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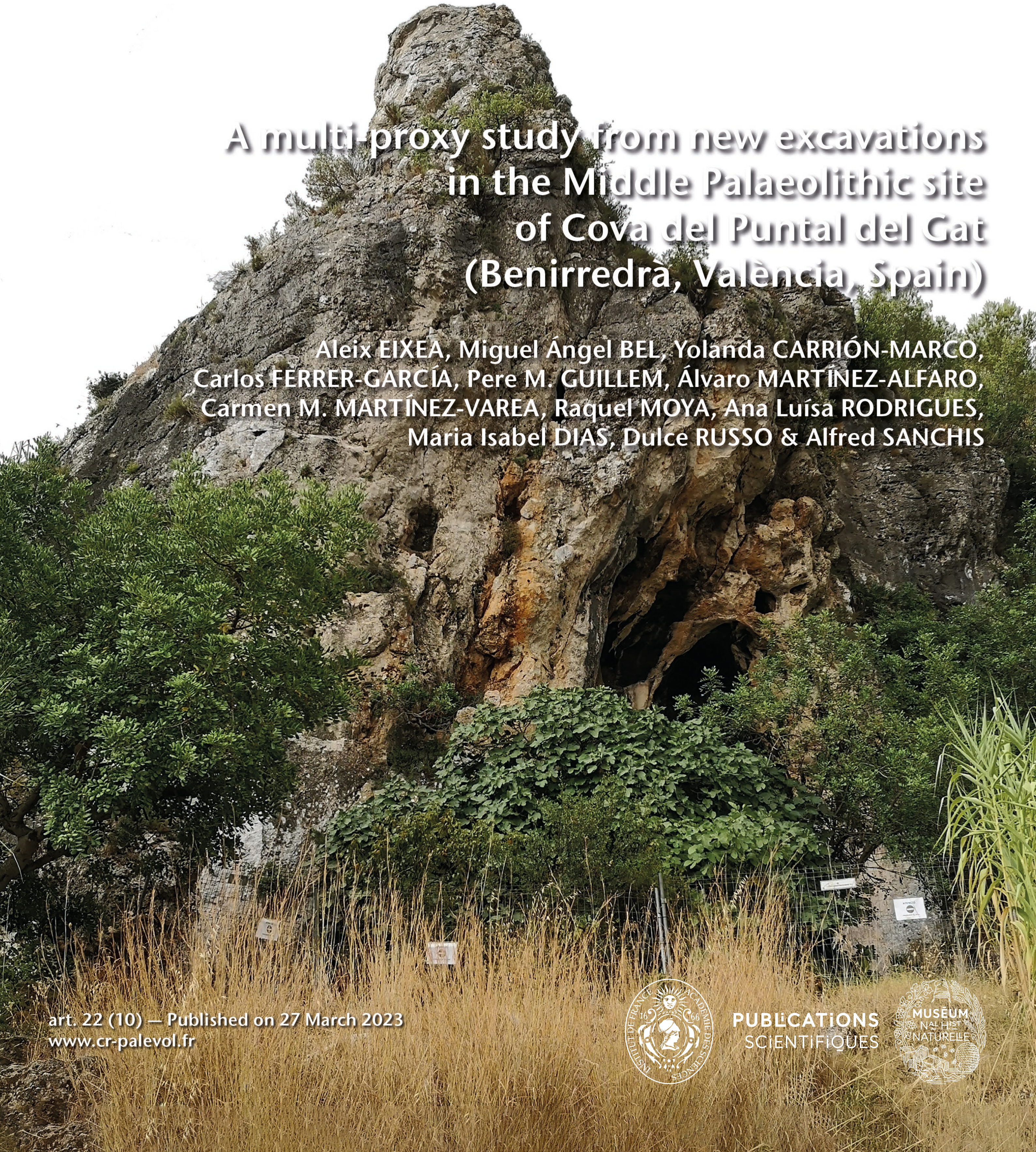

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Aleix EIXEA, Miguel Ángel BEL, Yolanda CARRIÓN-MARCO, Carlos FERRER-GARCÍA, Pere M. GUILLEM, Álvaro MARTÍNEZ-ALFARO, Carmen M. MARTÍNEZ-VAREA, Raquel MOYA, Ana Luísa RODRIGUES, Maria Isabel DIAS, Dulce RUSSO & Alfred SANCHIS

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ABSTRACT
The Mediterranean basin constitutes one of the best areas to analyse Neanderthal populations and lifestyles in South-Western Europe. In this context, new excavations conducted in the Middle Palaeolithic site of Cova del Puntal del Gat expand the information available regarding this rich region. In this study, new results are reported, including detailed studies on stratigraphy, lithic technology, anthracology, carpology, and zooarchaeology and taphonomy of macro and micromammals, with the final objective of characterizing the Neanderthals' subsistence strategies and occupational patterns. These results are framed within a broader regional study perspective that includes MIS 5 and 4 sites. Chronostratigraphic review has enabled us to reorganize many sites that were originally included in MIS 3, towards older stages belonging to the end of MIS 4 and throughout MIS 5.

KEY WORDS
Settlement dynamics, multi-proxy analysis, Middle Palaeolithic, Neanderthals, Mediterranean basin, Iberian Peninsula.

RÉSUMÉ
Une étude multi-proxy à partir des nouvelles fouilles du site paléolithique moyen de Cova del Puntal del Gat (Benirredrà, Valence, Espagne).
Le bassin méditerranéen constitue l'une des meilleures zones pour analyser les populations et les modes de vie néandertaliens dans le sud-ouest de l'Europe. Dans ce contexte, les nouvelles fouilles menées dans le site paléolithique moyen du Cova del Puntal del Gat élargissent les informations disponibles pour cette riche région. Nous rapportons ici les nouveaux résultats, y compris des études détaillées sur la stratigraphie, la technologie lithique, l'anthracologie, la carpologie, ainsi que la taphonomie et la zooarchéologie de macro- et micro-restes de mammifères, dans le but de caractériser les stratégies de subsistance des Néandertaliens et leurs modes d'occupation. Ces résultats s'inscrivent dans une perspective d'étude régionale plus large qui inclut des sites MIS 5 et 4. La révision chronostratigraphique nous a permis de réorganiser de nombreux sites qui étaient initialement inclus dans le MIS 3, vers des stades plus anciens appartenant à la fin du MIS 4 et tout au long du MIS 5.

MOTS CLÉS
Dynamique de peuplement, analyse multi-proxy, Paléolithique moyen, bassin méditerranéen, péninsule Ibérique.

INTRODUCTION

The Iberian Peninsula constitutes one of the most important enclaves for studying Neanderthal settlement dynamics (Álvarez-Alonso 2014; Navazo & Carbonell 2014; Arrizabalaga *et al.* 2015; Machado *et al.* 2015; Picin & Carbonell 2016; Rios-Garaizar 2017; Zilhão *et al.* 2017; Eixea 2018; Marín-Arroyo *et al.* 2018a; Marín *et al.* 2019; Eixea *et al.* 2020a; Sánchez-Hernández *et al.* 2020; Moclán *et al.* 2021). The Cantabrian region, the Atlantic coast, and the Mediterranean basin have some of the best records across Western Europe, with the largest number of excavated sites ascribed to the Middle Palaeolithic. New projects and new research teams have been added to the excavations conducted since the beginning of the twentieth century at previously unpublished sites. In the same manner, old sequences have also been re-excavated and/or restudied (Zilhão *et al.* 2016; Alcaraz-Castaño *et al.* 2017; Álvarez-Alonso *et al.* 2018; Gutiérrez-Zugasti *et al.* 2018; Marín-Arroyo *et al.* 2018b; Carrión *et al.* 2019a; Morales *et al.* 2019; de la Rasilla *et al.* 2020; Eixea *et al.* 2020b; Rios-Garaizar *et al.* 2020). In many of these cases, multi-proxy studies are combined and provide new chronostratigraphic, industrial, faunal, and paleoenvironmental data, which help to improve existing knowledge regarding the behaviour of Neanderthal populations that inhabited the Iberian Peninsula since the late Middle Pleistocene until their disappearance.

In this context, our study focuses on the central region of the Iberian Mediterranean, which represents one of the main Neanderthal population areas of the entire Iberian Peninsula. Despite the large number of sites with Neanderthal occupations, only a few structure in the regional sequence. Thus, the general panorama is established from the oldest dates documented in Bolomor (Fernández Peris 2007; Blasco & Fernández Peris 2012; Fernández Peris *et al.* 2012; Sañudo *et al.* 2016) and Cova Negra (Villaverde 1984; Villaverde *et al.* 1996, 2014; Richard *et al.* 2020) between Marine Isotope Stages (MIS) 9 and 4, to more recent sites such as El Salt (Galván 1992; Galván *et al.* 2001, 2014; Machado & Pérez 2016) around MIS 4-3, to the final Middle Palaeolithic in Beneito (Iturbe & Cortell 1982, 1987; Iturbe *et al.* 1993). Along with these classic sites widely known in the literature, new excavations and multidisciplinary analyses – mostly from Abrigo de la Quebrada (Villaverde *et al.* 2017; Eixea *et al.* 2018; Carrión *et al.* 2019b; Real *et al.* 2020), Abric Pastor (Machado *et al.* 2013; Vidal-Matutano *et al.* 2015; Mallol *et al.* 2019), Los Aljezares (Cuevas-González *et al.* 2018, 2019; Eixea *et al.* 2020c), and, now, Cova del Puntal del Gat – allow us the examination of the evolution of settlement of this area in recent years.

Within this scenario, new multidisciplinary results from Cova del Puntal del Gat are presented in this paper. First, we analyse stratigraphic and sedimentological features to establish the site's potential and its characteristics; second, we examine the emphasis on lithic technology in toolmaking processes as an extension of the human mind and in social and behavioural settings; third, zooarchaeology and taphonomy enable us to obtain information regarding the animal-based subsistence model and to determine the agent responsible for the faunal accumulations; fourth, anthracological and micromammal analyses are conducted for reconstructing paleoenvironmental background; and, finally, we performed luminescence dating in order to establish a chronological framework. The integration of the results obtained using all these methods provides a social, ecological, and chronological context for the Neanderthals living in the central area of the Mediterranean Iberian Peninsula.

HISTORICAL BACKGROUND AND NEW OBJECTIVES

At the end of the last century, the Ministry of Transport and Public Affairs (in Spanish, the *Ministerio de Obras Públicas y Transportes*) designed the Gandia offshoot of National Highway 332 (Fig. 1). The planned route limited the northwest flank of the Falconera range, an area where an abundance of important archaeological sites is located. The possibility that the road-opening works could affect any of these or other unknown sites, and the lack of the mandatory environmental impact report, led the Archaeological Museum of Gandia (in Catalan MAGA, *Museu Arqueològic de Gandia*) to inspect the section in question. Consequently, Cova del Puntal del Gat, also known as Cova de la Terreta, was discovered in 1993. A first report warned the alteration where the archaeological site was located due to the works carried out with heavy machine tracks. It was also noted that the materials collected on both sides of the open road and in the immediate surroundings of the cave (flakes, cores, and bone remains) indicated a prehistoric chronology, possibly belonging to the Middle Palaeolithic period. Among these materials, a human remain was discovered that, despite its small size and high fragmentation, appears to be of a Neanderthal and is currently under study. Given the interest of the findings and the state of the site, the report concluded the "need for an immediate rescue action in order to document at least its value and thus see the possibilities of a rapid excavation in the affected area", while simultaneously requesting to take pertinent measures in this regard.

In 1994, a preventive intervention was carried out (test pits 1, 2 and 3) in the same manner that several profiles were cleaned (Fig. 2). In the corresponding report, the extension of the site and its stratigraphic and sedimentary characteristics were established. Moreover, the lithic industry and the associated Pleistocene fauna confirmed the Middle Palaeolithic chronology (Guillem 1994; Miret 2017). With regard to test pit 1, measuring approximately 2 m^2 and reached a thickness of 1 m, there appeared a few yellowish-white marls at the base. The stratigraphy succession consisted of: 1) first level 20-30 cm thick, contaminated by current garbage; and 2) another level of approximately about 45-60 cm, which was reddish brown with large blocks and with a medium-coarse fraction in around 70% of the sediment. In relation to test pits 2 and 3, due to the breccia nature of the sediment, the excavation could only get to 30 cm of thickness. In all three test pits, archaeological remains that were deemed to belong to the Middle Palaeolithic, both lithic and faunal, were found. First, all stages of the operational chain were documented, with a predominance of flakes, some discoid and Levallois cores, and a few recycled retouched items. In the tooling, simple, transverse, and convergent sidescrapers dominated in front of the notches and denticulates group (Miret 2017). Second, the preliminary identification of faunal remains by J. V. Morales and M. Pérez Ripoll from the Universitat de València highlighted different species of large and meso herbivores such as *Bos* sp. (probably aurochs), *Cervus elaphus* Linnaeus, 1758, *Sus scrofa* Linnaeus, 1758, *Equus ferus* Boddaert, 1785, and *Equus hydruntinus* Regalia, 1907. In addition, an important collection of anthropic small prey, mainly *Oryctolagus cuniculus* (Linnaeus, 1758), was documented. All these bone remains presented a high degree of fracturing due to taphonomic alteration factors (butchery marks, thermoalterations, etc.) and other biological and post-depositional agents (roots, etc.) (Guillem 1994).

At the beginning of 2018, at a request from the Benirredrà city council to the *Direcció General de Cultura i Patrimoni de la Conselleria d'Educació, Investigació, Cultura i Esport* and to *Servei d'Investigació Prehistòrica and Museu de Prehistòria de la Diputació de València*, a group of archaeologists and curators from this institution – comprising Joaquim Juan Cabanilles and three of us (Carles Ferrer and Alfred Sanchis from the last one and Aleix Eixea from the Universitat de València) –

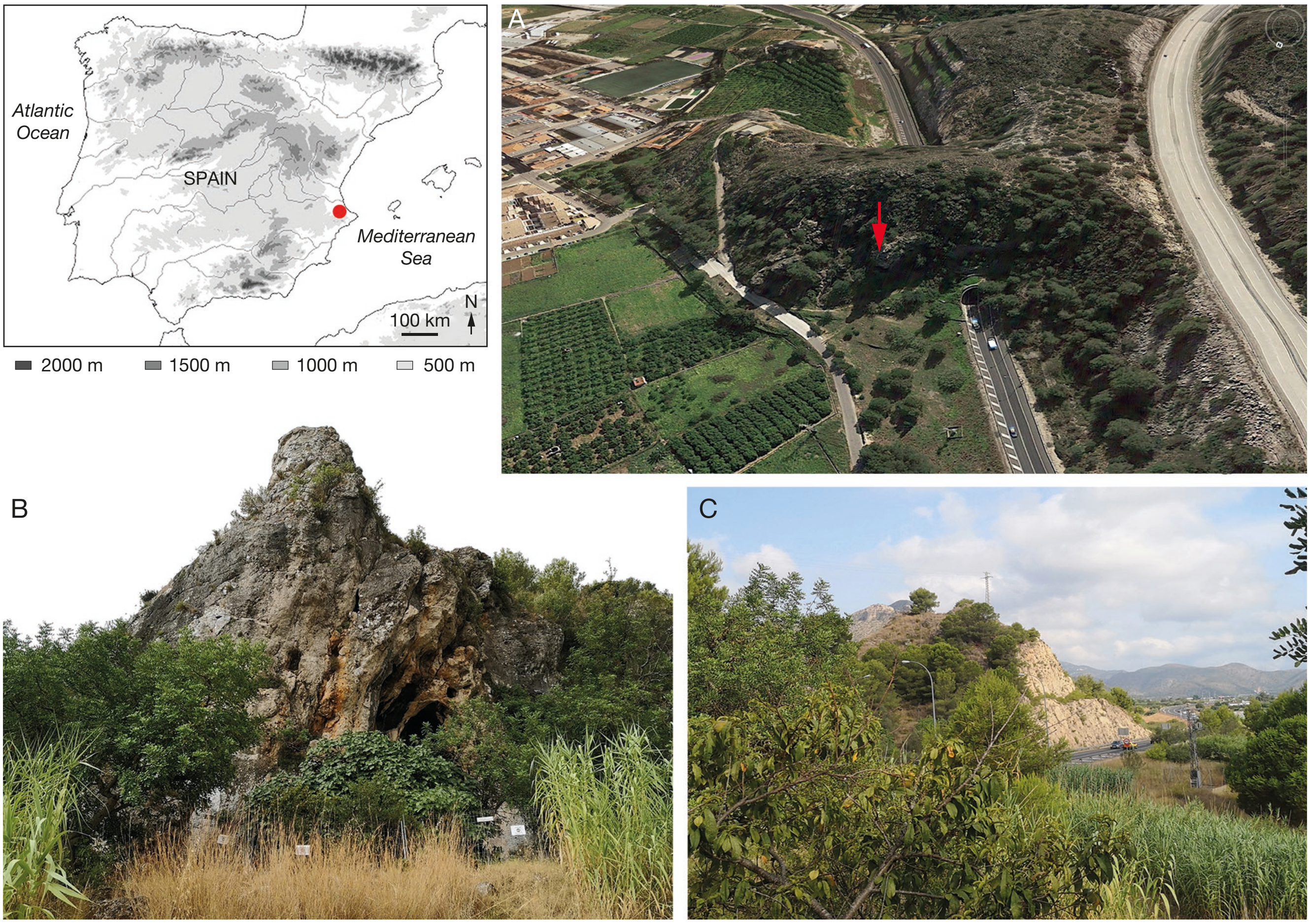

Fig. 1. — Cova del Puntal del Gat location: **A**, regional setting of the site; **B**, **C**, general views of the cave during the excavation in 2018 (pay attention to the proximity of the highway). Credits: A, Google map.

visited the cavity. After this visit, the first of the archaeologists wrote a technical report on the site evaluating the danger that the site was exposed to from the aforementioned works (Cabanilles 2016). In addition, this was complemented by the presentation of another report by archaeologist Carles Miret to propose the place to be declared a Site of Cultural Interest (in Spanish, BIC).

In this context, a decision was made to excavate during two field seasons: October 2018 and July 2019. At the beginning, the planned works focused on a testing pit of 1 × 2 m (squares A-2 and A-3) on the right side of the cavity, on the entrance platform (Fig. 3). The location of the excavated area was selected taking into account the bad state of preservation of the surface near the cavity and the preservation of sedimentary infill at certain points. Subsequently, it was decided to enlarge one square meter (A-4), in order to characterize the sequence with greater precision and observe how it developed towards the external area of the platform. In conclusion, the main objectives of these field seasons were, on the one hand, to provide an updated geoarchaeological, paleoenvironmental, and chronological framework for this site, and, on the other hand, to protect a site that had been frequently disturbed by neighbours in recent years.

REGIONAL SETTING

The Cova del Puntal del Gat site is located in the town of Benirredrà, approximately 65 km south of Valencia. The archaeological excavation was conducted on the northern foothill of the small calcareous promontory, beside the cave and next to the coastal plain of the Valencian Gulf. It is a small cavity located on the northeast flank of the Falconera range, 5 km from the current coastal line. Its immediate environment is conditioned by various short ravines with steep slopes that drain into an alluvial plain existing a few meters from the cavity. The Falconera range is a small karst area, part of the eastern end of the Iberian System (Fig. 4), with a very large system of caves and karstic forms (Pulido-Bosch 1979). The cavity is developed within Santonian-Coniacian (Miocene) dolomite and calcareous formations. The present morphology of the cave is defined by a circular entrance yielding direct access to the hall of *c.* 12 m deep, 8 m wide, and 9 m high. Its origin is attributed to a hydric upwelling, currently inactive, determining a slightly descending soil towards the outside that reveals a basal detrital conglomerate formed by elements of a different nature. This brecciation increases in the lower areas of the

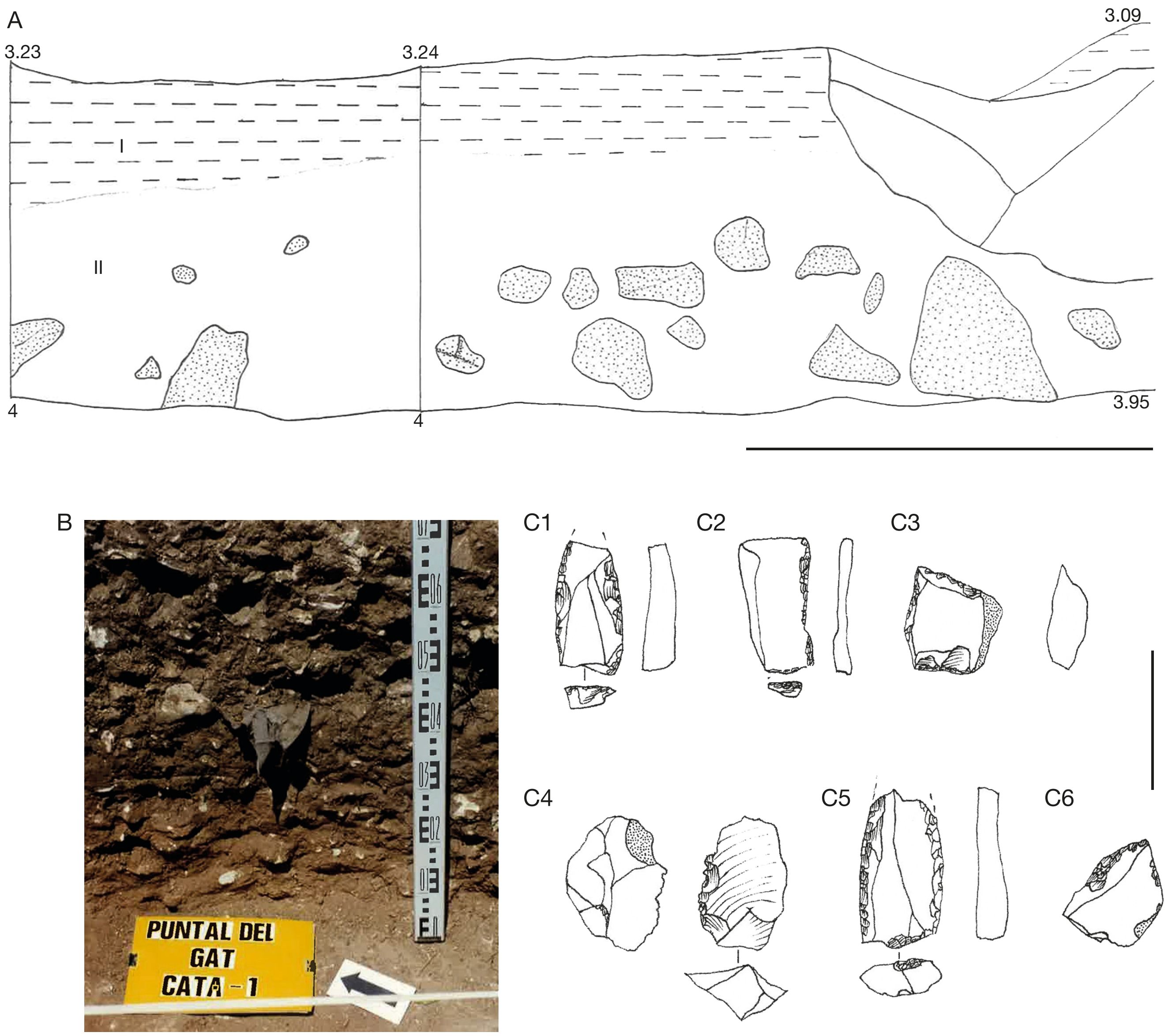

Fig. 2. — Stratigraphic sequence excavated in 1994: **A**, stratigraphic profile from test pit 1 indicating the levels I and II; **B**, cleaned profile from test pit 1; **C**, lithic remains from 1994 excavation: **C1**, Mousterian point (test pit 2, layer 1); **C2**, simple sidescraper (test pit 2, layer 1); **C3**, *déjeté* sidescraper (test pit 3, layer 1); **C4**, denticulate (test pit 3, layer 1); **C5**, Mousterian point (test pit 3, layer 1); **C6**, transversal sidescraper (test pit 3, layer 1). Scale bars: A, 1 m; C, 5 cm. Credits: B, adapted from Guillem 1994; C, adapted from Miret 2017.

walls and in front of the cave, the latter partially covered by large boulders that have fallen from an old drip line.

The upper sector of the hillslope is a convex element. It is a seepage area without soils with a low dip and karst absorption forms and limestone pavements. The next element is a fall face with a cliff (10-20 m), a tectonic sector over limestones. The middle/lower slope is a depositional element, a straight segment with a dip of approximately 20-30°. In this element, where the excavation was opened, soils are formed on colluvial deposits with relatively little coarse fraction. Large blocks detached from the escarpment and caliches and breccias also emerged. The foot of the excavated hillslope is separated from the coastal plain by a small escarpment, extremely modified by recent human action. This plain is a result of tectonic and neotectonic activity. It is a graben formed at the foot of the reliefs, which have been filled by Plio-Quaternary deposits. In this area, the depositional sequence is characterized by fluvial deposits – the fan delta of Serpis and Beniopa rivers and other small ravines as well as alluvial plains – that alternate with lagoons or marshes. The Serpis river is the most important fluvial collector, although the Beniopa river and the small ravines take on great importance in the configuration of the studied area. The Beniopa river builds a series of successive alluvial fan levels. In the immediate part of the Cova del Puntal del Gat site, there is a Pleistocene alluvial cone associated with the nearest ravines. The more recent and distal formation overlaps with that of the Serpis river, which is in the city of Gandia. Between the alluvial formations and the littorals, a new escarpment has been documented approximately 4 km from the archaeological area and has been interpreted as a marine

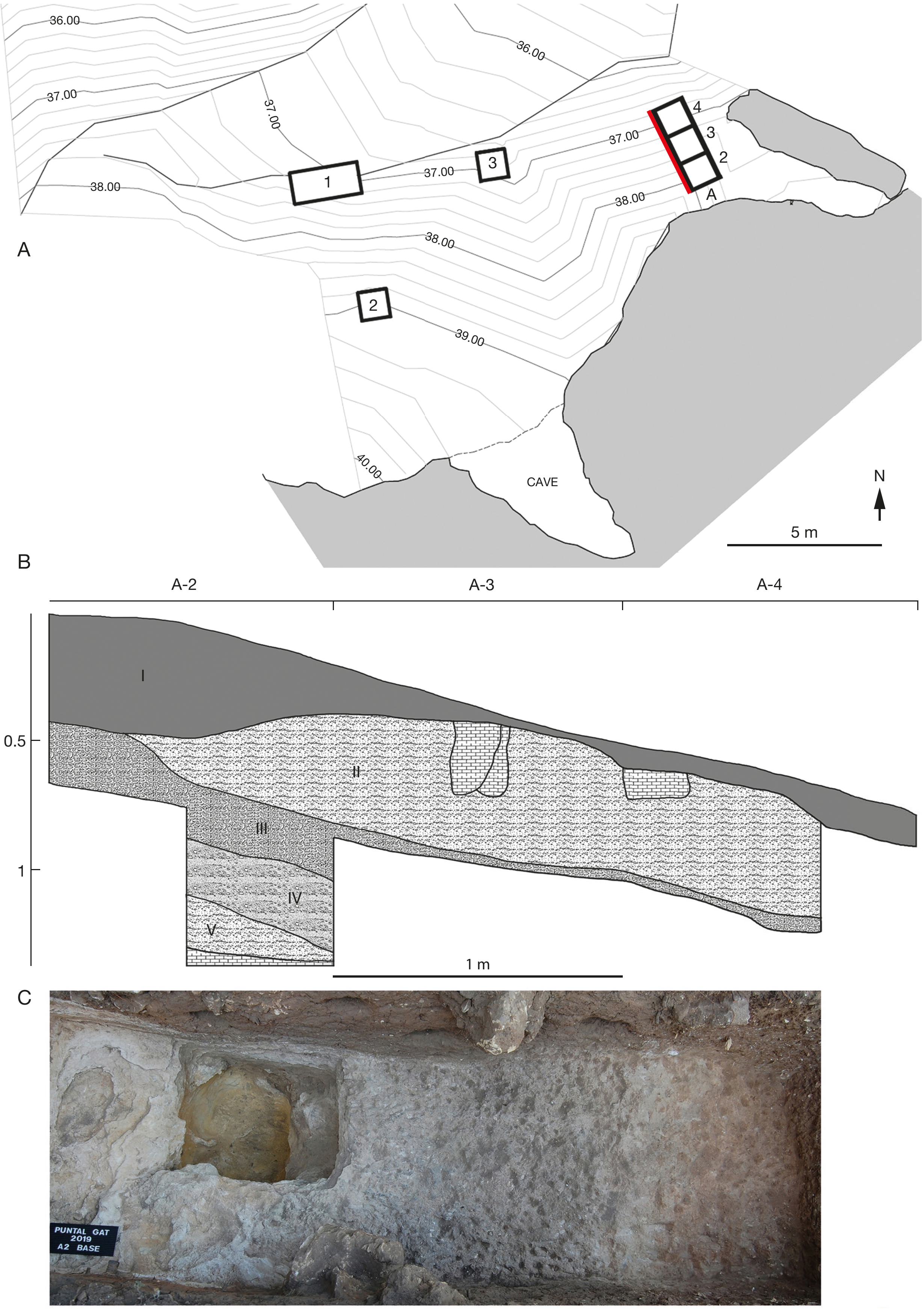

FIG. 3. — **A**, Plan overview of the cave and its surroundings indicating the different excavated areas (**1**, **2**, **3** are the test pits excavated by Guillem 1994); **red line**, left sagittal (LS) profile; **B**, stratigraphic sequence based on LS profile in squares A-2, A-3 and A-4; **C**, excavation surface showing breccia level and bedrock on the base.

