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ORIGINAL PAPER

A structure from the sixth millennium cal BC with no artifactual content at San Quirce (Palencia, Spain): a multidisciplinary study

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Abstract

During the course of the excavations of the San Quirce open-air archaeological site in Spain, an unusual negative structure was identified in the Holocene level dated ca. sixth millennium cal BC. A fire pit alongside a single post-hole and intense fire-burning activity was recorded. Yet, the most striking feature of the structure is the absence of any artifactual or faunal record associated to it, something without a known archaeological parallel. Its interpretation represents an archaeological challenge addressed through a multidisciplinary approach including geoarchaeological, paleobotanical techniques and experimental archaeology. Fifteen stratigraphically distinguishable combustion events showing a diachronic fire record, the significant structure's dimensions and particularly the post-hole, indicate its anthropic origin. Archaeomagnetic and micromorphological data allowed reconstructing and temporally sequencing some formation and post-depositional processes, some involving water flows. Maximum heating temperatures between 480 and 525 °C were determined in one of the combustion features studied. The identification of grassy tufts would suggest a seasonal settlement of the site. We cannot yield a definite explanation for the artifactual absence, but the available data and an experimental archaeology recreation suggest that the structure could be used as a small hut/open-air bivouac, over which short-lived occupations were repeatedly carried out.

Keywords Open-air camp · Sixth millennium cal BC · Start of Neolithic · Combustion structures · Duero River basin

Highlights

- This paper analyzes the Holocene level dated ca. Sixth millennium cal BC.
- A fire pit alongside a single post-hole and intense fire-burning activity was recorded.
- The most striking feature of the structure is the absence of any artifactual or faunal record.
- Its interpretation represents an archaeological challenge addressed through a multidisciplinary approach.
- The available data and an experimental archaeology recreation suggest that the structure could be used as a small hut/open-air bivouac.

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Introduction

Open-air archaeological sites are a valuable source of information to the study of human activities in the past. Although their preservation conditions are generally worse than those of caves and rock-shelters, they contain very interesting data about certain anthropic activities. One of these examples is San Quirce site which is a reference in the Iberian Peninsula for the study of Neanderthal open-air settlements (Terradillos-Bernal et al. 2017) (Fig. 1). Between 2009 and 2011, a singular finding was identified in renewed excavations at the site, which is the central theme of this article. It is a fire pit filled from the sixth millennium cal BC with rubified and carbonaceous sediments, charcoal, and a post-hole (Figs. 2 and 3).

This level of San Quirce stimulates a discussion of great value around the reconstruction of events in the absence of material artifactual elements. The interpretation of the functional activities at this level, without any associated artifactual archaeological records, represents the great challenge of this study.

In this paper, we have developed a multidisciplinary analysis based on archaeological, palaeoenvironmental, geoarchaeological, micromorphological, chronostratigraphic, and archaeomagnetic studies, with the aim of gathering data, to gain an understanding of both the formation of the structure and the environment in which it developed.

Site description

The archaeological site of San Quirce (Palencia, Spain) is found in the central valley of the river Pisuerga, within the Duero River basin (42° 37′ 26.47′ N lat/4° 18′ 27.10′ W long and altitude (a.s.l.) = 861 m) (Fig. 1). This region is very close to one of the main paths of

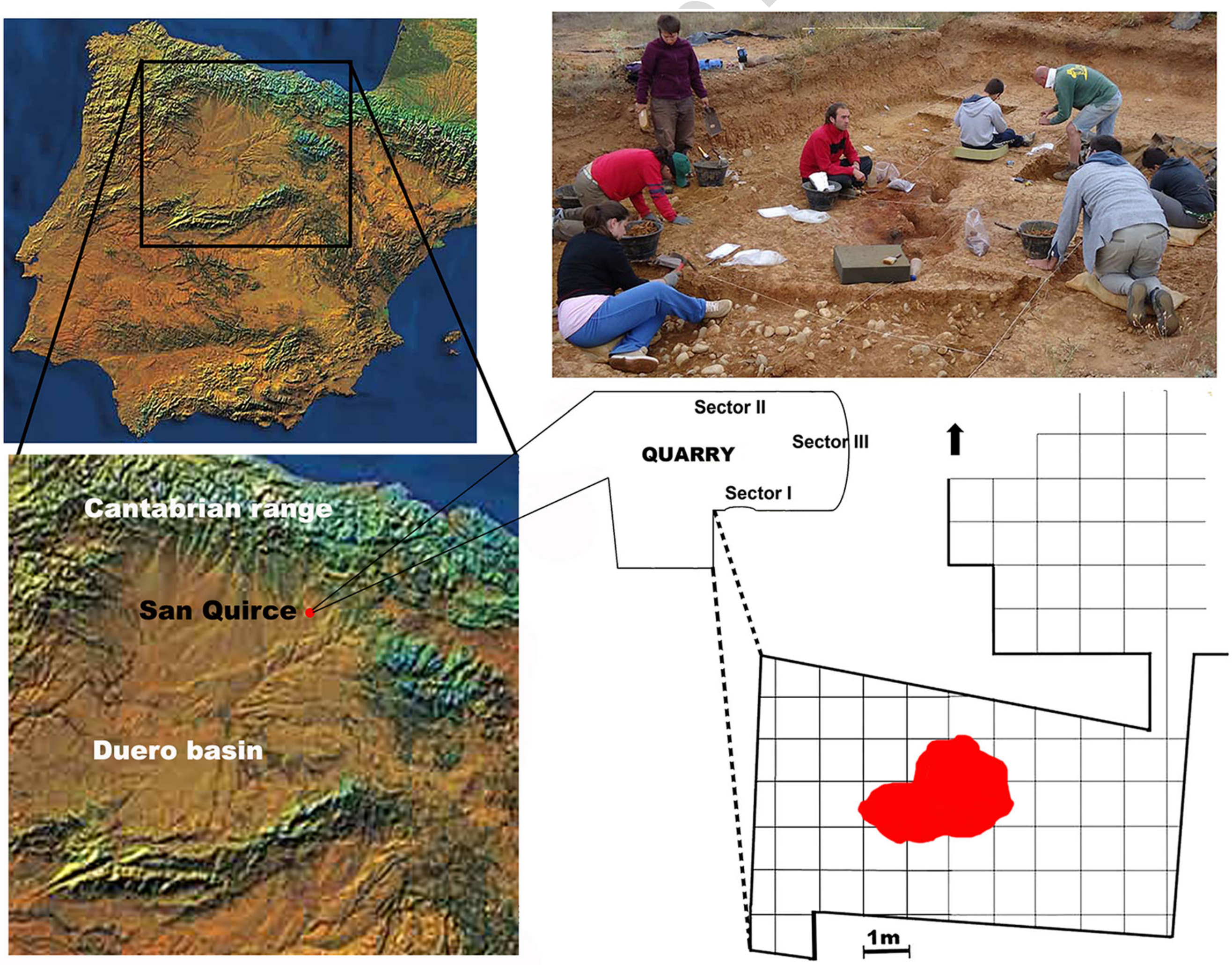

Fig. 1 Location of the San Quirce site. In red, the position of the fire pit analyzed in the present article

