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Cover figure: Last mining event at Casa Montero, Madrid (c. 5200 cal BC). Illustration by Juan Álvarez-Cebrián

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Working in the flint mine: Percussion tools and labour organisation at Casa Montero (Spain)

Marta CAPOTE

Abstract

This article provides an analysis of labour organisation at the Spanish mine of Casa Montero, based on the study of percussion tools. The study examines both individual pieces and refits, and was designed to throw light on tasks performed at the mine, workforce sizes, specialisation and changes in these aspects over time. To place this study in context, comparisons are made with other European mines using the information available on the percussion tools used. The results show that, even though flint mining was a very widespread phenomenon in Neolithic Europe, it was not at all uniform, at least not in terms of the way work was socially organised. The percussion tools of Casa Montero were less elaborate and less intensely used than most of those recovered at other mines, while the workforce size required at some moments was larger than might have been expected. At Casa Montero, work was organised in a relatively simple way while mobilizing more people than the size of contemporaneous groups would have us believe. Finally, although working procedures appear to have remained fairly stable over the lifespan of the mine, the scale of labour changed from some mining events to others.

Keywords

Iberian Peninsula. Labour organisation. Percussion tools. Specialisation. Standardisation. Labour intensity. Workforce size.

1. Introduction: Mines and work organisation

Prehistoric mines and quarries are the product of collective efforts. The persons involved in these efforts were engaged not only in the procurement of raw materials, but in social relationships that were reproduced and reinterpreted in the organisation of their activities. Work organisation analysis can be used to examine the way in which communities and individuals distributed and played their roles. Key questions in such analyses revolve around the number of persons making up the groups involved, the factors that determined the right to take part in activities, whether participants were organised on the basis of egalitarianism or through the imposition of authority, whether learning was part of the process, and how different tasks were distributed among group members. It is difficult to answer all these questions based only on the archaeological data recovered from mining sites, but important insights can be obtained by examining the number of extraction structures open at each mining site, the number of tools used, the intensity of their use, tool standardisation, and any changes in organisational patterns over time.

2. Percussion tools and work organisation in European mines

Neolithic percussion tools can be classified into two groups depending on the kind of action they once performed: incisive tools such as picks, levers and wedges, and pounding tools such as hammers, hammerstones and pounders. Pounding tools are found in almost every mine. These may be either antler tools, such as those found at Harrow Hill, Spiennes, Jablines, Villemaur-sur-Vanne “Les Grand Bois Marot”, Villemaur-sur-Vanne “Les Orlets”, Krzemionki, Polany Kolonie II, Sümeg-Mogyorósdomb or Kranaselsky (Holgate 1995a, 152; Collet 2004; Bostyn and Lanchon 1992, 111-114; Labriffe *et al.* 1995a, 332; Labriffe *et al.* 1995b, 343; Borkowski 1995a, 513; Schild 1995, 484, 487; Bácskay 1995, 388-390; Charniausky 1995, 266) or stone tools.

Regardless of the different raw materials used, from the point of view of work organisation the most important distinction between them lies in their degree of elaboration.

Unmodified cobbles of different raw materials have been documented at several sites, e.g., flint hammerstones at Grimes Graves (Holgate 1995a, 152), limestone and quartzite hammerstones at Rijckholt-St. Geertruid (Felder *et al.* 1998, 43-47), quartzite cobbles at Löwenburg (Diethelm 1997, 64), Miskolc-Avas Hill (Simán 1995, 377), Sümeg-Mogyorósdomb (Bácskay 1995, 389-390) and in the Den of Boddam (Saville 2008, 7-8), and sandstone hammers at Tusimice (Lech and Mateiciucová 1995, 273-274). Other cobbles show some kind of conditioning for hafting, such as that used in a hammer from Feuerstein (Leitner 2008) and more than 1100 grooved hammers from Kleinkems (Diethelm 1997, 63). Finally, some pounding tools, such as the notched hammers from Rijckholt-St. Geertruid (Felder *et al*. 1998, 48) and Lousberg (Weiner 1995), were configured by knapping. At Defensola, knapped and sometimes partially or totally pecked hammers have been found, along with flint hammerstones sometimes regularised by pecking (Galiberti 2005).

Incisive tools include both antler and stone (mainly flint) tools. Antler picks are the tools most commonly found in Neolithic European mines; they have been documented at Harrow Hill, Grimes Graves, Jablines, Serbonnes, Villemaur, Lowenburg, Tusimice and Sümeg-Mogyorósdomb (Holgate 1995a, 1995b; Clutton-Brock 1984; Holgate 1995a; Bostyn and Lanchon 1992; Labriffe *et al.* 1995a, 1995b; Diethelm 1997; Lech and Mateiciucová 1995; Bacskay 1995).

At Defensola and Tomaszów, picks were exclusively made of flint (Galiberti 2005; Schild 1995) and at Rijckholt-St. Geertruid the number of antler picks is anecdotal compared to the more than 14,000 flint picks discovered (Felder *et al.* 1998, 47). At Kvarnby-S.Sallerup (Rudebeck 1987), Spiennes or Krzemionki both stone and antler incisive tools have been recovered. The use of antler or stone tools might be linked to the hardness of the deposits excavated or represent different moments in time (Collet *et al.* 2006, 69). At Krzemionki four distinctive types of structures have been recognised, each linked to particular geological conditions, chronologies and specific toolkits (Borkowski *et al.* 1991; Borkowski 1995a; 1995b).

