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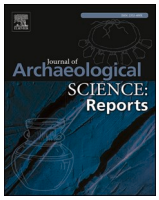

Pottery forming of the Cardial and Epicardial Neolithic wares: Analysis and systematisation of technological traces from the ceramic productions of Cova del Frare (NE Iberian Peninsula, 5200-4800 BCE)

Javier Cámara Manzaneda [a,*], Xavier Clop García [b], Jaume García Rosselló [c], Araceli Martín Cólliga [d]

[a] ARCHAEOM, Dept. Prehistòria, Universitat Autònoma de Barcelona, Edificio B, Facultad de Filosofia y Letras, 08193 Bellaterra, Barcelona, Spain
[b] ARCHAEOM, Dept. Prehistòria, Universitat Autònoma de Barcelona, Edificio B, Facultad de Filosofia y Letras, 08193 Bellaterra, Barcelona, Spain
[c] ArqueoUIB, Dept. Ciències Històriques i Teoría de les Arts, Universitat de les Illes Balears, 07122 Palma de Mallorca (Illes Balears), Spain
[d] Servei d'Arqueologia i Paleontologia, Departament de Cultura, Generalitat de Catalunya, Spain

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ABSTRACT

The onset and development of the Neolithisation process in the northeast of the Iberian Peninsula have been determined by the division between the Cardial and Epicardial chrono-cultural horizons based on the characteristic traits of the ceramic productions. The investigations about these productions have been fundamentally focused on their formal and decorative features, while other research dealing with their production and use have just recently emerged in the last years.

This paper focuses on the reconstruction of the forming technologies that were used for manufacturing the Early Neolithic vessels from Cova del Frare (Barcelona, NE Iberian Peninsula) assigned to the Cardial and Epicardial styles. The analysis and systematisation of manufacturing traces reveal that both ceramic wares were produced with the same forming practices, regardless of their decorative techniques: the use of circular juxtaposed patches and the assembly of coils. The evidence of these pot-forming processes, which prevailed during the Early Neolithic occupations of this cave (5217–4796 cal. BCE), provides the first empirical data of the forming practices that were used by the first communities of farmers in NE Iberia. Furthermore, these results enable us to include this area in the discussions on the distribution of these technical traditions and practices during the Early Neolithic in the Western Mediterranean.

1. Introduction

The Neolithisation process has been one of the largest investigated themes of the recent Prehistory to explain the spread and consolidation of farming, especially to the West of the Mediterranean. Studies focused on the Early Neolithic in this Mediterranean area has been boosted during the last years with the emergence of new research lines that are allowing us to broaden and deepen the discussions of this historical process. Among them, the ancient DNA analysis (e.g., Gamba et al., 2012; Olalde et al., 2019; Szécsényi-Nagy et al., 2017), investigations on the early husbandry practices (e.g., Debono Spiteri et al., 2016; Drieu et al., 2021; Navarrete et al., 2017), the analysis of the harvesting technologies (Mazzucco et al., 2020) or studies related to the different manufacturing phases of the first pottery productions in the Western Mediterranean (e.g., Bernabeu et al., 2017a; b; Capelli et al., 2017; Clop, 2011; Gabriele et al., 2019; Manen and Convertini, 2012, Pardo-Gordó et al., 2019). In this framework, one of the latest innovative studies being included in the discussions of the Neolithisation process is the recognition of the forming processes used in the context of the first ceramic productions (Gomart et al., 2017).

Pottery forming practices can be used as a proxy to characterise specific ways of doing and the transmission of know-how linked, in this case, to the first communities of farmers. The investigations conducted in different European regions have shown that several technical traditions coexisted since the beginning of the Early Neolithic and followed different trajectories linked with the paths and expansion of the

* Corresponding author.
E-mail addresses: javier.camara@uab.cat (J. Cámara Manzaneda), xavier.clop@uab.cat (X. Clop García), jaume.garcia@uib.es (J. García Rosselló), amcolliga@yahoo.es (A. Martín Cólliga).

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Neolithisation process (Gomart et al., 2017; 2020). With the introduction of farming towards Central and North-western Europe, the ceramic productions were clearly linked with the prevalence of the coiling techniques (Bosquet et al., 2005; Gomart, 2014; Neumannová et al., 2017), although they were also diffused with other forming processes such as the slab building or the beating technique (Gomart et al., 2020; Thér et al., 2019). In the Central and Western Mediterranean, the situation seems much more complex since two completely different technical traditions coexisted within the earliest *Impressa* ceramic productions (5900–5600 cal. BCE): the coiling techniques and the spiralled patchwork technology (Gomart et al., 2017). However, these first pot-forming processes are still largely and deeply unknown in other regions of the Western Mediterranean, such as the northeast of the Iberian Peninsula. Accordingly, the relationship of the pot-forming processes used by the first communities of farmers in the north-eastern Iberian Peninsula with other Mediterranean areas remains unexplored.

The introduction of farming and the first ceramic productions in the NE Iberian Peninsula is generally associated with the Cardial and Epicardial ceramic styles, which marked the chrono-cultural horizons in this area (Gibaja and Clop, 2012; Martín, 1990; Oms, 2014; 2017). Nonetheless, and compared to southern France (Binder and Sénépart, 2010; Manen, 2007; Manen et al., 2019a) and the Alicante area to the east of the Iberian Peninsula (Bernabeu et al., 2017a; 2018), there is no strong evidence to confirm an earliest Neolithic occupation phase associated with the *Impressa* horizon (Oms et al., 2020)[1].

The largest Early Neolithic occupations and the first evidence of the ceramic Cardial decorations in the northeast of the Iberian Peninsula appeared between c. 5550–4850 cal. BCE (Oms, 2014; 2017). The Cardial vessels characterised by seashell impressions comprise a range of shapes represented by bowls, cylindrical jars, tulip-shaped bowls, globular bottles with necks, among others. Surfaces are well-smoothened or polished and can be decorated with several impression types with serrated shells (*Cerastoderma edule*, *Cerastoderma glaucum*) and other multi-tipped tools (combs), with decorated or plain cords.

Ceramic productions associated with the Epicardial style are generally dated in the north-eastern Iberian Peninsula between c. 5100–4500 cal. BCE (Oms et al., 2016). The Epicardial vessels have very similar shapes to the Cardial ware, although their proportions can be larger, increasing the number of ovoid shapes with elongated necks. Surfaces are generally smoothened and present decorations with pointed tools, such as combs and punches, organised in bands and forming compositions of impressions, incisions, and grooves.

The Cardial evidence was distributed mainly in the coastal and prelittoral areas with the implementation of the Neolithisation process since 5550 cal. BCE. Instead, the Epicardial evidence was initially located from 5350 cal. BCE in the inlands of NE Iberia (the Segre basin and Pyrenees) (Oms, 2017), but after 5150–5100 cal. BCE appeared in the coastal areas and replaced progressively the Cardial style (Martín et al., 2010; Oms et al., 2016).

These Early Neolithic ceramic productions have been investigated in NE Iberia with focus on several phases of their manufacturing process, such as the decorative techniques (e.g., Manen, 2002; Oms, 2014; 2017; Laborda et al., 2021), raw materials acquisition, addition or not of temper (Clop, 2005; 2011) and pottery use based on organic residue analysis (Breu, 2019; Breu et al., 2021; Debono Spiteri et al., 2016; Tarifa, 2019). However, no study focused on the identification of forming processes has been developed so far.

This paper is focused on the identification of forming processes of the Cardial and Epicardial wares documented at Cova del Frare (Barcelona, NE Iberian Peninsula) (Fig. 1). This cave has provided one of the most complete stratigraphic sequences of the recent Prehistory for the NE Iberian Peninsula (Martín, 1980; 2000; Martín et al., 1981; 1985). Within this stratigraphic sequence, layers C6-C5c, and C5b are associated with the Early Neolithic and where significant Cardial and Epicardial ceramic assemblages have been documented. First, the analysis of technological traces enabled us to reconstruct the forming processes of vessels and systematise the evidence related to each forming technique. Second, given the representativeness of the Cardial and Epicardial wares from this site, the technological data was compared in order to assess whether or not the forming processes varied according to the decorative techniques. Finally, the results enabled us to obtain the first data on the forming practices that were used by the first communities of farmers in the NE Iberian Peninsula and to introduce this area into the discussions on the distribution of the first forming processes in the Western Mediterranean.

2. Site: Cova del Frare

Cova del Frare (Matadepera, Barcelona) is located in the Sant Llorenç del Munt Mountain, a karstic massif formed by conglomerate and marl strata, at 960 m asl. The cavity, developed from an N-S diaclase, has three entrances (sectors A, B, and C) that open to the southwest, with no more than 40 walkable meters and very irregular heights (Fig. 1). The cavity was first reported in 1878, whilst in 1970 a stratigraphic survey was conducted and between 1977 and 1984, systematic fieldworks directed by one of the authors (AMC) were carried out.

The archaeological fieldworks indicate that the cavity was used during different periods of the recent Prehistory, with a sequence that includes: Early Neolithic occupations (Cardial and Epicardial chrono-cultural horizons) (layers C6-C5c and C5b), Middle Neolithic occupations, with Montboló and Molinot regional pottery styles (layer C5a); a funerary use during the Early Late Neolithic (layer C4); presence of regional bell-beaker during the Chalcolithic (layer C3); and Early Bronze Age occupations (layer C2) (Martín, 1980; 2000; Martín et al., 1981; 1985). At the entrance there were areas with intrusions from the Iberian, Roman and Medieval periods (Martín and Biosca, 1994), as well as some hollows and removals that were performed when the cavity was discovered.

2.1. The Early Neolithic occupations

The Early Neolithic occupations correspond to the layers C5b and C5c-C6, which form a dark grey sedimentary package of about 20 cm of silts and clays. These layers were documented in the front part of the cavity up to the beginning of the corridor and lay on a thick stalagmitic slab. Below layer C5b is either C5c or C6 layers, which were distinguished depending to the presence or absence of stalagmitic slabs. The earliest Neolithic occupations of the cave (layers C6-C5c) associated with the Cardial evidence (Martín, 2000; Martín et al., 1985) are dated between 5208 and 5030 cal. BCE 1σ and 5217–4960 cal. BCE 2σ (Table 1). The subsequent layer of the cave (layer C5b), where the potsherds decorated with the impressed, incised and grooved decorations predominated (Epicardial style) (Martín et al., 1985; 2010), is dated between 5031 and 4846 cal. BCE 1σ and 5201–4796 cal. BCE 2σ.

