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NEW RADIOCARBON DATES FOR THE EARLY NEOLITHIC OF THE WESTERN MEDITERRANEAN

Samuel van Willigen[1] • Irka Hajdas[2] • Georges Bonani[2]

ABSTRACT. Understanding of processes that determined the expansion of farming and animal husbandry in south-western Europe is hampered by poor chronologies of the early Neolithic in this region. This paper presents new radiocarbon dates, which are used to construct such a chronological frame for a regional group of the most important culture of the early Neolithic in the western Mediterranean: the Cardial culture.

INTRODUCTION

Cardial Culture and Early Neolithic in Southwestern Europe

The beginnings of Neolithic lifeways in the western Mediterranean region date back to 5700 cal BC. It is believed that this development is a consequence of an expansion of early Neolithic groups from northern Italy to southern France (Guilaine et al. 2007). Existence of these scarcely documented Impressa groups is dated between 5700 and 5600 cal BC. Sometime later, ~5400 cal BC, a new archaeological culture appeared: the Cardial culture, which is thus far the best-documented early Neolithic culture in the western Mediterranean region. The Cardial culture had a well-developed production economy that included foraging (cattle, sheep/goat, and pig) and farming (mainly emmer and einkorn wheat). There is much evidence for the existence of open-air settlements, even if cave sites remain the most important source of information. The impressed decoration executed before firing the vessels obtained with the edge of a cardium shell and the applied cordons are the most characteristic elements of this culture, which is attested from the southern Alps to Portugal and Morocco (van Willigen 2006). At about the same time, Neolithic lifeways spread to the hinterland. This continental Neolithization is mainly related to cultures other than the Cardial culture (i.e. the so-called "Epicardial" and "Neolitico interior"; van Willigen 2006; Bernabeu et al., in press).

The Cardial Culture: Regional Groups

Despite the common assumption, the Cardial culture was not evenly distributed along the western Mediterranean coast. The extension of this culture was connected to zones with soils rich enough to allow agricultural activity (loess basins and alluvial plains). The main favorable regions were the great coastal plains but also regions such as Granada, the Auvergne, and the Saône Valley, which are distant from the coast (Figure 1). The cultural materials of those groups show common features such as small round-bottomed bowls decorated with complex cardium patterns, big pots decorated with applicated cordons, and stone bracelets, but also some differences. These variations in the material culture allow definition of regional groups of the Cardial culture, like the Valencian group, the Catalanian group, and the Bas-Rhône-Provence group. Considering that it is reasonable to assume that the evolution of each group might be different, the chronological reconstructions should be performed on a regional level. Below, we focus on the Bas-Rhône-Provence group, which is located in the lower Rhône Valley and the Provence.

[1]MMSH-UMR 6636 (Aix-en-Provence, F) and Swiss National Museum, Zurich, Switzerland. Corresponding author.
Email: Samuel.vanWilligen@slm.admin.ch.
[2]Ion Beam Physics ETH, Zurich, Switzerland.

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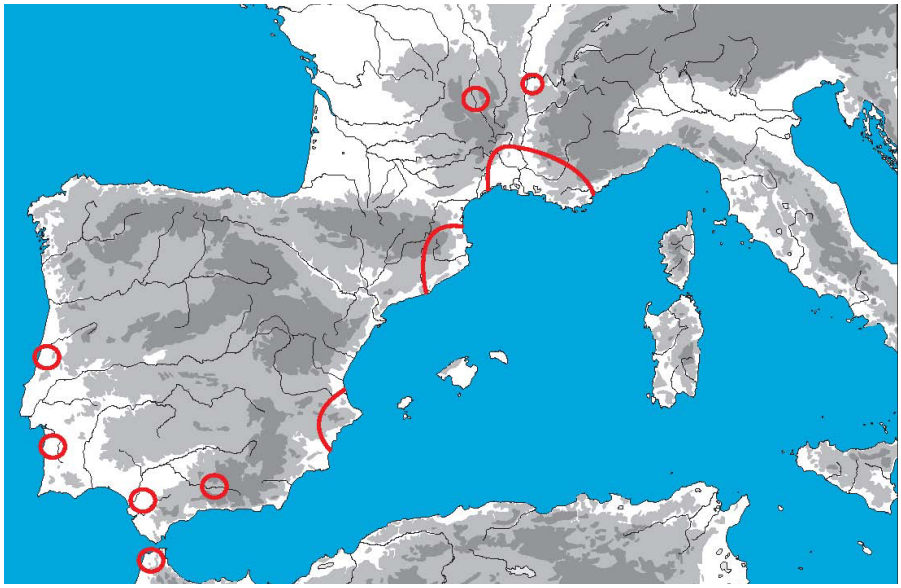

