Towards the periodization of the uses of Can Sadurní Cave (Begues, Catalonia) during the Middle Neolithic I. The contribution of Bayesian modelling to radiocarbon dating sequences

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Abstract. Excavations at Can Sadurní Cave since 2012 have uncovered a complex stratigraphy for the Middle Neolithic phase (ca. 4700-4000 cal. BC). This was not in agreement with our expectations from the previous excavation of a trial trench, where only 4 layers (10, 10b, 11 and 11b) were uncovered. After excavating a funerary layer with several in situ burials and further deposits containing multiple layers of burnt dung (fumier), the stratigraphy was revised and 5 episodes within layer 11 were detected. It became necessary to find a tool to refine the chronological sequence of these uses, under the premise that it is unlikely that the cave was used as a funerary area and a byre at the same time. Bayesian modelling allowed distinguishing these two phases, establishing an earlier use of the cave for animal herding purposes (ca. 4700-4450 cal. BC) and a funerary use of the cave in a more recent period (ca. 4400-4200 cal. BC).

1 Introduction

The beginning of the Middle Neolithic in the north-east of the Iberian Peninsula is not yet fully defined from an economic and social point of view, and thus also not chronologically demarcated. It is also not the purpose of this paper to achieve this aim, but the deposits that are presented in it comprise this period of time, roughly corresponding to the second half of the 5th millennium cal. BC. This phase had traditionally been connected to the Early Neolithic Epicardial traditions, and therefore its labelling as Postcardial Late Early Neolithic (or "Neolític Antic Evolucionat Postcardial") [Mes81]. This was the solution found to name the period between the early Neolithic and what had traditionally been known as the Middle Neolithic, the "Sepulcros de Fosa" (pit burials) Culture (ca. 4000-3500 cal. BC). Nevertheless, significant changes have been observed to take place in the second half of the 5th millennium cal. BC. Regarding technological traditions, this period is characterised by new pottery styles, including the Molinot style, more typical for the territory south and west of the Llobregat River, and the Montboló style (with clear connections with southern France) in the area to the north and east of this river [Bla05]. The typical Middle Neolithic pottery associated to the Sepulcros de Fosa Culture is actually an evolution of the Montboló pottery tradition with some influences from the French Chasséen Pottery [Edo11]. On an economic level, evidence for new agricultural practices (based on naked wheat and naked barley agriculture, regarding cereals), which continue during the 4th millennium cal. BC were also detected in this transitional phase [Ant15]. The adoption of new crops could also be due to new networks developing and new contacts with populations in the north of this region. In fact, the development of wider exchange networks during this period is one of its most significant characteristics [Edo12], which will be extremely developed in subsequent centuries.

The cave of Can Sadurní offers an interesting insight into this problematic, since multiple Neolithic occupation phases starting with the Cardial Early Neolithic (ca. 5350-5200 cal. BC) have been identified at the site [Edo11] [Edo17a].

Therefore, understanding the chronological sequencing of the processes taking place in the cave might be of significance at a larger scale. Regarding the main occupation and abandonment phases taking place during the Middle Neolithic at Can Sadurní cave one can highlight an initial use of the cave for stabling animals (mainly sheep and goats, but also pigs and cattle) [Sañ15]. This phase would be followed by a phase of funerary use of the cave [Edo17a] [Edo17b] (although other uses of the site during these funerary episodes cannot be excluded) and finally a second occupation phase, contemporary with three silo pits found outside of the cave [Edo11] was identified. After this phase, the cave was abandoned until the Late Neolithic period [Edo16], possibly because of the migration of the population towards the current coastal area of Gavà (8 km away), where a major mining complex ("Can Tintorer") developed during this period [Vil86]. This paper attempts to use Bayesian modelling of radiocarbon dates in order to test if the different uses detected in Can Sadurní Cave during the Middle Neolithic I were developed in different chronological phases and how long they could have lasted.

2 Can Sadurní Cave and its Middle Neolithic phases

Can Sadurní Cave is located in the Garraf Mountains (Fig. 1), in the central Catalan coast, on a slope and oriented towards SE, at a height of 425 m asl. Around 50 m^2 of surface are currently being excavated in extension following a grid of squares of 1 m of side (defined by a letter and a number, see fig.1; we will refer in this paper to "lines" meaning all squares found in a given line of numbers or letters) and artificial spits of 20 cm depth, always having natural and anthropogenic layers as a basic unit of analysis. These layers are considered to define the different occupation phases at the site. In addition to the cave site, ca. 200 m^2 in front of the cave were also available in the external terrace.

