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The chronology of megalithic funerary practices: a Bayesian approach to Grave 11 At El Barranquete necropolis (Almería, Spain)

Gonzalo Aranda Jiménez*, Agueda Lozano Medina

Department of Prehistory and Archaeology, University of Granada, Campus Cartuja s/n, 18071 Granada, Spain

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ABSTRACT

For the first time on the southern Iberian Peninsula it is possible to determine the timescale and funerary span of a single megalithic grave, as all the Minimum Number of Individuals identified by anthropological study have been dated. Thirteen radiocarbon measurements are now available from Grave 11 at El Barranquete necropolis. Two Bayesian models have been built on the basis of archaeological interpretations of the mortuary depositions. The results stress the late construction of the monument, probably in *2452–2316* cal BC, and the short, but intensive ritual use during the Chalcolithic period of between three and nine generations. The funerary reuse of the monument is one the most remarkable features of this tomb. According to the Bayesian models, these ritual practices began in *2154–2022* cal BC and spans a long period of at least half a millennium. The results are also discussed in the context of the megalithic phenomenon on the southern Iberian Peninsula.

1. Introduction

The megalithic necropolis of El Barranquete lies in a plains area to the west of a seasonal river, the Rambla de Morales, near the Mediterranean coast (*c.* 7 km as the crow flies) in the present-day province of Almería (Fig. 1). Discovered in 1968, the necropolis was immediately excavated by Manuel Fernández Miranda and María Josefa Almagro Gorbea during different fieldwork seasons between 1968 and 1971. In 1973, a full report on all the excavations undertaken during this period was published by María Josefa Almagro Gorbea (1973). This report also included an anthropological study of the first eight burials undertaken by Miguel Botella López. The investigations revealed at least 17 megalithic graves, of which 11 were excavated (Fig. 2). All burials conform to the classification of the megalithic type known as a *tholoi* or tombs with chambers covered by false vaults. The chambers were entered through passages that were normally divided into equal segments by slabs with holes in them. Small side chambers in both the passages and the main chambers were also a common feature. These tombs were covered by mounds built with concentric stone walls filled with earth and small stones (Almagro Gorbea, 1973).

Grave 11 is a perfect example of this type of megalithic grave (Fig. 3). The structure itself is defined by a circular chamber with dry stone walling and is 3.75 m in diameter. To the east and west of the mortuary structure, two oval-shaped side chambers were documented. The narrow passage has a single segment 1.30 m in length, with access to the chamber through a perforated sandstone slab. On the opposite side of the passage, a poorly preserved orthostatic forecourt was also a standing feature. The mound was 11 m in diameter with at least 5 concentric stone walls.

The mortuary deposit consisted of a mass of stratified, mixed anthropological remains broadly occupying the central and northern part of the main and western chambers. The southern half of the mortuary area and the corridor were almost completely empty as a result of looting that has fortunately not affected the whole tomb. This means that an unknown proportion of the anthropological remains has been lost and consequently the preserved human bones do not constitute the entire original burial population. This situation is not exceptional and can be found in most of the graves excavated in this necropolis.

In the undisturbed chamber area, bone remains appear piled on top of each other, overlapping in many cases. This complex stratigraphy was excavated in four layers. Layer I was found 30 cm from the surface, Layer II 50 cm, Layer III 70 cm and Layer IV was at the bottom, at a depth of 110 cm and just above the floor of the chamber. This stratigraphy follows a general trend documented in many other burials in the necropolis (Almagro Gorbea, 1973). It

* Corresponding author.
E-mail addresses: garanda@ugr.es (G. Aranda Jiménez), aguedalozanomed@gmail.com (A. Lozano Medina).

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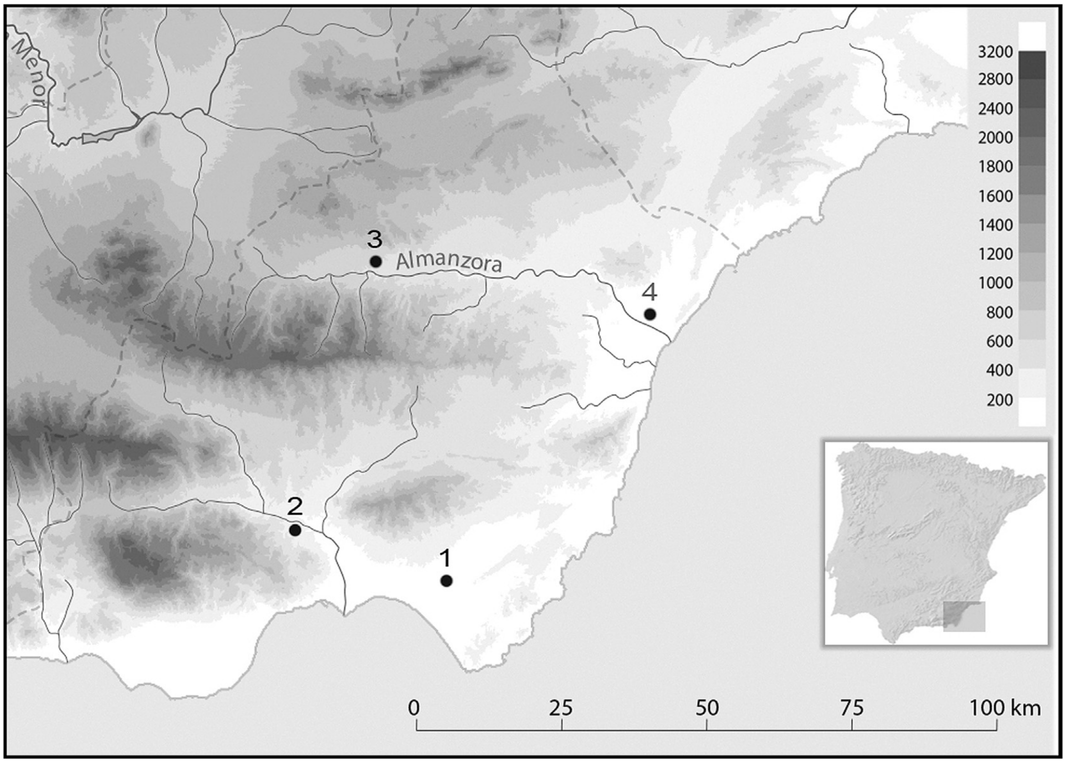

Fig. 1. Map showing the location of *tholoi* with radiocarbon dates in the southeastern Iberia: (1) El Barranquete; (2) Los Millares; (3) La Loma del llano del Jautón; (4) La Encantada I.

seems likely that the preserved anthropological remains could be representative of the majority of the ritual biography of the tomb. It is not possible to rule out the possibility that previous interments had been cleared out during the Copper Age, although this seems unlikely, especially if we take into account the fact that no evidence of this type of ritual behaviour has been reported elsewhere for the southern Iberian megalithic phenomenon.

It should be noted that these four layers mainly represent the phase order in which the skeletal remains were excavated. The regular thickness intervals between the four identified layers would imply that they were artefacts of excavation and recording. The exception can be found in the differentiation between Layers III and IV, in which the associated material culture was the main criterion. In fact, Layer III appeared to be related to typical Early Bronze Age grave goods, in contrast to Layer IV which was linked to Chalcolithic pottery vessels (Figs. 4 and 5). The radiocarbon dating from 40 years later presented in this paper supports that the different layers identified by the excavators are consistent with a chronological succession of depositional events.

The bones of Grave 11 were found in an articulated, semi-articulated and scattered state. These remains could be primary deposits that were disturbed by later activity in the chambers, mainly subsequent burials. Such activity would have involved moving and reorganizing the earlier anthropological remains. Therefore it was assumed that each individual was buried as an articulated skeleton still with flesh on its bones or at least with bones still connected by ligaments. With the data currently available it is not possible to rule out the possibility of secondary burials of bodies that had previously been interred elsewhere and subsequently placed in Grave 11. Nevertheless, this possibility appears to be very unlikely if the dating results are taken into account (see below). We also cannot disregard the possibility that some bones were removed from the chamber to be deposited elsewhere.

