

The Flint Quarry of Pozarrate (Treviño, Spain) in the Context of Iberian and Early European Neolithic Mining

**Antonio Tarrío^a, Irantzu Elorrieta^b, Diego Alonso-Herrero^c,
Cristina López-Tascón^d, Hugo H. Hernández^e, Nuria Castañeda^f,
David Larreina^g, Mikel Aguirre^b and José Antonio Mujikaⁱ**

This paper presents the current state of research on the Early Neolithic flint quarry of Pozarrate (Treviño, Burgos) in the north of Spain. This site is part of the Prehistoric Flint Mining Complex of Treviño. The geological features of the territory made it a suitable place for the exploitation of the Treviño flint since Paleolithic times, especially during the Neolithic. Recent research at the site has revealed interesting findings, such as antler and dolerite mining equipment and different

^a Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU). Dpto. Geografía, Prehistoria y Arqueología. Calle Francisco Tomás y Valiente, s/n. 01006 Vitoria-Gasteiz (Álava, Spain); e-mail: antonio.tarrinno@ehu.eus; ORCID: 0000-0002-1717-7457

^b Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU). Dpto. Geografía, Prehistoria y Arqueología. Calle Francisco Tomás y Valiente, s/n. 01006 Vitoria-Gasteiz (Álava, Spain); e-mail: irantzu.elorrieta@gmail.com; ORCID: 0000-0002-9159-788X

^c Museo Arqueológico de Cacabelos. Calle Las Angustias, s/n. 24540 Cacabelos (Castilla y León, Spain); e-mail: diegoherreroalonso@gmail.com; ORCID: 0000-0001-9013-0092

^d Universidad de Oviedo (UNIOVI). Dpto. Historia. Calle Amparo Pedregal, s/n. 33011 Oviedo (Asturias, Spain); e-mail: c.lopeztascon@gmail.com; ORCID: 0000-0002-9936-727X

^e Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU). Dpto. Geografía, Prehistoria y Arqueología. Calle Francisco Tomás y Valiente, s/n. 01006 Vitoria-Gasteiz (Álava, Spain); e-mail: hugohdezhdz@hotmail.com; ORCID: 0000-0002-8854-5202

^f Universidad Autónoma de Madrid (UAM). Dpto. Prehistoria y Arqueología. Campus de Cantoblanco. 28049 Madrid (Madrid, Spain); e-mail: nuria.castaneda@uam.es; ORCID: 0000-0001-6563-5750

^g Centro Nacional de Investigación sobre la Evolución Humana (CENIEH). Paseo Sierra de Atapuerca, s/n, 09002 Burgos (Burgos, Spain); e-mail: david.larreina@cenieh.es; ORCID: 0000-0003-1404-9094

^b Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU). Dpto. Geografía, Prehistoria y Arqueología. Calle Francisco Tomás y Valiente, s/n. 01006 Vitoria-Gasteiz (Álava, Spain); e-mail: mikelaguirrerdg@gmail.com; ORCID: 0000-0003-3377-4320

ⁱ Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU). Dpto. Geografía, Prehistoria y Arqueología. Calle Francisco Tomás y Valiente, s/n. 01006 Vitoria-Gasteiz (Álava, Spain); e-mail: joseantonio.mugica@ehu.eus; ORCID: 0000-0002-2130-6338

flint tools, among other recoveries. Radiocarbon dates indicate an Early Neolithic activity which makes Pozarrate one of the few flint procurement sites in the Iberian Peninsula from this period. Moreover, a considerable number of elements link Pozarrate to the Early European Neolithic flint mining phenomenon.

KEYWORDS: Treviño Flint, prehistoric mining, Early Neolithic, Iberian Peninsula

INTRODUCING THE MINING COMPLEX OF THE TREVIÑO FLINT, IN THE SIERRA DE ARAICO-CUCHO

Throughout Europe, there are many documented examples of the phenomenon of prehistoric flint extraction and mining that show certain similarities and a form of homogeneity between the mining sites. There are, of course also noticeable differences, reflecting the considerable social, economic, and ideological diversity of the human groups that exploited these specialized archaeological contexts. Labouring to extract flint involved an enduring transformation of landscapes, in contrast with the frequently small-scale, dispersed, and mobile residential patterns, whether carried out through small-scale, part-time, maybe seasonal, long-term actions, or through the efforts of some few generations involving large-scale actions, as seen for some European Neolithic mining events (Capote and Díaz-del-Río 2019).

In this context, whilst opencast quarrying of outcrops and shallow deposits was carried out, perhaps even as the first episodes of extraction at mining sites (Barber *et al.*, 1999: 33) as reported for some Palaeolithic and Mesolithic sites (e.g., Negro *et al.*, 2006; Oliva 2011; Osipowicz *et al.*, 2019), extensive flint mining seems to be a largely Neolithic phenomenon. According to the radiocarbon dating, the peak of mining activities occurred during the fourth millennium BC, but the best-known mines and circulating products are mainly dated to the third millennium BC (Longworth and Varnell 1996; Mallet *et al.*, 2004).

The flint mining complex of Treviño is located in the territory of Condado de Treviño (Burgos, Spain). The outcrop area is delimited by the boundaries of the Sierra de Araico-Cucho mountains, located in the Upper Ebro Basin, an area (Fig. 1) that provided easy contacts between the Bay of Biscay (Atlantic coastal zone), the Middle Ebro open valley (towards the Mediterranean) and the northern Meseta (interior highlands of Iberia and the Duero Basin).

There are some key features that help to interpret a flint mining complex, such as coherence in the structure and nature of their remains; the lack of overlapping extractive structures; some systematic technical reiterations of the operative chains;

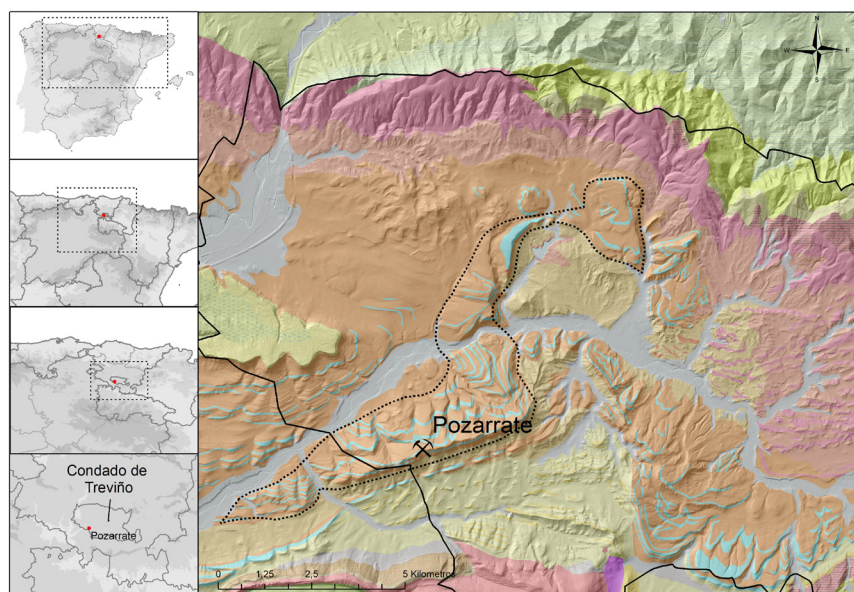


Fig. 1. Location of the Pozarrate site, the Sierra de Araico-Cucho and the Neolithic Flint Mining Complex of Treviño within the Iberian Peninsula. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.

sets of statistically identical radiocarbon dates (dating apparently different mining events); the reffitting of some of the rejected extracted flint (Capote and Díaz-del-Río 2019); or the planned procurement of tools in advance (Clutton-Brock 1984: 15–16; Felder *et al.*, 1998: 47). In the current state of the archaeological research at the Sierra de Araico-Cucho, we can observe most of these characteristics at the site. Furthermore, there are other aspects to take into account in order to describe this study area as a mining complex. The first common element is the presence of the so-called Treviño flint (Tarrío 2006a), the common name for the silicifications found in the Sierra de Araico-Cucho mountains. Secondly, there is undated evidence for ancient flint procurement along all the mountain ranges of Araico-Cucho, even in more recent times for use in threshing equipment (see Elorrieta and Berjón 2017).