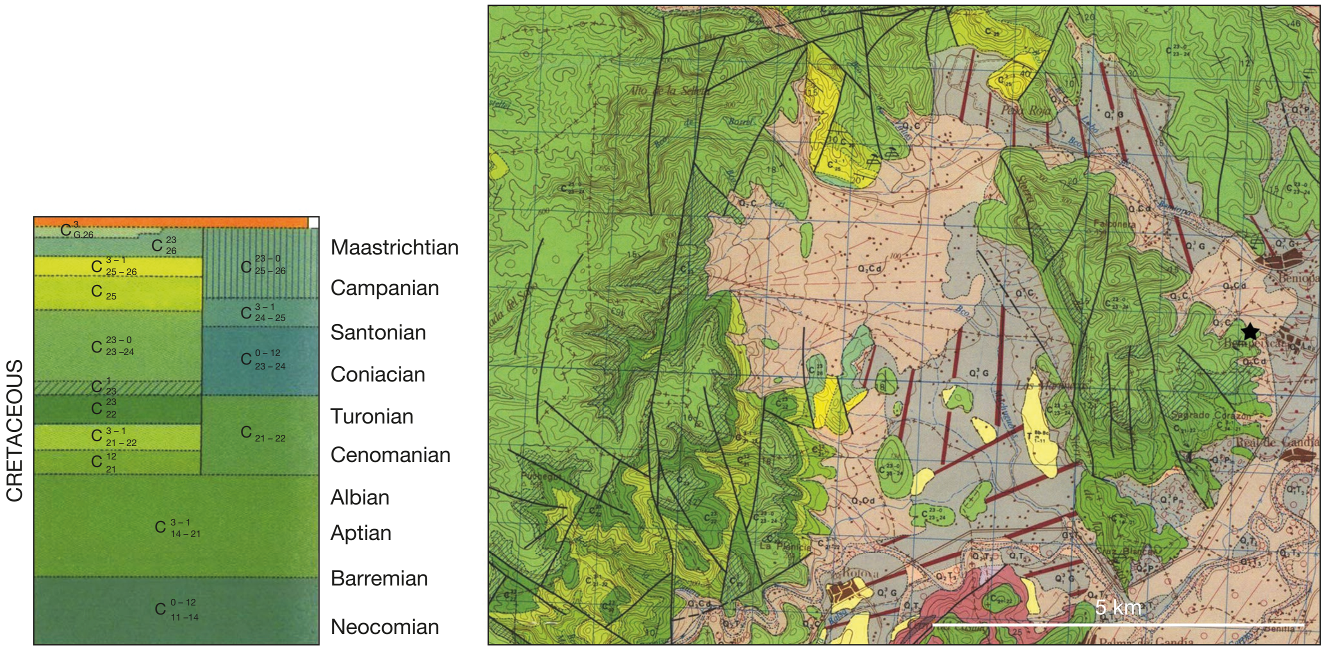

Fig. 4. — Geological location map (MAGNA) of the Cova del Puntal del Gat site. Data available from Instituto Geográfico Nacional (IGN) and Instituto Geológico y Minero de España (IGME).

micro-cliff that is active in recent phases of the Holocene. From this point, a few lagoon areas have developed, with a variable water level and a changeable variable salinity concentration. A great sandbar with dunes separated this wetland from the sea, which is located 5 km away today.

As indicated by different authors (e.g. Garay 1980, 1983; Aparicio *et al.* 1983; Eixea & Villaverde 2012; Miret 2017), a multitude of Palaeolithic sites can be found throughout this region. Many of these sites have been in the Valencian archaeological literature since the nineteenth century (Vilanova i Piera 1872; Puig y Larraz 1896; Calvo 1908). In a radius of approximately 30 km, there is abundant evidence of Middle Palaeolithic archaeological sites, such as Cova Negra, Cova de la Petxina, El Salt, Abric del Pastor, Cova Beneito, Cova Foradada, and Cova del Gat as well as Upper Palaeolithic sites such as Cova del Parpalló, Cova de les Malladetes, Barranc Blanc, Cova de les Meravelles, and Tossal de la Roca, among others. The extremely high density of Middle and Upper Palaeolithic sites in this area of the Iberian Mediterranean basin is related to the ecological richness and the different ecosystems present in this area.

MATERIAL AND METHODS

Archaeological remains

The archaeological material analysed in this work (lithics, macro and micromammals bones, wood charcoal, seeds, etc.) was recovered during the 2018 and 2019 excavation seasons. The materials from the 90s excavation along with the materials recovered over several years from the surface (mainly lithic industry and few macrofaunal remains) were examined in previous studies (Guillem 1994; Miret 2017) and, thus, are not included in this work. Currently, all the remains are deposited at the Museu de Prehistòria de València. All necessary permits were obtained for the described study. Field and laboratory research were authorized by the *Dirección General de Patrimonio de la Generalitat Valenciana.*

Excavation approach

The methodology used in the excavation process was adjusted to the classic digging system in squares measuring 1 m^2. As a general rule, lithic materials greater than 1 cm in length and bone materials greater than 3 cm were three-dimensionally plotted using X-Y Cartesian coordinates and depth or Z values. However, during the excavation procedure, a few identifiable materials that did not reach these measures (flake, blade or core fragments, bladelets, retouched tools, bone epiphyses, dental fragments, micromammals, etc.), were also situated. In order to facilitate a better control of the spatial dispersion not positioned or founded in the sieve, each square meter was divided into sub-squares of 33 cm on each side (0.09 m^2), thereby achieving a mesh of nine units per square meter.

The thickness of the artificial layers into which each level was divided was approximately 5 cm, adjusting the end of this as far as possible to the underlying stratigraphic unit. During the first field season, the sediment as well as all the sediment from the A-4 square recovered in 2019 was dry-sieved, except for five samples that were processed with a flotation machine. The flotation machine was fitted with a cloth mesh of 1 mm for the heavy fraction and a cloth mesh of 0.25 mm for the light fraction. Both fractions were split with a sieve stack, with 4, 2, 1, and 0.5 mm meshes to sort the archaeological remains. In the case of the heavy fraction, the residue larger than 2 mm was sorted with the naked eye, whereas residue smaller than 2 mm and the flotation fraction were sorted under a low-power microscope – Leica M165C. The material recovered in this process – normally chips, wood charcoal, seeds and small bones – becomes part of each layer bag to be counted and subsequently added to the database.

Furthermore, evidence of burrowing by small mammals was documented throughout the Cova del Puntal del Gat sequence. All the burrows identified during the excavation were mapped, isolated, and completely excavated prior to the excavation of the *in situ* areas. The burrow infills, and any archaeological materials found within these sediments, were isolated to avoid mixing with stratigraphically reliable assemblages. In addition, all *décapage* surfaces and stratigraphic cross-sections were drawn and/or photographed. Photo mosaics were assembled using PTGui (version 11.31) and orthorectified with the ARCGIS® software (version 10.3).

Geomorphology and sedimentology

Geomorphological and sedimentological studies were carried out to determine the different lithostratigraphic units based on their colour, texture, geometry, and structure. The area was analysed with geological and topographical maps and aerial images (stereoscopic pairs) in order to determine the attributes of the geomorphological environment. Finally, a series of samples was analysed in the Geomorphology Laboratory from the Universitat de València following the methodology developed in this institution: particle size analysis with the sieve-pipette method, sand morphoscopic properties, determination of organic matter (Walkley and Black method), and calcium carbonate content in total fine fraction (Fumanal 1986; Ferrer-García 2015).

Lithic industry

Lithic assemblage is studied from a technological and typological reading in accordance with the so-called *chaîne opératoire* approach (Lemonnier 1986; Karlin *et al.* 1991), with the aim of recognising various stages in lithic tool-making and investigating the basic conceptual processes that underlie the sequence of manufacturing steps in stone tool production – cortical flakes (>50% or 25-50%), preparation products, and tested cores were assigned to the initialization phase, raw blanks (<25% with no cortex) and core maintenance by-products to the exploitation phase, and retouched blanks and exhausted cores to the consumption and abandonment phase. Accordingly, we regarded the production of stone artefacts as a dynamic process, from the acquisition of raw material to the discarding of used tools. Thus, the process aims to re-establish the lifecycle of the stone tools. In this process, there are four main components: raw material acquisition, production, utilisation, and discarding (Tixier *et al.* 1980; Boëda *et al.* 1990; Julien 1992; Texier 1996). All cores, retouched tools, and unretouched blanks (complete flakes, blades, and bladelets) were individually measured, weighed, and recorded for a set of technological attributes (striking platforms, dorsal scars, bulb morphology, knapping angles, etc.). Typological classification (including those with macro-use wear) were classified using the Bordes' type-list (1961) and complemented by every retouched edge feature (dimensions, delineation, angle, type of retouch, etc.).

Zooarchaeology and taphonomy

The macrofaunal sample that was studied came from 3 m² (A-2, A-3, and A-4) corresponding to the excavation of level II in 2018, which preserved the largest number of remains, while those from level III were scarcer and brecciated. The materials were sieved *in situ* with 4-mm and 2-mm light mesh.

The taxonomic and anatomical classification of the materials was made with reference to the collection of the *Museu de Prehistòria de València*, deposited in the *Gabinet de Fauna Quaternària Innocenci Sarrión*. The age at death of the taxa was established in a very generic manner due to the scarcity of articular parts and diagnostic teeth because of the high fragmentation of the assemblage. The unidentified remains were divided into different categories, grouping together bone fragments with non-diagnostic parts and an appreciable size: large size (large mammals such as bovines and equines), medium size (medium-sized mammals such as cervids, caprines, and suids), and small size (small animals such as leporids, birds, small carnivores, etc.). Finally, unidentifiable fragments <3 cm were included as indeterminate. The materials were quantified by establishing the NISP, the minimum number of elements (MNE) in the best represented species, and the minimum number of individuals (MNI) (Klein & Cruz-Uribe 1984; Lyman 2008). In addition, skeletal survival profiles were established in the three main mammalian taxa (Caprinae Gray, 1821, Cervinae Goldfuss, 1820, and Leporidae Fischer, 1817). The origin of fractures was determined via Villa & Mahieu (1991). Moreover, the identification of bone surface modifications was performed with the aid of a binocular loupe from data collected in several studies (Pérez Ripoll 1992; Lyman 1994; Fernández-Jalvo & Andrews 2016).

Botanical characterisation

For the archaeobotanical analysis, 26 samples from level II were analysed. Wood charcoal fragments and seeds were recovered both in the heavy and light fractions. The anthracological remains were manually broken to produce diagnostic sections that were analysed under a Leica DM6000 M optical microscope with brightfield, darkfield, and polarisation contrast modes. The taxonomic identification of the remains was conducted following anatomical criteria with the help of specialised bibliography (Schweingruber 1990; Gale & Cutler 2000; Crivellano & Schweingruber 2013) and with reference to the collection of modern charred wood held at the Laboratory of Archaeology of the *Universitat de València*. Furthermore, for the observation of specific features and for taking pictures, we used a Hitachi S-4800 scanning electron microscope (SEM) with field emission gun (FEG) and a resolution of 1.4 nm – 1 kV, held at the Central Service for Experimental Research Support (SCSIE) at the University of Valencia.

The taxonomic identification of the carpological remains was done according to comparative morphology criteria, with reference to specialised bibliography (Bojnănský & Fargašová 2007; Cappers *et al.* 2006, 2009; Torroba Balmori *et al.* 2013) and to the seed collection of the Laboratory of Archaeology of the *Universitat de València* using a low-power microscope Leica M165C.

Micromammals

The micromammal remains analysed in this study were recovered in square A-4 in levels II and III during the 2019 field season. The sediments from this ossiferous aggregate were obtained throughout the excavation process. The sediment samples were washed and sieved with sieves of mesh sizes 1 cm, 0.5 cm, and 0.5 mm and with the help of a Luxo magnifying glass. The remains were determined with the help of the reference collection housed in the Archaeology and Palaeontology area of the IVCR+i.

Furthermore, arvicolids were described using van der Meulen's (1973) nomenclature as well as the m1 measurements modified by Cuenca-Bescós *et al.* (1995). With regard to the description of molars and measurement of glirids, the terminology and parameters proposed by Damms (1981) were used. In addition, the taxonomic characterization of the different micromammals species was carried out using individual anatomical units – that is, all the dental material in the case of arvicolines, glirids, and murines. The minimum number of individuals (MNI) was used to compare the relative abundance of the different taxa from the most abundant taxonomically identifiable specimen between the right and left: the lower first molar in the case of arvicolines and the most abundant dental element in the remainder of the micromammals (Cuenca-Bescós *et al.* 2008).

To obtain the measurements of the molars, the free-access image treatment program GIMP 2.10 and a Nikon MZ-O binocular loupe were used, which has a built-in Nikon Digital Sight camera. The measurements were taken on the molars' occlusal surface, oriented in their corresponding anatomical position, on 20 or 25× photographs, and were correlated with a micrometre of 1 mm. The measurements have an error of 0.003 mm. The paleo-ecological interpretation was conducted based on the habitat and climatic preferences of the identified taxa (Galindo-Pellicena *et al.* 2011).

Dating

The methods used to date the Cova del Puntal del Gat site were radiocarbon and luminescence dating. First, three isolated charcoal remains were individually selected and hand-collected during the excavation surface. Only level II could be sampled because level III had a lower density of charcoal remains, level I was mixed, and levels IV and V were sterile. Charcoal samples were first taxonomically identified and were submitted to Beta Analytic labs. With regarding to the bone remains, unfortunately, the poor collagen preservation did not provide us with conclusive information.

Second, absolute dating by using luminescence techniques was performed. This approach implies the use of chemical and dosimetric measurements, considering the following luminescence age equation:

$$\text{Luminescence Age (ka)} = \frac{\text{Absorbed Dose (Gy)}}{\text{Dose Rate }\left(\frac{\text{Gy}}{\text{ka}}\right)}$$

The absorbed dose (De) is obtained by dosimetry, applying luminescence protocols, and represents the laboratory dose of radiation (accumulated energy) required to induce "artificial" luminescence equal to the natural signal (Aitken 1999). The dose rate (Dr) is estimated by using a conventional protocol and includes alpha, beta, gamma, and cosmic radiation – based on chemical analyses and dosimetric measurements – and represents the rate at which energy is absorbed from the flux of nuclear radiation. This is evaluated by the assessment of the radioactivity of the sample and its surrounding burial material; this is conducted both in the laboratory (chemical analyses and estimative of cosmic radiation) and in the field (*in situ* gamma spectrometry) (Aitken 1999; Burbidge *et al.* 2014). The dose rate is relatively corrected to water content and the granulometry of the studied material (Odriozola *et al.* 2014; Rodrigues *et al.* 2019a).

The archaeological works in a 1 × 4-m survey, exposed previous, contemporary, and later levels of human occupation on the site. During the fieldwork, samples were collected from geological and archaeological contexts and field gamma spectrometry (FGS) was performed. Two sampling procedures were performed: 1) "profiling" samples for semi-quantitative luminescence tests; and 2) "luminescence dating" samples (seven samples), following the protocol described by Rodrigues *et al.* (2013, 2019a). The "profiling" procedure yielded samples of approximately 10 g of material were collected. The most promising horizons were selected for the subsequent "luminescence dating" procedure and samples of approximately 500 g were collected. The cut section was cleaned and then small and larger stainless-steel tubes were driven into the cleaned faces. In those holes, *in situ* FGS measurement was performed for the environmental dose rate estimation by the C^{2}TN/IST team, using a gamma spectrometer OSPREY with a 2"×2" NaI probe. Stripped counts in the windows 1380-1530 keV, 1690-1840 keV, and 2550-2760 keV (designed to obtain signals dominated by ^{40}K, ^{214}Bi and ^{208}Tl respectively), were calibrated relative to previous measurements in the Oxford and the Gif-sur-Yvette blocks (Richter *et al.* 2003; Marques *et al.* 2021) in order to obtain apparent parent element concentrations for K, Th, and U, assuming equilibrium in the ^{232}Th and ^{238}U series. Furthermore, in order to calculate the luminescence age, it is necessary to determine the natural radioactive elements (K, Rb, Th, U) by using a method with good precision and accuracy. The chemical composition of the studied samples was obtained by using a lithium metaborate/tetraborate fusion with subsequent analysis by using inductively coupled plasma (ICP) and ICP/mass spectrometry (ICP/MS) performed at Activation Laboratories Ltd. (Actlabs, in Canada). Details of the analytical techniques and detection limits are available on the ActLabs website (https://www.actlabs.com). The mineralogical composition was achieved by X-ray diffraction (XRD) by using a Philips Pro-Analytical spectrometer with a Cu-Kα source. In addition, non-oriented aggregate powders were prepared for the bulk material and scanned at

1°2θ/min, from 2°θ to 70°θ. In addition, diffractograms were compared with reference angle and intensity for identification of minerals (Brindley & Brown 1980). Semi-quantitative analysis of mineral assemblages was undertaken to measure the principal peak areas with intensities correction, using the recommended weighting factors (Schultz 1964; Biscaye 1965; Martin-Pozas 1968; Rocha 1993; Trindade *et al.* 2009, 2011; Marques *et al.* 2011; Rodrigues *et al.* 2019b, 2019c).

The laboratory procedures for the preparation of a quartz coarse grains enriched fraction of samples GAT#soil and GAT#-geo were performed as described in Rodrigues *et al.* (2013). For the quantitative and semi-quantitative luminescence measurements, the inner portion of the samples GAT#1-GAT#5 were selected in order to avoid analysing grains exposed to sunlight. An enriched quartz coarse grains (160-250 µm) fraction was obtained by wet sieving. A conventional laboratory procedure was applied to isolate the quartz grains by etching the samples with HCl 10% and H_2O_2 to remove carbonates and organic matter. The resulting material was washed with distilled water and a density separation process with heavy liquid LST was applied to obtain the fraction between 2.61 gcm^{-3} and 2.70 gcm^{-3}. Then, a final cleaning process of the quartz grains was performed by using a chemical treatment with HF 40% and HCl 10% solutions. After washing with distilled water, the enriched quartz coarse grains fraction was dried at 50°C. Thereafter, a small portion of each sample was observed by optical microscopy and, due to the presence of fluoride, a subsequent soaking the HF-etched quartz grains in 10% HCl (overnight) was performed to remove all fluorides and avoid the risk of these contributing to the luminescence signal of quartz (Porat *et al.* 2015)using a variety of laboratory procedures. This was followed by particle size distribution measurement , SEM/EDS and XRF analyses, and D e determinations employing SAR protocols-all used to characterize the mineral extracts. Etching quartz in 40% HF for 40 min removed all feldspars, with some preferential etching along fissures and grain boundaries. For miner-alogically less mature samples, HF reduced average quartz grain size by 30-50 µm, whereas in mature samples extended etching of up to 60 min reduces grain size by 10 µm. Ca-fluorides precipitated during HF etching but were fully removed by soaking overnight in 16% HCl. Extracting quartz by heavy liquids or by magnetic separation (both followed by HF etching. The processes of washing and drying were repeated.

For the luminescence measurements, using quantitative and semi-quantitative protocols, monolayers of quartz (160-250 µm) were fixed on stainless steel discs using silicone oil (aliquots). A semi-quantitative luminescence protocol (INIT) using five aliquots of each sample were performed. This protocol comprises multi-signal measurements (TL, OSL, and IRSL), performed on small amounts of material (Rodrigues *et al.* 2013), using a Risø TL/OSL automatic reader DA-20 equipped with a $^{90}Sr/^{90}Y$ beta source delivering 0.107 ± 0.002Gs^{-1}. This protocol enables the evaluation of dominant luminescence signals to guide subsequent quantitative analysis and efficiently produces semi-quantitative estimations of absorbed dose (apparent absorbed dose) for luminescence dating (Burbidge *et al.* 2007; Rodrigues *et al.* 2013; Sanderson *et al.* 2003)and contrasting results presented for three Palaeolithic archaeological sites in Russia. Three mineral/grain-size fractions (polymineral silt-sized, polymineral sand-sized, quartz-enriched sand-sized. For each sample, the average of the semi-quantitative absorbed dose and the respective uncertainty was calculated and the IRSL/OSL ratio was obtained. Moreover, the heterogeneity of the OSL response for each sample was also evaluated.

Furthermore, the application of quantitative luminescence protocols to attain the proposed objectives is mainly supported by the known response of quartz grains to the thermal and optical stimulation (Aitken 1999). These protocols can provide information about heating temperatures and ascertain the amount of time elapsed from the last heating. The latter is correlated with the emitted light intensity (De), considering the Dr in the studied material and its environment, and enables the obtaining of the luminescence age (De/Dr) (Aitken 1999).

For the chronological assessment, the luminescence approaches include the quantitative analyses to obtain the absorbed dose. Before these analyses, the quartz purity check (Duller 2003)including the shape of optically stimulated luminescence (OSL and the dose recovery test (Murray & Wintle 2003) were performed using six aliquot of each sample. For the quantitative determination of the absorbed dose, a SAR-OSL protocol with an internal pre-heat test was applied to the enriched quartz coarse grains fraction (Murray & Wintle 2003) of samples GAT#1-GAT#5. Forty-eight and thirty-six aliquots were measured using Risø readers DA-20 equipped with a $^{90}Sr/^{90}Y$ beta source delivering 0,0797 ± 0.0005 (Risø reader 1) and 0.116 ± 0.001 Gs^{-1} (Risø reader 3) with Hoya U-340 detection filter, respectively. Samples GAT#1, GAT#3, and GAT#5 were measured using Risø reader 3 and sample GAT#2 and GAT#4 using Risø reader 1. Signals were obtained by subtracting the average count rate in the last five seconds of measurement from that in the first five seconds, which included the majority of the rapidly decaying OSL. Signals normalized to subsequent test dose responses were fitted with exponential curves and the absorbed dose was interpolated. Based on Luminescence Analyst software (Duller 2015), the results were accepted when: 1) the relative uncertainty of the natural test dose signal σTn was <10%; 2) the recycling ratio was consistent with unity at 2σ; 3) the OSL/IRSL depletion ratio (Duller 2003) was consistent with unity at 2σ; and 4) the sensitivity-corrected recuperation signal (i.e., the OSL signal in response to a zero Gy regenerative dose) was consistent with zero at 2σ. The accepted results were statistically analysed to estimate the absorbed dose for the sample using the robust mean and the respective uncertainty calculated by Robust Statistics V1.0 (AMC 2002).

The dose rate was obtained by combining cosmic dose with alpha, beta, and gamma doses, achieved by using the content of K, Rb, Th, and U obtained by chemical analyses and the content of K, Th, and U obtained by *in situ* gamma spectrometry. In addition, the cosmic dose rate was calculated considering the density of the studied materials (Prescott & Stephan 1982; Prescott & Hutton 1988) and attenuation

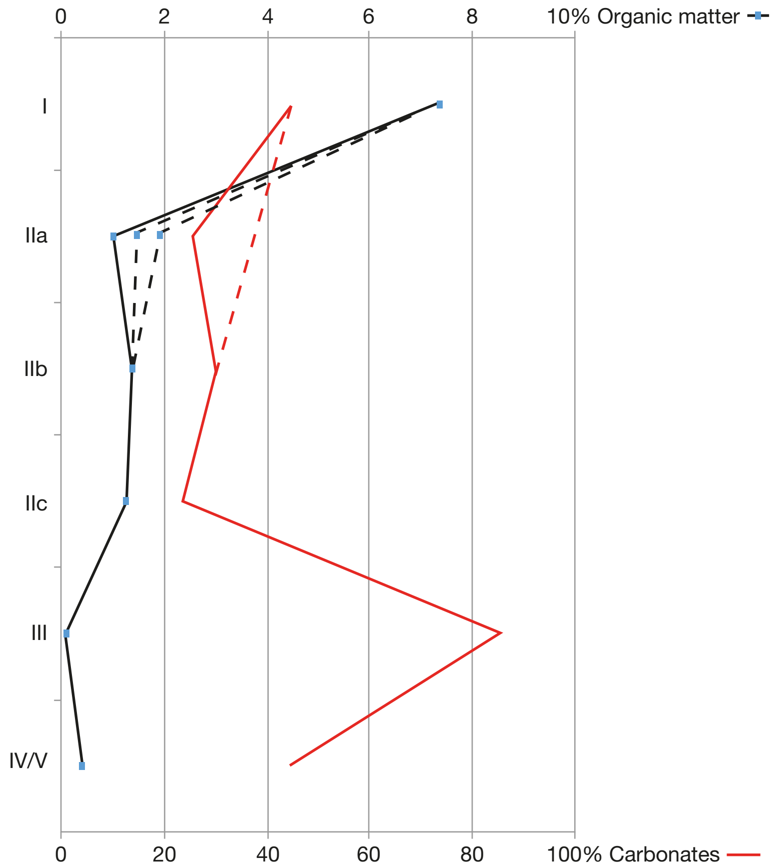

FIG. 5. — Percentage of organic matter and carbonates.

factors were applied (Adamiec & Aitken 1998). The estimation of alpha, beta, and gamma radiation was obtained from elemental concentrations of K, Rb, Th, and U using conversion factors (Adamiec & Aitken 1998) and was corrected for water content (Zimmerman 1971). Moreover, the water content was determined in the laboratory following the procedure described by Burbidge *et al.* (2014).

ABBREVIATIONS

CTE	core trimming elements;
BIC	Site of Cultural Interest (in Spanish);
De	absorbed dose/equivalent dose;
Dr	dose rate;
DRMc	deposition rate of the material in each context;
FEG	field emission gun;
FGS	field gamma spectrometry;
MIS	Marine Isotope Stages;
MNE	the minimum number of elements;
MNI	the minimum number of individuals;
SEM	scanning electron microscope;
SCSIE	Central Service for Experimental Research Support;
XRD	X-ray diffraction.

RESULTS

STRATIGRAPHY AND SEDIMENTOLOGY

The stratigraphic succession contains six artificial layers with a thickness of approximately 1.5 m; this is grouped around five major lithostratigraphic units separated by net contacts, thereby leading to the existence of only erosive contacts between levels I and II (Fig. 5). From top to bottom, these are listed below:

– Level I: The uppermost unit is the result of deposition of sandy black sediment (7.5YR 2.5/1) affected by bioturbation, mainly burrowing and root growth, but also by anthropic activities. Fine sandy fractions, occasionally heat-altered (54.26%), with abundant subangular limestone gravel (45.26%), certain coarse fraction (above 10 mm) of calcite, sandy aggregates, and caliche fragments (0.48%) are present. In addition, abundant charcoals are observed in the gravel fraction. Level-I thickness ranges from 40 cm in the inner area and reduces to 10 cm in the external one. Its upper limit, which constitutes the current surface of the slope, dips at approximately 15-20°. Its base has dips below 5°. Archaeologically, remains from Modern and Contemporary Age (ceramics, tiles, glasses, plastics, etc.) are mixed with lithic and bones from Middle Palaeolithic chronology.

– Level II: This is characterised by sand, silt, and clay of dark brown and reddish-brown colour (7.5YR 3/2, 3/2.5 and 3/3), present according to zones, with a tendency to blacken in the highest area due to contact with the black level. There are some medium-large and slightly rounded blocks. In the upper portion (sublevel IIa), this unit includes a few coarse fractions of angular limestone (between 6.2% and 7.11%

gravel and up to 1.47% larger coarse fractions). Sublevel IIb includes a small amount of coarse fraction. Sublevel IIc has a significant coarse fraction, calcareous pebbles, and caliche fragments. (14.12%/18.68% gravel and less than 1% of cobbles). Apparently, it is massive sediment. Its thickness oscillates between approximately 15 cm and 40 cm and its geometry are wedged in the upper part, with a quasi-horizontal contact with the upper level. From an archaeological perspective, this is the level that contains most of the Middle Palaeolithic remains.

– Level III: A breccia and a hardpan calcrete or caliche in the upper surface. The breccia is a thick layer of light brownish grey (10YR 6/2) formed of cross-bedded, poorly recognizable lenses, with stone-line intercalations. The detrital fraction is sandy silt with massive calcareous muddy sands of brownish-reddish colour, partially or totally infilling between angular pebbles, with a thickness of approximately 10-25 cm and a dipping geometry. The faunal remains and lithics found in this level belong to Middle Palaeolithic. The upper caliche is constituted of grey and white wavy laminations.

– Level IV: Sterile sands with some silts and clays in a unit with massive structure. Light yellowish brown in colour (10YR 6/4 and 5/4). Its thickness ranges between 20 cm and 30 cm. The contact with the upper level has a dip angle and it is horizontal on the bed.

– Level V: This has similar characteristics to the previous level but with the colour being more yellowish and greenish (5Y 8/6) and thickness of 15-20 cm reaching the calcareous bedrock at the base.

The results of the sedimentological analyses enable us to characterize these units as natural alluvial and colluvial sediments with similar textural features. Five samples from level II were studied, while only one from levels IV and V were studied, given their similarities.

The fine fraction of level I is formed by a heterometric sand sediment, silts, and clays, with a concentration of the fraction in very fine sands and a small tail of coarse material, and another of fine clays. The sand fraction is formed by limestone and quartz. The latter is rolled, matte in the medium sizes, and glossy in the smallest. The deposit has a very high percentage of organic matter (7.38%) and calcium carbonate (44.8%). The low classification in the sediment and the abundance of gravel leads us to suggest that it is a sediment related to a debris flow and a hyper-concentrated flow, with a percentage of coarse fraction below 50% (Worny *et al.* 2013). The richness in organic matter indicates that it is an organic horizon of a current soil.

Five samples were studied in level II in different profiles and at different heights (IIa, IIb, and IIc). From the textural perspective, in the fine fractions, these are very homogeneous and are concentrated in sands (over 45%), although these are poorly classified. The sediment has a coarse tail, but in the case of the finer clays, a great concentration is identified. The bimodal character indicates the formation of this deposit as a result of an overland flow with a certain energy and settling processes associated with flooding activities. We associate this type of distribution with alluvial sedimentary formations of glacis and distal ends of alluvial fans. The coarse sands are characterised by white and beige limestone and matte rolled quartz. The fine sands are bright angular quartz. The sediment in level IIb has barely any gravel; gravel is more frequent in level IIc. The percentages of organic matter and carbonates are moderately low or clearly low. This is associated with a sedimentary deposit scarcely edafized. Within this level there are significant variations in organic matter, calcium carbonate, and coarse fraction, but there does not appear to be a coherent evolution that indicates that it has an internal structure. Apparently it is massive sediment. It is difficult to offer an interpretation of the relationship between human occupation and the formation of this sedimentary unit, although the remains are clearly in a secondary position.