Figure 1 Map showing extension of the Cardial culture in southwestern Europe

METHODS

Cardial Culture: Classification Using Ceramic Typology and Seriation

Thanks to about 70 archaeological sites, the Bas-Rhône-Provence group is the best-defined regional group of the Cardial culture. However, one must keep in mind that only a small fraction of those sites were excavated and documented using modern techniques and methods. Moreover, most of the sites were located in caves, which were probably only occasionally visited for a specific purpose. Closed contexts like pits or graves are rare in this region and only 1 of the selected archaeological ensembles could be considered as a closed find: Céron, pit 1. Thus, we have to deal mostly with occupation levels in caves and rockshelters with a variable time span ranging from a few months to a few hundred years. In such conditions, mixing between older and younger occupation levels is possible. In order to reduce this possibility, we chose to study occupation layers in caves/rockshelters or open-air sites, which are the result of observation during modern excavations. In this regard, we do not deal with closed finds but with ensembles, which can be considered as homogenous.

Our approach consisted of submitting the 15 ensembles that can be attributed to the Franco-Iberian Cardial in eastern Languedoc and western Provence (Table 1), to an automatic seriation of ceramic types defined on the basis of pottery characteristics using the statistic program WINBASP 5.2.

Despite the expected low precision of the chronology, the seriation showed a clear picture and allowed separation of the studied ensembles (mainly occupation levels in caves) into 2 groups (Figure 2). The first group (A) includes the sites of Grotte de l'Aigle (layer 5), Abri de la Font des Pigeons (layer 4/1949 and 17/1979), Baume d'Oullins (layer 6), and Les Petites Bâties. This group is characterized by finger-pressed cordons and bands of parallel cardium impressions. The second group (B) includes finds from Le Baratin, Aven de Rochas (layer 4.3inf), Abri 2 du Fraischamps (layers 4 and 3), Baume Saint-Michel (layer 5b), Escanin ("couche cardiale"), Baume Fontbrégoua (layers 47–45 and 44–35), Abri de l'Eglise (layer 11), and Grotte Lombard (layer 5). This group is characterized by orthogonal-sorted cordons and lentil-like applications as well as complex cardium patterns (bands of zig-zag lines).

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Table 1 List of the ensembles submitted to the seriation and references.

Site	Bibliography
Abri de la Font des Pigeons, layer 4 (1949)	Escalon de Fonton 1974; Courtin 1974; Courtin et al. 1985
Abri de la Font des Pigeons, layer 17 (1979)	Escalon de Fonton 1974; Courtin 1974; Courtin et al. 1985
Baume Fontbrégoua, layers 47–45	Courtin 1974; Courtin and Binder 1986
Baume Fontbrégoua, layers 44–35	Courtin 1974; Courtin and Binder 1986
Baume d'Oullins, layer 6	Roudil and van Willigen 2002
Les Petites Bâties	Binder et al. 2002
Aven de Rochas, layer 4.3inf	Beeching 1987
Grotte de l'Aigle, layer 5	Roudil et al. 1979
Grotte Lombard, layer 5	Binder 1991
Baume Saint-Michel, layer 5b	Hameau et al. 1994
Abri de l'Eglise, layer 11	Courtin 1967
Abri n°2 du Fraischamps, layer 3	Paccard 1957
Abri n°2 du Fraischamps, layer 4	Paccard 1957
Le Baratin	Courtin 1974
Escanin-Eboulis, "couche cardiale"	Montjardin 1966, 1969–1970
Abri de la Font des Pigeons, layer 11 (1974)	Courtin et al. 1985
Station du Moulin, layer 6	Beeching 1999
Grotte du Mourre de la Barque, layer D4/16	van Willigen 2003
Céron, pit 1	Buisson-Catil 2001