Archaeological work in the Sierra de Araico-Cucho started in the 1950s and 1960s, when D. Estavillo collected several superficial finds, mainly dolerite hammer stones, and located several sites related to the extraction of flint (Estavillo 1975; Ortiz *et al.*, 1990, Tarrío 2005; Tarrío 2006a). Thirdly, a LiDAR survey carried out at

a resolution of: 1m/pixel (obtained from the cartographic server Geoeuskadi) resulted in the identification of a number of crescent-shaped associated structures at the top of the mountain range, coinciding with the area of the primary Treviño flint outcrop (Tarrío *et al.*, 2014; 2022). Despite the fact that most of these structures are difficult to observe in the field, on LiDAR images we can recognize eight of them of about 25–30 metres in diameter which overlap from the lowest part of the hill to the top, along a section of 160 metres. The mining structures are best accessed through individual interventions, but direct stratigraphic relationships between neighbouring structures are generally absent where the surface traces are less well preserved (Capote and Díaz-del-Río 2019), as in the case of the surveyed section of the Treviño flint mining complex.

From 2010 to the present, we have been excavating the first of the eight crescent-shaped structures, called Pozarrate. Therefore, the aim of this text is to present the current state of research on this mining structure (novel in terms of typology regarding its associated radiocarbon chronology) and the results of the fieldwork, as well as the preliminary research on the quarry of Pozarrate and its comparison with the evidence of other European prehistoric mines.

THE EARLY NEOLITHIC QUARRY OF POZARRATE

The first archaeological structure that is being excavated is Pozarrate (Fig. 2). After the fieldwork, we can confirm that it is a flint quarry from the Neolithic period that was totally filled by a dump. To determine and analyse the quarry's structure, a trench was dug perpendicular to the stratification in the lower dump. The flint layer exploited has a direction of N180° and a dip of 21° towards the north. The exploitation front in the deepest part of the quarry is more than five metres high. Two phases of infilling were identified in the quarry. The first dump is associated with the earliest linear extraction work along the geological flint layer, with an orientation of N90° approximately. The exploitation front in the west of the prehistoric quarry is more than twelve metres long and more than three metres high, including the appearance of a big burnt limestone structure, which we have called pyrobreccia, currently under study, and three small anthropogenic cavities in the rock (Tarrío *et al.*, 2022; Fig. 4a).

This mining feature is the oldest one of its type discovered until today in the Iberian Peninsula (5050–4370 cal. BC; Tarrío *et al.*, 2011; 2022). Currently, work is focussing on clearing the extraction front and we have already discovered that it is more than twelve metres long and more than three metres high. In the eastern cross-section, the clear stratigraphy shows three levels of archaeological deposits, including a superficial level (Tarrío *et al.*, 2022; Fig. 3).

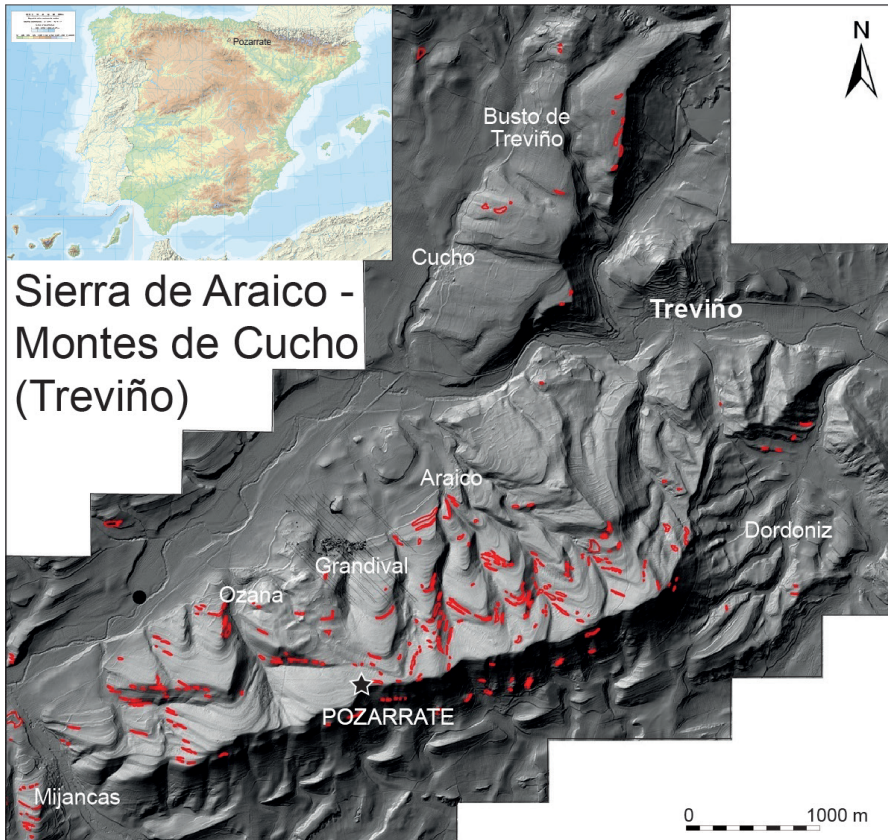


Fig. 2. Situation of the Pozarrate excavation on the northern slope of the Sierra de Araico near the top (star). Other anthropogenic signs of prehistoric flint procurement are marked in red after a LiDAR survey, defining the prehistoric flint mining complex of the Treviño flint. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.

ARCHAEOLOGICAL FINDINGS AT POZARRATE

As is consequent with an extraction site, the flint remains in Pozarrate are very abundant. The study of the lithic technology is based on the preliminary analysis of 13,634 pieces, with a total weight of 494 kg. The lithic assemblage was classified into nodules, fragments, debitage products, cores and retouched tools, only 4.3% of the material belong to the superficial level, 28.3% to level 1, and 67.5% to level 2.