With regard to levels IV and V, the fine fraction is formed by sandy sediment with coarse silts without gravel, with small tails of clayey and coarse material. The fine sand fraction is predominant; it is angular and shiny quartz. The deposit has a very low percentage of organic matter (0.42%) and a high percentage of calcium carbonate (44.7%). The moderate classification in the sediment reveals that it was deposited by a flow of moderate energy in a fluvioid alluvial context. The poverty in organic matter indicates that it was formed in a context of active morphogenesis.

Furthermore, the different depositional units along the stratigraphy have similar textural characteristics. They are loose sediments of fine fractions with some gravel, except for level III, which corresponds to a detrital breccia and calcareous crust. The depositional units are mainly composed of fine sands and coarse silts, with moderate classification, which is interpreted as a result of diffused water flow of moderate to low energy and mass movements. These sediments, mostly alluvial, were associated with various sedimentary environments: glacis, alluvial fans, and even river environments (Harvey *et al.* 2005; Bowman 2019). The environmental features enabled us to associate them mainly with alluvial fans. On the other hand, a slope of over 15° and the presence of a coarse angular fraction allow us to link certain sedimentary facies to hillslope environments.

The textural features of the basal unit put this in relation to the middle and distal facies of alluvial fans or glacis. In the opened profiles around the escarpments of the area, laminar calcareous crusts have been documented within this deposit. This deposit would likely have been formed in semi-arid environmental conditions interspersed with short periods of strong water deficit (Blair & McPherson 2009). This is consistent with the formation of these alluvial sediments, which we would associate with a phase of active morphogenesis. At level III, the calcareous crust and breccia that seals the previous deposit also presents laminar facies but includes a coarse subangular fraction. It also has a geometric and rather pronounced dip in favour of the slope which appears to link it to a deposit at the foot of the hill, also formed in a period with a marked water deficit. Furthermore, in this case, the geometry of level II has a much lesser dip in the upper contact than that in the other levels (Fig. 6). This indicates that it was part of a sedimentary structure that was created in geomorphological conditions different from the current ones, possibly in a confluence zone of

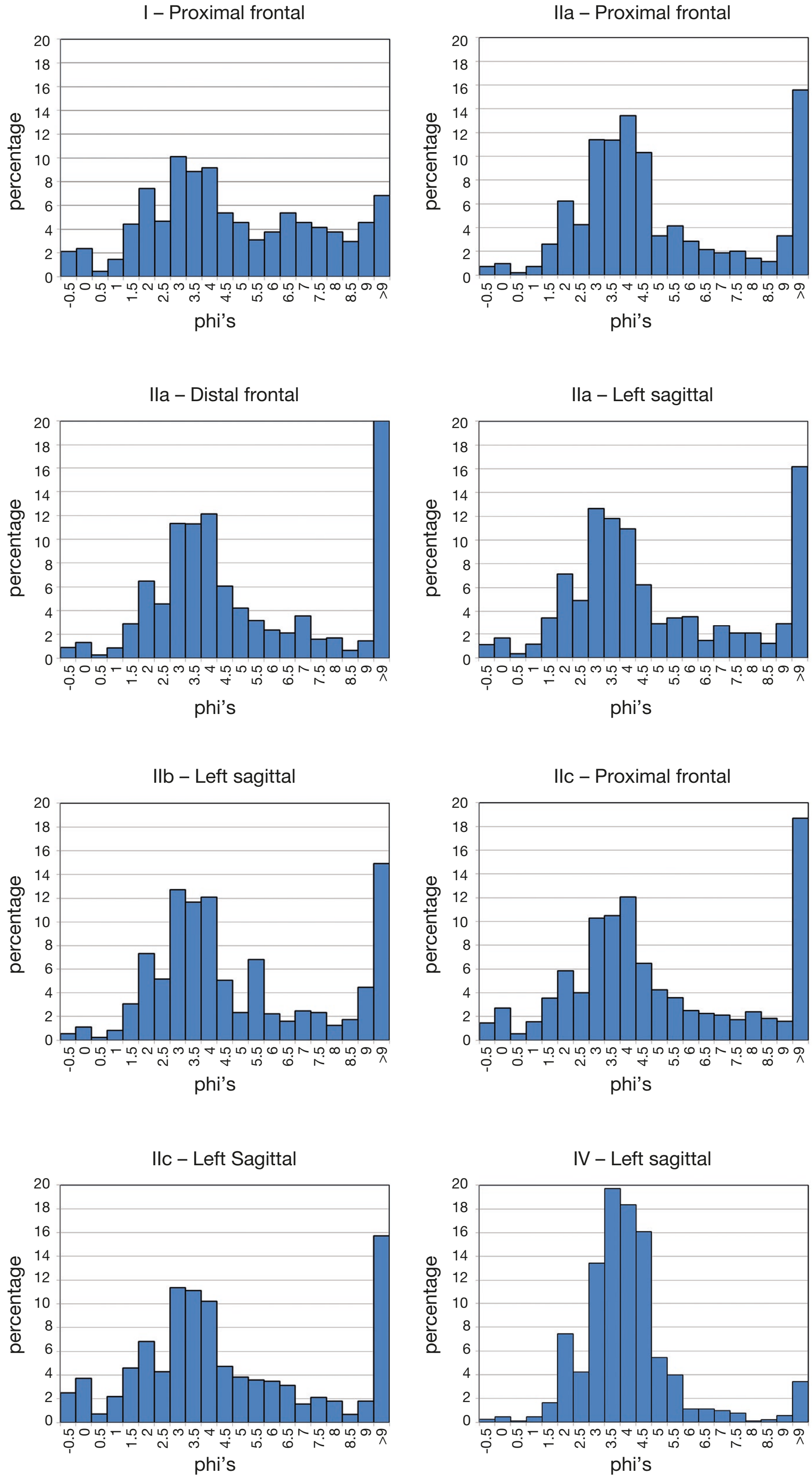

FIG. 6. — Grain size distribution of fines. Textural histograms. Particle diameter in phi (abscissa) and class weight in % (ordinate).

Table 1. — Technological categories.

	II				III			
	With debris and inform fragments		Without debris and inform fragments		With debris and inform fragments		Without debris and inform fragments	
Blanks	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
>50% cortical flake	102	1.49	102	11.11	2	0.40	2	6.90
50-25% cortical flake	88	1.28	88	9.59	2	0.40	2	6.90
<25% cortical flake	158	2.30	158	17.21	3	0.60	3	10.34
Flake	319	4.64	319	34.75	14	2.80	14	48.28
Outrepassing flake	59	0.86	59	6.43	1	0.20	1	3.45
Overshot flake	5	0.07	5	0.54	–	–	–	–
Hinged flake	30	0.44	30	3.27	–	–	–	–
Siret Fracture	2	0.03	2	0.22	–	–	–	–
Resharpening flake	17	0.25	17	1.85	2	0.40	2	6.90
Kombewa flake	11	0.16	11	1.20	–	–	–	–
Laminar flake	10	0.15	10	1.09	–	–	–	–
Core	103	1.50	103	11.22	5	1.00	5	17.24
Blade	2	0.03	2	0.22	–	–	–	–
Bladelet	11	0.16	11	1.20	–	–	–	–
Cobble	1	0.01	1	0.11	–	–	–	–
Débris	690	10.05	–	–	30	6.00	–	–
Inform fragment	116	1.69	–	–	–	–	–	–
Chips	5144	74.90	–	–	441	88.20	–	–
Total	6868	100.00	918	100.00	500	100.00	29	100.00

the hill with an alluvial fan. Finally, largely on the basis of the previous sedimentary record, it is likely that level I, in erosive contact with the previous one, formed at the foot of the relief in less dry climatic conditions. Its chromatic characteristics and high percentage of organic matter confirm that it is the superficial edaphic horizon of a soil.

The alternation of sediments on the lower slope with alluvial sediments could be related to climatic changes or to variations in the base level of the sedimentary system, due to changes in sea level and tectonic changes, but there are many factors, even dynamic ones, which influence this aspect (Sanders 2010; Sanders & Ostermann 2011). However, we propose that they were deposited (perhaps except in level I) in climatic conditions of certain aridity and seasonality. In the case of level II, this would have been formed in a geomorphological landscape that is significantly different from the current one in relation to the Pleistocene alluvial fans described in the area.

Raw materials and catchment areas

With regard to raw materials, a common pattern in the sequence is the almost-exclusive use of flint (>99%). Unfortunately, the identification of the different types of flint was not possible due to the bad conservation of the collection (dehydration, patina, thermal alteration, etc.). Despite this, the geological analysis of the area indicates the existence of flint nodules encompassed in the Coniacian (Upper Cretaceous) formations of the same Falconera mountain range in which the site is located. There, above the Turonian dolomites, a sequence of well-stratified limestone appears in banks of 40-60 cm, with irregular flint nodules. The archaeological remains with cortical surfaces show a high degree of rolling, thereby suggesting a secondary catchment of the dismantled nodules from the original source in the terraces and small ravines adjacent to the site where they are collected by human groups. The occurrences of flint nodules surrounding the cave are not rare and this material has been used despite its indifferent quality for knapping. Moreover, other flint varieties which could be imported and displaced over long distances have not been corroborated due to bad conditions, as we have stated earlier in the paragraph.

The other lithologies, quartzite and limestone, are present in the surroundings of the site but in low quantities. Geological maps do not confirm their presence and the field surveys conducted by us only documented a few specimens in the vicinity of the site. In this sense, the existence of an important asymmetry between the use of flint, which has an overwhelming majority, and these other rocks that are rather testimonial is understandable. Thus, the decision to use one or the other raw material is absolutely determined by the presence or absence of these different lithologies in the surrounding area.

Lithic technology

Reduction strategies

The lithic assemblage of Cova del Puntal del Gat consists of 6868 pieces in level II and 500 in level III (Table 1). The main group comprises chips and *débris*, which reach quantifications that range between 80% and 90% of the record, manifesting the intense lithic manipulation at the site (knapping, retouching, using, and resharpening). With regard to blank production, simple and no cortical flakes dominate the assemblage, followed by cortical flakes and cores. The latter are abundant in level II (n = 103), while practically non-existent in level III (n = 5) although the values attain similar quantifications. Cores and primary elements indicative of the initial stages of on-site reduction occur in low frequencies, while core trimming elements (CTE) appear in moderate percentages (5-6%). The presence of different knapping errors in an important portion of the flakes (outrepassing, overshot,

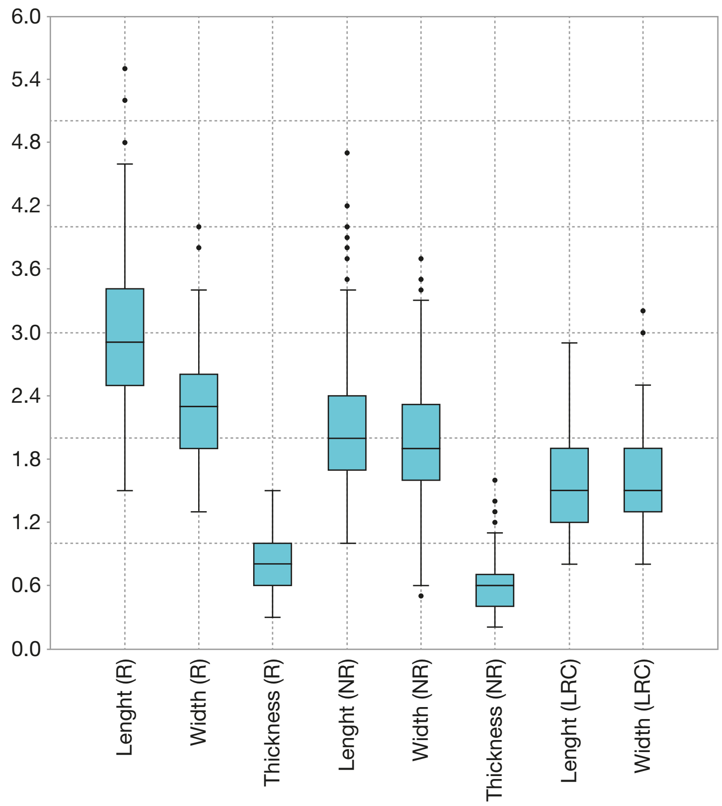

FIG. 7. — Level II box plots (in centimetres) of retouched (**R**) and non-retouched flakes (**NR**) and last removals from cores (**LRC**). **The boundary of the box closest to zero** indicates the 25th percentile, a **black line within the box** represents the median and the boundary of the box farthest from zero indicates the 75th percentile. **Whiskers above and below the box** indicate the 10th and 90th percentiles; **points above the whiskers** indicate outliers outside the 10th and 90th percentiles.

or hinged flakes) and in certain cores is noteworthy, probably linked to the low quality of the raw material. The number of resharpening flakes in level II is low but rises in level III, thereby indicating a greater intensive use and maintenance of the tools in the site. Finally, a few blanks can be interpreted as laminar flakes, blades, or bladelets.

Furthermore, typometry analysis reveals that the dimensions of the tools are larger than the non-retouched ones, both in terms of width and length. The first are approximately 2.5-3.5 cm in length and 1.9-2.5 cm in width, while the seconds are approximately 1.7 cm and 2.8 cm in length and width, respectively (Fig. 7). In terms of thickness, the retouched tools are also thicker – between 0.6 cm and 1 cm compared to 0.4 cm and 0.7 cm for raw flakes. They have a morphology characterised by quadrangular shapes, thin and small, in which more than half of the remains measure less than 2 × 2 cm. This is confirmed by observing the dimensions of the last core removals, as practically all of them are below this limit, thereby indicating a rather intensive use of the possibilities offered by the cores.

Five main production systems (discoid, Levallois, Quina, core-on-flake, and bipolar) have been identified, thereby indicating the great technological versatility and variability of these populations, particularly at level II (Table 2).

First, the Levallois system comprises thick semi-cortical flakes in which one functions as a *débitage* surface and the other one as a striking surface (Fig. 8). There are also a few minority

TABLE 2. — Core technology.

Cores	II	%	III	%
Levallois	32	31.07	–	–
Centripetal recurrent	31	30.10	–	–
Unipolar recurrent	1	0.97	–	–
Discoid	27	26.21	–	–
Bifacial	10	9.71	–	–
Unifacial	17	16.50	–	–
Quina	9	8.74	–	–
Core-on-flake	4	3.88	–	–
Bipolar	4	3.88	–	–
Ortogonal	2	1.94	–	–
Unipolar	1	0.97	–	–
Chunk	2	1.94	3	–
Indet.	22	21.36	2	–
Total	103	100.00	5	–

remains knapped from oval or flattened nodules. It must be noted that there is also a good portion that is undetermined due to their intense exploitation, which makes it impossible to appreciate the blank origin. Following the definition given by Boëda (1995), in all of the cores, the volume is conceived as two convex asymmetric secant surfaces whose intersection defines a plane and the *débitage* or exploitation surface has lateral and distal convexities that must be maintained. Moreover, there is an absolute prevalence of a recurrent centripetal variant in which short series (n = 2-3 flakes) are exploited on a wide

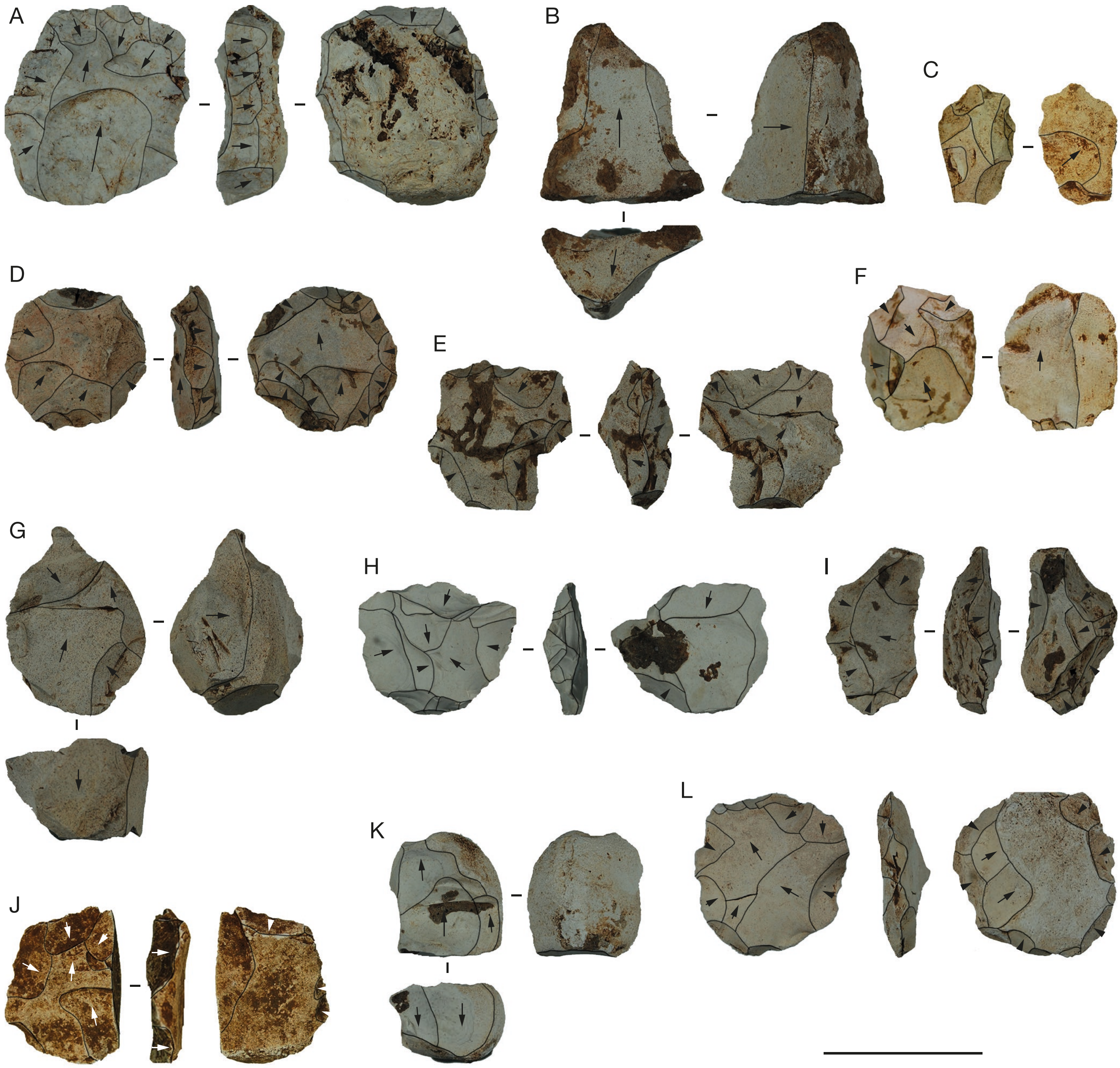

Fig. 8. — Cores from level II: **A**, **D**, **H**, **J**, **L**, recurrent centripetal Levallois; **B**, **G**, **K**, Quina; **C**, denticulate recycled on core; **E**, **I**, bifacial discoid; **F**, core-on-flake. Scale bar: 3 cm.

rectangular platform, mainly of quadrangular morphology. Only two pieces are classified as typical preferential Levallois flakes. The butts are flat and faceted. In certain occasions, due to the small size of the flakes, lateral *débordant* elements appear. In most cases (81%), cores are abandoned due to exhaustion. As we have previously indicated, the latest product dimensions indicate sizes that are below 2 cm, even <1 cm. In this regard, due to the inherent criteria of this method and the intense use of the cores, it is impossible to continue knapping and, thus, it is abandoned. It is interesting to highlight the presence of recycled cores as a tool (9%) in which one of the sides, usually the thinnest, is shaped like an edge and forms a scraper or microdenticulate.

In relation to discoid strategies, both the unifacial and bifacial schemes have been documented without attenuated differences in relation to one or the other management. In both cases, the organization of the core is conceived in two asymmetric, secant, and convex surfaces that delimit an intersection with an exploitation surface designed with a peripheral convexity that controls the knapping of each extraction. *Débitage* direction is centripetal, where the axis passes through the centre of the core. Products made from flakes, nodules, and indeterminate are similar. The blanks obtained are pseudolevallois points and *débordant* flakes (27%), which would have a centripetal direction that is wider than the long and quadrangular flakes. Furthermore, striking platforms are dominated by flat mor-

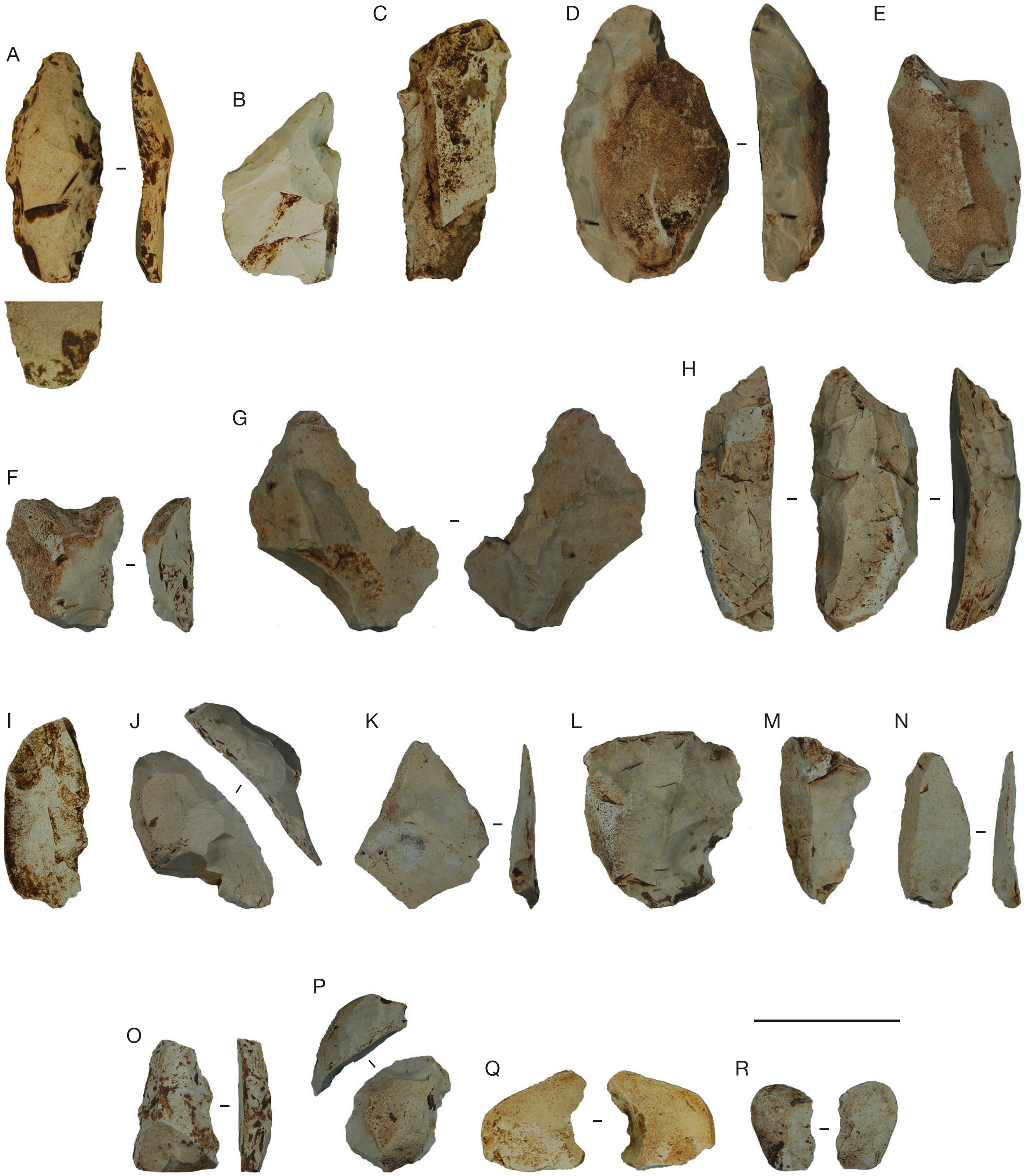

Fig. 9. — Tools from level II: **A**, **K**, **N**, **O**, Mousterian points (**A**, pay attention to the bulb reduction and the hafting management. All specimens have a slight distal percussion fracture); **B**, transversal sidescraper and opposite notch; **C**, awl; **D**, **F**, simple semiquina sidescrapers opposite to natural backed; **E**, natural Backed knife; **G**, **I**, **L**, **M**, **Q**, denticulates (**G**, **I**, **Q**, inverse denticulates); **H**, convergent semiquina sidescraper; **J**, **P**, simple semiquina sidescrapers; **R**, simple sidescrapers (invers) (pay attention to the small size). Scale bar: 3 cm.

phologies. Unlike the Levallois method, in this case, the cores are abandoned due to exhaustion (48%) and knapping errors (33%) in similar quantifications. It is interesting to observe how the hinged and plunged features that are reflected on the surface of the cores, forming an intense concavity, do not allow for the continuation of developing reduction sequences.

TABLE 3. — Tool composition.

	II		III	
Tools	**Total**	**%**	**Total**	**%**
Sidescraper	83	60.58	–	–
Simple	51	37.23	1	–
Transversal	8	5.84	1	–
Double	7	5.11	–	–
Convergent	2	1.46	–	–
Déjeté	4	2.92	–	–
Bifacial	2	1.46	1	–
Ventral surface	2	1.46	–	–
Others	8	5.84	–	–
Denticulates	9	6.57	1	–
Notches	6	4.38	–	–
Natural backed knife	12	8.76	–	–
Mousterian point	7	5.11	–	–
Endscraper	2	1.46	–	–
Awl	2	1.46	–	–
Others	3	2.19	–	–
Macro use-wear	13	9.49	–	–
Total	137	100.00	4	–

Similarly, unlike the previous one and to a lesser extent (11%), there are a few cases in which the state of the cores continues to be optimal but is abandoned for unknown reasons. It is notorious that while Levallois productions are exploited to the end, in discoid strategies, there is a greater flexibility before the abandonment.

With regard to Quina *débitage*, its determination from the flakes is complicated. In this sense, most part of the information we have comes from the cores. Thus, the verification of this strategy is done from the parameters established by Bourguignon (1996), in which the cores are organized into two secant surfaces from which unipolar sequences were detached with an inward motion. In all cases, the original starting blank is a nodule. Flaking production is short and limited to obtaining a maximum of 3-5 flakes. Wide and thick striking platforms, without the preparation of impact points, suggest that thickness is important. It is interesting to note the searching for planes and oblique lateral ridges to acquire backed products and asymmetrical cross sections. Finally, in relation to its abandonment, the parameters appear rather balanced in this case because the full production, the knapping errors, and the exhausted ones oscillate around 30% each. This system, which has been considered expeditious in many cases, could explain this fact – that is, they had a specific and fast use during a specific moment. While flakes are end-products of lithic reduction sequences, certain flakes were turned into sources for blanks. Hence, the selection of flakes as core blanks is perceived as the starting point of a separate operational sequence. In these cases, all the remains present the same technical management: the starting blanks are thick and semi-cortical flakes in which – on the ventral face, mainly in the proximal area which has a greater volume – a series of short flakes are exploited (n = 1-3) in an orthogonal or centripetal direction. The obtained products present the typical Kombewa morphology, with two well-defined ventral surfaces. Its transformation into tools through retouching is rather low (level II, n = 2 and level III, non-existent). Finally, they are abandoned for reasons of exhaustion because the blank does not allow the obtaining of more flakes. An analysis of the negatives on the surface of the cores indicates microlithic productions (an average of 1.5 cm in length and width). These small flakes produced *in situ* were most probably destined for immediate use. Another method documented is linked with bipolar sequences. This main characteristic is that parallel series of flakes are eliminated from an opposite striking platform. The blanks obtained are thin and slightly elongated. They are abandoned due to knapping errors related to distal hinged blanks and overshoots. Finally, other marginal reduction strategies, such as orthogonal and unipolar, complete the operating schemes of level II. Moreover, a few chunks, which are the only documented ones, along with the indeterminate ones were found in level III.

Tools

Tools constitute 17% in level II and 16.7% in level III of the assemblage (not including chips and *débris*). These values are relatively high when compared with other sites in the same regional area (Eixea 2018; Eixea *et al.* 2020a). Excluding level III due to the low number of remains, if we focus on level II, the most frequent tools are the sidescrapers, which present overwhelming quantifications (Table 3). Within these sidescrapers, simple and, to a lesser extent, transversal and double ones constitute the majority and are performed on non-cortical flakes and, in certain cases, semi-cortical flakes. This indicates that these tools are made from the first stages of production, although the more advanced stages predominate. With few exceptions, retouching is usually simple, direct, continuous, and with little effect on the contour of the edge. The remainder of the group – with less quantification – is composed of *déjeté*, bifacial, and convergent sidescrapers, which have two retouched edges (Fig. 9). These appear more pronounced and partially invade the piece delineation. In certain cases, there is an intense edge resharpening, as we can see in 11% of the sidescrapers. In the same manner, it is also interesting to note the presence of Quina (n = 4) and semiquina (n = 7) sidescrapers, which account for 13% of the record. Among these, the retouch was preferentially applied on thick and big size cortical and semi-cortical pieces; particularly on those that show significant backs. This fact is related to a specific mechanic of use in which this basic morphological attribute notably affects tool efficacy (Lin & Marreiros 2020).

With regard to notches and denticulates, they are less abundant but complement the sidescraper group. They are characterized by small notches (approximately 3-4 denticulations), are very shallow, and mainly affect one of the lateral edges. In certain cases, they are opposed to natural backs or *méplats*, thereby facilitating a better manual grip ergonomy. The same is true for certain semi-cortical flakes which present the same parameters and in which the continued use of the opposite edge determines their classification within the group of naturally backed knives.