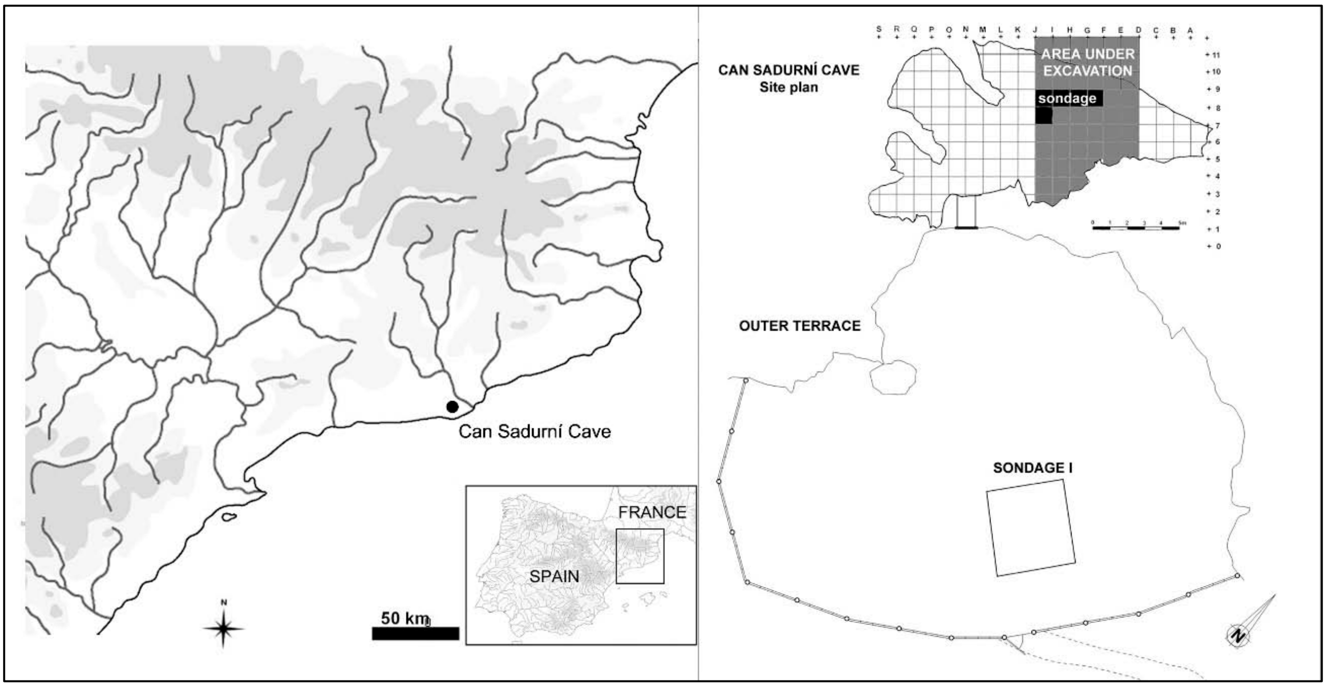

Figure 1 - Location of the site and site plan.

Archaeological research took place in several phases between 1978-1983, 1993-2007 and from 2009 to the present. Up to 33 archaeological (occasionally also natural) layers have been identified in the cave deposits so far, starting in the Epipaleolithic period (10840-10290 cal. BC) [Edo11] and ending in the Roman times. As mentioned above, the stratigraphy for the Neolithic period is particularly noteworthy, with early Cardial Neolithic deposits (layers 18 and 17), Epicardial layers (layers 15 to 13), Postcardial layers (layers 12 to 11b), Middle Neolithic layers (layers 11 to 9k1) and a Late Neolithic funerary episode (layers 9b and 9). The only large period that is not represented in the cave for the Neolithic is roughly the 4^{th} millennium cal. BC, as already mentioned above. We will from now on use the term Middle Neolithic for all layers between layer 12 and 9k1, in order to avoid the distinction between Postcardial and Middle Neolithic, which is primarily based on the presence of variscite, and therefore the evidence of the start of mining activities in Can Tintorer site [Edo12].

Figure 2 - Stratigraphy of the cave (NE profile, line D), starting in layer ("capa") 11a5 © CIPAG.

During the first two periods of research at the site (until year 2007) the excavation focused on the area closer to the entrance of the cave (more or less from line 4 to line 9, but the complete stratigraphy was only excavated in the sondage, in line 8) it was considered that the Middle Neolithic at the cave consisted on three phases and up to 6 stratigraphic layers (*capa*), beginning from the bottom: 12, 11b, 11, 10b, 10 and 9k1 [Edo11]. Soil micromorphology supported this interpretation [Ber11]. Layer 12 was defined as a layer of fumier, of about 5 cm of thickness. Layer 11b (ca. 4700-4500 cal. BC), a layer with big rocks with fallen from the cave ceiling, and a sedimentary matrix consisting of clayey limes, showed a very steep decline starting from the entrance of the cave and increasing towards the cave wall. Layers 12 and 11B should define the transitional phase between the Postcardial Neolithic and the Middle Neolithic sequence at the cave (NP0). Layer 11 (ca. 4500-4300 cal. BC) was a thick deposit of up to 70 cm in some parts of the layer (mostly towards the northern cave wall, becoming much thinner towards the entrance of the cave). It consisted on clayey limes and cobbles with abundant ashy and charred elements. It seemed to correspond with a very wet climatic phase [Ber11, Ber17]. The ashy and charred elements were mostly connected to anthropogenic accumulations of residues of animal penning (multiple thin layers observed in the soil micromorphology analyses denote a repeated use of the cave for this purpose). None of these layers of *fumier* were observed during fieldwork at that time. According to bioarchaeological analyses, the use of the cave could have taken place all year round [Sañ15]. This layer would define the first phase of the Middle Neolithic sequence (NP1). Layer 10B was again the result of a rock fall from the cave ceiling (of around 20 cm of thickness) and layer 10 (ca. 4200-4000 cal. BC; of 25 cm of thickness) would again present more limes and clay, representing a second settlement phase, possibly of similar nature to that of layer 11. These layers, together with 9k1, another small layer of rock fall, would define the second phase (NP2).

