8. The absolute chronology of northeastern Thessaly supported by new radiocarbon evidence

Agathe Reingruber, Giorgos Toufexis and Yannis Maniatis

8.1. Introduction

It is well known how difficult it can be to provide not only sufficient and suitable but also reliable sample material for radiocarbon dating. This is the case not only with exposed surface materials from systematic surveys (e.g. from Elateia 1), but also with samples from greater depths, protected by meter-high deposits (e.g. Chalki). Nevertheless, our efforts have been rewarded, as we are now able to present new data not only from a magoula but also from an extensive flat site, and draw better conclusions regarding the beginning of the EN and the transition to the MN in this part of Thessaly. Our results are based exclusively on animal bone material both from our surface investigations in Elateia 1 and from excavations carried out in the last century in Nessonis I-II (Theocharis in 1957) and in Chalki (Toufexis in 1994).

Of the total of 144 faunal remains, 67 bones from our working area were first carefully selected according to zoological criteria; to these 20 samples from Chalki 1 were added. With the help of the archaeozoologist Maaike Groot (compare Chapter 11), we have selected only bones from herbivores to avoid problems related to the reservoir effect in omnivores (humans, dogs and pigs) or aquatic species. Also bones with traces of fire were excluded as their collagen content is expectedly too low. Among the bones identifiable, the following animal species were determined by M. Groot (by photo only): sheep/goat (16) and medium mammal (8); cattle (10) and large mammal (8); bird (1); indeterminate (24).

As a first step, the bones were analysed for their collagen content at the Demokritos laboratory in Athens. Priority was given to bones determined by species and only if such bones were not available, also undetermined fragments were considered. Of the 87 specimen 33 contained enough collagen at first inspection, 27 too little and 27 none at all. The most promising ones were sent to the laboratory in Mannheim for AMS dating.[1] 16 turned out to be satisfactory[2] (Table 8.1). During the project period, the laboratory in Mannheim raised the lower limit of the collagen content necessary for reliable results to a minimum of 0.6%, preferably to 1.0% and above.[3] This means that samples with a very low content would not have been dated later on anymore and these results should be taken with caution. However, 11 of the valid samples have a content of 1% collagen or more. These dates can be considered very reliable. Additionally, the laboratory reported that only "collagen with C:N ratios of 2.9 to 3.6 is considered to be of good quality. Large deviations from that range indicates degraded collagen and may alter the ^{14}C ages".[4]

---

[1] We would like to thank the staff of both laboratories, especially Dr. Giorgos Polymeris from the Laboratory of Archaeometry, Institute of Nanoscience and Nanotechnology, National Centre for Scientific Research "Demokritos", Athens (laboratory code DEM), and Dr. Ronny Friedrich from the Klaus-Tschira-Labor für Physikalische Altersbestimmung, Curt-Engelhorn-Zentrum, Archaeometrie gGmbH, Mannheim (laboratory code MAMS).

[2] From the additional report sent by Dr. Ronny Friedrich, June 25, 2020: „All diese Proben wurden mit unserer milden Aufbereitungsprozedur behandelt und lagen dabei teilweise über Wochen in schwacher Säure im Kühlschrank. Damit wird sichergestellt, dass die Reaktion langsam abläuft und das Kollagen geschützt wird. Dabei werden sie täglich kontrolliert, damit bei abgeschlossener Reaktion die Säure sofort entfernt werden kann. Entweder sind die Proben auch nach vier Wochen in Säure nicht weich geworden oder hatten sich aufgelöst, ohne dabei Kollagen zu hinterlassen. Bei den Proben bei denen scheinbar Kollagen extrahiert werden konnte, wird natürlich der Prozess weiter geführt mit der Zugabe von Base (und nochmals Säure) und schlussendlich der Ultrafiltration. Bei all diesen Schritten kann nun ebenfalls Kollagen abgebaut werden. Besonders bei der Ultrafiltration werden nur die intakten langen Kollagenketten gefiltert, da die kurzen Ketten möglicherweise stark degeneriert sind oder gar nicht vom Kollagen kommen. Nur die langen Ketten liefern in der Regel belastbare Alter. Es kann also durchaus möglich sein, dass ein erster Kollagentest geringe Mengen Kollagen anzeigt aber diese Kollagen nur aus kurzen Ketten besteht. Davon bleibt dann schlussendlich leider nichts übrig was verlässlich datiert werden kann."

[3] Report by Dr. Susanne Lindauer, May 6, 2020.

[4] Report by Dr. Susanne Lindauer and Dr. Ronny Friedrich from February 10, 2022.