Grave goods are scarce and consist mainly of pottery sherds. Only in one case, that of an adult male found in an anatomical connection and flexed position, was it possible to link the remains to specific grave goods, including a copper dagger, two pottery vessels and a copper bracelet attached to the right radius and ulna. Another copper dagger from Layer I completes the list of metal grave goods found in this tomb. Of the pottery sherds, different fragments from the same vessel with Bell-Beaker decoration found in different areas of the tomb (mound, passage and chamber) can be highlighted. This is the only vessel with Beaker decoration found thus far at El Barranquete necropolis. As we will stress below, this finding is fully consistent with the radiocarbon measurements.

2. Materials and methods

El Barranquete necropolis was a pioneering site in Iberia in terms of radiocarbon dating. At the beginning of the 1970s, four samples were dated by the CSIC[1]: two pieces of charcoal from a wooden post that supported the roof of the mortuary chamber in Grave 7 and two more of human bones from Grave 11. The samples from Grave 7 produced statistically very consistent radiocarbon measurements (CSIC-81 4280 $\pm$ 130, 3339–2505 cal BC 2σ and CSIC-82 4300 $\pm$ 130, 3350–2550 cal BC 2σ). Together with the date of Tomb 19 at the Los Millares necropolis (KN-72, 4380 $\pm$ 120, 3400–2650 cal BC 2σ), they have traditionally been used to date, in broad terms, the beginning of the *tholoi* phenomenon in south-eastern Iberia to between the end of the fourth and the beginning of the third millennium. Radiocarbon measurements from Grave 11 revealed a very different picture. The results indicated very recent dates (CSIC-201B, 2570 $\pm$ 100, 898–412, cal BC 2σ and CSIC-201A, 840 $\pm$ 100, 995–1301 cal AD 2σ); this was considered

[1] Spanish National Research Council.

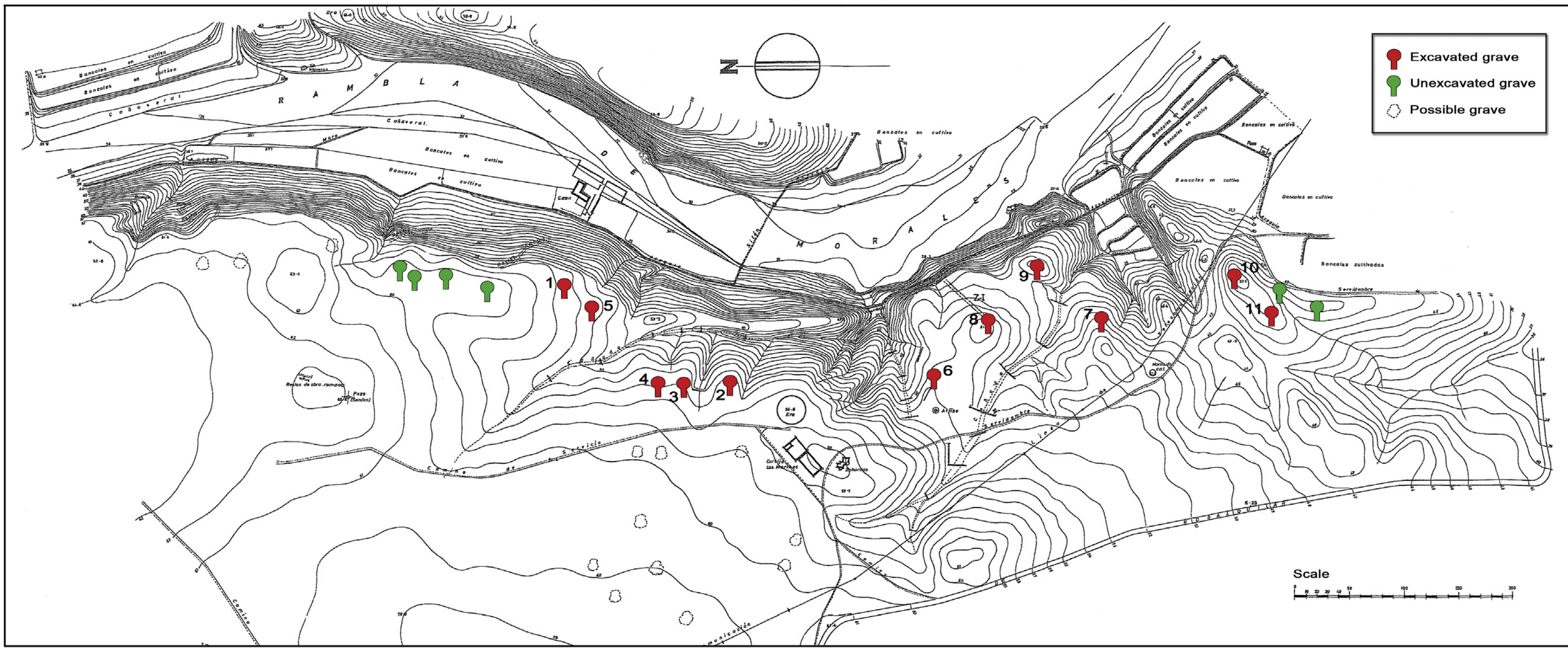

Fig. 2. Map of the necropolis of El Barranquete showing the location of megalithic graves (After Almagro Gorbea, 1973).

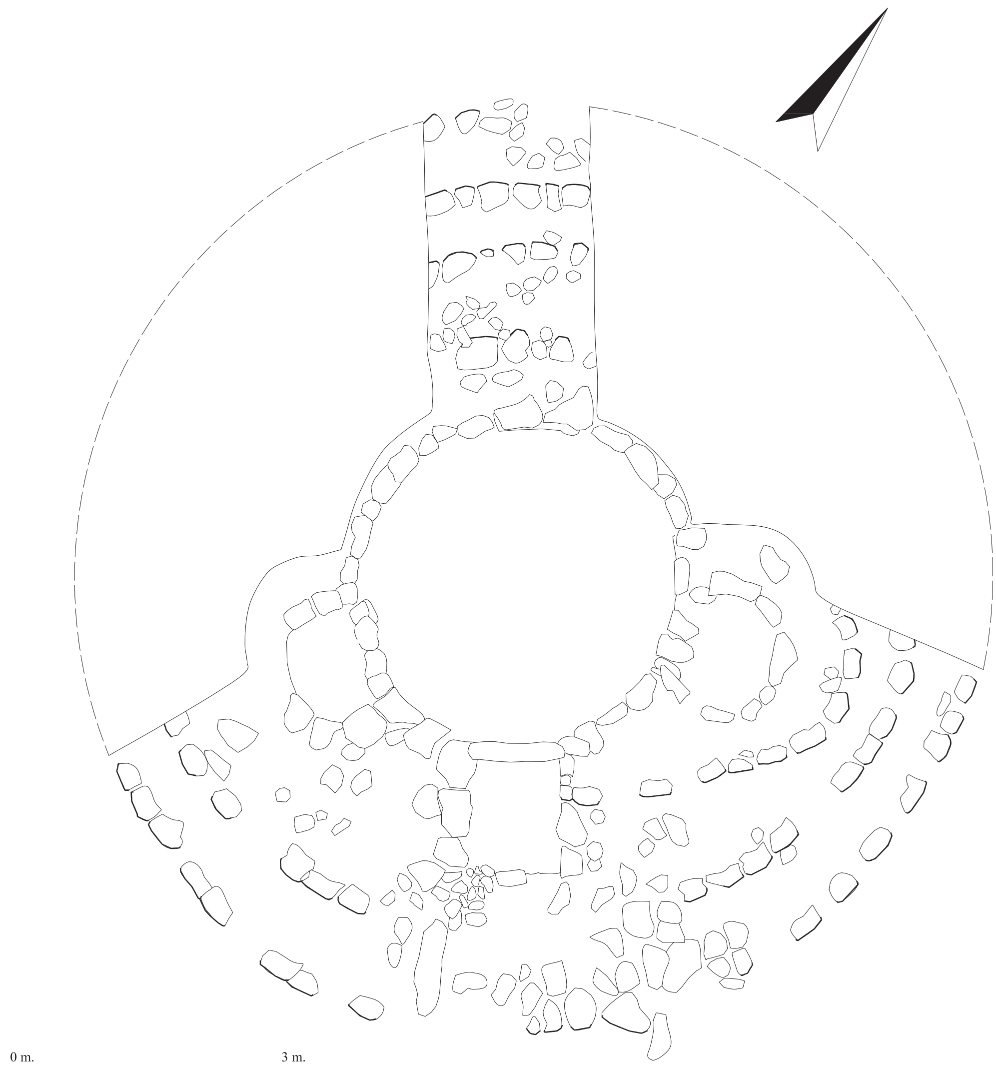

Fig. 3. Plan of the grave 11 at the necropolis of El Barranquete (after Almagro Gorbea, 1973).

completely inappropriate for the cultural context analysed and it was therefore assumed that the bone samples were contaminated or intrusive (Almagro Gorbea, 1973). As a result of the Late Bronze Age radiocarbon dates found at other *tholoi*, the CSIC-201B date is currently acknowledged as a part of the ritual re-use practices of these megalithic tombs (Castro et al., 1996; Lorrio and Montero, 2004; García Sanjuán et al., 2011; Aranda, 2013).