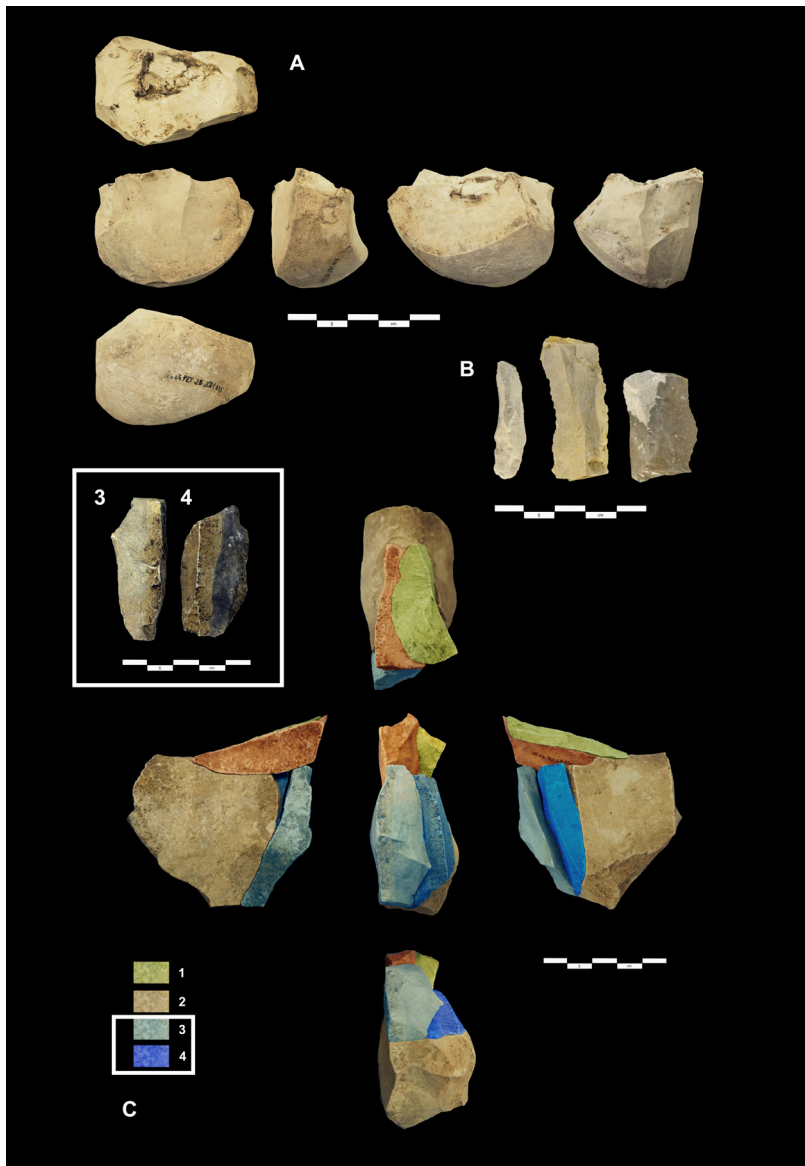


Fig. 3. Archaeological findings at Pozarrate: flint. A. Exhausted core with a unipolar parallel series of blade tendency products; B. Examples of some blade-like byproducts abandoned in the mine. C. Refitted group of five pieces (core and debitage elements) from an orthogonal reduction scheme with blade-like products defined by colours and detail of products 3 and 4. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.

The nodules are more abundant at the surface level, as this was the place of abandonment of the discarded material. Among all the categories, the percentage of fragments (64.24%) is the highest as a consequence of the presence of natural internal fractures in the material and breaks occurring during the extraction and testing process. As a consequence of both flake production and blade cores preparation, the best represented products of the debitage are flakes (99.77%), much higher than blades and bladelets (0.23%). Very few elements from the beginning (crests) and maintenance (flanks, edges, core tablets, etc.) phases of the reduction sequences have been recorded.

The identification of the production of the cores in a mine or quarry is difficult considering that many of them are by-products of testing the quality of the nodules or were broken, or they were reduced by inexperienced knappers as seems to have been the case. The reduction scheme of almost half was unidentified in 59 of the 130 analyzed cores from Pozarrate (45%). The rest show a systematic orthogonal reduction scheme of parallel series of blows that reveals the clear intention of producing blades or blade-like products of different sizes in 70% of the cases (51 pieces). The rest of the cores were devoted to the production of flakes (30%; 20 pieces). Although blade production is difficult to assess due to the previously mentioned factors, it is demonstrated by the presence of refittings; discarded blades, crests and rejuvenation core flakes (Fig. 3).

Most of the cores were abandoned in the early phases of the reduction process. Nevertheless, there are some cases in which reduction reached the exhaustion of the core, or technical or raw material difficulties arose in more advanced phases of the work. The scarcity of cores and by-products compared with the total number of pieces suggests testing of nodules on site, with an occasional production of blanks and transporting of the best quality nodules to knapping workshops outside Pozarrate. The occasional production on site corresponds to testing and learning and the need for tools related to tasks on the mining site.

Among the retouched pieces, scrapers, notches and denticulates are the most common types; probably related to wood or antler work and maintenance tasks on the mining tools. It is interesting to observe that 10% of the blanks of the configured tools show obtuse angles at the butt, possibly linked to percussion with mining hammer stones during nodule extraction. Finally, there is evidence of alternate be perforators, a recurring tool in regional Neolithic assemblages.

We can note that the vast majority of flint material shows mechanical damage associated with processes involving trampling and tumbling. It also shows high percentages of patina and thermal stress. In this sense, an experiment on flint damage by thermal stress has been developed (Hernández *et al.*, 2020) and this has permitted to

reinforce the idea of “fire attack”, but also some insights about a possible stabilization of the quarry front by the creation of a so-called pyrobreccia, as in quarrying strategies seen in other ancient mining structures (e.g., Tarantini 2005).

The weight of the dolerite fragments recovered until now exceeds 52 kg. This corresponds to more than 550 elements and all of them have been spatially located in the quarry. There are 15 hammer stone tools, with another 22 big fragments of hammers representing approximately 45 kg (86% of the total recovered; Fig. 4.1 and 4.2).

At least 10 of the identified hammer stones show signs of technical configuration (generally notches and picking) to adapt them to hafting and mining. This aspect appears in other Neolithic sites in Europe like Bad Sulzburg (Goldenberg *et al.*, 2003).

According to the modifications described in dolerite hammer stones, these can be assigned to the first stages of the previously developed typologies for this mining tool type (e.g., Pickin 1990; Léchelon 2001; Hunt Ortiz 2003: 285). For now, we can provisionally classify the dolerite tools recovered from Pozarrate as unmodified, or modified to adapt its shape by trimming and notching (with one, two or more notches). After confronting archaeological data with ethnographic and experimental approaches to check some hypotheses about quarrying activities (Hernández *et al.*, 2020), we are inclined to think that the weight and affordance of blanks could determine the design of different quarrying hammer stones.

In the case of antler mining tools, more than fifteen large pieces (Fig. 4.3) have been documented, with a multitude of fragments directly related to extractive work. These pieces show some technological modifications and functional features (these are currently under study). Also, a scapula, probably from a *Cervus* sp., was found in the lower level, on the rocky bed (Fig. 5).

Finally, there was also some procurement of Treviño flint in post-Neolithic times at Pozarrate, mainly evidenced by the presence of fragmented pottery (very few pieces generally of a size less than 4 cm), at high levels in the stratigraphical sequence (intermediate and remobilization levels), sometimes associated with metal objects. Four metal pieces found within the assemblage of Pozarrate consist of three bronze sheet fragments and one small iron blade (Tarrío *et al.*, 2022). The cultural affiliation of the ceramics is currently to be determined.

THE TREVIÑO FLINT: CHARACTERIZATION AND ARCHAEOLOGICAL DISTRIBUTION

The flint extracted in Pozarrate is the nodular variety. It is a very fine-grained flint of exceptional quality for knapping. It was formed in a Miocene lacustrine depositional

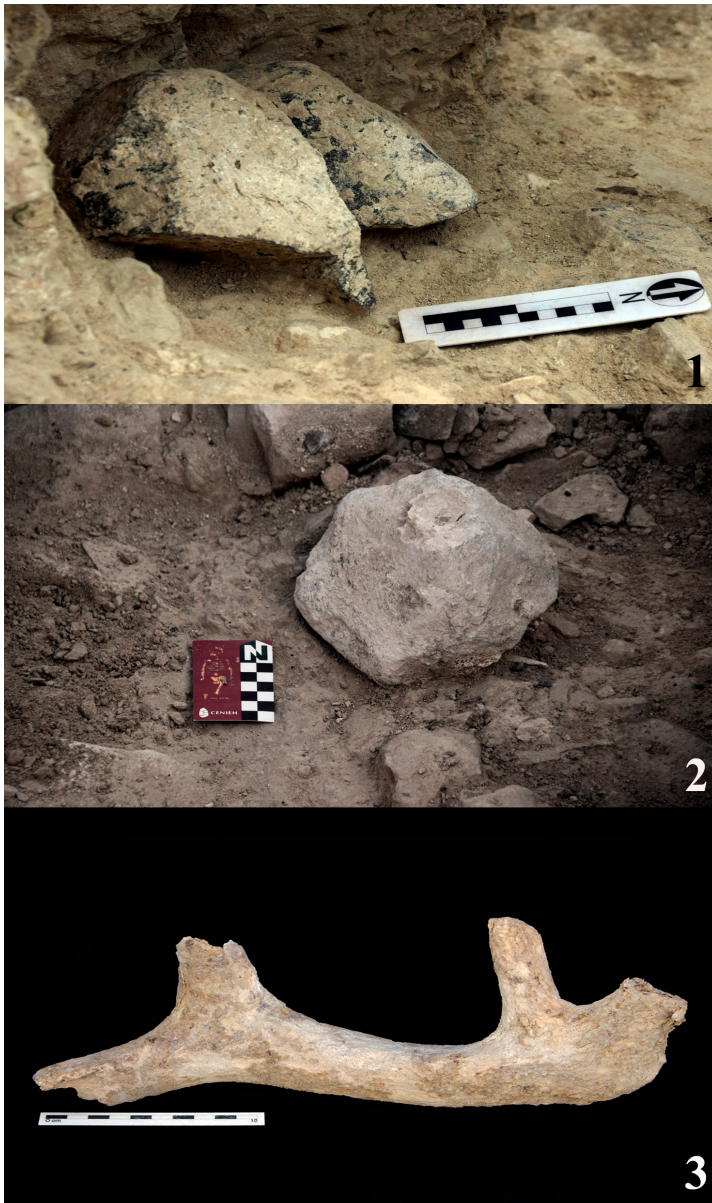


Fig. 4. Archaeological findings at Pozarrate: 1) and 2) dolerite hammerstones at the time of their archaeological recovery. An intensive but non-destructive cleaning protocol is currently being developed to avoid damaging the surfaces prior to conducting its techno-functional study; 3) antler. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.



