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Rediscovering Cova de la Sarsa (València, Spain): A Multidisciplinary Approach to One of the Key Early Neolithic Sites in the Western Mediterranean

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Abstract: Cova de la Sarsa (València, Spain) is one of the most important Neolithic impressed ware culture archaeological sites in the Western Mediterranean. It has been widely referenced since it was excavated in the 1920s, due partly to the relatively early excavation and publication of the site, and partly to the qualitative and quantitative importance of its archaeological remains. Unfortunately, as it was an older excavation and lacked present-day rigorous methodological approaches, this important site has been somewhat relegated to the background in the reviews about the Neolithic at the end of the 20th century. However, during the last few years, both the site itself and its archaeological remains have been the object of new studies that hopefully will return the site to the forefront of discussions about the Mediterranean Neolithic. We here present the most relevant results of the research carried out by our group (i.e., pottery study, radiocarbon dating, and isotope analysis), and contextualize them within the dense research history of the cave and the studies carried out by other colleagues with the purpose of revisiting its materials and increasing the knowledge available from the site. Radiocarbon dates on human remains show that the cave was used during prehistoric times as a funerary space longer than expected, and also sporadically afterwards. The characterization of the pottery assemblage concludes that most materials belong to the Early Neolithic. Isotopic analysis portrays an overall similar diet based on terrestrial C_3 resources throughout prehistoric times, with a possible varied dietary protein input between individuals during the Early Neolithic.

Keywords: CN stable isotopes; radiocarbon dating; pottery study; Neolithic; Eastern Iberia; prehistory

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1. Introduction: The Archaeological Site and Its Research Background

Cova de la Sarsa is situated in the municipality of Bocairent (València, Spain), 860 m above sea level, 650 m away from farming land, ca. 50 km away from the coastline in a straight line, and close to several river systems in the region like those of the Clariano and Serpis rivers (Figure 1). Opened in the karstic terrains formed by biomicrites and yellow loams of the Upper Cretaceous, its main entrance (trapezoid shape, 4.5 m wide × 2 m high) faces the northeast. This access quite possibly underwent modifications since Neolithic times, as fallen rocks along the entrance suggest there was a wide overhang before the cave's main hall. The main hall (12 m long × 7 m wide × 3 m high) connects with the remaining of the cave towards the southeast through an abrupt step, after which there is a narrow passage that leads into another inner hall before the start of the complex galleries that form a karstic maze of 200 m with 47 m of slope.

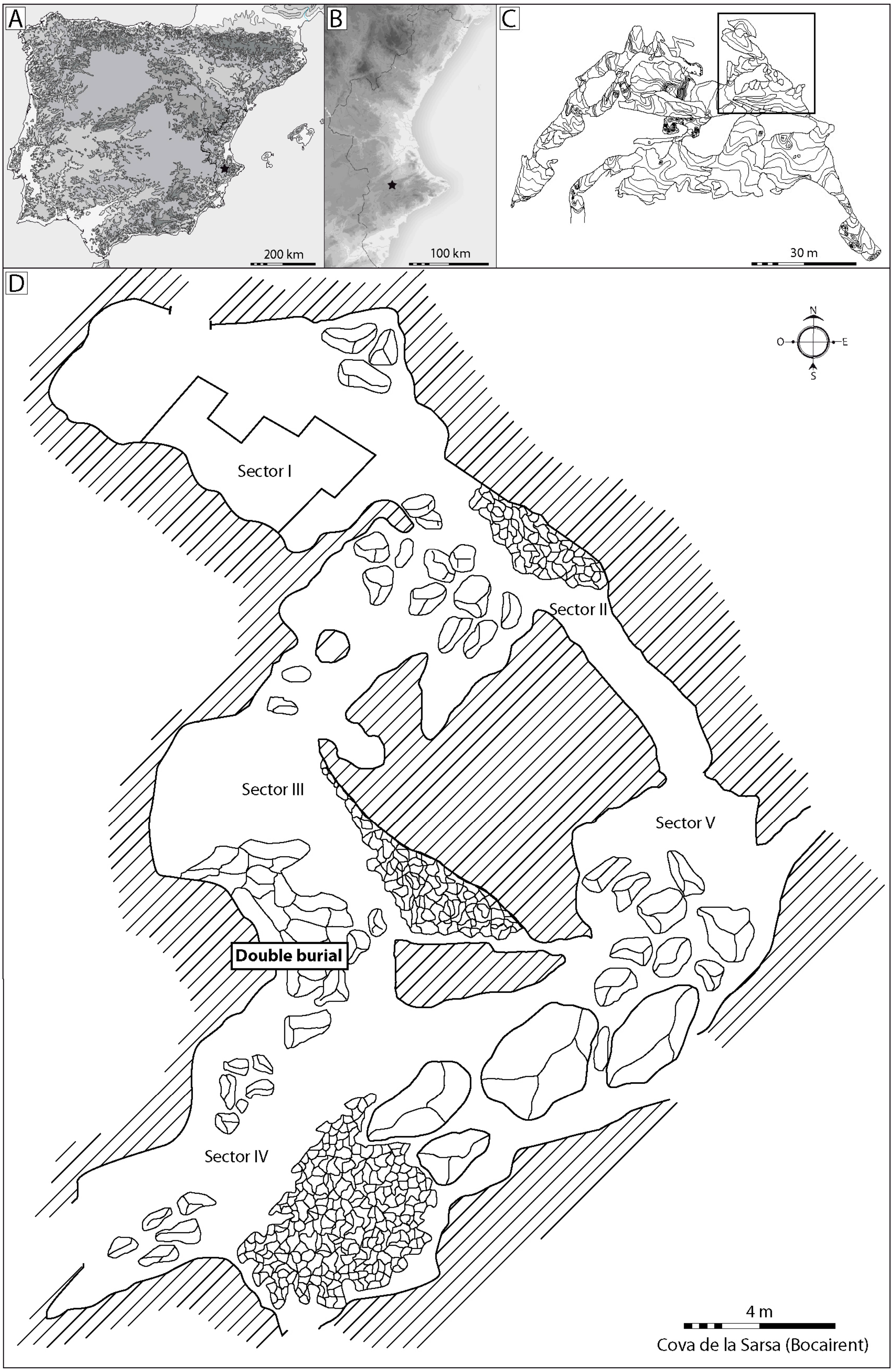

Figure 1. Maps of Iberia (**A**) and Eastern Iberia (**B**) with Cova de la Sarsa highlighted in them, a plan of the broader cavity in which the site was found (**C**) and an archaeological plan of the site (**D**).

The first academic visit to the cave was carried out by abbe Henri Breuil in 1913, who named it "Cueva de la Zarza de San Blas" [1,2]. Later on, Fernando Ponsell carried out the first excavation campaigns between 1927 and 1939 under the patronage of the Servicio de Investigación Prehistórica of the Diputación de Valencia [3,4]. Since then, Cova de la Sarsa became a relevant site that was initially included as part of the cultural group defined by pottery decorated using a jagged shell [5], which Colominas [6] named "Montserrat" or Montserratina-type. This was actually Cardial pottery, which was ascribed initially to the "Cultura Central" (or "Cultura de las Cuevas") and the "Cultura de Almería" [7,8]. Luis Pericot [9], influenced by Bosch Gimpera's work, placed the new Cardial discoveries at Cova de la Sarsa inside the assemblage of Neo-Eneolithic pottery linked to the Bell Beaker world.

This classification was used until the publication of the stratigraphic sequence of the Esquerda de les Roques site (Torrelles de Foix, Barcelona), which demonstrated the older chronology of Cardial pottery and disassociated it from the Bell Beaker one [10]. In the midst of this historiographic context, Cova de la Sarsa acquired more relevance thanks to the studies of Julián San Valero. This author showed the richness of the site, especially its cardial impression decoration, proposing its diffusion throughout Europe and Africa [11]. Martínez Santa-Olalla [12] placed the cave in the Hispano-Mauritanian Culture of which the most relevant element is cardial pottery [11].

The reference to Cova de la Sarsa then became mandatory for any synthesis on the Neolithic of Iberia and the Western Mediterranean [13–17], at a time where the study of other sites like Cueva de la Cocina (Dos Aguas), Cova de Malladetes (Barx) or Covacha de Llatas (Andilla) showed the existence of Mesolithic layers before the arrival of the Neolithic to the region. However, the archaeological sequence that explained the origin of the materials from Cova de la Sarsa, and that greatly influenced the future Iberian peninsula Neolithic expansion synthesis, was discovered in the northwest of Italy. In 1956, Luigi Bernabò Brea published the second volume of the excavations at the archaeological site of Arene Candide. His thoughts on the site drove the change from an Africanist Mediterranean perspective into a coastal continental Mediterranean perspective when he explained the diffusion of the Neolithic, discarding the African perspective in favor of one that considered that the cultural origin of the Mediterranean Neolithic must be searched for in the Near East instead. He also proposed that the impressed ware culture belonged to the Early Neolithic.