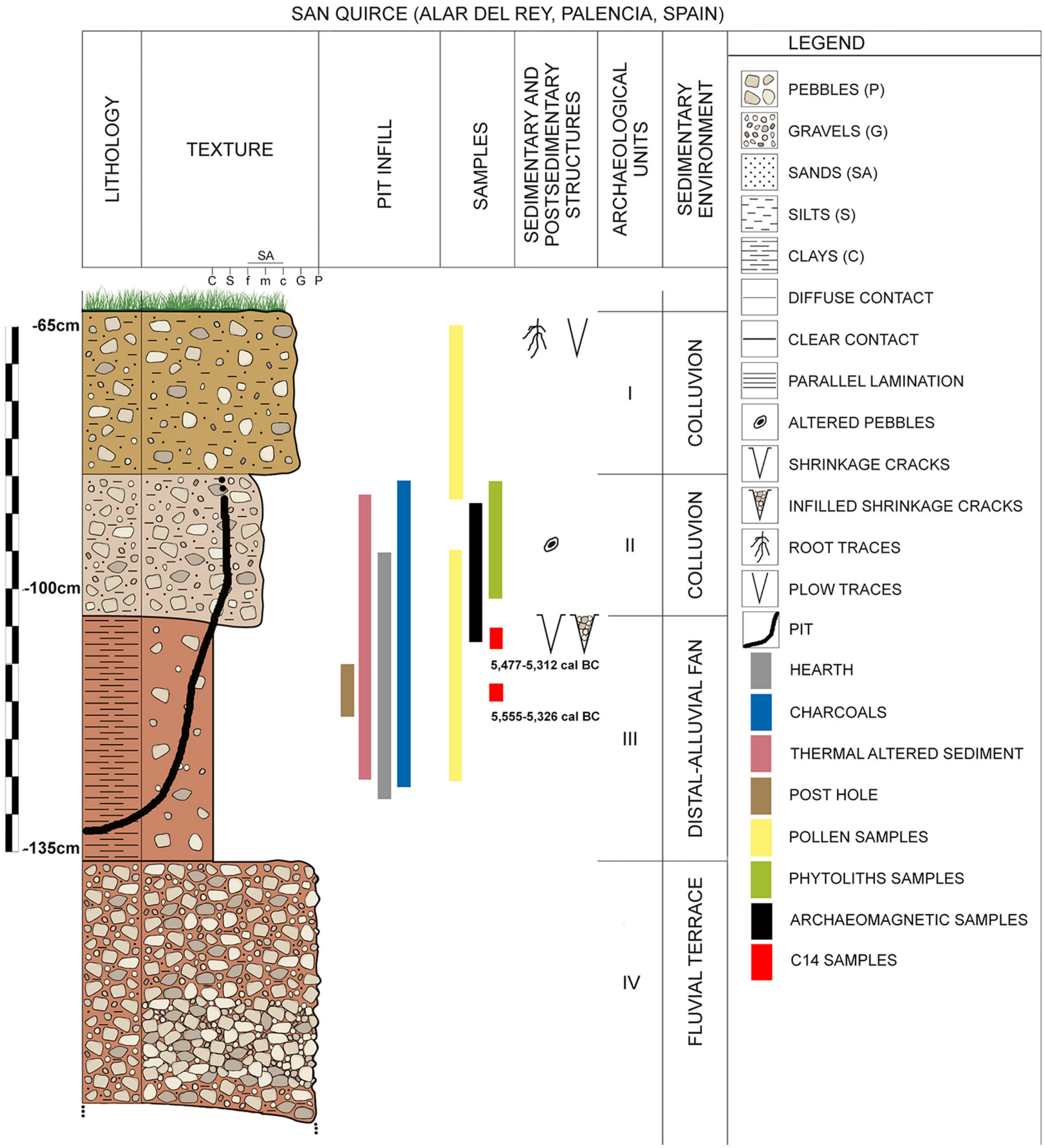

Fig. 2 Stratigraphy of the San Quirce site

communication between the Cantabrian mountain range and the northern plateau of the Iberian Peninsula. San Quirce is located on a T9 terrace on the left bank of the river Pisuerga, at +22–23 m. The southern profile exposed by a quarry contains four main units, from top to bottom (Fig. 2):

Level I: surface level, approximately 40 cm of colluvial deposits of sand that culminates the sequence

Level II: colluvium, approx. 20–30 cm of thickness. It has a tabular geometry, and its contact at the base is clearly erosive. The pebbles and gravels are of quartzite, quartz, shale, and sandstone (4 cm quantile, 0.5 cm mean). The fire pit in which

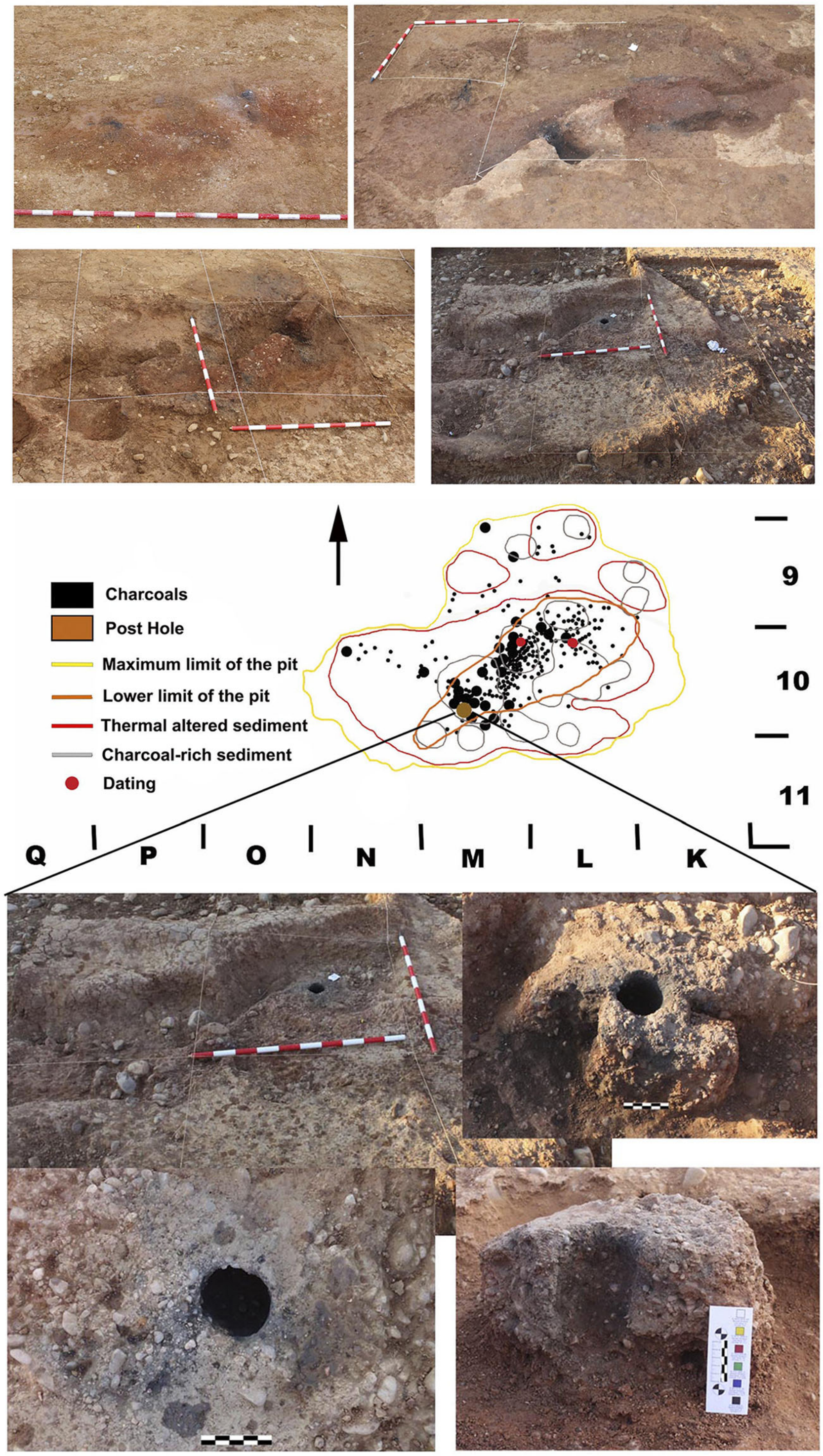

Fig. 3 Evolution of the archeological intervention in the fire pit and the post hole; drawing of the fire pit and its filling

the Holocene filling was located starts at Level II and descends through a complete section of Level III down to its base. The fire pit is filled with thermally altered sediment of coarse sand and clay, with grave and granules (Fig. 2).

Level III: distal facies from an alluvial fan, corresponding to a floodplain. With roughly 60 cm of thickness, this deposit consists of interspersed layers of clay and massive silt in gradual contact with underlying level. The Neanderthal archaeological level is located into a yellowish silty layer of 5 to 25 cm of thickness on the SE slope. This level belongs to the OIS 4 (74 ± 16 and 73 ± 10 ky, OSL).

Level IV: a 3–4 m of thickness terrace deposits composed of cobbles with a sparse matrix deposited by several interconnected channels (Terradillos-Bernal et al. 2017)

Methods

Archaeological intervention

A strict protocol of field records was followed, applying tridimensional coordinates to all materials (Fig. 1). The area in and around the fire pit was divided into 10 cm^2 quadrants. All of the sediment was recovered from each one, differentiating between (homogeneous and heterogeneous) carbonaceous sediment, rubified sediment, and thermally unaltered sediment (Figs. 2 and 3).