In relation to the Mousterian points, seven pieces present distal impact fractures that have been suggested as diagnostic

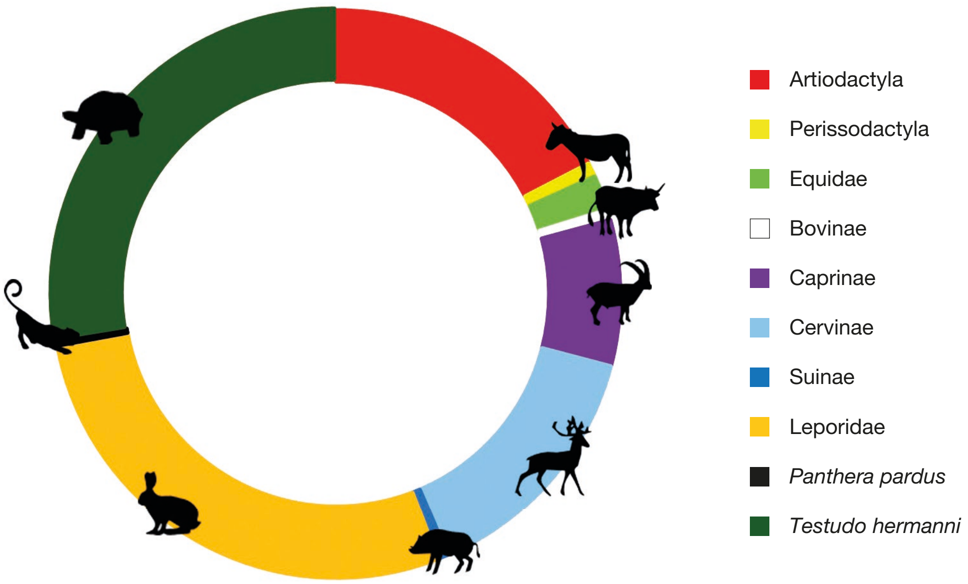

Fig. 10. — Main macrofaunal taxa represented according to %NISP.

for use as weapon tips, although the precise mode of use is difficult to determine. They certainly could have functioned as thrust or thrown spears. Moreover, they are obtained from discoid flakes in which the regularisation of the edges is made by intense retouches that search a convergent and pointed distal portion. The mean of the angle is below 45° and, in certain examples, the proximal area of the bulb is removed to facilitate the hafting. This evidence is by no means definitive, but it suggests the existence of complex projectile technology in the site.

Finally, with regard to the Upper Palaeolithic group, a few endscrapers and awls are represented. In addition to these, macro use-wear flakes complete the tool composition.

Table 4. — Frequencies of the charred carpological remains from Cova del Puntal del Gat.

Level			**II**		
Spit	**2**	**3**	**4**	**5**	**Total**
cf. Cistaceae Juss., 1789	–	1	–	–	1
cf. Fabaceae Juss., 1789	–	–	1	–	1
Ficus carica L., 1753	–	2	1	5	8
cf. *Ficus carica*	1	–	–	–	1
Galium sp.	–	1	–	–	1
Lamiaceae Martinov, 1820	–	1	–	–	1
Pinus sp. (cone bract)	–	1	1	–	2
Plantago sp.	–	1	–	–	1
cf. Poaceae Barnhart, 1895	1	–	–	–	1
Thymelaea sp.	–	1	–	–	1
Dicotyledon	–	–	1	–	1
Indeterminate	–	2	3	–	5
Unidentifiable	1	3	4	7	15
Total	3	13	11	12	39

Faunal remains

The macrofaunal assemblage from Cova del Puntal del Gat has been studied and recently published (Moya *et al.* 2021); thus, here we present a summary of the main results. The assemblage consists of 3006 elements, with a majority of <4 cm remains (94.4%) and very few completes. For this reason, only 11.7% of the assemblage could be taxonomically and anatomically identified, with representation of three groups: small prey, ungulates, and carnivores. Small prey represents 55.5% of the NISP, where Leporidae (27.9%), possibly rabbits in most cases and the Mediterranean tortoise *Testudo hermanni* (Gmelin, 1789) (27.6%) stand out. Among the ungulates, Cervinae (14.5%) and Caprinae (8.3%) predominate, with more modest values for equids (2%), bovines (0.6%), and suids (0.6%). Moreover, the remains attributed to Artiodactyla (17.4%) were likely associated with both cervids and caprines, while those of Perissodactyla (0.8%) with equids. Finally, only one carnivore remain has been identified, corresponding to the leopard *Panthera pardus* (Linnaeus, 1758) (0.3%). The unidentified assemblage is dominated by fragments corresponding to medium-sized animals (35.1%) and by undetermined chips of <3 cm (49.2%), which could also be associated with cervids and caprines, while those related to large (2.1%) and small (1.9%) taxa are in the minority (Figs 10; 11).

The study of the anatomical profiles reveals a possible differential transport of prey according to their size. In cervids and caprines, the remains of the skull, girdles, and axial skeleton are absent and the bones of the stylopodium stand out, which appears to indicate a selection in the elements transported. On the other hand, in the case of leporids, most of the elements are represented, thereby indicating that they were transported complete to the cave. This would also be the case of the tortoise, although we have a clear predominance of plastron plates (NISP = 80) over those of the carapace (NISP = 16) and long bones (NISP = 1). Biostratinomic modifications are rather scarce and were only observed on eight remains. Four remains show lithic marks related to butchery processing –

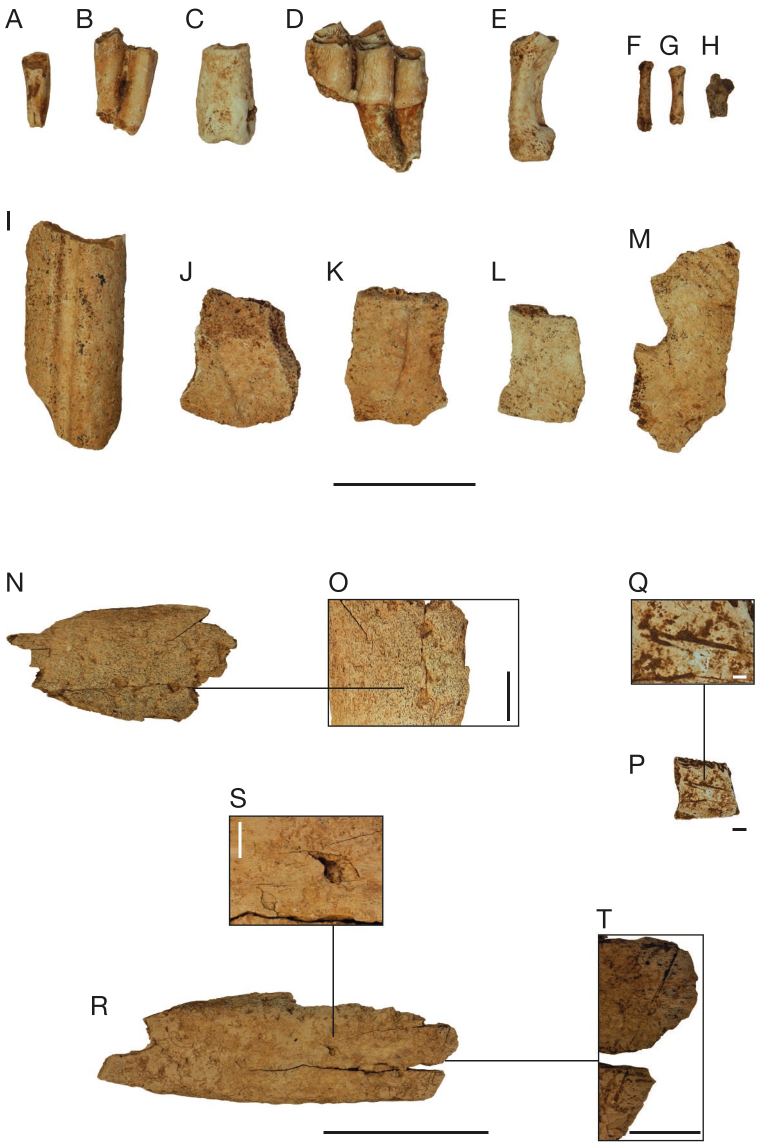

Fig. 11. — **A**-**M**, Main taxa represented: **A**-**C**, Caprinae (Gray, 1821): **A**, incisor; **B**, lower molar; **C**, first phalanx; **D**, **I**, Cervinae: **D**, lower third molar; **I**, metatarsal; **E**, *Panthera pardus* (Linnaeus, 1758), second phalanx; **F**-**H**, Leporidae (Fischer, 1817): **F**, metacarpus; **G**, first phalanx; **H**, coxal; **J**-**M**, *Testudo hermanni* Gmelin, 1789: **J**-**L**, carapace plates; **M**, plastron plates; **N**-**T**, main biostratinomic modifications: **N**, **O**, fragment of medium-sized diaphysis with carnivore bite; **P**, **Q**, tortoise plate with lithic incisions on the internal face; **R**-**T**, fragment of large-sized costal body with lithic incisions and carnivore bite. Scale bars: A-M, 3 cm; N, O, R, T, 1 cm; P, S, 25 mm; Q, 1 mm.

specifically, two fragments of medium-sized diaphysis with an incision each, a fragment of a large-sized costal body with an incision, and a peripheral plate of a tortoise with an incision on the internal face. We also identified pits that we relate to the action of the dentition of a carnivore on a large rib body fragment and on a proximal fragment of artiodactyl femur. Dental scores appear on two medium-sized diaphysis fragments. On the large rib fragment, evidence of human action (cut marks) and pits caused by the dentition of a carnivore have been found together; in any case, they do not appear superimposed and, thus, we cannot infer more data regarding the primary and secondary access. Furthermore, thermo-alterations are not very numerous but are present in both determined (4%) and undetermined (11.6%) remains. Among the determined ones, they appear on Leporidae (NISP = 5), *Testudo hermanni* (NISP = 4), Cervinae (NISP = 4), and Caprinae (NISP = 1); these elements are rather affected, both partially and totally, reaching calcination in many cases. The modifications due to the action of fire on the indeterminate fragments are distributed on the medium (NISP = 52), small (NISP = 14) and large (NISP = 3) size fragments and mainly on the <3 cm chips (NISP = 238).

Botanical remains

Two types of carpological remains were recovered in Cova del Puntal del Gat: charred and uncharred remains. With regard to the abundant uncharred seeds, those of *Mercurialis annua* L., 1753, Chenopodiaceae Vent., 1799, and Caryophyllaceae Juss., 1789 are particularly abundant. This assemblage is clearly intrusive and probably introduced by ants. In fact, some of

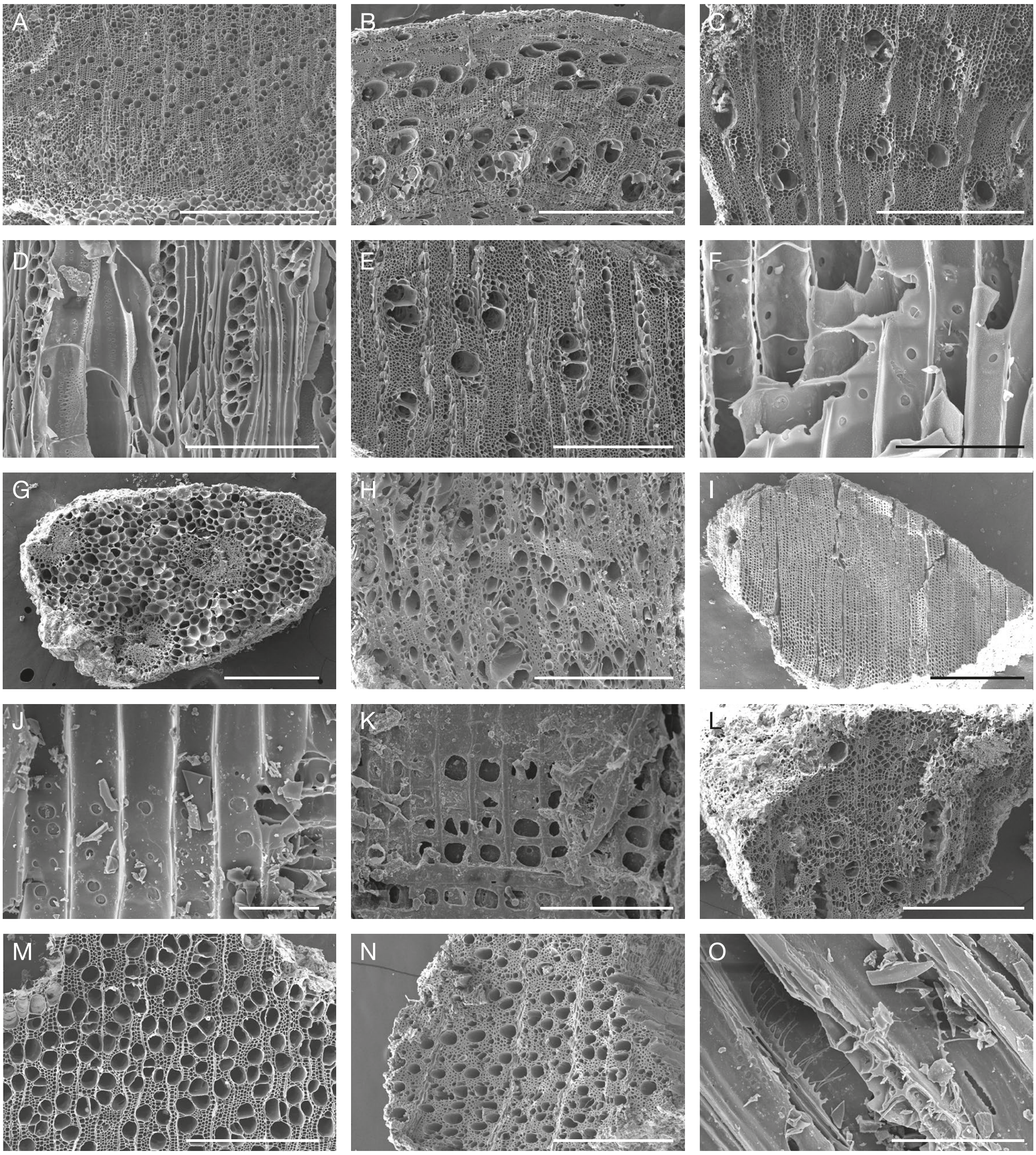

FIG. 12. — SEM photographs of some woody taxa identified at Cova del Puntal del Gat: **A**, cf. *Artemisia* sp. cross section; **B**, *Celtis/Ulmus* cross section; **C**, *Ficus carica* L. cross section; **D**, *Ficus carica* tangential section; **E**, *Fraxinus* sp. cross section; **F**, *Juniperus* sp. radial section; **G**, Monocotyledon cross section; **H**, *Olea europaea* L. cross section; **I**, *Pinus* L. cross section; **J**, *Pinus* tp. *halepensis* radial section; **K**, *Pinus* tp. *nigra* radial section; **L**, *Quercus* sp. cross section; **M**, *Salix* sp. cross section; **N**, cf. *Viburnum* sp. cross section; **O**, cf. *Viburnum* sp. radial section. Scale bars: A, H, 400 μm; B, C, G, I, M, 500 μm; D, K, O, 100 μm; E, L, N, 300 μm; F, 40 μm; J, 50 μm.

the documented taxa are myrmecochorus plants, producing seeds with elaiosomes to be dispersed by ants, like *Mercurialis annua*. With regard to the charred seeds, 39 remains were recovered. The most abundant taxon is *Ficus carica* L., and the presence of *Thymelaea* sp. and *Pinus* sp. must be highlighted (Table 4). Moreover, the origin of the charred remains must be assessed: with the exception of *Ficus carica*, the taxa identified among the charred seeds are not present among the uncharred intrusive remains. This fact, along with their charred state, points to a different route of entry to the site. Nevertheless, their scarcity prevents their possible link to an ancient human action.

With regard to wood remains, two types of charcoal are clearly evident: fragments of greater size and good conservation, three of which have resulted in recent dating; and the remaining are very small and with a morphology and state of conservation (rounded, very altered, etc.) that is more in line with the antiquity proposed for the site. At the taxonomic level, most of the wood belongs to a warm flora, while some fragments of *Pinus* tp. *nigra* are discordant (Fig. 12). In any

Table 5. — Frequencies of the charred wood remains from Cova del Puntal del Gat. Abbreviation: **n**, number of measurements performed.

Level	**II**									
Spit	**3**		**4**			**5**			**Total**	
Square	**A2**	**A4**	**A2**	**A3**	**A4**	**A2**	**A3**	**A4**	**n**	**%**
cf. *Artemisia* sp.	–	1	–	–	–	–	–	–	1	0.25
Ficus carica L., 1753	4	41	4	7	11	–	6	13	86	21.72
cf. *Ficus carica*	–	18	1	7	2	–	4	13	45	11.36
Fraxinus sp.	–	–	–	–	–	–	–	7	7	1.77
cf. *Fraxinus* sp.	–	–	–	–	–	–	–	2	2	0.51
Juniperus sp.	–	1	–	–	–	–	–	–	1	0.25
Monocotyledon DC, 1817	4	–	2	–	–	–	–	1	7	1.77
Olea europaea L., 1753	4	6	4	–	2	4	–	–	20	5.05
Pinus tp. *halepensis* Mill, 1768	4	7	–	5	3	2	–	9	30	7.58
Pinus tp. *nigra* Aiton, 1789	–	5	1	2	1	–	1	–	10	2.53
Pinus sp.	5	17	4	3	2	6	4	8	49	12.37
Prunus sp.	–	2	–	–	–	–	–	1	3	0.76
Quercus sp.	–	1	–	–	–	–	–	–	1	0.25
Salix sp.	–	2	–	–	–	–	–	4	6	1.52
Ulmus sp./*Celtis* sp.	–	–	–	–	1	–	–	1	2	0.51
cf. *Viburnum* sp.	–	3	–	–	–	–	–	–	3	0.76
Angiosperm	1	15	5	13	2	9	8	7	60	15.15
Conifer	1	8	1	2	5	–	3	2	22	5.56
Indeterminable	4	3	2	1	1	1	3	5	20	5.05
Charred bone	1	–	2	9	–	2	7	–	21	5.30
Total	28	130	26	49	30	24	36	73	396	100

Table 6. — Measures taken on *Iberomys cabrerae* (Thomas, 1906) (in mm). Abbreviations: **a**, maximum length of the anteroconid complex; **average**, average of the values obtained; **b**, width between T4-T5 and T6-T7 or neck of the anteroconid complex; **c**, pitimian rhombus width; **d**, shortest distance between LRA5 and BRA4; **e**, width between T6-T7; **L**, m1 maximum length; **La**, labial width (T4 mean width); **Li**, lingual width (T5 mean width); **n**, number of measurements performed; **W**, m1 maximum width. Transversal measurements are made between the internal faces of the enamel.

Dimensions	n	Average
L	1	3.30
W	1	1.37
a	1	1.77
b	1	0.02
c	1	0.02
d	1	0.53
e	1	0.76
Li	1	0.97
La	1	0.40

case, these refer to a probable Palaeolithic chronology, since they have not developed in this area at sea level since the last glacial cycle.

The presence of fig trees and pines stands out, many of which could not be identified at the species level due to their small size, although the presence of warm species (*Pinus* tp. *halepensis*) and cold species (*P.* tp. *nigra*) is systematically confirmed in all the analysed spits. The following species in percentage is *Olea europaea* L., 1753, and the *riparian* species – that is, ash, willow, and *Ulmus*/*Celtis*. The remaining taxa show very low values (Table 5).

The distribution of taxa by size indicates that the dominant species are represented in both large and small fragments; thus, we cannot use this characteristic as a variable to discern the intrusive or non-intrusive character of the charcoal (Fig. 13).

Micromammal analysis

The taxonomic categories used in this study are those proposed by McKenna & Bell (1997). Each species is accompanied by its morphological description, measurements, habitat, and Iberian Peninsula distribution.

In relation to *Iberomys cabrerae* (Thomas, 1906), in the Cova del Puntal del Gat, there is only one relatively well-preserved lower m1. It has a very marked buccolingual asymmetry; moreover, lingual triangles are much larger than labial ones. The cement is abundant and covers the re-entrant triangles. In addition, the enamel is wider in the mesial area than in the distal one. In the TTC, T1, T2, and T3 are isolated. In the ACC, T4 and T5 are not confluent. The AC is short and triangular, separated from T4-T5 by a very narrow neck. LRA4 always overlaps BRA3. LRA5 and T7 are well developed and BRA4 is barely noticeable; thus, T6 is undeveloped (Fig. 14A). From an analysis of biometric data of m1, Laplana & Sevilla (2013) found that, in the Iberian Peninsula, all populations of *Microtus brecciensis* (Giebel, 1847) ascribed to the Middle Pleistocene have a small size (mean length of m1 <2.95 mm), while in the Upper Pleistocene and Holocene, the populations are larger (mean length of m1 >3.05 mm), which is typical of *M. cabrerae*. At Cova del Puntal del Gat, it measures 3.30 mm (Table 6). Currently, it can be considered that the origin of *I. cabrerae* may be related to *Allophaiomys nutiensis* (Chaline, 1972), while *I. huescarensis* (Ruiz Bustos, 1988) would be the first representative of the *Iberomys* Chaline, 1972 genus (Cuenca-Bescós *et al.* 1997, 2005). This evolutionary line has also been documented in the Lower Pleistocene site of Alto de las Picarazas (Guillem & Martínez Valle 2017). In Cova del Puntal del Gat, both the morphological characteristics and the biometric values are those of *Iberomys cabrerae*.

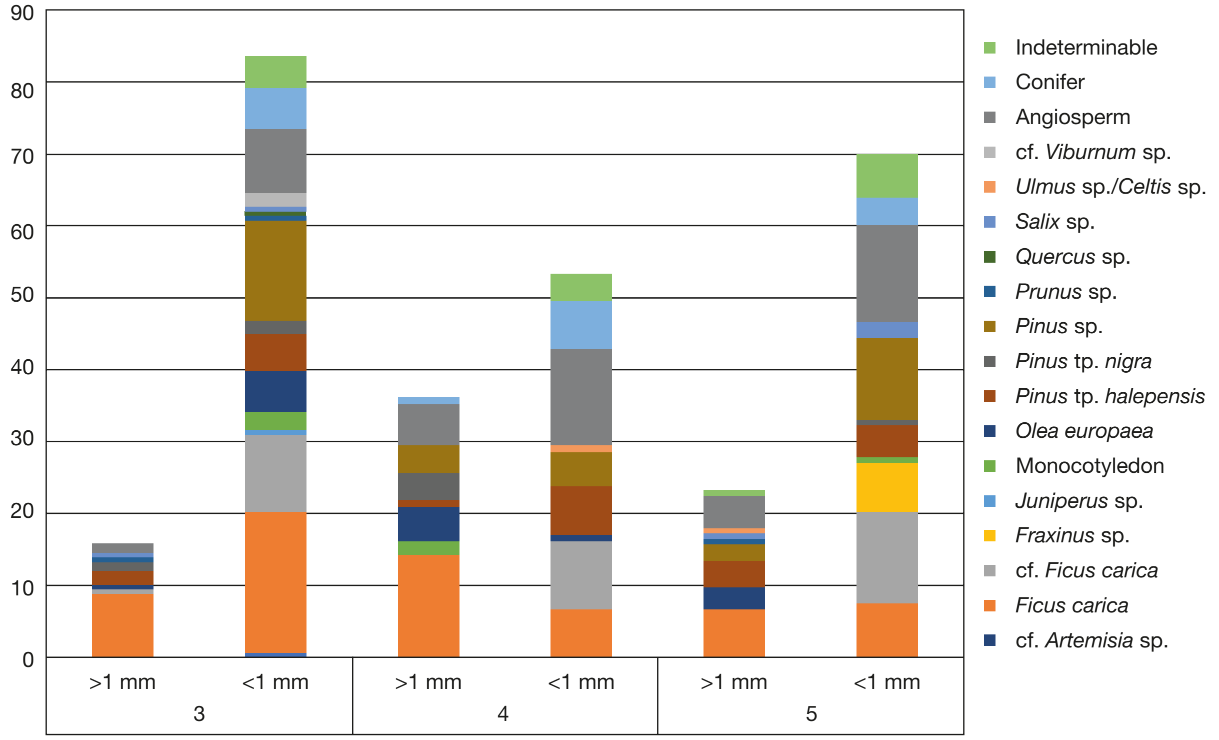

Fig. 13. — Size distribution of the identified woody taxa in each spit of Level II (burnt bones were not included in the quantification).

With regard to the habitat and geographic distribution, *I. cabrerae* is an Iberian endemic. Its current distribution is fragmented into several main foci located in the Pre-Pyrenees, the southern Iberian System, the Betic Mountains, the Central System and some areas of the Zamora provinces. In the central Mediterranean basin, it is present in the interior of the Valencia and Castellón province (Belenguer *et al.* 2016, 2017). It lives exclusively in strictly Mediterranean climatic zones and rejects Eurosiberian climates. In addition, this species requires a herbaceous cover that remains green all year round, so it is established in areas with high water tables – reed beds, perennial grasses and, to a lesser extent, reed beds and nitrophilic gutter vegetation. The colonies are found in the meso- and supra-Mediterranean bioclimatic belts and their altitudinal range extends between 250 m and 1500 m (Fernández-Salvador 2007).

With regard to *Microtus arvalis* (Pallas, 1779), it remains documented in Cova del Puntal del Gat and was characterized from m3 and m2, because no m1 has been preserved. m3 has a complex morphology that perfectly isolates it from *T. duodecimcostatus* (de Sélys-Longchamps, 1839) and *M. cabrerae*, which has three highly developed and closed lingual and three labial triangles (Fig. 14B), while in *Terricola's* m3 the mesiolabial triangle is smaller than the two others and the triangles are confluent (Fig. 14C). The m3 of *M. cabrerae* and T1 and T2 are confluent and reflect a marked lip-lingual asymmetry (Fig. 14B).

In the Iberian Peninsula, until 20 years ago, its distribution was limited to the Cantabrian Mountains, Central and Iberian System, and the Pyrenees. Today, it also occupies practically the entire Northern Plateau. In the Valencian area, it occupies the oro- and supra-Mediterranean climatic belts of the Penyagolosa massif (Jiménez *et al.* 1989), Ademuz, and is sporadically present in the elevated areas of the Utiel-Requena region (Jiménez *et al.* 2012).

With respect to *Terricola duodecimcostatus*, three species of *Terricolas* genus currently live in the Iberian Peninsula: *T. duodecimcostatus*, *T. pyrenaius gerbei* (de Sélys-Longchamps, 1847), and *T. lusitanicus* (Gerbe, 1879) (Brunet-Lecomte & Chaline 1993). Isolating them from the m1 morphology and biometrics is not always an easy task. The m1 of *Terricola duodecimcostatus* documented in Cova del Puntal del Gat is mainly characterized by having the confluent T4 and T5 triangles forming the pitiminian rhombus. The T6 is open and barely inclined and, along with the T7, forms a second symmetric pitiminian rhombus parallel to the rhombus formed by the confluence of T4 and T5 (Fig. 14E). However, the *Terricola pyrenaicus* Terricola Fatio, 1867 m1 has a very open T4 and T6 and the T6 is also inclined towards the distal portion, which causes the asymmetry of T6 and T7 and prevents the formation of another rhombus. The m1 of *Terricola lusitanicus* is very similar to *T. duodecimcostatus*. Nevertheless, the neck connecting triangles T6 and T7 with AC is wider in *T. duodecimcostatus* and the molars are usually larger. In this regard, López-García (2008) indicates that the neck width of triangles T6 and T7 offers values greater than 0.3 mm in *T. duodecimcostatus*. In our case, it is 0.76 and less than 0.3 mm in *T. lusitanicus*. While the m1 length of *T. lusitanicus* is less than 2.7 mm and greater than 2.80 mm in *T. duodecimcostatus*, there are molars that have a rather reduced length, such

TABLE 7. — Measures taken on *Terricola duodecimcostatus* (de Sélys-Longchamps, 1839) (in mm). Abbreviations: **a**, maximum length of the anteroconid complex; **average**, average of the values obtained; **b**, width between T4-T5 and T6-T7 or neck of the anteroconid complex; **c**, pitimian rhombus width; **d**, shortest distance between LRA5 and BRA4; **e**, width between T6-T7; **L**, m1 maximum length; **La**, labial width (T4 mean width); **Li**, lingual width (T5 mean width); **Max**, maximum of the values obtained; **Min**, minimum of the values obtained; **n**, number of measurements performed; **SD**, standard deviation of the values obtained; **W**, m1 maximum width. Transversal measurements are made between the internal faces of the enamel.

Dimensions	n	Min	Max	Average	SD
L	2	2.53	2.68	2.58	0.06
W	4	0.76	0.94	0.93	0.02
a	4	1.17	1.34	1.17	0.33
b	4	0.02	0.05	0.02	0.01
c	4	0.14	0.22	0.20	0.02
d	4	0.30	0.36	0.32	0.03
e	4	0.66	0.80	0.76	0.06
Li	4	0.41	0.55	0.52	0.05
La	4	0.34	0.43	0.43	0.002

TABLE 8. — Measures taken on *Eliomys quercinus* (Linnaeus, 1766) (in mm). Abbreviations: **average**, average of the values obtained; **L**, m3 maximum length; **n**, number of measurements performed; **W**, m3 maximum width.

Tooth	Dimensions	n	Average
P4	L	1	2.43
	W	1	2.27
M3	L	1	2.38
	W	1	3.44

as the m1 in Cova del Puntal del Gat and they cannot be characterized as *Terricola lusitanicus* (*C. Laplana* pers. com.) (Fig. 14E). In addition, in *T. lusitanicus*, the bulging of the apices of the labial triangles is appreciated, but this is not so in *T. duodecimcostatus* (Cuenca-Bescós *et al.* 2008). In this sense, all the molars from Cova del Puntal del Gat can be characterized metrically and morphologically as *Terricola duodecimcostatus* (Table 7).

In relation to the habitat and geographical distribution, *Terricola duodecimcostatus* and *T. lusitanicus* live only in the Iberian Peninsula and south-eastern France. It is an open-space species, with Mediterranean ecological requirements, and it requires stable soils in which to excavate its galleries with abundant herbaceous development. Moreover, it is found at altitudes ranging from the sea level to 3000 m in Sierra Nevada (Cotilla & Palomo 2007).