Neolithic miners were clearly able to adapt to the physical conditions imposed by the geological settings they encountered, the fact that most mines were located in chalky settings at least partly explaining the predominance of antler tools. The shapes and types of raw material used in the production of percussion tools, however, were determined not only by their efficiency but by the social organisation of work. It should be remembered that, regardless of the tools and techniques used, the operational chain almost always involved the same steps: excavation, extraction, flint preparation and knapping, and finally waste disposal. However, the way these tasks were temporally and spatially distributed, and the way that groups were socially organised, varied. This organisation is the focus of the present work, with special attention paid to the type of specialisation, the workforce size, and the transformations of these organisational patterns over time.

Specialisation

In agreement with Costin and Hagstrum's analysis of craft production (1995), this work does not attempt to establish whether percussion tools were specialised, but examines the kind of specialisation that was the context of their use. Costin and Hagstrum distinguish among different kinds of specialisation using the following concepts: *context*, which refers to the existence, or not, of the control of labour by elites ('attached labour' refers to that mobilized and controlled by elites, whereas 'independent labour' is not thus governed); *concentration*, which refers to the separation, or not, of production areas from consumption areas; *constitution*, which deals with the size and composition of working units; and *intensity*, which deals with the amount of time invested relative to other economic activities (work can therefore be full-time or part-time). The specialisations defined by these four concepts are manifested in the technology used through particular *labour intensities*, *standardisations* and *skills*.

Neolithic flint mining is usually interpreted as a periodic communal activity, which in Costin and Hagtrum's terminology corresponds to a community specialisation characterized by an independent context, a nucleated concentration, household constitution, and part-time intensity. However, this should not be taken for granted; each case must be examined separately, and even if almost every instance of flint mining can be described using these four general concepts, differences in work organisation may still exist. For example, the expression "part-time" merely describes a non-continuous activity, but obviously the implications of a *periodic* activity (taking place seasonally or at regular intervals) and of a *spasmodic* activity (taking place only a few times within certain periods) are different (see Díaz-del-Río and Consuegra in this volume). With respect to context, labour mobilisation by powerful elites might be argued in some cases, but it is unlikely for other European Neolithic mines; however, an independent context may refer both to community-based decision making and to collaboration and agreement between communities. As for concentration, mining might seem to inevitably imply a nucleated strategy since it represents the intensive exploitation of a particular point in the landscape rather than a more opportunistic exploitation of different and dispersed resources. However, this might may be more justified in some cases than others, depending on the regional availability and quality of raw materials. Further, group-specific mobility patterns and sizes are always important factors determining the use of a nucleated or other strategy. Moreover, a region may have just one or many more mines. Finally, the size of the workforce and its composition would depend on the size and organisation of the groups engaged in mining as much as on the number of groups that might work together in a mine. Thus, no single interpretative template of work organisation can be applied to every mine. To do so would give a false impression of homogeneity that would not account for the different social contexts of mining in Neolithic Europe.

Labour intensity

Labour intensity may be examined via the analysis of percussion tools, focusing on two features: the amount of work devoted to their production, and the amount of work performed with them. Contrary to the assumption by some authors that the elaboration of tools was minimal or indeed non-existent (see, for example, Sidéra 1995, 123), the production of antler and bone tools was often a complex process involving several stages that took place outside the mine before mining itself could begin (Clutton-Brock 1984, 26, Boguszewski 1991, Bostyn and Lanchon 1992, 105-114). For example, the making of antler tools required the gathering of antlers, the softening of their hard outer layer or *compacta* before cutting them (performed by immersing them in water for two days [Boguszewski 1991, 46] or using localized heat in the areas that were to be cut [Clutton-Brock 1984, 26]), and removing some of the tines in order to produce L-shaped of single-hafted picks. The effort invested in the configuration of these tools was therefore notable, and often required several days. In addition, and despite differences between mines, flint tools all show some degree of configuration for their use as mining instruments. In the Kvarnby-S. Sallerup mine in Sweden, crudely knapped picks have been identified (Rudebeck 1987, 153). At Defensola, picks were not only knapped but also pecked, and while picks from Rijckholt-St. Geertruid, Spiennes and Krzemionki, along with hammers from Rijckholt-St. Geertruid, Valkenburg aan de Geul (Brounen 1995) and Lousberg are not as elaborate as these Defensola picks, they were clearly configured to comply with specific requirements.

Stone tools made from other raw materials, mostly pounders and hammerstones, show greater variation in their degree of elaboration. Unmodified cobbles used as hammerstones have been found at Grimes Graves, Spiennes, Rijckholt-St.Geertruid, Feuerstein, Löwenburg, Krzemionki, Tusimice, Sümeg-Mogyosrósdomb and Miskolc-Avas Hill (although in most of these mines antler and flint tools have been found that required greater investment in terms of manufacturing time). In contrast, the cobbles used at Kleinkems show at least some conditioning for hafting. Finally, some very elaborate stone percussion tools are known, such as the cigar-shaped pick-axes of Krzemionki.