In 2011, we decided to undertake a radiocarbon dating programme of different megalithic burials and natural caves in southeastern Iberia to explore the continuity and reuse of these ritual spaces during the Bronze Age. Our main aim was to assess the scale and involvement attained by this phenomenon in a cultural context in which a new funerary ritual consisting of individual inhumations within settlement areas became widespread (Aranda, 2013, 2014). As a part of this programme, Grave 11 at El Barranquete necropolis was selected for dating, as there was material proof of its reuse during the Early Bronze Age. In fact, of the four burial layers identified during the excavation process, the first three fell within this period (Almagro Gorbea, 1973). Three bone samples from different individuals were dated; one from Layer II and two from Layer III. All the radiocarbon measurements fell within the Early Bronze Age (Beta-301933, 2190–1940 cal BC 2σ, Beta-301934, 1940–1760 cal BC 2σ, and Beta-301932, 1890–1690 cal BC 2σ), indicating that the permanence and continuity of collective funerary rituals was an outstanding feature (Aranda, 2013, 2014).

Nevertheless, it soon became clear that the number of existing measurements was inadequate for providing a detailed understanding of the chronology of El Barranquete, especially if we intended to use the Bayesian approach to the interpretation of chronological data. As a result, in 2013 an additional suite of samples was submitted for dating. In this case we planned to date all the minimum numbers of individuals (MNI) identified in Zita Laffranchi and Juan Sebastián Martín-Flórez's anthropological study. Information about sex, age and sidedness was used to avoid replicate individuals.[2] As a result, the Minimum Number of Individuals identified was twelve.[3] It should be noted that this figure estimates the minimum possible number of inhumations, but not the most

[2] The MNI was calculated for the whole assemblage taking into account the even number of bones of the same side of the body. Then sex and age were considered to establish the MNI of males, females and subadults. A complete study of the anthropological material from Burials 9, 10 and 11 not included in the report published in 1973 is now in progress, and full details will be provided elsewhere.

[3] If we take into account the date CSIC-201B, the MNI could reach at least 13 individuals.

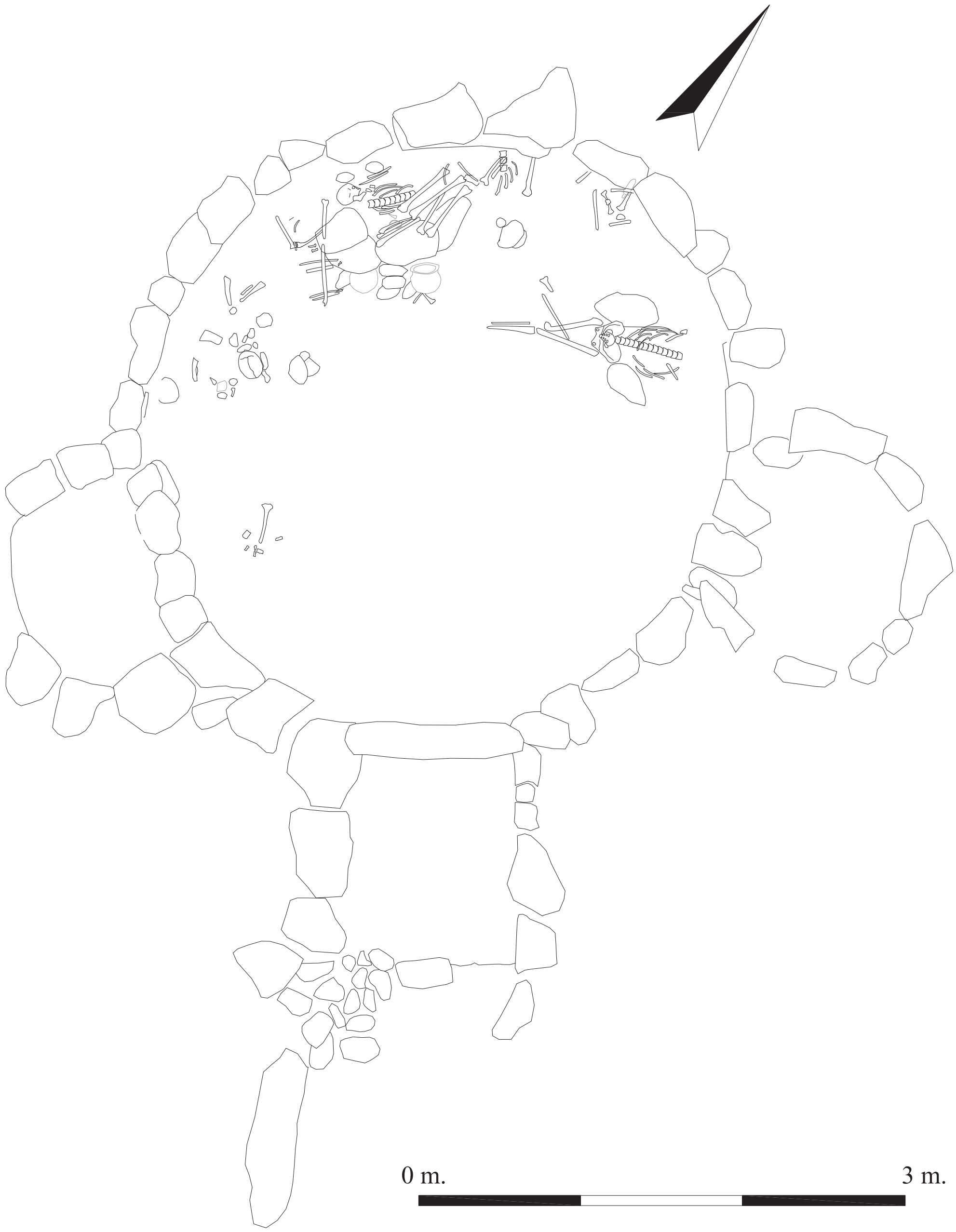

Fig. 4. Plan of the grave 11 including the anthropological remains of Layers I–III (after Almagro Gorbea, 1973).

likely. It is reasonable to expect a higher MNI if the incomplete preservation of the anthropological assemblage is considered. A similar situation can be found in the rest of the excavated burials. In fact, the anthropological study of the first eight tombs, which are also characterized by their incomplete preservation, shows that the MNI ranges from 6 to 23 individuals. Furthermore, Burials 6 and 8 offered a similar figure of 12 minimum number of individuals (Botella López, 1973).

The samples from Grave 11 were carefully selected to ensure that no individuals were dated twice. This pre-condition is very important as the algorithm used in the Bayesian analysis assumes that every date is statistically independent of the others (Bronk Ramsey, 2001). Following these criteria, 12 individuals were dated, including samples from adults, infants, males and females (see Table 1 for all the anthropological details). According to the stratigraphic sequence established by the excavators, eight samples came from Layer IV, two from Layer III and two from Layer II.[4]

One relevant concern, especially in cases like El Barranquete necropolis that are near the Mediterranean Sea, is determining the diet type of the people sampled for dating. If marine resources were a relevant weight in their diet, the radiocarbon measurements could be strongly influenced by the reservoir effect. The available data to assess this issue came from the nearby megalithic necropolis of Los Millares, also located near the sea. Stable isotope measurements ($\delta^{13}C$ and $\delta^{15}N$) of different individuals and graves indicate a diet based on plants and terrestrial animals, with very

[4] Unfortunately, no bone material belonging to Layer I has been identified among the anthropological collection currently deposited in the Museum of Almería. It is likely that there have been some losses in the 40 years since it was excavated.

Fig. 5. Plan of the grave 11 including the anthropological remains of Layer IV (after Almagro Gorbea, 1973).

little seafood input.[5] Although more analyses are needed, we can assume that the Chalcolithic populations buried in *tholoi* necropolises such as Los Millares or El Barranquete have not been significantly influenced by the reservoir effect, and therefore radiocarbon dates from human bone samples can be considered as accurate estimates.