Another micromammal documented in Cova del Puntal del Gat is *Arvicola sapidus* Miller, 1908. The m1 of this arvicolid is mainly characterized with a posterior fold preceded by three closed triangles. The anterior curve does not always have a sharp angulation lingual towards the medial edge. This morphological character translates into a narrower neck of less than 0.5 mm between LRA4 and BRA3, which differentiates it from *Arvicola terrestris* (Linnaeus, 1758), thereby offering values greater than 0.5 mm (López García 2008). In Cova del Puntal del Gat, this index is 0.5 mm. The enamel is differentiated and thicker at the back of the triangle than at the front. This morphological characteristic of *Arvicola sapidus* also clearly isolates it from *Arvicola terrestris*. From the biostratigraphic perspective, this negative differentiation of the triangle enamel is shared by other *Arvicola* species from the Lower Pleistocene, like *A. jacobeus* (Cuenca-Bescós, Agustí, Lira, Melero-Rubio & Rofes, 2010), and by species of the same genus from the Middle Pleistocene – *A. cantiana* (Hinton, 1910), and *A. mosbachensis* (Schmidtgen, 1911). No measurable m1 has been conserved, except that of Fig. 14F, whose b index offers a value of 0.5 mm, as we have seen previously. This index overlaps with the value offered by *A. terrestris*, an aspect that confirms the Upper Pleistocene chronology of the studied levels.

Furthermore, *Arvicola sapidus* is distributed throughout south-western Europe, occupying practically the entire Iberian Peninsula and France (Román Sancho 2007). It is a semi-aquatic rodent that lives on the banks as well as in courses or bodies of stable water with abundant herbaceous vegetation or scrub on its margins. It prefers gently sloping banks with a relatively soft texture that allow it to dig its burrows. Occasionally, it occupies areas far from water courses, in meadows, dry ponds, or slightly peaty areas. Its presence has been documented in aquatic habitats close to the sea (for example, Valencian lagoon and Ebro delta) up to an altitude of 2300 m (Sierra Nevada) (Ventura 2007).

With regard to the *Apodemus* genus, there are two species in the Iberian Peninsula: *Apodemus sylvaticus* (Linnaeus, 1758) and *Apodemus flavicollis* (Melchior, 1834). The m1s of both species are characterized by a low occlusal surface with six cusps that converge to form an X and are usually separated by a narrow and deep groove. Furthermore, on the labial side, the m1 have two or three secondary cusps and a mesial tubercle (Cuenca-Bescós *et al.* 1997). In addition, the two species differ because *Apodemus sylvaticus* has a smaller size and the m1 has well-developed T4, T7, and T9 tubers in the m2. While *Apodemus flavicollis*, has the T4 and T7 tubers separated in m1 and the T9 of m2 is undeveloped and barely visible (Pasquier 1974; Nores 1988). At Cova del Puntal del Gat, only one m1 and numerous upper and lower incisors were documented. The only two recovered *Apodemus* molars, as well as the upper and lower incisors are fractured. This lack of *Apodemus* molars prevents us from relating the molars with either of the two *Apodemus* species from the Iberian Peninsula. *Apodemus sylvaticus* occupies the entire Iberian Peninsula territory from sub-desert areas at sea level to 1850 m on the subalpine floor of the Eurosiberian region. It prefers to frequent areas with shrub and tree cover, although populations are smaller in closed and extensive forests (Jubete 2007). *Apodemus flavicollis* is a species with very strict forest requirements. In addition, it prefers moist deciduous forests and gallery formations of banks and streams. Rainfall appears to be the factor that limits its distribution, and in Navarra it is restricted to areas with over 1000 mm of precipitation. In the Iberian Peninsula, it barely occupies Mediterranean environments. It must be noted that the shrub and herbaceous cover can facilitate their presence as long as there are trees of a certain size.

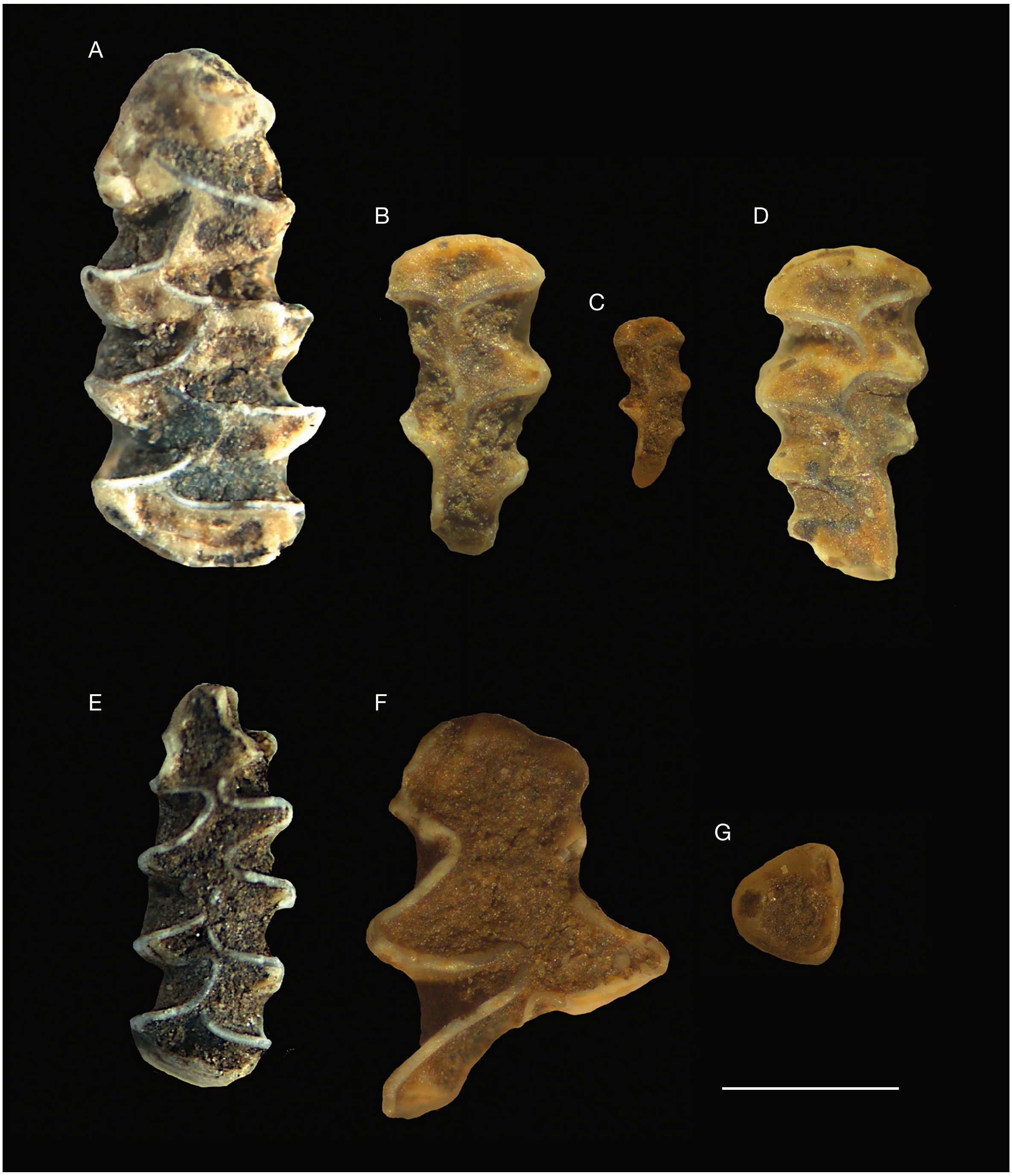

Fig. 14. — Micromammals remains: **A**, *Iberomys cabrerae* (Thomas, 1906) m1 left; **B**, *Iberomys cabrerae* m3 left; **C**, *Terricola duodecimcostatus* (de Sélys-Longchamps, 1839) m3 left; **D**, *Microtus arvalis* (Pallas, 1779) m3 right; **E**, *Terricola duodecimcostatus* m1 left; **F**, *Arvicola sapidus* Miller, 1908 m1 right; **G**, *Eliomys quercinus* (Linnaeus, 1766) P4 left. Scale bar: 1 mm.

If we focus on the glirids, the molars documented at the Cova del Puntal del Gat site have roots, the cusps are low and they present transverse ridges in occlusal view, in the labial-lingual direction, separated by valleys that run along a concave surface. The main cusps are distinguished, due to their great development, at the lingual and labial ends (Cuenca-Bescós *et al.* 2008). Therefore, we can relate these molars to *Eliomys quercinus* (Linnaeus, 1766) (Fig. 14G) (Table 8). This species is present throughout Europe, except in the British islands and Ibiza. It is a generalist species and they frequent stony and scrub areas and holm oaks, cork oaks, pine forests, and deciduous forests. It is not uncommon to find this species close to rural houses, on rooftops, or on stone walls among crops, and it lives in altitudes ranging from sea level to above 1500 m (Moreno 2007).

If we focus on the taphonomic processes, in Cova del Puntal del Gat, the presence of molars and incisors affected by gastric juices (Fig. 15A-C) generically indicates striguiformes,

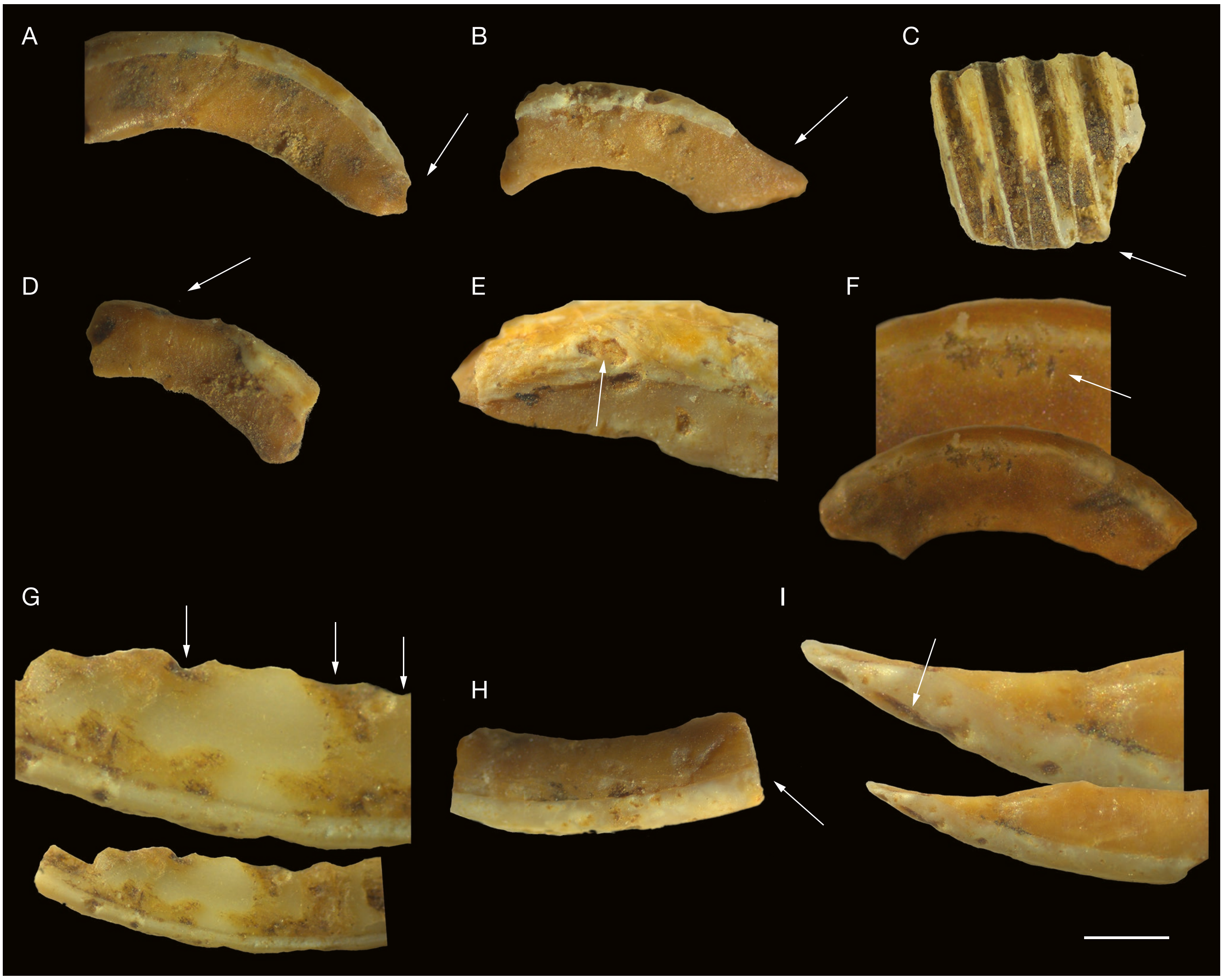

Fig. 15. — Micromammals remains: **A**, *Apodemus* sp. left upper incisor with dentin and enamel digested by gastric juices; **B**, *Apodemus* sp. left upper incisor with dentin and enamel altered by gastric juices; **C**, *Terricola duodecimcostatus* (de Sélys-Longchamps, 1839) molar digested by gastric juices; **D**, *Apodemus* sp. right upper incisor with dentin and enamel altered by gastric juices; **E**, *Eliomys quercinus* (Linnaeus, 1766) left upper incisor with dentin and enamel altered by roots; **F**, *Apodemus* sp. right upper incisor with enamel altered by roots; **G**, *Apodemus* sp. left lower incisor with carnivore punctures; **H**, *Apodemus* sp. right lower incisor with perpendicular fractures; **I**, *Apodemus* sp. right lower incisor with enamel altered by roots. Scale bar: 1mm.

carnivores, and titonids as the main responsible agents for the concentration of the bone remains of microvertebrates at both levels. It is more complex to specify the species of hunter or hunters who have acted in the genesis of the accumulation of microvertebrates bone remains from this site. The characteristics of this bone aggregate reveal a considerable post-depositional alteration which can strongly interfere in the accurate reading of the generated data (Table 9).

Fundamentally, the only bone remains of micromammals that have been preserved are the incisors and molars as well as a radius of *Apodemus* sp. The characteristics of this process have been reflected in the indices of representativeness, fracture, etc. From the perspective of representativeness, we can see how the process reflected in the two levels studied brings us closer to that characterized in the current sets of *Vulpes vulpes* (Linnaeus, 1758), as long as we admit the differences between these. In levels II and III, the mandibles are not represented; moreover, in our reference collection, it exceeds 20%. In addition, they would move away from the indices of broken molars when consumed by *Vulpes* Frisch, 1775*,* like that of Penyagolosa, which is the only predator that exceeds 20% of the fractured molars in our reference collection and far from 75%, at least, of the fractured molars in levels II and III from Cova del Puntal del Gat. A similar observation is made in the highest percentage of broken incisors, both in the reference collection and in the levels studied – the same extreme digestion that causes enamel to disappear and dentin to collapse, as seen in incisors. As observed in the incisors (Fig. 15C, D), it can cause the shape of the incisors to be almost unrecognizable and simultaneously accelerate the collapse of the dentin and finally cause its disappearance. This accumulation of skeletal remains of micromammals, once deposited in the form of pellets or excrements inside the cavity, must have been trampled on

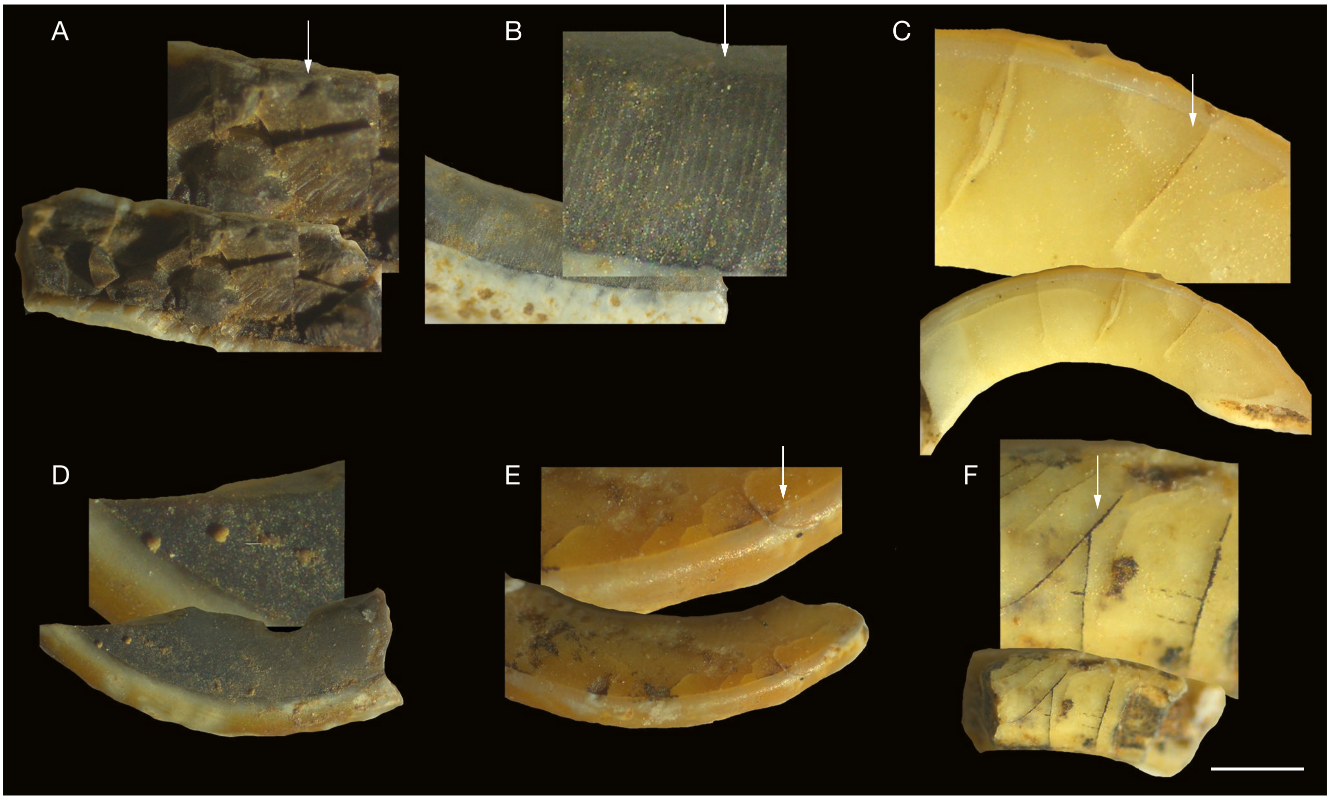

FIG. 16. — Micromammals remains: **A**, changes in the dentin structure of an *Eliomys quercinus* (Linnaeus, 1766) upper incisor caused by the action of fire; **B**, upper incisor of *E. quercinus* dentin with fire alterations; **C**, *Apodemus* sp. upper left incisor with fissures caused by the action of fire; **D**, *Apodemus* sp. incisor with greyish dentin; **E**, *Apodemus* sp. right upper incisor with thermal alterations causing the appearance of small sequins; **F**, *Terricola duodecimcostatus* (de Sélys-Longchamps, 1839) molar with thermal origin cracks. Scale bar: 1 mm.

TABLE 9. — Incisor (**In**) and molar (**M**) indices affected by gastric juices, altered and fractured.

	In affected		In altered		In fractured		M altered		M fractured	
	Total	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
II	18 (15)	83	18 (3)	17	50 (42)	84	44 (39)	87	67 (51)	76
III	6 (6)	100	6 (1)	17	12 (11)	92	21 (16)	75	12 (11)	92

by the same predators that generated the formation of this taphocoenosis, considering the high degree of fracturing exhibited in them. Effectively, all the micromammal remains in the site are fractured (Andrews 1990; Fernández-Jalvo 1992; Fernández-Jalvo & Andrews 1992). It is also possible that Neanderthal trampling also contributed to the increase in anthropogenic fractures, which is a process that must have occurred during the ossiferous formation and later, as indicated by the presence of perpendicular fractures in the diaphysis or incisors. Certain fractures occur on mineralized bones (Fig. 15H) (Guillem 1996). Diagenetic modifications such as weathering and root action is widely documented (Fig. 15E, I). This process is also responsible for the increase in the number of fractured bones. The same action of fire, a process that has been documented from the colour registered on the bone surface, is checked by the coloration that ranges from brown to white (Fig. 16A-C, F), which is in accordance with the colour-heat stages defined by Soler (2003). Furthermore, fire has facilitated the appearance of thermo-alterations that have manifested in the form of changes in the structure of the dentin (Fig. 14A), which facilitates the disappearance of the bones. In fact, no bright white bones appear which would have been calcined, thereby becoming dusty and prone to easy destruction. Fire has also altered the enamel on the incisors and molars, thereby causing the appearance of fissures (Fig. 16F) in the same manner that they also facilitate the disappearance of the incisor (Fig. 16A, B, D). In this same sense, Cova Negra level VIII is paradigmatic, where all the bones are burned and, from a taphonomic perspective, make it a totally different level from the others (Guillem 1996). It is clear that this type of action related to fire is entirely different from the deposition of manganese that occasionally causes the alteration recorded in Figure 15F and in black spots that can cover the entire surface. On other occasions, fire causes the development of a crack that resembles cut marks that can affect both enamel and dentin, as has been documented in a left upper incisor of *Apodemus* sp. (Fig. 16C). It can also cause the appearance of parallel incisions on the dentin, which are observed in a lower incisor of *Eliomys quercinus* (Linnaeus, 1766), or lead to thermal alterations that cause the appearance of small spangles (Fig. 16E).

Thus, despite how forced it can be to consider small carnivores as the main agents of the ossiferous aggregate formation in levels II and III, there are a few bones that invite us to consider this argument (Fig. 15G). In these incisors, puncture marks are observed in the tears that could only have been executed by small carnivores like *V. vulpes*.

Radiocarbon and OSL

Radiocarbon results were not as we expected, because the three samples obtained provided Holocene ages. The two samples recovered in square A-2 layer 4 provided a result of 102 ± 38 BP (Beta 511694) from an *Olea* L. charcoal and, the other, 160 ± 30 BP (Beta 511695) from a monocotyledon. The third, from square A-2 layer 5, was dated from a *Pinus* L. with a result of 50 ± 30 BP (Beta 511696). Taphonomical observations indicate some type of biological selective (and very small) post-depositional alteration (i.e., burrows difficult to determine during the excavation process, etc.), because charcoals and seeds present a few recent intrusive elements in the stratigraphy. In relation to the macrofauna or lithic industry, without any exception and assuming both for over 99% of the remains, there is no evidence of contamination, all exclusively belonging to the Pleistocene chronology, specifically to the Middle Palaeolithic chronology. In addition, it is even striking to note that during the level I excavation, no younger element was found, not even a single pottery remain (Roman, Bronze Age, Neolithic, etc.) or Upper Palaeolithic one.

In this context, and in order to improve our knowledge of the archaeological sequence, a complete battery of seven samples were collected for compositional and dosimetric analyses in order to perform luminescence dating at the luminescence dating laboratory of IST/University of Lisbon (Portugal).

The results of the chemical and dosimetric analyses, required to assess the reliability of the luminescence age, are presented in Table 10.

The content of K, Th, and U obtained *in situ* by gamma spectrometry and the respective uncertainties are, on average, 0.2%, 1.4 mg/kg, and 0.9 mg/kg, respectively. The estimated water content during the burial time ranges between 2% and 40%, with the highest value for samples GAT#3 and GAT#4 and lowest value for sample GAT#1. The dose rates ranged between 0.43 and 0.99 Gy/ka, increasing from the bottom to the top of the profile samples.

Furthermore, the thermal and optical stimulation signals obtained by semiquantitative protocol indicate minor changes in sensitivity along the profile (particularly for OSL signals), thereby revealing that the analysed quartz is suitable for the application of regenerative protocols. Moreover, the ratio between apparent absorbed doses obtained by IRSL and OSL (DeIRSL/DeOSL <1) for these samples indicates quartz-enriched fractions. The results obtained using the semiquantitative protocol indicate high reproducibility within each sample (low dispersion of the apparent absorbed dose obtained for five aliquots of each sample). The OSL measurements revealed variable apparent absorbed doses along the profile. In general, a consistent trend was observed, with the highest absorbed dose being at the bottom of the profile and at the bottom of the human occupation context, which decreases upwards.

Considering the results of the quartz purity (OS/IRSL depletion ratio around 1) and recovery dose tests (in the range of 0.9-1.1), a quantitative SAR protocol was applied for the determination of De. The signal intensity of the test dose is unrelated to De, which suggests the absence of partial bleaching of the quartz coarse grains for the majority of the samples. However, sample GAT#1 has the highest De value and also shows the highest scattering between aliquots. The majority of obtained De values are near the saturation zone of the luminescence curve; thus, the De obtained is not very precise for this sample and is only to be used as an indicative value.

The robust mean of the results obtained for all samples ranges between 100 and 198 Gy, with uncertainties between 3% and 9%. For all samples, a small dispersion was obtained and this dispersion in not dependent on the pre-heat temperature. Attending to the De and Dr obtained, the luminescence age of the samples was calculated and found to range between 101 ka and 465 ka, with higher values at the bottom of the profile and a decrease of the luminescence age in accordance with the stratigraphy (Fig. 17).

DISCUSSION

Chronological framework

The low contents of radionuclides and the consequent low dose rate are in accordance with similar carbonate-rich materials (Rodrigues *et al.* 2019a). The low values obtained for dose rate are related to high carbonate contents in the matrix of the samples, which promote the "dilution effect" of radionuclides content and a high-water retention.

The variation of the apparent absorbed dose determined by OSL observed along the profile sequence has been associated with and interpreted due to different deposition rates of various materials. The deposition rate of the material in each context (DRMc) has been calculated with the ratio between the obtained range of the apparent absorbed dose and the thickness of each context (DRMc = ΔDeapparent/(ΔThickness) gives a clear idea of the event speed (Rodrigues *et al.* 2019a). Along the context associated with human occupation level (GAT#3-GAT#5), the apparent De decreases upwards. The variation of the apparent absorbed dose reflects a more rapid event deposition, with a DRMc = 0.16 from GAT#3 to GAT#4 and a more gradual event from GAT#4 to GAT#5, with DRMc = 0.34.

The sample GAT#1 has the highest De value and shows the highest scattering between aliquots. This sample is representa-

Table 10. — Description of the samples collected at archaeological site of Puntal del Gat; chemical content determined by chemical and dosimetric analyses, mineralogical composition obtained by XRD, water contents and, dose rate and absorbed dose determined by luminescence for coarse quartz grains and consequent Luminescence ages (by using conventional and radionuclide weighted protocol).

				Chemical analyses				X-ray diffraction		Gravimetry	Field gamma spectrometry						Water content	Coarse Quartz Grains (160-250 µm)								
Samples	Depth (cm)	Context	Material description	Rb	Th	U	K_2O	Calcite	Dolomite	LOI	K	±	U	±	Th	±		Dr	±	De	±	Aliquots	Age	±	Age (“radionuclide weighted” protocol)	±
				mg/kg				%					mg/kg				%	Gy/ka		Gy			ka		ka	
GAT#-soil	9	Modern soil	Dark brown with high level of contaminations (recent human activities)	–	–	–	–	4	52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GAT#5	20	Human occupation level	Dark brown, with fauna and lithic materials	27	5	1.7	0.54	2	57	16.02	0.39	0.01	1.2	0.1	2	0.2	28	0.99	0.03	100	4	40/48	101	5	75	3
GAT#4	55			23	5.8	1.8	0.48	15	10	9.14	0.38	0.01	1.2	0.1	2.6	0.3	38	0.95	0.03	151	3	29/48	159	7	116	3
GAT#3	69			14	4.2	1.3	0.28	39	11	17.4	0.27	0.01	0.97	0.09	1.4	0.2	40	0.7	0.03	114	3	36/48	163	8	115	4
GAT#2	92	Context bellow human occupation level	Compact, light brown	9	3.1	0.8	0.18	25	26	22.43	0.105	0.003	0.86	0.09	0.23	0.04	18	0.57	0.02	114	3	44/48	200	8	160	6
GAT#1	108	Limestone with alluvial origin	Powdery, yellowish	<2	1.8	0.5	0.02	1	75	28.01	0.07	0.003	0.51	0.05	0.79	0.09	2	0.43	0.02	198	9	20/24	465	29	407	25
GAT#-geo	115	Geological Backgroud - Limestones and marls, dolomitic limestone and breccias	Limestone, yellowish/white, compact	–	–	–	–	45	47	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

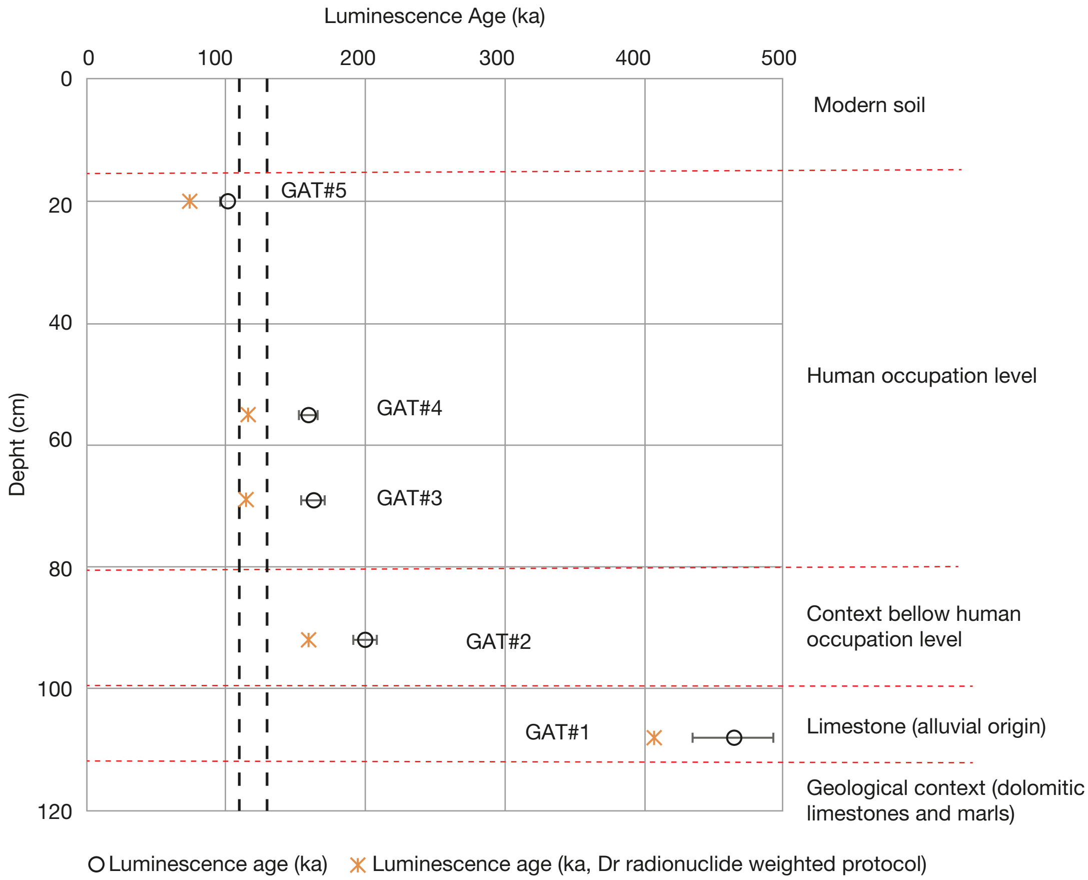

FIG. 17. — Luminescence age (ka) of samples from Cova del Puntal del Gat along the studied profile.

tive of the bottom level of the sequence and a high De value was expected as a consequence of a high contribution of the geological luminescence signal in the quartz fraction (no bleaching and/or partial bleaching of the quartz coarse grains). Moreover, the luminescence age obtained for sample GAT#1 has the highest value and considering that the obtained De is near the saturation zone of the luminescence curve for most of the analysed aliquots, despite the low uncertainty of the luminescence age, this is a non-accurate value (high contribution of geological signal).