These new proposals were immediately included in the Spanish bibliography [18–23]. Furthermore, a new Neolithic cave-site that presents similar archaeological evidence to Cova de la Sarsa was included at that time in the bibliography, Cova de l'Or [24], whose excavation was important to contextualize more precisely the Cova de la Sarsa materials [25–28]. From then onwards, both Cova de la Sarsa and Cova de l'Or became key in any synthesis of the Iberian or Western Mediterranean Neolithic. In the review that Fortea [29] undertook on the association of Epipalaeolithic and Neolithic contexts, Cova de la Sarsa and Cova de l'Or were defined as paradigm sites of "pure" Neolithic groups inside his "Dual model" proposal. They were portrayed as sites without influence from the previous Mesolithic levels and, therefore, pointing to the existence of a colonization process associated with the expansion of the Neolithic throughout the Mediterranean.

Soon thereafter, Cova de la Sarsa was excavated again under the supervision of María Dolores Asquerino, who contacted Vicent Casanova, a local who briefly dug the site in 1969 after he discovered some human remains in the crevice of the cave [30]. Asquerino's excavations are divided into two stages: the first one between 1971 and 1974 [31], and the second one between 1978 and 1981 [32]. The main objective of these campaigns was to establish the archaeological sequence of the cave and contextualize the new findings. Unfortunately, she found that the stratigraphy of the cave was destroyed by the older excavations. Since then, Cova de la Sarsa stopped being a mandatory citation in the new ideas on the nature of the Neolithic expansion developed during the 1980s and 1990s, and does not appear much in the debates of the end of the 20th century [24,33,34]. Only the study of specific materials, such as personal adornments, bone industry [35] and pottery with certain symbolic significance [36] associated with the discovered macroschematic art [37], was mentioned. Faunal remains have also been studied, suggesting that domestic animals (mainly *Ovis aries* and *Capra hircus*, but also *Sus domesticus* and *Bos taurus*) were the main source of meat even though wild species (mainly *Cervus elaphus*, *Capra pyrenaica*, *Capreolus capreolus* and *Oryctolagus cuniculus*) were still consumed [38,39]. Although zooarchaeologists and a few radiocarbon dates suggest that most of the faunal remains are from the Neolithic period, the lack of stratigraphy, together with the existence of different moments of occupation of the cave, demand caution.

At the beginning of the 21st century, new studies have reactivated the research on Cova de la Sarsa, aiming to return the site into current debates on the Mediterranean Neolithic. Case studies on schematic rock art [40], polished stone objects [41], pottery [42], human remains [43,44] and funerary contexts [45,46] have been carried out. These studies have also allowed the incorporation of materials from this cave to more ambitious projects aimed to study proteins in domestic remains [47] and perform ancient mitochondrial and nuclear DNA analysis in contexts of the Early Cardial Neolithic in the Western Mediterranean [48].

It is precisely in this context of new research topics and technological developments that we considered it necessary to broaden the number of studies carried out at the site by expanding radiocarbon dating, undertaking a typological study of all its prehistoric pottery, and studying dietary patterns through stable isotope analysis. Altogether, these new studies that we here present aim to re-evaluate the site and bring it back into the discussion and debates about the Early Neolithic of impressed ware in the Western Mediterranean [49].

2. Pottery Study

The stratigraphic position of pottery previously excavated from Cova de la Sarsa was, unfortunately, not recorded. Therefore, in our study, we group the pottery together by its style, specifically based on the essential decorative technique assigned to each vessel and fragment. Essential decorative technique is a generic category that refers to the design of the main decoration of each specimen. Its main trait is that of being exclusive, meaning that by its classification, each fragment only has one essential decorative technique (the chronologically most significant one) even if it has a combination of different ones. According to the chronological relevance of decorative techniques present in the prehistory of Eastern Iberia, we have proposed these different essential decorative techniques:

(1) Cardial-impressed. All decoration carried out anywhere in the vessel using the border of a dented shell (or its natis) will be considered cardial-impressed decoration. This includes the technique of cardial dragging, because even if the technical action is that of an incision, since it is performed with a dented shell it will still be considered cardial.
(2) Comb-impressed. This type has impressions carried out with a dented instrument (not a shell).
(3) Impressed–incised. This type combines impressions with incisions.
(4) Impressed. We have seen that amongst the pottery assemblages studied, there was a large amount of fragments with impressions made with other objects (not cardial- or comb-impressed). For this reason, we have grouped them here separately.
(5) Incised. The incision technique consists in a technical gesture of sliding in a continuous manner an instrument over the surface of the vessel.
(6) Sgraffito. The "esgrafiado" is, in essence, a very fine incision made on the surface of the vessel after it has baked or dried out.
(7) Combed. This technique consists in dragging a comb over the surface of the vessel. Because of its chronological relevance in Eastern Iberian collections, it will be considered a decorative technique in itself and not a mere surface treatment.
(8) Applied. A group of nipples or mamelons distributed along the vessel.
(9) Painted. Elaborated with a brush or similar tool, it can have different types of painted decorative motifs.

(10) Red-ochre or "Almagra". When talking of the "almagra" technique, it means that the whole surface of the vessel has been treated with red paint.
(11) Decorated cordon. We include here all varieties of decorated impressed and incised cordons, except those with cardial and gradina (dented object) impressions, which are included under items 1 and 2 of this list, respectively.
(12) Plain cordon. A cordon without any decoration.
(13) Impressed lip

The review of Cova de la Sarsa's handmade ware located in the different institutions has yielded a total number of 14,838 recorded pottery fragments (Figure 2). Of these, 4275 are decorated, while the remaining 10,563 have a plain surface (Table 1). Amongst the essential decorative techniques assigned, the great number of cardial-impressed fragments found must be noted. Also noteworthy is the high quantity of non-cardial-impressed fragments present, both from the surface of the vessel and from its cordons.

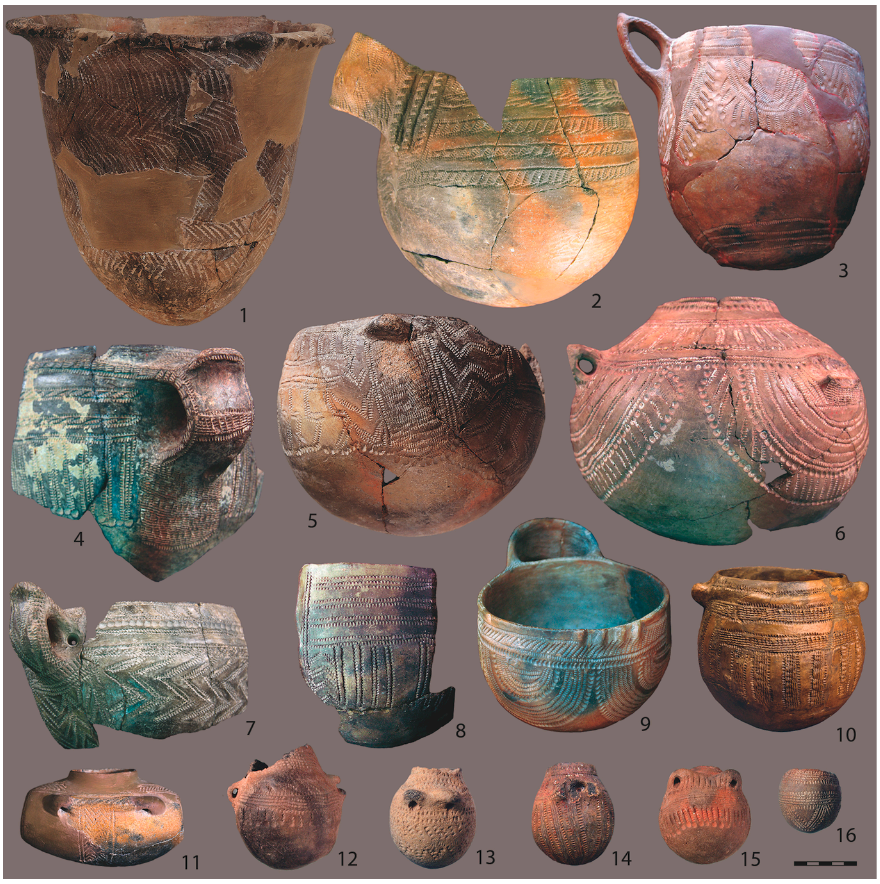

Figure 2. Photos of some of the Cardial decorated potsherds from Cova de la Sarsa studied.