Several factors need to be taken into account when assessing the intensity of the work carried out using these tools: the number of tools found, their signs of wear and reconditioning, and estimates of the number of tools that would be needed at a particular mining site. Not every publication provides the total number of tools found, although when figures are provided they are usually quite high. For example, more than 14,000 picks, apart from other types of tool, have been documented at Rijckholt-St. Geertruid, more than 1100 hammers have been cited for Kleinkems, and more than 500 antler tools and over 800 quartzite cobbles for Sümeg-Mogyorósdomb, despite the small size of the mine at just 1500 square meters and the fact that only a fifth of it has been excavated. In addition, 215 artefacts have been cited for 26 mining structures at Villemaur-sur-Vanne ‘Le Grand Bois Marot’, 284 tools for 128 mining structures at ‘Les Orlets’, and for Grimes Graves some 343 antlers, 171 antler fragments, an axe and 6 hammerstones have been catalogued among the material recovered from five mines or groups of shafts and galleries (Longworth and Varndell 1996, 96-98).

The extent of tool wear is difficult to establish, although apparent size reduction through use can provide some indication. At Rijckholt, unused picks have an average length of 161mm, while tools discarded after using both ends have an average length of 137.30mm (Felder *et al.* 1998, 48-49). The existence of tools used to recondition mining implements, such as the quartzite and sandstone whetstones used at Spiennes to sharpen antler tools, is also an indication that wear was heavy enough to render tools unusable without some degree of maintenance. At this site, refits also help our understanding of the progressive wear of tools (Collet *et al.* 2008). Clutton-Brock’s (1984) comparison of similar antler tools from the mine of Grimes Graves and the contemporary enclosure of Durrington Walls showed the mining tools had a greater degree of wear.

It is also important to note that a great number of tools were probably used. Sieveking estimated that 400 antlers would have been needed at Grimes Graves every year, while Legge estimated that between 100 and 150 picks per shaft would have been necessary (Clutton-Brock 1984, 15-16).

In conclusion, the percussion tools found in European flint mines generally show signs of relatively large labour investments, both in terms of their manufacture and use.

Standardisation

Costin and Hagstrum distinguish between *intentional* and *mechanical* standardisation. Intentional standardisation is the result of the effort required to make products or tools comply with technical or other (e.g., stylistic) requirements. Mechanical standardisation is the unintentional result of the way work is socially organised. Indications of both types of standardisation in percussion tools can be seen in European Neolithic flint mines, i.e., tools were intentionally configured to furnish them specific technical features, but they were also used in a standardised manner.

Both incisive and pounding percussion tools present signs of intentional standardisation. The similarity of antler tools is partly the result of the fact that antlers are very similar to one another. However, deliberate selection was also involved, as suggested by the dimensions of the