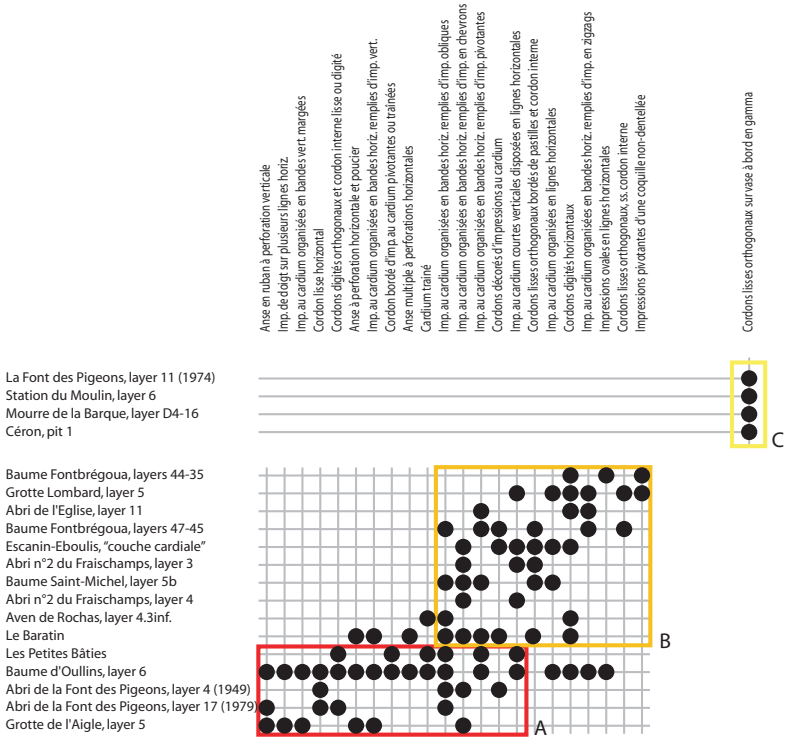

Figure 2 Automatic seriation of ceramic types for the Bas-Rhône-Provence group of the Cardial culture (group C was not submitted to the seriation process).

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A third group (C), consisting of 4 ensembles, was unfortunately underrepresented and thus not submitted to seriation: Céron (pit 1), Grotte du Mourre de la Barque (layer D4/16), Station du Moulin (layer 6), and Abri de la Font des Pigeons (layer 11/1974). Only 2 sites (Grotte du Mourre de la Barque and Station du Moulin) provide some information about the material culture. Besides the fact that the majority of the ceramic is undecorated and the cardium patterns are not present, the most characteristic element of this group is a large pot with orthogonal-sorted cordons and a so-called Γ-shaped rim. Nevertheless, because all the groups are present in the same region it is unlikely that they represent regional characteristics of the same phase.

RESULTS AND DISCUSSION

Toward a Relative Chronology of Cardial Culture in Southeastern France

We follow the hypothesis that these 3 groups represent 3 subsequent periods. Unfortunately, no stratigraphic sequence exists in this area, which could confirm that the groups A, B, and C follow each other. Only the stratigraphy of Abri de la Font des Pigeons yields elements of group A in the lowest layers (17–15 of the 1979 excavation). From the upper layers (14–11) comes a fragment of a large vessel with cordons and T-shaped rim (Dangel 1997); this indicates that group C is later than group A. Group B's position in the relative chronology, however, has to remain open. We can only propose that groups A and B share a couple of features (Figure 2), indicating their temporal proximity. Thus, stratigraphical evidence and typological reasons lead to the hypothetical sequence group A–B–C (Figure 3).

In order to improve this chronological relation between the groups A, B, and C, a set of ^{14}C data was obtained for ensembles belonging to each group. The 17 ^{14}C ages with a standard deviation <100 yr were obtained mainly for the seriated ensembles. One ^{14}C age was obtained for the level 14G.3 of the Grotte du Mourre de la Barque. This occupation level was too poor to be seriated but it provided a big vessel with cordons and lentil-like applications, which is typical for group B. The definitive set consists of 7 ages for group A, 4 for group B, and 6 for group C (Table 2).