Cova del Frare site was possibly a place of seasonal occupations (storage vessels, manufacturing processes of tools, abundant faunal domestic remains) by groups of herders who cohabited part of the year with domestic animals, even during the cold seasons (Albert et al., 1996; Estévez and Martín, 1982; Martín and Estévez, 1992). Animal husbandry is well-documented by the presence of ovine and caprine remains with a high number of foetal and neonatal individuals (Estévez and Martín, 1982; Navarrete, 2017), which suggested the hypothesis that the cave

[1] The possibility of an earliest Neolithic occupation phase in the NE Iberian Peninsula has been raised based on certain ceramic findings, such as Phase A of Guixeres de Vilobí (Barcelona) and the Structure 2014 of El Cavet (Tarragona) dated with short-lived samples (Oms et al., 2014; 2021; Martins et al., 2015). However, the scarcity of archaeological remains and the results of the radiocarbon dates do not allow at this time to verify the possible existence of a pre-cardial horizon in this area (Oms et al., 2020).

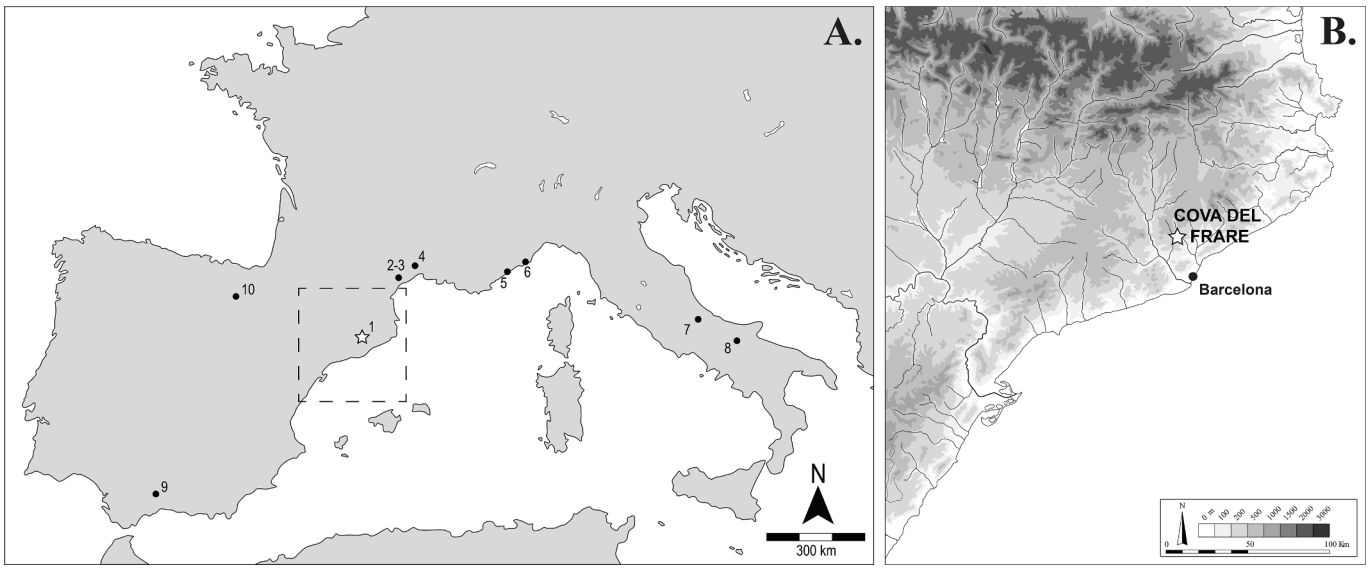

Fig. 1. Location of the Early Neolithic sites mentioned in the text: 1. Cova del Frare (NE Iberian Peninsula), 2. Peiro Signado, 3. Pont de Roque-Haute, 4. ZAC la Farigoule 2 (Languedoc, S France) (Manen et al., 2019b, Manen and Guilaine 2020), 5. Abri Pendimoun, 6. Arene Candide (Ligurian-Provencal Arc) (Gomart et al., 2017), 7. Colle Santo Stefano, 8. Ripa Tetta (SE Italian Peninsula) (Angeli and Fabbri, 2017; Colombo, 2017; Gomart et al., 2017), 9. Cueva de El Toro (S Iberian Peninsula) (Cámara et al., 2021), 10. Los Cascajos (N Iberian Peninsula) (Caro et al., 2020).

Table 1
Calibration of radiocarbon dates from Cova del Frare (NE Iberian Peninsula) with OxCal v.4.4.4 software (Bronk Ramsey 2021) and using IntCal20 atmospheric curve (Reimer et al. 2020). Selection of radiocarbon dates of Cova del Frare without large standard deviations.

Site	Layer	Lab-code	Material	BP date	1σ cal BCE (68.3%)	2σ cal BCE (95.4%)	Reference
Cova del Frare	C6/ C5c	Beta-325690	Ovis aeries	6170 ± 40	5208–5201 (3.3%) 5185–5141 (22.4%) 5136–5054 (42.6%)	5217–4997 (95.4%)	Oms et al., 2016 Martins et al., 2015
Cova del Frare	C6	Beta-436332	Animal bone	6150 ± 40	5208–5157 (24.6%) 5126–5030 (43.6%)	5215–4989 (95.2%) 4963–4960 (0.2%)	Navarrete et al., 2017
Cova del Frare	C5b	Beta-325688	Ovis aeries	6070 ± 30	5031–4937 (68.3%)	5201–5186 (2.6%) 5053–4896 (88.8%) 4869–4849 (4.1%)	Oms et al., 2016 Martins et al., 2015
Cova del Frare	C5b	Beta-325687	Ovis aeries	6020 ± 40	4981–4976 (2.4%) 4952–4846 (65.9%)	5010–4796 (95.4%)	Oms et al., 2016

was possibly used as an enclosure of herds (Antolín et al., 2018; Martins et al., 2015). The cavity was therefore probably inhabited during seasonal occupations, but was also abandoned for certain periods, which would have allowed the formation of tunnels and burrows of wild animals, the formation of stalagmitic slabs, etc.

The activities carried out by the inhabitants of the cave left a wide range of artefactual remains. In addition to pottery (see below), the archaeological assemblage is composed of lithic industry, with by-products associated with all stages of their production process, showing that the manufacture was carried out at the place. Most of the lithic remains correspond to a laminar industry of different flint qualities, jasper and quartz, overall including scrapers, retouched blades and some burins, etc. Stone tools also comprise some polished and bevelled artefacts on hornfel, in addition to crushers but with no evidence of grinding tools. Bone industry consists of several punches made from ovicaprine diaphysis as well as an assegai made from a long bovine bone. Personal ornamentation is reduced to discoidal beads on shell and perforated *Columbella rustica*, as well as some deer's teeth with recesses.

2.2. The Cardial and Epicardial ceramic productions

The Cardial ware comprises some 90 fragmented and very small potsherds recovered from layers C6-C5c, in addition to a few other sherds located out of context. The raw materials generally consist of fine ware, with a predominance of medium-sized vessels and occasionally larger vessels decorated with cords. Shapes decorated with *cardium* are only recognised in 7 spherical and sub-spherical individuals, 2 hemispherical vessels, and 3 vessels with necks (Fig. 2a). Non-*cardium* impressions were documented in 7 spherical, sub-spherical, and hemispherical vessels. The lips are generally rounded, T-shaped, and flat with a rim profile inward, outward, or straight (Martín et al., 2010). Decorative techniques usually correspond to impressions, with the predominance of *cardium* with a shell in an oblique position dominating over those made with the shell in a vertical position (Fig. 3a). In addition, there are impressions made with a comb, smooth shell, or other undefined tools. The *cardium* decoration is exclusive to 14 vessels, although it is also combined, for instance, with cords, incisions, or even impressions made with other tools. The many combinations of matrixes and the richness of the combined themes and motifs allowed to propose the classification of this ceramic assemblage within the Late Cardial horizon (Oms, 2014; 2017).

The Epicardial ware comprises a minimum of 370 decorated sherds from layer C5b, although 23% of the total number of the Epicardial sherds were also recognised in the lower layers, dispersed on the corridor (sector D) or in the upper layers, out of context. The shapes correspond to sub-spherical, hemispherical, ellipsoidal, and cylindrical vessels with a few exceptional cases with necks (Fig. 2b). Inward rims predominate over the straight and less-frequent outward rims (Manen, 2002). Cova del Frare presents the largest catalogue of Epicardial decorations of Catalonia. The use of grooves predominates within the ceramic assemblage, followed by the incisions and the impressed-incised decorations (Fig. 3b). A very reduced number of plastic cords can also be

