New ^{14}C evidence for the Late Neolithic-Early Bronze Age transition in Southeast Europe

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Abstract

The transition from the Late Neolithic (LN) period (locally also called Final Neolithic or Chalcolithic) to the Early Bronze Age (EBA) in Greece and the Southeast Balkans is an obscure period in human history. Previous radiocarbon evidence showed that in settlements with stratigraphical sequences stretching out on both periods, the absolute dates featured a gap ranging from 700 to 1000 years (roughly between 4000 and 3300/3000 cal. BC). On the other hand, there is only scarce evidence about settlements that would have been founded during the *missing* period, thus arising questions of paramount importance about the human occupational strategies in this period. Investigation tackling this particular problem is carried out within the framework of a broader research project (Balkans-4000) funded by the French National Research Agency (ANR). Here we discuss the latest radiocarbon results from three recently excavated multilayer settlements on the continental Greek Eastern Macedonia: Dikili Tash, Kryoneri and Sidirokastro. In all cases, the existing LN radiocarbon dates do not go beyond about 4000 BC, whereas the earliest EBA layer dates begin at around 3300 BC. A date in the last 1/3rd of the 4th millennium BC is also the date suggested for the one-layer *transitional* settlement on the neighbouring island of Thasos (Aghios Ioannis). The fact that the gap affects settlements of different types and locations, although there are no signs of major environmental changes, suggests that the reasons of their possible total or partial abandonment are more likely to be social than strictly environmental.

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Introduction

The general picture of the Late Neolithic-Early Bronze Age transition in the Balkans is rather controversial. Although a certain continuity in land occupation is recognized [*i.e.* many Early Bronze Age (EBA) settlements display also layers of Late Neolithic (LN) date], in terms of material culture there is a clear contrast between the two periods. This is mostly evident in the Northern part of the territory (Northern Greece, Bulgaria), where the material expression at the later stages of the Neolithic period, also called Final Neolithic or Chalcolithic, is richer: richly decorated and sometimes extremely fine pottery, such as black-on-red and graphite-painted, or vessels with incised and crusted decoration, elaborate anthropomorphic and zoomorphic figurines, clay models, ornaments such as *spondylus* bracelets, beads, *etc*. (Papathanassopoulos, 1996; Anthony and Chi, 2009; Papadimitriou and Tsirtsoni, 2010). All these features are completely out of use at the beginning of the next EBA period, which includes indeed only dark-coloured monochrome pottery, usually medium-grained, and no figurative or conspicuous artifacts. Incised pottery with white infill appears a little later, during the EBA II phase (2700-2300 BC), as do also the EBA Urfirnis and matt-painted wares found in the South (Treuil, 1983; Treuil *et al*., 2008). In Southern Greece, the contrast between the LN and the first EBA material culture is less obvious, for the Late (Final) Neolithic material culture is not that impressive: pottery is more usually monochrome and figurines are rare, although there exist elements which connect these regions to the rich Balkan Neolithic *koine*, such as characteristic stone and metal ornaments. Under these conditions, it is not strange that the possibility of a break in the occupation has been first pointed down archaeologically by the Bulgarians. Indeed, this is where the Chalcolithic period appears the richest, with several well-organized and eventually fortified settlements, and especially with extremely wealthy cemeteries, like that of Varna. The contrast between this literally golden era and the dull next EBA period is so brutal, that some archaeologists assume that a major catastrophe occurred between the two, due either to climatic changes or foreign invasions. The long duration of the chronological gap separating the two periods, pinpointed since the late 1980s, has reinforced the idea of a collapse that societies would have put several centuries to overcome. During the Transitional period, people would have moved to new, more secure locations, attested by scarce finds, and even scarcer radiocarbon dates (Todorova, 1978, 1995; Boyadziev, 1995).

It is only recently that archaeologists working in Greece started asking questions about the real nature of the LN/FN-EBA transition. Absolute chronology has helped a lot in this debate. The first signs of a possible hiatus in occupation have been registered at the site of Mandalo, in Greek Western Macedonia, with C-14 dates suggesting that *ca*. 1000 years separated the layers of phases II (Final Neolithic) and III (EBA), in spite of the fact that they were stratigraphically continuous (Maniatis and Kromer, 1990). In the following years, it became more and more obvious that the missing interval, *i.e.* the years between roughly 4000 and 3000 cal. BC, and especially the first half of the 4th millennium, was altogether very poor in radiocarbon dates (Manning, 1995;

