Application of Bayesian statistics using the OxCal programme to carbon dating of Tell Sabi Abyad I

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Abstract

At Tell Sabi Abyad I in Syria around 8200 years ago, inhabitance moved from one part of the Tell (Tell A) to another (Tell B). This was accompanied by other changes in the population, such as new architecture and pottery. To determine if this move from Tell A to Tell B was caused by the 8.2 ka climate event, a cold period of around 160 years which occured around the same time, Bayesian statistics has been applied to a large set of carbon datings from Tell Sabi Abyad I. This was done using the OxCal 4.1 programme.

The results showed that the end of the inhabitance of Tell A coincides with the climate event, as does the beginning of Tell B. The end of Tell A has been dated to 8173-8129 calBP (95.4% probability), and the beginning of Tell B 8191-8056 calBP (95.4% probability). Because the 8.2 ka climate event has not been dated very accurately (it is thought to have occurred in the time period 8400-8000 calBP), these data are not conclusive evidence that the changed in the Tell were or were not caused by the climate event, but simply do not exclude either option. Most important in reaching any further conclusions is more precise information on the time of the 8.2 ka climate event.

Contents

1 Carbon dating

1.1 A brief introduction to carbon dating

Since the introduction of carbon dating in the 1950s, its power to directly date prehistorical organic objects such as bone and wood has had a tremendous influence on our understanding of the past. The impact of carbon dating can be found in many fields of research, such as oceanography, geology and many others, but perhaps the field most significantly affected is archaeology. Before the introduction of carbon dating, archaeologists had a very limited ability to estimate the age of objects. Natural climatological archives such as tree rings form a reliable way of determining the age of wood, but for other objects like the remains of other plants and animals, archaeologists were mostly limited to indirect dating methods, for example based on the materials and methods that were used. Carbon dating gave them a reliable way to date organic materials, based on a physical property of one of the elements that make up organic materials.

Carbon, one of the most abundant elements on Earth and present in all known life, occurs in three isotopes in nature. The most common of these are ^{12}C and ^{13}C, the first and second in terms of occurrence respectively. The third isotope, ^{14}C, is by far the rarest of the three; only one in every 10^{12} carbon atoms is ^{14}C. ^{14}C has one characteristic which sets it apart from the other two, namely that it is radioactive, with a half-life of 5730 years. This means that given a certain amount of ^{14}C, approximately half of it will have decayed into other elements (the decay product of ^{14}C is ^{14}N) after 5730 years [7].

All living organisms ingest an amount of ^{14}C; plants absorb it from the air through CO_2, and animals in turn eat these plants (or other animals). Because this process stops after the plant or animal has died, the amount of ^{14}C present will slowly decay, and as such the amount of ^{14}C that is left in a sample after a certain time provides a way of determining how long the organism that the sample came from has been dead.

1.2 The calibration problem

One of the major problems that arises in carbon dating, aside from determining the ^{14}C concentration in the first place, is knowing how much of it was in the sample at the time of death. The current concentration will obviously be larger if the initial concentration was larger, and the initial concentration is not constant over time. We cannot simply assume that the ^{14}C concentration in the atmosphere now is the same as it was a thousand years ago, or ten thousand. New ^{14}C atoms are created in the atmosphere through nuclear reactions with cosmic radiation [7]. The rate at which this happens depends on the flux of cosmic radiation that penetrates the atmosphere, which in turn depends on the Earth's magnetic field and the solar activity. One way of getting around this problem is performing carbon dating on objects that have a precise, well-known age. Obviously objects dated with carbon dating are not suitable for this, but wood can be precisely dated using dendrochronology (tree ring analysis). This way a relationship between the actual age and the age as determined with carbon dating can be found. This relationship is generally illustrated in the so-called calibration curve (figure 1).