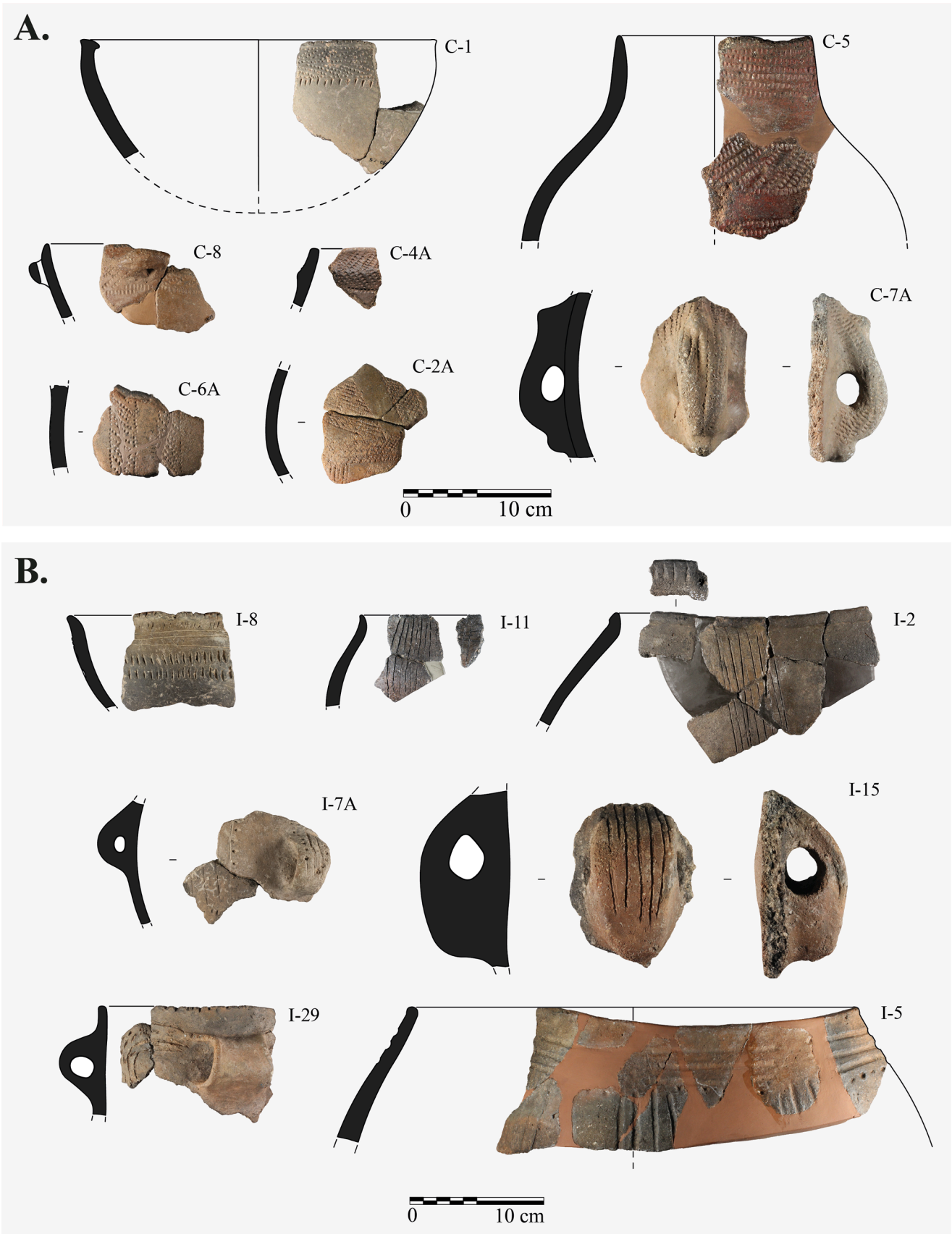

Fig. 2. Examples of pottery shapes and decorations from Cova del Frare. A. Cardial ware, B. Epicardial ware. Source: drawings provided by J. Ariza and A. Martín and photography provided by J. Cámara.

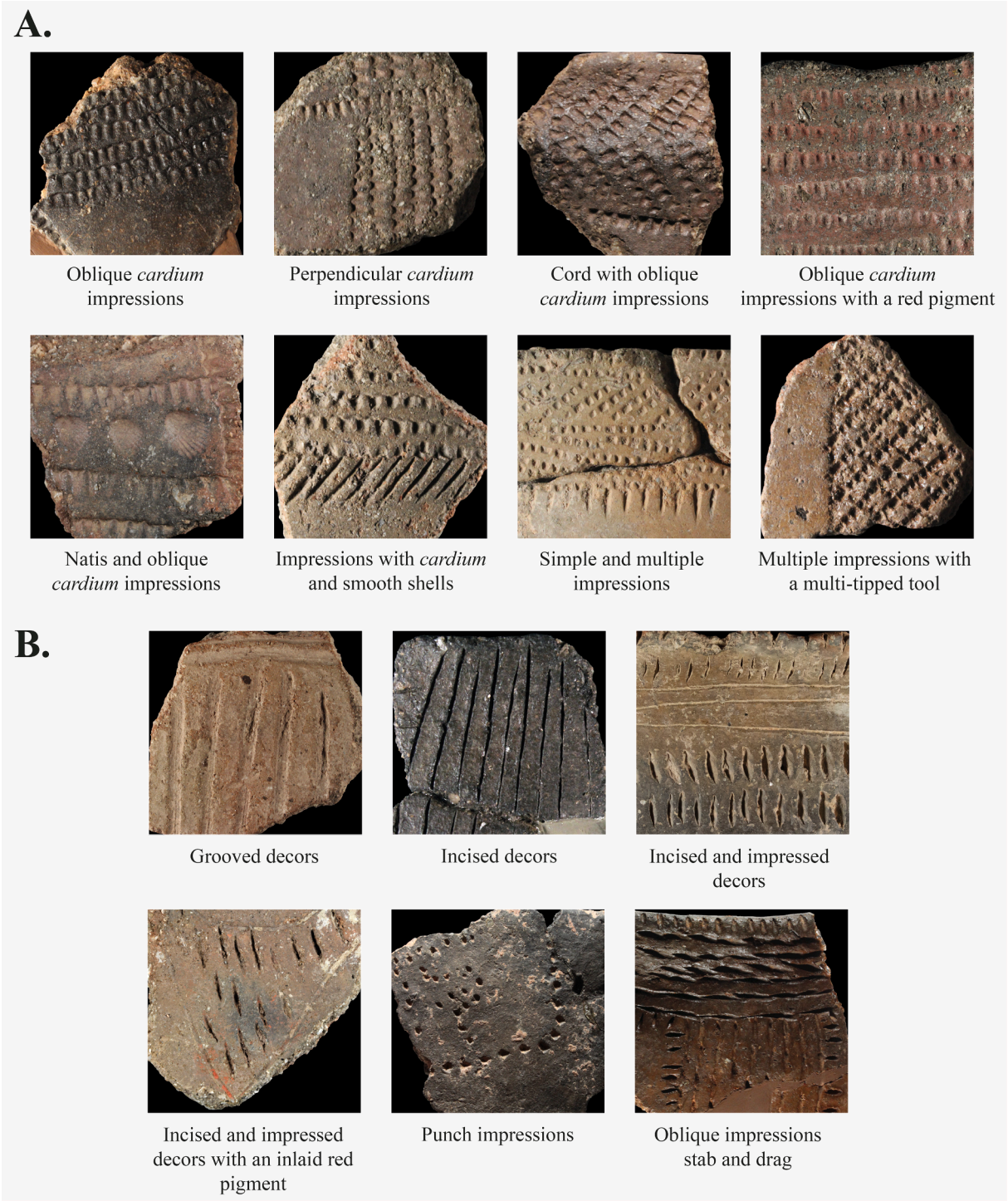

Fig. 3. Examples of the decorative techniques of the Cardial (A) and Epicardial (B) wares of Cova del Frare.

documented (Manen, 2002; Martín et al., 2010).

Several Cardial and Epicardial vessels from Cova del Frare were also sampled to analyse the provenance and management of raw materials, indicating that the acquisition of raw materials was local or proximate to the location of the site. In addition, no temper was added to the pastes, except for some samples where the addition of crushed calcite was identified (Binder et al., 2010).

3. Materials and method

3.1. Pottery sample analysed

A total of 86 vessels have been documented in Cova del Frare which, due to their spatial location or their decorative characteristics, are included in the Cardial or Epicardial styles (Table 2). Cardial vessels are mainly documented in layers C6-C5c, while the Epicardial ware was mainly found in layer C5b. The ceramic assemblages were documented in the front part of the cavity and other few potsherds were found very dispersed in the upper layers, probably displaced by taphonomic

Table 2
Total number of vessels analysed and sample of vessels with diagnostic traces.

	Cardial ware		Epicardial ware		Undecorated vessels		TOTAL	
	N°. Vessels	%	N°. Vessels	%	N°. Vessels	%	N°. Vessels	%
Total	40	100	46	100	–	–	90	100
Analysed	29	72.5	46	100	4	100	79	87.78
With diagnostic macro-traces	16	40	36	78.26	4	100	56	62.22

processes.

From a number of 86 vessels, 40 (89 potsherds) present impressed decorations made with *cardium*, combs, smooth shells or other multi-tipped instruments, which allow them to be classified within the Cardial ware. In this study, a maximum number of 29 vessels (76 potsherds) distinguished by their decorative techniques and compositions were analysed[2] (Table 2). The Cardial vessels are characterised by a high degree of fragmentation, barely with no any complete profile. Several vessels are determined by a single decorated potsherd (Oms, 2014, pp. 154-161). 16 of the 29 vessels analysed preserve macro-traces, which represent 40% of the total of the Cardial vessels (70.79% of potsherds).

The Epicardial ware is characterised by 46 vessels (363 potsherds) with incised, incised-impressed or grooved decorations, spatula or punch impressions and cords. Each ceramic individual is composed of several potsherds and they usually preserve part of their profile, generally from the rim to the body and, in a single case, from the rim to the base. All the Epicardial vessels have been analysed, of which 36 (348 potsherds) present diagnostic macro-traces (Table 2). This number of vessels represents 78.26% of the total of vessels belonging to this style (95.87% of potsherds).

In addition, the analysis of 4 undecorated vessels, comprised of 8 potsherds, were also included. These vessels, which display diagnostic macro-traces, were located in layers C5c (1 potsherd) and C5b (7 potsherds).

In order to expand the sample, 282 undecorated potsherds from layers C6-C5c and 667 from layer C5b were analysed. Diagnostic macro-traces were recognised in 54 potsherds from layers C6-C5c (19.15%) and in a number of 89 potsherds from layer C5b (13.34%).

Accordingly, from 79 vessels included in this study, technological traces have been identified in a number of 56 vessels, in addition to 143 non-decorated potsherds.

3.2. Technological analysis and examination of manufacturing traces

The technological analysis has focused on determining the pottery forming techniques and methods. Forming techniques encompass those processes by which the volume of vessels is obtained (forming, auxiliary techniques, drying phases, and reinforcements) and those techniques by which the surfaces are modified and the vessels shaped (García Rosselló and Calvo Trias, 2013). The ordered sequence of techniques and elementary gestures along the different parts of the vessels (base, belly, collar and rim) allows us to reconstruct the forming sequences or forming methods (Roux, 2010; 2019), integrated within the ceramic manufacturing processes.

Ceramic macroscopic analysis relies on the recognition of a series of traces produced as a consequence of the forming processes of vessels. The technological origin of traces is related to the type of forces applied on the raw materials and the modalities with which the paste is transformed into a volume (Roux, 2019). These actions lead to a direct and indirect formation of a series of technological features on the vessels: irregularities and textural variations on the surfaces, formal variations on the wall thickness, several fracturing patterns of vessels when broken and diverse modalities of the spatial organisation of pores and mineral inclusions in the internal structure of vessels. The systematic examination and comparison of traces provide an indicative and reproducible framework to reconstruct the technologies that were used in ceramic manufacture (Thér, 2020; García Rosselló and Calvo Trias, 2013).

The ceramic assemblages of Cova del Frare have been examined by combining direct observations with angular lighting and a stereomicroscope of low magnifications (5x to 8x). The descriptive parameters of two methodologies were used to systematically record technological traces and the orientation of pores and particles in the tangential and radial planes (Cámara, 2019; García Rosselló and Calvo Trias, 2013; Livingstone Smith, 2007). In parallel, macro-traces have been photographically recorded using a digital camera and alternating two lenses: an intermediate lens 18–55 mm and a macro lens 90 mm. The photography was conducted by using a static support and auxiliary LED lights, controlling the entry of natural light into the room. The scale of the photographs corresponds to the original scale of the traces.