Alram-Stern, 1996; Andreou *et al*., 1996; Treuil *et al*., 2008). More recently, evidence came up suggesting the existence of an independent, truly transitional phase also in Greece (Adrymi-Sismani, 2007; Johnson, 1999). However, the large deviations in the majority of the available radiocarbon dates, together with the widespread suspicion among the archaeologists, although not always clearly stated, that this gap could be simply (or partly) due to problems in the radiocarbon technique itself, somehow masked the problem. Thus, in many recent chronological tables the last phase of the Neolithic is shown to last uninterruptedly until the beginning of the EBA (*i.e.* from 4800 to 3300 BC), in spite of the fact that the absolute dates collected so far cluster systematically in years before 4000 cal. BC. The start of the EBA itself is not very well fixed. A general consensus exists for the date of 3300 cal. BC, but a possible earlier start in some regions is not excluded although cannot be verified due the very large error bars of the particular samples [*e.g.* Sitagroi IV in Greek Eastern Macedonia (Johnson, 1999)].

In order to help clarify these issues, we recently undertook research in several parts of Greece and Bulgaria, thanks to a generous funding from the French National Research Agency (ANR research project BALKANS 4000). One of the main aims was to circumscribe the presumed gap as accurately as possible, both chronologically and geographically, by proceeding to a new series of radiocarbon datings.

Materials and Methods

The new samples were collected from secure and well-defined archaeological contexts in freshly excavated settlements featuring long occupation sequences where one, or preferably both periods (*i.e.* Late Neolithic/Chalcolithic and EBA) are present. In order to better appreciate the general evolution of the settlement at the various sites, determine the frequency and duration of other possible hiatuses, *etc*., we decided to date the whole sequences and not just the affected parts. Naturally, we also dated samples from one-layer settlements that were suspected to belong to the Transitional period, whenever we had the chance to meet one of them. We preferred sites where excavations are currently in progress, in order to ensure interaction between ongoing radiocarbon measurements and excavation strategies.

Some 200 radiocarbon dates have been produced in archaeological contexts from 31 sites distributed in the two countries. Internal distribution is not uniform, neither in terms of geographical areas nor in terms of quantity of samples per site. Some sites are only represented by one or two samples, whereas others provided ten or more. The number of samples depended not only on the length of occupation or use of the site, but also on the availability and quality of samples (burned-unburned layers, eroded or washed out deposits, *etc*.), and also on extending the local sequence to undated portions. Thus, in sites with already well-established long chronological sequences, we just proceeded to a few targeted samplings, whereas others, with shorter sequences but with no prior information, necessitated a more abundant sampling. Three dating methods have been used concurrently: Gas Proportional Counting (at the Laboratory of Archaeometry, NCSR *Demokritos*), Liquid Scintillation Counting (at the Lyon Centre for Radiocarbon Dating), and Acceleration Mass Spectrometry (at CEA Saclay, under the responsibility of the Lyon lab). Details of sample treatment and measuring procedures can be found in Maniatis and Papadopoulos (2011), Foucher *et al*. (2011), and Cottereau *et al*. (2007) for each laboratory respectively.

The sites

The full results of this project will be presented elsewhere (Tsirtsoni, in press). Here we discuss in some detail evidence from three settlements in Northern Greece: Dikili Tash, Kryoneri and Sidirokastro. The new dates were combined with a series of older radiocarbon dates produced by the Laboratory of

Figure 1. Map of Southern Balkans with the sites studied and discussed in the text.

Archaeometry, NCSR *Demokritos* and the Radiocarbon Laboratory of the University of Heidelberg (Kromer and Münnich, 1992), using the Gas Proportional Counting Technique.

Comparison is made with the results obtained in previous years from a fourth settlement, Aghios Ioannis on Thasos (Maniatis and Papadopoulos, 2011). These sites are selected for they represent four geographically close settlements (Figure 1), but with completely different profiles, in terms of location, topography, type of settlement, and eventually duration of occupation.

Dikili Tash is a big *tell* settlement, one of the biggest in the Balkans, with a maximum height of ca. 17 m. It is located in an interior plain (plain of Drama or Philippi), a large part of which was previously occupied by a marsh. Sea is not very far (about 15 km), but the plain is cut from it by a low mountain range (Symvolon), which forms a clear geographical and climatic boundary. Occupation at the settlement started in in the Early Neolithic (Lespez *et al*., 2013 and lasted until the end of the Late Bronze Age, whereas there are also remains of historical periods. No stratigraphical hiatus has been observed at any part of the sequence, which seems continuous (Treuil, 1992; Darcque *et al*., 2007; Koukouli-Chryssanthaki and Treuil, 2008; Darcque and Tsirtsoni, 2010). The occupational sequence is supported by a series of 45 radiocarbon dates and 9 TL dates made in previous years (Treuil, 1992; Koukouli-Chryssanthaki *et al*., 1996; Roque *et al*., 2002), falling roughly between the mid-6th and the late 2nd millennia cal. BC. Most of them come from LN I and LN II layers (local phases I and II, respectively), which are frequently severely burnt, with well-preserved habitation units. However, none of the dates from phase II contexts felt into the early 4th millennium and this in spite of the large errors of the oldest dates (up to ±160 BP years). The unique useful date from EBA I contexts (phase IIIA) falls at the very end of the 4th millennium; it could not be excluded however that the true start of the period might have occurred earlier.