Publiziert in: Reingruber, Agathe; Toufexis, Giorgos (Hg.): Siedlungsdynamik in den Becken von Sykourio und Elateia, Nordost-Thessalien, in prähistorischer Zeit. Ergebnisse der archäologischen, geomorphologischen und geophysikalischen Untersuchungen, Heidelberg, Propylaeum, 2025 (Prähistorische Archäologie in Südosteuropa, Bd. 34). DOI https://doi.org/10.11588/propylaeum.1583

Site	Lab. code	BP	±	calBC[1] 1σ	δ13c (‰)[2]	%C	C:N	coll %	Sample No.	Area, Trench	Material
ELA1	DEM-3269, MAMS-37738	7464	26	6400-6250	-19,6	21.2	3.2	0.6	F148-B1	SW	cattle, indet.
ELA1	DEM-3270, MAMS-37739	7098	26	6020-5920	-21,4	27.8	3.2	**1.7**	F148-B2	SW	indet.
ELA1	DEM-3403, MAMS-45204	7044	33	5990-5890	-13,9	32.9	3.3	**6.1**	F213-B1	NW	indet.
ELA1	DEM-3272, MAMS-37741	6995	25	5970-5840	-20,6	28.8	2.9	**1.3**	F149-B5	SW	large mammal, indet.
ELA1	DEM-3268, MAMS-37737	6989	25	5970-5830	-18,3	19.3	3.2	0.5	F145-B3	SE	cattle?, pelvis?
ELA1	DEM-3271, MAMS-37740	6732	26	5670-5620	-20,5	19.7	3.3	0.5	F149-B4	SW	sheep/goat, humerus L.
ELA1	DEM-2805, MAMS-53367	6484	28	5480-5380	-24.5	12.9	3.9	0.8	F499-B4	CSE	indet.
CHA1	DEM-3365, MAMS-43466	7167	29	6070–6010	-12.0		3.5	0.9	52	Tr. A, #36-5	sheep/goat, radius
CHA1	DEM-3363, MAMS-43464	7142	30	6060–5980	-19.6		3.2	7.3	39	Tr. A, #30	sheep/goat?, calcaneum
CHA1	DEM-3364, MAMS-43465	7098	29	6020–5920	-20.2		3.3	1.0	49	Tr. A, #35	sheep/goat, metapodial
CHA1	DEM-3362, MAMS-43463	7090	29	6010–5920	-20.4		3.2	4.9	37	Tr. A, #27	sheep/goat, radius
CHA1	DEM-3358, MAMS-43460	6730	28	5670–5620	-18.4		3.3	1.5	11[3]	Tr. A, #9-1	sheep/goat, tibia
NESS	DEM–2821, MAMS-54585	7455	29	6390–6250	-18.1	33.1	3.2	3.6	NESS-09	Tr. 1957, 0.80 m	med. mammal, indet.
NESS	DEM–2820, MAMS-54584	7450	28	6380–6250	-18.7	40.9	3.2	11.9	NESS-08	Tr. 1957, 0.80 m	med. mammal, indet.
NESS	DEM-2819, MAMS-54583	7420	29	6370–6230	-19.5	28.9	3.3	2.8	NESS-02	Tr. 1957	sheep/goat? metacarpus?
PRO	DEM–2807, MAMS-53369	2473	22	750-540	-21.6	17.7	3.3	0.6	PRO-B1	Open profile	bird, tibiotarsus
MAK1	Lyon-7639, Sac-22600	6420	50	5480–5330						Pit in sq. A29, unit 21/23	Charcoal
MAK1	DEM-2158	6417	30	5480–5360	-24,6					Sq. A33, unit 9	Charcoal
MAK1	DEM-1249	6410	46	5480–5320						Pit in sq. A31, layer 11, unit 60	Charcoal
MAK1	DEM-1161	6370	25	5370–5310						Sq. A33, layer 1, unit 9	Charcoal
MAK1	Lyon-7638, Sac-22599	6190	50	5220–5050						Pit in sq. A27, unit 17	Charcoal

[1] For the calibration of the dates the program OxCal v.4.4.4, last updated November 24, 2021 with the most recent dataset of 2020 (Reimer et al. 2020) was used: (c) Christopher Bronk Ramsey 2021 (https://c14.arch.ox.ac.uk/oxcal/OxCal.html). Dates were rounded to the nearest decade.

[2] Note from the laboratory: The $\delta^{13}C$ values may be influenced by isotope fractionation in the ion source and hence this value is not comparable to the one obtained in a stable isotope mass spectrometer (IRMS).

[3] Note from the laboratory: Sample MAMS-43460 was not treated with base as it was almost dissolved, possibly also influencing to a certain extent its younger age.

Table 8.1. Results of the 16 succeeded samples: seven from Elateia 1, five from Chalki 1, three from Nessonis I/II and one from Profitis Ilias; deviations from the standard values are depicted in red. The five dates from Makrychori 1 are from Reingruber et al. 2017, 46, Fig. 15.

The 16 dates were obtained from animal bones of the following species: sheep/goat (7), medium mammal (2), cattle (2), large mammal (1), bird (1); undetermined (3).

The only radiocarbon dated site so far within our working area had been the Magoula Makrychori 1 with results falling into the range of the LN I[5] – for the LN and for the Chalcolithic we have not obtained any new datasets. The oldest dates in the new series are those from Nessonis, followed by the dates from Elateia 1 and Chalki 1. These dates cover specific phases of the EN and MN, as will be discussed below. The sample from the hilltop site of Profitis Ilias was taken from a bone in the profile that had been exposed to erosion and interventions: it is discussed in Chapter 6.2.8.