The interpretation of forming processes is based on the correlation of manufacturing traces documented on each ceramic vessel and their comparison with referential series of traces, both experimental and ethnoarchaeological (García Rosselló and Calvo Trias, 2013; 2019; Gelbert, 2003; Lara, 2017; Lepère, 2014; Martineau, 2000; Roux, 2019; Rye, 1981). Macroscopic analysis enabled us to detect a series of traces for which no current ethnographic or experimental references have been reported. These traces were systematically recorded following several parameters (Fig. 4). Their technological origin was inferred by correlating all manufacturing traces and conducting comparisons with similar traces identified in other Early Neolithic contexts (Gomart et al., 2017, Manen et al., 2019b).

4. Results

Analysis of traces preserved in the ceramic vessels revealed the use of two forming techniques linked with two forming sequences (Table 3). Forming techniques were also recognised in a series of potsherds associated with the Cardial and Epicardial assemblages from Cova del Frare. This study also allowed us to recognise the insertion systems of handles and secondary elements on the walls of the vessels.

4.1. Identification of forming techniques

4.1.1. Forming process with circular juxtaposed elements

The ceramic vessels that preserve part of the belly present a series of macro-traces that suggest the use of circular elements during the forming processes (Table 4). Moreover, a similar morphology of traces was recognised in 54 potsherds from layers C6-C5c and in 89 potsherds from layer C5b.

The ceramic productions develop a series of circular and arciform-shaped fractures on the belly, visible both from the inside and outside in a frontal view (Fig. 5, Fig. 6, Fig. 7). This modality of sub-circular fractures can be arranged together, forming several series of fractures with an arciform V-shape (Fig. 7b1-b2). The inner and outer surfaces of

[2] This study includes 5 ceramic vessels, 4 Cardial and 1 Epicardial (41 potsherds), which are currently on display at the Castell Cartoixa de Vallparadís (Museu de Terrassa). The other Cardial potsherds, among which 3 potsherds belonging to a vessel, are on display at the Museu d'Història de Catalunya (Barcelona) and were not considered for this study. Given the fragmentation of the Cardial ceramic assemblage, we cannot rule out that some of the individualised potsherds also belonged to the same vessel.

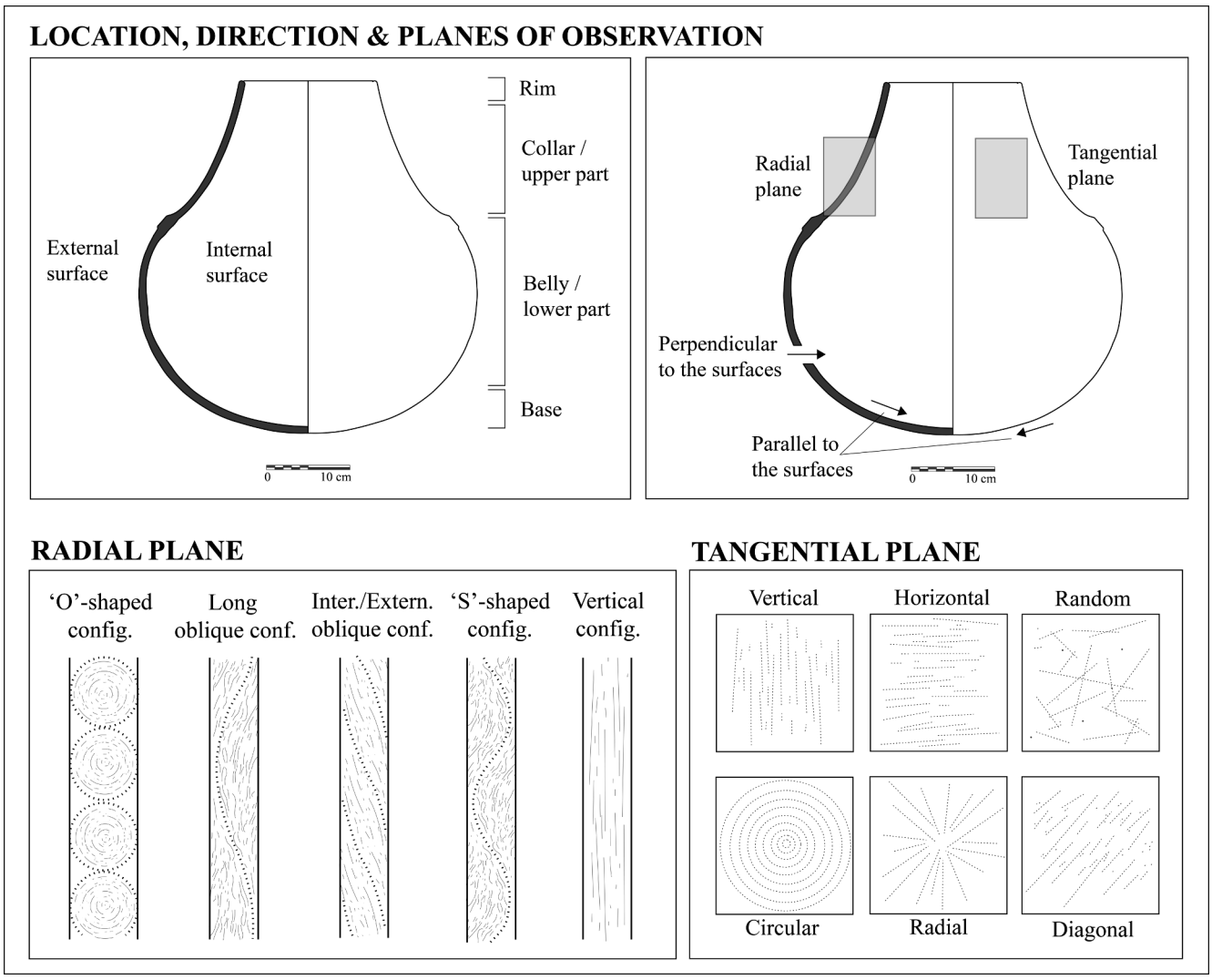

Fig. 4. Description and systematisation of macro-traces: location, direction and planes of observation. Descriptive parameters proposed by Livingstone Smith, 2007; García Rosselló and Calvo Trias, 2013.

the vessels and potsherds preserve several macroscopic features that can be grouped into the following traces: sub-circular depressions (Fig. 5c), which in occasional cases correspond to V-shaped wavy variations (Fig. 8b2), arciform burrs on the inside (Fig. 8b2), convexities (Fig. 6a3) and an uneven topography with flat areas on the outer surfaces (Fig. 8a2). When these series of traces are merged, it is possible to reconstruct circular elements (Fig. 5, Fig. 6), generally broken with sub-circular shapes (Fig. 7b4, Fig. 8b2).

In the radial plane, potsherds show a heterogeneous but not regular internal structure with long oblique configurations that can be associated with circular configurations (Fig. 5b). In some vessels that present a modification of the surfaces (Fig. 7a2-b2) or preserve laminar fractures with part of a detached sherd (Fig. 6a3), the distribution of pores and particles in the tangential plane can also be observed. In these cases, the organisation of pores and aplastic particles is circular to sub-circular, following the contour of the arciform fractures (Fig. 7b3).

At present, there are neither experimental nor ethnoarchaeological collections that present series of arciform traces related to the use of circular elements in the ceramic manufacturing processes. However, a similar morphology of traces has been reported during the last years documented in several Early Neolithic contexts of the Western Mediterranean (Gomart et al., 2017; Manen et al., 2019b). The macroscopic analysis of macro-traces and the integration of the micro-computed tomography on a set of samples from the *Impressa* layers of Abri Pendimoun have shown that these series of traces corresponded to circular juxtaposed and fused elements, each formed by a spiral coil, terming this forming process as a spiralled patchwork technology (Gomart et al., 2017).

In the case of Cova del Frare, the correlation of traces and their comparison with these archaeological cases indicate that the belly of the vessels was also formed by means of circular juxtaposed elements (series of arciform traces). Moreover, based on the available data from the sites of Abri Pendimoun, Arene Candide and ZAC la Farigoule (Gomart et al., 2017; Manen et al., 2019b), each circular element was also possibly formed by a spiral coil (circular organisation of pores and particles in the tangential plane). In several cases where circular elements can be completely delimited, they present a regular contour with an average diameter of 50 ± 6.4 mm. This forming process has been documented on the belly of vessels, although in several cases the use of circular elements reached the upper parts and the rim was also formed using this technology (Fig. 6a2). In particular, the arrangement of traces in the inner surface of one of the vessels (I-5) reveals that these elements were juxtaposed in successive rows, one over another, to completely build the vessels (Fig. 8).

Once the patches were partially or completely juxtaposed (Fig. 6b4), they were possibly fused and then scraped, causing a modification of the

Table 3
Reconstruction of pottery forming sequences identified at Cova del Frare.

Forming methods	N. ° Vessels	Base forming	Belly forming	Upper part - rim forming	Surface modification and shaping
CF1	9		Circular juxtaposed and fused elements, each possibly formed by a spiral coil (series of arciform traces)	Coiling with an oblique alternate overlapping (S/Z-shaped configurations), with a last coil internally overlapped (n = 3), externally overlapped (n = 4) or superimposed (n = 2)	Scraping the internal surface (n = 4)
CF2	7		Circular juxtaposed and fused elements, each possibly formed by a spiral coil (series of arciform traces)		Scraping the internal and external surfaces (n = 3)
–	9		–	Coiling with an oblique alternate overlapping (S/Z-shaped configurations), with a last coil internally overlapped (n = 3), externally overlapped (n = 3) or superimposed (n = 1)	–
–	31	Circular juxtaposed and fused elements (n = 1)	Circular juxtaposed and fused elements, each possibly formed by a spiral coil (series of arciform traces)	–	Scraping the internal surface (n = 5)
Total	56				

surfaces and on the thickness of the walls. Indeed, the scraping technique is attested on several vessels that display linear grooves on the inner surface, with marked edges and flattened sections associated with erratic striations (Fig. 7a4). Altogether, these traces suggest the extraction of clay during the modification of the surfaces.

4.1.2. Forming of the upper parts and rims with assembled coils

The upper parts of a limited number of vessels and the majority of the rims exhibit a series of traces associated with the coiling technique (Table 5). The assembly of coils is identified in 9 ceramic vessels that only preserve the rim and part of the belly or solely preserve diagnostic macro-traces corresponding to the forming of the rim. In another sample of 9 vessels, the rim is formed with coils while the body is built with the use of circular elements. In contrast, no traces of forming linked to this technique have been identified on the potsherds from layers C6-C5c and C5b.

The rim and the upper parts of vessels develop horizontal linear fractures, with an irregular or inverted U-shaped section (Fig. 9a1). The inner and outer surfaces present continuous or discontinuous wavy burrs that can be correlated with the horizontal variations. Altogether, these traces indicate that the rim and the upper parts were built with horizontal coils, varying from one to several coils according to each specific case.