The homogeneously charred carbonaceous sediment was determined by its abundance of microcharcoals and the absence of uncharred rock fragments. The heterogeneous carbonaceous sediments contained both charred and uncharred rocks. Finally, the rubified sediments were those affected by the thermal impact generating a more reddish color to the natural substrate (Vallverdú Poch 1999).

Mineralogy and micromorphology

The mineralogical components of the samples were determined by X-ray diffraction (DRX) applied to the sample matrix, sieved ground for grain size homogenization. All the samples were analyzed with the power method for identification and quantification of the predominantly mineral phases with a Philips-PW 1830 diffractometer equipped with a Cu cathode, with a wavelength of Ka = 1.54051 and an angular scan between 3° and 65° 2θ, providing output to a Philips PW 1710 digital recorder.

Diffractogram control and treatment was done with XPowder (Martín-Ramos 2008) for the qualitative and quantitative analysis of the samples (Martín-Ramos 2006).

A monolith for thin section fabrication of large size (0.13 × 0.05 m) was prepared for microscopical observation. The observations use various magnifications (up to × 10) and different types of light: normal polarized light and incident light for opaque and interference phase for hyaline components. The description of the thin section is based on the terminology established by sedimentary petrography and soil micromorphology (Bullock et al. 1985; Tucker 1988; Wattez 1988).

Archaeobotany

Palynology

The paleopalynology study consisted of four phases (Burjachs et al. 2003): a sampling of deposits, physical-chemical treatment of samples, the identification of pollen taxa and pollen and spore counts (Goeury and Beaulieu 1979), and, finally, representation in a graph and interpretation of the results. Pollen and non-pollen palynomorphs (NPP) determination was performed by optical microscopy (Nikon optical microscopy, Eclipse 50i model and Optiphot with × 40, × 60, and × 100 lens with immersion oil), supported by a palynological reference collection and a pollen atlas as references (Moore et al. 1991; Reille 1999; Beug 2004).

Two pollen samples were collected on level II, in the area not altered by fire (grid L7, *X*: 505, *Y*: 605, and *Z*: 86–81; and K12, *X*: 605, *Y*: 185, and *Z*: 112–126).

Phytoliths

The study of phytoliths was performed on four samples. The process of sample extraction was performed following the protocol described by Albert et al. (1999) and Albert and Weiner (2001). The International Code for Phytolith Nomenclature was followed for the determination of the phytoliths (Madella et al. 2005). Morphological identification is based on own reference collections (see http:/www.gepeg.org/enter_PCORE.html) as well as on standard literature: Twiss et al. (1969), Mulholland and Rapp (1992), Piperno (2006), etc. The description is based on the identification of the cells where they were formed. The phytolytes identified were divided according to their morphological characteristics and depending on whether the type or the part of the plant in which they were formed in the following groups: grassy plants, dicotyledonous leaf, and trunk/bark of dicotyledonous plants.

Anthracology

The anthracological study was based on the analysis of 132 remains. The methodology for taxonomic analysis in this study is based on Chabal et al. (1999). Each fragment was split by hand for taxonomic identification to obtain the three anatomy sections with which its cellular structure may be identified. Metallographic microscopy observations (Olympus BX41) were made at magnifications of × 50, × 100, × 200, and × 500. Schweingruber's atlas of wood anatomy (1990) and a reference collection of current species were used to support the identification.

Archaeomagnetic analyses

During the excavation, four hand-blocks from three different hearths were oriented with a magnetic compass and the aid of Plaster of Paris. The upper part of every block was composed of a rubified facies of intense reddish color or a dark carbonaceous facies and variable thickness (2–4 cm), generated by heating. Every block was consolidated and subsequently subsampled to obtain cubic specimens (10 cm^3). Directional archaeomagnetic analyses were carried out through thermal demagnetization of the natural remanent magnetization (NRM) in 16 steps from room temperature to 590 °C or by alternating fields (A.F.) up to a peak field of 100 mT. The measurement of the remanent magnetization was performed using a 2G SQUID cryogenic magnetometer (noise level 5×10^{-12} Am^2) (Fig. 4).

Additionally, several rock-magnetic analyses were carried out on bulk sample (~400 mg) from every hearth with a Variable Field Translation Balance (MM_VFTB), in order to identify the main magnetic carrier and its domain state and thermomagnetic stability. All archaeomagnetic experiments were carried out at the laboratory of paleomagnetism of Burgos University (UBU).

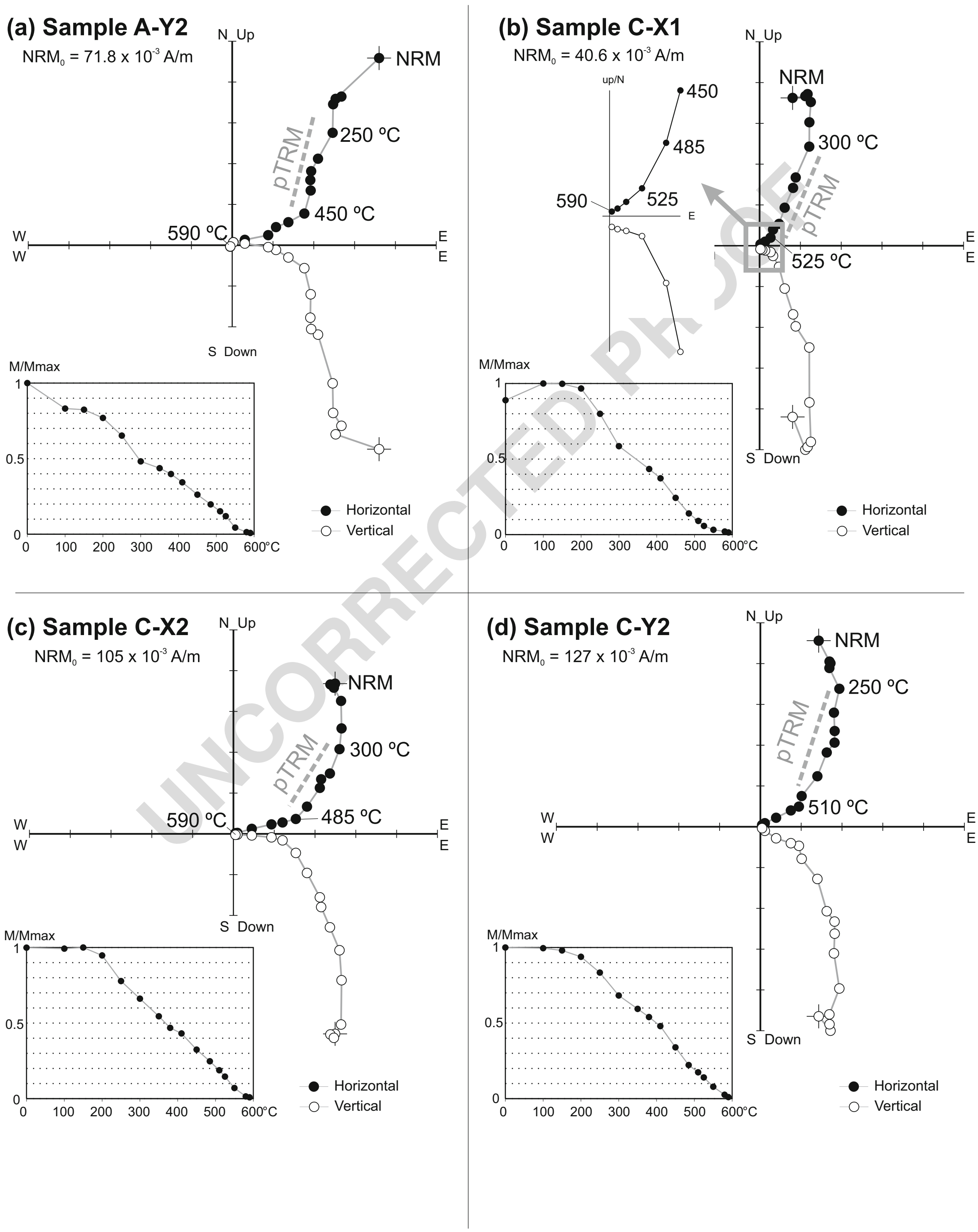

Fig. 4 Representative orthogonal NRM thermal demagnetization plots for four burnt samples. Open (closed) symbols represent the vertical (horizontal) projections of vector endpoints. The sample code, intensity (NRM0), main demagnetization steps, and normalized demagnetization spectra are indicated for each sample. "p-TRM" refers to partial thermoremanent magnetization. See text for explanation

Dating

The two charcoal fragments (80 × 40 × 30 mm and 30 × 20 × 10 mm; with *Z*: 113 and 105) (*Pinus* type *sylvestris*) (Figs. 2 and 3) were dated with ^{14}C at the National University of Australia (S-ANU 34526 & 34527), using the method described by Fallon et al. (2010). Dating has been done with carbons because it is the only organic material large enough to be dated. Only two samples have been dated because it was a prospective dating that has provided homogeneous and plausible dating.