[5] Reingruber et al. 2017, Fig. 15.

8.2. The radiocarbon dates from Nessonis I (Nessonis1-East)

In 1957, Dimitrios Theocharis examined by means of small sections two of the Nessonis sites, namely those in the proximity of the Thessalian Plain: Nessonis I and II[6] (compare Chapter 1.3). Since at that time the location of the Ephorate in charge was in Volos, all finds were stored and inventoried there, and only later on handed over to the Ephorate in Larissa. One such box contained decorated sherds, stone and bone tools from investigations carried out by Theocharis in the area of "Nessonis" between 1957 and 1964 (sites Nessonis I–VI). The documentation of these investigations has not yet been assessed. Fortunately, either under the instructions of Theocharis, or only later on, the finds were labelled in black ink or lead pencil with some specifications regarding their context. Therefore, we were able to sort (some) finds by sites and (a few) by stratigraphic positions. Among the finds were 14 bones with inventory numbers given in the museum of Volos, starting with O (for οστό, bone), followed by a code (144) and a number (e.g. O-144.002).

Our aim was to obtain a reliable sequence from these important, since contextualized, bone fragments. The bones were initially interpreted by the excavator as tools or fragments thereof and at such not discarded together with the faunal material. A detailed examination of the specimens revealed that only four of them were actually shaped and used as tools, the other ten were unworked fragments from medium mammals, mainly sheep/goat. Four were either burnt or lay in a greyish-dark soil, but other six were considered suitable for radiocarbon dating. We submitted them for pretreatment and subsequent dating to the laboratory in Athens in November 2021.

On some bones was written a Roman "II" that we related to the Magoula Nessonis II, as well as a figure (0.80) that we identified as the depth in meter (below the modern surface) of the layer in which the bones were found. We concluded that they could derive from the upper level of Nessonis 2 of the MN and expected an age of ca. 5800 calBC. This interpretation was grounded on the descriptions of Theocharis 1962, 81, according to which:

"The trial excavation on the adjacent magoula of settlement II showed that this place had been inhabited as soon as the previous one was deserted or abandoned. Indeed, here the deepest layer started within the EN III, i.e. the period of the A2 impressions, which are amazingly abundant (Pl. X), and the highest in the Middle Neolithic. From the end of this period we have a lot of "red monochrome" ("ερυθρά μονόχρωμα"), typical of A1 (Pl. XI.1) and painted A3b mainly (Pl. XI.2)."

To our surprise, all three dates were 500 years older than initially estimated (Table 8.1). We do take the results as reliable as the collagen content is above the limit, and the C:N ratios with values at 3.2 and 3.3 indicate uncontaminated collagen. A viable explanation may be that the faunal material was not found on the Magoula Nessonis II but rather in close-by Nessonis I, as this site was the only one that provided materials from the EN. Caution is indeed required when allocating finds, because in the 1962 report the assignments in the text and in the illustrations to either Nessonis I or II are not always consistent (see Chapter 1.3).

Theocharis described the stratigraphic situation in Nessonis I according to two layers separated by a stone alignment. The second layer started below the stone level that covered and sealed it at c. 0.9–1.2 m.[7] If the indication "0.80" written with ink on the bones is indeed relating to the depth of the level they were found in, they are attributable either to the level directly above the stones (if the depth is measured from top down) or to the level just under the stone (if the depth is measured from bottom up) – to this latter interpretation would fit the way the scale had been added to the graph in Theocharis 1962, Fig. 2 (compare Figure 1.3.4).

From the results we can conclude that the faunal material did not originate from the upper layer of the Middle Neolithic Magoula Nessonis II, but rather from the Early Neolithic site, Nessonis I, second (lower) layer (or layer II). If our reasoning holds true than we have indeed succeeded to directly date the earliest occupation level in the whole working area. Even if our interpretation is

[6] Theocharis 1962, 77–81.

[7] Theocharis 1962, 79: "The second, that is, the deeper layer (…) started right under a cobblestone (depth 0.90 m below the surface)."