In the radial plane, cross-sections present a heterogeneous internal structure with a regular distribution of pores and particles forming S/Z-

Table 4
Systematisation of traces associated with the juxtaposition of circular elements, similar to the traces documented in other Early Neolithic contexts from the Western Mediterranean (Gomart et al., 2017; Manen et al., 2019b). 1-2: Traces with an indirect formation process: fracturing patterns. 3-6: Traces with a direct formation process: formal variations on the wall-thickness, texture and irregularities on the surfaces. 7-8: Internal organisation of pores and a-plastic particles in the cross-sections and surfaces (tangential and radial planes).

	Feature	Shape/ morphology	Direction	Arrangement	Distribution	Structure	Location on the surfaces	Location	Edge	Section	Association	Overlapping	Figs.
1	Fractures	Circular/ arciform fractures	Perpendicular	Horizontal or isolated	Continuous	Disorganised	Internal-external	Belly	Irregular	Irregular	Individual	Without	5, 6, 8
		Arciform V-shaped fractures	Perpendicular	Horizontal, vertical or isolated	Discontinuous	Organised	Internal-external	Belly - rim	Irregular	Irregular	Grouped	Without	6, 7
2	Laminar fractures	Sub-circular and detached	Parallel	Horizontal or diagonal	Discontinuous	Disorganised	Internal-external	Belly - rim	Oblique	Flat	Individual	With	6
3	Convexities	Circular/Sub-circular	Parallel	Horizontal or isolated	Discontinuous	Disorganised	Internal-external	Belly	Without	Convex	Individual or grouped	Partial or without	6
4	Depressions	Arciform V-shaped	Parallel	Horizontal or diagonal	Discontinuous	Organised	Internal	Belly	Irregular	Concave	Grouped	Partial	5, 8
5	Flat areas	Sub-circular and flattened	Parallel	Isolated	Discontinuous	Disorganised	External	Belly	Blunt	Flat	Individual or grouped	Partial or without	8
6	Leftovers / burrs	Arciform	Parallel	Circular	Discontinuous	Disorganised	Internal	Belly	–	–	Grouped	Partial or without	6, 8
7	Orientation of pores and particles (radial plane)	Long oblique configurations	Perpendicular	Vertical	Discontinuous	Disorganised	–	Belly - rim	–	–	Grouped	–	5
		Long oblique configurations with circular configurations	Perpendicular	Vertical	Discontinuous	Disorganised	–	Belly - rim	–	–	Individual	With	–
8	Orientation of pores and particles (tangential plane)	Circular/sub-circular	Parallel	Circular	Continuous	Organised	Internal	Belly	–	–	Grouped	Partial	6, 7

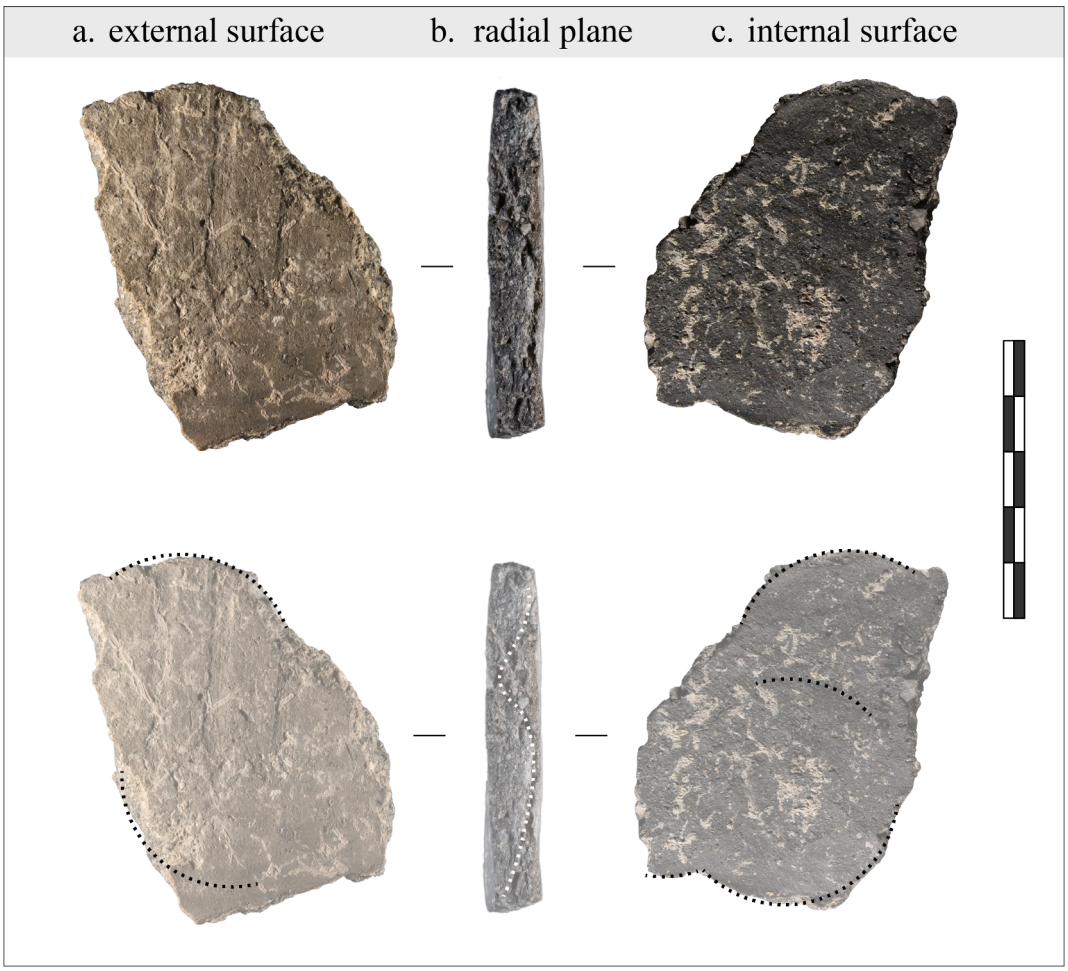

Fig. 5. Macro-traces associated with the juxtaposition of circular elements [I-4]. a & c. Arciform fractures and depressions visible on the external and internal surfaces of the sherds. These fractures delimit the edge of circular elements (patches), partially juxtaposed among them. b. Heterogeneous internal structure without a regular distribution of particles and voids in the radial plane. Long oblique configurations can be observed in the cross-sections of the vessels, which in this case correspond to the edge of a patch. Scale bar: 50 mm.

shaped configurations (Fig. 9a2). These configurations suggest the use of thin or slightly deformed coils with a slightly internal-external overlapping.

The height of coils on the upper part of the vessels oscillates between 13.3 mm (thickness of 8.1 mm) and 17.9 mm (thickness of 11.8 mm). The last coil of the rim is assembled with an internal overlapping (internal oblique discontinuity) (n = 6), external overlapping (external oblique discontinuity) (n = 7) or superimposed (O-shaped discontinuity) (n = 3) (Fig. 7a3). Here, the height of coils oscillates between 9.2 and 20.8 mm for a wall-thickness of 8.2 and 10.8 mm respectively. The number of assembled coils vary according to the upper part and rim of each vessel, comprising from 1 to 6 coils, being the assembly of one or two coils the most common ones.

4.2. Attachment systems of handles and secondary elements

Grip elements are mainly represented by ribbon handles, placed vertically or diagonally, although other grip elements such as ring handles, tunnelled handles and digitally impressed cords can be documented within the ceramic assemblages. Out of 12 handles associated with the ceramic individuals and 4 individual handles, 9 show traces associated with their attachment systems. Two more secondary elements related to cords also exhibit traces associated with their joining systems.

The main attachment system corresponds to partial insertions by creating a concavity on the walls (n = 5). This system is observed on the edge of the handles (4 ribbon handles and 1 non-determinable handle), which present convexities at their edges. Handles were inserted on the bellies applying direct pressure without completely drilling the walls (Fig. 10). However, none of the handles is completely detached, so it cannot be ruled out that some handles were also attached to the belly by using complete insertions.

Furthermore, 3 beginnings of handles, 1 tunnelled handle, and 2 cords were attached with a simple hook by applying direct pressure without requiring any type of insertion (n = 6). In these cases, the handles are detached from the walls and their edges present laminar fractures parallel to the surfaces with flat sections.

4.3. Reconstruction of forming sequences

Forming techniques were recognised in 56 ceramic vessels and 143 non-decorated potsherds, showing that at least two forming sequences (CF1 and CF2) were used in the ceramic productions of Cova del Frare (Table 3). The CF1 method combines the coiling technique (upper parts and rim) and the use of the circular juxtaposed elements (belly), whilst the CF2 method is based on the exclusive use of circular elements for building the belly and rim. The forming of bases, rarely preserved in the context of Cova del Frare, was only identified in a single base from an Epicardial vessel which was built with circular elements. Given the large number of undecorated potsherds associated with this forming technology, the use of patches probably covered from the base to the belly in