Dates were calibrated using OxCal 3.10 (Bronk Ramsey 1995, 2001) and the IntCal04 atmospheric data (Reimer et al. 2004). The distribution of calibrated ages shows a large overlap of the calendar ages between the groups A, B, and C (1-σ range): A between 5370 and 5070 cal BC; B: 5330 and 5050 cal BC; C: 5310 and 5030 cal BC (Figure 4). The calibrated dates sequence of group A followed by C, which would support the sequence of Abri de la Font des Pigeons. The calibrated dates of group B, however, overlap both with those of group A and group C, so that the chronological position of group B cannot be clarified with ^{14}C dates.

The overlap between the data of groups A-B and B-C could partly be due to taphonomic processes. This is probably the case for the 2 oldest ages from layer D4/16 of the Grotte du Mourre de la Barque (ETH 27979 and ETH 27980). Here, one must accept the possibility of post-depositional sample displacement, since this cave also provides some indications of an earlier occupation that belonged to our group B (layer 14G.3, in a nearby sector of the cave). For the other sites, post-depositional processes cannot explain an overlap between the data of each group because there is no evidence of older or younger occupational layers.

In order to test if the present set of ^{14}C ages supports the proposed sequence of A–B–C groups, the data set was submitted to a Bayesian calibration (Buck et al. 1994) using the program OxCal v 3.10. (Bronk Ramsey 1995, 2001). Our premise was that groups A, B, and C follow each other and that there is no overlap but also no hiatus between them. The results of this analysis (Figure 5) show that