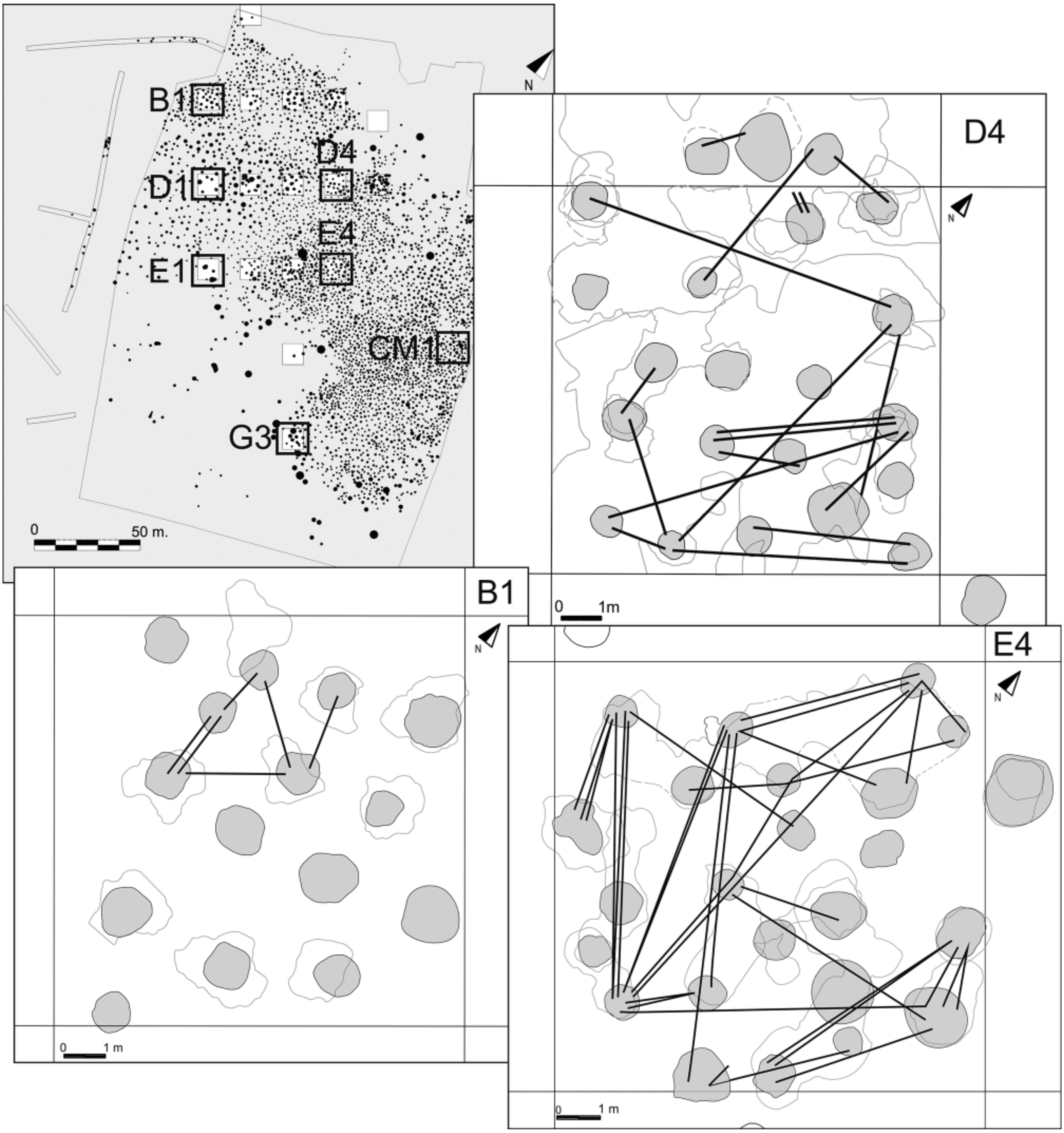

Figure 1: Localisation of selected sampling units where refits of material from different shafts have been attempted and detail of the three sampling units in which these refits have been achieved.

antler tools from Grimes Graves and Durrington Walls (Clutton Brock 1984, 25, 36). The antlers recovered from the former site show more uniformity in their length and are, on average, longer and heavier than at the latter. The deer in the area of Grimes Graves may simply have been bigger, but the fact that their dimensions also vary less suggests specific lengths were selected. In fact, Grimes Graves antlers are more often those of mature animals than those at Durrington Walls (Clutton-Brock 1984, 23). Sidéra (1995, 133) also indicates that parts of the antlers not used at contemporary settlements and burial sites were employed in the Villemaur-sur-Vanne 'Le Grand Bois Marot' mine.

After particular blanks had been selected, the process of tool configuration was performed with the aim of producing similar tools that conformed to technical requirements. Antler picks were made either by cutting off some of their points, leaving just the distal one in order to create L-shaped picks, or by hafting single points in wooden handles. Each standardised type of antler pick would be later used in a specific manner.

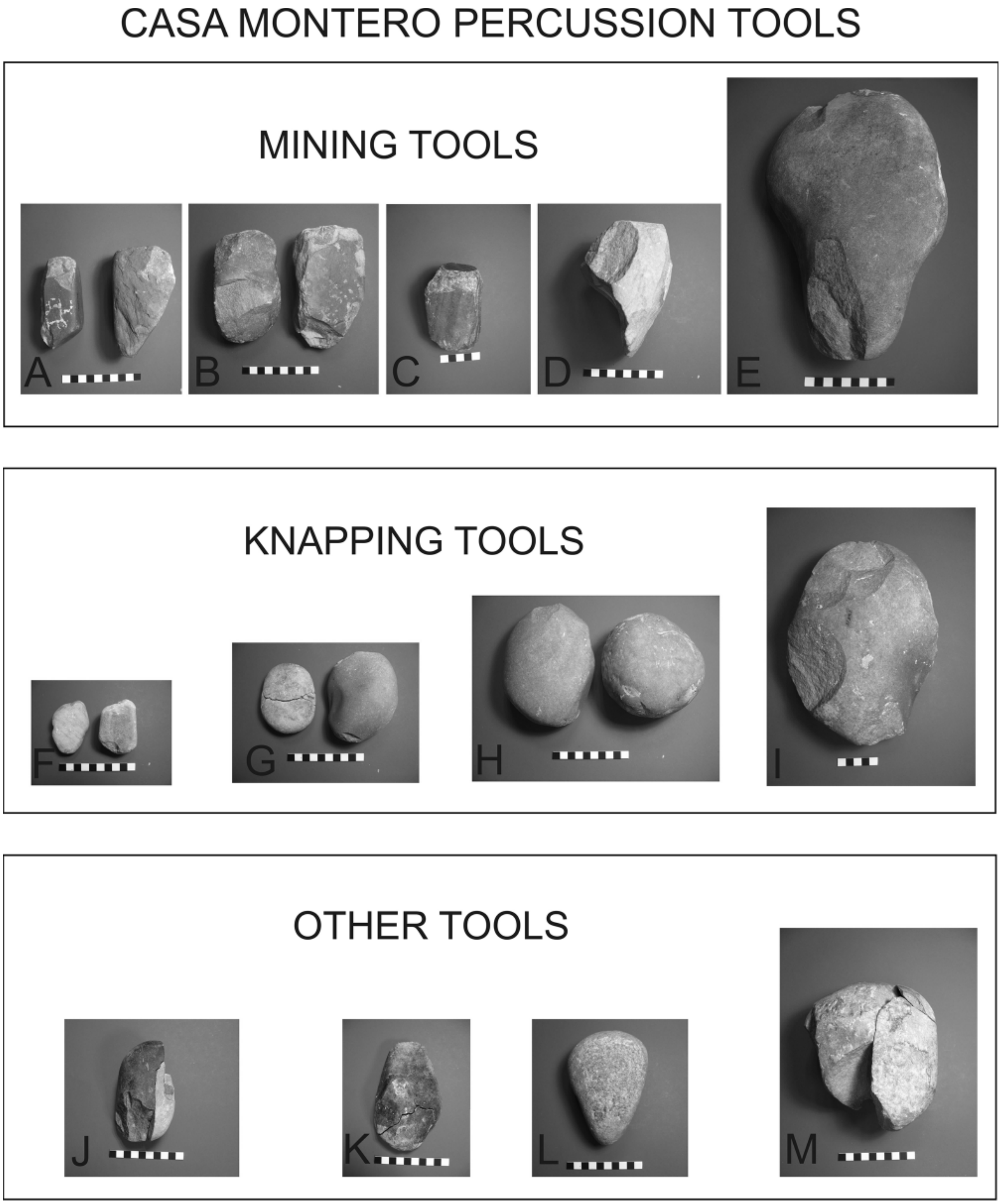

Figure 2: Percussion tools from Casa Montero. A-Bipolar A; B- Bipolar B; C-Bipolar C; D-Wedge; E- Big Hammerstone; F, G, H, I- Different sizes of knapping hammerstones; J, K-Thermally altered tools; L- Grinder; M- Anvil.