Sample preparation backgrounds have been subtracted, based on measurements of samples of 14C-free CO2. Samples were pretreated with an acid-base-acid protocol. d13C values are the AMS machine quoted values and are used to correct the age. The quoted age is in radiocarbon years using the Libby half-life of 5568 years and following the conventions of Stuiver and Polach (1977). Radiocarbon concentration is given as percent Modern Carbon and conventional radiocarbon age. The radiocarbon dates were calibrated with OxCal 4.2 (Bronk Ramsey and Lee 2013).

Results

Archaeology

The structure presented dimensions of 3.5 m in length, 2.5 m in width, and 50 cm in maximum depth, covering an area of approximately 6.9 m^2 (Figs. 2 and 3). Half of the combustion structure pit is totally filled with rubified, carbonaceous (charcoal-rich), and burned sediments generated by at least 15 focal points of fire use of between 100 and 20 cm in diameter, while the western half is only partially infilled with burned sediment (Figs. 2 and 3). At the central point of the combustion structure pit, a post-hole was unearthed (20 cm in height and 10 cm in diameter. *Z*: between 116 and 96). This post-hole is surrounded by a hearth and its base appears carbonaceous (Figs. 2, 3, and 5).

The development of an experimental reproduction of the structure showed that a small hut may be assembled with a single post. The most stable result, in keeping with the morphology, surrounding materials (pine trees and heather), and the composition of the structure, is shown in Fig. 5. This structure remained intact in an open and windswept environment for over 30 days before its dismantlement, with no significant structural damage (Fig. 5).

Sedimentology and archaeostratigraphy

At least three different phases of sedimentary burial of fire use were documented. Charcoal-rich sediments were microstratified, and 15 lenticular strata were identified pointing to 15 focal points of fire use.

The sediments which buried charcoal-rich and burned sediments show discontinuous horizontal bedding on which granules and gravels in subvertical position can be observed (Fig. 6). The subvertical orientation of gravel and granule points to colluvial particle transport. However, the microstratified nature of the strata points to sedimentary processes that are related to hyperconcentrate water flows, characteristic of discontinuous episodes of sedimentary deposition. These different depositional events are likely formed by rainwater surface runoff. The appearance of microcharcoals in at least three bands suggests repeated washing and colluvial accumulation and, therefore, different phases in the abandonment of the combustion structure (Fig. 6).

Mineralogically, the fine fraction of infilling from the combustion structure pit is characterized by an abundant presence of quartz, slightly over 50%, accompanied by potassic mica (24 and 28%) and potassic feldspars (13.8–19.3%) and, to a lesser extent, sodium feldspar (2.2–2.5%). This mineralogy is compatible with the fine colluvial fraction that comprises level II.

Palynology, anthracology, and phytolith studies

The palaeoenvironmental features point to an earlier cold phase and a subsequent edaphic level, marked by the appearance of textural features of sub-surface B horizons, with edaphic processes characteristic of Mediterranean soils (alfisols and aridisols).

The clear predominance of herbaceous-shrub vegetation is evident from the pollen study, because the values of forest cover do not exceed 12%. The tree cover consisted of *Pinus* sp., *Juniperus*, *Betula*, *Corylus*, and *Alnus*. The main components of the herbaceous stratum were Poaceae, *Compositae liguliflora*, *Compositae tubuliflora*, and Umbelliferae. Records of hazelnut and above all *Alnus* reflect the existence of a stable water course throughout the year (Fig. 7).

A high presence of phytoliths in the analysis was produced in dicotyledonous plants, from both the trunk/bark and the leaves. The identification of grassy tufts would suggest a seasonal settlement of the site, in the flowering periods of this family, normally spring and summer.

A total of 247 charcoal pieces were documented (35 over 20 mm, 18 over 50 mm, and 10 over 100 mm) from which we could analyze 132 pieces (Fig. 3). The anthracological results showed scarce variability where the *Pinus* type *sylvestris* and the *Pinus* type *uncinata* were the only taxa identified. These taxa correspond to montane pines that in the Iberian Peninsula include *Pinus sylvestris*, *Pinus nigra*, and *Pinus uncinata*.

The rest of the fragments are undetermined conifers. The high percentage of indeterminable fragments is the consequence of alterations of the charcoal pieces. The most

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Fig. 5 Different steps in the experimental reconstruction of a hut with a single post and with no ties. **a** Original substrate of the structure. **b**–**e** Construction stages of the hut. **f** Profile view of the hut. A Area of the hut. B Area of fire-burning activity

