Świętokrzyski district, Poland; Bąbel 2008) and Spiennes (Mons district, Belgium; Collet *et al.*, 2008), appearing to increase output. There is also limited evidence for later activity at Rijckholt, with one Beaker period radiocarbon date and possible shallow pit mines, although the evidence is far from certain (De Grooth *et al.*, 2011).

In wider society, the second peak in mining is contemporary with the spread of the Chalcolithic, a process of economic intensification that that created new world views, not only driven by the adoption of bronze but also by increasing socio-economic complexity due to population growth and more structured settlement expansion, as is the case in the British Isles (Heyd 2012; Pearson *et al.*, 2019). One lithic form, flint daggers, are particularly linked to the Chalcolithic and Early Bronze Age periods, with a long production tradition from the late fourth to the second millennium in Continental Europe, but a much shorter lifespan in Britain, limited to the late third millennium (Frieman 2014). It is therefore of significance that at least one knife-like dagger was recorded in the Stoke Down assemblage.

The reasons for the chronological ebbing and waning of deep mining are much debated, as is the need to deep mine. Currently, an increase in supply and demand of raw flint needed for both axeheads and blades due to larger populations is perhaps the most accepted model (Kerig *et al.*, 2015; Edinborough *et al.*, 2019). Although the cultural need for mining interwoven with ideological and social practices is also argued, with mining interpreted as a cultural activity not solely focused on economic demand, but instead as a ritualised activity integral to Neolithic belief systems (Holgate 1995; Barber *et al.*, 1999; Russell 2000; Bączkowski 2019b; Topping 2019; 2021). It is certainly the case that the allure of exotic material, in this case flint obtained from deep subterranean sources, added to the metaphysical qualities of mining via engagement with the "underworld" and "otherworldly" environments (Mökkönen *et al.*, 2017).

As a cultural tradition and ritualised activity, mining may have formed part of a yearly routine for nascent Early Neolithic communities in southern Britain (Bączkowski 2021). Whilst mining events were underway social and cultural bonds may have been maintained and transmitted, information and material culture could have been traded, relationships between communities, individuals and ancestral landscapes may have been managed and re-established, and finally knowledge may have been shared and new skills taught (Edmonds 1995; 1999; Bączkowski 2019b; Topping 2019). Overall, it seems likely mining was undertaken for many social, cultural

and economic reasons, and its meaning may have changed and developed through the working life of a flint mine.

A cultural model of mining is especially compelling for Britain where there is an abundance of easily accessible natural flint resources, such as from rivers and cliffs, which negates the need for deep extraction (Gardiner 1990; Barber *et al.*, 1999). It is noted that the end of mining in southern England is associated with a shift of axe production to the utilisation of abundant surface deposits (Gardiner 1990). The assumed transition away from deep mines in the Middle Neolithic does not explain the start of mining at Grimes Graves in the Late Neolithic, which may have began and continued as a reaction to the start of Chalcolithic (Healy 2012). As this paper has shown, in southern England the Early Neolithic mines once again became the focus of flint working in the Late Neolithic and Early Bronze Age periods, a pattern repeated not only at Grimes Graves with new deep mines being opened, but also across Continental Europe with increased mining and the recycling of previous mine waste.

The reason for engagement with the spoil of earlier and long abandoned flint mines, rather than open new ones is not clear. Re-cycling of mine waste could be purely functional, as the mines were convenient sources of good quality raw flint that required minimal extraction effort. Alternatively, the locations of the mines and the material from them could have retained special meaning for these later communities long after Early Neolithic mining had ceased. For example, southern English flint mines may have been considered ancestral landscapes (Edmonds 1999; Topping 2021). The allure of sourcing exotic stone is well documented in the Neolithic, mostly from remote stone sources such as the jadeite from the Italian Alps (Pétrequin *et al.*, 2015) and greenstone from the mountains of the Lake District, England, including the Langdale Pikes (Bradley and Edmonds 1993). Notably greenstone was sourced from the Langdale Pikes in the Early Bronze Age as a raw material for Beaker bracers or wrist guards (Woodward and Hunter 2011), demonstrating that the material itself, previously sourced for the manufacture of Neolithic axeheads, may have retained special significance for later communities (Bradley *et al.*, 2019).

This attraction may not apply to mine waste as there is nothing alluding to its exoticness, inasmuch as it was not sourced from remote locales. Instead, the waste material, which would have been recognised as resulting from earlier mining and flint working, and the mine complexes themselves may have been associated with the ancestors. The process of selecting and re-working older flintwork into new forms, such as knifes, may have also been a symbolic act that resulted in a "special" class of artefact (Bradley 1990). This activity is not limited to the Sussex mines and was also recorded at the Langdale stone quarries (Bradley and Edmonds 1993), where evidence of the

quarrying and the re-cycling of earlier Neolithic waste heaps was undertaken long after the initial phase of extraction had ceased.