With the exception of Sample CSIC-201B, all recent dates were measured using Accelerator Mass Spectrometry and dated by Beta Analytic Radiocarbon Dating[6] and the CNA (National Accelerator Centre) (Santos Arévalo et al., 2009) labs. All results were calibrated using the Oxcal (v.4.2) program (Bronk Ramsey, 1995, 2001, 2009), and the *IntCal13* calibration curve (Reimer et al. 2013). The dating results provide a coherent sequence of dates for the megalithic burial (Table 1). The Bayesian models were built using the OxCal program, which has been available since 1994 and has subsequently been developed (Bronk Ramsey, 2013).

3. Objectives

The methodological advances in radiocarbon measurements and their interpretation in the last few decades (Buck et al., 1991, 1999; Bronk Ramsey, 1994, 2013; Taylor, 1997; Bayliss, 2009; Bayliss and Whittle, 2007; Whittle et al., 2011) make it possible to achieve a much more precise dating of the megalithic phenomenon. These developments provide a great opportunity to

[5] Waterman, A.J. and Robert H. T (in preparation) "Evidence of dietary variability and breadth at Los Millares (Almeria, Spain) (c. 2500–1800 BC) based on stable isotope analysis of human remains".

[6] Procedure details are described in http://www.radiocarbon.com/.

Table 1
Radiocarbon dates from grave 11 at the necropolis of El Barranquete.

Laboratory code	Type of material and anthropological details	Layer	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence) Cal BC	First model		Second model	
						Posterior density estimate (68%) Cal BC	*Posterior density estimate (95%) Cal BC*	*Posterior density estimate (68%) Cal BC*	*Posterior density estimate (95%) Cal BC*
El Barranquete Tholos 11 dates included in models									
CNA-2405	Human right humerus from an adult female (21–40 years old)	IV	3925 ± 35	−20.19	2558–2295	*2383–2292*	*2469–2233*	*2384–2292*	*2468–2236*
CNA-2404	Human right radius from an adult female (21–40 years old)	IV	3865 ± 35	−20.10	2465–2209	*2367–2231*	*2431–2207*	*2368–2232*	*2432–2208*
CNA-2407	Human left radius from an adult male (21–40 years old)	IV	3860 ± 35	−19.72	2463–2208	*2355–2215*	*2432–2206*	*2357–2230*	*2433–2207*
CNA-2408	Human skull fragment from an infantile (7–12 years old)	IV	3860 ± 35	−20.22	2463–2208	*2354–2215*	*2431–2206*	*2357–2230*	*2433–2207*
CNA-2411	Human skull fragment from an adult male (+30 years old)	IV	3830 ± 35	−19.02	2457–2150	*2332–2214*	*2429–2155*	*2234–2227*	*2429–2197*
CNA-2410	Human tibia from an adult male (21–40 years old)	IV	3785 ± 35	−25.30	2339–2051	*2291–2199*	*2336–2143*	*2292–2200*	*2336–2146*
CNA-2406	Human left humerus from an adult male (21–40 years old)	IV	3730 ± 35	−18.82	2276–2028	*2286–2164*	*2297–2115*	*2286–2169*	*2295–2196*
CNA-2409	Human skull fragment from an adult male (30–35 years old)	III	3625 ± 40	−23.11	2132–1889	*2015–1931*	*2050–1887*	*2028–1936*	*2118–1886*
Beta-301933	Human skull fragment from an unsexed adult (41–60 years old)	III	3670 ± 40	−18.7	2195–1939	*2039–1944*	*2111–1911*	*2057–1951*	*2131–1926*
Beta-301934	Human right femur from a adult male (21–30 years old)	III	3530 ± 30	−18.3	1943–1763	*1947–1879*	*2016–1820*	*1917–1777*	*1943–1764*
Beta-301932	Human femur from an adult male (41–60 years old)	II	3470 ± 40	−18.4	1894–1687	*1786–1689*	*1863–1660*	*1878–1703*	*1895–1687*
CNA-2412	Human right ulna from an adult male (21–40 years)	II	3120 ± 35	−17.89	1492–1285	*1490–1324*	*1498–1303*	*1490–1326*	*1498–1303*
El Barranquete Tholos 11 date not included in models									
CSIC-201B	Human bone	–	2570 ± 100	–	898–412	Unmodelled			

create a refined chronological framework. Based on the new radiometric data and the stratigraphic interpretation provided by Almagro Gorbea (1973), alternative models for the chronology of Grave 11 can now be discussed. The new dating series and the Bayesian models were designed to address the following objectives:

To determine the chronology of the construction of this sepulchre and its abandonment as a burial site;

To estimate the absolute date and duration of the burial activity as a whole and the different inhumation layers identified;

To determine if there were gaps between the different inhumation levels and, if so, to estimate the length of these hiatus;

To investigate the relevance of the reuse burial practices during the Bronze Age and later periods;

To evaluate the Bayesian chronological models of Grave 11 in the context of the megalithic phenomenon in southern Iberia;

To place El Barranquete necropolis within its wider regional sequence.

4. Results and discussion

Thirteen radiocarbon measurements are now available from Grave 11, a situation that has never before been achieved for Iberian megalithic phenomenon. Among the few graves with radiocarbon dates, the number of measurements fluctuates between one date, the most common situation, and four, which is only reached at a few sites (Boaventura, 2009; García Sanjuán, 2011; Balsera et al., forthcoming). Most of these radiocarbon measurements only confirm the Neolithic/Chalcolithic chronology of this cultural phenomenon. Therefore, megalithic chronology in Iberia is based on too few dates from too few burials.

This current chronometric scenario of the megalithic phenomenon in southern Iberia imposes major limitations on chronological studies. Visual inspection of the probability distribution of series of calibrated radiocarbon dates is the normal method used to build chronological models. The most advanced approaches attempt to take into account the statistical scatter on the radiocarbon measurements, reducing the probabilistic distribution to a period where most of the dates are concentrated. Nevertheless, this type of approach produces imprecise chronologies and broad discussions that divide every millennium into no less than three or four intervals[7] (Bayliss et al., 2007; Whittle and Bayliss, 2007). Bayesian analysis has emerged as an alternative to build more accurate chronological estimates. This methodology combines evidence of absolute chronology, for instance radiocarbon dating, with other forms of chronological information, such as the stratigraphic relationships between the archaeological contexts that contain the dated samples.[8] In accordance with these prior beliefs, this technique calculates a shorter probability distribution for every radiocarbon measurement and estimates the dates for the beginning and end of the phases or events in which the dates are clustered.[9] Furthermore, by comparing these probability distributions, it is also possible to measure in numbers of years the length of each phase or the hiatus between periods of social activity (Bronk Ramsey, 1995; Bayliss et al., 2007).

The Bayesian approach is causing a profound change in our perception of temporality in prehistoric societies. Where the number and diversity of samples that can potentially be dated is sufficient and the stratigraphic or sequential information is also accurate, the chronological models have demonstrated a

[7] Radiocarbon measurements frequently provide ranges spanning 250 years or more.

[8] *Informative prior beliefs* in the Bayesian terminology.

[9] *Posterior density estimate* in the Bayesian chronology.