Table 1. Current location of the prehistoric pottery sherds analysed based on their essential decorative technique.

	Total	No Dec.	Dec.	Essential Decoration												
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Museu Arqueològic Municipal de Bocairent	10,231	8039	2192	1039	71	31	24	69	13	95	3	6	6	196	622	17
Museu Arqueològic Municipal d'Alcoi	2350	1179	1171	765	58	8	28	20	2	26		1		102	159	2
Museu de Prehistòria de València	2064	1332	732	304	70	33	14	33	4	11	1	2	3	62	195	
Museu Arqueològic d'Ontinyent i la Vall d'Albaida	55	6	49	32	2			3		2				7	3	
Museu de Belles Arts de Castelló	47	3	44	17	4	1	2			2				13	5	
Museo Arqueológico Municipal de Enguera	15		15	10	2			2							1	

Table 1. *Cont.*

	Total	No Dec.	Dec.	Essential Decoration												
				1	2	3	4	5	6	7	8	9	10	11	12	13
Museo Arqueológico Nacional	14	1	13	9			2	1						1		
Centre excursionista de Tavernes de Valldigna	13	2	11	5	1		2							2	1	
Casa de la Cultura de Chella	11		11	6	3			1	1							
Museu Arqueològic i Etnològic del Comtat	11	1	10	6										4		
Museu Arqueològic de Burrina	6		6	6												
Universitat de Barcelona	6		6	5	1											
Pebody Museum of Archaeology and Ethnology	5		5	4	1											
Universidad de Granada	6		6	6												
Known fragments unlocated	4		4	3									1			
Total	14,838	10,563	4275	2211	213	73	72	129	20	136	4	9	10	387	986	19

Typology

A typological study was carried out on the assemblage of differentiated vessels. We considered as "differentiated vessel" any fragment or group of fragments that because of their shape, technology, decoration or any other trait, can be the only remain/s of an individual vessel (even if its typology is not known). Keeping this in mind, we established a minimum number of 525 handmade pottery vessels for Cova de la Sarsa. The criteria followed were (1) formal differentiation based mainly on the possibility of establishing a typology for each fragment, (2) technique singularity and decorative technique, and (3) technology. Fragments that could not be classified typologically (especially those <3 cm^2), and that generated doubts as to their potential adscription to another already differentiated vessel, were not considered as a vessel.

The typological classification used for this study was carried out according to metric and morphological attributes present, following the previously published reference table for Cova de la Sarsa's pottery assemblage [42,50]. There are four levels of typological description: Class, Group, Type, and Sub-type. Class is defined by the calculated depth index, except for Class D, which groups containers of special traits for which the depth index calculation is useless. The different Classes are as follows:

(i) Class A: Containers with a depth index ≤ 0.45.
(ii) Class B: Containers with a depth index > 0.45 and ≤ 0.7.
(iii) Class C: Containers with a depth index > 0.7.
(iv) Class D: Special containers (cups, kegs, cheese strainers, etc.) and small-sized containers (small bottles, micro-vessels, etc.).
(v) Class F (indeterminate): Vessel fragments without shape or enough size, or that display a particular trait (technological, decorative, etc.) that confers them the category of vessel even if typological classification is not possible.

Once Class has been established, the Group, Type and Sub-type are assigned. This is done in an arbitrary way depending on their formal aspects, with the vessel's profile and size or the presence of a specific morphological trait normally being the most important factors when deciding to which Group, Type and Sub-type a vessel is ascribed to. Aiming to simplify and make the resulting data more comprehensible, typology is presented in relation to each of the essential decorative techniques defined, the Class and the typological groups (Table 2).

The containers with a higher depth index (Class C) are the most numerous in the assemblage, representing 53% of the total. Amongst the vessels of this Class, the most abundant ones are those with cardial-impressed decoration (38%), followed by those with plain cordons (15%), the vessels without decoration (13%), and those with impressed cordons (10%). Of the remaining vessels in Class C, it is just worth mentioning the acceptable number of those with applied gradina impressions, incision–impressions and incisions. Class B is the second most abundant Class, representing 23% of the total vessels at the site. The cardial-impressed vessels are here also the most abundant ones (56%). Also, significantly present are those without decoration (18%), those with plain cordon (12%), the comb-impressed ones (7%), and the incised ones (2%). Inside Class B, those vessels for which another essential technique has been defined show only a mere testimonial presence. Fragments with a category of vessel that has not been able to be classified in any typological group (Class F) represent 14% of the total assemblage; all of them present decorations. Class D amounts to 8% of the total assemblage, with vessels without decoration being the most numerous amongst them. Those decorated with cardial and gradina impressions, linked to small bottles, small barrels and micro-vessels, are also well-represented inside Class D. Class A is the least abundant one, with only 9 fragments, and none of them are decorated.

Table 2. Typological classification of the vessels according to their essential decorative technique.

Essential Decoration	1 N (%)	2 N (%)	3 N (%)	4 N (%)	5 N (%)	7 N (%)	11 N (%)	12 N (%)	Others N (%)	No Dec. N (%)	Total N (%)
Class A	...	...	...	...	...	...	...	...	...	**9 (100)**	**9 (2)**
Class B	**68 (56)**	**8 (6.5)**	**2 (1.6)**	...	**3 (2.4)**	...	**1 (0.8)**	**15 (12)**	**2 (1.6)**	**22 (18)**	**121 (27)**
Group 6 (simple bowls)	64	8	2	...	3	1	...	15	...	21	114
Group 8 (compound bowls)	4	...	...	...	...	...	...	...	2	1	7
Class C	**106 (38)**	**14 (5)**	**10 (3.6)**	**5 (1.7)**	**9 (3.2)**	**5 (1.7)**	**49 (17)**	**41 (15)**	**2 (0.7)**	**36 (13)**	**277 (61)**
Group 10 (jugs and spouts)	2	...	...	...	...	...	...	...	...	4	6
Group 11 (beakers)	9	1	1	1	1	...	5	4	...	7	29
Group 12 (storage jars)	30	8	7	1	3	3	6	11	...	8	77
Group 13 (pots)	44	4	2	1	...	1	5	3	1	8	69
Group 14 (storage vessels)	16	...	...	1	5	1	24	14	1	9	71
Group 15 (big storage vessels)	5	1	...	1	...	...	9	9	...	...	25
Class D	**10 (23)**	**6 (14)**	...	**1 (2.3)**	...	...	...	**1 (2.3)**	...	**25 (58)**	**43 (9.5)**
Group 16 (phials)	6	6	...	...	...	...	...	1	...	1	14
Group 17 (ladles/spoons)	...	...	...	...	...	...	...	...	...	18	18
Group 18 (microvessels)	1	...	...	...	...	...	...	...	...	6	7
Group 19 (others)	3	...	...	...	...	...	...	...	...	...	3
Class F	**28**	**17**	**6**	**7**	**5**	**5**	**0**	**0**	**7**	**0**	**75**
Total	212	45	18	13	17	10	50	57	11	92	525

Some of the essential decoration types are poorly represented. These appear in Table 2 under "others". Some of them can be singled out: three sgraffito vessels included in Class F (indeterminate), one vessel with excised decoration and a combined profile which has been classified as a "bowl" in Group 8 of Class B, two decorated vases with applied decoration (one from Class F and another from Class C) which correspond to a container with a protruding rim from Group 14, three vessels with non-covering paint belonging to Class F, and two vessels with almagra essential decoration (one from Group 8 of Class B, and the other from Group 13 of Class C).

3. Radiocarbon Dates

3.1. Materials Studied

The presence of abundant human remains at Cova de la Sarsa has traditionally been attributed to the use of this cave as a necropolis during the different stages of the Neolithic period [51]. However, due to the lack of appropriate archaeological excavation, there is no clear association of the remains to the Neolithic contexts (see point 1). In order to check this chronological context, besides carrying out the pottery study to check the chrono-cultures present at the site, we carried out direct radiocarbon dating on human remains.