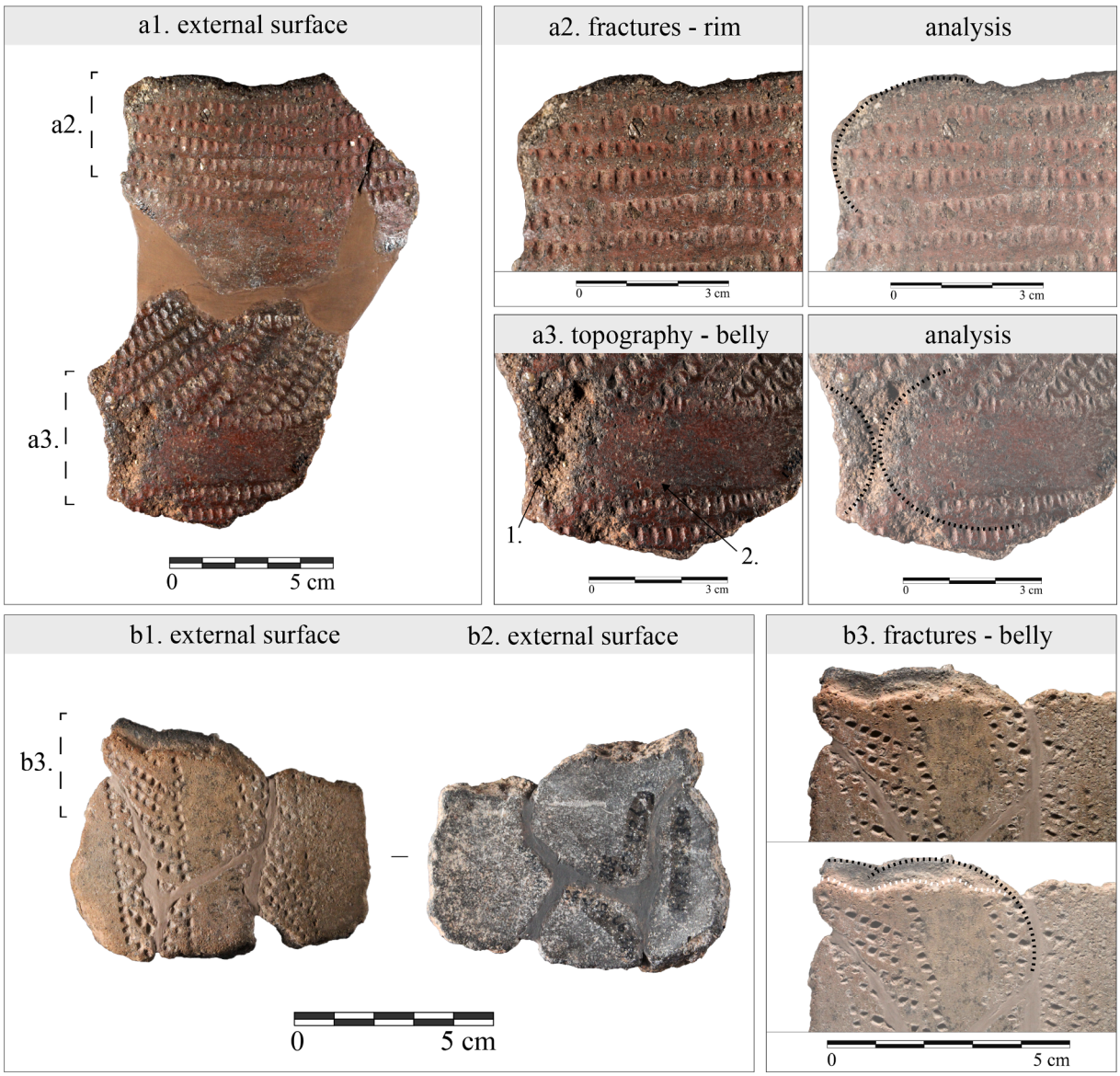

Fig. 6. Macro-traces associated with the CF2 forming sequence [C-5 & C-6A]. a2-b3. Arciform traces visible on inner and the outer surface of the rim (a2) and the belly (b3). a3. Laminar fractures (1) with an arciform shape (sub-circular distribution of particles and voids) and circular convexities (2) on the outer topography of the belly. These traces, that delimit the edge of circular-shaped elements, suggest the use of juxtaposed patches for building both the belly and rim of vessels.

several cases.

In the Cardial vessels, very fragmented but with several profiles decorated with *cardium* shells, smooth shells or other multi-tipped tools, the recurrent use of circular elements is observed (Fig. 6a-b) (Table 6). The coiling technique was also identified in 2 vessels decorated with *cardium* and 1 vessel with multiple impressions. The Epicardial vessels, represented by ceramic individuals with several sherds and a large part of their profile preserved, provide the largest evidence of the use of circular elements and the assembly of coils for the entire Early Neolithic assemblage of Cova del Frare. Circular elements are documented on vessels with distinct shapes and decorative techniques (Fig. 5, Fig. 7, Fig. 8) (Table 6), to which 1 or several coils were assembled to finish the rim with an internal and/or external overlapping (Fig. 7a3; Fig. 9a2). Finally, the use of circular elements and the assembly of coils were identified in 1 and 3 undecorated vessels respectively.

Overall, the CF1 method is identified in 9 ceramic individuals (1 Cardial and 8 Epicardial vessels) and the CF2 method is recognised in 7 vessels (2 Cardial, 4 Epicardial and 1 undecorated vessel).

5. Discussion

5.1. Cardial/Epicardial ceramic decorations and forming practices at Cova del Frare

The Early Neolithic occupations of Cova del Frare are characterised by the presence of a wide range of decorative techniques included within the Cardial and Epicardial ceramic styles. The reconstruction of forming processes shows that the ceramic productions of Cova del Frare assigned to these decorative styles were produced with circular juxtaposed elements and then a series of generally one or two coils were used for building specific parts of the vessels.

These two ceramic styles represent the most common decorative features of the Early Neolithic ceramic productions in the northeast of the Iberian Peninsula, excluding here some sporadic ceramic evidence assignable to the *Impressa* decorations (Oms et al., 2014; 2020). The ceramic productions belonging to the Cardial sphere appeared with the implementation of the Neolithisation process towards 5550 cal. BCE and prevailed until 4850 cal. BCE (Oms 2017; Oms et al., 2016). Decorations

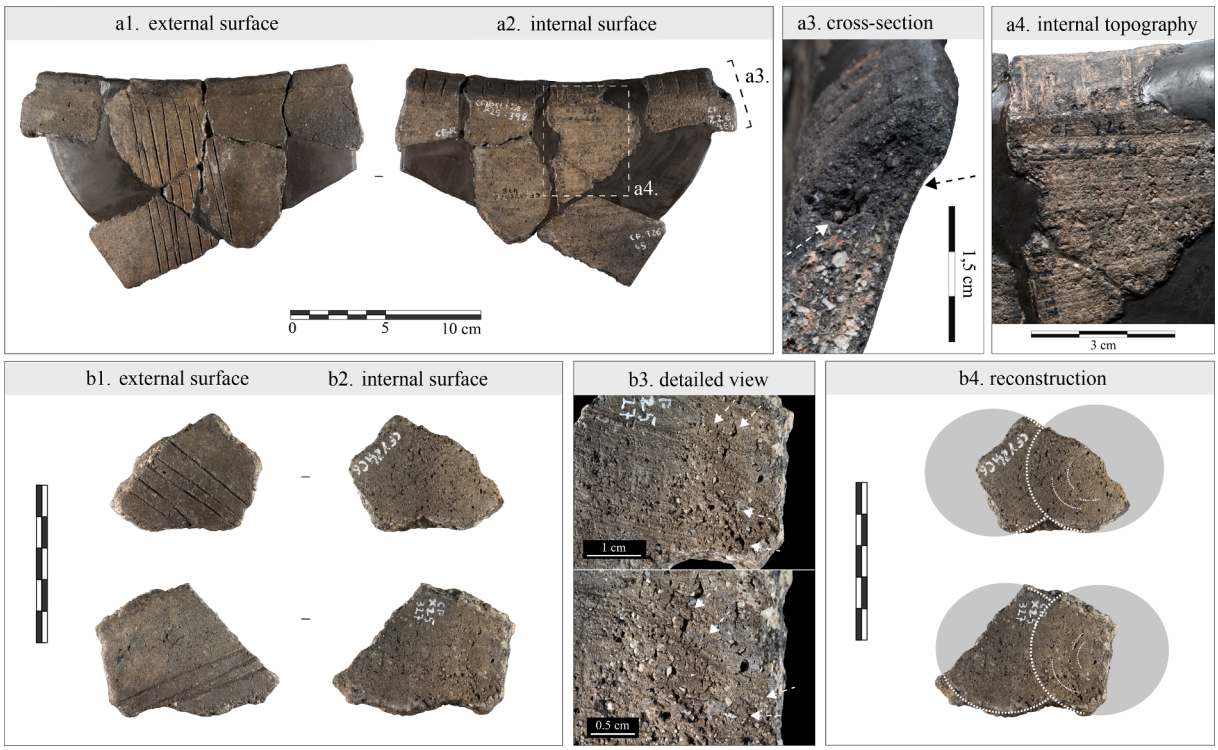

Fig. 7. Macro-traces associated with the CF1 forming sequence [I-2]. a1-a2. External and internal surfaces. a3. Cross-section of the rim with an internal oblique discontinuity. a4. Horizontal & diagonal grooves on the inner surface of the belly. Surface grooves present a morphology with flat sections, lineal striations with marked edges and protruded grains. b1-b2. Arciform 'V'-shaped fractures observed on the inner surface of the sherds from the belly. b3. Circular and sub-circular organisation of pores and particles in the tangential plane. The distribution of pores and particles follows the contour of the subcircular fractures. Altogether, these traces indicate that the belly was formed by means of juxtaposed and fused circular patches (b4), each previously formed by a spiral coil (b3), which were scraped afterwards (b). The rim was formed with a coil internally overlapped (a3). Scale bars: 50 mm.

of the Cardial style were mainly concentrated in the coastal and pre-littoral areas, although they were also documented in several Early Neolithic sites of the mid-Ebro valley and the pre-Pyrenees area (Oms, 2017; Laborda, 2019; Rojo Guerra et al., 2018). Furthermore, the Cardial wares were extensively distributed along the Mediterranean coast of the Iberian Peninsula (Bernabeu et al., 2017b; 2018) and southern France (Guilaine, 2018; Manen et al., 2019a). In contrast, the Epicardial style, which includes the impressed-grooved/incised decorations, as well as the *boquique* technique (stab-and-drag), were initially located in the inner lands of the northeast Iberia from c. 5350 cal. BCE (Oms, 2017), but latter spread throughout the NE territory between c. 5100 and 4500 cal. BCE (Oms et al., 2016; 2020). These set of decorative techniques also had an important entity on the Early Neolithic sites located in the mid-upper Ebro valley and the inner lands of the Iberian Peninsula (e.g., Alday Ruiz, 2009; Alday and Moral del Hoyo, 2011; García-Martínez de Lagrán, 2015; Rojo Guerra et al., 2018, Laborda, 2019).

The distribution of these ceramic styles, mainly between the coastal and inland areas (e.g., Laborda, 2019; Guilaine, 2018; Oms, 2017; Rojo Guerra et al., 2018) opened the discussion that these two decorative complexes were contemporary, linked with two Neolithisation traditions (e.g., Manen et al., 2019a; Van Willigen, 1999). Moreover, other proposals also derived to interpret that the Epicardial was originated from the Cardial or the former emerged independently from an acculturation process of Mesolithic groups (Bernabeu & Martí Oliver, 2014; Van Willigen, 2004). Although these questions are still the subject of several discussions, after c. 5150–5100 cal. BCE the irruption of the impressed-incised decorations progressively replaced the Cardial impressed ceramics, thus covering the coastal areas of the Iberian Peninsula and southern France (e.g., Bernabeu & Martí Oliver, 2014; Bernabeu et al., 2017b; Manen et al., 2019a; Oms, 2017).