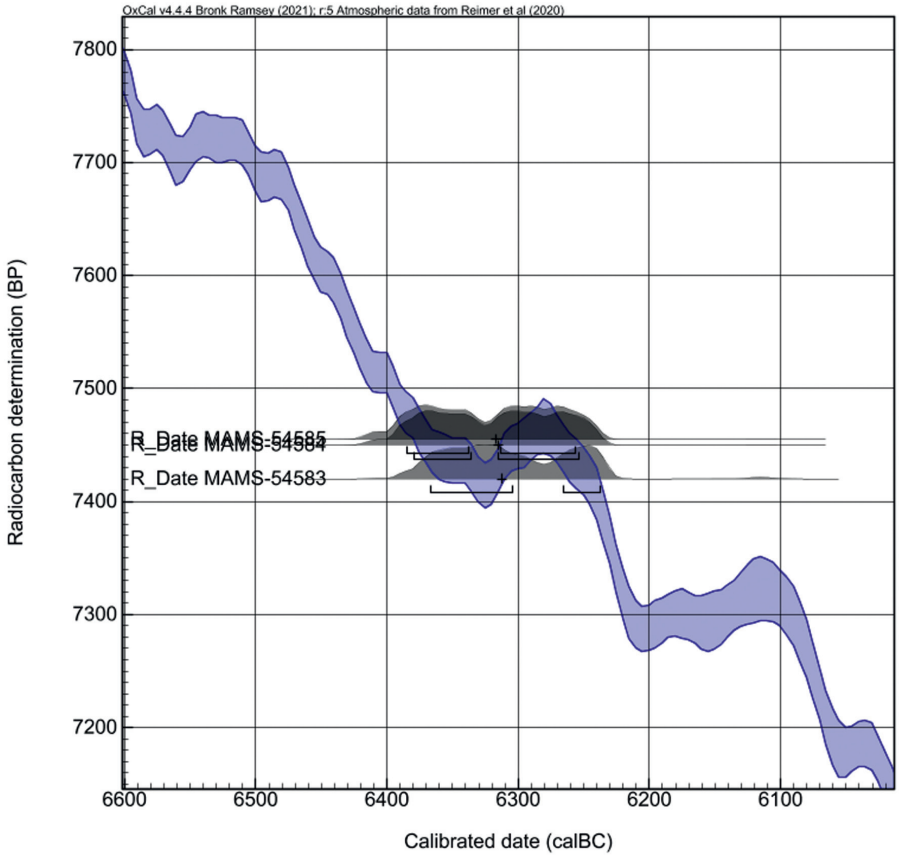

Figure 8.1. Nessonis: Calibrated radiocarbon dates plotted on the calibration curve, with medians around 6320 calBC.

wrong, we nevertheless have been able to obtain new dates for the EN in the area of Nessonis I–II, confirming that the hitherto oldest sites in the working area are to be found in the SW-part of the Basin of Sykourio, close to the Thessalian Plain.
From the six selected samples only three contained enough collagen for dating. Their agreement is convincing, and they are probably dating the same event. As they overlay two wiggles in the calibration curve, their span is artificially extended over a long duration of almost 200 years (Figure 8.1). In this interpretation we are taking their medians at shortly before 6300 calBC as possible indications for a more precise dating. The lower layer of the site Nessonis I may thus be attributed to the EN II and the upper one either to a later stage of the same phase or to the EN III.
As such, 6320 calBC is considered a reliable *Terminus a quo* (TAQuo) for the beginning of the Neolithic way of life in the Basin of Sykourio.

8.3. Absolute chronology in Elateia 1

During our surface surveys we were able to collect 117 animal bones, teeth and shells from the flat extended site of Elateia 1 (compare Chapter 11). From them 32 animal bones were pre-selected for radiocarbon analysis. Priority was given to sheep-goat and cattle; pig and dog were omitted. First, a collagen test was undertaken in the Laboratory of Archaeometry "Demokritos" in Athens, and only the most promising samples were sent to the Curt-Engelhorn-Zentrum in Mannheim. Unfortunately, not all of them succeeded, but, still, seven bones were found with sufficient datable matter (Table 8.1).
Of these, four contained less than 1% collagen (three of them even only 0.6% or less) – but these dates were obtained before the laboratory in Mannheim raised the limits to preferably above 1% collagen. The C:N ratios are within acceptable limits except for sample