After the new excavation campaigns since 2009 a more complex stratigraphy, particularly within layer 11 was detected (Fig. 2). This was particularly clear after an *in situ* funerary episode (with several individual burials) was detected half-way through this layer in the area closer to the cave wall (lines 9-11, see fig. 1), which forced a revision of previous work. Five short episodes were identified by revising the stratigraphy observed in the profiles [Edo17a]: 11a5 and 11a4 would be at the basis of layer 11, mainly corresponding to the use of the cave as a byre (phase NP1a); 11a3 is a presumably short-lasting multiple funerary episode [Edo17a, Edo17b, Cas17] (phase NP1b FASE 1); 11a2 is a thin layer of small-sized stones fallen on 11a3 and 11a1 a layer of sedimentation on top of 11a4 and 11a2 [Edo17a], also containing human bones, but mainly dispersed [Cas17]. Both would define a second phase of inhumations that were probably similar to episode 11a3 but less well preserved (phase NP1b FASE 2). Significantly, several *fumier* were found *in situ* (Fig. 3), presumably all of them belonging to episodes 11a5 and 11a4. A second hypothesis regarding the taphonomy of the layers was put forward. According to observations during fieldwork, it was considered that the burials of layer 11a3 were not placed right against the wall of the cave because that space was "empty" (due to erosion processes? Due to a particular dynamic of sedimentation that did not reach the cave wall?) and that subsequent layers deposited in this area close to the wall of the cave with a marked inclination, almost presenting a vertical stratigraphy (Fig. 4).

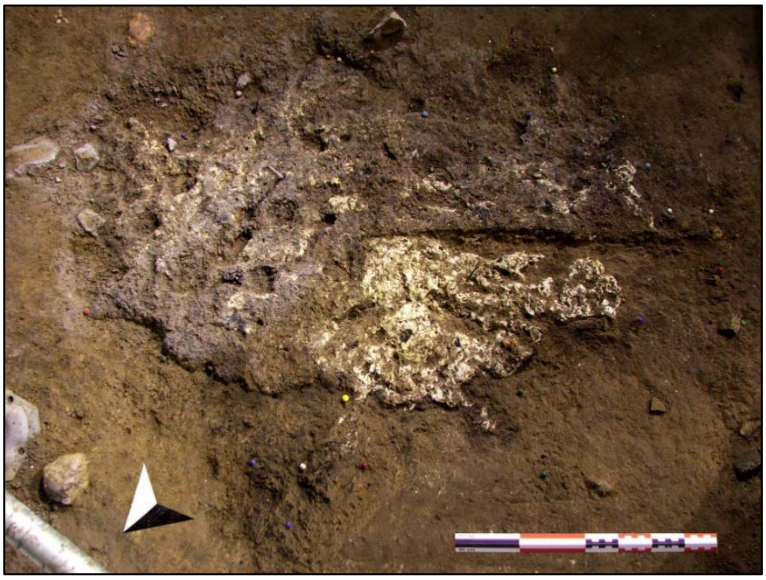

Figure 3 - Structure XIII. Multi-layered *fumier* © CIPAG.

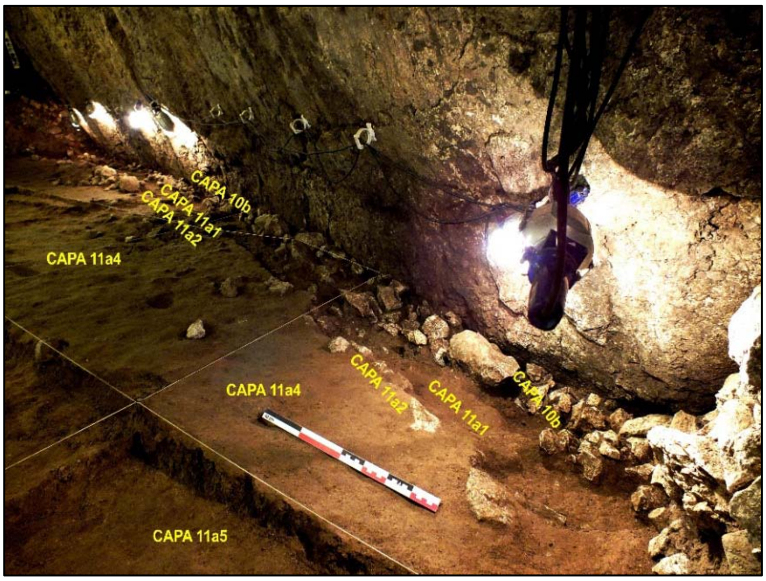

Figure 4 - Layer sequencing in the area close to the cave wall (north of the cave) as observed in during fieldwork © CIPAG.

The main aim of this paper is to prove that the sequence is consistent with the results of the radiocarbon dates and, therefore, that the different uses of the cave took place in different moments. As a secondary aim (given the limited sampling to answer this question), it is attempted to test by radiocarbon dating if there is an inclination of all layers above 11a3 in the area next to the cave wall (as indicated in fig. 4). Since the materials to be dated have been gradually obtained over decades of fieldwork, this is not a specific selection of remains dated to answer this particular question (although some new materials were dated for this paper and with the intention of improving the sampling of the sequence), but an arbitrary selection aimed at having materials dated from as many of the episodes as possible. Being aware of the limitations of the sampling strategy, we will use Bayesian modelling to refine the chronological span of each of the phases.