The new samples come from the new excavation programme started at the site in 2008, aiming, among others, to control the existence or not of layers that would bridge the LN II-EBA I gap (Darcque *et al*., 2008, 2009).

Sidirokastro is a rock-shelter in a narrow river valley (Krousovitis, a tributary of Strymon), far from the sea. All stratified finds date from the EBA period, but there are also some sparse fragments of LN II pottery that could indicate an earlier occupation. Three radiocarbon dates produced at the National Center for Scientific Research *Demokritos*, from samples collected during the 2004 excavation, showed already that the EBA settlement had started by 3300/3000 CAL.BC (Poulaki-Pantermali *et al*., 2004). But subsequent fieldwork suggested that there could be an even earlier phase. The samples discussed here come mostly from the 2006 and 2007 campaigns (Siros *et al*., 2007).

Kryoneri is a flat settlement (max. height 3.5 m), lying on the foothills boarding a river valley (lower Strymon valley), which was previously partially occupied by a marshy lake. The settlement is very close to the sea (less than 7 km from today's coastline). Occupation goes from the LN I to the EBA, but the greatest part of the deposits excavated in the years 1996-1997 belong to the LN II period (Malamidou, 1997, 2007). A series of radiocarbon dates, unpublished so far, suggested the absence of layers that could be assigned to the early 4th millennium; AMS dating of a few additional samples from the same contexts should allow completing the data. Finally, *Aghios Ioannis* is a flat coastal site, apparently single-layered. Probably this is not a permanent settlement, but rather a seasonal location of herders and/or fishermen (Papadopoulos *et al*., 2001; Lespez and Papadopoulos, 2004; Papadopoulos and Bechtsi, 2003). Evidence from the pottery collected suggests a chronology in the transition from the LN to the EBA; however the radiocarbon dates suggest a chronology in the last part of the 4th millennium BC, with only one outlier reaching the middle of the 4th millennium (Maniatis and Papadopoulos, 2011).

Results and Discussion

The results of the new datings reinforce the previous evidence and bring some useful precisions to the overall picture both in Greece and Bulgaria.

Indeed, comparing the previous series of radiocarbon dates (Figure 2a) with the new ones (Figure 2b) in Northern Greece, the area mostly considered here, one observes that the number of those falling in the first part of the 4th millennium BC continues to be conspicuously low compared to those of other periods. The lack of dates in this period is actually