Cova de la Sarsa's human remains are curated at three different Valencian institutions: the Museum of Prehistory of Valencia (Valencia, Spain), the Museum Camil-Visedo Moltó (Alcoi, Spain), and the Bocairent Archaeological Museum (Bocairent, Spain). This spread of the remains between institutions, together with the fact that most of the remains are all mixed and not associated with one another, makes the sample selection for radiocarbon dating and isotope analysis difficult. In this context, and amongst the isolated remains without clear context, we targeted skulls because they are the skeletal element that gives the highest minimal number of individuals (MNI) according to the anthropological study by De Miguel Ibáñez [43]. The exception is the double individualized burial curated at the Bocairent Archaeological Museum, from which vertebrae and maxillae were sampled. By following these criteria, we ensured avoiding duplicities and studied the maximum MNI at the site (Table 3).

Table 3. AMS ^{14}C dating of Cova de la Sarsa. C:N ratios, amount of collagen extracted (% Collagen) refer to the >30 kDa fraction. Calibrated AMS ^{14}C dates (unmodeled) are also included. All calibrations were performed using OxCal v 4.4 [52] with the IntCal13 curve [53].

N	Sample Code *	Description	Age	Sex	Collagen Preparation Lab Code	C:N	%Col.	AMS Lab Code	^{14}C Age ± Err	Cal BP 2σ	Cal BC 2σ
1	C-21833 (VAL)	Neurocranium	Old Adult	Female	S-EVA 7675	3.3	1.9	MAMS-19066	6532 ± 24	7507-7339	5558-5390
2	1714/85 (ALC)	Parietal	Perinatal	Indeterminate	S-EVA 7677	3.2	5.4	MAMS-19068	6459 ± 33	7429-7310	5480-5361
3	CSA 00026 (BOC)	Vertebra	Old Adult	Female	S-EVA17064	3.4	1.6	OxA-V-2392-26	6341 ± 30	7325-7166	5376-5217
4	CSA 00022 (BOC)	Maxila	Adult	Male	S-UCT 20232	3.2	1.4	OxA-31629	6309 ± 36	7309-7162	5360-5213
5	548/85-2 (ALC)	Neurocranium	Adult	Indeterminate	S-EVA 7679	3.2	1.2	MAMS-19070	4573 ± 22	5438-5068	3489-3119
6	548/85-1 (ALC)	Neurocranium	Adult	Indeterminate	S-EVA 7678	3.2	1.4	MAMS-19069	4534 ± 22	5314-5052	3365-3103
7	M-22055-Occ1 (VAL)	Occipital	Adult	Male?	S-EVA 7670	3.3	3.1	MAMS-19065	4241 ± 27	4860-4652	2911-2703
8	M-22055-Occ2 (VAL)	Occipital	Adult	Female?	S-EVA 7671	3.3	3.6	OxA-V-2360-23	4062 ± 28	4792-4425	2843-2476
9	C-21834 (VAL)	Parietal	Adult	Female	S-EVA 7674	3.2	1.9	MAMS-19067	3552 ± 21	3906-3724	1957-1775
10	548/85-3 (ALC)	Neurocranium	Adult	Indeterminate	S-EVA 7680	3.2	4.5	MAMS-19071	1457 ± 18	1370-1305	580-645 AD
11	C-21835 (VAL)	Occipital	Young Adult	Female	S-EVA 7672	3.2	2.5	OxA-V-2360-24	927 ± 24	917-779	1033-1171 AD

*: VAL: Museum of Valencia; ALC: Museum of Alcoi; BOC: Museum of Bocairent.

3.2. Collagen Extraction and Analysis

Prior to collagen extraction, visible contaminants were removed using aluminium oxide powder abrasion. Collagen extraction for radiocarbon dating was carried out at the Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology (MPI-EVA), Leipzig, Germany, using the method established by Talamo and Richards [54]. First, 500 mg of bone was decalcified in 0.5 M hydrochloric acid (HCl) until no CO_2 effervescence was observed. Then, 0.1 M sodium hydroxide (NaOH) was added for 30 min, to remove humic substances. The NaOH step was followed by a final immersion in 0.5 M HCl for 15 min. The resulting solid was gelatinized following Longin [55] at pH 3 in a heater block set at 75 °C for 20 h. The gelatine was then filtered using an Eeze-Filter™ (Elkay Laboratory Products Ltd., Basingstoke, UK) to remove small (<80 mm) particles. The gelatine was then ultrafiltered using Sartorius "Vivaspin 15" 30 kDa ultrafilters [56]. Prior to use, the filters were cleaned to remove any carbon-containing humectants [57]. The samples were finally lyophilized for 48 h. All 11 human samples produced enough collagen for radiocarbon dating. Between 3 and 5 mg of the 11 samples were then sent to the Klaus-Tschira-AMS facility of the Curt-Engelhorn Centre in Mannheim, Germany [58], and to the University of Oxford Radiocarbon Unit, where they were graphitized and AMS-dated. All dates were corrected for a residual preparation background estimated from pre-treated ^{14}C free bone samples, kindly provided by the ORAU and pre-treated in the same way as the archaeological samples.

The collagen quality control was performed through the analysis of stable isotopes and the collagen yield. The stable isotope analysis was carried out at the MPI-EVA, Leipzig (S-EVA: lab code), using a Thermo Finnigan Flash EA coupled to a Delta V isotope ratio mass spectrometer.

3.3. Results

The radiocarbon dating results are listed in Table 3. The uncalibrated radiocarbon dates of Cova de la Sarsa burials range from 927 ± 24 to 6532 ± 24 ^{14}C BP. The two younger radiocarbon dates (MAMS-19071 and OxA-V-2360-24) indicate that the cave was not only used during prehistoric times as a funerary space but also sporadically during several historic periods (Visigothic kingdom and Medieval times). That no material remains from these periods have been recovered from the site perhaps suggests that the cave was not really a funerary space during historic periods but possibly a convenient hidden place to deposit corpses.

The ^{14}C dataset from Cova de la Sarsa presented in this paper is particularly interesting since the cave was undoubtedly used during the Early Neolithic as a funerary space, as is shown in the Bayesian Model confirming the archaeological finds previously discussed. The radiocarbon dates were calibrated using OxCal 4.4 [52] and IntCal20 [53]. The calibrated dates are shown in Table 3 and Figure 3. The site was used for burying human individuals from ca. 5500 cal BC to 1100 cal AD. As is visible, there are several huge time gaps in which human individuals were not buried at the site, from the later stages of the Early Neolithic to the Late Neolithic (ca. 5000–3000 cal BC), as well as during times in which ancient civilizations were already present in the region (ca. 1500 cal BC-500 cal AD).

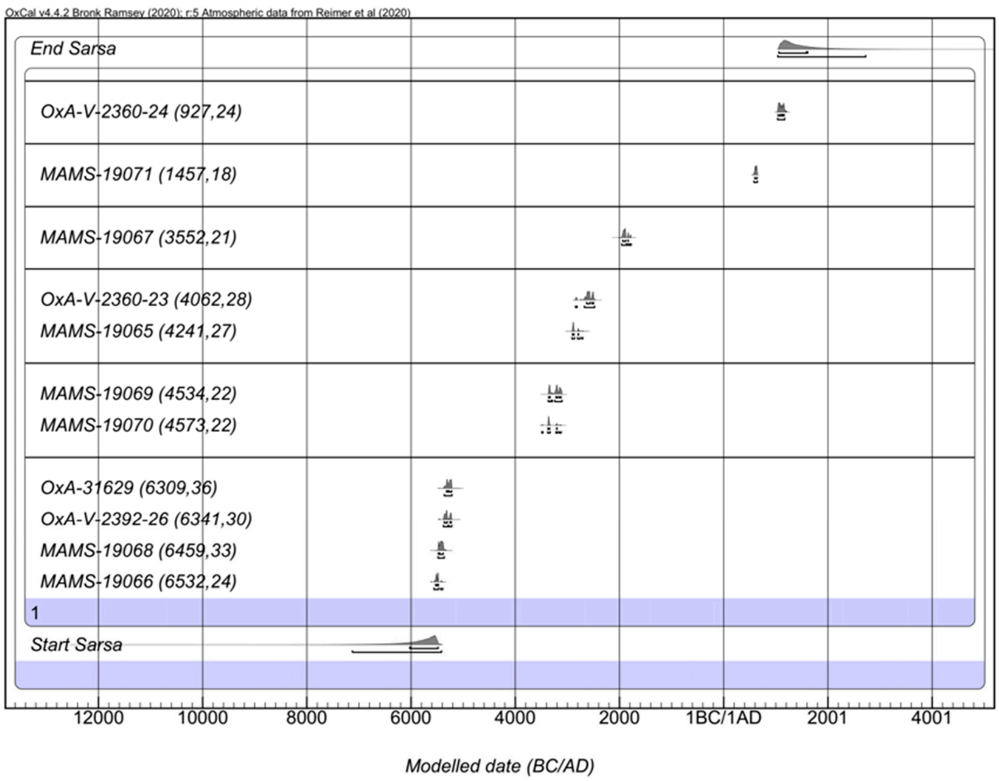

Figure 3. Calibrated ages and boundaries calculated using OxCal v 4.4 and IntCal20 [52,53] from Cova de la Sarsa human remains.