Flint tools were also manufactured with the goal of producing standardised tools. In the region of Rijckholt-St.Geertruid, several mines (Rijckholt-St.Geertruid, Valkenburg aan de Geul and Lousberg) have been found to contain the same type of notched hammer (Weiner 1995). At Rijckholt, flint picks are also fairly standard, and were repaired and sharpened on site to continue to meet technical requirements.

The picks and hammers from Defensola show considerable variation in terms of their degree of elaboration, size and weight (Galiberti 2005, 139), but nonetheless they have relatively uniform shapes and active parts.

Intentional standardisation is sometimes made manifest through the existence of uniform toolkits, or even particular toolkits linked to different types of extraction structure. Such is the case at Rijckholt, Spiennes, Valkenburg, Krzemionki, Sümeg and Kvarnby. At Krzemionki, four extraction strategies have been distinguished, each requiring its own, specific toolkit.

Mechanical standardisation is the result of recurrent patterns in the use and abandoning of tools. Mining percussion tools show specific traces of use and greater wear than similar tools used in other contexts (Clutton-Brock 1984, 38; Sidéra 1995, 123), once again reflecting particular ways of organising labour. At Rijckholt, for instance, three groups of picks with standardised lengths and degrees of wear have been distinguished: unused picks, picks with one used end, and picks showing wear at both ends (Felder *et al.* 1998, 48-49). If wear depended exclusively on tool function, all these picks would show a similar pattern, but the existence of these three groups suggests that more picks than eventually used were taken into the mine, and that among those that were used some were more curated than others despite their having similar characteristics. Other factors besides technical considerations must therefore be taken into account if we are to explain this different treatment of the same type of tool.

Skill

Of all the factors that Costin and Hagstrum define as manifestations of specialisation, skill is probably the most difficult to analyse. Given the time invested in the manufacture of percussion tools, and the difficulty involved, it is reasonable to think that at least moderate skill would be necessary in this task. However, little else can be said if we are to rely exclusively on their analysis. Some data indicate that, in mines, skills different to those required in other contemporary contexts were necessary. Sidéra (1995, 132), who compared tools from the Villemaur-sur-Vanne 'Le Grand Bois Marot' mine with those from other sites of similar chronology, reached the conclusion that the manufacture of mining tools required know-how that was different and complementary to that needed for making the tools found at settlements and burial sites. There is no doubt that the efficient use of mining tools required some degree of skill, but these tools have no specific attributes that can be used to compare the skills required in different mines.

Workforce size

The size of mining groups seems to have been variable across Europe, as indicated by the differences in the scale of mining activity detected. While at Rijckholt mining must have been relatively large-scale (see Díaz-del-Río and Consuegra, this volume), in other mines such as Jablines only two shafts were opened at any one time (Bostyn and Lanchon 1992, 217). Other data provide information on the size of workforces. Felder estimates that, at the mining structures of Rijckholt, up to six persons might have worked together at any one time, while at those of Grimes Graves up to 21 may have been involved (Felder 1979, 60-62). At the other end of the spectrum is the Arnhofen mine, where shafts are so narrow that only one or two persons could have worked them simultaneously (Rind 2003).

There is also some experimental evidence that the number of persons working in some mines was considerably small. For Jablines, Bostyn *et al.* (2005, 30-31) showed that three persons would be enough to dig a shaft 2.5 meters deep in nine days (55 hours of work).

Certainly, the analysis of percussion tools from different mines strongly suggests that workforce sizes varied. For example, over 14,000 picks have been recovered at Rijckholt, while just four tools have been recovered at Feuerstein.

The scale of mining sites, the number of persons working in each extraction structure, and the variety of activities carried out at a mine, therefore provide an indication of the workforce size.

Changes in labour organisation over time

Data from some mines show that labour organisation changed over time. For example, at Krzemionki, the four types of structures seen, along with their respective toolkits, are not only adapted to different geological conditions but are interpreted as belonging to different periods. Sidéra (1995) reports how, in the same area in the Paris Basin, two mines with different chronologies show different ways of structuring mining activities. At Serbonnes - Middle Neolithic - antler tools were manufactured in the mine using the same fragments and techniques as at contemporary settlements, enclosures and burial sites. Their manufacture did not require too much time and they were directly used without additional hafts, while at Villemaur - Final Neolithic - percussion tools were configured outside the mine using specific techniques and antler parts not employed in other contexts. These tools are more elaborate and more standardised than those of Serbonnes, and are also hafted. Differences also exist in the number of mining structures at each mine. While at Serbonnes there are only 300 shafts, at Villemaur there are thousands. Sidéra concluded that, in the Final Neolithic, mining was more intensive and that mining technology had become more specific. In the same way that mining technology evolved so that specific tools and techniques were reserved for mining, it is possible that specific persons became devoted to this activity.