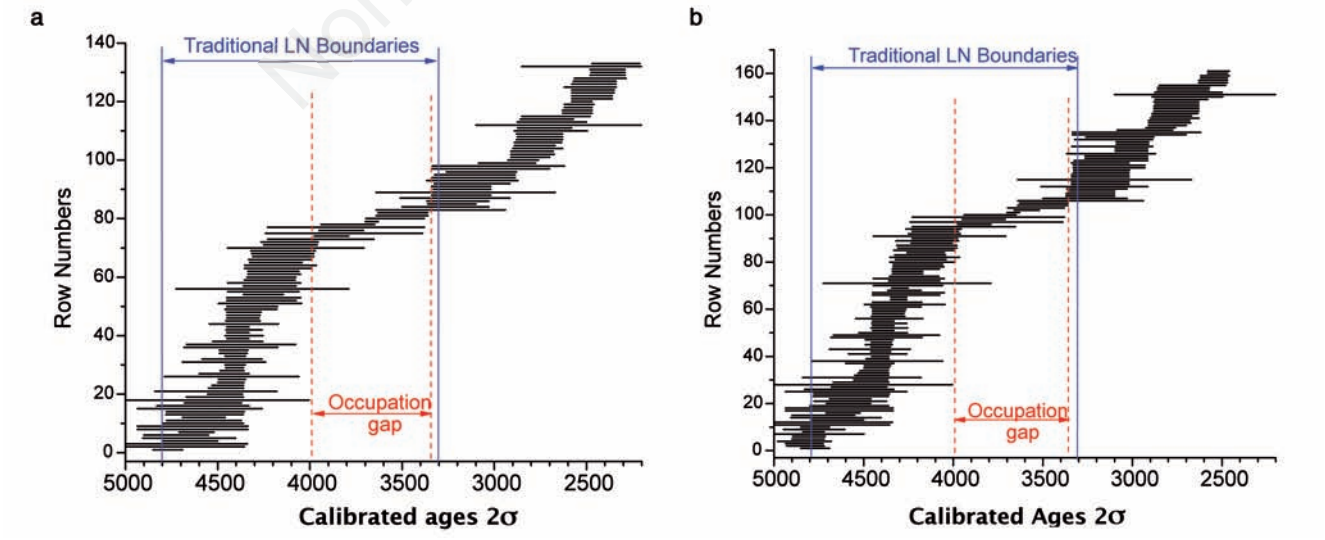

Figure 2. Bar diagram of calibrated 2σ dates for North Greece produced by various laboratories in the period 4500-2400 BC a) before the BALKANS 4000 project and b) after the BALKANS 4000 project.

emphasized as most of the new dates populate the periods before 4000 and after 3300 BC.

Furthermore, the number of high-precision dates for the later part of the 4th millennium has increased considerably, especially thanks to the important Sidirokastro series. These dates seem to confirm that the Early Bronze Age starts in North Greece around 3300 Cal. BC, and not before. It is even possible that the true start of the period is closer to 3100 than to 3300 cal. BC.

Considering the four key-sites individually, one notices what follows.

The sixteen new radiocarbon dates from *Dikili Tash* complete the existent absolute chronology sequence in several parts that were previously poorly known (Late Bronze Age, late historical periods), but the LN II-EBA transition is not among them, although half of the dates come from areas related with one and/or the other period. Thus, the new dates confirm (at least so far) the abandonment of the settlement in the years just before the end of the 5th millennium BC. The modeled value of the last dated sample of phase II (*Last* LN-IIC+; Figure 3) falls in the period 4230-3999 cal. BC with a mean date 4135±66 cal. BC. A more detailed analysis, however, of the stratigraphic and contextual evidence of all the relevant new dates and several older ones (seventeen dates with a standard deviation equal or inferior to 100 BP years) allows distinguishing between several episodes: a major destruction episode around 4260±17 BC, as is attested by a cluster of 4 short-lived samples from a group of burnt houses in sector 6, in the Eastern slope of the *tell* (*Last* seeds, Figure 3), and a more *discrete* reoccupation of some parts until roughly 4000 cal. BC (Phase IIC+). The full presentation of this analysis will be given in a separate paper.

In spite of the repeated efforts for sampling among the EBA structures (mostly pits), only one additional date is obtained (Lyon-6012), which together with the older one (DEM-552) confirm a chronology in the range 3300 and