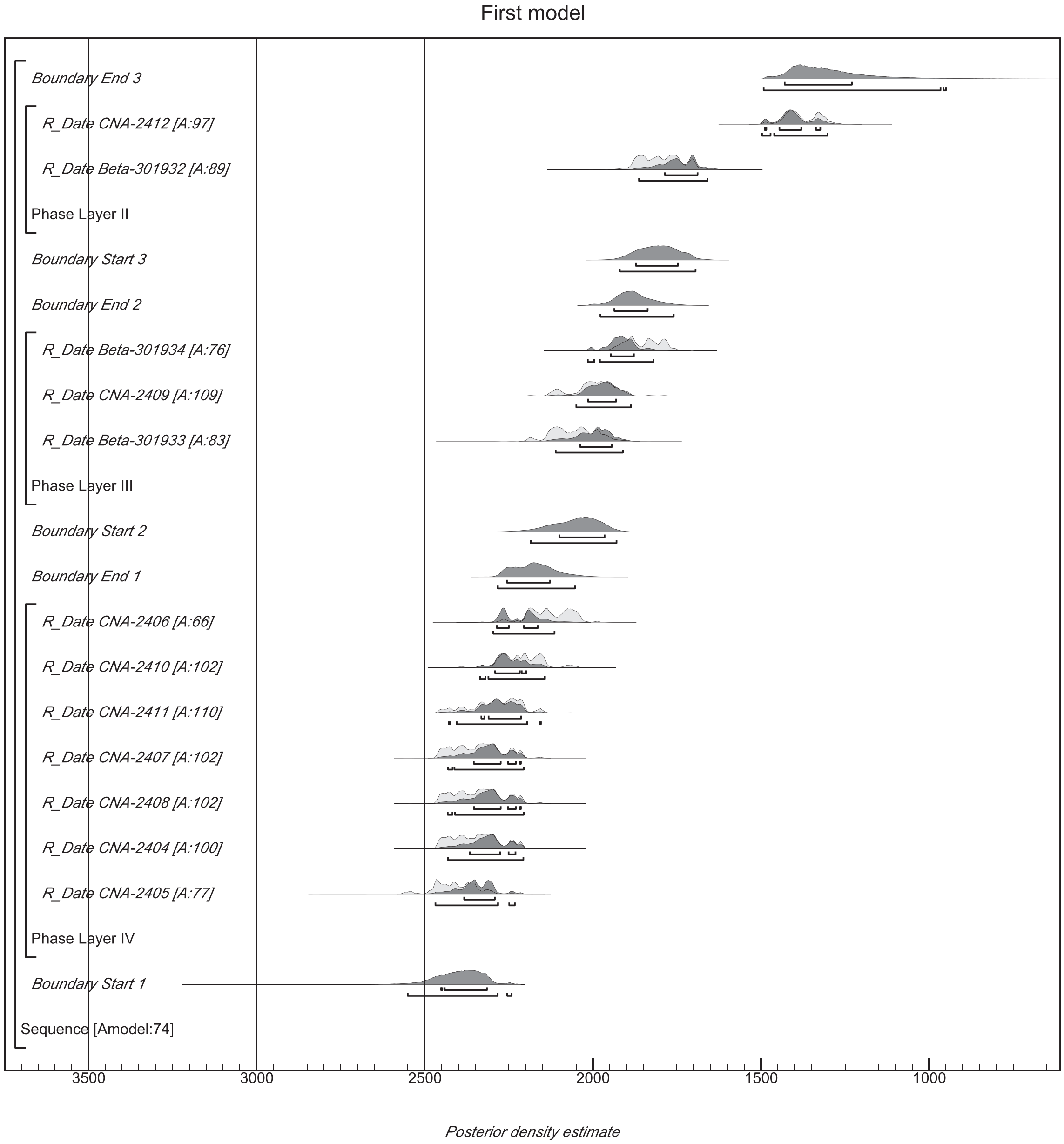

Fig. 6. Probability distributions of dates from grave 11. Each date shows two distributions: one in light grey represents the radiocarbon calibration and another in dark grey indicates the result of the bayesian model (*posterior density estimates*). Distributions other than those relating to particular dates correspond to aspects of the model. The square brackets down the left-hand side and the OxCal keywords define the overall model exactly.

misleading impression of longevity in some cultural phenomena and the possibility of reducing the broad spans of prehistoric chronology to the scale of an individual lifetime (Whittle and Bayliss, 2007; Whittle et al., 2008, 2011; Scarre, 2010). As has recently been stated, "It is now possible to think in terms of lifetimes, lifespan and generations" (Whittle and Bayliss, 2007: 23).

In the case study analysed in this paper, the conditions are far from ideal, with several existing limitations that affect the degree of

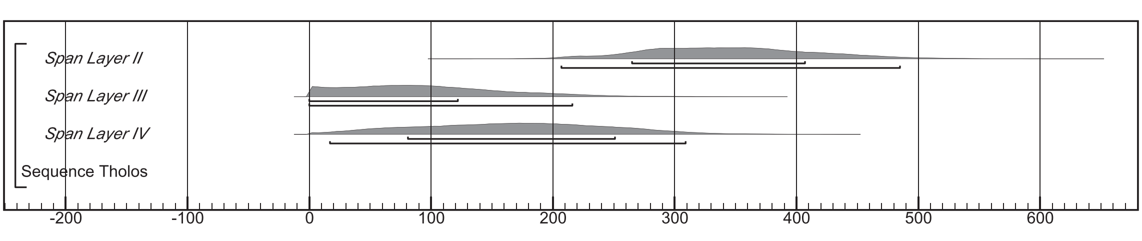

Fig. 7. Probability distributions of the number of years for every phase of burial activity, derived from the model shown in Fig. 5.

resolution that can be achieved for the model. The only material available for dating is the anthropological remains; these have a low Minimum Number of Individuals and an uneven distribution between the different phases identified through the inhumation sequence of the burial. Furthermore, the archaeological information does not allow the stratifying of mortuary depositions within each phase. The limited number of suitable samples and the particular stratigraphic relationships reduce the options for providing robust answers to some of the objectives of this study. Despite these limitations, Bayesian analysis certainly remains the best option for building a detailed and more secure chronology and for improving the chronological assessments that do not take into account the statistical dispersion of the radiocarbon dating probability intervals.

Therefore, the main relative chronological information used to construct the Bayesian model is the four stratified layers identified in the burial sequence. This arrangement of the bone remains has not taken into account the complex taphonomy that normally operates in such contexts. Horizontal and vertical displacements, both of individual and grouped bones, are common as a result of different factors such as gravity, successive interments, voids created by the decomposition of soft tissue, or the collapse of the burial chamber vaults. The Bayesian modelling incorporates a statistic known as the index of agreement, which calculates the reliability of the model and provides useful information to identify samples whose archaeological taphonomy has not been properly characterized. This index estimates a figure of how well any posterior probability distribution agrees with the relative sequence information (Bronk Ramsey, 1995: 427–8). If the index of agreement falls below 60%, the radiocarbon measurement should be considered somewhat problematic.

Out of the twelve radiocarbon dates, only one (CNA-2409) presents a poor agreement index $A = 47.1\%$ ($\acute{A}c = 60\%$). This sample appears to be affected by taphonomic processes that would imply a vertical movement. Although according to the excavators the sample belongs to the fourth layer, we have assumed it is part of the interments above. Furthermore, the posterior density estimates are not substantially modified if the CNA-2409 date is included as part of the fourth or the third level of inhumations.

Taking into account the available archaeological information and its restrictions, we built two chronological models that incorporate two assumptions: a) that within each phase, samples correspond to a continuous activity in which the internal order is unknown and b) that all the individuals died after the *tholos* had