4. CN Isotopic Analyses

4.1. Dietary Reconstructions

Aiming to give value again to this important Neolithic site in the Western Mediterranean, carbon, nitrogen and sulphur stable isotope analysis on bone collagen were also carried out at the site. The isotopic composition of food consumed by mammals is recorded after a predictable isotope fractionation in their body tissues [59]. Carbon, nitrogen and sulphur stable isotope dietary studies are based on this main principle [60]. Bone collagen is usually the preferred substrate for these analyses, because it has accepted quality indicators that easily assess its isotopic integrity [61–63] and it is the only considerable source of nitrogen and sulphur found in skeletal remains [64]. However, when interpreting results, it is always important to consider that stable isotope ratios in bone collagen also have limitations and reflect only the average isotopic signals of the main dietary protein sources consumed several years prior to death [65,66].

The consumption of C_3 and C_4 terrestrial resources is distinguishable by the $\delta^{13}C$ stable isotope ratio [67]. Isotopic signals also help us to define the input in the diet of terrestrial and marine foods [68], although, if freshwater or estuarine fish are involved, the interpretation of $\delta^{13}C$ values becomes more complex [69]. The $\delta^{15}N$ stable isotope ratio increases by 3–5‰ up the food chain with each trophic level, and is usually used to indicate the position of an organism in the food chain [70]. Even if this quantification is less straightforward than previously thought [71], based on the exact values of the nitrogen ratio it is potentially possible to differentiate between individuals that consumed more animal resources from those who consumed very little animal protein [72]. Furthermore, the fact that aquatic food chains tend to contain more trophic levels than terrestrial ones, and therefore show an increase in $\delta^{15}N$, helps us to discriminate between the consumption of marine and C_4 terrestrial foods when samples are ^{13}C enriched [73]. As a complement to carbon and nitrogen stable isotope ratios, $\delta^{34}S$ isotope ratios can help us to discriminate even further in terms of the consumption of aquatic resources or the proximity to the coast, but unfortunately they require a much larger amount of extracted collagen for analysis [74].

4.2. Collagen Extraction and Analysis

Methods outlined by Richards and Hedges [75] were followed to extract collagen for C, N and S isotope ratio analysis at the Max-Planck Institute for Evolutionary Anthropology (MPI-EVA) in Leipzig, Germany. Whole bone fragments weighing ca. 300 mg obtained from each of the specimens were demineralized in a 0.5 M HCl solution at 5 °C. They were then rinsed three times with deionized water until the pH became neutral, and gelatinized over 48 h at 70 °C before being filtered and ultrafiltered using 50–90 µm EZEE© filters and >30 kDa Amicon© ultrafilters, respectively. Finally, the purified solutions were frozen and lyophilized before being weighed into tin capsules and loaded into the mass spectrometers.

The resultant collagen product was combusted to N_2, CO_2, SO and SO_2. The carbon and nitrogen isotope ratios in collagen were measured in duplicate (reproducibility better than 0.1‰) using a Delta XP continuous-flow isotope ratio mass spectrometer interfaced with an elemental analyser, Flash EA 2112 (Thermo-Finnigan©, Bremen, Germany). The sulphur isotope ratios in collagen were measured using a dedicated Delta V Plus (Thermo-Finnigan©, Bremen, Germany) continuous-flow isotope ratio mass spectrometer coupled with an elemental analyser Heka EuroVector (HeKaTech©, Wegberg, Germany). All samples were analyzed in the MPI-EVA isotope labs except one, which was analysed at the isotope facilities of the University of Cape Town (South Africa). Stable carbon isotope ratios were expressed relative to the VPDB scale (Vienna PeeDee Belemnite), stable nitrogen isotope ratios were measured relative to the AIR scale (atmospheric N_2), and stable sulphur isotope ratios were measured relative to standard sulphur gas. All of them are expressed using the delta notation (δ) in parts per thousand (‰). Repeated analysis of internal (methionine for carbon and nitrogen, casein for sulphur) and international standards determined an analytical error $< 0.1‰$ (1σ) for $\delta^{13}C$ and $\delta^{15}N$, and $<0.3‰$ (1σ) for $\delta^{34}S$.

4.3. Results

Samples from 11 humans and 17 faunal specimens from 10 different species (both wild and domestic) were taken for stable isotope analysis. All samples yielded sufficient collagen in the >30 kDa fraction for $\delta^{13}C$ and $\delta^{15}N$ analysis in duplicate, but only 2 human samples and 11 animal samples had enough collagen to be analysed for $\delta^{34}S$. All of them met published collagen quality controls: appropriate C and N elemental percentages together with C:N ratios between 2.9 and 3.6 [61,63,76], and S percentages from 0.15 to 0.35% [62]. All isotope ratio results from Cova de la Sarsa are presented in Table 4 and illustrated in Figure 4.

Table 4. Cova de la Sarsa $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ values from fauna and humans, human sex and age, chronology, collagen control indicators (yield, %C, %N, %S, C:N), S-EVA number, sampled bone and archaeological context.

S-EVA	Museum Code *	Species	Element	Sex	Age	$\delta^{13}C$(‰)	$\delta^{15}N$(‰)	$\delta^{34}S$(‰)	%Col.	%C	%N	%S	C:N	Cultural Group According to ^{14}C
7670	M-22055-Occ1 (VAL)	Human	Occipital	Male?	Adult	−19.8	7.0	-	3.1	39.4	14.1	-	3.2	Chalcolithic
7671	M-22055-Occ2 (VAL)	Human	Occipital	Female?	Adult	−20.1	8.2	-	3.6	40.9	14.4	-	3.3	Chalcolithic
7672	C-21835 (VAL)	Human	Occipital	Female	Young adult	−16.3	9.6	-	2.5	29.8	10.9	-	3.2	Medieval
7674	C-21834 (VAL)	Human	Parietal	Female	Adult	−18.9	9.1	-	1.9	29.1	10.6	-	3.2	Bronze Age
7675	C-21833 (VAL)	Human	Skull	Female	Old Adult	−20.5	7.1	-	1.9	32.0	11.4	-	3.3	Early Neolithic
7677	1714/85 (ALC)	Human	Parietal	Indeterminate	Perinatal	−18.5	10.2	3.8	5.4	43.5	15.7	0.2	3.2	Early Neolithic
7678	548/85-1 (ALC)	Human	Skull	Indeterminate	Adult	−18.7	10.3	-	1.4	42.6	15.4	-	3.2	Late Neolithic
7679	548/85-2 (ALC)	Human	Skull	Indeterminate	Adult	−18.7	10.3	-	1.2	40.3	14.6	-	3.2	Late Neolithic
7680	548/85-3 (ALC)	Human	Skull	Indeterminate	Adult	−18.2	10.4	5.9	4.5	43.9	16.2	0.2	3.2	Visigothic
17064	CSA 00026 (BOC)	Human	Vertebra	Female	Old Adult	−19.4	10.0	-	1.6	42.1	14.6	-	3.4	Early Neolithic
20232 (S-UCT)	CSA 00022 (BOC)	Human	Maxilla	Male	Adult	−18.7	10.2	-	1.4	43.3	15.6	-	3.2	Early Neolithic
7653	22050 (VAL)	*Ovis aries*	II Phalanx	*	*	−19.9	5.5	6.2	4.1	43.9	15.9	0.1	3.2	*
7654	22050 (VAL)	*Ovis aries*	Skull	*	*	−19.4	5.0	8.2	2.8	42.4	15.3	0.2	3.2	*
7657	22050 (VAL)	*Ovis aries*	II Phalanx	*	*	−19.9	5.0	3.8	5.3	44.3	16.1	0.2	3.2	*
9049	172/005/008 390 (ALC)	*Ovis aries*	Mandible	*	*	−17.6	7.0	7.7	3.2	43.2	16.0	0.2	3.2	*
7669	172/004/003 547 (ALC)	*Capra hircus*	Humerus	*	*	−18.7	3.2	-	3.1	34.4	12.7	-	3.2	*
7665	172/004/003 547 (ALC)	*Capra pyrenaica*	Femur	*	*	−18.2	5.5	8.2	4.9	42.5	15.0	0.2	3.3	*
7658	21985 (VAL)	*Cervus elaphus*	II Phalanx	*	*	−20.2	4.8	6.0	5.1	43.1	15.7	0.2	3.2	*
7662	172/004/003 547 (ALC)	*Cervus elaphus*	II Phalanx	*	*	−19.6	4.2	-	1.5	39.0	14.0	-	3.3	*
9050	172/004/003 547 (ALC)	*Cervus elaphus*	Mandible	*	*	−19.8	5.4	8.7	3.7	42.8	15.8	0.2	3.2	*
7661	172/004/003 547 (ALC)	*Equus caballus*	Humerus	*	*	−19.8	3.7	-	0.8	38.4	13.4	-	3.4	*
7668	172/004/003 547 (ALC)	*Equus caballus*	Humerus	*	*	−20.1	3.8	-	0.8	32.4	11.4	-	3.3	*
7664	172/004/003 (ALC)	*Oryctolagus cuniculus*	Calcaneus	*	*	−19.7	3.2	-	1.9	37.6	13.2	-	3.3	*
7655	22050 (VAL)	*Sus domesticus*	Mandible	*	*	−20.3	5.0	4.9	3.4	40.9	14.1	0.2	3.4	*
7667	172/004/003 547 (ALC)	*Sus scrofa*	Femur	*	*	−19.3	5.5	5.0	3.4	44.0	16.0	0.2	3.2	*
9047	172/005/008 390 (ALC)	*Sus* sp.	Mandible	*	*	−19.2	6.1	6.3	4.0	44.7	16.2	0.2	3.2	*
9046	172/005/008 390 (ALC)	*Lynx* sp.	Mandible	*	*	−19.2	6.9	-	2.6	38.7	14.2	-	3.2	*
7659	21985 (VAL)	*Vulpes vulpes*	Cubitus	*	*	−18.5	7.6	4.9	5.8	44.6	16.3	0.2	3.2	*