3 Materials and methods

A total number of 25 samples for the stratigraphic sequence corresponding to the Middle Neolithic at Can Sadurní Cave have been radiocarbon dated (Table 1). The majority of them were done during the last 10 years, but still 11 of these dates were measured with conventional methods, instead of by AMS, which means that usually large amounts of material were needed for the measurement (this is particularly relevant when aggregates of charcoal or seeds are measured in one sample). Different types of elements were dated: human bone (N: 6), animal bone (N: 4), charcoal or charcoal aggregates (N: 11) and seeds/fruits (N: 4). This means that not all samples chosen were short-lived material and that not all of them, particularly those which are not connected to any feature (see Table 1), have proven evidence to belong to the layer where they were found. It is important to keep in mind that dates obtained from charcoal might have an old-wood effect added to them [Sch87]. Besides, five of the dates obtained from charcoal (mostly measurements from the eighties and the nineties of the past century) presented very large standard deviations (above 100 years). Most dates come from the same area (squares F-G-H/9-10-11) but some come from the area close to the entrance of the cave, where the stratigraphic sequence was not equally clear (F-G/5-6-7). A total of 17 measurements were undertaken on materials recovered dispersed in an archaeological layer. Only 8 came from more or less clear contexts such as hearths or burials. One of the materials dated (Lab. Ref.: Beta-332263) was found to be too poor in collagen, so eventually 24 radiocarbon dates were used for further analyses.

We need to take several aspects into account. The dated materials do not cover equally well the totality of episodes documented in the Middle Neolithic in the cave. There is only one date for layer 10, one for layer 10b, 2-4 for episode 11a1 (2 dates were originally linked to layer 10b but it was later considered that they actually belonged to the layer below it. Two for episode 11a2, 4 for 11a3, 2 for 11a4, 2 for 11a5, 4 for layer 11b and 1 for layer 12. We cannot exclude processes of percolation for those materials coming from open contexts. We only have one date (Beta-445238) from the part close to the cave wall where the layers could have been deposited with a more pronounced steepness.

With this in mind, a Bayesian chronological model was designed with Oxcal 4.2 [Bro09] in order to test stratigraphic information, grouping dates from materials belonging to the same phase (phases may include more than one episode that would otherwise be difficult to be dated on its own due to their nature, e.g. a thin layer of stones) (Table 1). The calibration curve used was IntCal13 [Rei13].

Lab Reference	Type of measurement	Year	Dated material	Date BP	Date cal. BC (2σ)	Field campaign	Square	Spit	Depth (cm)	Layer	Phase ordering 1st Bayesian modelling	Phase ordering 2nd Bayesian Modelling	Publication
OxA-15490	AMS	2007	Grains of Triticum dicoccum/monococcum	**5279± 31 BP**	4232-3995 BC	1995	I8/I9	If	330-350	10	NP2	idem	Edo et al., 2017d