Support for the attraction to abandoned flint mines and discarded mining material can also be found in the wider environs of the Sussex mines, where many Bronze Age round barrows were constructed, as on Blackpatch, Stoke Down and Church Hill. On Stoke Down a series of possible burial mounds have been surveyed close to the mines that are likely to date to the Late Neolithic/Early Bronze Age periods (Barber 2014). Engagement with older monuments is also a phenomena noted across Europe (Bradley 2002). Although this activity is often focused on burial sites, with successive communities re-using older sites (Bradley 2002), it is likely that the pockmarked landscapes of flint mine complexes may have been also been considered as ancestral burial grounds for later communities, most notably in the Bronze Age and Iron Age.

This re-use of an ancestral landscape is perhaps most evident at Blackpatch and Church Hill (Fig. 8) where numerous burial mounds, features and pottery dating to the Late Neolithic/Early Bronze Age have been discovered (Russell 2001). A series of burials were also found at Blackpatch (Fig. 9), not only in round barrows formed within the mine spoil mounds, but also including human bones and cremations directly placed in the top of mineshafts (Russell 2001). Intriguingly, large nodules were placed over the top of the central burials in several of the round barrows, showing their clear association with mining waste and possibly also inferring new episodes of mining at Blackpatch (Barber 2005; 2014). Such use of mine waste to cover human burials and associated deposits supports the hypotheses that the Early Neolithic, or even possibly new mining waste, was considered symbolic. This symbolic meaning may explain why mine waste was chosen and curated into new forms of lithics, as detailed in this paper.

One barrow close to the Blackpatch mine complex, Barrow 9 (Fig. 9), contained Beaker pottery, a flint axe and knife and had possibly been capped with densely packed flint nodules (Wessex Archaeology 2006). It is possible that the barrow mirrors the form of the abandoned flint mines, demonstrating the importance of the earlier pockmarked landscape to later communities who chose to bury their dead close to the mineshafts and incorporate structural and physical elements of the mines into their burial monuments.

Other activities within the vicinity of the Early Neolithic mines include a Bronze Age settlement, excavated by the Curwens in the 1930s, that was located some 800 m south of the Harrow Hill mine complex (Curwen 1934; Russell 2001). Significantly, the Curwens also discovered an Early Neolithic pit that contained flintwork associated with the neighbouring mine (Bączkowski 2019c). A Bronze Age rectangular enclosure was also constructed on Harrow Hill (Hamilton and Manley 2001), which

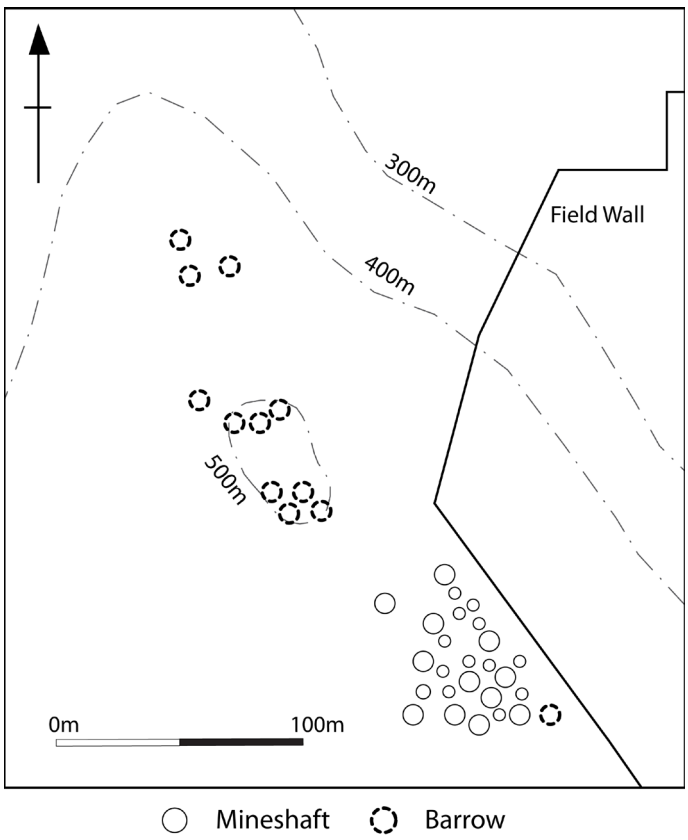


**Fig. 8.** Survey of Church Hill showing relationship between Neolithic mine complex and Late Neolithic/Early Bronze Age barrows. Graphic elaboration: J. Bączkowski, adapted from M. Russell 2001: Fig. 88.

partially covers the earlier mine complex. Lastly, probable Bronze Age roundhouses were constructed within the Easton Down mine complex (Stone 1931).

Overall, it is unknown if new mining took place in Sussex. At present there are no radiocarbon dates from the Late Neolithic or Early Bronze Age recovered from an entirely closed mining context. Many of the dates, such as from Church Hills Shaft 4 and from the top of the mineshaft on Long Down are mixed with other, mostly earlier dates. Such mixing may favour the theory that any new extraction activity could have been limited to quarrying and re-cycling of earlier waste via extraction from spoil heaps or by re-cutting old mineshafts, as may have been undertaken on Stoke Down.

