

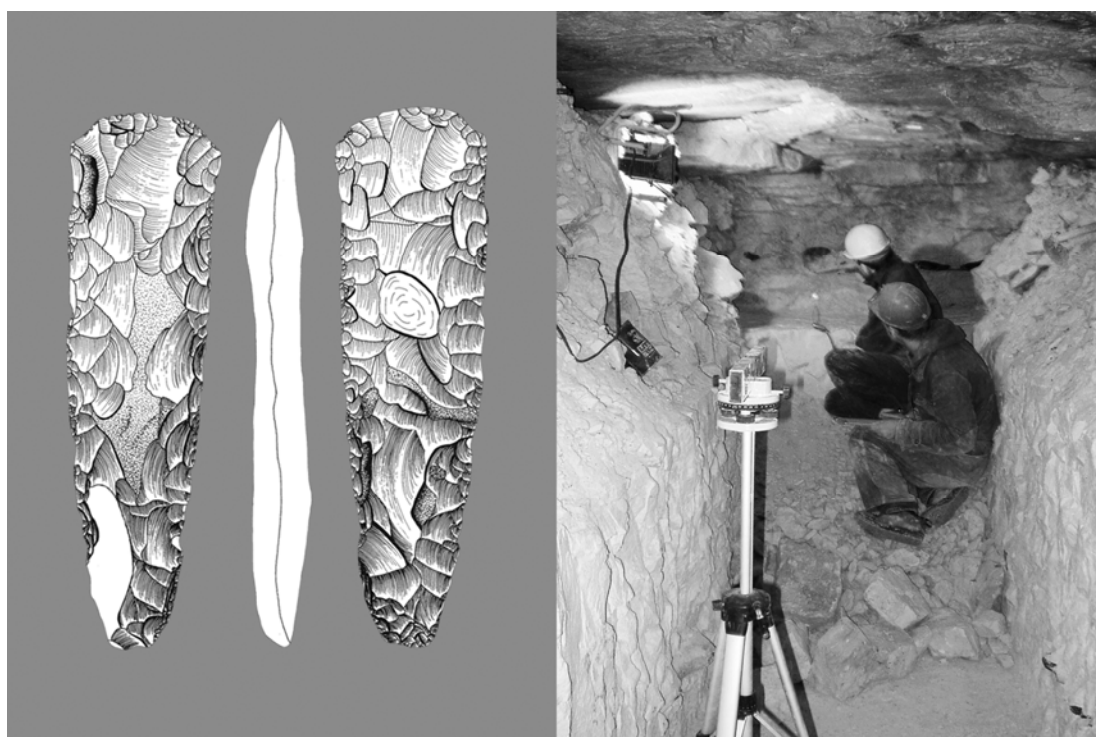
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Flint Mining in Prehistoric Europe

Interpreting the archaeological records

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FLINT MINING IN EARLY NEOLITHIC IBERIA: A PRELIMINARY REPORT ON 'CASA MONTERO' (MADRID, SPAIN)

**Marta Capote, Nuria Castañeda, Susana Consuegra,
Cristina Criado, Pedro Díaz-del-Río**

Abstract: The Early Neolithic (c. 5400-5100 cal BC) flint mine of Casa Montero was located in 2003 and partially excavated throughout three field seasons. This paper describes the excavation strategies that have been applied –both random selection of shafts and aligned systematic sampling–, and some of the preliminary results obtained from excavation and post-excavation analyses. We conclude that the dimensions of the site and the characteristics of the shafts suggest short term seasonal expeditions of small mining teams. This mining process produced use and probably exchange value, but also a durable monumental landscape, erected as a result of a cumulative materialization of social labour.

Keywords: Flint mine, Neolithic, Iberia, operative chain, shafts, labour, monuments, landscape.

INTRODUCTION

Until the nineties most Iberian prehistoric flint mines had been located in southern Spain through surface collections. Of these, barely one had been explored (Ramos Millán 1997; Ramos Millán *et al.* 1997). All lacked absolute chronologies, and from what we now know, many were actually mined in modern times for military purposes. In a similar way, Neolithic studies have only recently committed to long-term regional research in areas other than the well-known Levantine coast.

This is particularly the case for the Central Meseta, until fairly recently an area almost devoid of Early Neolithic evidence. Our present knowledge relies on a few recently excavated sites, most known through preliminary reports and only one completely published. There are two different categories of sites: caves and open-air settlements (Bueno *et al.* 2002; Díaz-del-Río and Consuegra 1999; Estremera 2003; Kunst and Rojo 1999; Rojo and Kunst 1999; Rodríguez 2006). While the nature of the caves and the

limitations of the small areas where digging took place do not allow a precise functional interpretation of the earliest Neolithic layers, open-air settlements are mostly made up of small unimpressive clusters of pit-features. One of their shared features is the limited amount of portable remains recovered in early Neolithic layers. This is especially true when quantifying flint tools, which seem to be extremely scarce, compared both to other contemporary evidence elsewhere, or to the subsequent regional Copper Age settlements (Díaz-del-Río 2004).

Under these circumstances, the discovery, in 2003, of the Early Neolithic flint mine of Casa Montero in the centre of Iberia was a striking novelty on account of its location, early chronology, density of shafts, and the historical context in which flint mining developed. The present paper is an overview of the evidence recovered after three years of fieldwork, and a preliminary report on post-excavation analyses in progress.



Fig. 1: Location of Casa Montero in Iberia and in relation to the Jarama basin.

1. THE SITE AND THE DIGGING CAMPAIGNS

The flint mine of Casa Montero was discovered as a result of the Archaeological Impact Assessment of Madrid's M-50 highway belt. The site is situated in the south-east of Spain's expanding capital city, in the centre of Iberia (Fig. 1). Located on a river bluff, the position dominates one of the main regional river basins, the Jarama valley, where some scattered Neolithic sites have been known to exist (Mercader *et al* 1989; Díaz-del-Río and Consuegra 1999). The results from three excavation seasons combined with an intensive surface survey with systematic sub-plowzone control pits suggest that the prehistoric mine may roughly cover eight hectares.

Four chronological phases were documented in the 4 hectare open-area excavations undertaken at the site. These offer evidence of Middle Pleistocene and Bronze Age occupation, and Neolithic and Contemporary flint mining exploitations. The oldest phase was located in the north of

the excavation, characterized by an open-air Pleistocene stratigraphic sequence.

The Neolithic evidence includes 3824 small vertical shafts, one meter wide on average, and of up to nine meters deep, dependent on the variable depth and quality of the flint seams. The lithic record is exceptional, both in quantity and quality, and includes all phases of the operative chain. Radiocarbon dating of two charcoal samples have afforded early Neolithic dates that suggest that the flint mine was exploited throughout the second half of the VI millennium cal BC (Díaz-del-Río *et al.* 2006). To date, Casa Montero is, after Defensola, (Galiberti *et al.* 1997; 2001), the second oldest Neolithic flint mine in Europe (Fig. 2).