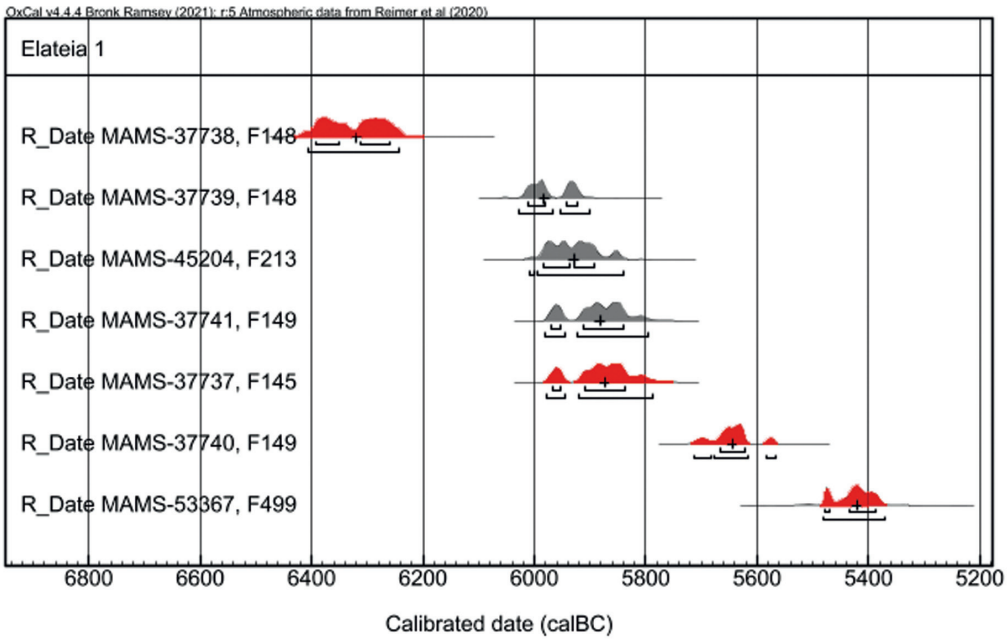

Figure 8.2. All seven calibrated ^{14}C dates from Elateia-Bigmeni Petra in chronological order (in red: samples with insufficient collagen).

MAMS-53367 (from F499), with a high ratio at 3.9. Besides its insufficient collagen content, this deficit further prevents a closer assessment.

In Figure 8.2 are indicated in red color those dates with insufficient collagen. Three of them are much older or younger than the rest of the dates and with our todays knowledge we would certainly not have submitted these samples for costly treatment. That these three dates are outliers is justified by the fact that no older and also no younger materials than those of the MN I have been found on the vast surface of the site. Of course, we cannot exclude short visits to the site during the EN, the late MN and the early LN, but they are not provable by the archaeological material.[8]

In our interpretation we treat the three dates (MAMS-37738[9], MAMS-37740 and MAMS-53367) as outliers. The other three dates together with MAMS-37737 are consistent and cover almost 200 years between 6020 and 5830 calBC (at 1σ-interval). If we use their medians, the time span narrows to 110 years only between 5980–5870 calBC.

This important assessment regarding the validity of the dates is based on the one hand upon the detailed information we received from the laboratories. On the other hand, our interpretation is supported by the reference site we chose for comparison, namely Chalki 1 (see below). We are now in a better position to assess the pottery production shortly before and after 6000 BC and to determine how quickly shapes and decorative styles changed (or not) and new ones were added.

The pottery styles from 6000 calBC onwards belong in a relative chronological terminology to the early MN (compare Chapter 6.3.1). Decoration styles from the EN do continue into the MN but with slight changes: the impressed decorations are now mainly obtained with a comb-like instrument and are as such a bit younger than impressions made with a broad tool or nail.[10] Comb-impressions are

[8] Pottery styles of the EN (blacktopped, early painted pottery), late MN (e.g. grey-on-grey) and early LN (e.g. black polished or mat painted) are completely missing.

[9] MAMS-37738 was collected from the same field as the more reliable date MAMS-37739 to which priority is given.

[10] This observation is supported by the situation in Otzaki Magoula, where the so called "Cardiumzier" occurs in the upper spits of "Fläche III" (Milojčić-v. Zumbusch 1971) and the lower spits of "Fläche II" (Mottier 1981).

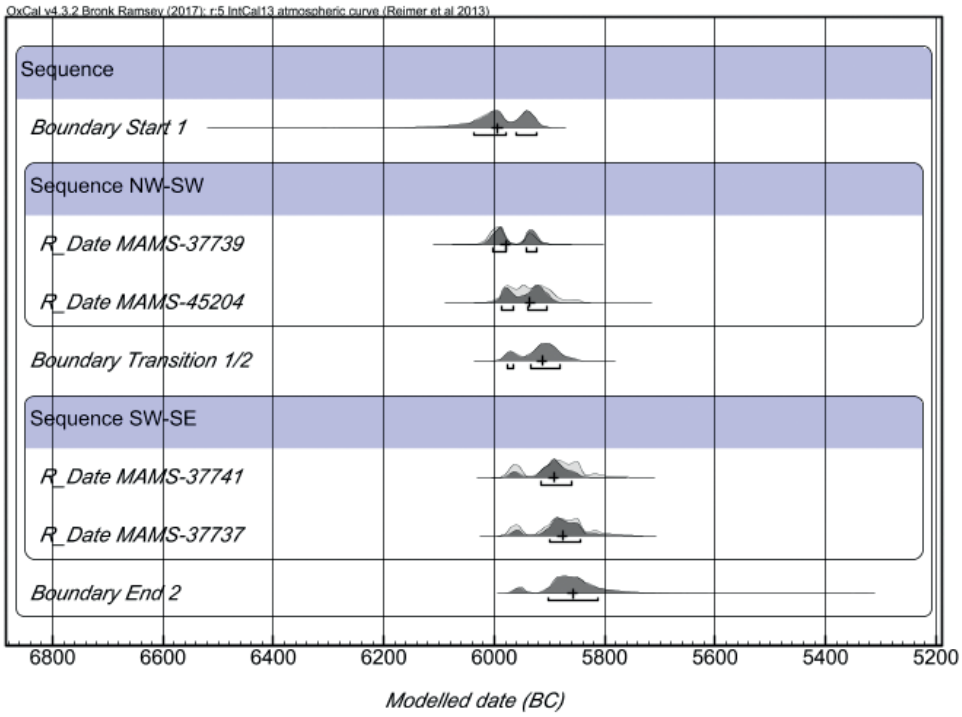

Figure 8.3. Modelled ^{14}C dates from Elateia-Bigmeni Petra according to areas, omitting the outliers.