At Cova del Frare, the radiocarbon dates place the Cardial evidence from layers C6-C5c between 5208 and 5030 cal. BCE 1σ and 5217–4960 cal. BCE 2σ. The Epicardial evidence, largely documented in layer C5b, is dated between 5031 and 4846 cal. BCE 1σ and 5201–4796 cal. BCE 2σ (Table 1). These radiocarbon dates indicate the temporal extension of these two styles in Cova del Frare, although they present deviations corresponding to the plateau on the calibration curve between 5200 and 5050 cal. BCE (Reimer et al., 2020), which affects the accuracy of the calibration intervals (Manen et al., 2019a; Laborda et al., 2021). Thus, based on the radiocarbon dates but also on the decorative traits of the ceramic vessels, the Cardial ceramics of Cova del Frare belonged to the Late Cardial horizon in NE Iberia (Oms, 2014). The Epicardial ceramics, in contrast, correspond to the floruit of the Epicardial decorations, widely documented during the first half of the Vth millennium BCE in this area (Oms et al., 2016; Martín et al., 2010).

From a technological perspective, the analysis of traces reveals that forming processes did not changed significantly in parallel to the decorative techniques, especially the patchwork technology used in both ceramic wares. Nonetheless, the use of coils, whether due to the assemblage preservation or other factors, seems that were more frequently used in the Epicardial than in the Cardial ceramics of Cova del Frare. Hence, it is not possible to rule out the hypothesis that the coiling technique would have been more linked with Epicardial productions, but limited to a reduced number of coils for building the upper parts and the rims. The fact that these two techniques were used within the same forming sequence (CF1 method) also suggests that they were potentially integrated within the same forming practices of Cova del Frare communities. Indeed, the combination of several techniques is a common practice attested in the archaeological record and documented in modern-day societies that maintain handmade ceramic traditions (e.g., Calvo Trias and García Rosselló, 2012, 2013; Gelbert, 2003; Gosselain,

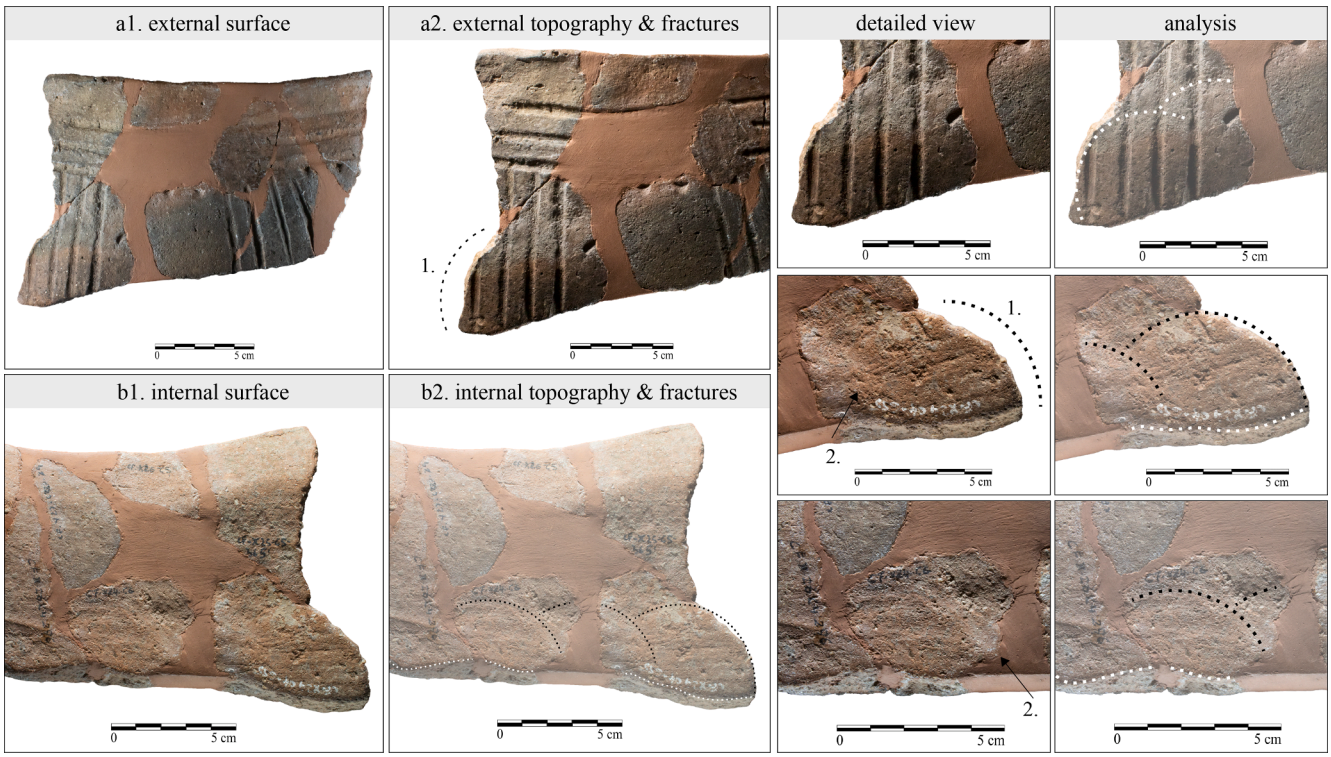

Fig. 8. Macro-traces associated with the juxtaposition of circular elements [I-5]. The belly present sub-circular fractures (1) visible on the inner and the outer surfaces of the vessel. The external topography of the belly is uneven, combining both sub-circular variations and flat areas (a2). The internal topography displays inverted 'V'-shaped arciform depressions (1) which merge with the sub-circular fractures into circular elements (b2). Altogether, these circular elements appear partially juxtaposed among them, forming horizontal bands of patches for building the vessels (b2). On the other side, the lower part of these elements appears fractured, forming an irregular wavy fracture (white discontinuous dashes).

2002). It seems therefore that the groups of herders that seasonally inhabited Cova del Frare used the same forming practices to produce their Cardial and Epicardial wares, regardless of their shapes and decorations, and solely varied between the use of patches (CF2 method) or the assembly of coils (CF1 method) for building the rims.

This evidence from Cova del Frare raises the question of whether the Cardial and Epicardial decorations were not necessarily connected with forming practices, which indeed would have prevailed during the Early Neolithic occupations of Cova del Frare over four hundred years, between 5217 and 4796 cal. BCE 2σ. A large number of ceramic productions assigned to the Cardial and Epicardial spheres must be analysed to see if these forming technologies were also connected with the earliest ceramic productions from NE Iberia or whether there was a transfer of technical know-how between the Cardial-Epicardial spheres (García-Martínez de Lagrán, 2015) or if this occurred in a reciprocal way (Manen et al. 2019a).

5.2. *Distribution of first pot-forming processes in the Western Mediterranean*

With the expansion of the Neolithisation process across the Western Mediterranean, the pioneer communities of farmers that settled the coastal areas of Italy and southern France used two completely different technical traditions to produce the earliest *Impressa* ceramic productions: the coiling techniques in south-east Italy and the patchwork technology in southern France and the Ligurian-Provencal Arc (Gomart et al., 2017; Manen and Guilaine, 2020). The forming processes identified in the ceramic productions of Cova del Frare present similarities with these forming practices, being especially prominent the parallels with the patchwork technology, but also with the coiling techniques that were limited for building the rims.

The earliest evidence of the coiling techniques in the West of the Mediterranean correspond to the sites of Ripa Tetta and Colle Santo Stefano from southeast Italy (5900–5600 cal. BCE) (Angeli and Fabbri, 2017; Colombo, 2017). The coiling techniques were initially used during Early Neolithic in the Balkans (c. 6100 BCE) (Gomart et al., 2020) and spread with the introduction of farming to Central (Hungary, Czech Republic) (Neumannová et al., 2017; Thér et al., 2019; Gomart et al., 2020) and North-western Europe (Belgium and north-eastern France) (Bosquet et al., 2005; Gomart, 2014; Van Doosselaere et al., 2013). The *Impressa* vessels from the Italian sites were built with thin and elongated coils, superimposed or internally-externally overlapped (Angeli and Fabbri, 2017), showing similarities on the assembly procedures and coils' deformation to the coiling sequences documented in the Linear Pottery in continental Europe (c. 5500–4950 cal. BCE) (Gomart et al., 2017).

The production of the Early Neolithic ceramics with the coiling forming sequences clearly contrasts with the spiralled patchwork technology documented in the Ligurian-Provencal Arc and the Mediterranean Languedoc, in southern France. The first evidence of this technology has been attested in Abri Pendimoun and Arene Candide sites (Gomart et al., 2017), as well as in the open-air sites of Peiro Signado, Pont de Roque-Haute (Manen and Guilaine, 2020) and ZAC la Farigoule 2 (5800–5600 cal. BCE) (Manen et al., 2019b). The fact that these two forming sequences coexisted at separate areas of the Western Mediterranean derived to propose that the Neolithisation process was linked with the arrival of several groups of farmers bearers of distinct technical practices (Gomart et al., 2017; Gomart et al., forthcoming).

In this context, the reported data of Cova del Frare show that the use of circular patches was also distributed in the northeast of the Iberian Peninsula during the Early Neolithic and linked with the Cardial and Epicardial productions. Indeed, this technology has also been recognised in more recent chronologies such as the Cardial layers of Abri Pendimoun (5550–5150 cal. BCE) (Drieu et al., 2021), in several sites of the

Table 5
Systematisation of traces associated with the coiling forming technique. 1: Traces with an indirect formation process: fracturing patterns. 2-3: Traces with a direct formation process: formal variations on the wall-thickness, texture and irregularities on the surfaces. 4: Internal organisation of pores and a-plastic particles in the cross-sections (radial planes).

	Feature	Shape/ morphology	Direction	Arrangement	Distribution	Structure	Location on the surfaces	Location	Edge	Section	Association	Overlapping	Fig.
1	Linear fractures	Horizontal	Perpendicular	Horizontal	Discontinuous	Disorganised	–	Upper part - rim	Irregular	Inverted U-shape	Individual or grouped	–	9
2	Horizontal variations	Horizontal and elongated	Parallel	Horizontal	Discontinuous	Organised	Internal -external	Upper part - rim	–	Wavy variations in vertical	Grouped	Without	7
3	Leftovers/ burrs	Wavy and elongated	Parallel	Circular	Continuous or discontinuous	Disorganised	Internal or external	Rim	–	–	Individual	Without	7
4	Orientation of pores and particles (radial plane)	S/Z shaped configurations	Perpendicular	Vertical	Continuous	Organised	–	Upper part - rim	–	–	Grouped	–	9
		Internal/ external oblique discontinuity	Perpendicular	Vertical	Discontinuous	Organised	–	Rim	–	–	Individual	–	7
		O-shaped discontinuity	Perpendicular	Vertical	Discontinuous	Organised	–	Rim	–	–	Individual	–	–

Epicardial horizon from southern France (Languedoc, c. 5200–4800 cal. BCE) (Caro, 2020) and in more remote sites, such as Cueva de El Toro (Málaga, 5280–4780 cal. BCE) in the south of the Iberian Peninsula (Cámara et al., 2021). At Cova del Frare, these elements present an average diameter of 50 ± 6.4 mm, more variable than those reported for Abri Pendimoun (44 ± 2.3 mm) and ZAC La Farigoule 2 (42 to 47 mm), but slightly smaller than those of Cueva de El Toro (52 ± 8.4 mm). Regardless of their location and chronology, these Early Neolithic productions were manufactured using spiralled juxtaposed patches irrespective of the ceramic shapes (Gomart et al., 2017) and linked to vessels with Impressa, Cardial and Epicardial decorations (Caro, 2020; Manen and Guilaine, 2020). These studies, therefore, seem to indicate that this forming technology was generally used and distributed since the onset and development of the Early Neolithic in several regions of the Western Mediterranean.