At other mines, such as Grimes Graves, different working strategies have been detected (Longworth and Varndell 1996, 89), but it has not been possible to establish how mining evolved and which strategies belong to which periods.

3. The materials studied: percussion tools from the Spanish mine of Casa Montero

The percussion tools analysed from the Casa Montero mine are mainly unmodified cobbles and fragments involved in different percussion tasks. The vast majority of these remains are quartzite cobbles. A few quartz items and a very small number of igneous rocks (such as granite) have been found. All of these raw materials can be found on the banks of the Jarama and Henares rivers which run quite close to the site.

A very small group of flint percussion tools - unretouched discarded pieces resulting from different phases of the operational chain and that show macroscopic traces of possible use – has also been analysed. They show no conditioning and appear to have been chosen in an opportunistic manner for short percussion tasks. Ten flint picks had been already identified by Nuria Castañeda and Cristina Criado. Most of the 24 flint tools subsequently analysed have been interpreted as wedges or slashing tools.

As part of the analysis of the cobble percussion tools, refits have been attempted with materials from selected sampling units (Figure 1) (including pieces from different shafts and different units). Refits between pieces recovered from different shafts have been obtained from three sampling units: B1, D4 and E4. Thus, these shafts were filled with residues from ongoing percussion activities. Since shafts were refilled shortly after they had been excavated, these refits suggest that related shafts were opened and refilled in the same mining event.

A total of 513 complete or almost complete tools (both individual pieces and refits) have been analysed; the rest are fragments. These 513 tools have been interpreted according to their shape, size, weight and the number, location, use traces and other characteristics of their working surfaces. Almost all the working surfaces documented show macroscopic percussion marks, the most common being pits, accidental extractions and battered ridges. Alterations have also been recorded. From every sampling unit a small number of pieces showing thermal alterations has been found. The main alteration affects their colour, the pieces taking on a reddish appearance. Some of these pieces are also fire-cracked.

The *Used Area Index* analyses the intensity of the use of cobble tools. This index is obtained by dividing the total working area by the estimate of the total surface area of the cobbles.

The *Shape Ratio* (Grace 1989) studies the relationship between the size of the working surfaces and the area left for handling or hafting the tools. This ratio is more variable in some tools than in others, although fairly regular for some.

The arrangement of working surfaces also provides information on the way tools were handled. Most of the tools show bipolar use, but interesting differences between tool types have been recorded (see below).

Tasks performed at the mine

Most of the tools examined seem to have been used in very heavy percussion tasks, where the contact materials would have been very hard (probably rock in most cases). These heavy percussion activities would have been mainly linked to shaft excavation, flint extraction and flint-knapping. More than 50% of the percussion tools found are related to flint-knapping. Hammerstones of different sizes have been documented that might have been used in all the steps of the operational chain (Figure 2).

Large hammerstones, *Bipolar B* tools, *Bipolar C* and incisive tools such as wedges and *Bipolar A* tools could have been used in the process of breaking up and extracting nodules (Figure 2). Anvils and (exceptionally) grinders have also been identified. It is not clear what materials were processed using them since no residues have been recovered from their working surfaces. In any event, these tools were certainly not involved in extraction or knapping.

Finally, some cobbles were recycled for use in association with hearths after their use in percussion activities (Figure 2).

Specialisation

- *Labour intensity*

At Casa Montero, neither the cobble tools nor flint percussion tools show any sign of conditioning prior to their use in percussion tasks. With respect to the cobble tools, some time would have had to be spent in the procurement of cobbles from river deposits and transportation to the mine, although this would have been minimal given the deposits are located one km from Casa Montero. Indeed, cobbles may simply have been gathered on the way to the mine. No time was invested in their modification and only in very few cases may some time have been spent in their hafting.

The mean value for the *Used Area Index* is 0.04, with most values between 0 and 0.1 (Figure 3). These low figures are partly due to the fact that only some areas of the cobbles were used, the rest of the surface being in contact with the hand or the haft. But even so, in most cases less than 10% of the surface was used, suggesting that tools were discarded when they still had usable areas.

- *Standardisation*

The cobble percussion tools at Casa Montero show little intentional standardisation; they were not modified but simply chosen for their size, weight and shape. However, some degree of mechanical standardisation resulted through repeated working procedures. The *Shape Ratio* (Figure 4) is fairly regular for the mine's hammerstones, and very little

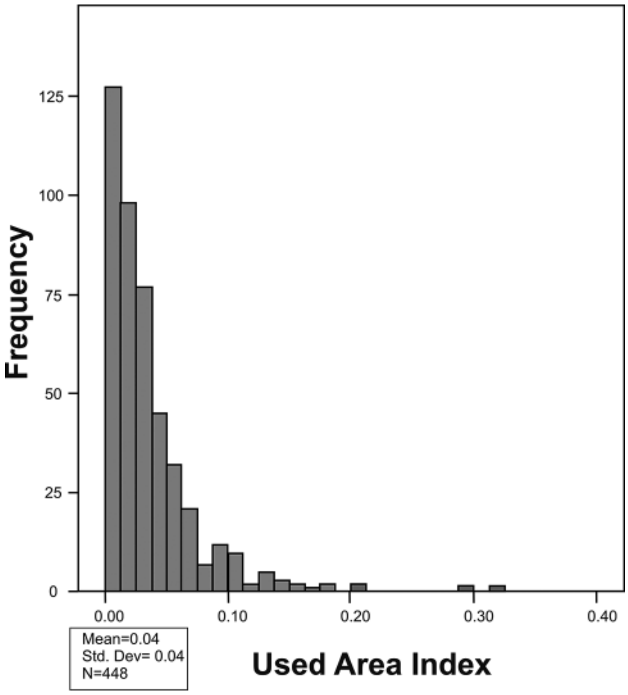

Figure 3: Histogram that shows the distribution of the values of the Used Area Index of complete tools.

variation is seen for its *Bipolar A* tools, *Bipolar C* tools or grinders. Thus, each of these types of tools, regardless of differences in size and sometimes shape among cobbles within it, was manipulated in a regular manner.