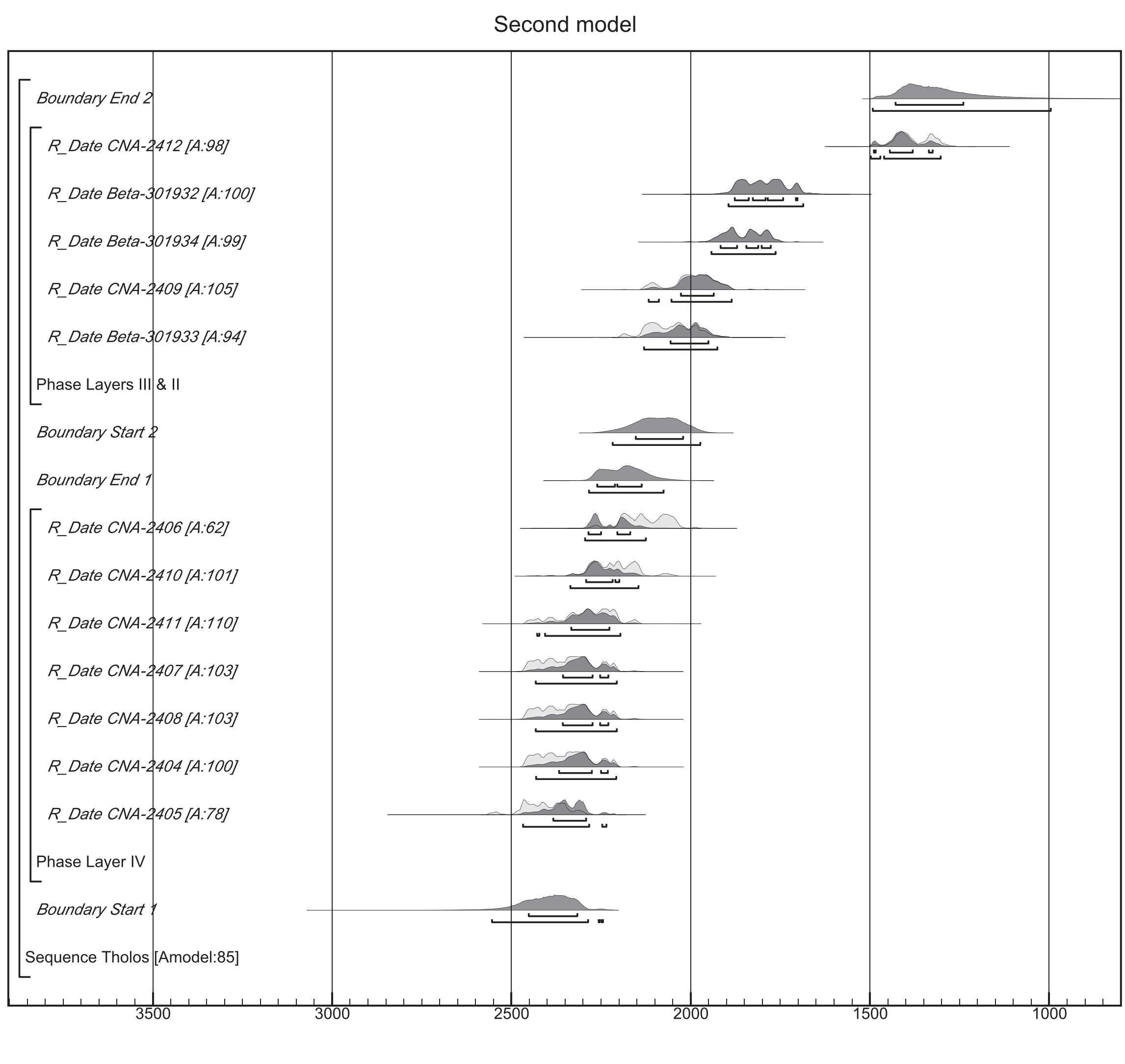

Fig. 8. Probability distributions of dates from burial 11, incorporating the interpretation of the second model. The format is identical to that in Fig. 5.

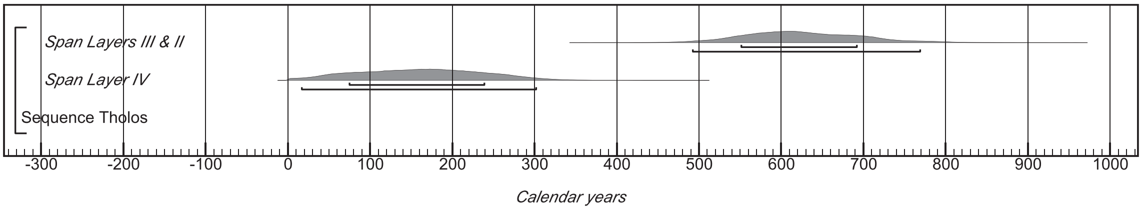

Fig. 9. Probability distributions of the number of years for every phase of burial activity, derived from the model shown in Fig. 7.

been built (see below for further discussion). According to the stratigraphic and sequential information, the first model includes seven dates in Layer IV, three in Layer III and just two in Layer II (Fig. 6 and Table 1). This model displays good overall agreement ($A_{overall}$ = 74.2%), which indicates that the radiocarbon dates conform to the archaeological information incorporated in the Bayesian analysis. If we accept that the earlier interments were made just after the construction of the *tholoi* had been completed, it

Table 2
Radiocarbon dates from the *tholoi*-type graves of southern Iberia.

Site	Province/Region	Laboratory code	Type of material	Context	Radiocarbon age (BP)	Calibrated date range (68% confidence) Cal BC	Calibrated date range (95% confidence) Cal BC	Bibliography
Cabeço da Arruda 2	Lisboa (Portugal)	Sac-1613	Human left femur	–	4700 ± 80	3629–3373	3652–3196	Silva, 2012
Huerta Montero	Badajoz (Spain)	GrN-17628	Human bone	First deposit at the chamber	4650 ± 250	3656–3026	3981–2697	Blasco and Ortiz, 1991
Castro Marim	Algarve (Portugal)	OxA-5441	Human tibia	–	4525 ± 60	3356–3106	3491–3024	Gomes et al., 1994
Cabeço da Arruda 2	Lisboa (Portugal)	Sac-1784	Human left femur	–	4460 ± 45	3328–3028	3347–2942	Boaventura, 2009
Praia das Maçãs	Lisboa (Portugal)	OxA-5509	Bone	Occidental chamber	4410 ± 75	3312–2917	3339–2903	Cardoso and Soares, 1995
Praia das Maçãs	Lisboa (Portugal)	OxA-5510	Bone	Occidental chamber	4395 ± 60	3097–2916	3331–2899	Cardoso and Soares, 1995
Los Millares	Almería (Spain)	KN-72	Wood charcoal of mixed composition	Grave XIX	4380 ± 120	3325–2894	3485–2678	Schwabedissen and Freundlich, 1966
El Barranquete	Almería (Spain)	CSIC-82	Charcoal	Grave 7. Wooden post	4300 ± 130	3263–2677	3341–2581	Almagro Gorbea, 1973
Olival da Pega 2b	Alentejo (Portugal)	ICEN-955	Human bone	Phase 1 Deposit level 5/7	4290 ± 100	3090–2699	3330–2586	Soares, 1999; Gonçalves, 2006
El Barranquete	Almería (Spain)	CSIC-81	Charcoal	Grave 7. Wooden post	4280 ± 130	3092–2670	3339–2505	Almagro Gorbea, 1973
Praia das Maçãs	Lisboa (Portugal)	H-2049/1467	Charcoals	Occidental chamber	4260 ± 60	3000–2701	3077–2638	Soares and Cabral, 1984
Paimogo 1	Lisboa (Portugal)	Sac-1556	Human left femur	–	4250 ± 90	3009–2671	3261–2574	Boaventura, 2009
Cabeço da Arruda 2	Lisboa (Portugal)	UBAR-538	Human left femur	–	4230 ± 100	2923–2632	3096–2495	Silva, 2012
Huerta Montero	Badajoz (Spain)	GrN-16955	Human bone	Second deposit or reuse at the chamber	4220 ± 100	2916–2632	3090–2495	Blasco and Ortiz, 1991
Olival da Pega 2b	Alentejo (Portugal)	ICEN-956	Burnt bones and charcoals	Phase 1 Deposit level 7/7	4180 ± 80	2887–2666	2920–2497	Soares, 1999; Gonçalves, 2006
La Pijotilla	Badajoz (Spain)	CNA-034	Charcoal	Grave 3. UE 18 (lower level)	4168 ± 55	2877–2677	2891–2583	Odriozola Lloret et al., 2008
La Loma del llano del Jautón	Almería (Spain)	¿	Human bone	Chamber	4160 ± 60	2876–2668	2889–2581	Maicas Ramos, 2007
Paimogo 1	Lisboa (Portugal)	UBAR-539	Human left femur	–	4130 ± 90	2871–2584	2896–2486	Silva, 2012
Olival da Pega 2b	Alentejo (Portugal)	ICEN-957	Burnt bones and charcoals	Phase 1 Deposit level 5/7	4130 ± 60	2866–2620	2884–2501	Soares, 1999; Gonçalves, 2006
La Pijotilla	Badajoz (Spain)	Beta-121143	Charcoal	Grave 3. UE 15 (intermediate level)	4130 ± 40	2862–2625	2872–2581	Hurtado Pérez et al., 2002
Agualva	Lisboa (Portugal)	Beta-239754	Human left femur	–	4110 ± 40	2855–2582	2871–2505	Boaventura, 2009
Paimogo 1	Lisboa (Portugal)	Sac-1782	Human left femur	–	4100 ± 60	2859–2574	2876–2491	Silva, 2012
Tintuaria	Lisboa (Portugal)	OxA-5446	Human bones (?)	–	3995 ± 65	2624–2369	2851–2297	Cardoso et al., 1996
Samarra	Lisboa (Portugal)	Sac-1827	Human bone	–	3820 ± 60	2401–2146	2466–2060	Silva et al., 2006.
Huerta Montero	Badajoz (Spain)	GrN-16954	Human bone	Second deposit or reuse at the chamber	3720 ± 100	2284–1974	2458–1889	Blasco and Ortiz, 1991
Praia das Maçãs	Lisboa (Portugal)	H-2048/1458	Charcoals	Chamber	3650 ± 60	2133–1942	2201–1884	Soares and Cabral, 1984
La Encantada I	Almería (Spain)	CSIC-249	Human bone	Chamber	2830 ± 60	1074–906	1192–837	Alonso Mathias et al., 1978
Tholos de Palacio III	Sevilla (Spain)	Beta-165552	Charcoal	Structure 3 (cremation)	2660 ± 90	971–766	1043–540	García Sanjuán, 2005a