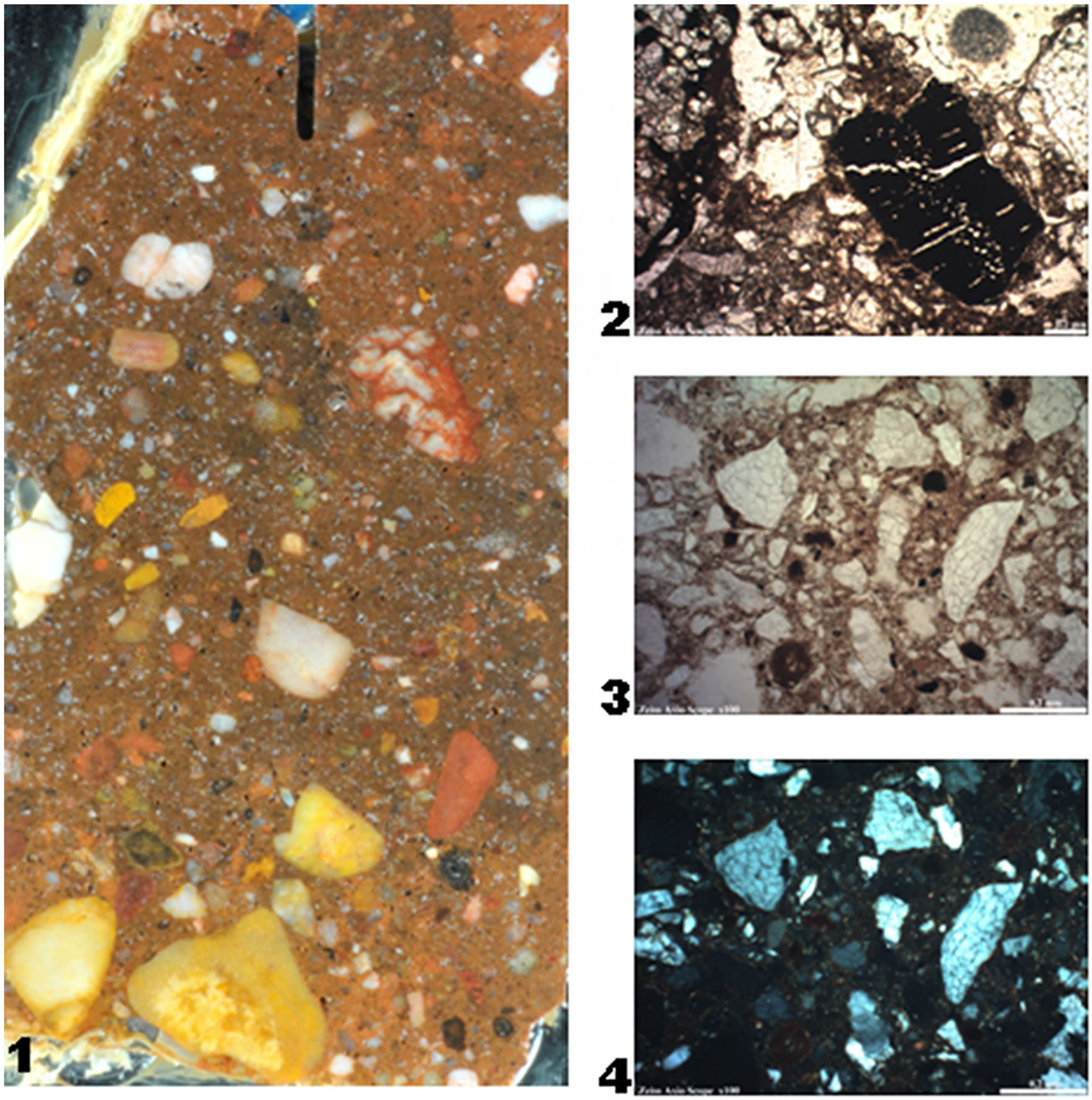

Fig. 6 **a** Polished block impregnated with polyester resin used to prepare the thin section (L10; *X*: 60; *Y*: 58). The polished section of the core shows the microstratified properties in discontinuous layers and the different colors of the groups of beds-sheets from the bottom to the top: gray, brown, reddish-brown, and brown. A sedimentary crust may be seen at the base of the bed. Width of the photography is 5 cm. **b** Microstructure formed by a porosity of cavities next to a charcoal fragment. Normal transmitted light (×50). **c** Fine yellow-colored material with punctuations under normal transmitted light (×100). **d** Same material under analysis observed under normal light. The isotropy of the micromass may be observed (×100)

significant alteration is vitrification, which may be related to high temperatures and recombustion (Allué et al. 2009).

Archaeomagnetic analyses

Initial natural remanent magnetization (NRM) intensity values of the studied samples range between 5.49×10^{-5} and 1.47×10^{-3} A/m, whereas magnetic susceptibility oscillates between 4.39×10^{-3} and 3.74×10^{-1} S.I. In order to evaluate the stability of the magnetic signal, Koenigsberger values were calculated (Qn ratio = NRM/(χH) (cf. Stacey 1967)), where χ is the magnetic susceptibility and H is the local geomagnetic field strength. The obtained values oscillate between 0.76 and 12.17 with only two values < 1 (Supplementary Fig. 1). These results are similar to those reported for analogous materials (e.g., Carrancho et al. 2016) indicating that the magnetization is of thermal origin.

Rock-magnetic analyses indicate that the main magnetic carrier in the unburnt substrate (outside of the basin) is hematite with Curie temperatures (Tc) of ~ 675 °C (Supplementary Fig. 2a). However, the main magnetic carrier in the burnt samples is mostly slightly substituted magnetite with Tc ~

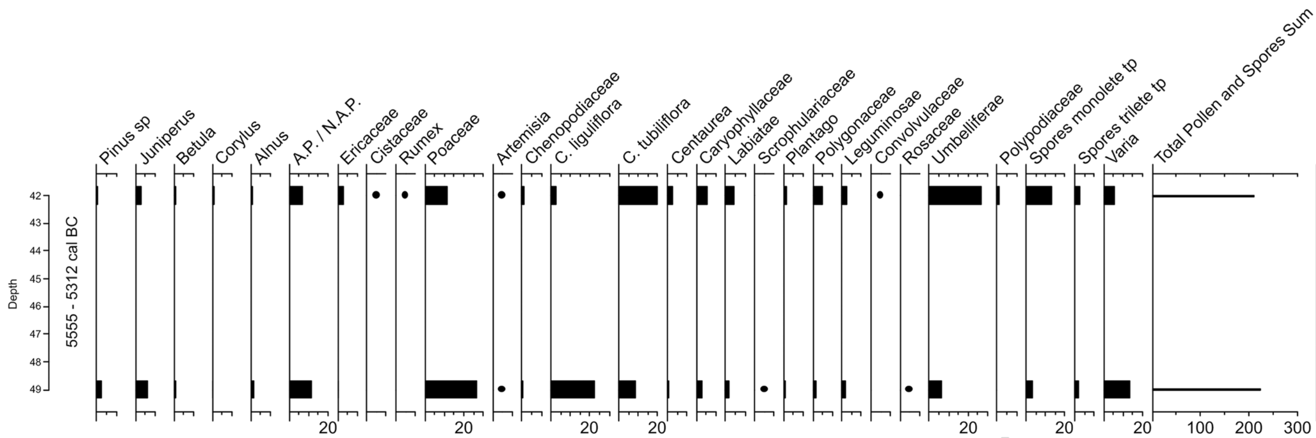

Fig. 7 Pollen percentage diagram

580 °C (Supplementary Fig. 2b). The burnt samples exhibit intensities of magnetization of at least one order of magnitude higher than the unburnt ones.

The archaeomagnetic directional results have turned out to be quite variable. Two out of the three hearths studied show anomalous directional behavior characterized by multicomponent NRM diagrams with low magnetization intensities and high directional scatter. This pattern is most likely explained by post-depositional processes that reorganized the sedimentary matrix. Such reworking does not necessarily have to be seen on a macroscopic scale since any physical alteration even at the microscopic scale may distort the archaeomagnetic record (Carrancho et al. 2012). Nevertheless, the samples from one of the hearths studied (L10–54), displayed a very interesting and reproducible behavior. After cleaning a secondary viscous component up to 250 °C, a stable palaeomagnetic component of normal polarity with maximum unblocking temperatures (max T_{UB}) between 485 and 525 °C is observed (Fig. 4a–d). This component has been interpreted as a partial thermoremanence (pTRM) resulting in a well-defined statistical mean direction (Fig. 8b). Finally, a high-temperature (HT) component up to 580–590 °C with dominant NE direction was observed (Figs. 4 and 8a).

The reproducible and characteristic behavior observed in this hearth has allowed reconstructing and temporally sequencing various formation and taphonomic processes (including human-induced ones) in order to interpret the basin usage. After the original sedimentation, some type of mechanical post-depositional process took place which distorted the direction of the high-temperature (HT) palaeomagnetic component which originally had to be north. However, this HT component displays a mean NE direction (Fig. 8a). According to the available sedimentological and archaeostratigraphic data, the most plausible explanation for this is a process such as a runoff or water flow which rearranged the original direction of the HT component. Whatever the process involved, there was undoubtedly some physical process that reworked the matrix after its original deposition. Otherwise, a northward HT component should be observed and that is not the case.

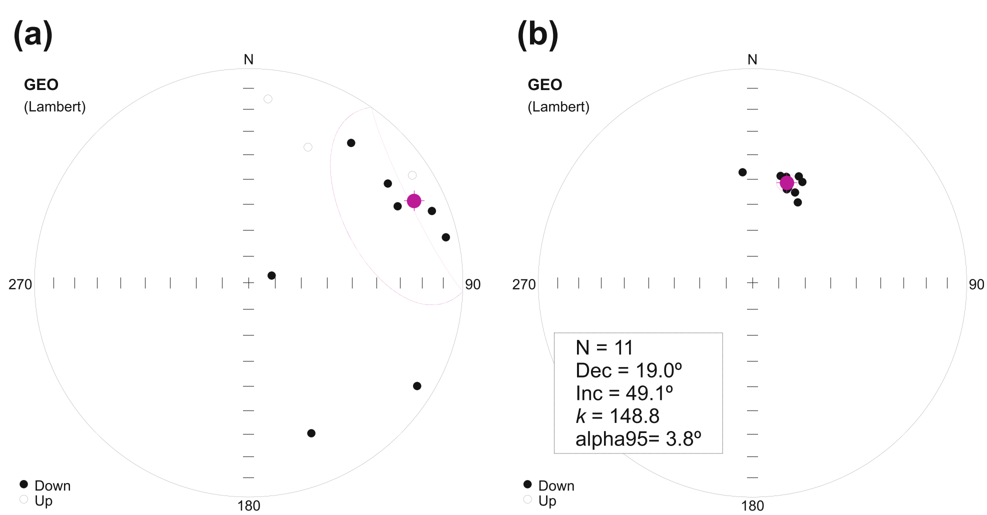

Fig. 8 Equal-area projections of **a** the high-temperature component and **b** p-TRM component of the L10–54 hearth from San Quirce site. N, number of samples accepted; Dec., declination; Inc., inclination; k and α95, precision parameter and confidence limit of characteristic remanent magnetization (ChRM) direction at the 95% level (after Fisher 1953). See section 4.3 for explanation

Afterwards, a burning took place reaching maximum temperatures between 480 and 525 °C. These temperatures are defined by the maximum T_{UB} of the intermediate palaeomagnetic component interpreted as a pTRM in Fig. 4a–d. The fact that this component shows a systematic and well-grouped directional behavior of normal polarity (Fig. 8b) strongly supports its interpretation as a pTRM.