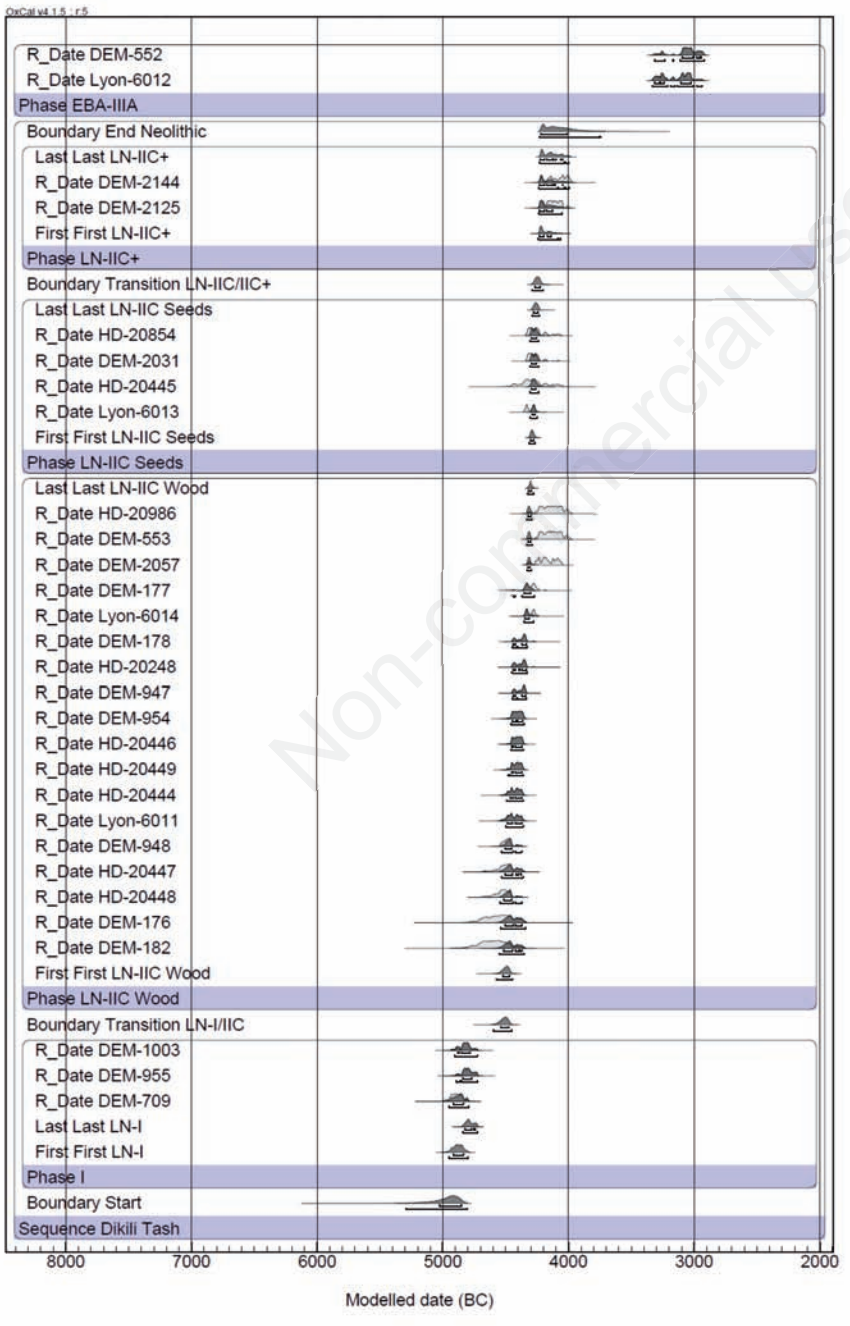

Figure 3. Dikili Tash: multi plot of 2σ Final Neolithic and Early Bronze Age dates modelled statistically in phases using the OxCal v4.1.5 programme.

3000 BC. Troubling, but highly instructive from a methodological point of view, is the absence of any visible sign of a hiatus in the areas where the layers of the two periods are superimposed: thus, in sector 6, as the EBA pits are directly dug into the burnt house debris, their filling contains also material originally belonging to the underneath Late Neolithic structures.

An analogous picture is provided by the fourteen new radiocarbon dates from *Sidirokastro* (Figure 4a). Three of them confirm the existence of late 5th-millennium layers (LN II) in the main area of the cave (phase C, spanning a period 4370-4060 BC). All the others dates are from the period between 3350 and 2600 cal. BC, *i.e.* the fully developed EBA, which is further subdivided into an early and a late stage (local phases B and A, respectively). Thus, no intermediate stage is attested here either leaving a mean gap of 837±211 years, according to the statistical model.

The last 1/3rd of the 4th millennium where the EBA begins is affected by medium-term variations in the atmospheric ^{14}C content, resulting in a plateau in the calibration curve around 3300-3000 BC. This leads to an artificial spreading of the calibrated dates reducing precision and prohibiting discrimination between events that could be dating close to 3300 and events close to 3000 BC, since they all give 2σ calibrated dates generally in the range 3300-3000 cal. BC (Boyadziev, 1995; Johnson, 1999; Maniatis and Papadopoulos, 2011). In order to improve the discrimination within this range, we apply statistical modeling on the eleven dates of the sole phase B using OxCal v 4.1.5 (Bronk Ramsey, 2009, 2010). The fact that all samples come, archaeologically speaking, from the same horizon allows us to consider this group of events as a single phase and treat them statistically as such. The results of this treatment show that the modeled dates of phase B mostly accumulate closer to 3100 than 3300 BC. Even the earliest dated sample in the group (Figure 4b) shows a modeled date with highest probability in the range 3199-3040 BC, indicating that the EBA I does not begin before about 3200 CAL.BC.

Concerning *Kryoneri,* all four dates from the LN II layers (DEM-779, DEM-780, DEM-1045, Lyon-6028) (Figure 5) fall well before the end of the 5th millennium, with the latest date between 4460 and 4360 cal. BC.

A single date with very large error spanning the thousand-year interval between 3640-2670 BC (DEM-790) is the only trace of a possible occupation during the latter part of the 4th millennium or the early 3rd. But the only reliable date (Lyon-6029) is from the second half of the 3rd millennium BC, *i.e.* from an advanced stage of the Early Bronze Age (EBA II); this would agree also with the mobile finds. In that case, the gap in dates would be of almost 2000 years, but we need to consider the small excavated area. Anyhow, the absence of dates falling in the phase in question is of some importance for our discussion.