is possible to conclude that the tomb was finished almost at the same time as the first bodies were deposited in *2551–2242* cal BC (*95% probability; Boundary_Start 1*), probably in the second half of the twenty-fifth or during the twenty-fourth century (*2452–2316* BC: *68% probability*; *Boundary_Start 1*). The end of this Phase IV, which could be considered the proper Chalcolithic period of this monument, occurred in *2283–2054* cal BC (*95% probability*; *Boundary_End 1*), probably in the second half of the twenty-third or first half of the twenty-second century (*2256–2128* BC: *68% probability*; *Boundary_End 1*). This probability distribution is fully consistent with the date *c.* 2200 cal BC, which is traditionally considered as a benchmark for the end of the Copper Age and the beginning of the Early Bronze Age (known as the Argaric Culture in south-eastern Iberia) (Aranda Jiménez et al., forthcoming). The differences between these two distributions suggest that the mortuary deposition continued for between 81 and 249 years (*68% probability*; *Span_Layer IV*) (Fig. 7). The dates included in this phase have not provided statistically consistent measurements ($T' = 19.4$; T' (5%) = 12.6) (Ward and Wilson, 1978), which also means that people must have died and been deposited in the burial chamber over a period of time.

The burial activity in the second phase (Layer III) began in *2185–1930* cal BC (*95% probability*; *Boundary_Start 2*), probably in the twenty-first or the first half of the twentieth century (*2100–1966* cal BC: *68% probability*; *Boundary_Start 2*). It appears that there was no hiatus between the two phases, or if there were, it was very short. The radiocarbon measurements for the most recent date from Layer IV (CNA-2406) and the earliest date from Layer III (Beta-301933) are statistically consistent ($T' = 1.3$; T' (5%) = 3.8), suggesting that these people died over a relatively short period of time. Although with less intensity, the continuity in the use of the grave appears to be an outstanding feature. The end of this phase occurred in *1978–1760* cal BC (*95% probability*; *Boundary_End 2*), probably between the last decades of the twentieth century and the first half of the nineteenth century (*1937–1838* cal BC: *68% probability*; *Boundary_End 2*). At the same time as this phase ended, major changes in rituals were taking place in the Argaric societies. The funerary rights were extended to other groups of people, especially children, and a new set of grave goods, including swords, axes and diadems, appeared for the first time (Lull et al., 2011). As with Layer IV, in this phase the radiocarbon measurements do not form a statistically consistent group ($T' = 8.8$; T' (5%) = 6.0). Again the funerary deposits were probably made over a relatively long period lasting approximately 217 years (*95% probability*, *Span_Layer IV*).

The limited number of measurements available for the third phase (Layer II) has resulted in imprecise probability estimates. The beginning of this phase occurred in *1921–1695* cal BC (*95% probability*; *Boundary_Start 3*), probably between the nineteenth century and the first half of the eighteenth century *(1873–1747* cal BC: *95% probability*; *Boundary_Start 3*). The last interments in the burial chamber took place in *1493–951* cal BC (*95% probability*; *Boundary_End 3*), probably between *1430* and *1230* cal BC (*68% probability*; *Boundary_End 3*). It should be noted that the CSIC-201B date has not been modelled, as the context and stratigraphic position of the sample are unknown. If the results of this date were taken into account, the period of use would extend into the first millennium cal BC.

A second model was built combining Layers III and II in a single phase. According to the excavators, these layers can be clustered because they contain grave goods that place them typologically in the Early Bronze Age (Fig. 8). The model that only includes two phases (Layer IV and Layers III–II) also has a good overall agreement ($A_{\text{overall}} = 83.9\%$), indicating that the radiocarbon dates do not disagree with the prior information. The posterior density estimates for the dates provided by this second model are very similar to those given by the first model (Table 1). The main change can be found at the beginning of the second phase (Layers III–II), which occurred in *2218–1974* cal BC (*95% probability*; *Boundary_Start 2*), probably between the second half of the twenty-second and the first half of the twenty-first century (*2154–2022* cal BC: *68% probability*; *Boundary_Start 2*). According to this model, the interments in this phase would have started a little earlier than in the previous model. These probability estimates are even closer to the date *c.* 2200 cal BC, which is conventionally acknowledged as the beginning of the Early Bronze Age.

This second phase (Layer III–II) spans a period of between *493* and *769 years* (*95% probability, Span_Layer III–II*) or more likely between *552* and *629 years* (*68% probability*, *Span_Layer III–II*) (Fig. 9). These figures indicate that the mortuary chamber was in use for a very long time, almost the entire Bronze Age. This scenario contrasts strongly with the shorter period in which the Chalcolithic phase of the tomb (Layer IV) was in use: between *17* and *302* years (*95% probability, Span_Layer IV*) and more likely between 75 and 239 years (*68% probability, Span_Layer IV*). If we assume a figure of 25 years for each generation, just a few generations – between three and nine – were buried in this *tholos* during the Copper Age. Both models display good overall agreement and posterior density estimates are very similar, with only slight differences. Now we move on to discuss all these results in a more general cultural context.

5. Conclusions

Using the dating results presented above, we can now note a number of broad suggestions as to how Grave 11 and the necropolis of El Barranquete fit into the local and regional sequence. To date it has not been possible to determine the timescale and funerary span of any megalithic monument, due to the lack of complete dating programmes for single graves. Despite the sample restrictions previously noted, we now have a much more precise chronology, which raises fresh questions and shakes traditional assumptions.

The Bayesian models underline how late the construction and use of Grave 11 is. If we assume that interments began in the burial chamber just after its construction, this grave would have been built in the second half of the twenty-fifth or the first half of the twenty-fourth century cal BC (*2452–2316* BC, *68% probability*). As a far as we know, it is one of the latest megalithic monuments to be constructed in southern Iberia. By the time the first bodies were deposited at this burial site, other *tholoi* would have already been older and they may even no longer have been used for ritual activity (Table 2).

The beginning of the construction and use of this *tholoi*-type tomb has been traditionally dated to the last centuries of the fourth millennium, as a part of the second megalithic tradition (García Sanjuán, 2011). The oldest radiocarbon dates currently known in southern Iberia correspond to different Portuguese *tholoi*, such as Praia Das Maças (OxA-5509, 3312–2917 cal BC 2σ), Paimogo 1 (Sac-1556, 3261–3098 cal BC 2σ), Cabeço da Arruda 2 (Sac-1613, 3652–3196 cal BC 2σ) and Castro Marim (OxA-5441, 3490–3020 cal BC 2σ). From the end of the fourth millennium and mainly during the first centuries of the third millennium, this new type of megalithic tomb became widespread throughout southern Iberia. In this context, the notion that the *tholoi* monuments remained in use over a span of centuries containing long sequences of mortuary depositions became widely accepted.