Dating

The dating of the two pieces of charcoal was calibrated with Q6 curve IntCal 13 (Reimer et al. 2016), using OxCal 4.2 software (Bronk Ramsey and Lee 2013), and was, with a probability of 95.4% (2-sigma), dated between 5555–5326 and 5477–5312 cal BC (6410 ± 50 and 6490 ± 60 years. BP). The difference in depth between two charcoal is 8 cm (Figs. 2 and 9).

Discussion

The absence of remains such as lithic, bone, and ceramic records at this level of San Quirce is surprising. Any cultural adscription of this site and reconstruction of the succession of events that took place in this space in the absence of material elements implies a great archaeological challenge.

In the central Iberian Peninsula, the knowledge that we have of the sixth millennium cal BC culture is very recent and of complex interpretation. It is very difficult to arrive at a summary of this period in this environment because there are no much relevant faunistic data sets, absolute dating is scarce, and sites in very few well-identified contexts provide very few archaeological records (Alday 2002, 80–81; Jiménez Guijarro 2008, 214; Rojo Guerra 2014).

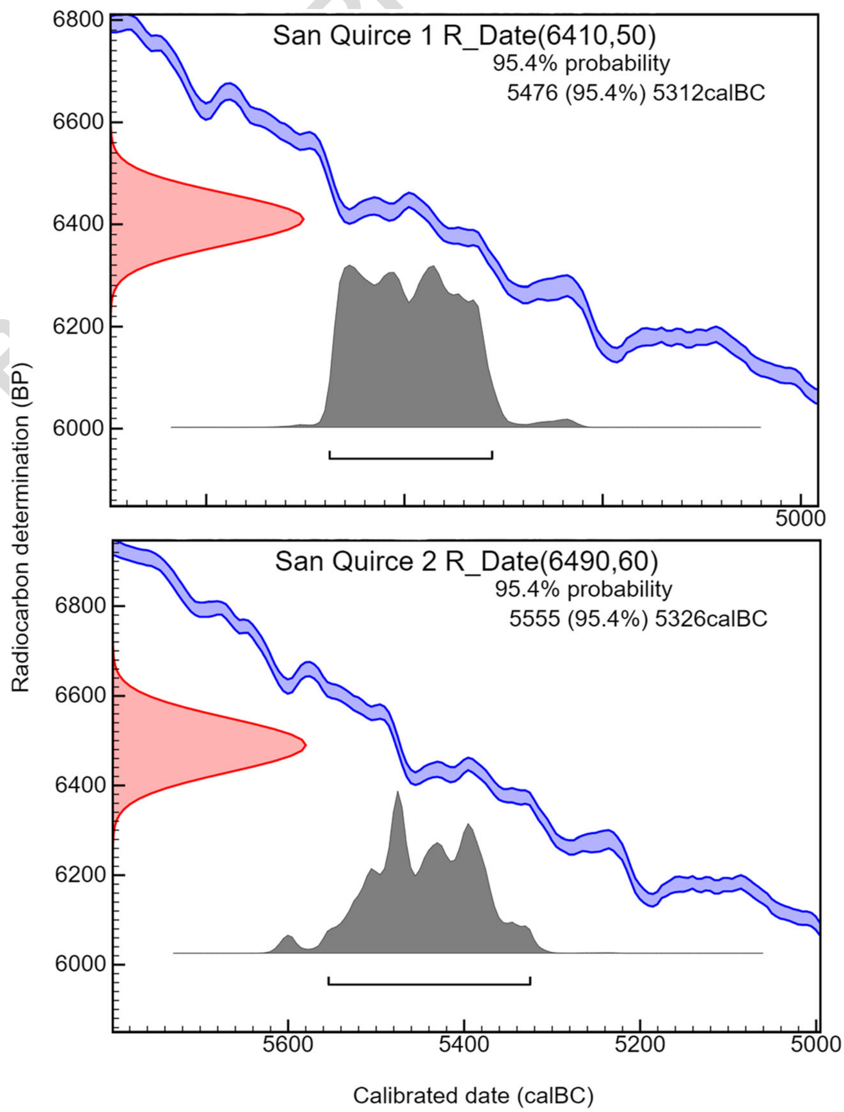

Fig. 9 Calibrated ages of San Quirce site. Curves generated Q7 from OxCal 4.2. Bronk Ramsey (2017); IntCal13 atmospheric Q8 curve (Reimer et al. 2013)

Palaeoenvironmental context

In the northeast of the Iberian Peninsula, the climatic improvement of the Holocene strengthened arboreal colonization of vast open areas that characterized the landscape of the last glacial period. Various bio-geographical zones responded in different ways to the new climate dynamic, in accordance with the degree of humidity, the altitude, the orography, etc. Conifer woods persisted in the high mountainous zones and in the more continental depressions (*Pinus* and/or *Juniperus*) (Iriarte-Chiapusso et al. 2016).

The pollen sequences closest to the site of San Quirce were from deposits located on highland to the northeast of the Northern plateau with regard to La Piedra (a small depressed sedimentary basin at an altitude of 950 m) (Muñoz-Sobrino et al. 1996) and San Mamés de Abar (broad flat surface at an altitude of 920 m) (Basconcillos del Tozo, Burgos, Spain) (Iriarte-Chiapusso et al. 2001).

Q9 In both pollen records, shrubs and woodland spread during the early Holocene above all meso-thermophilus species. In both cases, *Pinus sylvestris* tp. developed earlier than *Betula* and alongside them, although in lesser proportion, *Quercus robur* tp., *Quercus ilex* tp., *Corylus*, *Castanea*, *Fagus*, *Frangula*, *Olea*, *Alnus*, and *Salix*. The climatic deterioration of the 8.2 ky event affected the evolution of the forest cover, above all, with the meso-thermophyllus species.

In the pollen records of La Piedra, the pines reached their maximum expansion in the Holocene (> 50%) towards 7450 ± 50 years BP (6422–6233 cal BC) (Fig. 10), as the birch trees receded. The greater presence of hydrophytic vegetation suggests conditions of greater humidity. The start of the middle Holocene presented similar conditions to those recorded earlier with those recorded before the arboreal regression.

The principal difference of the pollen records of San Quirce with regard to the preceding ones is its reduced arboreal growth (< 12%), in which the juniper tree stands out. Charcoal analyses have recorded only *Pinus sylvestris* type suggesting that there was a preferential gathering of this wood for fuel.

At a more detailed level, the analysis of tufts of grasses would suggest a seasonal occupation of the site that perhaps corresponded with the periods of flowering of this Poaceae family—normally in both spring and summer. The grasses (Poaceae), together with *Compositae liguliflora*, represented the predominant taxa of the herbaceous-arboreal stratum at the foot of the sequence.

Chronocultural context

The dating of this level of San Quirce in the sixth millennium cal BC is insufficient in itself for its contextualization on a cultural basis, having no documented artifacts (lithic and bone remains used by human beings).

Hence, the dating from San Quirce has a certain chronological correlation with an incipient Neolithic culture from the northeast in the Ebro valley (Alto de Rodilla, El Prado and Mendandia I and II in Burgos, Peña Larga in Álava, Lóbrega in La Rioja) to the east (Portalón de Cueva Mayor and Mirador in the Sierra de Atapuerca), to the south-east (zone of Ambrona, Soria), and to the south (Casa Montero in Madrid, La Vaquera in Segovia) (Estremera Portela 2003; Barrios Gil 2005; Alday 2006; Rojo Guerra et al. 2006; Ortega et al. 2008; Fernández Eraso 2011; Vergès et al. 2016; Alonso-Fernández 2018; Rojo Guerra et al. 2018).

The structure of san Quirce: anthropic or natural action?