Finally, all five samples from Aghios Ioannis fall in the 4th millennium BC (Figure 6). Four of them (2 bone samples DEM-932 and 933, and 2 charcoals DEM-849 and 1072) group nicely in the last part of the 4th millennium (3370-3100 cal. BC). The fifth sample (DEM-848), which is a charcoal taken from a hearth, gives a higher age (3700-3400 cal. BC) but it is most likely that this is an outlier and should be considered with caution. This chronology accords well with the archaeological evidence: if we accept that the mature EBA I, represented by phase B at Sidirokastro and IIIA at Dikili Tash, starts only around 3150 BC (see above), then Aghios Ioannis would represent, indeed, the stage just preceding it.

Conclusions

The three sites with long occupation sequences provide no or very few dates in the years after about 4250 cal. BC, *regardless of their type* (tell, flat settlement, cave) *or location* (in lowland or on a terrace, far or close to the sea). This datum probably marks the end of the mature Late Neolithic (Chalcolithic) period in cultural terms. This is very clear at Dikili Tash, where it dates the destruction of a group of houses with material typical of the last LN phase (Dikili Tash IIC, more or less synchronous to Karanovo VI). The picture agrees well

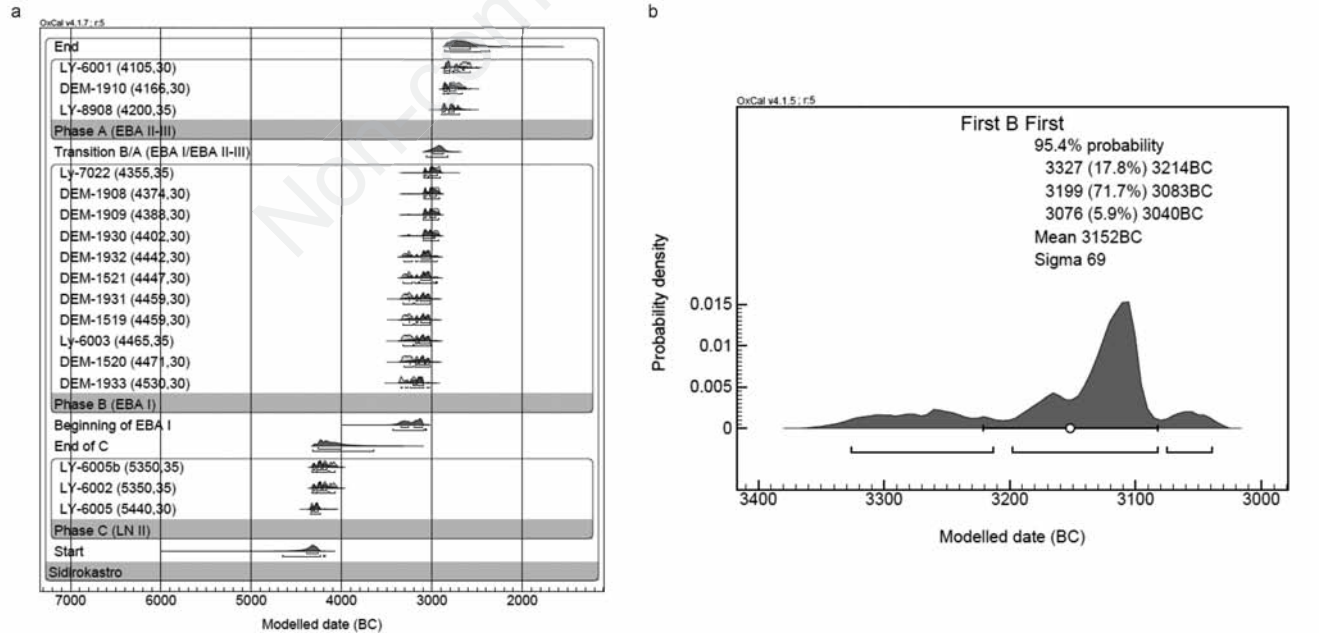

Figure 4. Sidirokastro. a) Multi plot of 2σ calibrated dates modeled statistically in one Late Neolithic phase (C) and two Early Bronze Age phases (B and A) using the OxCal v4.1.5 programme; b) modelled 2σ calibrated date of *first* event of Phase B (Early Bronze Age I) treated separately as a single phase group. Modelling performed with OxCal v4.1.5 programme.