The arrangement of the working surfaces is also fairly uniform for these same types of tool. Most of the tools show bipolar use, almost exclusively so for *Bipolar A* tools and hammers. The grinders normally show such use, with the obverse or reverse faces - but almost never any lateral faces-involved. The hammerstones predominantly reflect bipolar use and sometimes lateral use, but no obverse or reverse use. The lack of any statistically significant difference among the sampling units in terms of the type of tools found in each further supports the idea that working procedures were repeated time and again.

- *Skill*

Although no specific attributes of these tools can be clearly linked with specific skills, their repeated use in a standardised fashion must have required some degree of know-how. Other mining activities would also require some experience.

Thus, these tools seem to be associated with low labour intensity. They reflect almost no intentional standardisation and only moderate mechanical standardisation. No skill was necessary in their manufacture, but at least moderate skill would have been necessary for their proper use in flint-knapping. These characteristics agree with what Costin and Hagstrum call *community specialisation*, i.e., an independent context, nucleated concentration, household constitution (household-based productive units aggregated in this case for a communal activity) and part-time intensity.

Workforce size

Based on the refits from sampling units B1, D4 and E4 (Figure 1), the minimum number of shafts open in each mining event can be estimated. Differences are seen between different areas of the mine. With respect to sampling unit B1, just 5 shafts are connected by refits, while for sampling units D4 and E4, 18 and 17 shafts are connected respectively. Both in D4 and in E4, the few shafts with no refits with other shafts were also refilled during the same mining episode, as shown by the horizontal excavations connecting them with other shafts that do have refits and which have the same infill. Hence, at the centre of the mine, at least 21 shafts were excavated during each mining event, while at the margins there is no evidence for more than five being opened in a single event. Consequently the workforce would have been relatively large during some events and smaller during others. The possibility that instead of more persons more time was involved is considered unlikely because we would have to explain why a single group would spend in the mine much more time than was necessary in order to meet its own raw material needs (given that we have no reason to believe that they would be producing a surplus for exchange).

Labour intensity and differences over time

A substantial difference exists between the central area of the mine and the margins, not only in terms of the total weight of percussion tools recovered but also in terms of the mean weight of percussion tool remains per shaft (Figure 5). In some areas more shafts were excavated than in others, but also, particularly in some areas at the centre of the mine (sampling units D2, D3, E2 and E4), more percussion tools per shaft were used. The intensity of the use of these tools is similar throughout the mine, with no significant difference in the *Used Area Index* of tools between sampling units. Thus, regardless of the number of shafts excavated, the intensity of percussion tasks per shaft was greater in some areas than in others. If these different areas were exploited at different times, some mining events must have involved more work than others, independent of the use of different extraction methods. For example, in sampling unit D4, where flint seams were more intensively exploited by horizontal excavations, the weight of percussion tools per shaft is in fact smaller than that recorded for other sampling units.

4. Conclusions

The attributes of the percussion tools from Casa Montero point to a specialisation in which independent individuals from one or more groups gathered periodically for projects