Fig. 5. Scapula, presumably cervid, at the time of its recovery. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.

environment and contains bioclasts (ostracods and small gastropods and *Charophyta* algae). It has a high percentage of silica (>98 %) and its main impurities are carbonate and organic matter (Tarrío 2006a). The matrix is opaque with colours in the yellowish-red range (Munsell 10YR). When the flint is patinated, it acquires whitish-yellowish colours and the presence of “Liesegang rings” are visible. The cortex is very thin and smooth, rarely exceeding 2 mm in thickness. In the case of the better-quality flints, this cortex is reduced to a minimum thickness (patina type).

The distribution of Treviño flint predates the beginning of the mining processes carried on at the Sierra Araico-Cucho. The first archaeological sites where items of raw material from Treviño have been identified are those located in the Basque-Cantabrian Basin (Fig. 6), on sites such as Amalda, Axlora and Bolinkoba, dating from the Middle Palaeolithic (Tarrío 2003; González-Urquijo *et al.*, 2005; García-Rojas 2014; Arrizabalaga and Iriarte-Chiapusso 2015).

It is from the beginning of the Upper Palaeolithic when the number of remains associated with the Treviño flint sources multiplied (Fig. 6). There are many sites in the Basque-Cantabrian Basin where this variety has been identified (Tarrío 2000; 2006a; 2011a; 2011b; 2013; Tarrío and Aguirre, 2002; Elorrieta 2016; Sánchez *et al.*, 2016). Furthermore, in contrast to the previous period, remains of Treviño

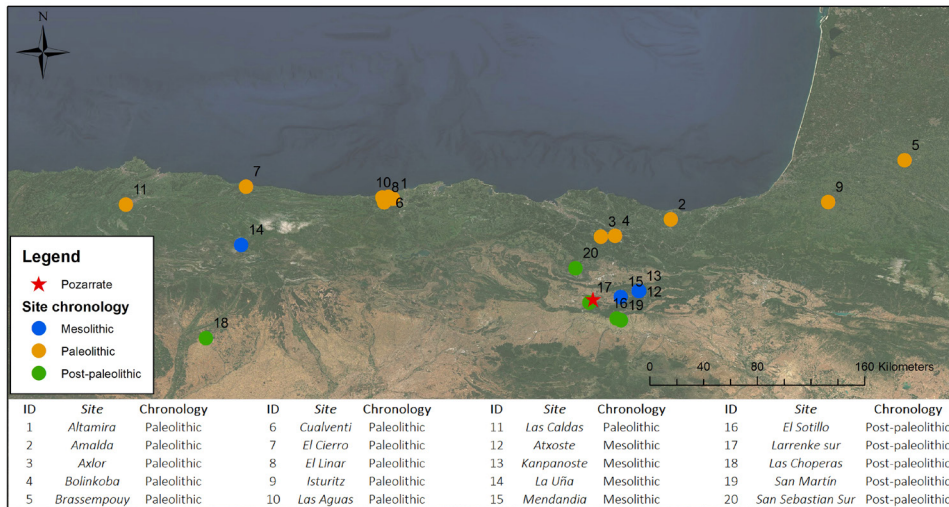


Fig. 6. Distribution of Treviño Flint by sites and its chrono-cultural adscription. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.

flint are beginning to be identified throughout the Cantabrian region, even reaching Asturian sites such as El Cierro and Las Caldas (Corchón *et al.*, 2009; Tarrío 2016; Martín-Jarque *et al.*, 2019) or Cantabrian sites such as Altamira, El Linar, Las Aguas or Cualventi (Tarrío *et al.*, 2013; Tarrío *et al.*, 2016). This variety is also identified in some sites in the south of France and north of the Pyrenees, such as at Brassemoupy or Isturitz (Tarrío and Normand 2002; Tarrío *et al.*, 2007; Elorrieta 2016; Elorrieta and Tarrío 2016).

Treviño flint continued to be collected during the Holocene, as Mesolithic groups continued to make extensive use of this variety (Fig. 6) in sites such as Aizpea, Mendandia, Kanpanoste or Atxoste (Tarrío 2001; Tarrío 2006b; Soto 2014), but it also appeared in areas further away from the Cantabrian Mountains, such as at La Uña (León), although in limited quantities (Herrero-Alonso 2018).

With the transition to producer societies and the beginning of the mining activity at Treviño, the raw material from the exploitation evidences long-distance exchange, becoming an economic axis of connection for the northern area of the peninsula. However, some specific studies have been carried out on the collection of raw material from the Neolithic and during the development of the dolmen phenomenon in the north of the Iberian Peninsula (Fig. 6), as in the case of dolmens such as San Sebastián Sur, El Sotillo or San Martín (Álava), among others (Tarrío and Mujika

2004; Tarrío *et al.*, 2009). In addition, in sites of these later chronologies, we also find cores evidencing exploitation processes, such as those identified in the northwest of the Duero basin (Fuertes-Prieto *et al.*, 2018).

POZARRATE IN CONTEXT: OTHER NEOLITHIC MINING ACTIVITIES ATTESTED IN IBERIA AND EUROPE

There are very few well-attested Early Neolithic flint mines or quarries within the Iberian Peninsula. Together with Defensola (Italy), they can be geographically ascribed to a broader Mediterranean region within the European mining phenomenon (Consuegra and Díaz-del-Río 2018). Other Iberian archaeological sites contemporary to Pozarrate are Casa Montero (Madrid), in the hinterland, with a large field of mining shafts and similar radiocarbon dates, suggesting the flint procurement would only last a century, between 5317 and 5230 cal BC (2σ) (Díaz-del-Río and Consuegra 2011: 226), during the Early Neolithic period, and Montvell (Castelló de Farfanya, Lleida), in the northeastern part of Iberia, the only excavated Neolithic flint quarry in north-eastern Spain (Catalonia). Although no radiocarbon dates have been published yet for this site, a chronological span has been suggested that would extend to the epicardial or postcardial Neolithic ware (Terradas *et al.*, 2019), based on the presence of continental molluscs in the stratigraphy, and radiocarbon dating from the adjacent Les Auelles site, with a chronology between 4516 and 3983 cal BC (2σ), in the Early-to-Middle Neolithic transition (Oms *et al.*, 2019). Procurement activities were performed with the use of consecutive quarry fronts, by taking the flint nodules out of the slopes of the Serra Llarga mountains (Terradas and Ortega 2017).

Other sites with possible evidence of Neolithic mining, to be confirmed, also provide interesting data. One such site is La Leandra (La Muela, Zaragoza), which has been the subject of intense surveys (Picazo *et al.*, 2018) to detect the very subtle traces of ancient trenches that could be prehistoric, probably from the Neolithic (Picazo *et al.*, in press), underneath some circular depressions in the lower part of the slopes that seem to be filled with limestone blocks, gravel, patinated flint remains, sandstone and quartzite hammer stones and other debris, corresponding to 18th-19th flint procurement structures (Picazo *et al.*, 2020), or the Portuguese sites of Pedreira do Aires and Monte das Pedras, in the Lisbon region (Andrade and Cardoso 2004; Andrade 2011), the evidence from which leads its researchers to ascribe both sites to the end of the regional Neolithic or the beginnings of the Chalcolithic (Andrade and Matias 2011).