*: VAL: Museum of Valencia; ALC: Museum of Alcoi; BOC: Museum of Bocairent.

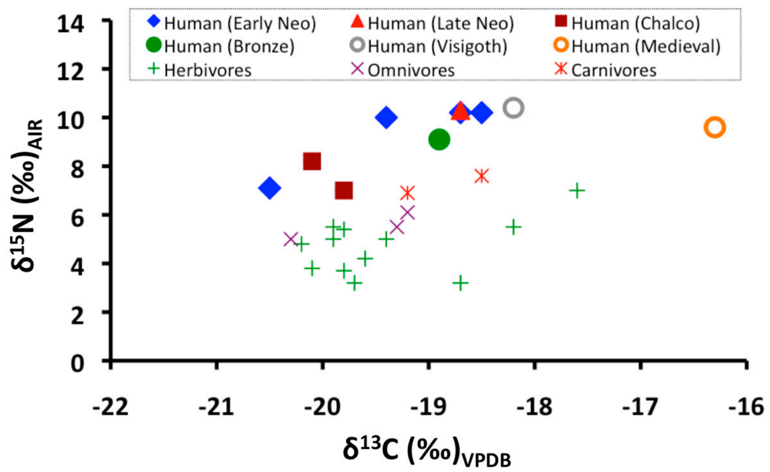

Figure 4. Plot of human and animal bone collagen δ^{13}C and δ^{15}N values from Cova de la Sarsa.

As can be seen in Table 4, all humans are ascribed to a cultural context based on the direct radiocarbon dating (see point 4). Since the chronologies of the individuals are from a wide time span (Early Neolithic, Late Neolithic, Chalcolithic, Bronze Age, Visigothic, Medieval), results are presented independently per period. Unfortunately, the fauna was not dated, so we elected a conservative approach and decided to use all specimens as background for all periods in the discussion.

Analysing the carbon values, it can be seen that the terrestrial herbivore δ^{13}C mean value is −19.4 ± 0.8 (1σ)‰ and its minimum and maximum values are −20.2‰ and −17.6‰, respectively. Except for the herbivore that sets the maximum value, most of the herbivores range between −20.2‰ and −18.2‰, which is overall compatible with typical C_3 terrestrial ecosystems. The mean carbon value of the only three omnivores analyzed is of −19.6‰, and that of the only two carnivores analysed is of −19.6‰, both of which are also consistent with the general herbivore values and a terrestrial C_3 food ecosystem. Analysing the nitrogen values, the herbivore mean δ^{15}N value is 4.7 ± 1.1 (1σ)‰ and has minimum and maximum values of 3.2 and 7.0‰, respectively, with rabbit and horse having the lower values. The mean δ^{15}N value of the three omnivores analysed is of 5.5‰, which is only slightly higher than the herbivore mean value. The mean δ^{15}N value of the two carnivores analysed is of 7.3‰, which is around 2.5‰ higher than the herbivore mean value and situates the carnivores almost one complete step higher than the herbivores in the food chain. Regarding the δ^{34}S values, the range goes from 3.8 to 8.7‰, far away from a coastal influence (>15.0‰), and being compatible with an inland locality. Unfortunately, no aquatic resources are available for this site, and thus the marine and freshwater specific 'baseline' is lacking for Cova de la Sarsa.

All humans from the Early Neolithic period (n = 4) have δ^{13}C and δ^{15}N mean values of −19.3 ± 0.9 (1σ)‰ (min: −20.5‰, max: −18.5‰) and 9.4 ± 1.5 (1σ)‰ (min: 7.1‰, max: 10.2‰), respectively. The two individuals from the Late Neolithic have the same result, a δ^{13}C value of −18.7‰ and a δ^{15}N value of 10.3‰. The Chalcolithic individuals (n = 2) have δ^{13}C values of −19.8‰ and −20.1‰ and δ^{15}N values of 7.0‰ and 8.2‰. Finally, δ^{13}C and δ^{15}N values from the Bronze Age human are −18.9‰ and 9.1‰, from the Visigothic Period human are −18.2‰ and 10.4‰, and from the Medieval human are −16.3‰ and 9.6‰. These values show that all different period populations had an overall similar diet based on terrestrial C_3 resources, although with some differences that will be later discussed only for the Prehistoric individuals. Only two humans yielded δ^{34}S values: an Early Neolithic perinatal individual reflecting the mother's values (3.8‰), and an individual who lived in the Visigothic Kingdom (5.9‰). Assuming that the local range value from the site is defined by the faunal δ^{34}S mean value (±3–5‰) [62], these data suggest that the Cova de la Sarsa humans were local as they align closely with the local herbivore values. Furthermore, they show no evidence of a coastal influence, either via diet or the sea spray influence. Not knowing the exact chronology of each of the faunal specimens analysed, it is difficult to find out which specific animal species might have been consumed more abundantly during each period.

5. Discussion

5.1. Cultural-Chronological and Funerary Contexts at the Early Neolithic

The morpho-typological and technological comparative study is still a useful tool for Prehistoric Archaeology to establish assemblage chronologies lacking a clear stratigraphic reference, as is the case for Cova de la Sarsa. Regarding the Valencian Neolithic, the quantification and percentage representativity of the decorative techniques along with the archaeological sequences are one of the main elements defining the different phases [77–79]. When comparing the Cova de la Sarsa pottery assemblage to those from the Eastern Iberian Early Neolithic sites, it is concluded that most materials belong to the Early Neolithic. The 16 radiocarbon dates available now for the site confirm this. Besides the Early Neolithic pottery assemblage, some Middle Neolithic decorated sherds were found. However, no radiocarbon dates from this period have been obtained yet. Radiocarbon dates also show that the cave was used as a funerary space for longer than originally expected. Some human remains are directly dated to the Late Neolithic, the Chalcolithic and the later stages of the Bronze Age, although no characteristic grave goods from these periods have ever been found.

The funerary use of the space at Cova de la Sarsa during the Early Neolithic is also of interest. Two of the individuals were deposited in the habitat area of the cave, while two others were buried in a crevice situated in the lower galleries of the cave. The presence of inhumations inside intensely occupied caves is not a unique trait in the region. Inside Cova de l'Or there is an Early Neolithic human mandible associated with a funerary ritual [44,46]. Close to the mouth of the cave in Cueva de Chaves (Bastarás, Huesca) there is also a primary inhumation with scarce grave goods in a habitat area over which pebbles and an ash layer were identified [80]. Furthermore, radiocarbon dates from domestic cereals and animals from Cova de l'Or [81], Cova de la Sarsa [44] and Cueva de Chaves [82] are similar to those from human remains associated with Cardial contexts, and therefore suggest that funerary practices were carried out while the caves were used as habitat sites.