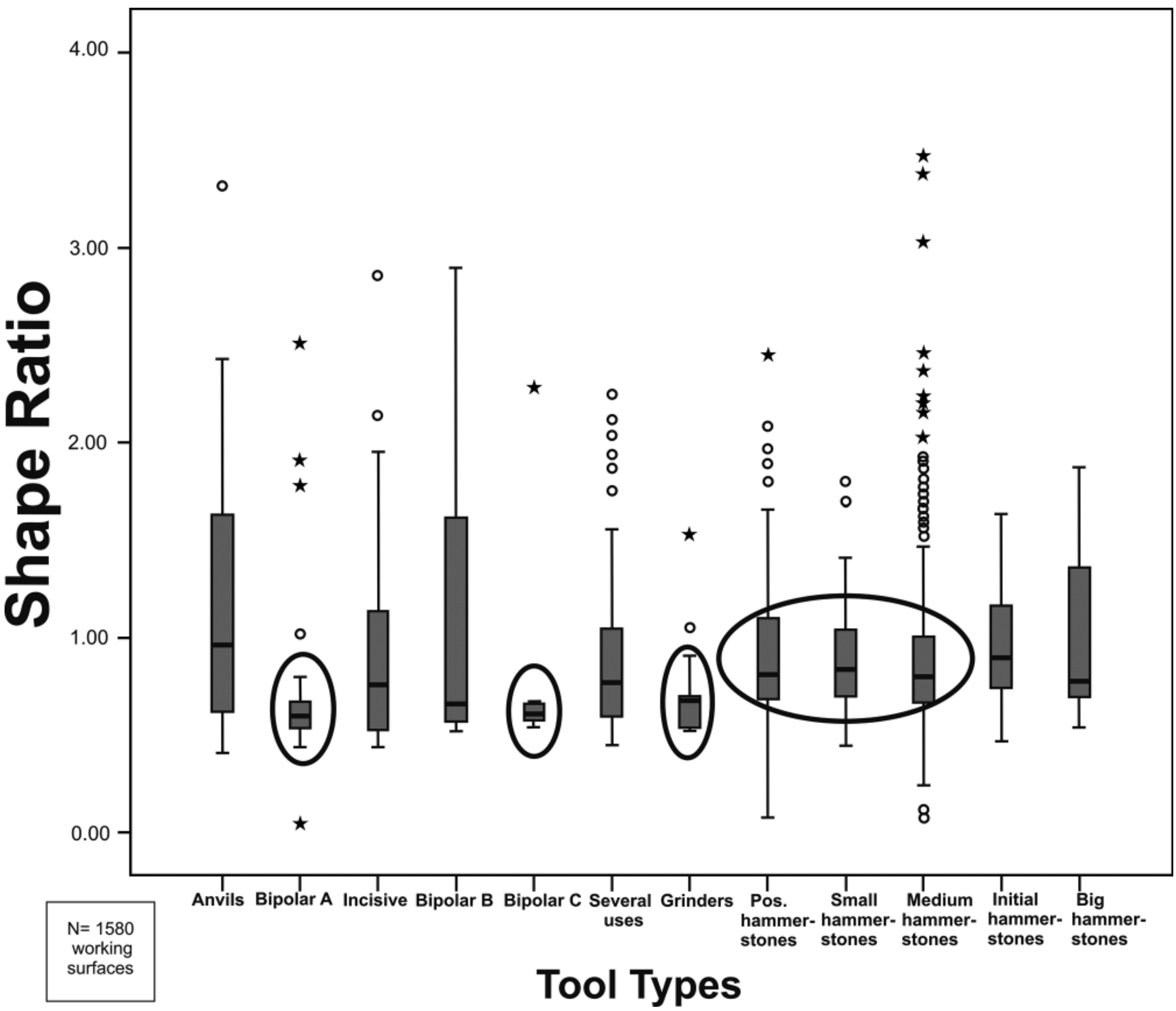

Figure 4: Shape Ratio for each different type of tool. Some types of tools present remarkably low variability, suggesting they have been handled in a regular manner despite differences in size and shape.

that entailed a low labour intensity, low intentional standardisation, moderate mechanical standardisation, and at least a moderate degree of skill.

Cobble tools were systematically used in the same way, in a standardised procedure that was repeated with little variation. The flint percussion tools, on the other hand, are exceptional and the consequence of opportunistic behaviour. Along with cobble tools, other elements such as wooden wedges or digging tools must have formed part of the relatively standardised mining toolkit.

Percussion tools were involved in shaft digging, raw material extraction, flint-knapping, grinding activities and hearth-related use. In the relatively short period of use of the mine, working techniques did not change significantly, with tasks being performed using the same tools in almost the same way every time. This may be linked to mechanisms of knowledge acquisition and transmission that ensured procedures were perpetuated. What did change was the scale of collective labour. This could merely be a result of a changing demand for raw material, but also of a changing capacity or need for the mobilisation of shared labour by communities. Givenz the large scale of some mining events in a regional and chronological context of very small groups, an unsolved question is how and why such a workforce was mobilised.

From a methodological point of view, the efficiency of analysing a minority element such as the cobble tools of Casa Montero should be noted; this strategy allowed us to tackle the question of the number of shafts opened in a mining single event with a relatively small investment in time.

Neolithic flint mining in Europe was not a uniform phenomenon, at least not in terms of labour organisation. There was considerable variability in labour intensity, the degree of elaboration of percussion tools, tool standardisation, the scale of mining events and the size of the workforce involved.

Sampling Unit	Number of pieces	Total weight of cobbles and fragments (Kg)	Number of shafts	Cobble weight per shaft (Kg)
A2	4	2.75	2	1.38
B1	308	138.71	15	9.25
B2	166	89.55	8	11.19
B3	429	133.39	14	9.53
D1	184	58	5	11.6
D2	223	150.92	9	16.77
D3	284	233.41	10	23.34
D4	684	325.86	22	14.81
E1	30	30.46	3	10.15
E2	638	240.95	14	17.21
E3	476	257.72	19	13.56
E4	1074	355.65	21	16.94
G3	86	32.36	5	6.47
CMI	36	11.5	10	1.15

Figure 5: Total weight of cobbles and fragments for each sampling unit and average weight per shaft in each case.

Even given the important differences among European mines, Casa Montero seems to be a special case. From the point of view of labour intensity, the percussion tools found in most European Neolithic mines reflect considerable time investments in their making, that large quantities of them were needed, and that they were intensely used. At Casa Montero, however, these tools were obtained close to the mine, used without further modification, and discarded when they might still have been useful, as suggested by their low mean *Used Area Index* value.

Percussion tools from other Neolithic mines show signs of intentional standardisation, while those from Casa Montero were not selected or transformed in order to comply with technical requirements. Indeed, those of Casa Montero seem rather more opportunistic in character. Mining activities at this site seem to have been less structured and developed than in other parts of Europe, maybe due to the short life-span of the mine.

The differences documented here are not merely adaptations to different geological settings, nor are they strictly technical. Since this work examines variables related to labour organisation, these differences must reflect variations in the way that mining work was socially organised.

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