UBAR-1281	Conventional	2014	Charcoal. Structure XI (hearth)	**5075± 40 BP**	3965−3783 BC	2010	H10	Ig	350-370	10b	NP2	idem	Edo et al., 2017d
Beta-210652	AMS	2006	Human bone	**5340± 40 BP**	4322-4048 BC	1996	H9	Ig	350-370	10b	NP1b FASE 2	idem	Edo et al., 2011
UBAR-1282	Conventional	2014	Human bone	**5260± 40 BP**	4231−3979 BC	2011	D10/H11/I11	Ig/Ih	350-390	10b	NP1b FASE 2	idem	Edo et al., 2017d
Beta -197134	AMS	2004	Human bone	**5290± 40 BP**	4238-3994 BC	2001	H9	IId	350-370	11a1	NP1b FASE 2	idem	Edo et al., 2011
UBAR -766	Conventional	2003	Charcoal	**5470±140 BP**	4602-3982 BC	2001	G9	IId	350-370	11a1	NP1b FASE 2	idem	Edo et al., 2011
UBAR-1193	Conventional	2012	Charcoal. Structure X (hearth)	**5370± 45 BP**	4332-4055 BC	2011	D7	IIe	370-390	11a2	NP1b FASE 2	idem	Edo et al., 2017d
Beta-445238	AMS	2016	Cereal grain. Triticum "nudum"	**5670± 30 BP**	4583-4448 BC	2015	F11	IIg	410-430	11a2	NP1b FASE 2	NP1b FASE 1	Unpublished
Beta -363819	AMS	2013	Human bone (Burial 1)	**5460 ±40 BP**	4368-4236 BC	2013	Burial 1	IIf	390-410	11a3	NP1b FASE 1	idem	Edo et al., 2017d
Beta -363818	AMS	2013	Animal bone. Bovine (Burial 1)	**5540 ±40 BP**	4456-4335 BC	2013	Burial 1	IIf	390-410	11a3	NP1b FASE 1	idem	Edo et al., 2017d
OxA-29640	AMS	2014	Human bone (Burial 2)	**5487±33 BP**	4445-4261 BC	2013	Burial 2	IIf	390-410	11a3	NP1b FASE 1	idem	Edo et al., 2017d
OxA-29641	AMS	2014	Human bone (Burial 4)	**5568±34 BP**	4459-4347 BC	2013	Burial 4	IIf	390-410	11a3	NP1b FASE 1	idem	Edo et al., 2017d
I-17918	Conventional	1994	Charcoal	**5350±150 BP**	4490-3804 BC	1993	G6	IIc	330-350	11	NP1b FASE 1	not included	Edo et al., 2011
I-13314	Conventional	1984	Charcoal	**5470±110 BP**	4535-4043 BC	1983	G7	IIe	370-390	11	NP1a	not included	Edo et al., 1986
Beta-238657	AMS	2008	Animal bone. Domestic goat	**5570± 40 BP**	4486-4342 BC	2008	F6	IId	350-370	11	NP1a	idem	Edo et al., 2011
UBAR-1310	Conventional	2014	Charcoal. Structure XIII.	**5560± 60BP**	4526-4273 BC	2014	E7	IIf	390-410	11a4	NP1a	idem	Edo et al., 2017d
Beta-332263	AMS	2012	Animal bones (poor in collagen)	**5240± 40 BP**	not used	2012	G5	IIf	390-410	11	NP1a	idem	Unpublished
UBAR-1352	Conventional	2015	Charcoal	**5620± 50BP**	4545-4353 BC	2014	D7	IIg	410-430	11a4	NP1a	idem	Unpublished
Beta-445239	AMS	2016	Cereal grain. Hordeum vulgare nudum	**5680± 30 BP**	4590-4453 BC	2015	H11	IIg	410-430	11a5	NP1a	idem	Unpublished
Beta-394625	AMS	2014	Charcoal	**5730± 30 BP**	4684-4496 BC	2014	F7	IIg	410-430	11a5	NP1a	NP0	Edo et al., 2017d
UBAR-846	Conventional	2006	Charred fruits of strawberry tree	**5635± 45 BP**	4550-4358 BC	2002	I6/I5/H6	unknown		11b	NP0	not included	Edo et al., 2011
I-11789	Conventional	1983	Charcoal	**5700±110 BP**	4785-4346 BC	1980	H5	IIb	310-330	11b	NP0	idem	Edo et al., 1986
Beta-210653	AMS	2006	Animal bone. Suidine	**5790 ± 40 BP**	4763-4536 BC	2003	I6	IIe	370-390	11b	NP0	idem	Edo et al., 2011
I-11787	Conventional	1983	Charcoal	**5800±160 BP**	5053-4339 BC	1980	F/G/H5	IIe	370-390	11b	NP0	idem	Edo et al., 1986
CNA-3172.1.2	AMS	2015	Sediment rich in charred material	**5794 ± 36 BP**	4723-4546 BC	2013	G9	IIIa	430-450	12	NP0	idem	Unpublished