coeval with the red on white painted pottery with geometric designs and with the scraped variant. The two styles of painting (with red and/or white colour) and impressing (always with a tool) were at a later stage of the MN combined into the so-called 'fusion style'. But the site of Elateia 1 was left before this style got more prominent as only one sherd of this kind was found. Both the relative and the absolute chronological assessment point to the fact that Elateia 1 was not inhabited during the whole period of the MN. It may have been left just shortly before 5800 calBC. According to our previous evaluations of Aegean data sets[11] this period belongs to the first phase of the Middle Neolithic (MN) in Thessaly. When calculating with 25 years per generation, the site Elateia 1 has been inhabited only over maximum eight and minimum four generations.

Additionally, the different decoration styles were not evenly distributed over the settlement area. This suggests that a horizontal shift may have taken place: the oldest pottery styles appeared in areas NW and CSW, the youngest in SW and SE. Four ^{14}C dates are by far not sufficient to independently create a reliable reconstruction of the chronology of the site. Yet, they offer slight indications that such a horizontal shift may indeed have occurred from NW/W towards SW/SE (Figure 8.3).

8.3.1. Failed samples and post-depositional processes

Dating surface material is, of course, not without risk. The fact that no later archaeological materials than that of the MN were found on the surface of Elateia, as well as the good state of preservation of some of the bones, encouraged us to use them for dating purposes. To our satisfaction, the samples with sufficient collagen and an intact C:N ratio provided results in the same time range. This fact once more supports our appraisal of the relative chronology of the site within the MN I.

We were further rewarded by the fact that even bones containing no collagen are not useless, as they also provide information: their occurrence is not a matter of coincidence but determined by post-depositional processes. If no collagen is preserved, this may be an indicator that it has been washed out when standing over longer periods of time in water. As such, it must be pointed out that from

[11] Reingruber and Thissen 2009; Maniatis 2014; Reingruber et al. 2017.

12 samples collected from five fields in the deeper northern areas NW and CNW (F046, F049, F051, F201, and F213), only one single bone contained enough collagen for dating (F213-B1) – a ratio of 1:12 or of 0.08. On the other hand, the bones from the higher southern part of the site, south of the almond grove, gave far better results with almost half of the bones containing enough datable collagen (ratio 5:11 or 0.45). These fields in areas SW and SE (F108, F109, F144, F145, F148, F149), were presumably safe from intruding waters.

Results from pottery analysis showed that in the northern areas most of the sherds were heavily rolled, as if lain in water. Also the magnetogram suggests that in the northwestern area (and at the fringes of the southern ones) water may have washed out the soils resulting in whitish spotted parts (compare Chapter 9.3.6.2 and Fig. 9.3.1). And if the collagen has been washed out of many of the bones again from the northern part, this may be an additional hint that water was indeed an issue especially in this part of the site. The ditch surrounding the NE part, may have been constructed to control both the desirable water for irrigation and household activities and the undesired inundations in times of heavy rainfall. But water may have posed a problem at certain times, specifically at the end of the site's occupation. As climate curves show, the extremely dry and cold 8.2 ka event was followed by a sudden warm and humid period that reached a peak around 5800 calBC that has not been exceeded afterwards (compare Chapter 12 and Fig. 12.7). Eventually, the site was abandoned, presumably because of flooding. Its later coverage with dense vegetation (forest?) may have been one of the reasons that the area was not inhabited thereafter again.

8.4. The importance of the absolute dates from Chalki 1 and Makrychori 1

All samples from Chalki derive from trench A with five layers excavated in July 1994. We opted for this site as reference site as it was excavated according to modern methodology with a clear and comprehensive documentation.[12] Together with a reliable relative chronological appraisal, also a detailed description of the bones' contexts was available. The lowest levels 39–28 belong to layer 5. They were esteemed as "very informative for the definition of the early MN and require an in-depth study."[13] The 2 m thick deposit above contained valuable information regarding the smooth transition between the EN and MN that has until now not been well described, not even in Achilleion and Otzaki.