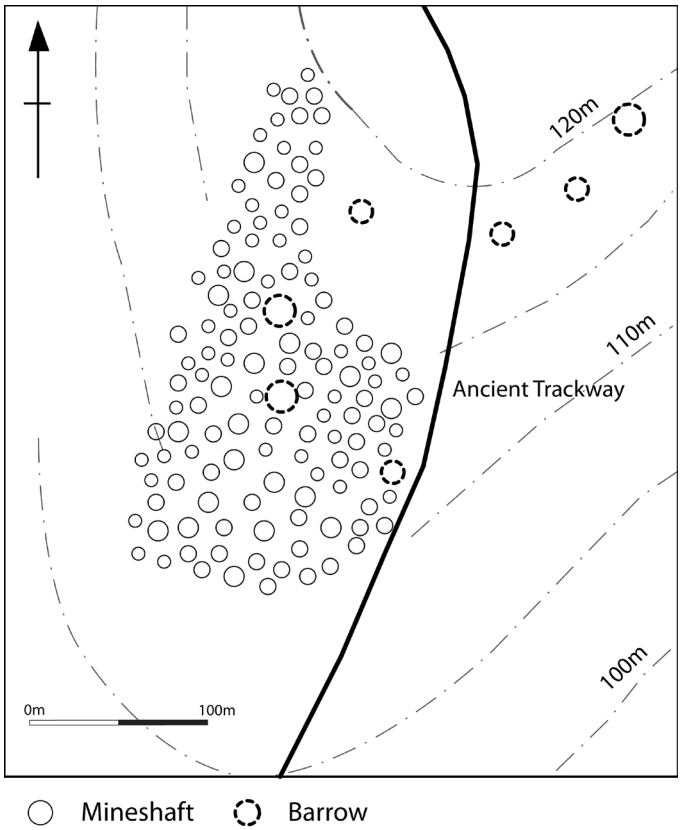


**Fig. 9.** Survey of Blackpatch showing relationship between Neolithic mine complex and Late Neolithic/Early Bronze Age barrows. Graphic elaboration: J. Bączkowski, adapted from M. Russell 2001: Fig. 23.

However, the presence of later mining should not be ruled out at any of the Sussex mines as such a small sample of mineshafts have been explored, less than 20 of an total *c.* 1000 plus recorded mine workings across six complexes. It is worth remembering that, as Grimes Graves demonstrates, the communities still retained knowledge of mining and were fully capable of opening and working deep mineshafts.

Finally, it is notable that the activity presented here also reflects wider social and cultural trends in the mid-third millennium for the production of finely worked flint objects, including discoidal forms, knives and axes (Edmonds 1995: 100–110). Renewed interest in the production of such flint objects has been proposed as the reason for mining at

Grimes Graves (Bishop 2014), with groups travelling to, and gathering at the mines to produce specialist flint objects (Bishop 2014; Healy *et al.*, 2014). In Norfolk, the location of Grime's Graves, such activity may have substituted a wider Late Neolithic trend for large-scale communal monument construction, such as henges, because these are lacking in the region (Bishops 2014). It may be no coincidence that such monuments are also largely absent in the Late Neolithic of Sussex. This could infer that later activity at the mines replicated the cultural need for gatherings based on community activities, including quarrying alongside the specialist production of fine flint objects. Such social and cultural activity directly connects later extraction activity with the earlier need to deep mine. Therefore, the British Neolithic is bookmarked by deep mining and associated extraction at both its start, *c*. 4000 calBC, and at its end, *c*. 2200 calBC.

The precise reason there is a renewed interest in the mines is not clear, but it may be the case that, as cultural ideologies shifted towards the Bronze Age, mining once again became important to communities. These communities continued to maintain a Neolithic tradition of activities on deep mining sites, including even opening new deep mines at Grimes Graves and also re-engaging with Early Neolithic mines, as in Sussex. Mining would have been a tradition that was anchored in the Neolithic and was important for retaining social and cultural links, which were perhaps beginning to be eroded by the arrival of new communities, namely the Beaker people, and the increasing production of bronze implements and ornaments (Pearson *et al.*, 2019). Therefore, the opening of new deep mines, and also the renewed extraction activity in Sussex, appears to have been carried out in an unstable world within which mining may have offered stability and a connection to old traditions and ancestors that were increasingly becoming a distant memory.

## CONCLUSION

Despite of the lack of clarity on later activity at the Sussex mines, it remains important to acknowledge its existence and what it can tell us about the importance of mining to both Late Neolithic and Early Bronze Age communities. The evidence outlined in this paper has shown that, in Sussex, there was renewed interest in the earlier mines, activity that is contemporary with mining at Grimes Graves and reflecting wider trends of specialist lithic production in a world in flux due to the introduction of bronze. Overall, this paper has shown that there are further horizons of complexity to the Sussex flint mines that are, at present, under-researched and under-represented in the literature.

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