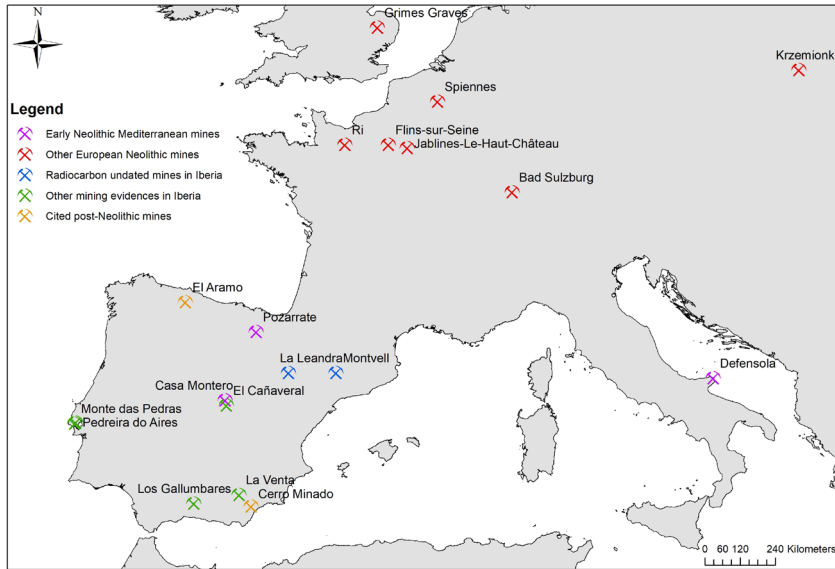


Fig. 7. Iberian and European mining sites referred to in the text. Image of the Spanish Ministry of Science Research Project PID2020-118359GB-I00 “Treviño Flint”.

Flint mining exploitation strategies during the Neolithic period are the result of the adaptation of human groups to the geology and natural environment of the outcrops, as a consequence of specialized tasks that accumulate considerable technical knowledge, transmitted from generation to generation (Castañeda 2018). The main objective of these communities was to extract the raw material without spoiling it, in the most planned, efficient way that was safe for the individuals involved. According to its morphology, in the Iberian Peninsula two extraction systems have been documented: the excavation of shafts, as seen in Casa Montero, and creation of an open-air quarry, as in the examples of Pozarrate, Montvell and small areas of Casa Montero (where they are part of a mixed procurement system that combines quarry fronts with the digging of shafts; Díaz-del-Río *et al.*, 2018: 57). In an open-air quarry system, the disposition of the strata where the raw material is found, at different degrees of inclination along the slope, determines the effort required to access flint nodules. Regarding this aspect, Pozarrate and Montvell share a similar morphology, as they are composed of consecutive trenches, potentially covered with the debris generated by a subsequent exploitation trench higher up.

As in the case of other Early European Neolithic flint mining complexes (Fig. 7), in the Iberian ones, there are two models of exploitation: nodule testing with scarce evidence of on-site reduction and complete or almost complete reduction at the mine. Examples of the first exploitation model are Pozarrate (Tarriño *et al.*, 2011; 2014) and Montvell in Spain (Terradas and Ortega 2017; Terradas *et al.*, 2017), together with Defensola A (6990±80 BP, 5993-5652 cal. BC 2σ), in Italy (Galiberti 2005). The second model of complete or almost complete reduction on site took place more often as in Casa Montero (Consuegra *et al.*, 2018) in Spain, Jablines-Le-Haut-Château (Bostyn and Lanchon 1992) and Flins-sur-Seine (Giligny and Bostyn 2016) in France, Spiennes (e.g., Collet and Woodbury 2007; Collet *et al.*, 2016) in Belgium among others. Indeed, at Pozarrate, evidence of lithic production is scarce when quantitatively compared with the total amount of extracted flint, since it was probably conditioned by immediate needs related to quarrying activities. Regarding the objectives of the lithic production, it seems that Early Neolithic examples of flint quarrying and mining from Southern Europe were devoted to blade and bladelet production as at Casa Montero, Defensola and probably Pozarrate, contrary to Central Europe's later mines, which produced mostly axes. In fact, the main activity that all flint mining archaeological establishments have in common is the organized supply of the raw material, frequently associated with lithic production areas in immediate or close surroundings.

As for the mining tools, those classified as hammer stones are made of harder materials than the materials that the quarry is made of, allochthonous to the lithology of the sites of the mines: quartzites in Casa Montero (Capote 2011), dolerites in Pozarrate and quartz, quartzite and hornfels in Montvell (Terradas *et al.*, 2017), among others. The typologies identified include more or fewer modifications from natural forms (large pebbles and blocks from primary outcrops). In general, the Early Neolithic tools present fewer modifications compared to the standardized characteristics, such as polish and central grooves, more typical of those of epi or post-Neolithic times. In the case of Casa Montero, raw materials were collected from nearby terraces within a maximum radius of 2 km and were used without any previous modification (Capote 2011). However, in the case of the Pozarrate site, the sources of the material used occur in diapiric outcrops located at a greater distance (approx. 10/15 km). It would seem that there was considerable effort expended to collect the dolerite blocks from which the hammer stones would be made, some of them weighing more than 9 kg.

According to the evidence, macrolithic tools in flint were recycled from byproducts of lithic reduction. Both in Casa Montero and Pozarrate, pieces of flint have been documented that were used as wedges and picks, and in Pozarrate and La Leandra some cores have been reused as hammer stones and mauls of oval form and deep

splintering all around their edges. Neolithic miners, therefore, took advantage of the mine's own raw material to continue with the extraction of the flint they wanted to access. In some other European Neolithic mines such as Defensola (Galliberti 2005) or Spiennes (Collet and Woodbury 2007) flint picks have also been used.

Regarding the use of bone materials, in Pozarrate, more than fifteen large antler pieces have been documented, with a multitude of fragments directly related to extractive work. Meanwhile, at Casa Montero, three small horn fragments (<4 cm) that cannot be related to work in the mine have been documented (Terradas *et al.*, 2011), as well as seven sharp objects made of bone and twenty-one pieces related to personal adornment that correspond to bone rings or matrices to obtain them (Yravedra *et al.*, 2008). In European mining contexts, antler picks are usual, as in the case of Ri (Tsobgou *et al.*, 2011).

Finally, pottery appears in Casa Montero and Pozarrate. In the first, ceramics are distributed in 23 shafts, including practically complete containers (Consuegra *et al.*, 2018), while in Pozarrate, there are only few very small fragments located at specific points high up in the stratigraphy.

CONCLUSIONS

The Treviño flint mining complex relates to a greater area in which flint procurement occurred from the Palaeolithic to post-Neolithic times following different extraction strategies that, before the archaeological works performed at Pozarrate, were known only by survey and indirect evidence, such as the Treviño flint distribution all along the Cantabrian region. The abundance, quality and accessibility of flint levels made this place a perfect procurement place.

The discovery of the Pozarrate flint quarry has indicated the importance of the phenomenon of Early Neolithic flint procurement by huge modification of landscape that occurs in Europe from the beginning of this critical chronological period. Until then, there was only one example in the Iberian Peninsula.

The Pozarrate quarry is associated with at least seven other crescent-shaped dumps of about 25–30 m diameter, extending deep in the ground over linear trenches. This type of structure is unique at the moment in the Iberian Peninsula. The only excavated dump was dated from 5050–4370 cal. BC.

The raw material extracted in Pozarrate is a very fine-grained nodular flint of exceptional quality for knapping. The variety exploited is a nodular flint with bioclasts from the Miocene. Its wide distribution in the Cantabrian region during prehistory allows us to consider this flint as a tracer of long-distance exchange.