The elaboration of a complete sequence from Chalki 1 was intended to serve as a reference for the relative and absolute chronology in the basins of Elateia and Sykourio. In a first step we selected 56 samples from the bulk of the faunal material[14]. With the help of Maaike Groot we further selected from these the only well determinable bones especially from herbivores (sheep or goat, in one case No. 39 with question mark). These 20 samples were sent to Athens for a first control of the collagen content. Seven were found to be worth to be submitted for AMS dating in Mannheim and five of them succeeded. Based on the stratigraphical context of each bone we were fortunate to obtain solid data for the beginning of the sequence (four bones from the lowest levels 36–27). Even though only one date succeeded from the upper end of the sequence (level 9) we were nevertheless able to determine the chronological frame of the site. More bones have to be selected from units in levels A10–A26 in order to finalize the representative sequence we aimed at. Nevertheless, we are encouraged in our interpretation that these few dates do represent the entire duration of the Thessalian MN by the new sequence obtained at Platia Magoula Zarkou in western Thessaly. The duration of this sites' occupation between c. 5900 and 5600 calBC was determined on the basis of ten dates modelled using Gauss-Monte-Carlo-Wiggle Matching (GMCWM).[15]

[12] Toufexis 2003, 501–505.

[13] Reingruber 2008, 301: Already in level 39 impressed decoration occurred together with concave profiles of vessels, comparable to examples from Achilleion III b und IV a (Winn and Shimabuku 1989, Fig. 5.56/27 and 5.61/16–19). Decorated sherds are rare, but single impressed examples occurred. In level 27 the comb-like (dotted) decoration was present and other impressed bodysherds continued to be produced until level 21 when red on white paint prevails with the well-known patterns (flames, chevrons and lattice designs). The shapes now have carinated profiles or are slightly concave; the bases are flat and the walls are sometimes very thin.

[14] We would like to thank Angeliki Chalkia for her support in this work.

[15] Weninger et al. 2022, 195 and Fig. IV.5.

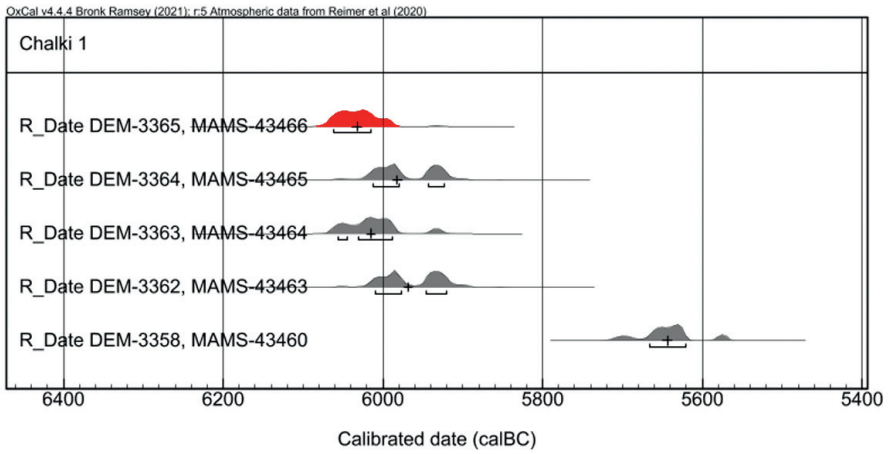

Figure 8.4. Calibrated dates listed in stratigraphical order (from old to young) – in red the sample with collagen content less than 1%.

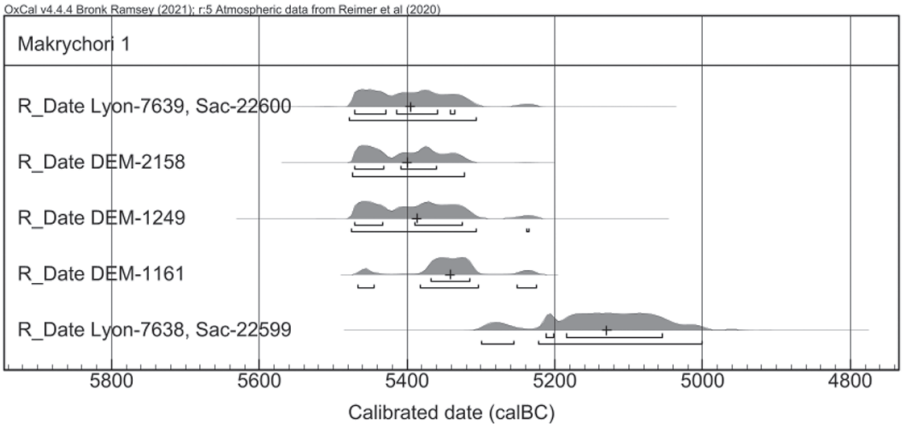

Figure 8.5. Calibrated dates from Makrychori 1 listed in chronological order (from old to young).

The start of the sequence in Chalki (Table 8.1 and Figure 8.4) fits well with the start of occupation in Elateia 1: the oldest date (DEM-3365, MAMS-43466) may be due to the collagen content of just below 1% a bit too old and the youngest date (DEM-3358, MAMS-43460) may be a bit too young. Nevertheless, we can assume that the site was used in a first phase of occupation – according to the medians – between 6030 and 5970 calBC. The youngest date can serve, as it is not from the uppermost level but from level 9, only as a *Terminus post quem* (TPQ) for the abandonment of the site around/after 5640 calBC.