Bronze Age pit structures are found in small percentages, both in between the cluster of Neolithic shafts and in its contiguous area. None can be considered to be mining



Ref. Lab.	Date BP	Dated material	Cal 2 sig	Provenience	Meth
Beta 206512	6410 +/- 40	Carbon <i>Quercus ilex</i> / <i>Q. coccifera</i>	5480-5320 BC	Shaft ue. 2384 Layer ue. 2382	AMS
Beta 206513	6270 +/- 40	Carbon <i>Quercus ilex</i> / <i>Q. coccifera</i>	5330-5070 BC	Shaft ue. 2701 Layer ue. 2229	AMS

Atmospheric data from Reimer et al (2004); OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]

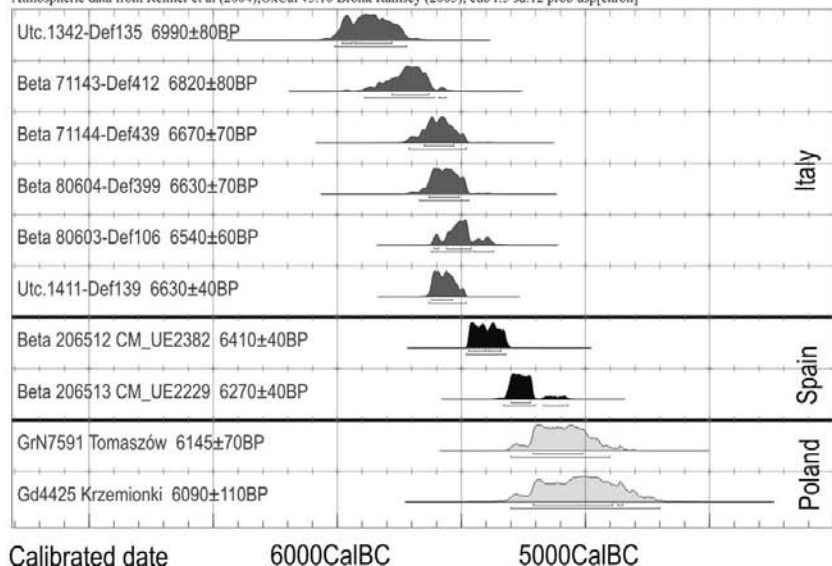


Fig. 2: Calibrated radiocarbon dates of the earliest Neolithic flint mines in Europe: Defensola, Casa Montero, Krzemionki and Tomaszów.

shafts, but they share characteristics with all regional BA sites: the pits are mostly related to storage and waste disposal. These shallow pits include a few crude throwaway flint tools, potsherds, charcoal, some faunal remains, and occasional individual burials. Many BA sites seem systematically to reoccupy certain previously significant sites, like

Copper Age enclosures (Díaz-del-Río 2004) or this Neolithic flint mine. The distribution of features also shows a pattern: a few structures on the previous site, while most cluster around in its immediate vicinity. Considering the extremely irregular topography of the mine by the end of the Neolithic, and the limited use of flint during the Bronze

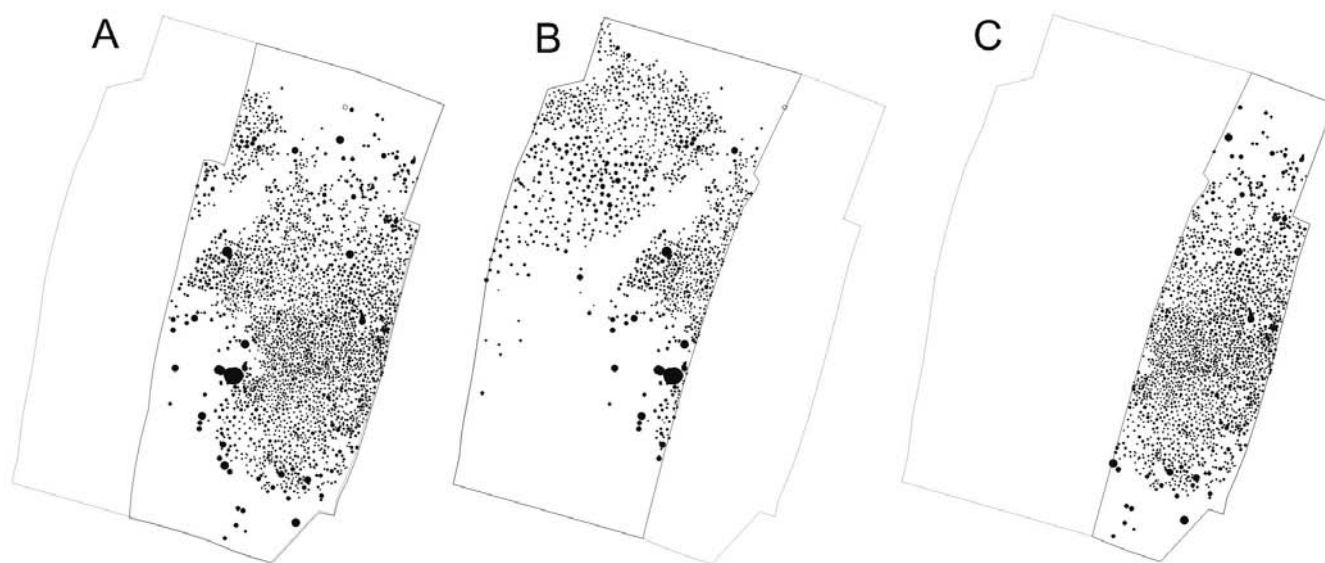


Fig. 3: (A) Area documented during the first field season. (B) Area documented and sampled during the second and third field seasons. (C) Documented area that has been preserved and protected.

Age, it is functionally unclear why scattered BA groups would occupy this particular spot. Nevertheless, the presence of two individual burials suggests that at least some ritual behaviour may have been involved. Whatever those groups thought about previous flint mines or enclosures, the pattern seems to suggest a strong interest in claiming a connection with their -real or fictitious- ancestors, wherever they had left visible earthworks.

Finally, the surroundings of Casa Montero are known today as 'Cerro de las Canteras' (Quarry Hill). Both the Neolithic site and its surroundings were mined for flint to be used in threshing machines and possibly for gunflint. The historical record suggests that they may have been under exploitation until the mid-Nineteenth century (Consuegra *et al.* 2004; Castañeda and Criado, 2006; Prado 1864).

The site of Casa Montero was excavated during three field seasons, from September 2003 to July 2006, under different circumstances and with varying research aims (Fig. 3). The first season (September 2003-March 2004) involved the excavation of 123 shafts, randomly selected from the approximately 2500 shafts mapped in 2.4 hectares of open-area excavation. The objective was a first assessment of the variability of prehistoric flint extracting methods, the geological structure of the site, and the absolute and relative dating of the site through the available evidence: charcoal remains and pottery fragments (Bustillo and Pé-

rez-Jiménez, 2005; Capote *et al.* 2006; Castañeda *et al.* 2008; Castañeda and Criado 2006; Consuegra *et al.* 2004; 2005; Díaz-del-Río *et al.* 2006; Díaz-del-Río *et al.* 2008; Pérez-Jiménez *et al.* 2005).

That Casa Montero was the first Neolithic flint mine discovered and extensively dug in Iberia gave regional Heritage Managers some arguments to push for a modification of the highway belt some 60 meters to the west from its original track, saving from destruction and permanently protecting the main concentration of prehistoric shafts. As a result, during the second season (August 2004-February 2005), the open-area excavation was extended 1.8 hectare further west, and more than 500 new shafts were mapped. This excavation led to reconsideration of our research objectives, as key matters such as mining strategies, contemporaneity of extractions or other issues could only be potentially answered by recovering information from clusters of shafts.