The two individuals that were buried in a crevice outside the living space, in the pathway to the internal galleries, are still the most relevant find to propose the existence of a ritual concerning the transition from life to death in the Eastern Iberian Early Neolithic. They were discovered beside a cardial-impressed vase, and close to a panel with some schematic rock art [40]. This shows that Cova de la Sarsa's inhabitants developed non-domestic daily activities in the internal areas of the cave, away from natural light. This might imply the existence of a sacred space annexed to the domestic area.

The pottery assemblage present in the domestic area of the site is quite diverse. There are bowls, pots, containers, jars, beakers, pitchers and some special items such as micro-vessels, small bottles, small barrels and geminated vessels (geminated vessels are duplicated small-sized containers with the same shape, size and decoration that are joined together before being cooked, resulting in a single container made up of two vessels). Hemispheric and globular bowls and pots are the most frequent. This, together with a lack of dishes, platters and "escudillas", could be associated with eating and cooking styles in the Early Neolithic. Their designs suggest that they were used to contain and cook liquids, also allowing the direct consumption of their contents both individually and collectively. Results from first lipid organic residue analysis from the Cardial Early Mediterranean Neolithic seem to confirm this possibility, proposing the combination of vegetable and animal products, mainly ruminants [83]. The abundance of hemispheric shapes with capacity of up to 5 L could also be associated with the importance in the Neolithic diet of soups, broths and gruels.

Besides the possible use of pots and bowls for storage purposes, the fact that several types of containers with a bigger volumetric capacity such as pitchers (for liquids) and bigger containers (for solids) are also present, seems to discard the storage hypothesis for pots and bowls. The main difference with regard to pots and bowls consists in the higher depth index of the storage containers, which makes them more cylindric and therefore less suitable for cooking foods. These last vessels also have thicker walls, and their surfaces are mainly plain except for some cordons, sometimes even having a capacity of more than 40 L. The presence of these large containers is associated with the absence of silos from Eastern Iberia's Early Neolithic; later on, the number of large containers starts to dwindle when silos start appearing after the 5th millennium cal BC [84,85], and they eventually disappear during the Late Neolithic. Very possibly these large storage containers were used to store grain, while the big pitchers probably were used to store liquids. Pitchers are the most abundant type of storage containers in Cova de la Sarsa (78, of which 18 are higher than 30 cm). The use of these vessels with a narrow mouth and neck is associated with the storage and transport of liquids, and therefore explains the high presence in Cova de la Sarsa where cave water is available. Liquids could then be moved from these pitchers into cooking, serving or drinking vessels.

Other Early Neolithic vessels present at Cova de la Sarsa are micro-cups, small bottles, little barrels and geminated vessels. All of them are containers whose function is difficult to establish by typological traits and that could even be associated with non-dietary activities. Almost all small bottles have two small ring handles in their frontal area that would allow them to be fastened to the waist, allowing them to be used as containers for colorants, adherent materials or even poison [86]. Inside some of the specimens the presence of red colorant has been documented [87].

Besides the use of the above-mentioned vessels to satisfy basic needs, their symbolic features should also be discussed. Specifically two issues will concern us: the vessel's association to religious practices, and its consideration as the expression of membership of a community (identity). At Cova de la Sarsa there are pots that could have been used to facilitate the transition of the dead to the afterlife. The presence of ritual behaviours attests to the importance that religion had among Cardial Neolithic communities [88]. In Eastern Iberia, the macroschematic rock art [37,89] shows evident parallels with decorations on some Neolithic vessels [36,86,88], as is the case of the anthropomorphic vertical figures. The macroschematic art motifs and those impressed on Early Neolithic vessels are possibly representations of religious experiences. The significance of these decorations goes beyond identity values based purely on technical and ornamental aesthetics, representing specific aspects of their practices and beliefs. However, the presence of these types of vessels is minor, representing, for example, less than 1% of the total if considering anthropomorphic representations.

Overall, the high diversity and total number of pottery vessels found at Cova de la Sarsa are a solid argument when interpreting the cave as being used during the second half of the 6th millennium cal BC by a community whose economic strategy was based on cereal production. Besides the numerous pot sherds, there are human and faunal remains, malacofauna, grinding stones, polished stones, personal adornments, bone tools and colouring materials. The minimum number of vessels, its typological variety and the big size of some of the pieces, are traits not easily linked to groups that move over long distances regularly. Therefore, the cave site, being one of a number of sites from which the nearby valley was exploited, was probably used for a variety of reasons.

The cardial impression technique, i.e., the decoration by means of a denticulated shell in any of its varieties [90], is one of the archaeological indicators of the existence of a shared identity from which others develop, to a lesser scale. This does not imply total uniformity among the existing Cardial subcultures in the Western Mediterranean. The development of these particularities explains the diversity in the assemblages, as there exist greater differences in pottery styles between those areas that are geographically further apart. The contextualization of Cova de la Sarsa in its immediate surroundings and in the existing set of Cardial Valencian sites has allowed us to sketch an interpretative model that helps us to understand the emergence and development of the first Neolithic groups in Eastern Iberia.

5.2. Isotopic Dietary Evidence at the Onset of Farming

Stable isotope studies are commonly used for past human dietary reconstructions. The application of this analytical technique in Mediterranean Iberia and its hinterland has significantly increased during the past decade [91,92], creating an important corpus of dietary data from different chronologies in the region and its hinterland. Studies from the Palaeolithic [93,94], Mesolithic [69,95,96], Neolithic-Chalcolithic [80,97–110], Bronze Age [99,101,111], Iron Age [112], Punic [113], Roman [105,106] and Medieval [64,106,114,115] periods have been carried out in Mediterranean Iberia. However, until now, only few isotopic data directly dated to the earlier stages of the Neolithic [108], differently to what is observed in Western Iberia [116,117].

The Early Neolithic individuals from Cova de la Sarsa show a range of carbon and nitrogen isotope ratios that, although clearly portraying a protein diet based on C_3 terrestrial resources, could also suggest a varied dietary protein input (Figure 4). Two of the four individuals have higher δ^{13}C values (S-EVA 7677 and S-UCT-20232). Since these values are associated with relatively high δ^{15}N values (especially higher than that of one of the other two Early Neolithic individuals with lower δ^{13}C values), perhaps this difference could imply selective marine resource consumption by some of the individuals in small quantities, but enough to be reflected in the bone collagen composition. At this point, this difference cannot be attributed to sex (not enough sexed individuals available) nor to age (the perinatal individual would possibly have the biological mother's values, not yet being influenced by breastfeeding). Interestingly, it cannot be attributed to place of burial either (S-UCT 20232 and S-EVA 17064 are the individuals buried in a crevice in the lower galleries of the cave, while remains S-EVA 7675 and 7677 appeared in the habitat area of the cave). If this aquatic resource consumption is confirmed, it would mean that the diet of the last hunter-gatherers and the first farmers in the region was similar, at least isotopically. The inland Neolithic individuals from Cova de la Sarsa would have a marine/terrestrial proportion in the diet similar to that observed amongst inland Mesolithic individuals from Santa Maira and Cingle del Mas Nou [69], suggesting a trade network connecting this inland farming population to the coast, or the use of the territory that integrated the two different environments. Alternatively, it could show that these two individuals with higher δ^{13}C values might have been living in other communities with easier access to marine resources and later ended up in the inland site of Cova de la Sarsa. It could also mean that these two individuals consumed some C_4 resources (plants or animals that consumed them), as their δ^{15}N values are similar to one of the two other Early Neolithic individuals with lower δ^{13}C values. Something similar could be said about the Late Neolithic human values from Cova de la Sarsa, which are similar to these two Early Neolithic individuals with higher δ^{13}C values. Contrary to this, the Chalcolithic δ^{13}C and δ^{15}N values show no evidence of aquatic protein nor C_4 resource consumption and could be defined isotopically as reflecting only a C_3 terrestrial protein diet; the Bronze Age isotope value would be in an intermediate position between the two.