Flint remains in the site reveal a light transformation of nodules that appear mostly to have been tested on site and transported to other places to reduce them. Blade production seems likely to have been the aim of lithic production. A few tools were made on site in connection with the peripheral tasks carried out during the mining process. Transport of both nodules and blades without on-site reduction seems to be the most frequent strategy used in Mediterranean Early Neolithic flint mining contexts.

One of the most important features of the site is the assemblage of mining tools, consisting of more than forty dolerite hammers, some flint cores reused as hammers and more than fifteen large antler fragments (the largest set of antler tools found in Iberia). Procurement of hard stones for use on the mining site and reutilization of flint elements are common strategies in European Neolithic flint mining.

Early Neolithic flint mining contexts of the Iberian Peninsula, although scarce, were specialised places, in which adaptation strategies to geological formation were developed employing open-air quarries and the excavation of deep shafts.

The Pozarrate quarry shows several elements that link it to the European phenomenon of flint mining. It reinforces the idea of the complexity of flint mining in the Neolithic and that it is expressed in a heterogeneous way with a variety of strategies from the beginning of the Neolithic. Flint mining became a critical strategy for Early Neolithic groups and may be considered one of the elements that characterized this period of history.

ACKNOWLEDGMENTS

This paper has been made possible by the Spanish Science and Innovation Ministry funding project: “The Treviño flint as lithologic tracer in the Prehistory of the Cantabrian Region and Western Pyrenees: Characterization, Exploitation and Diffusion” (PID2020-118359GB-I00), in collaboration with the “APPREND” project: Apprenticeship in Prehistory (PGC2018-093309-A-I00), funded by the National Spanish Program of Knowledge Generation R&D&I, MICINN, FEDER and AEI. NC benefited from the Research Talent Attraction postdoctoral fellowship, 2017-T2/HUM-3488, funded by Comunidad de Madrid and the Universidad Autónoma de Madrid.

REFERENCES

- Andrade, M. A. 2011. O sítio pré-histórico de Monte das Pedras (Mina, Amadora): identificação e caracterização de uma possível oficina de talhe neolítica. *Revista Portuguesa de Arqueologia* 14(1): 5–39.

- Andrade, M. A. and Cardoso, M. S. 2004. O sítio pré-histórico da Pedreira do Aires (Ramada, Odivelas): notícia da sua identificação. *Revista Portuguesa de Arqueologia* 7(1): 137–163.
- Andrade, M. A. and Matias, H. 2011. Pedreira do Aires and Monte das Pedras: two Neolithic flint ‘mines’ in the Lisbon Peninsula. In M. Capote, S. Consuegra, P. Díaz-del-Río and X. Terradas (eds), *Proceedings of the 2nd International Conference of the UISPP Commission on Flint Mining in Pre- and Protobhistoric Times (Madrid, 14–17 October 2009)*, 149–156. Oxford. Archaeopress. British Archaeological Reports International Series 2260.
- Arrizabalaga, Á. and Iriarte-Chiapusso, M. J. 2015. Los tecnocomplejos líticos en el yacimiento de Bolinkoba (Abadiño, Bizkaia). La contribución de las excavaciones recientes. *Kobie* 6: 127–148.
- Barber, M., Field, D. and Topping, P. 1999. *The Neolithic flint mines of England*. Swindon. Royal Commission on the Historical Monuments of England, English Heritage.
- Bostyn, F. and Lanchon, Y. 1992. *Jablins Le Haut Château (Seine-et-Marne). Une minière de silex au Néolithique*. Paris. Ed. de la Maison des sciences de l’Homme. Documents d’archéologie française 35.
- Capote, M. and Díaz-del-Río, P. 2019 (2015). Shared Labour and Large-scale Action: European Flint Mining. In C. Fowler, D. Hofmann and J. Harding (eds), *The Oxford handbook of Neolithic Europe* (2^o Edition), 499–514. Oxford. OUP Oxford.
- Castañeda, N. 2018. Apprenticeship in early Neolithic societies. The transmission of technological knowledge at the flint mine of Casa Montero (Madrid, Spain), c. 5300–5200 cal BC. *Current Anthropology* 59(6): 716–740.
- Clutton-Brock, J. 1984. *Excavations at Grimes Graves, Norfolk 1972–1976. Fascicule 1. Neolithic antler picks from Grimes Graves, Norfolk and Durrington Walls, Wiltshire: a biometrical analysis*. London. British Museum Press.
- Collet, H., Lavachery, P. and Woodbury, M. 2016. Raw material exploitation strategies on the flint mining site of Spiennes (Hainaut, Belgium). *Journal of Lithic Studies* 3(2): 1–36.
- Collet, H. and Woodbury, M. 2007. Étude et caractérisation des déchets lithiques abandonnés dans les niveaux d’exploitation de la minière ST 20 de Petit-Spiennes (Province de Hainaut). *Notae Praehistoricae* 27: 151–122.
- Consuegra, S. and Díaz-del-Río, P. 2018. Early Prehistoric Flint Mining in Europe: a Critical Review of the Radiocarbon Evidence. In D. H. Werra and M. Woźny (eds), *Between History and Archaeology: Papers in honour of Jacek Lech*, 1–8. Oxford. Archaeopress Archaeology.
- Consuegra, S., Castañeda, N., Capote, M., Criado, C., Casas, C., Nieto, A., Capdevila, E. and Díaz-del-Río, P. 2018. Casa Montero (Madrid): the earliest Neolithic flint mine in Iberia (5300–5200 BC). *Trabajos de Prehistoria* 75(1): 52–66.
- Corchón, M.S., Tarrío, A. and Martínez, X. 2009. Mobilité, territoires et relations culturelles au début du Magdalénien moyen cantabrique: nouvelles perspectives. In F. Djindjian, J. Kozłowski and N. Bicho (eds), *Le concept de territoires dans le Paléolithique supérieur européen. Actes du XV Congrès Mondial UISPP (Lisbonne, 4–9 septembre 2006)*, 217–230. Oxford. Archaeopress. British Archaeological Reports International Series 1938.
- Díaz-del-Río, P. and Consuegra, S. 2011. Time for action. The chronology of mining events at Casa Montero (Madrid, Spain). In M. Capote, S. Consuegra, P. Díaz-del-Río and X. Terradas (eds), *Proceedings of the 2nd International Conference of the UISPP Commission on Flint Mining in Pre- and Protobhistoric Times (Madrid, 14–17 October 2009)*, 221–229. Oxford. Oxford. Archaeopress. British Archaeological Reports International Series 2260.
- Elorrieta, I. 2016. *Aprovisionamiento y disponibilidad de las materias primas silíceas en el Pirineo occidental durante el Paleolítico Superior*. Unpublished PhD thesis, Universidad del País Vasco (UPV-EHU).