A first step to interpret the structure of San Quirce is to determine whether it was a consequence of anthropic or natural causes. In view of such a singular record of fire, a natural forest fire has first to be ruled out.

The hearths of San Quirce are a result of human action because three phases of fire-burning have been documented, 15 combustion points, and there are a carbonaceous post-hole and reuse of fires. This evidence can only be of anthropic origin.

Interpretation of the structure of San Quirce

Proposing a hypothesis on the interpretation of this structure in the absence of material elements is very complex. Interpretational difficulties of this structure are evident and very different functions have been attributed to it, from huts to saunas or spaces for drying out hides (Vaquer et al. 2003).

Could the structure of San Quirce be a pottery kiln? The principal arguments for discarding this hypothesis are the absence of ceramic remains and quality raw clayey material in the surrounding area. In addition, the archaeomagnetic data indicate that maximum temperatures of between 480 and 525 °C (L10–54 samples) were reached, while average temperatures of between 600 and 900 °C are required for fired ceramic clay products (Vega Maeso 2012; *interalia*).

Could the structure of San Quirce be a kitchen oven? Unable to dismiss it out of hand, its confirmation is difficult in view of the absence of residues (for example, non-consumable parts of food). They might have processed vegetables (Zvelebil 1994; Bosch-Lloret et al. 2011; Gascó 2002; Q10 Dunne et al. 2016) or even roasted cereals and other culinary activities as has been documented in nearby sites (García Gazólaz and Sesma Sesma 2005; Alonso-Fernández 2018); at San Quirce though, there was no evidence of cereal crops nor food remains. Neither have fragments of receptacles been found (normally ceramic recipients used for cooking), but numerous ethnographic examples are known where cooking

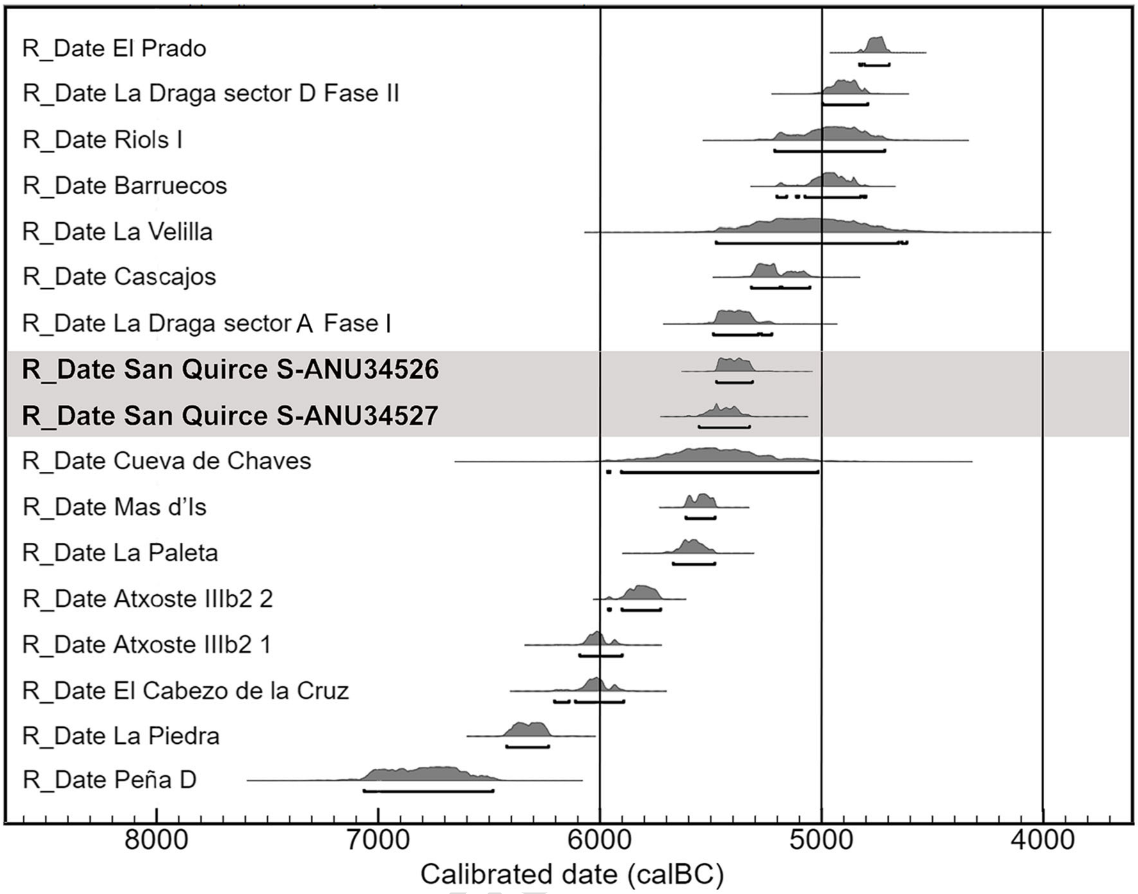

Fig. 10 Calibrated ages of sites mentioned in the text. Curves generated from OxCal 4.2. Bronk Ramsey (2017); IntCal13 atmospheric curve (Reimer et al. 2013)

was done without these types of containers (in bark or in tripe) (Gómez Tabanera 1985).

The people of Oceania, as well as many others, used hot stones for cooking (García Gazólaz and Sesma Sesma 2005). But, these types of cooking stones have not been documented at San Quirce, although they are not essential for cooking.

Polynesian ovens and to the "curantos" are relatively simple (Orliaz and Wattez 1989; Carbonell et al. 2007, *interalia*) like fires at San Quirce, but these would fit into this morphology, although the thermo-altered area at this site is of a very large size.

Although these kitchen hearths may also be found at special localizations, such as surveillance points, they are more common in residential settlements. In these settlements (according to the ethnoarchaeological analysis), there is a specific rest area with hearths, usually clear of remains, and the kitchen fire is found in front of this rest zone, where food is shared out and\or cooking is done (Binford 2009; Sañudo et al. 2012). There are neither material records at the structure nor in its immediate surroundings, at San Quirce, and the fire pit has not been cleaned (the charcoal remains unaltered and the sediment close to the original position). If the "clean" area is related to the rest area, the structure of San Quirce would correspond, hypothetically, to a structure of bivouac of very short duration.

The hypothesis of the function as a hut/shelter is the simplest (Occam's razor), as sleeping or resting produced no residues and, as discussed below, there are other archaeological references to huts with a single post. The experimental reconstruction of a hut has shown that one post is sufficient to sustain a small, but stable shelter. The function of hearths would be simply to warm up at the outdoors (Fig. 5).

Structures in the sixth millennium cal BC

This type of structures around the sixth millennium cal BC is not abundant in the Iberian Peninsula. Determining the functionality of these structures is difficult because some of these excavations are incomplete, there are palimpsests, and/or there have been conservation and dating problems. We do not have the intention of presenting a complete inventory of deposits with structures, but we want to present different typologies of meaningful structures in San Quirce's surroundings. The Mesolithic site of El Cabezo de la Cruz (Zaragoza) dated to 7146 ± 62 years BP (6110–5892 cal BC) (Fig. 10) has contributed an open-air structure. The plant is circular with a length of 4.8 m and a perimeter of 15.47 m. Inside the hut, a circular fire pit/hearth can be distinguished, filled with ashes sediment, small pieces of charcoal, and some lithic elements. Three post-holes were found around this hearth (Rodanés and Picazo 2009).

A hut built against a wall was documented at the rock-shelter of Atxoste IIIb2 (Álava) dating between 7140 ± 50 and 6940 ± 40 years BP (6092–5901 and 5905–5730 cal BC) (Fig. 10), some 13 m^2, with a stony exterior structure and a single post-hole (Perales et al. 2016).

Evidence was recovered at Mas d'Is of three houses and a ditch dating back to 6600 ± 40 (5617–5485 cal BC) (Fig. 10). House 2, the oldest, has contributed the remains of boundary posts, ceramic remains, a large mill in situ, as well as very few flint tools. At house 1, an excavated fire pit was found (2.5 × 1.5 m), containing an open combustion structure filled with fragmented stone pebbles, charcoals, fired clay, and thermally altered sediment (Bernabeu Aubán et al. 2003).