The Cova de la Sarsa isotope values complement the picture that the isotope analysis has already portrayed for Eastern Mediterranean Iberian Holocene prehistory (Figure 5) (Eastern Mediterranean Iberia defined as the territory south of the Ebro river and north of Cabo de Palos). Especially useful for this are the Early Neolithic individuals, as very few have previously been published for this chronology in the region. As we can see in the graph, the values from all chronological periods (Mesolithic, Early Neolithic, Middle Neolithic, Late Neolithic, Chalcolithic) are partially overlapping. However, it can also be observed that, overall, the Late Neolithic and Chalcolithic values are in general more homogeneous than the ones from previous chronological moments. All of this might suggest that the biggest shift in the variety of the protein diet component took place between the earlier and later stages of the Neolithic, and not so much between the last hunter-gatherers and the first farmers. Regarding marine protein consumption, if we observe on the graph which individuals are from sites near to the coastline and which from inland sites, we can notice interesting patterns. Mesolithic hunter-gatherers show intermixed isotopic values whether from coastal or inland sites (Figure 6a), which is expected from a population with high mobility through different environments. However, since the start of the Neolithic, when people start to live in more stable settlements, and especially during its last stages and into the Chalcolithic period, we could consider that the amount of marine resource consumption is mostly linked to the proximity to the sea rather than to chronology or archaeological culture (Figure 6b).

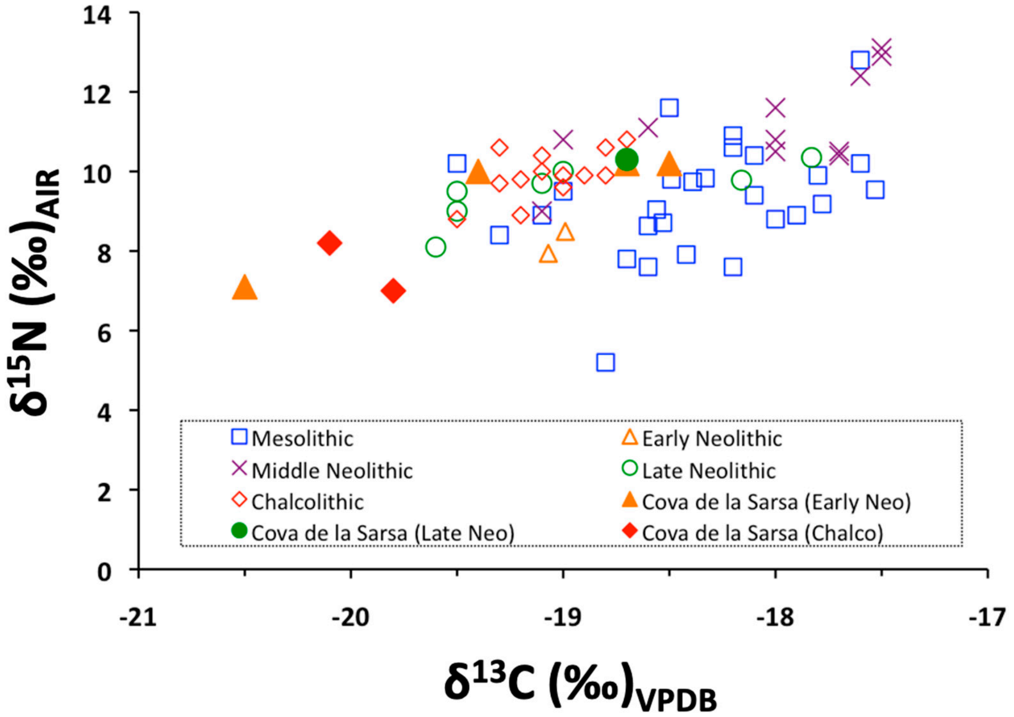

Figure 5. Plot of human bone collagen $\delta^{13}C$ and $\delta^{15}N$ values from all Eastern Mediterranean Iberia Mesolithic, Neolithic (Early, Middle, Late) and Chalcolithic sites, including Cova de la Sarsa. Mesolithic: Casa Corona, Cingle Mas Nou, El Collado, Penya del Comptador, Santa Maira [69,95,96]. Early Neolithic: Costamar, Cova de la Sarsa [102], this study. Middle Neolithic: Tossal de les Bases [106]. Late Neolithic: Costamar, Cueva de la Pastora, Cova de la Sarsa [101,102], this study. Chalcolithic: Avenc dels dos Forats, Cova dels Diablets, Cova de la Pastora, Coveta dels Frares, La Vital, Cova de la Sarsa [99,101,103,104], this study.

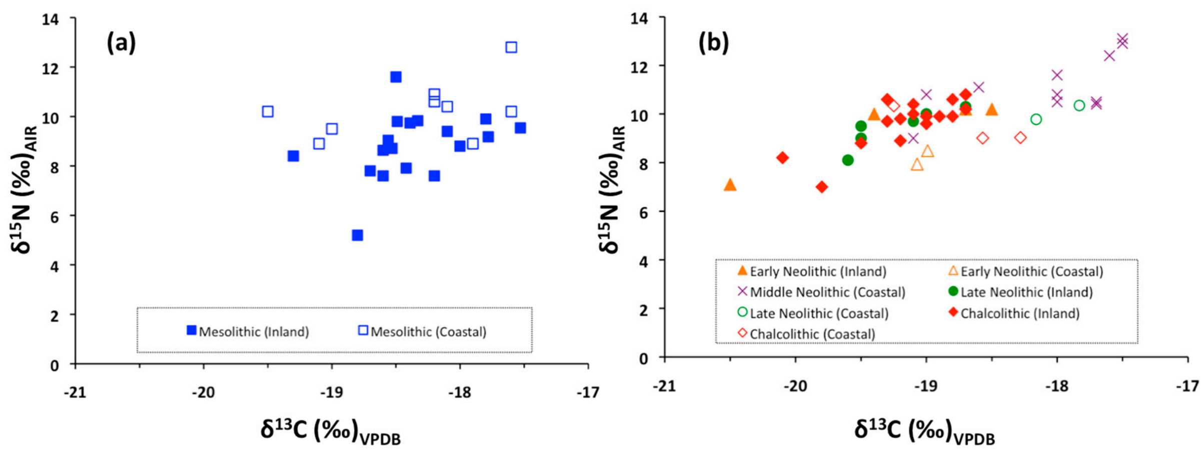

Figure 6. Plot of human bone collagen $\delta^{13}C$ and $\delta^{15}N$ values from the same individuals plotted in Figure 5, but divided between coastal and inland sites from (**a**) the Mesolithic, and (**b**) the different stages of the Neolithic and Chalcolithic (sites and references in Figure 5).

We must keep in mind that some of the differences observed between chronological periods and even sites of a same period could be due to direct non-dietary influences that modify the isotopic composition of resources consumed regardless of resource type (i.e., factors that influence the food chain values themselves). For example, different environmental conditions between contemporary sites (e.g., coastal vs. inland; mountain vs. plain) or even between sites of a same geographic area but of different chronology, could have different isotopic food chain baselines [118]. The use of complex husbandry practices and associated manuring in the region from the Late Neolithic onwards could also influence crops, as well as domestic animals that feed on them, and eventually humans who consume the domestic crops or animals [119]. Physiological traits of both animals consumed (e.g., infantile vs. adult specimens) and humans themselves (e.g., age, nutritional status, etc.), as well as the types of bones sampled (e.g., high vs. low collagen turnover skeletal elements), could also influence to a certain extent the isotopic composition passed eventually into human bone collagen. Some of these "non-dietary" influencing factors are difficult to assess, as the archaeological assemblages are what they are, but we should nevertheless try to avoid "absolute truth interpretations" or rigid quantified interpretations, and be more flexible when interpreting isotopic studies applied to archaeological material.

6. Conclusions

The Early Neolithic site of Cova de la Sarsa has been a key site for understanding the expansion of the Neolithic along the Mediterranean and its arrival in the westernmost part of the region. However, during the past few decades, the importance of this site has diminished, due to its early excavation methods not preserving the chronological integrity of the excavated materials, and the lack of radiocarbon dates and modern scientific analyses. Yet, we argue here that its archaeological assemblage is indeed one of the most relevant ones in the Western Mediterranean for understanding the Early Neolithic, and so this paper has outlined how we have applied new methods to the material excavated from this site to highlight its importance in our understanding of this time period. In this study we have (a) chrono-culturally studied the pottery assemblage in order to understand better the different stages of Early Neolithic occupation of the site; (b) directly dated the highest possible NMI of human remains present at the site in order to contextualize funerary practices; (c) carried out a dietary isotopic study, which was especially useful to assess the continuity between hunter-gatherer and first farming subsistence in the region. All of these combined approaches at Cova de la Sarsa help us to return this site to a place of prominence in Neolithic research and highlight that it is an exceptional site that has an important role in our understanding of Western Mediterranean prehistory.

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