Table 1: Radiocarbon dated samples for the Middle Neolithic layers of Can Sadurní Cave.

4 The Bayesian modelling

We used Oxcal v. 4.2 to develop a Bayesian model of our radiocarbon dates. The aim was to reduce the calibration ranges and to understand the duration of each type of use of the cave. Since our hypothesis is that we are dealing with a stratigraphic sequence, we used a sequential model, with an initial and a final boundary. The phases were defined as shown in Table 1 (Model 1). This resulted in several dates with a low agreement index with the model (Fig. 5). Among the problematic dates there was the grain chosen from layer 11a2 (Beta-445238), in the area close to the cave wall, precisely to test if the layers here really deposited in a much greater steepness as proposed after field observations. This grain is actually at a depth similar to layer 11a5 (see Table 1). A second problematic date was a piece of charcoal that was found in contact with layer 11b (Beta-394625). Among the remaining dates with poor agreement with the model, there were several conventional dates on long-lived samples with very high standard deviations (I-17918, I-13314, UBAR-846).

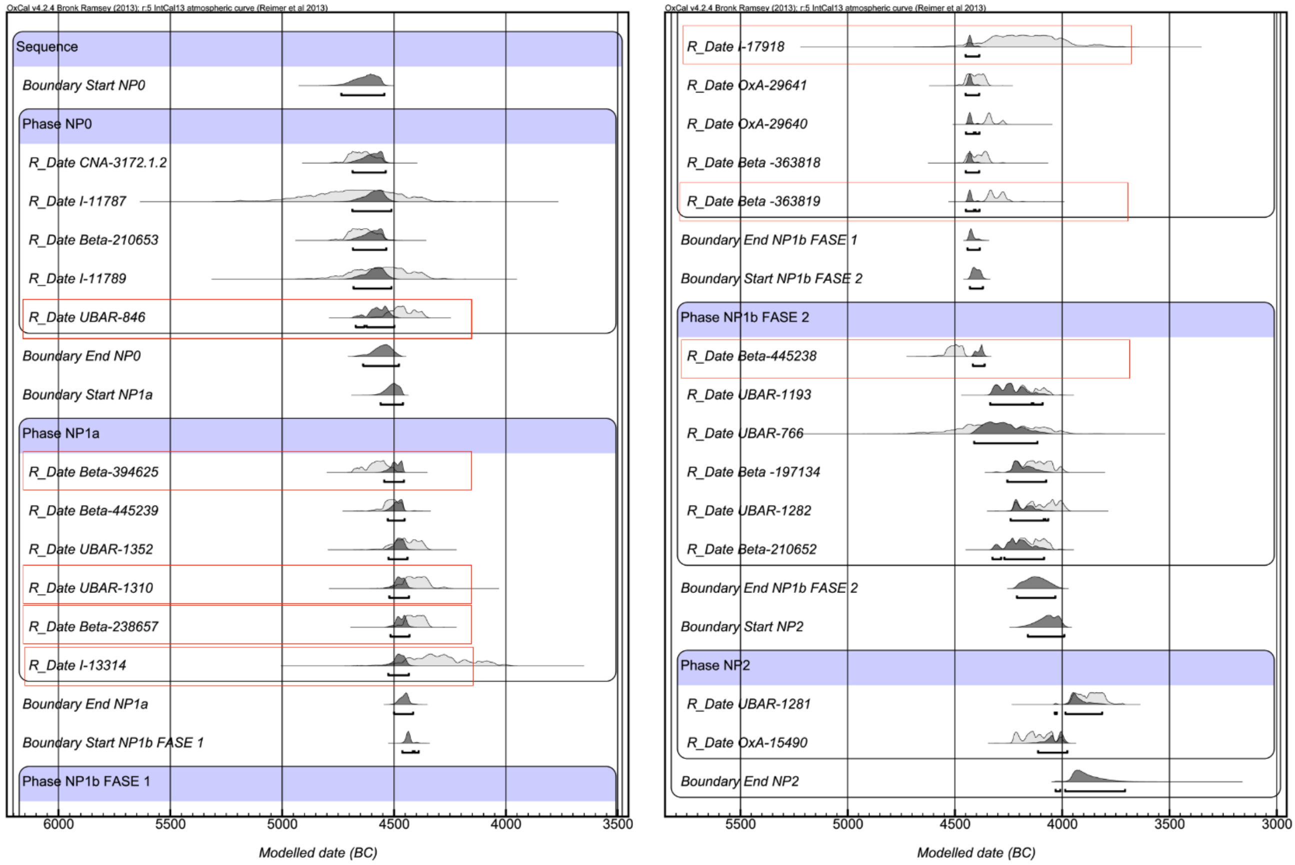

Figure 5 - First Bayesian modelling of the dates according to field observations. Modelled dates appear in a darker grey colour. Dates in boxes were marked as not fitting with the model.

We decided to run a second model excluding the latter dates and reclassifying the former. Beta-445238 was grouped with other dates from layer 11a5 and Beta-394625 was grouped with other dates of layer 11b. The result was a new model (Fig. 6) with a high agreement index for all dates (Table 2). The model used is as follows:

```
Plot()
 {
  Sequence()
  {
   Boundary("Start NP0");
   Phase("NP0")
   {
    R_Date("CNA-3172.1.2", 5794, 36);
    R_Date("I-11787", 5800, 160);
    R_Date("Beta-210653", 5790, 40);
```

```
 R_Date("I-11789", 5700, 110);
 R_Date("Beta-394625", 5730, 30);
};
Boundary("End NP0");
Boundary("Start NP1a");
Phase("NP1a")
{
 R_Date("Beta-445239", 5680, 30);
 R_Date("Beta-445238", 5670, 30);
 R_Date("UBAR-1352", 5620, 50);
 R_Date("UBAR-1310", 5560, 60);
 R_Date("Beta-238657", 5570, 40);
 };
Boundary("End NP1a");
Boundary("Start NP1b FASE 1");
Phase("NP1b FASE 1")
{
 R_Date("OxA-29641", 5568, 34);
 R_Date("OxA-29640", 5487, 33);
 R_Date("Beta -363818", 5540, 40);
 R_Date("Beta -363819", 5460, 40);
};
Boundary("End NP1b FASE 1");
Boundary("Start NP1b FASE 2");
Phase("NP1b FASE 2")
{
 R_Date("UBAR-1193", 5370, 45);
 R_Date("UBAR-766", 5470, 140);
 R_Date("Beta -197134  ", 5290, 40);
 R_Date("UBAR-1282", 5260, 40);
 R_Date("Beta-210652", 5340, 40);
};
Boundary("End NP1b FASE 2");
Boundary("Start NP2");
Phase("NP2")
{
 R_Date("UBAR-1281", 5075, 40);
 R_Date("OxA-15490", 5279, 31);
};
Boundary("End NP2");
};
};
```

The result of the second model is that the start of phase NP0 (=layers 12 and 11b) took place between 4735-4551 cal. BC (95% of probability), and the end around 4660-4501 cal. BC (95% of probability). The start of NP1a (=layers 11a5 and 11a4) would occur between 4567-4459 cal. BC (95% of probability), and the end around 4486-4368 cal. BC (95% of probability). The following pase, NP1b FASE 1 (=layer 11a3) would have the start at 4442-4343 cal. BC (95% of probability) and the end at 4362-4243 cal. BC. Phase NP1b FASE 2 (=layers 11a2 and 11a1) would take place between 4324-4102 cal. BC and 4224-4042 cal. BC (95% of probability). The final phase NP2 (=layers 10b and 10) would have started at 4174-3993 cal. BC (95% of probability) and ended at 3984-3713 cal. BC (94% of probability) [Table 2].