Consequently, during the third season (September 2005-July 2006) the excavation strategy shifted from a focus on individual mining shafts to groups of shafts. In order to control potential horizontal variations in mining strategies or chronology, we established an aligned systematic sampling. The approach involved the complete excavation of all the shafts included in each one of the seventeen grid squares of ten by ten meters systematically distributed

throughout the area that would ultimately disappear under the highway (Fig. 4).

For safety reasons, this sampling was accompanied by a different excavation technique. All selected shafts were dug down to two meters deep, followed by the complete extraction of the remaining geological layers with a backhoe. The grid squares were once again topographically located and the excavation process repeated four times until most of the deepest shafts had been completely dug out. Of all these, only three shafts were deeper than 10 meters and not completely excavated. As a result, we obtained both detailed information on shafts and a precise three dimensional view of the geological structure of the complete excavation area. This new excavation technique allowed for the recording of several narrow passages that connected groups of shafts, a result that would have been impossible if we had followed the previous single shaft excavation procedure. Neolithic miners would have crawled through these passages following some horizontally disposed flint seams.

2. GEOLOGICAL CONTEXT

Casa Montero is located in sedimentary rocks from the Intermediate Unit of the Miocene in the Madrid basin (Brell *et al.* 1985; Junco and Calvo 1983). The stratigraphic column is composed of beds of clay, dolomite and silica rocks. Deep sections show the existence of four major silicification episodes, each consisting of one or more silica levels. The three upper levels are composed of opal and opaline chert, and were formed by silicification of Magnesian smectites (Pérez-Jiménez *et al.* 2005; Bustillo and Pérez-Jiménez 2005) (Fig. 5).

Silica rocks from Casa Montero form nodules arranged in discontinuous beds that may have some lateral continuity. These beds have been classified in four episodes of silicification (Bustillo and Pérez-Jiménez 2005); they appear deformed as a result of collapses of the underneath evaporitic episodes. This deformation produced a depression in which most of the shafts are concentrated, and

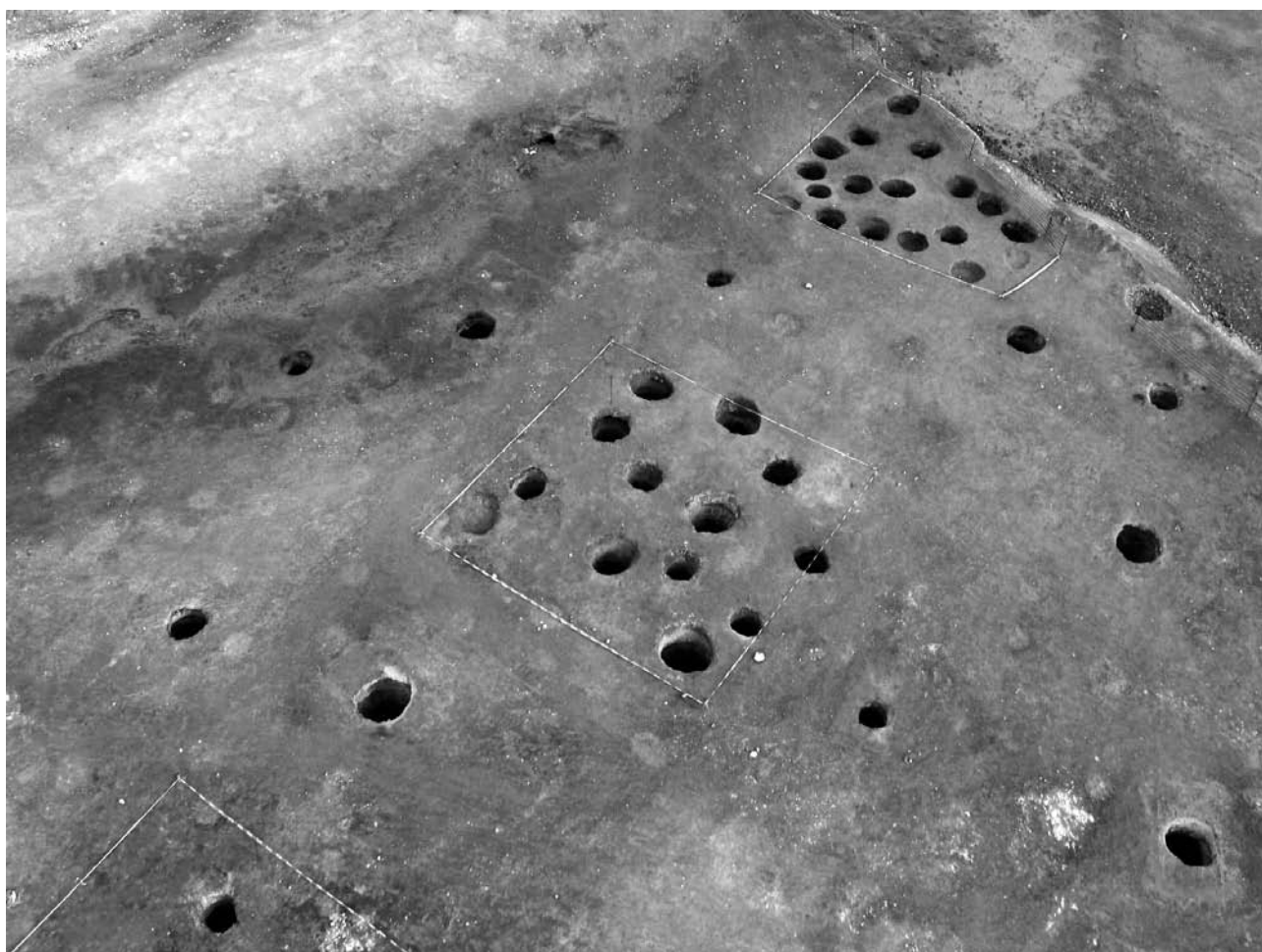


Fig. 4: Aerial view of three of the 10x10 meter areas during their excavation.