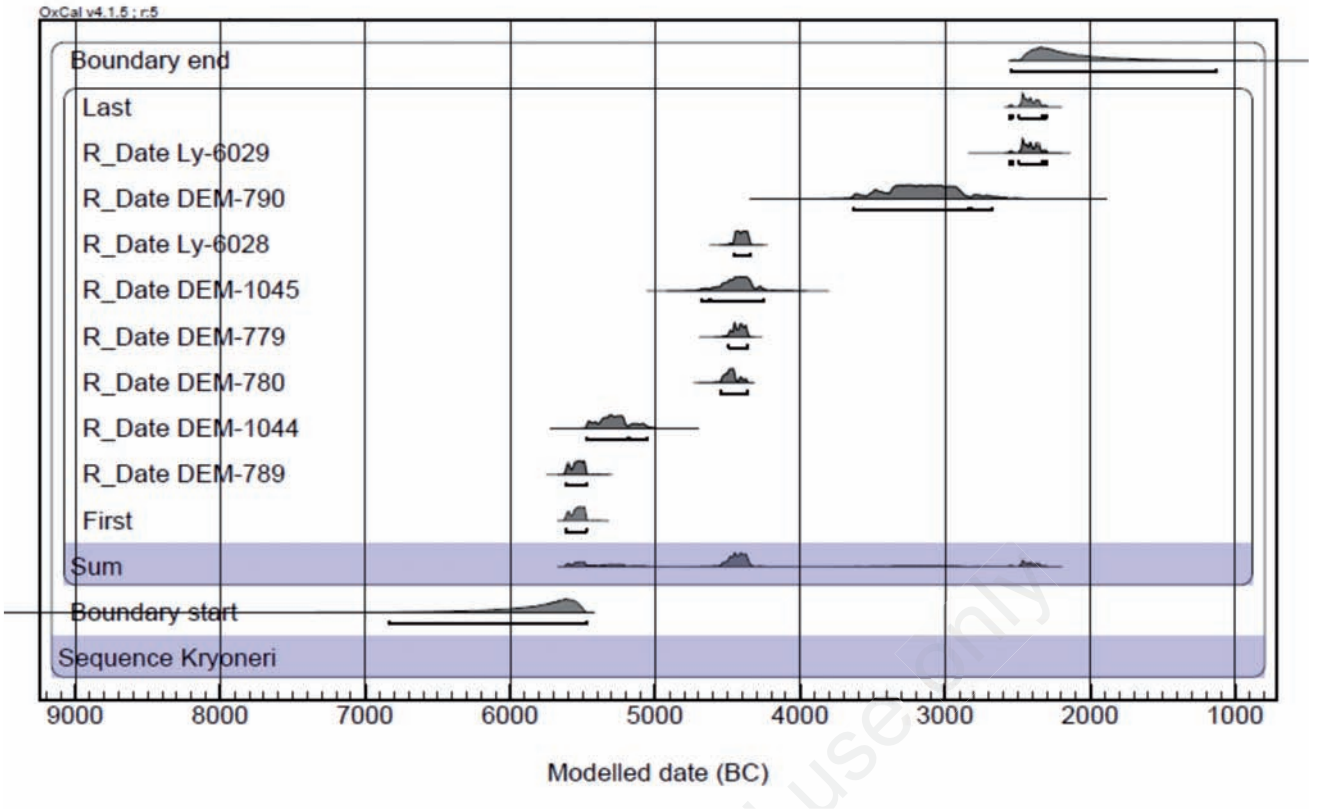

Figure 5. Kryoneri: multi plot of 2σ calibrated dates using the OxCal v4.1.5 programme..