An interesting site because of its findings and its proximity to San Quirce (24 km) is La Velilla (Osorno, Palencia) (Zapatero Magdaleno 2015) dating back to 6130 ± 190 years BP (5477–4618 cal BC) (Fig. 10). The trouble with this site is the existing overlapping of habitat, fire, and megalithic structures. A small oval-shaped structure excavated in the ground of some 12 m^2, delimited by 16 post-holes, was identified. A fire pit with a diameter of 1.5 m can be identified in the center of the structure. Ceramic materials and geometric and polished instruments were unearthed in the interior of the hut (Zapatero Magdaleno 2015).

Various huts were distinguished at the site of La Paleta (Toledo) (6660 ± 60 years BP; 5671–5483 cal BC) (Fig. 10). The dimensions of the largest were about 8–10 m in length and 3–5 m in width, covering areas of between 50 and 7 m^2. Some structures functioned as windbreaks (Jiménez Guijarro et al. 2008).

In Cascajos (Navarra), eight huts dated to 6250 ± 50 years BP (5321–5192 cal BC) (Fig. 10) were documented (two of them Early Neolithic) marked by post-holes. The hearths and the storage holes lay outside the huts. This site presents spaces set aside for exploitation or rituals (Stika 2008; García Gazólaz et al. 2011).

At the Riols I site (Zaragoza) (6040 ± 100 years BP; 5216–4720 cal BC) (Fig. 10), the findings pointed to huts paved with flat slabs filling the inferior fire pits with overlying hearths (Guillén and Lecumberri 1992).

At levels I and II of La Draga (Girona) (between 6410 ± 70 and 6010 ± 40 years BP; 5271–5227 and 4999–4796 cal BC) (Fig. 10), there were large huts (between 10 and 15) with a rectangular floor plan, three or four rows of posts and walls, with interwoven branches covered with clay and straw, and a double-pitch roof. Auxiliary structures have been distinguished (such as granaries), organic remains (related with the technology and food), ceramics, lithic instruments, and hearths upon pit fireplaces (directly excavated in lacustrine sediment) (Bosch-Lloret et al. 2011).

In El Prado (end of the sixth millennium, between 5295 and 4690 cal BC and 4045–3299 cal BC) (Pancorbo, Burgos) (Fig. 10), 50 structures were described including silos, fire pits, individual funerary remains, structures related with exploitation, water, and a "Polynesian" oven. Neither hut foundations nor post-holes were identified (Alonso Fernández and Jiménez Echevarría 2014; Alonso-Fernández 2018).

In the final phases of the 5th millenium BC, a living structure in the open air was identified at the Els Vilars de Tous site (Igualada, Barcelona). This hut was excavated in the ground with a shallow fire pit (30–25 cm), and abundant flint tools were prepared in it (Clop et al. 2005).

Other structural typologies were recognized at the sites of Barruecos (Cáceres), one with 6060 ± 50 years BP (between 5040 and 4900 and 5050–4945 cal BC), and at the Cueva de Chaves (Huesca) around 6770–6330 years BP (5905–5016 cal BC) (Fig. 10). They are storage structures (in ditches and excavated fire pits) and for combustion (Cerrillo Cuenca and Prada Gallardo 2006, 58–60; López-Sáez 2006; Sánchez Cebrián 2015). Holes excavated in the geological substrate were also found at the sites of La Lámpara and La Revilla. These holes contained ceramic fragments and lithic technology worked in flint and polished, as well as principally domestic palaeobotanic and faunistic remains. In addition, ditches with sunken posts were located at La Revilla interpreted as possible corrals (Rojo Guerra et al. 2006, 2008; Stika 2008).

Another site with numerous storage and hearth structures is Prazo (Freixo de Numão, Portugal). Numerous hearths have been detected in the recent Mesolithic occupations (between the third quarter of the 7th to the mid-sixth millennium cal BC) and the old Neolithic (end of the 6th to the third quarter of the fifth millennium cal BC), most of them with stony structures. A pavement was also detected and two hearths, one of which in a fire pit with quartz thermoclasts and the other with a structure of granite slabs (López Sáez et al. 2006-2007).

Traces of hearths were identified at Peña D (Navarra) (7890 ± 120 years BP; 7067–6486 cal BC) (Fig. 10) and heaps of medium-sized stones, as well as remains of cultural materials and consumed fauna.

One of the most common points of all these sites, except in Atxoste and Chaves, is that all the domestic structures were found in open-air settlements. Equally, the largest part of these sites under analysis must have had some huts (but in Prazo, Chaves, La Lámpara, Barruecos, and El Prado), with fire pits (but in Atxote and Peña del Bardal) and with stones and/or perimeter blocks in Atxoste, Prazo, La Paleta, and La Velilla. As in San Quirce, in one of these sites, the fire pit contained pyrotechnology and was located at the base of the hut (Riols I). In seven of them, the fire pits contained pyrotechnology unrelated to the base of the hut (El Cabezo de la Cruz, Prazo, Cueva de Chaves, Mas d'Is, La Velilla, La Draga, and Barruecos).

Another common element was the evidence of the use of fire, within and outside the huts (but in La Paleta, La Lámpara, and La Revilla). As in San Quirce, the hearths in the interior of the structure are commonplace (El Cabezo de la Cruz, Mas d'Is, La Velilla, Riols I, and Barruecos).

Half of these sites, as at San Quirce, have (one or more) post-holes (Atxoste, El Cabezo de la Cruz, Mas d'Is, La Velilla, La Revilla, Los Cascajos, and Draga). Unlike San Quirce, half of these sites had a ditch or similar structure (Prazo, La Paleta, Cueva de Chaves, Mas d'Is, La Lámpara, La Revilla, Los Cascajos, and Barruecos).

Hence, the structure of San Quirce presents very common characteristics in this chronocultural context (developed in the open-air, related with post-holes, hearths, and fire pits). Other characteristics are less common and stand out, as are the presence of single post-hole (as in Atxoste) and the reduced dimensions of its hut.

Conclusions

The Holocene level of the San Quirce site has contributed very particular evidence on the management of the land in the sixth millennium cal BC. A fire pit has been uncovered over which a small-sized structure, with a post-hole, with no other associated archaeological element (such as ceramics, lithic remains and bone remains used by human beings), and a broad sequence of reused hearths. This structure represents a rare example of archaeological evidence of this typology from the 6th millenium cal BC in the Iberian Peninsula, the only open-air campsite in the Duero River basin repeated fire-burning activity may be studied. The charcoal analyses have yielded single taxa *Pinus* type *sylvestris* that suggests that this wood was preferred as fuel. Higher taxa diversity is reflected by the pollen analyses.

Archaeomagnetic analyses combined with micromorphological observations carried out on samples from this structure have allowed reconstructing and temporally sequencing some formation processes. After the original sedimentation and before the last burning, some type of post-depositional processes reworked the sedimentary matrix at least at microscopic scale since the archaeomagnetic record was distorted. However, one of the combustion features studied showed very good physical preservation after burning and maximum heating temperatures between 480 and 525 °C were determined.

At this level, there were small groups, who occupied a small and fragile hut/shelter, possibly over a short time (searching heat), but on repeated occasions during spring and summer.

The fact that the occupations took place in the same space, with the same distribution, and the more than likely reuse of some constructive elements has led us to propose that the occupations were carried out by the same group, which would establish a rotary system with temporary occupations, as proposed for sites of similar chronology (Rodanés and Picazo 2004).

Although the presence of huts, fire pits, and hearths in this chronocultural context is relatively common, we have found no parallels with the most differentiating aspect of San Quirce—the absence of artifacts with no natural explanation. Many of the structures of the sites that share a geographical and chronocultural context with San Quirce have been interpreted as living places and cooking and storage areas, and even as symbolic/religious elements. But, in view of the absence of artifacts at this site, we have not been able to define the specific functions of this structure. Given the lack of cultural remains, it is reasonable to think that it may have worked as a bivouac or as an open-air temporary refuge in short-term occupations.

We currently cannot yield a definite explanation for the artifactual absence within this structure. The lack of other cultural remains is the most singular feature of the structure and it might presumably correspond to short-term occupations.

The repeated occupation of this small space is due to its strategic location close to a very important natural path of communication: the canyon of Horadada that links the Northern plateau to Cantabria. Wide-ranging views from San Quirce exercise control over the land, because of its location that accesses different ecotones and because of its proximity to water.

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