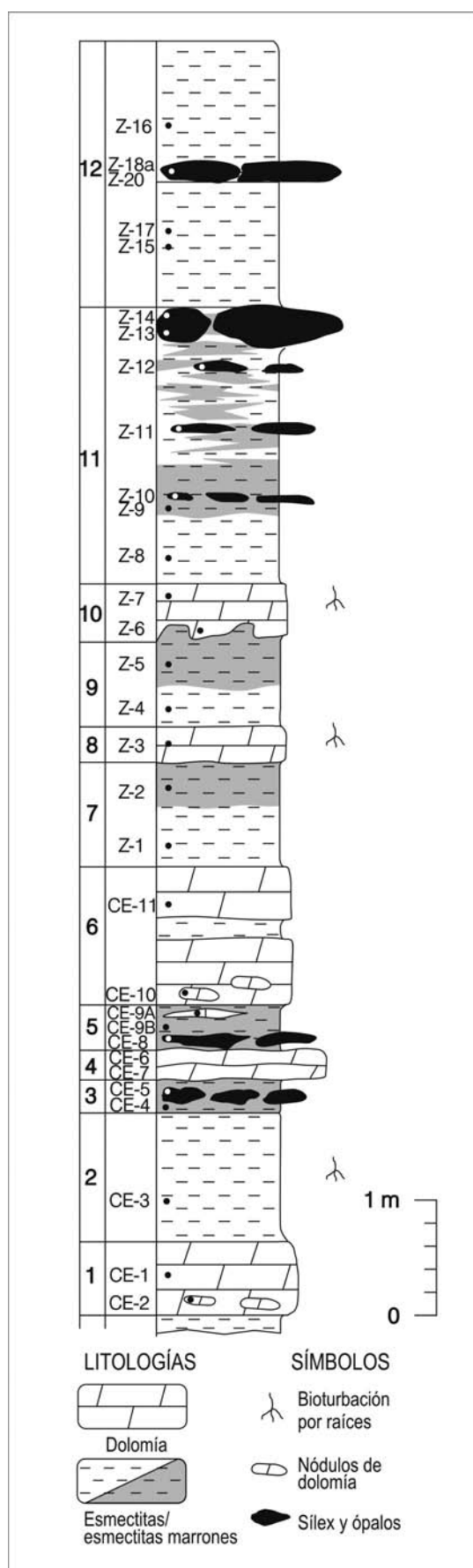


Fig. 5: Stratigraphical column documented at Casa Montero.

may be particularly related to the horizontal depth variability of shafts throughout the site: as a general pattern, shafts are deeper in the central area of the excavation.

The selection of this particular mining area was no coincidence. The regional geology of Madrid is known for its abundance in siliceous rocks; that is, the profusion of flint at this site cannot be considered a uniquely distinctive feature. Although we cannot rule out the possibility of other regional flint mines, Casa Montero's flint has a particular genesis: it was formed from smectites and later underwent an aging process. This involved a re-crystallization of opal to form quartz in the inner part of nodules, developing a fine-grained core. As a result, there are frequent nodules with opaline outer parts and microcrystalline quartz inner parts (Bustillo and Pérez-Jiménez 2005). This process gave the flint particularly suitable knapping qualities (Pérez-Jiménez *et al* 2005; Bustillo and Pérez-Jiménez, 2005; Bustillo *et al.* 2008).

3. RAW MATERIALS

Casa Montero's lithic remains have been classified in two groups of raw materials. First, rocks which were necessarily obtained off-site, and used in the process of extraction, quartering, and reduction of flint nodules. Secondly, silica rocks, which were the main object of the mining activity.

Off-site rocks are quartzite, quartz, and sandstone pebbles, most probably obtained from the nearby Jarama river bank, less than a kilometre away. Such rocks constitute a minimal part of the overall assemblage.

The second group is composed of siliceous rocks: opals and opaline cherts. Four silicification episodes have been documented. Neolithic shafts cut through the three upper episodes, all opaline. The main exploited levels are the second and fourth, while the third is only exploited whenever it has good knapping qualities (Fig. 5).

We undertook a macroscopic and petrographic characterization of the raw materials represented in the archaeological record, in order to analyze in depth the cultural and/or physical characteristics that had determined either its selection or refusal. In order to carry out this characterization, a sample of 43 lithic remains was selected out of a population of 5043 artefacts obtained from the first field

season. The macroscopic characterization has allowed us to distinguish seven types of raw materials. Subsequently, the petrographic study has defined the properties of the opaline cherts.

Refits and chaîne opératoire analyses have provided evidence indicating that when nodules have an opaline outer part, this material is worked as a second phase of removal of cortex, whereas the raw material chosen for lithic exploitation is chert from the inner part of the nodules. Precisely this inner part is the one reduced in the phases of configuration and production. The reason for this selection is knapping quality, since opal is fragile and, consequently, less suitable than chert as a blank. Moreover, the frailty of opals cause fractures, faults and errors in the process of flaking. As a result, a large quantity of this raw material inevitably has to be discarded. On the other hand, the heterogeneity of nodules always involves additional difficulty for flint-knappers, as the response of each material to the force of the blow will be unexpected and consequently difficult to control (Castañeda *et al.* 2008). (Fig. 6)



Fig. 6: Flint refits from Casa Montero

4. THE MINE

The archaeological record of Casa Montero is the result of sequential short term activities which took place over a relatively short period of time. In order to tackle this typical problem of time scales, the information has been contextualized and sorted out distinguishing different working processes. The labour process involved at least the following succession of actions, each one of them preceded by

specific decision-making in respect to parameters such as space, quality and quantity: excavation of the shafts, extraction of raw materials, transformation of raw materials, and waste management. Each action has produced a particular kind of archaeological record.

4.1. Shaft excavation

In order to analyze this action, we rely on the following evidence. First, the mining structures themselves and their spatial distribution. Second, the mining tools employed in the process of shaft digging and recovered in the archaeological record. Finally, the marks left by mining tools on shaft walls and the traces of preparation of structures to facilitate both access to shafts and evacuation of mine spoils.

Mining shafts offer little variability in respect to size and shape. They are mainly simple cylinder-like structures on average one meter wide and up to nine or ten meters deep. Their infillings show little differentiation, and few archaeological remains other than an impressive amount of flint. However, one of the sampling units dug during the last field season revealed a cluster of five shafts with small connecting galleries (Fig. 7). These were the result of side workings dug to exploit the one meter deep seam. This seam may have been abandoned when nearly exhausted or when the costs and efforts to continue it exceeded those of opening a new shaft. Occasionally, several of these small connecting galleries are documented at different depths in a single shaft. Although the system is more complex and labour intensive than the straightforward excavation of vertical structures, it is still extremely simple, given the total scale of the mining activity.



Fig. 7: Side workings documented at one of the sampled areas.

As has been demonstrated for other Iberian mines (Camprubí *et al.* 2003), Neolithic miners certainly had a good knowledge of the geological structure of the area. Test pits at Casa Montero are an excellent testimony to this knowledge (Consuegra *et al.* 2004). The Neolithic miners stopped excavating the shallow pits whenever they found green clay levels that are stratigraphically located under the opaline episodes. Furthermore, the depths of the shafts adapt to deformations resulting from siliceous episodes. This geological know-how would have been the result of a transmission of local mining knowledge from generation to generation: extraction and debitage methods, best conditions for lateral excavations, safety measures, and so forth. Shafts were dug close together, none superimposed on another, and with just enough distance so as to walk between them while avoiding wall collapses. These more than 4000 Neolithic shafts are probably the result of several centuries of mining. The total mining intensity would have been about 13 shafts per year, considering a time-span of 300 years for the whole period of activity.

Antler and bone tools for shaft digging are commonly found in other European mines such as Jablines (Bostyn and Lanchon 1992; 1997), Grimes Graves (Holgate 1995; Topping 1997; Barber *et al.* 1999), Zele (Lech and Lech 1984; 1997) or Krzemionki (Migal and Salacinski 1997). These tools may be picks, chisels, shovels or even rakes. On the contrary, most of the tools related to mining activities recovered so far from Casa Montero are made out of stone. They are picks, maces or wedges, as is the case for other mines like Ryckholt (Felder 1997) or Defensola (Galiberti *et al.* 1997; 2001; di Lernia *et al.* 1995). The very rare antler fragments recovered during the excavation seem to relate more to small bone utensils such as awls or pressure flakers than to picks (Yravedra *et al.* 2008). Nevertheless, the information recovered from several casts of tool marks on shaft walls suggests the use of bone implements in at least parts of the mining process. Both the analyses of these casts and of possible use wear on the antler points will be decisive for their interpretation.