- Elorrieta, I. and Berjón, M. A. 2017. *Estudio histórico, etnográfico y documental del aprovechamiento de la sierra de Araico-Cucho, Condado de Treviño/Trebiñuko Konderrria*. Beca Ibita: Instituto de Estudios Treviñeses. Unpublished report.
- Elorrieta, I. and Tarrío, A. 2016. La gestión de las materias primas silíceas en el Pirineo Occidental: la ocupación Magdaleniense de Berroberria (Urdax, Navarra). *MUNIBE Antropología-Arkeologia* 67: 285–293.
- Estavillo, D. 1975. Contribución a la prehistoria del País Vasco. Los hallazgos líticos de la zona de Araico; un poblado protohistórico en Portilla la Alta y otros datos de arqueología treviñesa. *Estudios de Arqueología Alavesa* 8: 11–85.
- Felder, P. J., Rademakers, P., Cor, M. and De Grooth, M. E. 1998. *Excavations of prehistoric flint mines at Rijckholt-St. Geertruid (Limburg, the Netherlands) by the 'Prehistoric Flint Mines Working Group' of the Dutch Geological Society, Limburg Section*. Bonn. Archäologische Berichte 12, Deutsche Gesellschaft für Ur-und Frühgeschichte V.
- Fuertes-Prieto, M. N., Herrero-Alonso, D., Martín Fernández, A., Redondo Álvarez, P. V. and Neira Campos, A. 2018. Aproximación al estudio de las industrias líticas de la Prehistoria Reciente en el noroeste de la cuenca sedimentaria del Duero (León). *Férvedes* 9: 41–50.
- Galiberti, A. (ed.) 2005. *Defensola: una miniera di selce di 7000 anni fa...* Siena. Protagon Editori Toscani.
- García-Rojas, M. 2014. *Dinámicas de talla y gestión de las Materias Primas silíceas a finales del Pleistoceno en el País Vasco*. Unpublished PhD thesis, Universidad del País Vasco (UPV/EHU).
- Giligny, F. and Bostyn, F. (eds) 2016. *La hache de silex dans le Val de Seine*. Leiden. Sidestone Press.
- Goldenberg, G., Maass, A., Steffens, G. and Steuer, H. 2003. Hematite Mining during the Linear Ceramic Culture in the Area of the Black Forest, South West Germany. In T. Stöllner, G. Steffens and J. Cierny (eds), *Man and Mining*, 179–186. Bochum.
- González-Urquijo, J., Ibáñez, J. J., Ríos, J., Bourguignon, L., Castaños, P. and Tarrío, A. 2005. Excavaciones recientes en Axlor. Movilidad y planificación de actividades en grupos neandertales. In R. Montes Barquín and J. A. Lasheras Corruçhaga (eds), *Actas de la Reunión científica: Neandertales Cantábricos. Estado de la cuestión*, 527–539. Madrid. Museo de Altamira, Monografía 20.
- Hernández, H. H., López-Tascón, C., Aguirre, A. and Tarrío, A. 2020. Mining at Pozarrate: applying experimental approaches to understand the Neolithic extraction of flint in the Sierra de Araico (Treviño, Spain). *EXARC Journal*, 2020(1): 1–5. <https://exarc.net/issue-2020-1/ea/mining-pozarrate>
- Herrero-Alonso, D. 2018. *La gestión de las materias primas y cadenas operativas en el Mesolítico de la vertiente sur de los Picos de Europa*. Unpublished PhD thesis, Universidad de Salamanca.
- Hunt Ortiz, M. A. 2003. *Prehistoric Mining and Metallurgy in south Western Iberian Peninsula*. Oxford. Archaeopress. British Archaeological Reports International Series 1188.
- Léchelon, B. 2001. Mines et métallurgie préhistorique. In Ph. Grouat (ed.), *Du silex au metal, mines et métallurgie en Rouerge*, 116–142. Montrozier.
- Longworth, I. and Varndell, G. 1996. *Excavations at Grimes Graves, Norfolk 1972–1976. Fascicule 5: mining in the deeper mines*. London. British Museum Press.
- Mallet, N., Richard, G., Genty, P. and Verjux, C. 2004. La diffusion des silex du Grand-Pressigny dans le Bassin Parisien. Le troisième millénaire dans le nord de la France et la Belgique. *Anthropologica et Praehistorica* 115: 123–138. Mémoire de la Société Préhistorique Française XXXV.
- Martín-Jarque, S., Tarrío, A., Bécares, J., Jordá, J. F. and Álvarez, E. 2019. Gestión y determinación de las materias primas líticas y cadenas operativas durante el Magdaleniense inferior en la Región

- Cantábrica: el nivel G1 de la cueva de El Cierro (Ribadesella, Asturias). In AEQUA (ed.), *XV Reunión Nacional Cuaternario*: 28–31. Bilbao.
- Negrino, F., Martini, S., Ottomano, C. and del Lucchese, A. 2006. Palaeolithic evidence for quarrying activity at ‘I Ciotti’ (Mortola Superiore, Ventimiglia, Imperia, Italy). In G. Korlin and G. Weisgerber (eds), *Stone Age-Mining Age*, 153–162. Bochum. Deutsches Bergbau Museum.
- Oliva, M. 2011. Chert mining in the Krumlov Forest (southern Moravia). In M. Capote, S. Consuegra, P. Díaz -del-Río and X. Terradas (eds), *Proceedings of the 2nd International Conference of the UISPP Commission on Flint Mining in Pre-and Protohistoric Times (Madrid, 14–17 October 2009)*, 97–107. Oxford. Archaeopress. British Archaeological Reports International Series 2260.
- Oms, F. X., Sánchez de la Torre, M., Petit, M. À., López Cachero, F. J. and Mangado, X. 2019. Nuevos datos del VI y V milenio cal BC en el llano y Prepirineo de Lleida (NE de la Península Ibérica): el Abric del Xicotó y Les Auvelles. *Munibe. Antropologia-Arkeologia* 70: 93–107.
- Ortiz, L., Vicanco, J. J., Ferreira, A., Lobo, P. J., Muñoz, M. D., Pinillos, R., Tarrío J. M. and Tarrío, A. 1990. El hábitat en la Prehistoria del valle del río Rojo (Álava). *Cuadernos de Sección de Eusko-Ikaskuntza (Prehistoria-Arqueología)* 3: 1–315.
- Osipowicz, G., Kerneder-Gubała, K., Bosiak, M., Makowiecki, D. and Orłowska, J. 2019. The oldest osseous mining tools in Europe? New discoveries from the chocolate flint mine in Orońsko, site 2 (southern Poland). *Quaternary International* 512: 82–98.
- Picazo, J. V., Fanlo, J., Pérez-Lambán, F. and Leorza, R. 2018. Minas de sílex prehistóricas en el valle medio del Ebro. Las explotaciones de La Leandra (La Muela, Zaragoza). In J. I. Lorenzo and J. M. Rodanés (eds), *Actas del II Congreso de Arqueología y Patrimonio Aragonés*, 103–111. Zaragoza.
- Picazo, J. V., Morgado, A., Fanlo, J. and Pérez-Lambán, F. 2020. El aprovechamiento histórico del sílex para piedras de fusil. El caso del río Huerva (Zaragoza). *Zephyrus* 86: 191–216.
- Picazo, J. V., Pérez-Lambán, F., Fanlo, J., Peña Monné, J. L., Sampietro-Vattuone, M. M., Pueyo Anchuela, O., Poció Juan, A. and Tarrío, A. in press. Archaeological field survey strategies for the study of prehistoric Flint mines at La Leandra (La Muela, Zaragoza, España). *Journal of Archaeological Science*.
- Pickin, J. 1990. Stone tools and early metal mining in England and Wales. In P. Crew and S. Crew (eds), *Early Mining in the British Isles*, 39–42. Maentwrog, Wales.
- Sánchez, A., Domínguez-Ballesteros, E., García-Rojas, M., Prieto, A., Calvo, A. and Ordoño, J. 2016. Patrones de aprovisionamiento de sílex de las comunidades superpaleolíticas del Pirineo Occidental: el “coste” como medida de análisis a partir de los SIG. *Munibe* 67: 235–252.
- Soto, A. 2014. *Producción y Gestión de la industria lítica en Atxoste (Álava): una aproximación a las sociedades epipaleolíticas-mesolíticas del Alto Ebro*. Unpublished PhD thesis, University of the Basque Country (UPV/EHU).
- Tarantini, M. 2005. I muretti a secco. Tecniche costruttive e tipologie morfologico funzionali. In A. Galiberti (ed.), *Defensola. Una miniera di selce di 70000 anni fa...*, 93–102. Siena. Protagon. Editori Toscani.
- Tarrío, A. 2000. Estudio de la procedencia de los sílex recuperados en el yacimiento de Labeko Koba (Arrasate, País Vasco). *Munibe* 52: 345–354.
- Tarrío, A. 2001. Procedencia de los sílex de la industria lítica del yacimiento de Aizpea (Arive, Navarra). In I. Baradiarán and A. Cava (eds), *Cazadores-recolectores en el Pirineo navarro. El sitio de Aizpea entre 8000 y 6000 años antes de ahora*, 51–61. Veleia, Anejos, Series Maior 10, Vitoria.
- Tarrío, A. 2003. La piedra como materia prima en la Prehistoria. In *Manos a la Piedra. Las herramientas de la Prehistoria*, 17–30. Bilbao.