As verified, the dose rate of these samples is lower related to the higher carbonate content, particularly for samples with higher carbonate contents. This effect is due to the presence of carbonates in the sample matrix and in the environment – the "dilution effect" of the radionuclide content and greater water retention capacity, which promotes a better shielding of quartz grains to environmental radiation. In this case, an overestimation of the luminescence age can be considered – that is, the obtained luminescence age indicates a sample older than it actually is. This effect in the studied samples can be discussed using the approach of "radionuclide weighed" protocol, which intends to minimize the carbonate content effect (Rodrigues *et al.* 2019a). By employing this approach (Table 10 and orange portions in Fig. 17) all the ages are lower and – particularly for samples from human occupation context, GAT#3 and GAT#4 – luminescence ages are in accordance with the archaeological information (110-130 ka).

Palaeoenvironmental context and Neanderthal subsistence strategies in the central region of Mediterranean Iberia

MIS 5e (Level III)

The information provided here is fundamentally focused on the lithic industry because, as mentioned above, the faunal remains have not been studied due to their poor state of conservation.

The industrial characteristics reveal how human groups used flint as the main lithology. This was collected in the nearby formations immediate to the site, no farther than 5 km. The rolled cortical formats and, in certain cases, practically polished ones indicate how this lithology was also collected in the secondary deposits immediate to the site, eroded from these. This raw material, in a pebble morphology, was carried to the site without any prior preparation. Once it was introduced into the site by human groups, they conducted lithic production from its initial stages. As evident from the lithic composition, if we leave the chips aside, all the phases of the operative chain are represented, dominated by the non-cortical flakes but also with the presence of cortical elements in different stages of knapping. In relation to the

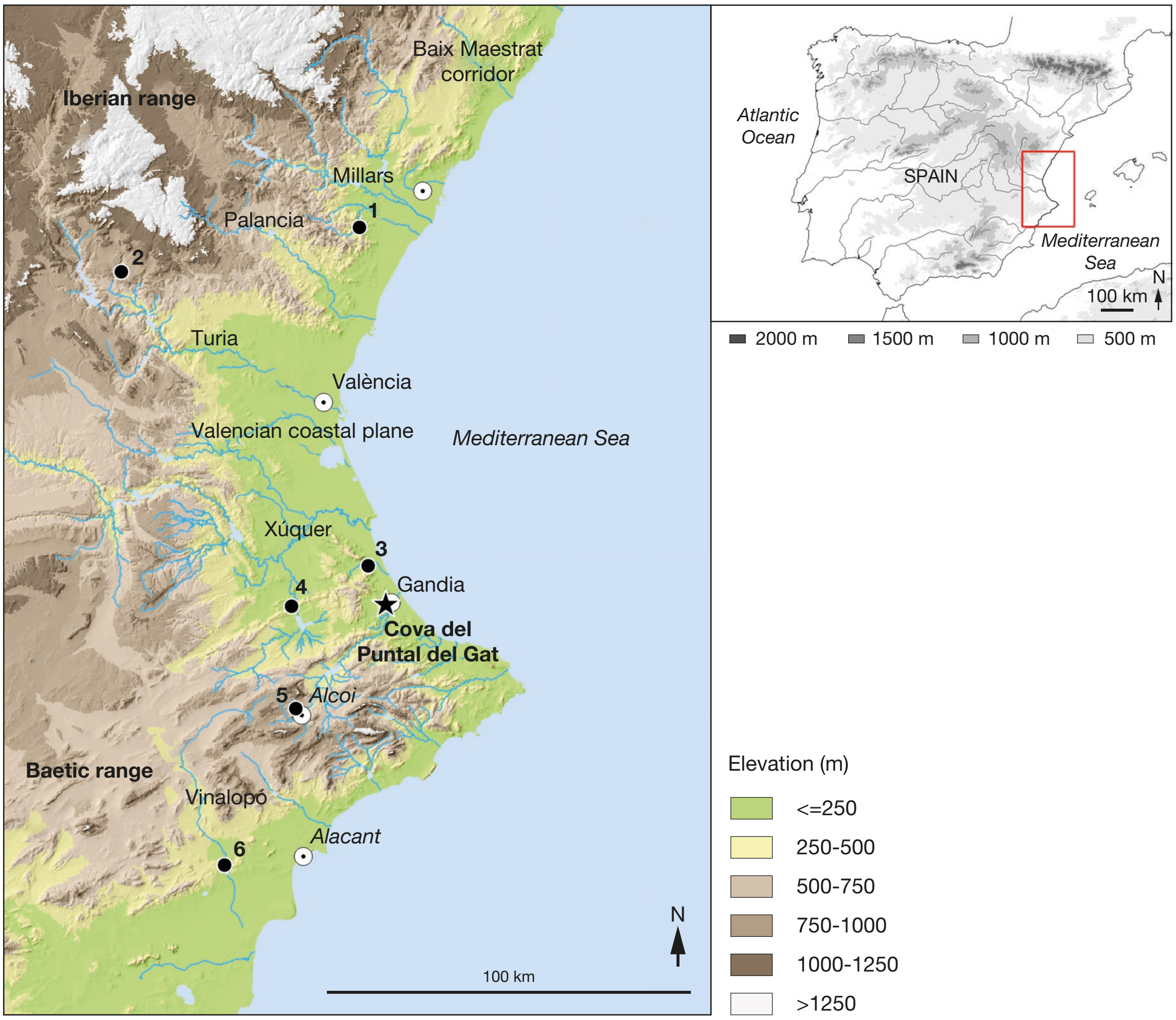

Fig. 18. — Location of Cova del Puntal del Gat in the Mediterranean Basin of the Iberian Peninsula and main sites belonging to MIS 5 and 4 cited in the text: **1**, El Pinar; **2**, Abrigo de la Quebrada; **3**, Cova del Bolomor; **4**, Cova Negra; **5**, Abric del Pastor; **6**, Los Aljezares.

chips, most of them are the product of lithic manufacturing, which supports the interpretation that intensive knapping processes took place in the site. Moreover, the cores appear proportionally well represented. However, it has not been possible to determine exactly which technical procedures were used, only that they are included within the definition of chunk in which it is only possible to appreciate a certain isolated exploitation without a defined scheme, some testing, etc. The lithic production objectives were oriented towards obtaining flakes, normally with a quadrangular morphology, with which the tooling was configured – in this case, it was a certain variety of sidescrapers with simple, very marginal retouches and little reshaped edges.

At the occupational level, the little information we have for this level, which is focused only on lithics, prevents us from making detailed comments. Despite this, we appreciate that: 1) there are no refitting elements that reveal longer exploitation sequences; 2) the low diversity in the technical systems and the dominance of expeditive strategies; or 3) the reuse and recycling of certain elements would indicate that we are facing short and recurring occupations in which different subsistence activities were conducted (lithic manufacturing, processing of different hunted prey, etc.) by the human groups that inhabited the cavity.

If we focus on the immediate regional panorama (Fig. 18), other sites are also documented during this period, among which we can highlight Cova del Bolomor (Tavernes de la Valldigna, Valencia). In phase IV, there are several indicators of a climatic improvement, with higher temperatures and an increase in humidity, that allowed the expansion of forest areas. In the faunal assemblage, there are a few taxa of marked temperate influence, such as wild boar, hippopotamus, or wild ass. With regard to the pollen data, this forest phase is characterised by an increase of mesothermophilous flora, such as *Olea* or *Pistacia* L. (Ochando *et al.* 2019). With regard to lithic technology, unlike Cova del Puntal del Gat level III, it presents an industry characterized by an important technical diversity in which, on local rocks, flint, discoid, and Levallois reduction methods are specifically applied. Trifacial strategies also stand out within

TABLE 11. — Lithic and bone densities and occupational patterns from MIS 5 and 4 sites.

Site	Level	MIS	Lithic density/m3	Bone density/m3	Occupational pattern	References
Cova del Puntal del Gat	II	5e-4	6541	4294.3	Short-term and recurrent occupations	In this work
	III	5e	833.3	–		
Bolomor	IV-1	5e	1178	7864.3	Residential camp with different episodes of multifunctional activities	Sañudo & Fernández Peris 2007
Cova Negra	II	5	3.9	562.2	Low human presence	Villaverde *et al.* 2009; Martínez Valle 2009
	IIIa-b		9.7	776.4	Short-term and recurrent occupations alternated with carnivores	
	IV	5e	0.6	635.8		
Los Aljezares	I	5	2.22	–	Short-term and recurrent occupations	Cuevas-González *et al.* 2018; Eixea *et al.* 2020a
Abrigo de la Quebrada	IV	5-3	3156	16817.8	Short-term and recurrent occupations	Sanchis *et al.* 2013; Eixea 2015; Real *et al.* 2020
	VIII-1	5	23.9	1092.6	Short-term and recurrent occupations	Villaverde *et al.* 2017
	VIII-2		41.6	1599.3		
	VIII-3		37.4	1378.3		
Pastor	IVa	5-4	27.2	30.2	Short-term and recurrent occupations	Machado *et al.* 2013
El Pinar	–	5-4	–	–	Workshop area/Atelier	Casabó & Rovira 1992

branched productions (Cuartero 2007). On the other hand, as in Cova del Puntal del Gat, the operational chains appear fragmented and, to a large extent, are oriented towards obtaining elements of microlithic size on which they mostly form denticulates (Fernández Peris 2007), with the only difference being that in our case they are mainly scrapers. In relation to hunting strategies, this is oriented towards small and medium-sized species, such as red deer, rabbits, and tortoises (Blasco & Fernández Peris 2012). With the data obtained and from the distribution of the remains in the protection zone of the cave, Sañudo & Fernández Peris (2012) propose an occupational pattern focused on a residential camp with different episodes of multifunctional activities (Table 11).

Another of the most important sites in this area is Cova Negra (Xàtiva, Valencia). The levels dated in these chronologies are II, IIIa-b, and IV, although they present a few common features that can be addressed together. Climatically, it oscillates between a temperate initial moment with seasonal rainfall, towards colder and drier climatic conditions and with a certain aridity (Fumanal & Villaverde 2009). Industrially, the remains are very scarce (3.9/9.7/0.6 lithics per m^3), with discoid strategies made on local and semi-local flint from which these populations were supplied in a distance of 10-30 km. The operating chains are short and highly fragmented, as observed in the absence of cores and the low index of retouching blanks (Villaverde *et al.* 2009; Eixea *et al.* 2020b). A site that, in light of the data presented above, is very different from Cova del Puntal del Gat level III and, practically, from the remaining sites in the region. With regard to faunal assemblages, the differences continue compared to the other sites in the area, with a high taxonomic diversity (n = 12-18) as well as a high presence of birds (n = 10-17) and carnivores (n = 2-8). The main taxon is the rabbit, although only a part appears to be anthropic. The remainder comprises *Hemitragus* sp. and *Equus* Linnaeus, 1758 (Martínez Valle 1996; Martínez Valle 2009). In this context, the interpretation that the authors made based on the occupational pattern focuses on recurrent and short-term occupations by small groups that are temporally spaced, limited extension, and alternated with carnivores (Soler 2003; Villaverde *et al.* 2009).

In a broader panorama, 130 km to the north, Abrigo de la Quebrada (Chelva, Valencia) is dated in these similar chronologies. At the basal levels VII-IX, among the identified micromammals, two species (*M. cabrerae* and *T. duodecimcostatus*) have clearly Mediterranean ecological requirements. Another, *A. sapidus*, implies the presence of a permanent water course with a riverbank where it could dig its tunnels and featuring a herbaceous vegetation or the plants with non-woody stems upon which it feeds. The anthracological results reveal not only that pine wood was the preferred fuel during the accumulation of levels VII and VIII but also that angiosperms were present in the pine forest developed under supra-Mediterranean conditions extant in the immediate environment of the site (Carrión *et al.* 2019b). With regard to the lithic technology, discoid productions of very low impact are documented, although not as abundantly as those in Cova Negra. As in Cova del Puntal del Gat, the catchment of the different lithologies is local (<10 km), although certain elements appear to arrive from distances longer than 100 km, which indicates the extensive mobility networks of these populations. The operative chains also appear fragmented and, on the tooling, the resharpening of the edges are present (Eixea *et al.* 2016, 2018). In the fauna, leaving aside the rabbit – which is partially provided by human groups to the site – Equidae, Caprinae, and Cervidae predominate (Real *et al.* 2020). As Villaverde *et al.* (2017) indicate, the combination of these data along with the low density of remains (23-43 pieces per m^3) as well as the combustion structures, indicates short-term and recurrent occupations with few materials in each one.

Two other sites – in this case, open-air – provide interesting information: El Pinar (Artana, Castellón) and Los Aljezares (Aspe, Alicante). In El Pinar, located 120 km to the north of Cova del Puntal del Gat, the knapping methods were not determined. Operational chains also appear fragmented, raw materials are entirely local, and sidescrapers are the dominant tools (Casabó & Rovira 1992). There are no faunal remains, and from an occupational perspective, this site is considered an *atelier* or workshop in which the blanks produced from the different knapping activities were imported. On the other hand, at a similar distance, but in a south-western direction, we find Los Aljezares site (Aspe, Alicante). Charcoal analysis demonstrated the dominance of conifers, among which *Juniperus* sp. (juniper) and *Pinus* tp. *halepensis* (Aleppo pine) were identified. Only one Angiosperm fragment is documented, which could not be further identified. The identification of the species Aleppo pine was relevant, as this species is one of the most characteristic of the Mediterranean basin owing to its resistance to heat and drought stresses and being a good ecological marker of warm conditions (Barbéro *et al.* 1998). At level I, the lithic remains are rather low (n = 24) as is the variety of reduction strategies (unipolar or Quina). Moreover, the catchment areas are entirely local, the operational chains are incomplete and, unlike in Cova del Puntal del Gat, the predominant tooling includes both notches and sidescrapers (Eixea *et al.* 2022). Occupational patterns show how Los Aljezares is formed as a passage point for Neanderthal populations' route between the Mediterranean coast and the interior of the Iberian Peninsula within a wide territorial network that the different groups used for supplying themselves with biotic and abiotic resources. Different short-term activities were carried out, related to lithic activity and, also perhaps, with the processing of certain hunted prey and woodworking (Eixea *et al.* 2022).

In summary, the paleoclimatic reconstruction during this period indicates that the marine pollen sequences establish a warming at the beginning of MIS 5e and a tendency towards an increase in rainfall, accompanied by a slight cooling (Sánchez-Goñi *et al.* 1999). In the East of the peninsula, climatic conditions were probably milder (Schulte *et al.* 2008). The scarce regional palaeobotanical data indicates this climatic improvement. Based on the lithic technology, it is observed that there is a dominance in the capture of local raw materials in an extension that does not usually exceed 10 km from the sites. The productions are managed towards expeditive reduction strategies (Cova del Puntal del Gat, Quebrada or Los Aljezares), branched sequences (Bolomor) or of low/sporadic activity (Cova Negra or El Pinar). The operational chains appear fragmented, which indicates a spatio-temporal differentiation between the occupations at different levels. In the tooling, the values oscillate between assemblages dominated by sidescrapers (Cova del Puntal del Gat, Cova Negra, El Pinar, or Quebrada) versus notches and denticulates (Bolomor and Los Aljezares) but without being able to determine the reason for one purpose or another. Moreover, the faunal assemblages, although not in all the sites, were documented and reveal a duality between: 1) those in which the repertoire is wide and combined with the presence of birds and a good presentation of carnivores (Cova Negra); and 2) those whose taxa as well as the incidence of carnivores is lower (Quebrada). Finally, with regard to occupational patterns, there is a general trend that is fundamentally focused on the typical palimpsest structures in which short and recurrent occupations overlap over time, without a clear specialization around one activity or another. These occupation events can be composed, on the one hand, by short-term and recurrent occupations with few materials in every one or, on the other hand, be spaced occupations with longer duration and more contributions in each (Eixea *et al.* 2020a). The determination of one or the other will depend on the degree of resolution that we can obtain from these multi, inter, and transdisciplinary studies that are currently being conducted.

MIS 5e-4 (Level II)

In relation to the upper level of Cova del Puntal del Gat, the information obtained here is greater than in the previous one. In this, in addition to the lithic technology, we conduct a detailed study of the data from the faunal assemblages and the paleoenvironment record (charcoal, seed, and micromammals), which allows us to obtain a more complete information and with greater interpretative guarantees.

Thus far, paleoenvironment data reveal a micromammal association that is typical of the Upper Pleistocene, in which the following species with Mediterranean ecological requirements predominate: *Arvicola sapidus*, *Microtus duodecimcostatus*, *Microtus arvalis*, *Microtus cabrerae*, *Apodemus sylvaticus*, and *Eliomys quercinus*. The taxa linked to the middle European climatic conditions (i.e., *Galemys* sp., *Sorex araneus coronatus* (Millet, 1828) or *Neomys* sp.) are no longer present. On the other hand, *Microtus* (*Iberomys*) *brecciensis* registers an evolutionary process of anagenetic speciation that concludes with the appearance of the descendant species, *Microtus cabrerae* (Cabrera-Millet *et al.* 1983). Compared to *M.* (*Iberomys*) *brecciensis*, this new species has more marked Mediterranean ecological requirements than its ancestor (*M. brecciensis*) and its populations register a considerable decrease, as confirmed in the faunal associations of micromammals that are documented in the Upper Pleistocene sites. There has been a chronological episode in which there is an increase in *Terricola duodecimcostatus*. This evolutionary process coincides with the Early Upper Pleistocene on the central Mediterranean basin with the appearance of new species (*M. cabrerae*) and the documentation of others (*T. duodecimcostatus* and *M. arvalis*), an aspect that is corroborated from the absolute dates obtained in Cova del Puntal del Gat. The presence of *M. arvalis* is related to the development of cooler climate conditions than the current ones. Nowadays, in the Valencian region, *M. arvalis* occupies the supra-Mediterranean and oro-Mediterranean belts of Penyagolosa and Rincón de Ademuz and lives mainly among the high mountain pastures that develop under cool and humid climatic conditions, although also occasionally found in lower areas of the Requena-Utiel region (Jiménez *et al.* 1989). Populations that are isolated are rather sensitive to climate change, which will possibly cause their disappearance in these interior lands. However, currently in Cova del Puntal del Gat, humid thermo-Mediterranean climatic conditions prevail, with mean annual temperatures between 17°C and 19°C, which is 15° higher than in the oro-Mediterranean bioclimatic belt (mean annual temperature around 4°-8°C) (Rivas-Martínez 1983).

With regard to the palaeobotanical data, most of the documented taxa are characteristic of thermo- and meso-Mediterranean formations – *Olea europaea*, *Ficus carica*, *Pinus* tp. *halepensis*, or *Thymelaea* sp. – in accordance with the MIS 5 chronology of the deposit. Just *Pinus* tp. *nigra* is a cold species, but this taxon is also abundant in other MIS 5 sites of the region – such as Abrigo de la Quebrada (Carrión *et al.* 2019b), Abric del Pastor (Vidal-Matutano *et al.* 2015), and Cueva Antón (Zilhão *et al.* 2016) – where associations of warm and cold species are usually detected. The coexistence of species with a cold and warm ecology is not an isolated case, particularly in certain areas of the Iberian Peninsula, which are considered a refuge. In fact, it is documented in records, not only of flora but also of mammals and birds, thereby creating combinations that have no current parallels. This is due to the fact that cold species decrease with latitude and altitude, but they do not displace those that were in the lower areas; thus, they coexist in what some authors term "compression zones" (Finlayson 2019). The presence of this cryophilous pine could point that our assemblage is dated to the transition between MIS 5 and 4 or to a cold stadial of MIS 5, as it appears to be slightly more abundant in spits 3 and 4 than in spit 5 (Level II).

With regard to the lithic record, the intensive use of the environment near the site is remarkable. As in level III, the catchment areas for raw materials are mainly local. In the same manner, there is no technical pre-treatment of the different rocks prior to their introduction into the site. Therefore, neither the quality nor the shape of the blocks or nodules appear to have influenced the selected reduction strategy. Despite the state of conservation of the record (patina, dehydration, thermal alterations, etc.), which has not allowed us to search refitting connections, it is observed that the different phases of lithic production are present. This local flint has a medium-quality feature for knapping, as shown by the good percentage of knapping errors present in certain pieces, particularly outrepassing and hinged flakes and, to a lesser extent, Siret fractures. Both in the cortex quantity on the pieces and in relation to blanks typometry, a progressive reduction is observed from the first maximum stages offered by the raw material (6 cm and 8 cm in length and width, respectively) until reaching the smallest formats (<2 cm in both axes). Quantitatively, these blanks have similar percentages, which indicate a certain productive balance of the different phases, thereby slightly highlighting the non-cortical raw flakes, which are the main aim of production. On the other hand, the elements with an elongated trend are sporadic and, probably, obtained by fortune, considering the absence of cores oriented towards this type of production. In relation to the technical variability, the cores indicate a domain of Levallois and discoid knapping methods, particularly the recurrent centripetal and unifacial variants, respectively. Along with these, other reduction strategies are also documented (although to a lesser extent), like Quina, which is managed in flaking in a short series of two or three blows, probably in sequences and searching wide and thick striking platforms, thereby suggesting that thickness is important. Moreover, cores-on-flakes consist of a flake with a different mode of platform preparation or lacking any deliberate preparation. Thus, the blanks obtained have rather small dimensions, which are normally below 2 cm in length and width and usually have a Kombewa morphology. Finally, on a smaller scale, other more expeditious knapping methods constitute the technical set (bipolar, unipolar, orthogonal, etc.). These respond to parameters of size and rapid use that is focused at direct and instantaneous actions.

With regard to the tooling, production is aimed at configuring sidescrapers, where the simple ones dominate. Unlike level III, the edges appear more defined and, in certain cases, with a particular reduction, which indicates a long useful life. This is also confirmed by the resharpening flakes attested. In a few cases, this results into sidescrapers of Quina and semiquina morphology, which have a particular thickness and very marked scalariform retouches. To a lesser extent, the tooling configuration is completed by a few notches and denticulates, back knives, and other tool types belonging to the Upper Palaeolithic Group (endscrapers and awls). It is interesting to highlight the Mousterian points because they corroborate the hunting activity of these populations in the site in which the hunting of some Caprinae and Cervidae must have been a fundamental activity.

With regard to the faunal study, data corresponds to a taxonomically diversified assemblage. This is a pattern observed in other regional Middle Palaeolithic contexts, such as Cova Negra, Cova del Bolomor, Abrigo de la Quebrada, or El Salt, generated as a consequence of the development of generalist prey acquisition practices by Neanderthals (Pérez Ripoll 1977; Martínez Valle 1996; Blasco 2011; Salazar-García *et al.* 2013; Sanchis *et al.* 2013; Pérez Luis 2019; Real *et al.* 2019, 2020; Eixea *et al.* 2020a).

The presence of certain thermophilic taxa, like the Mediterranean tortoise (Morales & Sanchis 2009; Sanchis *et al.* 2015a), fits well with the assemblage to MIS 5e-4, when this species proliferates in a prominent manner, as has been observed in contemporary levels of other sites in the area like Cova del Bolomor (Blasco 2008, 2011). In this temperate phase, the appearance of taxa related to the development of forests – like wild boar – is also consistent, while cervids, caprines, leporids and leopards can be considered eurythermal species (Martínez Valle 1995; Sanchis *et al.* 2015b). With regard to the presence of the leopard in the cave, it is interesting to note that this feline is also documented in the nearby sites of Cova de les Malladetes and Cova del Bolomor (Sanchis *et al.* 2015b). The appearance of the remains of this carnivore, free of modifications, prevents us from identifying whether it is an anthropic contribution or an accumulation originated from the natural death of this predator when it occupied the cavity.

Further, the high fragmentation of the assemblage has negatively influenced the level of taxonomic and anatomical determination as well as the quantification and characterization of the modifications. Despite the scarce evidence, the few lithic marks determined in addition to the presence of fresh fractures and a few thermo-alterations appear to indicate an anthropic origin of the accumulation, at least of part of the remains (medium and large ungulates and tortoises). The occurrence of anthropic accumulations of tortoise in Middle Palaeolithic contexts has also been determined in other sites in the area, such as Cova del Bolomor (Blasco 2008, 2011), Abric del Pastor (Sanchis *et al.* 2015a), or Abrigo de la Quebrada (Sanchis *et al.* 2013; Real *et al.* 2020). However, we must also consider the presence of carnivores, both by the appearance of the leopard remains and by the carnivore marks present on the remains of ungulates, although we do not have sufficient data to further specify the role of carnivores at the site. Furthermore, in the case of leporids, there are no signs indicating the origin of these contributions. In other synchronic contexts, like Cova del Bolomor, accumulations of these prey of anthropic and mixed origin have been identified (Blasco 2011; Sanchis 2012), while in Cova Negra most of these aggregates are related to birds of prey (Martínez Valle 1996; Sanchis 2000).

The poor state of preservation of the faunal assemblage along with the high level of fragmentation and the spatial limitations of the excavation imply insufficient information to justify the use of the cave as a stable settlement. The conclusions provided by the study of the fauna, along with the results of the lithic industry, suggest a probable occasional use of this space for short periods of time where Neanderthal groups would take advantage of the environment for supplies.

With regard to occupational patterns, there is a certain difference between levels II and III. As we indicated earlier, these are based on the different technical aspects of the lithic industry, but the most interesting aspect is density. In level III, the density of pieces per m^3 is 833.3, while in level II it exceeds 6500 remains. In this sense, the Cova del Puntal de Gat level II constitutes the regional record with the highest density of lithic elements. In addition, it doubles in number to one of the richest sites like Abrigo de la Quebrada level IV. Thus, we believe that this high density is due to frequent use of the cavity by human groups which settled there for short periods of time (lack of refitting, presence of fragmented operative chains, documentation of intense processes of resharpening on the cutting edges, recycling tools, etc.). The density of the materials and the thickness of the level makes it difficult to distinguish all occupational events and the intensity or duration of each one. Despite this, we believe that probably the intensity of the activities was high, as is evident with the amount of remains generated, both at the lithic and faunal viewpoints (high fracturing, no refitting lines, etc.).

If we focus on the regional context, the sites dated around MIS 5e, but particularly with the arrival of MIS 4, are scarce. Despite being an area very rich in Palaeolithic sites, there is no evidence of any assemblage assigned to this chronology in the neighbourhood near Cova del Puntal del Gat. To do this, we have to look further away in areas both to the south and north. On the one hand, heading southwest, approximately 50 km away, we find Abric Pastor (Alcoi, Alicante). Anthracological data show a rich diversity of woody taxa, thereby indicating meso-supra-Mediterranean conditions, with the dominance of *Juniperus* sp. along with low proportions of *Pinus nigra*/*sylvestris* and the presence of some termophilous plants (*Pistacia* sp., evergreen *Quercus* L. or *Taxus baccata* L.) (Vidal-Matutano *et al.* 2015). As in Cova del Puntal del Gat level II, lithic technology is characterised by a predominance of recurrent centripetal Levallois sequences, alongside a lesser representation of other non-Levallois technical strategies, such as polyhedral and orthogonal procedures (Machado *et al.* 2013). Furthermore, faunal strategies are focused on cervids, goats, and tortoises (Sanchis *et al.* 2015a). The occupational pattern shows low density of finds around hearths (27.2 lithic remains per m^3 and 30.2 bone remains per m^3), which indicates a single episode of human occupation linked to animal processing and consumption (Machado *et al.* 2015; Mallol *et al.* 2019).