For the transition from the MN to the LN there are no reliable absolute-chronological sequences available for the whole of Thessaly. In our working area we were not able to cover the time after 5800 calBC with ^{14}C data.. However, the delimitation of the late MN is also poor at other Thessalian sites. Some tell sites were abandoned at the end of the MN, others founded in the LN I, some reoccupied only during the LN II or later. A site with a continuity through these periods may be Makrychori 1. The five radiocarbon dates available (three are from pits) all belong to the LN I. According to their medians they cover a period between 5400 and 5130 calBC (Figure 8.5). These are the only dates obtained from the basins for this period. No dates are available from the LN II and CH..

8.5. Conclusions

Within the framework of the Thessaly project, we were able to select 87 bones from both surface collections and excavated material, which were

tested in a first step for their collagen content. Only 16 proved to be datable, 11 of them yielded very good results, both in terms of laboratory and archaeological expectations. We have thus succeeded in narrowing down the beginning of sedentism in our working area much more precisely: the oldest dates are from around 6320 calBC. They derive from the SW area of the Sykourio basin, which is closest to the Thessalian Plain.

In addition, we can make more precise statements about the transition from the EN to the MN around/shortly after 6000 calBC. In particular, the first phase of this period, the MN I, we can narrow down to between 6000 and 5800 calBC thanks to the new data from Elateia 1 and Chalki 1. The temporal closeness of the two sites allows us to better interpret the surface finds from Elateia 1 in relative chronological terms and to look at its occupation span in absolute chronological terms with greater clarity.

That the MN ended before 5600 calBC is suggested by the youngest date from Chalki 1 – but more information would be needed from this complete stratigraphical sequence of the MN. Dates for the LN I are available only from Makrychori 1. Much more efforts are required to establish a well-founded sequence for this and all the subsequent periods as well.

Bibliography

Maniatis 2014: Yannis Maniatis, Radiocarbon dating of the major cultural changes in prehistoric Macedonia: Recent developments. In E. Stefani, N. Merousis and A. Dimoula (eds.), A Century of Research in Prehistoric Macedonia 1912–2012. International Conference Proceedings. Archaeological Museum of Thessaloniki. (Thessaloniki 2014) 205–222.

Milojčić-v.Zumbusch 1971: Johanna Milojčić-v.Zumbusch, Die deutschen Ausgrabungen auf der Otzaki-Magula in Thessalien I. Das frühe Neolithikum. In V. Milojčić (Hg.), Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes 10). Habelt (Bonn 1971) 19–152.

Mottier 1981: Yvette Mottier, Die deutschen Ausgrabungen auf der Otzaki-Magula in Thessalien: Das mittlere Neolithikum. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes, 22 (Bonn 1981).

Reimer et al. 2020: P. Reimer, W. Austin, E. Bard, + 38 co-authors, and S. Talamo, The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). Radiocarbon 62(4), 2020, 725–757. https://doi.org/10.1017/RDC.2020.41

Reingruber 2008: Agathe Reingruber, Die Argissa-Magula: Das frühe und das beginnende mittlere Neolithikum im Lichte transägäischer Beziehungen. Die deutschen Ausgrabungen auf der Argissa-Magula II. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer Kulturraumes 35 (Bonn 2008).

Reingruber and Thissen 2009: A. Reingruber and L. Thissen, Depending on ^{14}C Data: Chronological Frameworks in the Neolithic and Chalcolithic of Southeastern Europe. Radiocarbon 51, 2009, 751–770.

Reingruber et al. 2017: Agathe Reingruber, Giorgos Toufexis, Nina Kyparissi-Apostolika, Michalis Anetakis, Yannis Maniatis, Yorgos Facorellis, Neolithic Thessaly: radiocarbon dated periods and phases. Documenta Praehistorica 44, 2017, 34–53. DOI: 10.4312\dp.44.3

Theocharis 1962: Dimitrios Theocharis, Nessonis. Thessalika 4, 1962, 77–81.

Toufexis 2003: Γ. Τουφεξής, Μαγούλα Χάλκη 1 (Μαγούλα Υδατόπυργου), ΑΔ (Χρονικά Β‘ 2) 52, 1997 (2003), 501–505). [Magoula Chalki 1 (Magoula Ydatopyrgou). ADelt (Chronika B‘ 2) 52, 1997 (2003), 501–505).

Weninger et al. 2022: B. Weninger, G. Toufexis and Chr. Batzelas, The Absolute Chronology of the Excavations: Radiocarbon Dating and Stratigraphic Age Modelling. In: E. Alram-Stern, K. Gallis and G. Toufexis (eds.), Platia Magoula Zarkou, The Neolithic Period: Environment, Stratigraphy and Architecture, Chronology, Tools, Figurines and Ornaments (Vienna 2022) 183–195.

Winn and Shimabuku 1989: S. Winn and D. Shimabuku, Pottery. In: M. Gimbutas, S. Winn and D. Shimabuku (eds), Achilleion. A Neolithic Settlement in Thessaly, Greece, 6400–5600 bc. University of California Press (Los Angeles 1989) 75–164.