- Tarrío, A. 2005. Indicios de minería de sílex en Treviño (sur de la Cuenca Vasco-Cantábrica). In M. Santonja, A. Pérez-González and M. J. Machado (eds), *Geoarqueología y Patrimonio en la Península Ibérica y el entorno mediterráneo*, 439–447. Soria.
- Tarrío, A. 2006a. *El sílex en la cuenca vasco-cantábrica y Pirineo Navarro. Caracterización y su aprovechamiento en la Prehistoria*. Madrid.
- Tarrío, A. 2006b. Fuentes de aprovisionamiento de los sílex del yacimiento arqueológico de Mendandia (Sáseta, Condado de Treviño). In A. Alday (ed.), *El legado arqueológico de Mendandia: los modos de vida de los últimos cazadores en la Prehistoria de Treviño*, 473–494. Valladolid.
- Tarrío, A. 2011a. Procedencia de los sílex de la industria lítica del yacimiento en cueva de Santimamiñe (Kortezubi, Bizkaia). In J. C. López-Quintana (ed.), *La cueva de Santimamiñe: revisión y actualización (2004–2006)*, 281–290. Kobie. Bizkaiko arkeologi indusketak 1. Bizkaiko Foru Aldundia-Diputación Foral de Bizkaia.
- Tarrío, A. 2011b. Procedencia de los sílex de la cueva de Aitzbitarte-III (Rentería, Gipuzkoa). In J. Altuna, K. Mariezkurrena and J. Ríos (eds), *Ocupaciones humanas en Aitzbitarte III (País Vasco) 33.600–18.400 BP (Zona de entrada a la cueva)*, 353–374. Vitoria-Gasteiz. Servicio Central de Publicaciones del Gobierno Vasco.
- Tarrío, A. 2013. Los sílex de Mugardua sur. In I. Barandiarán, A. Cava and M. Aguirre (eds), *El taller de sílex de Mugardua Sur. Una ocupación de Urbasa (Navarra) durante el Gravetiense*. Anejos de Veleia, Series Maior 13, 525–548. Vitoria. Servicio Editorial EHU Press.
- Tarrío, A. 2016. Procedencia de los sílex del proyecto: Los tiempos de Altamira (yacimientos de Cualventi, El Linar y Las Aguas). In J. A. Lasheras Corrujada (ed.), *Los tiempos de Altamira. Actuaciones arqueológicas en las cuevas de Cualventi, El Linar y Las Aguas (Alföz de Lloredo, Cantabria, España)*, 457–476. Madrid.
- Tarrío, A. and Aguirre, M. 2002. Datos preliminares sobre la procedencia de los sílex recuperados en el yacimiento de Antoliñako Koba (Bizkaia, País Vasco). In N. Cazals (ed.), *Comportements techniques et économiques des sociétés du Paléolithique supérieur dans le contexte pyrénéen*, 6–25. Projet Collectif de Recherche Service Regional de l'Archéologie de Midi-Pyrénées.
- Tarrío, A. and Mujika, J. A. 2004. La gestión del sílex como uno de los elementos articuladores del territorio en el megalitismo vasco. *KOBIE (Serie Anejos)* 6(1): 191–202.
- Tarrío, A. and Normand, C. 2002. Procedencia de los restos líticos en el Auriñaciense Antiguo (C4b1) de Isturitz (Pyrénées-Atlantiques, Francia). *Espacio, Tiempo y Forma, Serie I, Prehistoria y Arqueología* 15: 135–143.
- Tarrío, A., Bea, M., García, L. M., Pérez-Lambán, F. and Domingo, R. 2016. Centros de explotación de sílex en la zona central del Valle del Ebro. La Muela (Zaragoza). *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 26: 229–243.
- Tarrío, A., Bon, F. and Normand, C. 2007. Disponibilidad de sílex como materia prima en la Prehistoria del Pirineo occidental. In N. Cazals, J. E. González-Urquijo and X. Terradas (eds), *Frontières naturelles et Frontières culturelles dans les Pyrénées préhistoriques*, 103–123. Santander.
- Tarrío, A., Cava, A. and Barandiarán, I. 2013. Recursos líticos en las industrias del Solutrense Cantábrico: el caso de Altamira (Cantabria, España). *Le Solutréen... 40 ans après Smith'66. 47 Supplément à la Revue Archéologique du Centre de la France*, 261–272. Sous la direction de la Société d'Etudes et de Recherches Archéologiques sur le Paléolithique de la Vallée de la Claise.
- Tarrío, A., Elorrieta, I., García-Rojas, M., Orue, I. and Sánchez, A. 2014. Neolithic flint mines of Treviño (Basque-Cantabrian Basin, Western Pyrenees, Spain). *Journal of Lithic Studies* 1(2): 129–147.

- Tarriño, A., Lobo, P. J., García-Rojas, M., Elorrieta, I., Orue, I., Benito-Calvo, A. and Karampanglidis, T. 2011. Introducción al estudio de las minas neolíticas de sílex de la Sierra de Araico (Condado de Treviño): campaña de excavación del 2011. *Estudios de Arqueología Alavesa* 27: 7–48.
- Tarriño, A., López-Tascón, C., Hernández, H. H., Elorrieta, I., Herrero-Alonso, D., Aguirre, M., Larreina, D., Castañeda, N. and Mujika, J. A. 2022. The Neolithic flint quarry of Pozarrate (Treviño, northern Spain). *Open Archaeology* 8: 273–286.
- Tarriño, A., Mujika, J. A. and Aguirre, M. 2009. Las grandes láminas en el mundo funerario del País Vasco: contexto cultural, tecnología y materias primas. In J. F. Gibaja, X. Terradas, A. Palomo and X. Clop (eds), *Les grans fulles de sílex. Europa al final de la Prehistòria*. Actes, 113–118. Barcelona.
- Terradas, X. and Ortega, D. 2017. Flint quarrying in north-eastern Iberia: quarry sites and the initial transformations of raw material. *Antiquity* 91(359): e5 (1–6).
- Terradas, X., Clemente, I. and Gibaja, J. F. 2011. Mining tools use in a mining context or how can the expected become unexpected. In M. Capote, S. Consuegra, P. Díaz-del-Río and X. Terradas (eds), *Proceedings of the 2nd International Conference of the UISPP Commission on Flint Mining in Pre- and Protohistoric Times (Madrid, 14–17 October 2009)*, 243–252. Oxford. Archaeopress. British Archaeological Reports International Series 2260.
- Terradas, X., Marín, D., Masclans, A., Ortega, D. and Roqué, C. 2019. L'explotació prehistòrica del sílex a la Serra Llarga: les pedreres de Montvell (Castelló de Farfanya, Noguera). *Tribuna d'Arqueologia* 2018–2019: 119–134.
- Terradas, X., Ortega, D., Marín, D., Masclans, A. and Roqué, C. 2017. Neolithic Flint quarries on Montvell (Catalan pre-Pyrenees, NE, Iberia). In T. Pereira, X. Terradas and N. F. Bicho (eds), *The Exploitation of Raw Materials in Prehistory: Sourcing, Processing and Distribution*, 77–89. Newcastle upon Tyne.
- Tsobgou, R., Marcigny, C., Deloze, V., Ghesquière, E., Charraud, F., Gallouin, E. and Quesnela, L. 2011. New Approach for analysing Mining Production and Management combining Geomorphological, Geological and Physical approaches: the case of Ri/Fresne Neolithic flint mine, France. In M. Capote, S. Consuegra, P. Díaz-del-Río and X. Terradas (eds), *Proceedings of the 2nd International Conference of the UISPP Commission on Flint Mining in Pre- and Protohistoric Times (Madrid, 14–17 October 2009)*, 51–66. Oxford. Archaeopress. British Archaeological Reports International Series 2260.
- 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). In M. S. Hernández Pérez, J. A. Soler Díaz and J. A. López Padilla (eds), *IV Congreso del Neolítico en la Península Ibérica*, vol. 2, 240–247. Alicante. Museo Arqueológico de Alicante.