On the other hand, more than 100 km towards the north is the Abrigo de la Quebrada (Chelva, Valencia). There, levels II-V are dated within a range that oscillates between MIS 5 and 3. Although it cannot be specified in better detail, we must interpret and assess the results with some caution. Paleoenvironmental reconstruction reveals mountain pine forests and permanent grass formations containing humid zones and open spaces that would have harboured an eurythermal microfauna, which were the dominant landscape type. In addition, cold-climate pines provided most of the firewood (Carrión *et al.* 2019b). With regard to lithic technology, the productions are combined between discoid and Levallois strategies, both with similar values at all these levels. In these cases, the operating chains present lower fragmentation than at the other levels, thereby documenting different refitting lines, particularly in minority raw materials such as quartzite and limestone. A high representation of the production is microlithic (approximately 30-50% of the total assemblage) in which the core volumetric reduction ends in final blanks below 2 cm in length and width (Eixea *et al.* 2016). In the tooling, there is an absolute dominance of the simple sidescrapers and a good proportion of Mousterian points. With regard to faunal remains, the bone assemblage is highly fragmented (>90%) and the remains are smaller than 3 cm. The data indicate a hunting activity focused on medium and large ungulates such as Caprinae, Equidae, and Cervidae, but also with the presence of small prey such as tortoise and rabbit, although the latter could not be determined as being of anthropic origin (Sanchis *et al.* 2013; Real *et al.* 2020). In addition, spatial distribution constitutes a clear cumulative palimpsest with an enormous density of finds, both lithic (3156 lithics per m^3 in level IV) and bone (16 817.8 bones per m^3 in level IV), in which different occupations, short though recurrent, are structured around the combustion structures and the same rockshelter morphology (Eixea *et al.* 2011-2012; Villaverde *et al.* 2017).

Thus, during this period, particularly for the final part, regional knowledge is rather scarce. As has been indicated by van Andel & Davies (2003), archaeological evidence across the European continent from the end of MIS 5 through MIS 4 suggests that the cooling effects of the latter in the northern hemisphere influenced the Neanderthal population. There is an apparent reduction in the number of sites which suggests population shrinkage or redistribution. In our case, these features are similar because, as we defined previously and from the sites that we have directly dated, the presence of levels assigned to MIS 5 are abundant (Bolomor IV-1 and IV-2, Cova Negra II to IV; El Pinar; Tossal de la Font; Quebrada VII to IX; Aljezares I and II; Cova del Puntal del Gat III). In this sense, we agree that those with chronologies belonging to MIS 4 would be the minority (Abric Pastor IVa, b, and c and, probably, a part of Cova del Puntal del Gat II). In the same manner, we disagree that there are more sites, in recent years, that belong to MIS 3 (only Beneito X to XII, El Salt V to XII) because most of them do not have direct dates (i.e., San Luís, Las Fuentes, Petxina, Cochino, Cova de les Calaveres, Cova del Corb, Carcalín, Alt de la Capella, Bancals de Pere Jordi, or La Coca). Another special example is south of the Loire river valley, where Banks *et al.* (2021) observed that the ecological niche of culturally cohesive Neanderthal populations contracted and shifted. Some of these populations elaborated highly adaptive cultural innovations in order to continue exploiting habitual territories whose environmental characteristics were affected by pronounced climate change. A continuous exploitation of the same territories throughout periods of dramatic environmental change required cultural flexibility, as previous cultural adaptations could no longer be effective in the face of new ecological conditions. Such flexibility was manifested by the appearance of the Quina lithic production system during MIS 4 (Banks *et al.* (2021).

CONCLUSION

The new works developed at Cova del Puntal del Gat site provide new information regarding the Neanderthal settlement in the central area of the Mediterranean Basin. In addition, this information obtained from different proxies – such as stratigraphic, micromorphological, chronometric, paleoenvironmental, archeozoological, and technological data – helps us to better understand the economic, cultural, and social dynamics of these groups. All this is framed within a battery of dates that enables us to establish the site in its specific context and draw up a comparative framework in a regional study bodywork in which numerous assemblages dated during MIS 4 and 5 are documented.

In this sense, the review of these chronostratigraphic sites has enabled us to reorganize many of them that were originally included in MIS 3, towards older chronologies belonging to the end of MIS 4 and throughout MIS 5. During this last period, the paleoclimatic data indicate an improvement episode that appears to translate into a greater and more stable population settlement throughout the central region of the Iberian Mediterranean than during MIS 4. In this context, new work perspectives are opened when interpreting a regional archaeological record with the aim of revaluing lithic and faunal collections, paleoclimatic data, etc. and conducting extensive dating programs by means of greater reliability than that provided by radiocarbon methods, such as ESR or OSL. This is essential to integrate all these sites in a new regional chronostratigraphic sequence that enables us to analyse the different subsistence strategies of the Neanderthal groups that inhabited this area.

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REFERENCES

Adamiec G. & Aitken M. 1998. — Dose-rate conversion factor: update. *Ancient TL* 16: 37-50.

Aitken M. 1999. — Archaeological dating using physical phenomena. *Reports on Progress in Physics* 62 (9): 1333-1376. https://doi.org/10.1088/0034-4885/62/9/202

Alcaraz-Castaño M., Alcolea-Gonzalez J., Kehl M., Albert R. M., Baena-Preysler J., de Balbín-Behrmann R., Cuartero F., Cuanca-Bescós G., Jiménez-Barredo F., López-Sáez J. A., Piqué R., Rodríguz-Antón D., Yravedra J. & Weniger G. C. 2017. — A context for the last Neandertals of interior Iberia: Los Casares cave revisited. *PLoS ONE* 12: e0180823. https://doi.org/10.1371/journal.pone.0180823

Álvarez-Alonso D. 2014. — First Neanderthal settlements in northern Iberia: The Acheulean and the emergence of Mousterian technology in the Cantabrian region. *Quaternary International* 326-327: 288-306. https://doi.org/10.1016/j.quaint.2012.12.023

Álvarez-Alonso D., de Andrés-Herrero M., Díez-Herrero A., Medialdea A. & Rojo-Hernández J. 2018. — Neanderthal settlement in central Iberia: Geo-archaeological research in the Abrigo del Molino site, MIS 3 (Segovia, Iberian Peninsula). *Quaternary International* 474 Part A: 85-97. https://doi.org/10.1016/j.quaint.2016.05.027

AMC 2002. — Analytical Methods Committee. RobStat.xla. Available at the following address: https://www.rsc.org/membership-and-community/connect-with-others/join-scientific-networks/subject-communities/analytical-science-community/amc/software/

Andrews P. 1990. — *Owls, caves and fossils*. Chicago, University of Chicago Press, 239 p.

Andrews P. & Nesbit-Evans E. 1983. — Small mammal bone accumulations produced by mammalian carnivores. *Paleobiology* 9 (3): 289-307. https://doi.org/10.1017/S0094837300007703

Aparicio J., Gurrea V. & Climent S. 1983. — *Carta arqueológica de La Safor*. Ayuntamiento de Gandía, Gandia, 401 p.

Arrizabalaga A., Ríos Garaízar J. & Álvarez-Alonso D. 2015. — The Past is Out There. Open-air Palaeolithic sites and new research strategies in the Cantabrian region (northern Iberia). *Quaternary International* 364: 181-187. https://doi.org/10.1016/j.quaint.2014.07.051

AYARZAGÜENA J.& LÓPEZ-MARTÍNEZ N. 1976. — Estudio filogenético y comparativo de *Microtus cabrerae* y *Microtus brecciensis*. Doñana. *Acta Vertebrata* 3: 181-204.

BANKS W., MONCEL M. H., RAYNAL J. P., COBOS M., ROMERO-ALVAREZ D., WOILLEZ M. N, FAIVRE J. P., GRAVINA B., D'ERRICO F., LOCHT J. L. & SANTOS F. 2021. — An ecological niche shift for Neanderthal populations in Western Europe 70,000 years ago. *Scientific reports* 11: 5346. https://doi.org/10.1038/s41598-021-84805-6

BARBÉRO M., LOISEL R., QUÉZEL P., RICHARDSON D. M. & ROMANE F. 1998. — Pines of the Mediterranean basin, *in* RICHARDSON D. M. (ed.), *Ecology and biogeography of* Pinus. Cambridge University Press, Cambridge: 153-170.

BELENGUER R., MONSALVE M. A., LÓPEZ-ALABAU A., GUILLEM P. M., BARONA J., BELDA A. & LÓPEZ-IBORRA G. M. 2016. — Nuevas aportaciones al conocimiento de la distribución del topillo de *Cabrera Iberomys cabrerae* (Thomas, 1906) en el Levante peninsular. *Galemys* 28: 53-56. https://doi.org/10.7325/Galemys.2016.N1

BELENGUER R., LLORIS F. J., AGUILAR J. M., MONSALVE M. A., BELDA A. & LÓPEZ-IBORRA. G. M. 2017. — Primeros datos sobre la situación del topillo de *Cabrera Iberomys cabrerae* (Thomas, 1906) en la provincia de Castelló y ampliación hacia el sur de su distribución en València. *Nemus* 7: 123-128

BENNÀSAR M. 2010. — *Tafonomía de micromamíferos del Pleistoceno Inferior de la Sierra de Atapuerca (Burgos): La Sima del Elefante y la Gran Dolina*. Unpublished PhD thesis, Universitat Rovira i Virgili, Tarragona, 646 p.

BISCAYE P. E. 1965. — Mineralogy and sedimentation of recent deep-sea clay in the Atlantic Ocean and adjacent seas and oceans. *Geological Society of America Bulletin* 76 (7): 803-832. https://doi.org/b7mfh5

BLAIR T. C. & MCPHERSON J. G. 2009. — Processes and forms of alluvial fans, *in* PARSONS A. J. & ABRAMS A. D. (eds), *Geomorphology and Desert Environments*. Springer, Dordrecht: 413-467. https://doi.org/10.1007/978-94-015-8254-4_14

BLASCO R. 2008. — Human consumption of tortoises at level IV of Bolomor cave (Valencia, Spain). *Journal of Archaeological Science* 35 (10): 2839-2848. https://doi.org/10.1016/j.jas.2008.05.013

BLASCO R. 2011. — *La amplitud de la dieta cárnica en el Pleistoceno medio peninsular: una aproximación a partir de la Cova del Bolomor (Tavernes de la Valldigna, Valencia) y del subnivel TD10-1 de Gran Dolina (Sierra de Atapuerca, Burgos)*. Unpublished PhD thesis, Universitat Rovira i Virgili, Tarragona, 704 p.

BLASCO R. & FERNÁNDEZ-PERIS J. 2012. — A uniquely broad spectrum diet during the middle pleistocene at bolomor cave (Valencia, Spain). *Quaternary International* 252: 16-31. https://doi.org/10.1016/j.quaint.2011.03.019

BOËDA E. 1995. — Levallois: a volumetric construction, methods, a technique, *in* DIBBLE H. & BAR YOSEF O. (eds), *The definition and interpretation of Levallois technology*. Prehistory Press, Madison: 41-68.

BOËDA E., GENESTE J. M. & MEIGNEN L. 1990. — Identification de chaînes opératoires lithiques du Paléolithique ancien et moyen. *Paléo* 2: 43-80. https://doi.org/10.3406/pal.1990.988

BOJNĂNSKÝ V. & FARGAŠOVÁ A. 2007. — *Atlas of seeds and fruits of Central and East European flora. The Carpathian Mountains Region*. Springer, Dordrecht, 1046 p. https://doi.org/10.1007/978-1-4020-5362-7

BORDES F. 1961. — *Typologie du Paléolithique ancien et moyen*. CNRS, Paris, 238 p.

BOURGUIGNON L. 1996. — La conception de débitage Quina. *Quaternaria Nova* IV: 149-169.

BOWMAN D. 2019. — *Principles of alluvial fan morphology*. Springer, Dordrecht, 151 p. https://doi.org/10.1007/978-94-024-1558-2

BRINDLEY G. W. & BROWN G. 1980. — *Crystal Structures of Clay Minerals and their X-Ray Identification*. Mineralogical Society, London, 485 p.

BRUNET-LECOMTE P. & CHALINE J. 1993. — Mise ou point sur *Microtus (Terricola) pyrenaicus gerbei* (Gerbe, 1879) (Rodentia, Arvicolidae). *Mammalia* 571: 139-142.

BURBIDGE C. I., SANDERSON D., HOUSLEY R., JONE P. & ALLSWORTH JONES P. 2007. — Survey of Palaeolithic sites by luminescence profiling, a case study from Eastern Europe. *Quaternary Geochronology* 2 (1-4): 296-302. https://doi.org/10.1016/j.quageo.2006.05.024

BURBIDGE C. I., TRINDADE M., DIAS M. I., OOSTERBEEK L., SCARRE C., ROSINA P., CRUZ A., CURA S., CURA P., CARON L., PRUDÊNCIO M. I., CARDOSO G., FRANCO D., MARQUES R. & GOMES H. 2014. — Luminescence dating and associated analyses in transition landscapes of the Alto Ribatejo, Central Portugal. *Quaternary Geochronology* 20: 65-77. https://doi.org/10.1016/j.quageo.2013.11.002

CABANILLES J. J. 2016. — *Cova del Puntal del Gat (Benirredrà, València). Informe tècnic del jaciment arqueològic*. Conselleria d'Educació, Investigació, Cultura i Esport de la Generalitat Valenciana, Valencia. Unpublished report, 26 p.

CABRERA-MILLET M., LÓPEZ-MARTÍNEZ N. & MICHAUX J. 1983. — Un exemple de ligne endémique iberoccitane, les campagnols *Microtus brecciensis* et *Microtus cabrerae* (Mammalia, Rodentia). Etude Phylogénétique et contexte écologique d'un phénomène évolutif récent, *in* BUFFETAUT E., MAZIN J. M. & SALMON E. (eds), *Actes du Symposium Paléontologique*, Montbéliard, France: 69-83.

CALVO L. 1908. — *Hidrografía subterránea: conocimientos sobre los terrenos para la investigación de manantiales*. Auca Llibres Antics, Gandía, 289 p.

CAPPERS R. T. J., BEKKER R. M. & JANS J. E. A. 2006. — *Digital seed atlas of The Netherlands*. Barkhuis, Groningen. Available at the following address: https://www.plantatlas.eu/

CAPPERS R. T. J., NEEF R. & BEKKER R. M. 2009. — *Digital atlas of economic plants*. Barkhuis, Groningen. Available at the following address: https://www.barkhuis.nl

CARRIÓN J., FERNÁNDEZ S., JIMÉNEZ-ARENAS J. M., MUNUERA M., OCHANDO J., AMORÁS G., PONCE DE LEÓN M., ZOLLIKOFER C., MARTÍN-LERMA I., TORO-MOYANO I., HAJDAS I. & WALKER M. J. 2019a. — The sequence at Carihuela Cave and its potential for research into Neanderthal ecology and the Mousterian in southern Spain. *Quaternary Science Reviews* 217: 194-216. https://doi.org/10.1016/j.quascirev.2019.04.012

CARRIÓN Y., GUILLEM P., EIXEA A., MARTÍNEZ-VAREA C., TORMO C., BADAL E., ZILHÃO J. & VILLAVERDE V. 2019b. — Climate, environment and human behaviour in the Middle Palaeolithic of Abrigo de la Quebrada (Valencia, Spain): The evidence from charred plant and micromammal remains. *Quaternary Science Review* 217: 152-168. https://doi.org/10.1016/j.quascirev.2018.11.032

CASABÓ J. & ROVIRA M. L. 1992. — El Pinar, yacimiento al aire libre con industria sobre lascas del Paleolítico Medio. Avance preliminar, *in* UTRILLA P. (ed.), *Aragón-litoral Mediterráneo: intercambios culturales durante la Prehistoria. Homenaje a Juan Maluquer de Motes*. Institución Fernando el Católico, Zaragoza: 89-95.

CHALINE J. 1977. — Les rongeurs au pilori ? Analyse critique des reconstitutions paléoécologiques en microthériodontologie. *Bulletin de l'Association Française pour l'étude du Quaternaire* 47: 75-81.

COTILLA I. & PALOMO L. J. 2007. — *Microtus duodecimcostatus* (de Sélys-Longchamps, 1839), *in* PALOMO L. J., GISBERT J. & BLANCO J. C. (eds), *Atlas y libro rojo de los mamíferos terrestres de España*. Dirección General para la Biodiversidad, Madrid: 422-425.

CRIVELLANO A. & SCHWEINGRUBER F. H. 2013. — *Atlas of Wood, Bark and Pith Anatomy of Eastern Mediterranean Trees and Shrubs with a Special Focus on Cyprus*. Springer, Heidelberg, 583 p. https://doi.org/10.1007/978-3-642-37235-3

CUARTERO F. 2007. — Tecnología lítica en Cova del Bolomor nivel IV. ¿Una economía de reciclado? *Saguntum* 39: 27-44.

Cuenca-Bescós G., Canudo J. I. & Laplana C. 1995. — Los arvicólidos (Rodentia, Mammalia) de los niveles inferiores de Gran Dolina (Pleistoceno inferior, Atapuerca, Burgos, España). *Revista Española de Paleontología* 10: 202-218.

Cuenca-Bescós G., Laplana C., Canudo J. I. & Arsuaga J. L. 1997. — Small mammals from Sima de los Huesos. *Journal of Human Evolution* 33 (2-3): 175-190. https://doi.org/10.1006/jhev.1997.0153

Cuenca-Bescós G., Rofes J. & Garcia-Pimienta j. 2005. — Environmental change across the Early-Middle Pleistocene transition: small mammalian evidence from the Trinchera Dolina cave, Atapuerca, Spain, *in* Head M. J. & Gibbard P. L. (eds), *Early-Middle Pleistocene Transitions: The Land-Ocean Evidence*. Geological Society 247 (1): 277-286. https://doi.org/10.1144/GSL.SP.2005.247.01.16

Cuenca-Bescós G., Straus L. G., Gonzalez Morales M. & García Pimienta J. C. 2008. — Paleoclima y Paisaje del final del Cuaternario en Cantabria: los pequeños mamíferos de la cueva del Mirón (Ramales de la Victoria). *Revista Española de Paleontología* 23 (1): 91-126. https://doi.org/10.7203/sjp.23.1.20398

Cuenca-Bescós G., Rofes J., López-García J. M., Blain H. A., de Marfá J. R., Galindo M. A., Bennàsar M. L., Melero Rubio M., Arsuaga J. L., Bermúdez de Castro J. M. & Carbonell E. 2010. — Biochronology of Spanish Quaternary small vertebrate faunas. *Quaternary International* 212 (2): 109-119. https://doi.org/10.1016/j.quaint.2009.06.007

Cuevas-González J., Pérez-Tarruella Díez-Canseco D., Élez J., García-Gandía J. R. & Mejías F. 2018. — Estudio de los depósitos cuaternarios del Paraje Natural Municipal de Los Aljezares (Aspe, Alicante): primeras aportaciones. *Geogaceta* 63: 15-18.

Cuevas-González J., Díez-Canseco D., Élez J., Eixea A., Ibáñez V. & Civieta O. 2019. — *Reconstrucción paleoambiental del yacimiento arqueológico del Paleolítico medio de Los Aljezares (Aspe, Alicante): Implicaciones con otros yacimientos y depósitos cercanos*. Actas XV Reunión Nacional de Cuaternario, Bilbao: 129-132.

Damms R. 1981. — The dental pattern of the dormice Dryomys, Myomimus, Microdyromys and Peridryomys. *Utrecht Micropaleontological Bulletins Special Publication* 3: 1-115.

Duller G. 2003. — Distinguishing quartz and feldspar in single grain luminescence measurements. *Radiation Measurements* 37 (2): 161-165. https://doi.org/10.1016/S1350-4487(02)00170-1

Duller G. 2015. — The Analyst software package for luminescence data: overview and recent improvements. *Ancient TL* 33: 35-42.

Eixea A. 2015. — *Caracterización tecnológica y uso del espacio en los yacimientos del Paleolítico medio de la región central del Mediterráneo Ibérico*. Unpublished PhD thesis, Universitat de València, Valencia, 1043 p.

Eixea A. 2018. — Middle Palaeolithic lithic assemblages in western Mediterranean Europe from MIS 5 to 3. *Journal of Archaeological Science: Reports* 21: 643-666. https://doi.org/10.1016/j.jasrep.2018.08.039

Eixea A. & Villaverde V. 2012. — Materiales líticos del Paleolítico medio y superior en el yacimiento de superficie dels Bancals de Pere Jordi (La Vall de Gallinera, Alicante). *Archivo de Prehistoria Levantina* XXIX: 65-79.

Eixea A., Villaverde V., Zilhão J., Sanchis A., Morales J., Real C. & Bergadà M. 2011-2012. — El nivel IV del Abrigo de la Quebrada (Chelva, Valencia). Análisis microespacial y valoración del uso del espacio en los yacimientos del Paleolítico medio valenciano. *Mainake* XXXIII: 127-158.

Eixea A., Villaverde V. & Zilhão J. 2016. — Not Only Flint: Levallois on Quartzite and Limestone at Abrigo de la Quebrada (Valencia, Spain): Implications for Neandertal Behavior. *Journal of Anthropological Research* 72 (1): 24-57. https://doi.org/10.1086/685265

Eixea A., Villaverde V. & Zilhão J. 2018. — L'évolution des assemblages lithiques des niveaux du Paléolithique moyen de l'Abrigo de la Quebrada (Valencia, Espagne). *L'Anthropologie* 122 (4): 1227-1251. https://doi.org/10.1016/j.anthro.2018.09.002

Eixea A., Bargalló A., Chacón M. G., Romagnoli F., Sanchis A., Vaquero M. & Villaverde V. 2020a. — Neanderthal spatial patterns and occupation dynamics: a focus on the central region in Mediterranean Iberia. *Journal of World Prehistory* 33: 267-324. https://doi.org/10.1007/s10963-020-09143-3

Eixea A., Oltra I., Bergadà M. & Villaverde V. 2020b. — The reinterpretation of Cova Negra archaeological and stratigraphical sequence and its implications in the knowledge of the Middle Palaeolithic Iberian Peninsula. *Quaternary International* 566-567: 98-112. https://doi.org/10.1016/j.quaint.2020.04.007

Eixea A., Cuevas-González J., Díez-Canseco D. & García-Gandía J. R. 2020c. — *Proyecto geoarqueológico en el Paraje Natural Municipal de Los Algezares: una estación al aire libre del Paleolítico medio en la cuenca del río Vinalopó. Campañas 2016-2020*. Ayuntamiento de Aspe, Aspe, 73 p.

Eixea A., Cuevas-González J., Díez-Canseco D., Bel M. A., Bonnet A., Carrión Y., Martínez-Alfaro A., Martínez-Rubio V., Martínez-Varea C., Pardo R. & Rios-Garaizar J. 2022. — Los Aljezares site (Alicante, Spain) and the MIS 6/5 open-air settlement in the Iberian Peninsula. *Journal of Quaternary Science* 37 (6): 1091-1111. https://doi.org/10.1002/jqs.3424

Fernández-Jalvo Y. 1992. — *Tafonomía de microvertebrados del complejo kárstico de Atapuerca (Burgos)*. Unpublished PhD thesis, Universidad Complutense de Madrid, Madrid, 559 p.

Fernández-Jalvo Y. & Andrews P. 1992. — Small mammal taphonomy of Gran Dolina (Atapuerca, Burgos, Spain). *Journal of Archaeological Science* 19 (4): 407-428. https://doi.org/10.1016/0305-4403(92)90058-B

Fernández-Jalvo Y. & Andrews P. 2016. — *Atlas of Taphonomic Identifications: 1001+Images of Fossil and Recent Mammal Bone Modification*. Vertebrate Paleobiology and Paleoanthropology Series. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-7432-1

Fernández Peris J. 2007. — *La cova del Bolomor (Tavernes de la Valldigna, Valencia). Las industrias líticas del Pleistoceno medio en el ámbito del Mediterráneo peninsular*. Servicio de Investigación Prehistórica, Diputación Provincial de Valencia 108, 463 p.

Fernández Peris J., Guillem P., Fumanal M. P. & Martínez Valle R. 1994. — Cova del Bolomor (Tavernes de la Valldigna, Valencia), primeros datos de una secuencia del Pleistoceno medio. *Saguntum* 27: 9-37.

Fernández Peris J., Barciela V., Blasco R., Cuartero F., Fluck H., Sañudo P. & Verdasco C. 2012. — The earliest evidence of hearths in southern Europe: the case of Bolomor Cave (Valencia, Spain). *Quaternary International* 247: 267-277. https://doi.org/10.1016/j.quaint.2010.10.014

Fernández-Salvador R. 2007. — *Microtus cabrerae* (Thomas, 1906), *in* Palomo L. J., Gisbert J. & Blanco J. C. (eds), *Atlas y libro rojo de los mamíferos terrestres de España*. Dirección General para la Biodiversidad, Madrid: 429-433.

Ferrer-García C. 2015. — *Estudios geoarqueológicos en las comarcas meridionales valencianas. Procesos sedimentarios holocenos*. Unpublished PhD thesis, Universitat de València, Valencia, 417 p.

Finlayson C. 2019. — *The Smart Neanderthal: Bird catching, Cave Art, and the Cognitive Revolution*. Oxford University Press, Oxford, 240 p.

Fumanal M. P. 1986. — *Sedimentología y clima en el País Valenciano: las cuevas habitadas en el cuaternario reciente*. Servicio de Investigación Prehistórica, Diputación Provincial de Valencia 83, 207 p.

Fumanal M. P. & Villaverde V. 2009. — Las excavaciones en la Cova Negra en los años 80, la estratigrafía y el marco cronológico, *in* Villaverde V., Pérez Ballester J. & Ledo A. (eds), *Historia de Xàtiva, Prehistoria, Arqueología y Antigüedad, II. Los primeros pobladores de la Costera: los Neandertales de la Cova Negra de Xátiva*. Ajuntament de Xátiva, Xàtiva: 35-57.

Gale R. & Cutler D. 2000. — *Plants in Archaeology. Identification Manual of Vegetative Plants Materials Used in Europe and Southern Mediterranean to C. 1500*. Westbury and Royal botanic Gardens, Kew, 512 p.

Galindo-Pellicena M. A., Cuenca-Bescós G. & Arsuaga J. L. 2011. — Los micromamíferos (Rodentia, Soricomorpha, Erinaceomorfa, Lagomorpha y Chiroptera) del Pleistoceno Medio de la Covacha de los Zarpazos (Sierra de Atapuerca, Burgos, España). *Boletín de la Real Sociedad Española de Historia Natural. Sección geológica* 105: 87-97.

Galván B. 1992. — El Salt (Alcoy, Alicante): Estado actual de las investigaciones. *Recerques del Museu d'Alcoi* 1: 73-80.

Galván B., Hernández C. M., Alberto-Barroso V., Barro R., Francisco M. I. & Rodríguez A. 2001. — Las sociedades cazadoras-recolectoras Neandertalianas en los Valles de Alcoi (Alicante, España). El Salt Como Un Centro de intervención Referencial. *Tabona* 10: 7-33.

Galván B., Hernández C. M., Mallol C., Mercier N., Sistiaga M. A. & Soler V. 2014. — New evidence of early Neanderthal disappearance in the Iberian Peninsula. *Journal of Human Evolution* 75: 16-27. https://doi.org/10.1016/j.jhevol.2014.06.002

Garay P. 1980. — *Hidrogeología de la sierra Falconera y valle de Marjuquera (Valencia)*. VII Simpòsium d'Espeleologia, Sabadell: 1-18.

Garay P. 1983. — Tipología del karst mediterráneo. El macizo del Mondúver (Gandía, Valencia). *Lapiaz* 11: 47-57.

Guillem P. 1994. — *Sondeos arqueológicos en la variante de la carretera N-332 a su paso por la localidad de Gandía*. Unpublished report, 12 p.

Guillem P. M. 1996. — *Micromamíferos cuaternarios del País Valenciano: tafonomía, bioestratigrafía y reconstrucción paleoambiental*. Unpublished PhD thesis, Universitat de València, Valencia, 441 p.

Guillem P. M. 2001. — Los micromamíferos y la secuencia climática del Pleistoceno medio, Pleistoceno superior y Holoceno en la fachada central mediterrània, *in* Villaverde V. (ed.), *De Neandertales a Cromañones. El inicio del poblamiento humano en las tierras valencianas*. Universitat de València, Valencia: 57-72.

Guillem P. M. & Martínez Valle R. 2017. — Secuencia bioestratigráfica del Alto de las Picarazas (Andilla-Chelva,València) a partir de Arvicolidae, *in* Sanchis A. & Pascual J. L. (eds), *Interaccions entre felins i humans. III Jornades d'arqueozoologia*. Museu de Prehistòria de València, Valencia: 289-307.

Gutiérrez-Zugasti I., Rios-Garaizar J., Marín-Arroyo A. B., Rasines del Río P., Maroto J., Jones J. R., Bailey G. N. & Richards M. P. 2018. — A chrono-cultural reassessment of the levels VI–XIV from El Cuco rock-shelter: a new sequence for the Late Middle Paleolithic in the Cantabrian region (northern Iberia). *Quaternary International* 474 Part A: 44-55. https://doi.org/10.1016/j.quaint.2017.06.059

Harvey A. M., Mather A. E. & Stokes M. 2005. — Alluvial fans: geomorphology, sedimentology, dynamics - introduction. A review of alluvial-fan research. *Geological Society, London, Special Publications* 251 (1): 1-7. https://doi.org/10.1144/GSL.SP.2005.251.01.01

Iturbe G. & Cortell E. 1982. — Cova Beneito: avance rpeliminar. *Saguntum* 17: 9-44.

Iturbe G. & Cortell E. 1987. — Las dataciones de Cova Beneito y su interés para el paleolítico mediterráneo. *Trabajos de Prehistoria* 44: 267-270.

Iturbe G., Fumanal M. P., Carrión J., Cortell E., Martínez R., Guillem P., Garralda M. D. & Vandermeersch B. 1993. — Cova Beneito (Muro, Alicante): Una perspectiva interdisciplinar. *Recerques del Museu d'Alcoi* 2: 23-88.

Jiménez J., Guillem P. M. & Martínez Valle R. 1989. — Notas sobre la distribución en el extremo meridional del Sistema Ibérico de *Neomys anomalus* y *Microtus Arvalis*. *Medi Natural* 1-2: 121-123.

Jiménez J., Monsalve M. A. & Raga J. A. 2012. — *Los mamíferos de la Comunitat Valenciana*. Conselleria d'Infraestructures. Territori i Medi Ambient. Generalitat Valenciana, Valencia, 303 p.

Jubete F. 2007. — *Apodemus sylvaticus* (Linnaeus, 1758), *in* Palomo L. J., Gisbert J. & Blanco J. C. (eds), *Atlas y libro rojo de los mamíferos terrestres de España*. Dirección General para la Biodiversidad, Madrid: 449-451.