Lithic mining tools have been classified in two groups, according to the kind of activity they permitted: raw material procurement tools -composed of shaft digging tools (picks, maces or wedges)- and maintenance tools -mostly scrapers, denticulates and unmodified flakes- (Consuegra *et al.* 2004; 2005).

Two types can be identified among the raw material procurement tools: striking tools and incisive tools. The first group includes maces and big hammerstones; the second picks and wedges.

Striking tools were heavy, with rounded forms. They were manufactured using raw materials obtained off-site, like quartzite from the nearby terraces of the Jarama River. An example of this kind of tool is a mace manufactured from a quartzite pebble, with prismatic shape and a quadrangular and homogeneous section (Fig. 8). It measures 137x81x78 mm and weights 1,400 grams, presenting two use areas on both ends, with traces of an intensive percussion that provoked numerous accidental extractions. The mace has a medial zone with traces of crushing and abrasion, a consequence of the elimination of protuberances and conditioning for hafting. Maces may have been multifunctional, used for both the excavation of shafts and the fragmentation of big nodules (Consuegra *et al.* 2005).



Fig. 8: An example of a flint pick and a quartzite mace from Casa Montero.

Incisive tools, on the other hand, were usually selected from discarded fragments that resulted from in situ knapping activities. These fragments were chosen because of their size, weight and pointed or angular morphology. Configuration is practically nonexistent in most of these objects. When it does, it is simply performed in order to facilitate hafting. They all show evident traces of percussion and use.

Ten flint picks have been identified so far (Fig. 8), one of them made out of silicified clay. The average dimensions

of these items are 103x53x27 mm. Their width and thickness are normally more homogeneous than their length. Working areas are usually very homogeneous, with a triangular or more rarely a quadrangular or trapezoidal section; they usually are 15 mm thick. Most of them show longitudinal and oblique striations on their active areas, and abrasion on ridges. On most of them, microflakes and traces of abrasion have been observed in their medial and proximal ends. The light weight of these picks suggests that they may have not been used by themselves, but instead, employed as chisels in combination with maces (Consuegra *et al.* 2005).

We have classified denticulates, scrapers, endscrapers and burins as maintenance tools. They were all expediently manufactured from discarded flint fragments, and probably used in activities such as the manufacture and repair of hafts, ladders or ropes. Non-modified flakes that resulted from knapping activities would also have been employed for these maintenance activities. These would not have required any further modification, as the presence of flakes with macroscopic use-wear traces –especially microflakes– seems to suggest.

Digging tools have occasionally left marks on shaft walls. Most of these are longitudinal marks with V or occasionally U sections. They appear in groups of parallel marks with vertical or oblique disposition, although exceptionally some shallow and circular marks have been documented. Only occasionally do some shaft walls show certain modifications such as small depressions to facilitate access, or pairs of small opposite holes with circular section to support some kind of pulleys. As the mean diameter of shafts does not allow for more than one miner at a time, any shaft more than 2 meters deep would require a minimum of two individuals to work it. The assistant stationed above would help with the process of waste disposal, hauling up the raw material, and handing down tools to the miner below.

4.2. Raw material extraction

This stage comprehends all the tasks performed in order to extract nodules from flint seams, quarter them, and raise the nodules and fragments to the surface. Although shafts do cut through flint seams, miners did not always exhaust these, so some seams are still visible in the shaft walls.

They occasionally show evidence of intentional fractures, or the voids resulting from the withdrawal of whole nodules.

Resistance to fracture is greater when nodules are inserted in their matrix, and knapping becomes increasingly difficult inside narrow shafts that do not allow the miner to choose an adequate angle to strike. Depending on the size of the nodule, and its position inside the shaft, nodules would have been extracted whole or quartered and extracted in large flakes. Those nodules small enough to be manipulated would have been directly removed from flint seams, while the bigger ones would have been fractured with the aid of big hammerstones, maces and wedges. Accordingly, there are few examples of exploitation of complete nodules among the lithic production of Casa Montero. As a rule, large flakes are extracted from nodules because they make more suitable core blanks (Consuegra *et al.* 2005).

Tools used in raw material extraction can be divided into two groups: incisive implements such as wedges, and percussion implements such as big hammerstones.

Some wedges have occasionally been recovered at the site. These implements were either manufactured from discarded pieces resulting from flint knapping, or from fragments of broken quartzite hammerstones, selecting those with a particular morphology, size and weight, without any specific configuration. Consequently, these wedges are improvised implements, as happens with all the tools so far documented at Casa Montero. This kind of incisive tool shows a thin distal end that increases in thickness towards its medial part and proximal end. Its working area is an edge with highly variable length. This working edge has macroscopic marks on the edge, and striations parallel to the main axis of the artefact. The proximal end of these tools also display macroscopic use wear traces, such as crushing and accidental extractions. These traces are percussion marks resulting from the use of wedges as intermediate elements. The edge of the tool would have been inserted into cracks or crevices in shaft walls, and the proximal end would have been struck with a mace in order to extract the nodules.

The frequent difficulties occurring while quartering and extracting nodules required the use of heavy hammer-

stones and, occasionally, the use of maces for shaft digging. These big hammerstones have been recovered either complete or –more often– as fragments. They are always manufactured from quartzite, with a spherical or elliptical morphology, an approximate length of 163 mm and an average weight of 1200 gr. They show many traces of hard percussion producing extensive accidental flakes and/or longitudinal fractures.

4.3. Raw material transformation.

At the Casa Montero flint mine, the raw material was both procured and processed. This has resulted in a massive amount of recovered archaeological remains: lithic materials recovered from the three digging seasons weigh 65 T, and amount to more than one and a half million pieces. This abundance of material creates extreme difficulties for its efficient management, processing, analysis and comprehensive publishing. On the other hand, it offers the advantage of allowing the complete study and careful reconstruction of the *chaîne opératoire* (Consuegra *et al.* 2004; Castañeda and Criado 2006; Castañeda *et al.* 2008).

A preliminary analysis of lithic remains from the first field season led us to understand the main aim of flint exploitation: the production of blades. There is also a secondary, although important, flake production, identified with its own independent *chaîne opératoire*. This kind of production is peculiar to Casa Montero, especially when compared to other European Neolithic flint mines that mostly aimed at the production of axe rough-outs, such as Grimes Graves (Barber *et al.* 1999), Jablines (Bostyn and Lanchon 1997) or Defensola (Galiberti *et al.* 1997). Examples of Neolithic flint mines aiming at blade production, such as Tomaszów (Schild 1995), are somehow less common in Western Europe.

Evidence from Neolithic contexts suggests that blades played both a functional and ritual role. Blades have been documented in early Neolithic individual burials from Central Iberia, such as La Lámpara (Rojo and Kunst 1999), although they later become a generalized funerary offering in megaliths (e.g. Rojo *et al.* 2005; Delibes *et al.* 1993). Not infrequently, blades were specifically manufactured for burials, showing no evidence of wear for use.