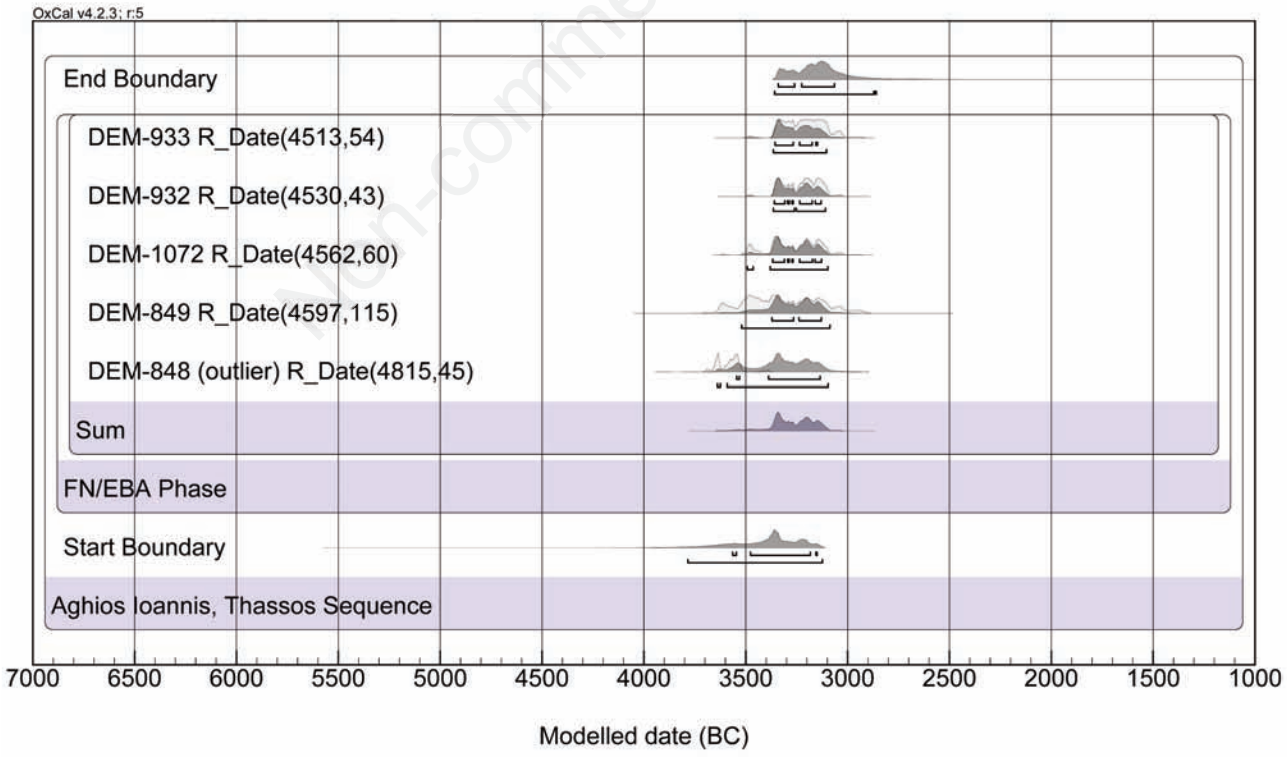

Figure 6. Aghios Ioannis Thasos: multi plot of 2σ calibrated dates modelled for one phase and treating sample DEM-848 as an outlier.

with what we know from the rest of Greece, and from Bulgaria, where the end of the local Late Chalcolithic is currently seriously revised; cf. latest radiocarbon dates from Varna (Higham *et al*., 2007), and further results of the BALKANS 4000 programme (Tsirtsoni, in press). At Dikili Tash, and maybe also at Sidirokastro, it seems that there existed *a short additional stage with LN features*, going as far as 4000 BC. Furthermore, there are several sites in East and West Macedonia where the LN is extended as far as the beginning of the 4th millennium cal. BC (Maniatis and Kromer, 1990). Similar observations are made in a number of sites further to the North, in the Bulgarian part of the Rhodopes, with dates going as late as 3800/3700 cal. BC (Görsdorf and Boyadziev, 1996; Tsirtsoni, in press). The latter have sustained the hypothesis of a relocation of LN settlements towards mountainous areas. But the presence of continuing occupation until the first centuries of the 4th millennium in several low land sites in North Greece contradicts this hypothesis. Thus, a different explanation is required for the generalized disruption of the settlement pattern in the plains near or just after 4000 BC.

The dates of the first properly speaking EBA layers fall between 3300 and 3000 BC, as in most other Aegean and Balkan settlements. But evidence from Sidirokastro suggests that the true start could be close to 3100 BC, thus leaving room for a precursory stage, represented by Aghios Ioannis.

Even so, a gap of several centuries remains with no visible trace of human occupation in the area: 700 or 1000 years at Dikili Tash, 1000 at Sidirokastro, maybe more at Kryoneri. The same picture is provided by the rest of Greece (Northern and Southern), which counts for the moment (2010) *no more than 20 radiocarbon dates with acceptable errors* (≤80 years) falling in this interval, representing hardly more than a dozen of sites.

This, as it appears, extensive – although not simultaneous – abandonment of previously occupied settlements is definitely a major human behavioral event. But it does not mean that human activity ceased completely. Evidence from paleo-environmental research in the frame of the BALKANS 4000 programme shows *only minor changes in the rate of sedimentation* or the agricultural practices in the vicinity of settlements. In other words, people are definitely somewhere close, but their traces remain to be found — if still preserved. The very diversity of the affected settlements points towards a social phenomenon rather than towards environmental pressure. Thus, changes in the settlement pattern in Greece at the transition from LN to the EBA could be triggered by some climatic instability, but would be mostly due to human choices.

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