The ceramic productions of Cova del Frare show that a limited number of coils were also used for building the rims, but combined with the circular juxtaposed elements that predominated within the forming sequences. The use of the coiling technique at Cova del Frare could have followed a similar dynamic to Cueva de El Toro where several coils were frequently used for producing the upper parts, collar and rim of vessels (Cámara et al., 2021). Conversely, patches could have been generally used for building from the base to the body and could reach the upper parts, both in Cova del Frare and Cueva de El Toro contexts. The integration of both forming techniques within the same forming sequences has also been reported in other Early Neolithic sites from the Mediterranean Languedoc between c. 4800-4550 cal. BCE (Caro, 2020). However, the use of complete forming sequences with coils cannot be ruled out, as it has been proposed for the site of Los Cascajos (Navarra, 5200–4800 cal. BCE) (Caro et al., 2020), in the north of the Iberian Peninsula.

Given that the coiling techniques were included within the manufacturing sequences of patches, this raises the hypothesis that the forming practices might have slightly varied or changed with the development of the Neolithisation process. In addition, within the patchwork technology, some modifications might have emerged depending on the size of these circular elements. Based on the evidence of Cova del Frare and Cueva de El Toro, these variations can respond to the hypotheses that the first communities of farmers integrated both techniques since the beginning of the Neolithisation process in the Iberian Peninsula (i) and/or the same communities progressively varied their forming practices and included technical modifications (ii), such as the assembly of a large number of coils or the use of more sized patches.

6. Conclusion

The technological analysis of the Cardial and Epicardial wares of Cova del Frare (5217–4796 cal. BCE 2σ) brings the first evidence of the forming practices that were used by the first communities of farmers in the northeast area of the Iberian Peninsula. The analysis and systematisation of technological traces, as well as their comparison with the traces reported from other Early Neolithic contexts, facilitated the recognition of two forming processes: the use of circular juxtaposed elements, possibly each formed by a spiral coil, and the assembly of thin coils. These forming processes were used irrespective of the shapes and decorations to produce the Cardial and Epicardial vessels and were potentially integrated within the same technical practices of the groups of herders that inhabited Cova del Frare, standing out the use of patches over the assembly of coils.

The circular elements recognised at Cova del Frare present clear parallels with the ‘spiral patchwork technology’ documented in the earliest Neolithic sites in the Ligurian-Provencal Arc (Gomart et al., 2017), as well as during the development of the Early Neolithic in southern France (Caro, 2020; Manen and Guilaine, 2020) and in the south of the Iberian Peninsula (Cámara et al. 2021). This research also confirms that this technology was distributed in the northeast of the

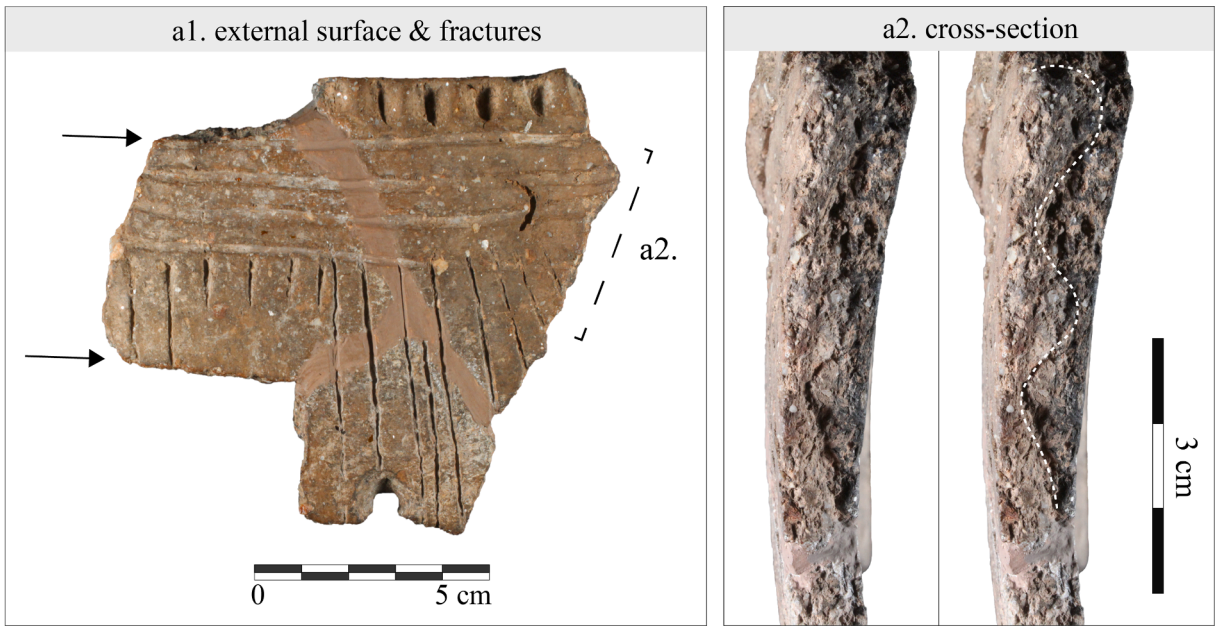

Fig. 9. Macro-traces associated with the forming of the upper part and rim with coils with slightly oblique alternate overlapping [I-26]. a1. Horizontal lineal fractures on the upper part of the belly. a2. Cross-section with 'S'-shaped configurations. The orientation of the porosity and particles is oblique to vertical.

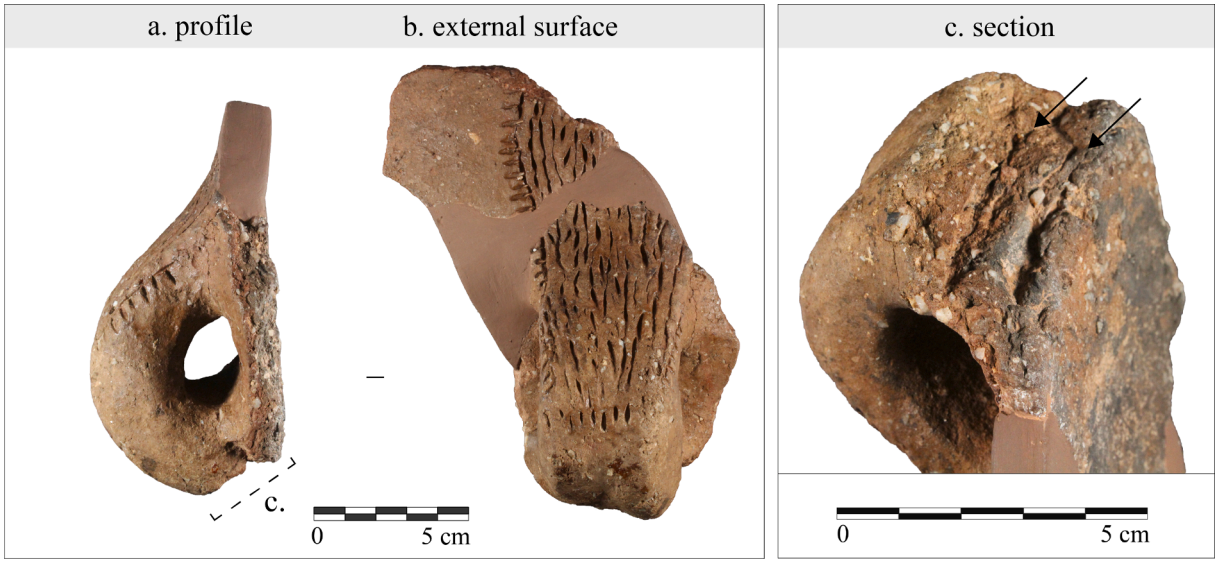

Fig. 10. Macro-traces associated with the attachment system of ribbon handles [I-3]. a-b. Vertical handle with its lower part broken. c. Parallel laminar fracture on the lower edge of the handle. The edge present convexities visible on its part, which indicate that was joined on the walls with a partial insertion, without completely drilling the wall.

Iberian Peninsula and was possibly transmitted with the spread of the Neolithisation process to this area. Nonetheless, the reported results from Cova del Frare as well as the ones from Cueva de El Toro (south Iberia, 5280–4780 cal. BCE) (Cámara et al., 2021) also reveal that several technical variations existed within the ceramic production of these sites complementary to the patchwork technology, such as the assembly of a series of coils or variations in the size of circular elements. Regardless of whether the spiralled patchwork method was used during the Early Neolithic in these areas, these variations raise the possibility that these pottery forming practices would have varied with the advance of the Neolithisation process in the northeast and south of the Iberian Peninsula.

The hypotheses arisen throughout this work will have to be proven by analysing a large number of Early Neolithic vessels from several geographic areas of the Iberian Peninsula, including here the Cardial and Epicardial productions, as well as expanding the methodological analyses for reconstructing forming processes. These new data will allow us to deepen in their relation with implementation of the Neolithisation process in the Iberian Peninsula and, to a larger extent, in the Western Mediterranean.

CRediT authorship contribution statement

Javier Cámara Manzaneda: Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing. **Xavier Clop García:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Jaume García Rosselló:**

Table 6
Comparison between decorative techniques and forming techniques and methods identified on the Early Neolithic ceramics from Cova del Frare.

Decorations		CF1 (belly and rim)	CF2 (belly and rim)	Use of coils (upper parts/ rim)	Use of circular elements (belly)	Total
Cardial ware	Impressions with *cardium*	–	2	2	9	13
	Impressions with multi-tipped tools	1	–	–	2	3
Epicardial ware	Incisions	3	–	2	6	11
	Grooves	1	3	–	5	9
	Incisions/ grooves	1	–	–	2	3
	Impressions with/ without incised/ grooved decors	1	1	1	7	10
	Stab-and-drag	2	–	1	–	3
Undecorated		–	1	3	–	4
Total		9	7	9	31	56

Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Araceli Martín Cólliga:** Resources, Writing – original draft, Writing – review & editing, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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