Blade production is documented at the mine through blade cores, crested blades, discarded blades and knapping accidents. Blade products of good quality do not appear, mainly because they were removed, probably along with some configured blade cores. Neither used nor retouched blades have been recovered at the mine, that is, tool configuration and use are not represented in the blade *chaîne opératoire*.

The exceptional lithic record of Casa Montero allows for the recognition of different blade production schemes. The choice of one or another reduction strategy depends on the nature of the blank –a complete nodule or a large flake– and on the blade needed. The lithic record analyzed from the first field season suggests that the preferred raw material for blade production was flint rather than opal. As documented through several refits, this preference required the elimination of all opal parts previous to the configuration of the flaking surface (Consuegra *et al.* 2004; Castañeda *et al.* 2008).

When the blank is a whole nodule, the systems developed are mainly prismatic, beginning with the preparation of a crested blade. Flake blanks are more suitable and versatile than entire nodules. These large flakes allow for different reduction strategies. So far, three reduction schemes for blade production have been documented, two in volume and one in surface. Each will produce a particular kind of blade: either more elongated and thin or shorter and thicker (Castañeda and Criado 2006; Díaz-del-Río *et al.* 2006).

Flake production has been identified thanks to the presence of predetermined and predetermining flakes and their corresponding cores. Flakes are obtained through bifacial exploitation systems, either hierarchical or non-hierarchical: both discoidal and levallois schemes have been identified (Consuegra *et al.* 2004).

Hammerstones used for knapping activities were collected and selected among materials from the Jarama river bank. They are quartzite, quartz and sandstone pebbles that can be sorted in two different volumetric groups: medium and small, fitting an average hand.

4.4. Waste Management

The soil extracted during the excavation of shafts was either dumped into other nearby shafts along with the remaining waste from flaking, or left aside and finally dumped back in. This of course depends on whether miners opened more than one shaft at a time. It seems reasonable to suggest that the second option was preferred: we lack evidence for natural sediments at the base of any excavated shaft, and layers that can be interpreted as wall collapses are rare. In any case, it seems that shafts were filled almost immediately after being excavated. Shaft in-fills show a repetitive pattern where density of lithic finds increases with depth. This behaviour would keep working areas free from spoils and flaking residues, and, given the proximity of shafts, the systematic backfilling may have been the most practical safety measure.

5. EVIDENCE OF OTHER ACTIVITIES

Miners at Casa Montero understandably performed other activities. Among the archaeological evidence recovered are pottery fragments, bone industry, faunal remains and ochre fragments.

The few fragments of pottery recovered at Casa Montero are in form and decoration characteristic of central Iberia's Early Neolithic, similar -if not identical- to those recovered at Cueva de la Vaquera (Estremera 2003; Consuegra *et al.* 2004). Frequently they are fragments of impressed wares (Fig. 9), occasionally decorated with red dip-coatings, and their shapes suggest mostly middle-sized containers. Pottery will be analyzed for phytoliths, and thin-sections

will be obtained in order to define the potential technological and/or compositional variability between wares. These may inform us about functional differences between wares, or differences in the provenance of pottery productions, perhaps related to the social conditions of accessibility to the mine.

On the other hand, there is a small assemblage of bone tools, most of them corresponding to bone and antler shafts, and finished rings that were produced and abandoned on site (Yravedra *et al.* 2008). This evidence suggests that the manufacture of bone and antler rings was somehow required while labouring at the mine. Although the function of these rings and their relation with flint mining are yet to be found, it seems that these artefacts -typical of Iberian Levantine Early Neolithic sites (Pascual Benito 1996)- should be considered rather as functional than ornamental, as previously thought. Whatever their function, they must relate to an activity performed in both mining and non-mining contexts, and they are one of the best chronological markers of Casa Montero.

Finally, ochre impregnated on lithic elements and bones, has been documented in considerable quantity, as well as a large 2 kg portion of pigment. Ochre has usually been related to both ritual and functional contexts: it was used in funerary monuments, to process different raw materials, and in the production of elements such as hafts. Nevertheless, there is so far no unambiguous evidence for Neolithic ritual activities at Casa Montero, as opposed to other Iberian (Bosch and Strada 1994) or European mines (e.g. Barber *et al.* 1999; Topping 1997). However, mining itself may have been a ritualized practice.

6. CONCLUDING REMARKS

Some preliminary conclusions can be drawn from Casa Montero, especially when compared to European Neolithic flint mines in general.

The first observation bears on the scale of mining activity. This Iberian mine is noticeably small in extension, compared to many other western European flint mines. This is not so strange, if we consider the most probable low population densities of the Madrid region during the late Sixth millennium BC, and the 300 year life-span of the



Fig. 9: Two impressed ware fragments recovered at Casa Montero.

mining activity suggested by radiocarbon dates (see Fig. 2). These similarities are less obvious when comparing Casa Montero with the flint mines of Defensola (Galiberti *et al.* 1997; 2001), its contemporary central Mediterranean counterpart. Although they are both associated with the first introduction of a production economy in their respective regions, differences in the size and complexity of labour and mining techniques seem obvious.

The shafts are also considerably smaller than in most flint mines, with the 117 cm mean diameter of shafts at Casa Montero¹ (Fig. 10). They allow for no more than one miner working inside at a time, all of which suggests that the minimum Neolithic working team may not have been more than two individuals. However, we should consider the possibility of some labour coordination throughout the whole mining and knapping procedure, as seems to be the case in most known ethnographic cases (Burton 1984; Stout 2002). Whatever the size of the mining teams, the width of the shafts seems to result from the combination of a limited availability of labour force and practical reasons related to the geological structure of the area, where collapses are common when clays are exposed.

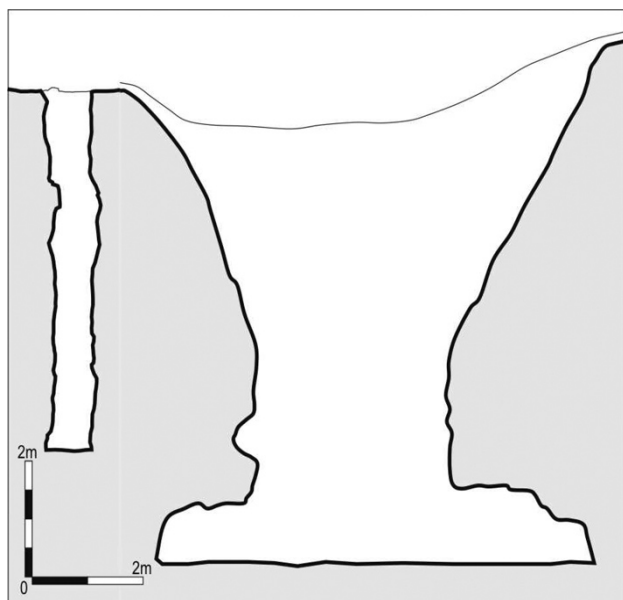


Fig. 10: A deep mining shaft from Casa Montero compared to scale with Grimes Graves Pit 1.

The second observation refers to the main purpose of flint exploitations throughout Neolithic Europe. While many European mines are associated with the manufacture of flint axes, some with outstanding aesthetic qualities (e.g. Whittle 1995), the flint of Casa Montero – lacking all evident aesthetic quality – was dedicated to the production of blades. In fact, there is no evidence in Iberia of the use of flint for the manufacture of polished axes, mainly because of the wide variety of available hard stones such as sillimanite, ofite or amphibolite (e.g. Lillios 1997; Orozco 2000).