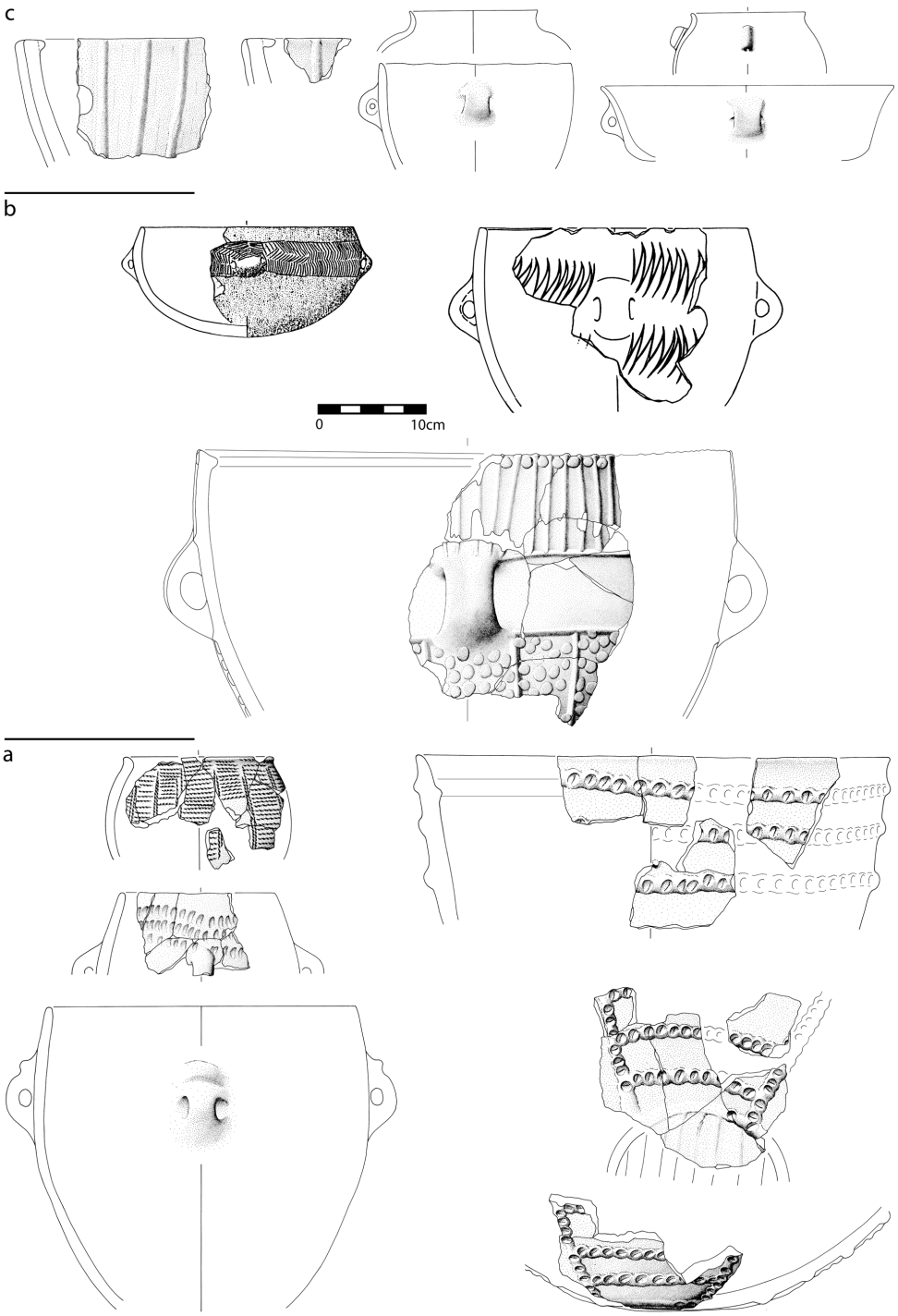

Figure 3 The 3 groups of the Cardial culture in southern France. A: Baume d'Oullins, layer 6 (Roudil and van Willigen 2002); B: Baume Fontbrégoua, layers 47–35 (Echallier and Courtin 1994) and Grotte du Mourre de la Barque, layer 14G.3 (van Willigen 2003); C: Grotte du Mourre de la Barque, layer D4/16 (van Willigen 2003).

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Table 2 List of ^{14}C dates (ETH 27975 has been by mistake published with a value of 6230 ± 60 BP; van Willigen et al., in press).

Site	Lab nr	Sample	Date BP	$\delta^{13}C$ (‰)	Bibliography
Baume d'Oullins, layer 6	ETH 27972	bone (*Bos* sp.)	6510 ± 60	–17.4 ± 1.2	unpublished
	ETH 27973	bone (large rum.)	6265 ± 65	–19.6 ± 1.2	
	ETH 27974	bone (*Bos* sp.)	6250 ± 60	–18.6 ± 1.2	
	ETH 27975	bone (large rum.)	6360 ± 60	–18.7 ± 1.2	
Le Baratin, structure 5	LYON 99	charcoal	6145 ± 70	n/a	Sénépart 1998
Le Baratin, s structure 2	LYON 100	charcoal	6125 ± 80	n/a	
Le Baratin, structure 1	LYON 252	charcoal	6290 ± 70	n/a	
Mourre de la Barque, layer C6-14G.3	ETH 26417	caramel	6305 ± 55	–26.2 ± 1.2	unpublished
	ETH 27978	bone (*Bos* sp./humerus)	6165 ± 65	–19.6 ± 1.2	
Mourre de la Barque, layer D4-16	ETH 27979	bone (*Bos* t./metapodium)	6225 ± 60	–20.8 ± 1.2	
	ETH 27980	bone (*Bos* t./metatanus)	6285 ± 65	–19.2 ± 1.2	
	ETH 27981	bone (*Bos* t./tibia)	6065 ± 65	–21.0 ± 1.2	
Céron, pit 1	Gif 9997	charcoal	5990 ± 75	n/a	Buisson-Catil 2001
Font des Pigeons, layer 11/14	MC 942	charcoal	6050 ± 100	n/a	Courtin et al. 1985
	Beta 103862	charcoal	6290 ± 50	n/a	Binder et al. 2002
Les Petites Bâties	Beta 103867	charcoal	6230 ± 50	n/a	
	Beta 103868	charcoal	6270 ± 50	n/a	