Julien M. 1992. — Du fossile directeur a la chaîne opératoire, *in* Garanger J. (ed.), *La Prehistoire dans le monde*. Presses Universitaires de France (coll. Nouvelle Clio), Paris: 163-193.

Karlin C., Bodu P. & Pelegrin J. 1991. — Processus techniques et chaînes opératoires. Comment les préhistoriens s'approprient un concept élaboré par les ethnologues, *in* Balfet H. (ed.), *Observer l'action technique: des chaînes opératoires, pour quoi faire?* Éditions du CNRS, Paris: 101-117.

Klein R. G. & Cruz-Uribe K. 1984. — *The Analysis of Animal Bones from Archaeological sites*. The University of Chicago Press, Chicago, 272 p.

Laplana C. & Sevilla P. 2013. — Documenting the biogeographic history of *Microtus cabrerae* through its fossil record. *Mammal Review* 43 (4): 309-322. https://doi.org/10.1111/mam.12003

Lemonnier P. 1986. — The study of material culture today: toward an anthropology of technical systems. *Journal of Anthropoogical Archaeology* 5 (2): 147-186. https://doi.org/10.1016/0278-4165(86)90012-7

Lin S. C. & Marreiros J. 2020 — Quina retouch does not maintain edge angle over reduction. *Lithic Technology* 46 (1): 45-59. https://doi.org/10.1080/01977261.2020.1819048

López-García J. M. 2008. — *Evolución de la diversidad taxonómica de los micromamíferos en la Península ibérica y cambios paleoambientales durante el Pleistoceno superior*. Unpublished PhD thesis, Universitat Rovira i Virgili, Tarragona, 407 p.

Lyman R. L. 1994. — *Vertebrate Taphonomy*. Cambridge University Press, Cambridge, 524 p. https://doi.org/10.1017/CBO9781139878302

Lyman R. L. 2008. — *Quantitative Paleozoology*. Cambridge University Press, Cambridge, 348 p. https://doi.org/10.1017/CBO9780511813863

Machado J. & Pérez L. 2016. — Temporal frameworks to approach human behavior concealed in Middle Palaeolithic palimpsests: A highr esolution example from El Salt Stratigraphic Unit X (Alicante, Spain). *Quaternary International* 417: 66-81. https://doi.org/10.1016/j.quaint.2015.11.050

Machado J., Hernández C. M., Mallol C. & Galván B. 2013. — Lithic production, site formation and Middle Palaeolithic palimpsest analysis: in search of human occupation episodes at Abric del Pastor stratigraphic Unit IV (Alicante, Spain). *Journal of Archaeological Science* 40 (5): 2254-2273. https://doi.org/10.1016/j.jas.2013.01.002

Machado J., Mallol C. & Hernández C. 2015. — Insights into Eurasian Middle Palaeolithic settlement dynamics: the palimpsest problem, *in* Conard N. (ed.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age*. Kerns Verlag, Tübingen: 361-382.

Mallol C., Hernández C., Mercier N., Falguères C., Carrancho A., Cabanes D., Vidal-Matutano P., Connolly R., Pérez L., Mayor A., Ben Arous E. & Galván B. 2019. — Fire and brief human occupations in Iberia during MIS 4: Evidence from Abric del Pastor (Alcoy, Spain). *Scientific Reports* 9: 18281. https://doi.org/10.1038/s41598-019-54305-9

Marín-Arroyo A. B., Rios-Garaizar J., Straus L. G., Jones J. R., de la Rasilla M., González Morales M. R., Richards M., Altuna J., Mariezkurrena K. & Ocio D. 2018a. — Chronological reassessment of the Middle to Upper Paleolithic transition and Early Upper Paleolithic cultures in Cantabrian Spain. *PLoS ONE* 13 (6): e0194708. https://doi.org/10.1371/journal.pone.0194708

Marín-Arroyo A. B., Geiling J. M., Jones J. R., González-Morales M. R., Straus L. G. & Richards M. 2018b. — The Middle to Upper Palaeolithic transition at El Mirón Cave (Cantabria, Spain). *Quaternary International* 544: 23-31. https://doi.org/10.1016/j.quaint.2018.06.036

Marín J., Rodríguez-Hidalgo A., Vallverdú J., Gómez de Soler B., Rivals F., Rabuñal J. R., Pineda A., Chacón M. G., Carbonell E. & Saladié P. 2019. — Neanderthal logistic mobility during MIS3: Zooarchaeological perspective of Abric Romaní level P (Spain). *Quaternary science Review* 225: 106033. https://doi.org/10.1016/j.quascirev.2019.106033

Marques R., Dias M. I., Prudêncio M. I. & Rocha F. 2011. — Upper cretaceous clayey levels from western Portugal (Aveiro and Taveiro regions): clay mineral and trace-element distribution. *Clays and Clay Minerals* 59: 315-327. https://doi.org/10.1346/CCMN.2011.0590307

Marques R., Prudêncio M. I., Russo D., Cardoso G., Dias M. I., Rodrigues A. L., Reis M., Santos M. & Rocha F. 2021. — Evaluation of naturally occurring radionuclides (K, Th and U) in volcanic soils from Fogo Island, Cape Verde. Journal of Radioanalytical and Nuclear Chemistry 330: 347-355. https://doi.org/10.1007/s10967-021-07959-7

Martin-Pozas J. M. 1968. — *El análisis mineralógico cuantitativo de los filosilicatos de la arcilla por difracción de rayos X*. Unpublished PhD thesis, University of Granada, Granada, 479 p.

Martínez Valle R. 1995. — Fauna cuaternaria del País Valenciano. Evolución de las comunidades de macromamíferos, *in El Cuaternario del País Valenciano*. Asociación Española para el Estudio del Cuaternario, Valencia: 235-244.

Martínez Valle R. 1996. — *Fauna del Pleistoceno superior en el País Valenciano: Aspectos económicos, huella de manipulación y valoración paleoambiental*. Unpublished PhD thesis, Universitat de València, Valencia, 936 p.

Martínez Valle R. 2009. — Restos óseos de macromamíferos y aves, *in* Villaverde V., Pérez Ballester J. & Ledo A. (eds), *Historia de Xàtiva, Prehistoria, Arqueología y Antigüedad, II. Los primeros pobladores de la Costera: los Neandertales de la Cova Negra de Xátiva*. Ajuntament de Xátiva, Xàtiva: 59-83.

Martínez Valle R. & Guillem P. M. 2015. — Fauna cuaternaria de Molí Mató (Agres) en el Museu del Centre d'Estudis Contestans, *in Cocentaina: Arqueología y sus museos*. MARQ, Alicante: 42-47.

McKenna M. & Bell S. 1997. — *Classification of mammals above the species level*. Columbia University Press, New York, 631 p.

Miret C. 2017. — La Cova del Puntal del Gat (Benirredrà): una ocupación litoral del paleolític mitjà. *Revista de La Safor* 8: 51-70.

Moclán A., Huguet R., Márquez B., Laplana C., Galindo-Pellicer A. García N., Blain H. A., Álvarez-Lao D., Arsuaga J. L., Pérez-González A. & Baquedano E. 2021. — A neanderthal hunting camp in the central system of the Iberian Peninsula: A zooarchaeological and taphonomic analysis of the Navalmaíllo Rock Shelter (Pinilla del Valle, Spain). *Quaternary Science Reviews* 269: 107142. https://doi.org/10.1016/j.quascirev.2021.107142

Morales J. V. & Sanchis A. 2009. — The Quaternary fossil record of the genus Testudo in the Iberian Peninsula. Archaeological implications and diachronic distribution in the western Mediterranean. *Journal of Archaeological Science* 36 (5): 1152-1162. https://doi.org/10.1016/j.jas.2008.12.019

Morales J. I., Cebrià A., Burguet-Coca A., Fernández-Marchena J. L., García-Argudo G., Rodríguez-Hidalgo A., Soto M., Talamo S., Tejero J. M., Vallverdú J. & Fullola J. M. 2019. — The Middle-to-Upper Paleolithic transition occupations from Cova Foradada (Calafell, NE Iberia). *PLoS ONE* 14: e0215832. https://doi.org/10.1371/journal.pone.0215832

Moreno S. 2007. — *Eliomys quercinus* (Linnaeus, 1766), *in* Palomo L. J., Gisbert J. & Blanco J. C. (eds), *Atlas y libro rojo de los mamíferos terrestres de España*. Dirección General para la Biodiversidad, Madrid: 392-394.

Moreno D., Duval M., Rubio-Jara S., Panera J., Bahain J. J., Shao Q., Pérez-González A. & Falguères C. 2018. — ESR dating of Middle Pleistocene archaeo-paleontological sites from the Manzanares and Jarama river valleys (Madrid basin, Spain). *Quaternary International* 520: 23-38. https://doi.org/10.1016/j.quaint.2017.09.003

Moya R., Sanchis A., Guillem P. M., Martínez Varea C. M., Carrión Marco Y., Martínez Alfaro A., Bel M. A., Ferrer García C. & Eixea A. 2021. — Nuevos conjuntos de fauna del Paleolítico medio de la Cova del Puntal del Gat (Benirredrà, València), *in* Sanchis A. & Pascual Beneito J. L. (eds), *Recull d'estudis de fauna de jaciments valencians. V Jornades d'arqueozoologia*. Museu de Prehistòria de València, Valencia: 61-86.

Murray A. S. & Wintle A. G. 2000. — Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol. *Radiation Measurements* 32 (1): 57-73. https://doi.org/10.1016/S1350-4487(99)00253-X

Murray A. S. & Wintle A. G. 2003. — The single aliquot regenerative dose protocol: Potential for improvements in reliability. *Radiation Measurements* 37 (4-5): 377-381. https://doi.org/10.1016/S1350-4487(03)00053-2

Navazo M. & Carbonell E. 2014. — Neanderthal settlement patterns during MIS 4-3 in Sierra de Atapuerca (Burgos, Spain). *Quaternary International* 331: 267-277. https://doi.org/10.1016/j.quaint.2014.03.032

Nores C. 1988. — Diferenciación biométrica de *Apodemus sylvaticus* y *Apodemus flavicollis* en la Cordillera Cantábrica. Primeros resultados. *Revista de Biología de la Universidad de Oviedo* 6: 109-116.

Ochando J., Carrión J. S., Blasco R., Fernández S., Amorós G., Munuera M., Sañudo P. & Fernández Peris J. 2019. — Silvicolous Neanderthals in the far West: the mid-Pleistocene palaeoecological sequence of Bolomor Cave (Valencia, Spain). *Quaternary Science Reviews* 217: 247-267. https://doi.org/10.1016/j.quascirev.2019.03.015

Odriozola C. P., Burbidge C. I., Dias M. I. & Hurtado V. 2014. — Dating of las mesas copper age walled enclosure (La Fuente, Spain). *Trabajos de Prehistoria* 71 (2): 343-352. https://doi.org/10.3989/tp.2014.12138

Pasquier L. 1974. — *Dynamique évolutive d'un sousgenere de Muridae, Apodemus (Sylvaemus). Etude biometrique des caractères dentaires de populations fossiles et actuelles d'Europe occidentale*. Unpublished PhD thesis, Université de Montpellier, Montpellier, 184 p.

Pérez Luís L. J. 2019. — *Estrategias de subsistencia y dinámicas de asentamiento en los Valles de Alcoy durante el Paleolítico medio. Análisis zooarqueológico, tafonómico y paleoecológico de la secuencia arqueológica de El Salt*. Unpublished PhD thesis, Universitat Rovira i Virgili, Tarragona, 448 p.

Pérez Ripoll M. 1977. — *Los mamíferos del yacimiento musteriense de Cova Negra*. Servicio de Investigación Prehistórica, Diputación Provincial de Valencia 53.

Pérez Ripoll M. 1992. — *Marcas de carnicería, fracturas intencionadas y mordeduras de carnívoros en huesos prehistóricos del Mediterráneo español*. Instituto de Cultura Juan Gil-Albert, Alicante, 269 p.

Picin A. & Carbonell E. 2016. — Neanderthal mobility and technological change in the northeastern of the Iberian Peninsula: the patterns of chert exploitation at the Abric Romaní rock-shelter. *Comptes Rendus Palevol* 15 (5): 581-594. https://doi.org/10.1016/j.crpv.2015.09.012

Porat N., Faerstein G., Medialdea A. & Murray A. S. 2015. — Re-examination of common extraction and purification methods of quartz and feldspar for luminescence dating. *Ancient TL* 33: 255-258.

Prescott J. R. & Stephan L. G. 1982. — The contribution of cosmic radiation to the environmental dose for thermoluminescence dating. Latitude, altitude and depth dependences. *PACT* 6: 17-25.

Prescott J. R. & Hutton J. T. 1988. — Cosmic ray and gamma ray dosimetry for TL and ESR. *International Journal of Radiation Applications and Instrumentation. Part D. Nuclear Tracks and Radiation Measurements* 14 (1-2): 223-227. https://doi.org/10.1016/1359-0189(88)90069-6

Puig y Larraz G. 1896. — *Cavernas y simas de España*. Boletín de la Comisión del Mapa geológico, Madrid, 397 p.

Pulido-Bosch A. 1979. — *Contribución al conocimiento de la hidrogeología del Prebético nororiental (Provincias de Valencia y Alicante)*. Memoria del Instituto Geológico y Minero de España, Madrid, 350p.

de la Rasilla M., Duarte E., Sanchis A., Carrión Y., Cañaveras J. C., Marín-Arroyo A. B., Real C., Núñez-Lahuerta C., Sánchez-Moral S., Gutiérrez-Zugasti I., Jones J. R., Rigaud S., Martínez-Cuesta R., Torres L., Agudo L. & Santos G. 2020. — Environment and subsistence strategies at La Viña rock shelter and Llonin cave (Asturias, Spain) during MIS 3. *Journal of Archaeological Science: Reports* 30: 102198. https://doi.org/10.1016/j.jasrep.2020.102198

Real C., Eixea A., Sanchis A. & Villaverde V. 2019. — Neanderthal subsistence and short-term human occupation patterns during MIS 5. New data from Abrigo de la Quebrada (Valencia, Spain). *Journal of Archaeological Science Reports* 28: 102056. https://doi.org/10.1016/j.jasrep.2019.102056

Real C., Eixea A. Sanchis A., Morales J. V., Klasen N., Zilhão J. & Villaverde V. 2020. — Abrigo de la Quebrada Level IV (Valencia, Spain): Interpreting a Middle Palaeolithic palimpsest from a zooarchaeological and lithic perspective. *Journal of Palaeolithic Archaeology* 3: 187-224. https://doi.org/10.1007/s41982-018-0012-z

Richard M., Falguères C., Pons-Branchu E., Foliot L., Guillem P. M., Martínez-Valle R., Eixea A. & Villaverde V. 2019. — ESR/U-series chronology of early Neanderthal occupations at Cova Negra (Valence, Spain). *Quaternary Geochronology* 49: 283-290. https://doi.org/10.1016/j.quageo.2018.05.004

Richter D., Zink A., Przegietka K., Cardoso G., Gouveia M. & Prudêncio M. I. 2003. — Source calibrations and blind test results from the new Luminescence Dating Laboratory at the Instituto Tecnológico e Nuclear, Sacavém, Portugal. *Ancient TL* 21: 43-48.

Rios-Garaizar J. 2017. — A new chronological and technological synthesis for Late Middle Paleolithic of the Eastern Cantabrian Region. *Quaternary International* 433 Part B: 50-63. https://doi.org/10.1016/j.quaint.2016.02.020

Rios-Garaizar J., Maíllo-Fernández J. M., Marín-Arroyo A. B., Sánchez Carro M. A., Salazar S., Medina-Alcaide M. A., San Emeterio A., Martínez de Pinillos L. Garate D. & Rivero O. 2020. — Revisiting Hornos de la Peña 100 years after. *Journal of Archaeological Science: Reports* 31: 102259. https://doi.org/10.1016/j.jasrep.2020.102259

Rivas-Martínez S. 1983. — Pisos bioclimáticos de España. *Lazaroa* 2: 33-43.

Rocha F. J. F. T. 1993. — *Argilas aplicadas a estudos litoestratigráficos e paleoambientais na bacia sedimentar de Aveiro*. Unpublished PhD thesis, University of Aveiro, Aveiro, 418 p.

Rodrigues A. L., Burbidge C. I., Dias M. I., Rocha F., Valera A. & Prudêncio M. I. 2013. — Luminescence and mineralogy of profiling samples from negative archaeological features. *Mediterranean Archaeology and Archaeometry* 13: 37-47.

Rodrigues A. L., Dias M. I., Valera A. C., Rocha F., Prudêncio M. I., Marques R., Cardoso G. & Russo D. 2019a. — Geochemistry, luminescence and innovative dose rate determination of a Chalcolithic calcite-rich negative feature. *Journal of Archaeological Science: Reports* 26: 101887. https://doi.org/10.1016/J.JASREP.2019.101887

Rodrigues A. L., Dias M. I., Rocha F., Prudêncio M. I., Marques R., Russo D. & Cardoso G. 2019b. — Palaeoenvironmental significance and pathways of calcretes development by using nuclear and related methods. *Journal of Radioanalytical and Nuclear Chemistry* 321: 541-556. https://doi.org/10.1007/s10967-019-06591-w

Rodrigues A. L., Dias M. I., Prudêncio M. I., Rocha F., Ruiz Muñoz F., Marques R., Luz González-Regalado M., Russo D. & Cardoso G. 2019c. — Paleoenvironmental considerations based on geochemistry and mineralogy of a miocene lacustrine calcrete, Southern Portugal. *E3S Web of Conferences* 98: 06012. https://doi.org/10.1051/e3sconf/20199806012

Román Sancho J. 2007. — *Historia Natural de la Rata de Agua (Arvicola sapidus) en Doñana*. Unpublished PhD thesis, Universidad Autónoma de Madrid, Madrid, 197 p.

Salazar-García D. C., Power R. C., Sanchis A., Villaverde V., Walker M. J. & Henry A. G. 2013. — Neanderthal diets in central and southeastern Mediterranean Iberia. *Quaternary International* 318: 3-18. https://doi.org/10.1016/j.quaint.2013.06.007

Sánchez-Goñi M. F., Eynau E., Turon J. L. & Shackleton N. J. 1999. — High resolution palynological record off the Iberian margin: direct land-sea correlation for the Last Interglacial complex. *Earth and Planetary Science Letters* 171 (1): 123-137. https://doi.org/10.1016/S0012-821X(99)00141-7

Sanchis A. 2000. — Los restos de *Oryctolagus cuniculus* en las tafocenosis de *Bubo bubo* y *Vulpes vulpes* y su aplicación a la caracterización del registro faunístico arqueológico. *Saguntum* 32: 31-50.

Sanchis A. 2012. — *Los lagomorfos del Paleolítico medio en la vertiente mediterránea ibérica. Humanos y otros predadores como agentes de aporte y alteración de los restos óseos en yacimientos arqueológicos*. Servicio de Investigación Prehistórica, Diputación Provincial de Valencia, 115 p.

Sanchis A., Morales J. V., Real C., Eixea A., Zilhão J. & Villaverde V. 2013. — Los conjuntos faunísticos del Paleolítico medio del Abrigo de la Quebrada (Chelva, Valencia): problemática de estudio, metodología aplica da y síntesis de los primeros resultados, *in* Sanchis A. & Pascual J. L. (eds), *Animals i arqueologia hui. I Jornades d'arqueozoologia*. Museu de Prehistòria de València, València: 65-82.

Sanchis A., Morales J. V., Pérez L., Hernández C. & Galván B. 2015a. — La tortuga mediterránea en yacimientos valencianos del Paleolítico medio: distribución, origen de las acumulaciones y nuevos datos procedentes del Abric del Pastor (Alcoi, Alacant), *in* Sanchis A. & Pascual J. L. (eds), *Preses petites i grups humans en el passat. II Jornades d'arqueozoologia*. Museu de Prehistòria de València, València: 97-120.

Sanchis A., Tormo C., Sauqué V., Sanchis V., Díaz R., Ribera A. & Villaverde V. 2015b. — Pleistocene leopards in the Iberian Peninsula: New evidence from palaeontological and archaeological contexts in the Mediterranean region. *Quaternary Science Reviews* 124: 175-208. https://doi.org/10.1016/j.quascirev.2015.07.013

Sanders D. 2010. — Sedimentary facies and progradational slyle of a Pleistocene talus-slope succession, Northern Calcareous Alps, Austria. *Sedimentary Geology* 228 (3-4): 271-283. https://doi.org/10.1016/j.sedgeo.2010.05.002

Sanders D. & Ostermann M. 2011. — Post-last glacial alluvial fan and talus slope associations (Northern Calcareous Alps, Austria): A proxy for Late Pleistocene to Holocene climate change. *Geomorphology* 131 (3-4): 85-97. https://doi.org/10.1016/j.geomorph.2011.04.029

Sanderson D., Bishop P., Stark M. T. & Spencer J. Q. 2003. — Luminescence dating of anthropogenically reset canal sediments from Angkor Borei, Mekong Delta, Cambodia. *Quaternary Science Reviews* 22 (10-13): 1111-1121. https://doi.org/10.1016/S0277-3791(03)00055-6

Sañudo P. & Fernández Peris J. 2007. — Análisis espacial del nivel IV de la Cova del Bolomor (La Valldigna, Valencia). *Saguntum* 39: 9-26.

Sañudo P., Blasco R. & Fernández-Peris J. 2016. — Site formation dynamics and human occupations at Bolomor Cave (Valencia, Spain): An archaeostratigraphic analysis of levels I to XII (100–200 ka). *Quaternary International* 417: 94-104. https://doi.org/10.1016/j.quaint.2015.09.044

Sánchez-Hernández C., Gourichon L., Blasco R., Carbonell E., Chacón G., Galván B., Hernández-Gómez C. M., Rosell J., Saladié P., Soler J., Soler N., Vallverdú J. & Rivals F. 2020. — High-resolution Neanderthal settlements in mediterranean Iberian Peninsula: A matter of altitude? *Quaternary Science Reviews* 247: 106523. https://doi.org/10.1016/j.quascirev.2020.106523

Schulte L., Julià R., Burjachs F. & Hilgers A. 2008. — Middle Pleistocene to Holocene geochronology of the river Aguas terrace sequence (Iberian Peninsula): fluvial response to Mediterranean environmental change. *Geomorphology* 98 (1-2): 13-33. https://doi.org/10.1016/j.geomorph.2007.03.018

Schultz L. G. 1964. — Quantitative interpretation of mineralogical composition X-ray and chemical data for the Pierre Shale. *US Geological Survey Professional Paper* 391, 38 p. https://doi.org/10.3133/pp391C

Schweingruber F. H. 1990. — *Anatomie Europäischer Hölzer, HAUPT*. Bern und Stuttgart, 70 p.

Soler B. 2003. — *Estudio de las estructuras de combustión prehistóricas: Una propuesta experimental. Cova Negra (Xàtiva, Valencia), Ratlla del Bubo (Crevillente, Alicante) y Marolles-sur-Seine (Bassin Parisien, Francia).* Servicio de Investigación Prehistórica, Diputación Provincial de Valencia (coll. Serie de trabajos varios; 102), Valencia, 163 p.

Soulié-Märsche I. & García A. 2015. — Gyrogonites and oospores, complementary viewpoints to improve the study of the charophytes (Charales). *Aquatic Botany* 120 Part A: 7-17. https://doi.org/10.1016/j.aquabot.2014.06.003

Texier P. J. 1996. — Evolution and diversity in flaking techniques and methods in the Palaeolithic, *in* Anati E. (ed.), *Oltre la pietra. Modelli e tecnologie per capire la Preistoria*. Abaco Edizioni, Forli: 297-321.

Tixier J., Inizan M. L. & Roche H. 1980. — *Préhistoire de la pierre taillée. 1. Terminologie et technologie*. Cercle des recherches et études préhistoriques, Valbonne, 120 p.

Tormo C. & Guillem P. M 2015. — Los micromamíferos del yacimiento del Paleolítico medio del Abrigo de la Quebrada (Chelva, Valencia): Niveles I-VIII, *in* Sanchis A. & Pascual J. L. (eds), *Petites preses i grups humans en el passat. II Jornades de Arqueozoologia*. Museu de Prehistòria de València, València: 181-208.

Torroba Balmori P., Zaldívar García P. & Hernández Lázaro A. 2013. — *Guía de identificación. Semillas de frutos carnosos del norte ibérico*. Ediciones Universidad de Valladolid, Valladolid, 252 p.

Trindade M. J., Dias M. I., Coroado J. & Rocha F. 2009. — Mineralogical transformations of calcareous rich clays with firing: a comparative study between calcite and dolomite rich clays from Algarve, Portugal. *Applied Clay Science* 42 (3-4): 345-355. https://doi.org/10.1016/j.clay.2008.02.008

Trindade M. J., Dias M. I., Rocha F., Prudêncio M. I. & Coroado J. 2011. — Bromine vola- tilization during firing of calcareous and non-calcareous clays: Archaeometric im- plications. *Applied Clay Science* 53 (3): 489-499. https://doi.org/10.1016/j.clay.2010.07.001

van Andel T. H. & Davies W. 2003. — *Neanderthals and modern humans in the European landscape during the last glaciation: archaeological results of the Stage 3 Project*. McDonald Institute for Archaeological Research monographs, Cambridge, 284 p.

van der Meulen A. J. 1973. — Middle Pleistocene small mammals from the Monte Peglia (Orvieto, Italy) with special reference to the philogeny of Microtus (Arvicolidae, Rodentia). *Quaternaria* 16: 1-144.

Ventura J. 2007. — *Arvicola terrestris* (Linnaeus, 1758), *in* Palomo L. J., Gisbert J. & Blanco J. C. (eds), *Atlas y libro rojo de los mamíferos terrestres de España*. Dirección General para la Biodiversidad, Madrid: 449-451.

Vidal-Matutano P., Hernández C. M., Galván B. & Mallol C. 2015. — Neanderthal firewood management: evidence from Stratigraphic Unit IV of Abric del Pastor (Eastern Iberia). *Quaternary Science Review* 111: 81-93. https://doi.org/10.1016/j.quascirev.2015.01.010

Vilanova i Piera J. 1872. — *Origen, naturaleza y antigüedad del hombre*. Reproducción digital de la edición de Madrid, Imprenta de la Compañia de impresores y Libreros del Reino, Madrid, 446 p.

Villa P. & Mahieu E. 1991. — Breakage patterns of human long bones. *Journal of Human Evolution* 21 (1): 27-48. https://doi.org/10.1016/0047-2484(91)90034-S

Villaverde V. 1984. — *La Cova Negra de Xàtiva y el Musteriense de la región central del Mediterráneo español.* Servicio de Investigación Prehistórica (coll. Diputación Provincial de Valencia; 79), València, 38 p. http://mupreva.org/pub/110/es

Villaverde V., Martinez Valle R., Guillem P. M. & Fumanal M. P. 1996. — Mobility and the role of small game in the Middle Paleolithic of the central region of the Spanish Mediterranean: a comparison of Cova Negra with other Paleolithic deposits, *in* Carbonell E. & Vaquero M. (eds), *The Last Neandertals the first anatomically modern humans. Cultural change and human evolution: The crisis at 40.* Universitat Rovira i Virgili. Tarragona: 267-288.

Villaverde V., Martínez Valle R. & Blasco R. 2009. — Análisis de la industria lítica y de la economía: Aproximación al uso del espacio, *in* Villaverde V., Pérez Ballester J. & Ledo A. (eds), *Historia de Xàtiva, Prehistoria, Arqueología y Antigüedad, II. Los primeros pobladores de la Costera: los Neandertales de la Cova Negra de Xátiva*. Ajuntament de Xátiva, Xàtiva: 147-193.

Villaverde V., Guillem P. M., Martínez Valle R. & Eixea A. 2014. — Cova Negra, *in* Sala R., Carbonell E., Bermúdez de Castro J. M. & Arsuaga J. L. (eds), *Pleistocene and Holocene Hunter-gatherers in Iberia and the Gibraltar Strait. The Current Archaeological Record*. Universidad de Burgos and Fundación Atapuerca, Burgos: 361-367.

Villaverde V., Eixea A., Zilhão J., Sanchis A., Real C. & Bergadà M. 2017. — Diachronic variation in the Middle Paleolithic settlement of Abrigo de la Quebrada (Chelva, Spain). *Quaternary International* 435 Part A: 164-179. https://doi.org/10.1016/j.quaint.2015.09.075

Worny R., Huggel C., Dorren L. K. A. & Jaboyedoff M. 2013. — 7.28 Numerical modeling of flows and falls, *in* Shroder J. F. (ed.), *Reference Module in Earth Systems and Environmental Sciences, from Treatise on Geomorphology*. Elsevier, Amsterdam: 273-283.

Wright V. P. & Tucker M. E. 1991. — Calcretes: an introduction, *in* Wright V. P. & Tucker M. E. (eds), *Calcretes*. Blackwell Scientist Publications, Oxford: 1-22. https://doi.org/10.1002/9781444304497.ch

Zilhão J., Ajas A., Badal B., Burow C., Kehl M., López-Sáez J. A., Pimenta C., Preeece R. C., Sanchis A., Sanz M., Weniger G. C., White D., Wood R., Angelucci D., Villaverde V. & Zapata J. 2016. — Cueva Antón: A multi-proxy MIS 3 to MIS 5a paleoenvironmental record for SE Iberia. *Quaternary Science Reviews* 146, 251-273. https://doi.org/10.1016/j.quascirev.2016.05.038

Zilhão J., Anesin D., Aubry T., Badal E., Cabanes D., Kehl M., Klasen N., Lucena A., Martín-Lerma I., Martínez S., Matias H., Susini D., Steier P., Wild E. M., Angelucci D., Villaverde V. & Zapata J. 2017. — Precise dating of the Middle- to-Upper Paleolithic transition in Murcia (Spain) supports late Neandertal persistence in Iberia. *Heliyon* 3 (11): e00435. https://doi.org/10.1016/j.heliyon.2017.e00435

Zimmerman D. W. 1971. — Thermoluminescent dating using fine grains from pottery. *Archaeometry* 13 (1): 29-52. https://doi.org/10.1111/j.1475-4754.1971.tb00028.x

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