Prehistoric flint mines such as Casa Montero are particularly suitable archaeological sites for the analysis of how labour was organized and deployed by the first Neolithic societies. It is difficult to think of a site that materializes labour in a more direct and manifest form. There is absolutely no evidence of human activity other than flint mining. It was all production, with practically no consumption. Nevertheless, there is an aspect that should not be underestimated: the construction of monumental spaces and their use in the process of social reproduction. Unquestionably, one of the most relevant features of the Neolithic is a ‘massive increase in the quantity of durable materiality’ (Hodder 2005: 131). The mining process produced both use and probably exchange value, but also involved the progressive creation of a collective space. The first regional monumental space was erected as a result of the cumulative materialization of social labour. Generations of Neolithic miners created a durable monumental landscape while reinforcing the mechanisms of social reproduction involved in the transmission of communal rights over resources.

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¹ Compare, for example, with the 232 cm mean diameter of the excavated shafts at Jablines (Bostyn and Lanchon 1992).

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REFERENCES

Barber, M., Field, D. and Topping, P. 1999. The Neolithic Flint Mines of England. Swindon: English Heritage.

Bosch, J. and Strada, E. 1994. La Venus de Gavá (Barcelona). Una aportación fundamental para el estudio de la religión neolítica en el suroeste europeo. *Trabajos de Prehistoria* 51(2), 149-158.

Bostyn, F. and Lanchon, Y. (eds.) 1992. Jablines. Le Haut Château (Seine-et-Marne). Une minière de silex au Néolithique. *Documents d'Archéologie Française*, 35. Paris: Editions de la Maison des Sciences de L'Homme.

Bostyn, F. and Lanchon, Y. 1997. The Neolithic Flint Mine at Jablines, 'Le Haut Château' (Seine-et-Marne). In A. Ramos-Millán and M.A. Bustillo (eds.), *Siliceous Rocks and Culture*, Granada : Universidad de Granada, 271-291.

Brell, J. M., Doval, M. and Caramés, M. 1985. Clay mineral distribution in the Evaporitic Miocene Sediments of the Tajo Basin, Spain. *Minealogica et Petrographica Acta* 29-A, 267-276.

Burton, J. 1984. Quarrying in a Tribal Society. *World Archaeology* 16 (2), 234-247.

Bustillo, M. A., Castañeda, N., Capote, M., Consuegra, S., Criado, C., Díaz-del-Río, P., Orozco, T., Pérez-Jiménez, J. L. and Terradas, X. 2008: Is the macroscopic classification of flint useful ? A petroarchaeological analysis and characterization of flint raw materials from the Iberian Neolithic mine of Casa Montero. *Archaeometry*, DOI: 10.1111/j.1475-4754.2008.00403.x.

Bustillo, M. A. and Pérez-Jiménez, J. L. 2005. Características diferenciales y génesis de los niveles silíceos explotados en el yacimiento arqueológico de Casa Montero (Vicálvaro, Madrid). *Geogaceta* 38, 243-246.

Bueno Ramírez, P., Barroso Bermejo, R., Balbín Behrman, R., Campo Martín, M., Etxeberria Gabilondo, F., González Martín, A., Herrasti Erlogorri, L., Treserras, J. J., López García, P., López Sáez, J. A., Matamala, J. C. and Sánchez, B. 2002. Áreas habitacionales y funerarias en el Neolítico de la cuenca interior del Tajo: La provincia de Toledo. *Trabajos de Prehistoria* 59 (2), 65-79.

Camprubí, A., Melgarejo, J-C., Proenza, J.A., Costa, F., Bosch, J., Estrada, A., Borell, F., Yushkin, N.P. and Andreichev, V.L. 2003. Mining and geological knowledge during the Neolithic: a geological study on the variscite mines at Gavà, Catalonia. *Episodes* 26(4), 295-301.

Capote, M., Castañeda, N., Consuegra, S., Criado, C., Díaz-del-Río, P., Bustillo, M. A. and Pérez-Jiménez, J. L. 2006. Casa Montero, la mina de sílex más antigua de la Península Ibérica. *Tierra y Tecnología* 29, 42-50.

Castañeda, N., Capote, M., Criado, C., Consuegra, S., Díaz-del-Río, P., Terradas, X. and Orozco, T. 2008. Las cadenas operativas líticas de la mina de sílex de Casa Montero (Madrid). IV Congreso del Neolítico en la Península Ibérica (Alicante, 27-29 de Noviembre de 2006). Volume 2, Alicante: Museo Arqueológico de Alicante, 231-234.

Castañeda, N. and Criado, C. 2006. La industria lítica de Casa Montero (Vicálvaro, Madrid): resultados preliminares. In N. Ferreira and H. Verissimo (eds.). *Do Epipaleolítico ao Calcolítico na Península Ibérica*. Actas do IV Congresso de Arqueologia Peninsular (Faro, 14 a 19 Setembro de 2004), Faro, 229-234.