Nevertheless, the late construction of Grave 11 challenges these assumptions. In Fig. 10 we have joined the Bayesian model with the dates of the southern Iberian *tholoi* graves, which produces a

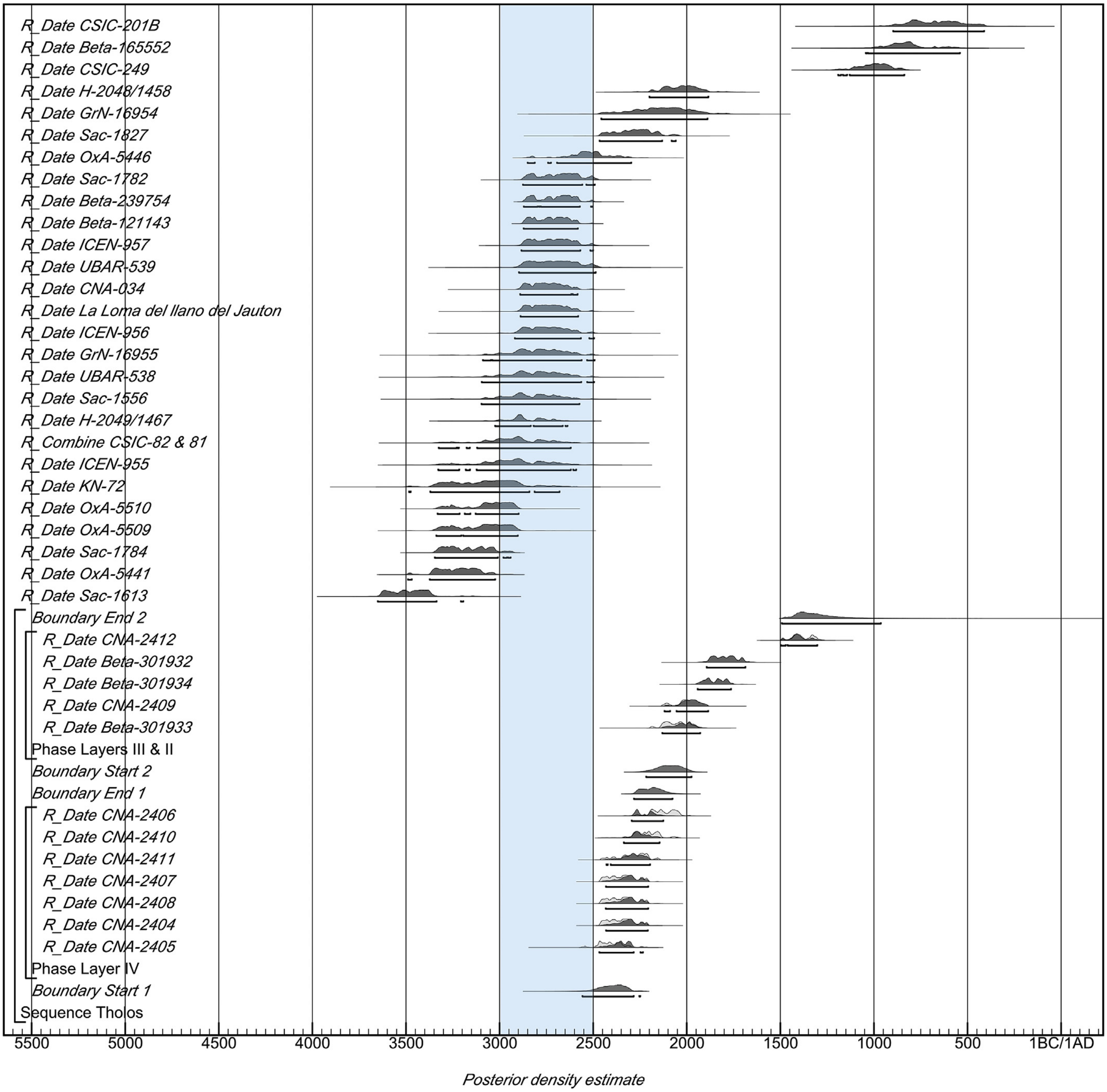

Fig. 10. Relationship between the Bayesian model of grave 11 shown at the bottom and all the *tholoi* radiocarbon dates available for the south of Iberia.

temporal gap of no less than five centuries between Grave 11 and most of the dates. For a more local perspective, the El Barranquete radiocarbon dates also indicate how the burials of a single necropolis could have been temporarily sequenced. As we have already noted above, Tomb 7 has provided two dates from the wooden post that supported the roof (CSIC-81 4280 ± 130, 3339–2505 cal BC 2σ and CSIC-82 4300 ± 130, 3350–2550 cal BC 2σ). The combination of these dates (*R_combine* 4290 ± 92, 3327–2621 cal BC 2σ, 3087–2702 cal BC 1σ) confirms that its construction and use probably began at the very end of fourth millennium or during the first centuries of the third millennium. This indicates that Grave 7 was finished between seven and three centuries before the first inhumations were deposited in Grave 11 (*338–683 year at 68% or 190–905 at 95%, Difference construction Barranquete 11 and 7*).[10]

The late construction of Grave 11 also challenges the idea of long sequences of inhumations that would roughly occupy the whole Chalcolithic period or at least most of it. During this phase (Layer IV), the ritual use of the funerary chambers was intense but short, between *75* and *239* years (*68% probability*), which would mean between three and nine generations of successive mortuary depositions. All these temporal differences in the construction and

[10] The large standard deviations of dates from Grave 7 make it impossible to provide a more accurate probability.

use of the megalithic monuments indicate the weaknesses of those social interpretations that consider this phenomenon as temporarily unitary (Afonso Marrero et al., 2011). The internal chronology and especially the diachrony of megalithic necropolises such as El Barranquete or Los Millares emerge as crucial factor for a better understanding of these social practices.

A final implication of the late construction of Grave 11 is related to the possibility that ancestral remains were deposited within the burial chamber. Because the skeletons appear in varying states of articulation and completeness, this option remains open. Nevertheless, the presence of bones significantly older than those found in Grave 11 places the construction date of the *tholos* in the Early Bronze Age, which, according to our current knowledge, appears to be quite unlikely. In fact, the short period of time that the first phase of the mortuary structure was in use does not leave room for assuming that ancestral remains were placed in a tomb built during the Chalcolithic period.

One of the most outstanding features of Grave 11 is its "reuse" after the Chalcolithic phase (Layers III and II). According to the Bayesian models, the beginning of these ritual practices occurred in *2218–1974* cal BC at *95% probability or in 2154–2022* cal BC *at 68% probability*, which agrees with the beginning of the Early Bronze Age. Statistically, there are no chronological differences with the Chalcolithic interments, suggesting that there was continuity in the use of this ritual space without any major hiatus. This is quite a remarkable phenomenon and the lack of any temporal break has led us to wonder if the traditional concept of reuse is appropriate for this type of ritual behaviour. Is it possible that before *c.* 2200 cal BC we are dealing with a "use phase" and after that date with a "reuse phase"? The radiocarbon dates from Grave 11 challenge this notion, showing continuous mortuary depositions during the second half of the third millennium and the first centuries of the second millennium cal BC. The benchmark of *c.* 2200 cal BC seems to work for other cultural manifestations, but not for this type of funerary ritual. The phenomena of continuity and discontinuity shows a complex scenario of cultural manifestations and the inadequacy of traditional Copper and Bronze Age divisions.

Although the mortuary depositions related to this phase of use span a very long period (*552–629 years at 68% probability*), their frequency remains a significant feature. If the Minimum Number of Individuals is considered as representative of the temporal distribution of inhumations, *c.* 40% of the individuals buried in Grave 11 would correspond to the Bronze Age. This figure is consistent with the situation in south-eastern Iberia. Among the total of 18 known *tholoi* grave dates, seven (*c.* 38%) belong to more recent cultural periods than those considered in terms of construction and use.

Because of the low number of dates, these figures could not be assumed to be indicative of the relative weight of the "reuse" practices for a wide regional perspective. Nevertheless, the evidence of this phenomenon is growing quickly for the study area (Lorrio and Montero, 2004; García Sanjuán, 2005b, 2011; Mataloto, 2007; Aranda et al. 2013). In this respect, it is especially noticeable that the frequent occurrence of radiocarbon dates for human bones that fall into cultural periods would be unthinkable if only the typology of their grave goods were analysed (Aranda, 2013, 2014). This is also the case of Grave 11, where there is no archaeological evidence that would lead one to suspect the presence of interments from the times shown by the dates CNA-2412 (3120 ± 35, 1492–1285 cal BC 2σ) and CSIC-201B (2570 ± 100, 898–412 cal BC 2σ). It is true that there are not many dates, although those we have allow us to glimpse a panorama involving the continuity of certain ritual spaces on a scale and intensity that, according to our current state of knowledge, is hard to imagine.

The dating project presented in this paper, which is based on a single grave instead of several dates from different burials, emerges as a powerful tool that contributes to changing many of our current approaches to the megalithic phenomenon. Grave 11 displays a short but intense ritual use during the Copper Age, followed by a much longer period with the interments taking place over many generations. Despite the previously noted limitations of the radiocarbon dating, the results of the Bayesian models allow the construction of much more precise chronologies that challenge different traditional assumptions and open the way for unexpected research inquiries. New dating programmes are a critical necessity if we really want to base our assessments on robust chronological foundations and if our goal is to discuss the agency of particular people within a human lifespan.

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