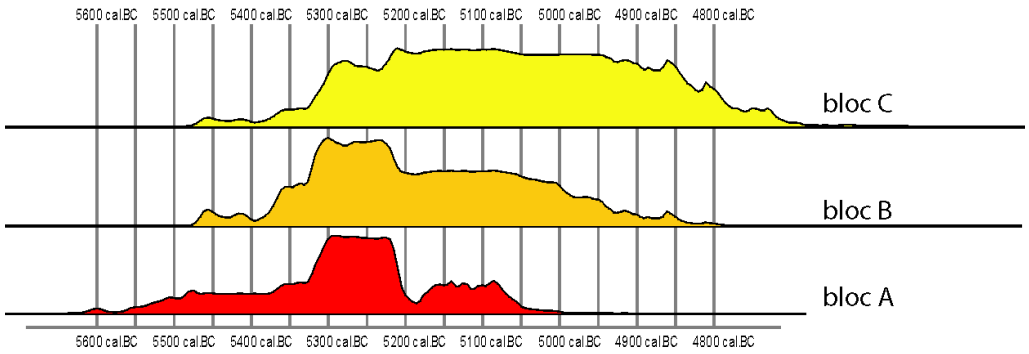

Figure 4 Probability distribution of ^{14}C ages obtained for Groups A, B, and C

the available data do not contradict our hypothesis. Based on the Phase analysis, the shift from Cardial A to Cardial B, which takes place around 5250 cal BC, is followed 100 yr later (i.e. at 5150 cal BC) by the transition from Cardial B to Cardial C.

CONCLUSIONS

We have attempted to develop a chronology for the Cardial culture on the basis of ^{14}C dates from a reconstructed sequence of ensembles considered to be homogenous. This procedure has proved to be a good alternative to the examination of stratigraphies from caves, which is common in south-western Europe. Usually, these stratigraphies provide neither reliable dates nor complete sequences (van Willigen et al., in press). However, our procedure requires the inclusion of further ensembles (if possible, closed finds), which are dated absolutely. Producing a detailed sequence using seriation and correspondence analysis in combination with a sufficient number of ^{14}C dates would enable us

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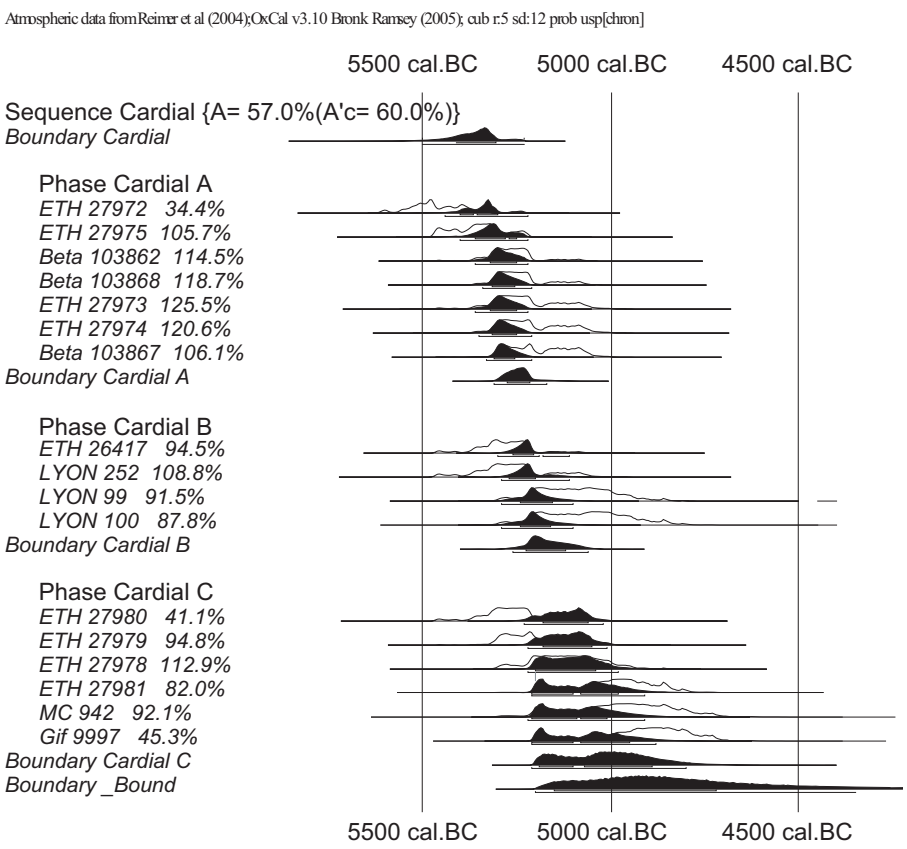

Figure 5 Results of Bayesian Phase model applied to Groups A, B, and C

to apply methods such as wiggle-matching and, thus, to overcome the plateaus in the calibration curve between 5500 and 4800 cal BC.

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