- Consuegra, S., Castañeda, N. and Gallego, M. M. 2005. Explotación minera de sílex neolítica de Casa Montero (Vicálvaro, Madrid). Avance de los resultados de las excavaciones. In O. Puche and M. Ayarzagüena (eds.), *Minería y metalurgia histórica en el sudoeste Europe*, 45-51. Madrid.
- Consuegra, S. Gallego, M. M. and Castañeda, N. 2004. Minería neolítica de sílex de Casa Montero (Vicálvaro, Madrid). *Trabajos de Prehistoria* 61(2), 127-140.
- Delibes, G., Rojo, M. and Represa, I. 1993. Dólmenes de La Lora: Burgos. Junta de Castilla y León. Consejería de Cultura y Turismo.
- Díaz-del-Río, P. 2004. Copper Age ditched enclosures in Central Iberia. *Oxford Journal of Archaeology* 23 (2), 107-121.
- Díaz-del-Río, P. and Consuegra, S. 1999. Primeras evidencias de estructuras de habitación y almacenaje neolíticas en el entorno de la Campiña madrileña: el yacimiento de 'La Deseada' (Rivas-Vaciamadrid, Madrid). In J. Bernabeu Aubán and T. Orozco Köhler (eds) *II Congreso del Neolítico a la Península Ibérica*, 251-257. València: Saguntum Extra.
- Díaz-del-Río, P., Consuegra, S., Capote, M., Castañeda, N., Criado, C., Orozco, T. and Terradas, X. 2008. Estructura, contexto y cronología de la mina de sílex de Casa Montero (Madrid). *IV Congreso del Neolítico en la Península Ibérica* (Alicante, 27-29 de noviembre de 2006). Volume 1, Alicante: Museo Arqueológico de Alicante, 200-207.
- Díaz-del-Río, P., Consuegra, S., Castañeda, N., Capote, M., Criado, C., Bustillo, M. A. and Pérez-Jiménez, J. L. 2006. The earliest flint mine in Iberia. *Antiquity* 80 (307). <http://antiquity.ac.uk/ProjGall/diazdelrio/index.html>
- Di Lernia, S., Fiorentino, G., Galiberti, A. and Basili, R. 1995. The Early Neolithic mine of Defensola 'A' (I 18): flint exploitation in the Gargano area. *Archaeologia Polona* 33, 119-132.
- Estremera, M. S. 2003. Primeros agricultores y ganaderos en la Meseta Norte: el Neolítico de la Cueva de la Vaquera (Torreiglesias, Segovia). *Arqueología en Castilla y León. Consejería de Educación y Cultura. Junta de Castilla y León*.
- Felder, P. J. S. 1997. Excavations of Prehistoric Flint Mines at Ryckholt-St. Geertruid (Netherlands), Grimes Graves and Harrow Hill (United Kingdom). In A. Ramos-Millán and M.A. Bustillo (eds), *Siliceous Rocks and Culture*, 143-150. Granada: Universidad de Granada.
- Galiberti, A., Di Lernia, S., Fiorentino, G. and Guariscio, M. 1997. New Data on The Neolithic Flint Mine of Defensola, Vieste (Italy). In A. Ramos-Millán and M.A. Bustillo (eds.), *Siliceous Rocks and Culture*, 211-222. Granada: Universidad de Granada.
- Galiberti, A., Sivilli, S. and Tarantini, M. 2001. La miniera neolitica della Defensola (Vieste-Foggia): Lo statu delle ricerche. *Origini* XXIII, 85-110.
- Hodder, I. 2005. The spatio-temporal organization of the early 'town' at Çatalhöyük. In D. Bailey, A. Whittle and V. Cummings (eds), *(Un)settling the Neolithic*, 126-139. Oxford: Oxbow.
- Holgate, R. 1995. Neolithic flint mining in Britain. *Archaeologia Polona* 33, 133-161.
- Junco, F. and Calvo, J. P. 1983. Cuenca de Madrid. In W. Gibbons and T. Moreno (eds), *Geología de España. IGME, Tomo II*, 534-543.
- Kunst, M. and Rojo, M. 1999. El Valle de Ambrona: un ejemplo de la primera colonización Neolítica de las tierras del Interior Peninsular. In J. Bernabeu Aubán and T. Orozco Köhler (eds), *II Congreso del Neolítico a la Península Ibérica*, 259-270. València: Saguntum Extra.
- Lech, H. and Lech, J. 1984. The Prehistoric Flint Mine at Wierzbica 'Zeke': A Case Study from Poland. *World Archaeology* 16(2), 186-203.
- Lech, H. and Lech, J. 1997. Flint Mining among Bronze Age Communities: A Case Study from Central Poland. In R. Schild and Z. Sulgostowska (eds), *Man and Flint. Proceedings of the VIIth International Flint Symposium. Warszawa-Ostrowiec Świętokrzyski*, 91-98. Warszawa: Institute of Archaeology and Ethnology Polish Academy of Sciences.

- Lillios, K.T. 1997. Amphibolite tools of the Portuguese Copper Age (3000-2000 BC): a geoarchaeological study of prehistoric economics and symbolism. *Geoarchaeology* 12(2), 137-163.
- Mercader, J., Cortés, A.F. and García, M.E. 1989. Materiales neolíticos en el valle del Jarama (Arganda, Madrid). *Trabajos de Prehistoria* 46, 255-260.
- Migal, W. and Salacinski, S. 1997. Studies at Krzemionki during the last decade. In R. Schild and Z. Sulgostowska, Man and Flint. Proceedings of the VIIth International Flint Symposium. Warszawa-Ostrowiec Świętokrzyski, 103-108. Warszawa: Institute of Archaeology and Ethnology Polish Academy of Sciences.
- Orozco, T. 2000. Aprovisionamiento e Intercambio: Análisis petrológico del utillaje pulimentado en la Prehistoria Reciente del País Valenciano (España). B. A. R. Int. Ser. S867, Oxford: BAR.
- Pascual-Benito, J. L. 1996. Los anillos neolíticos de la Península Ibérica, *Congrés del Neolítico a la Península Ibérica* (Gavá-Bellaterra). Rubricatum I, 279-289.
- Pérez-Jiménez, J.L., Alonso-Zarza, A.M. and Bustillo, M.A. 2005. Sedimentología y diagénesis de las secuencias lacustres someras en el área del yacimiento neolítico de Casa Montero (Vicálvaro, Madrid). *Geo-Temas* 8, 77-80.
- Prado, C. de, 1864. Descripción física y geológica de la provincia de Madrid. Madrid: Imprenta Nacional.
- Ramos-Millán, A. 1997. La Venta. A prehistoric Flint Mine in a Tribal Society (Iberian South East). In R. Schild and Z. Sulgostowska (eds), Man and Flint. Proceedings of the VIIth International Flint Symposium. Warszawa-Ostrowiec Świętokrzyski, Warszawa: Institute of Archaeology and Ethnology Polish Academy of Sciences, 117-121.
- Ramos-Millán, A., Osuna-Vargas, M.M., Tapia-Espinosa, A., Pena-González, B. and Aznar-Pérez, J.C. 1997. Archaeological Research in the La Venta Flint Mine (Iberian Southeast). In A. Ramos-Millán and M.A. Bustillo (eds), Siliceous Rocks and Culture, Granada: Universidad de Granada, 245-270.
- Rodríguez González, D. 2006. Historia de la investigación y estado de la cuestión del Neolítico en Castilla-La Mancha: una visión de conjunto. In N. Ferreira y H. Verissimo (eds), Do Epipaleolítico ao Calcolítico na Península Ibérica. Actas do IV Congresso de Arqueologia Peninsular (Faro, 14 a 19 Setembro de 2004), 217-228.
- Rojo, M. and Kunst, M. 1999. La Lámpara y la Peña de La Abuela. Propuesta secuencial del Neolítico Interior en el ámbito funerario. In J. Bernabeu Aubán and T. Orozco Köhler (eds), II Congrès del Neolític a la Península Ibèrica, València: Saguntum Extra, 503-512.
- Rojo, M., Kunst, M., Garrido, R., García, I. and Morán, G. 2005. Un desafío a la eternidad: tumbas monumentales del valle del Ambrona, Soria. *Memorias de Arqueología en Castilla y León*, 14, Consejería de Cultura y Turismo. Valladolid : Junta de Castilla y León.
- Schild, R. 1995. Tomaszów, Radom Province. *Archaeologia Polona*, 33, 455-465.
- Stout, D. 2002. Skill and Cognition in Stone Tool Production. An Ethnographic Case Study from Irian Jaya. *Current Anthropology* 43(5), 693-722.
- Topping, P. 1997. Structured deposition, symbolism, and the English flint mines. In R. Schild and Z. Sulgostowska (eds), Man and Flint. Proceedings of the VIIth International Flint Symposium. Warszawa-Ostrowiec Świętokrzyski, Warszawa: Institute of Archaeology and Ethnology Polish Academy of Sciences, 127-131.
- Yravedra, J., Maicas, R., Díaz-del-Río, P. and Consuegra, S. 2008. Anillos para una mina. Industria ósea y fauna de la mina de sílex neolítica de Casa Montero (Madrid). IV Congreso del Neolítico en la Península Ibérica (Alicante, 27-29 de noviembre de 2006). Volume 2, Alicante: Museo Arqueológico de Alicante, 240-247.
- Whittle, A. 1995. Gifts from the earth: symbolic dimensions of the use and production of Neolithic flint and stone axes. *Archaeologia Polona* 33, 247-259.