These results confirm that there is a temporal sequence that can well separate both uses of the cave as a byre (from 4735-4551 cal. BC to 4486-4367 cal. BC) and for funerary purposes (from 4442-4323 cal. BC to 4223-4043 cal. BC). The span dates for the use of the cave as a byre are between 0 and 240 years (95% of probability - Fig. 7), Phase NP0 and NP1a). The funerary phase could have lasted between 0 and 246 years (95% of probability - Fig. 7), Phase NP1b FASE 1 and FASE 2). The maximum span of the funerary use of the cave was reduced in ca. 150 years in comparison to previous calculations [Edo17b].

While this would prove that both activities had low chances to have been taking place at the cave at the same time, we cannot totally exclude this possibility due to several reasons mentioned above regarding the samples available and the fact that Bayesian models are an interpretation of radiocarbon dates and they should always be further tested [Bay16].

On the other hand, it was not possible to prove that the layers really present a much higher inclination in the area close to the cave wall. The corresponding sample dated from this layer actually fitted with the expected date that other samples had at similar depths in that part of the cave. This is at the same time also not a final statement, since more dates need to be carried out and other types of material dated to exclude percolations or contaminations. A more detailed analysis of the stratigraphy in this part of the layer will become necessary eventually to solve this issue.

Table 2 - Bayesian model 2 applied to the radiocarbon dated samples of Can Sadurní Cave: calibrated age, modelled age and agreement (A).

	Unmodelled (BC/AD)			Modelled (BC/AD)			Indices	
							A_{model}=91.3	
							$A_{overall}$=91.7	
Show structure	**from**	**to**	**%**	**from**	**to**	**%**	**A**	**C**
Sequence								
Boundary Start NP0				-4735	-4551	95.4		98.4
Phase NP0								
R_Date CNA-3172.1.2	-4723	-4546	95.4	-4687	-4546	95.4	92.8	99.7
R_Date I-11787	-5053	-4339	95.4	-4695	-4532	95.4	133.8	99.8
R_Date Beta-210653	-4763	-4536	95.4	-4686	-4546	95.4	99	99.8
R_Date I-11789	-4785	-4346	95.4	-4690	-4531	95.4	115.7	99.8
R_Date Beta-394625	-4684	-4496	95.4	-4680	-4541	95.4	101.5	99.8
Boundary End NP0				-4661	-4501	95.4		99.6
Boundary Start NP1a				-4568	-4458	95.4		99.7
Phase NP1a								
R_Date Beta-445239	-4590	-4453	95.4	-4533	-4451	95.4	98.8	99.9
R_Date Beta-445238	-4583	-4448	95.4	-4531	-4449	95.4	106.3	99.9
R_Date UBAR-1352	-4545	-4353	95.4	-4524	-4401	95.4	114	99.9
R_Date UBAR-1310	-4526	-4273	95.4	-4515	-4392	95.4	80.2	99.9
R_Date Beta-238657	-4486	-4342	95.4	-4501	-4391	95.4	72.6	99.9
Boundary End NP1a				-4486	-4367	95.4		99.8
Boundary Start NP1b FASE 1				-4442	-4343	95.4		99.8
Phase NP1b FASE 1								
R_Date OxA-29641	-4459	-4347	95.4	-4414	-4336	95.4	84	99.9
R_Date OxA-29640	-4445	-4261	95.5	-4383	-4272	95.4	124.1	99.9
R_Date Beta -363818	-4456	-4335	95.4	-4407	-4330	95.4	110.8	99.9
R_Date Beta -363819	-4368	-4236	95.4	-4371	-4274	95.4	100.3	99.9
Boundary End NP1b FASE 1				-4362	-4243	95.4		99.6
Boundary Start NP1b FASE 2				-4323	-4102	95.4		99.6
Phase NP1b FASE 2								
R_Date UBAR-1193	-4332	-4055	95.4	-4266	-4071	95.4	92.6	99.8
R_Date UBAR-766	-4602	-3982	95.4	-4275	-4068	95.4	90.6	99.8
R_Date Beta -197134	-4238	-3994	95.4	-4239	-4073	95.4	103.8	99.8
R_Date UBAR-1282	-4231	-3979	95.4	-4236	-4070	95.4	86.7	99.8
R_Date Beta-210652	-4322	-4048	95.4	-4256	-4074	95.4	108.8	99.8
Boundary End NP1b FASE 2				-4223	-4043	95.4		99.7
Boundary Start NP2				-4173	-3992	95.4		99.8
Phase NP2								
R_Date UBAR-1281	-3965	-3783	95.4	-4034	-3814	95.4	89	99.7
R_Date OxA-15490	-4232	-3995	95.4	-4120	-3976	95.4	78.9	99.9
Boundary End NP2				-4026	-3701	95.4		98.4

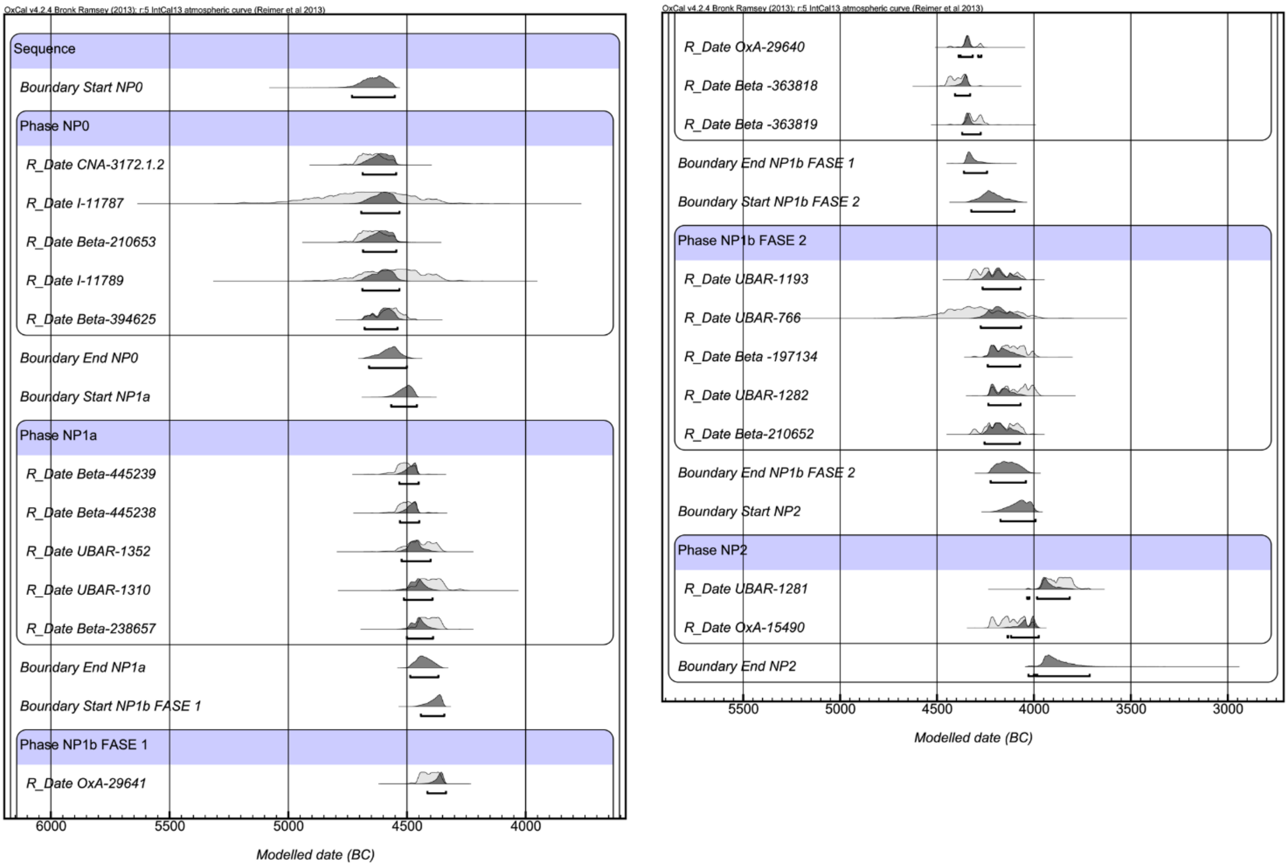

Figure 6 - Second Bayesian modelling of the dates according to field observations. Modelled dates appear in a darker grey colour.

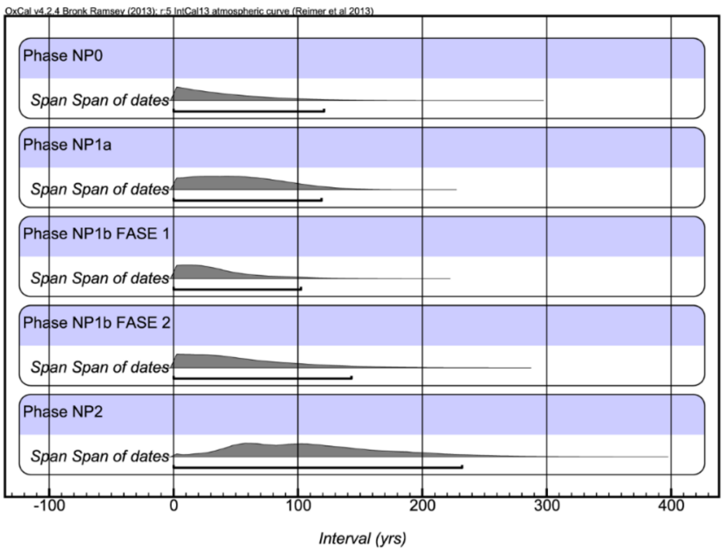

Figure 7 - Calculations of the span of each phase of the sequence.

5 Conclusions

We used Bayesian modelling in order to establish the sequence of the uses of the Middle Neolithic layers of Can Sadurní Cave with greater accuracy. Two main different episodes were distinguishable: the use of the cave for keeping animals lasted up to ca. 240 years (taking place at some point between the years 4735-4368 cal. BC, with 95% of probability) and was followed by a funerary episode that lasted a maximum of 246 years and took place at some point between 4442 and 4042 cal. BC. If we want to make a more final statement, direct and secure evidence of both uses of the cave needs to be further dated, e.g. wild plant remains connected to foddering practices or other animal remains found in the uppermost layers. These results indicate changes in the uses of Can Sadurní Cave that might be relevant for the understanding of the beginning of the Middle Neolithic in the study region. Why did the users of the cave stop stabling animals inside the cave? Why did they chose to use this space as a burial context? Although we have tried to give some explanation to this phenomenon in other papers [Edo17a, Edo17b], connecting this funerary tradition to other caves with similar assemblages, answering these questions falls beyond the goals of this paper and are a direct consequence of the results provided by the Bayesian modelling of the radiocarbon dates.

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