But even with this curve, not all problems have been solved. Because the calibration curve exhibits many small fluctuations (called "wiggles" [15]) in addition to the overall trend, a single ^{14}C age can correspond to more than one real age, and carbon dating does not uniquely determine the objects age. Add to this the experimental uncertainty that arises in any measurement, and instead of a well-defined age one gets a probability distribution for the calibrated ^{14}C date; a function that shows how likely it is that the age of the object is in a certain age range. Because of the erratic behavior of the calibration curve these distributions are no longer Gaussian [18]. An example of such a distribution is shown in figure 2.

The timescale used in carbon dating (BP, before present) uses the year 1950 as a reference point (the "present"). This means that 5000 BP is 5000 radiocarbon years before 1950. It is important to note that BP only refers to *uncalibrated* ^{14}C dates, and as such they do not correspond to actual dates or years. After a ^{14}C date has been calibrated, the unit calBP is used, now meaning calendar years before 1950.

Because the complexity of the calibration curve, calibration is not done manually but with software that has been created for this purpose. An example of such a programme is OxCal [10]. The functioning of OxCal

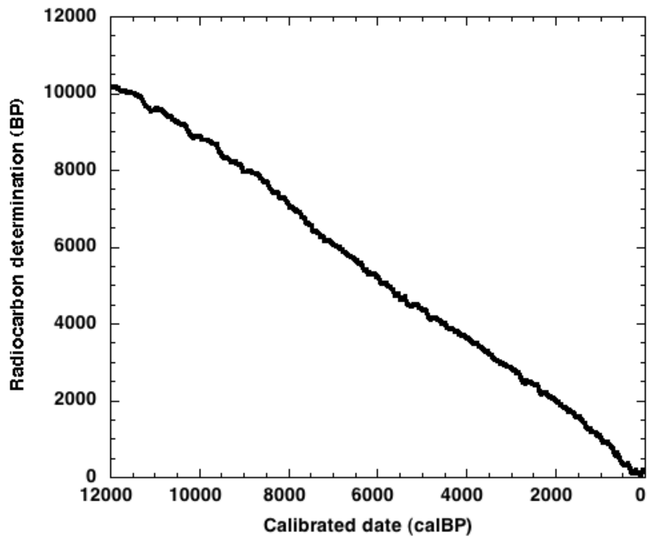

Figure 1: The calibration curve shows the relationship between carbon dates before and after calibration [12].

4.1 is described in chapter 3.

1.3 Physical criteria for reliable carbon dating

Not all organic samples are suited for carbon dating. Samples have to meet certain quality requirements in order to produce an accurate measurement, and sometimes no measurement can be done at all.

Larger samples can be more easily dated than small samples because it is easier to extract enough usable material from a larger sample. Small samples can be dated, but these datings are often much less reliable, as small samples get contaminated more easily. Small samples are harder to process into a usable material because of this, resulting in a less accurate measurement, which in the most extreme cases can render the dating useless entirely.

There are also requirements for the composition of the sample. Since carbon needs to be extracted in order to date the material, the percentage carbon in the sample needs to be sufficiently high. A low carbon percentage does not mean that it cannot be dated, but, as with small samples, it will produce less accurate measurements. The amount of ^{13}C present in a sample is an indication of what kind of material it is made of, as this amount is characteristic for various materials. It can be used as an additional check in case it is not obvious what the sample is made of [17].

The ^{13}C content of a sample also has to be measured in order to apply a necessary fractionation correction to a radiocarbon measurement. Different isotopes behave a little differently in chemical reactions, so for example $^{12}CO_2$ is absorbed by plants more easily than $^{13}CO_2$, which in turn is more easily absorbed than $^{14}CO_2$. Because of this, there is a difference between the amount of the substance that was in the air and the amount that was actually absorbed by the plant. $\delta^{13}C$ is used for this correction [14]. Because it must be measured for this purpose anyway, using it as an additional check does not require extra work. On top of that it is a quality parameter, for example for degraded bone. For details of fractionation (isotope effects), see [14].

There are no absolute, objective rules for when the carbon percentage or the amount of ^{13}C is sufficient, but observations can be made about the values that have tended to produce good results in the past. These values differ per material, and some often used examples are shown in table 1.

$\delta^{13}C$ is defined by

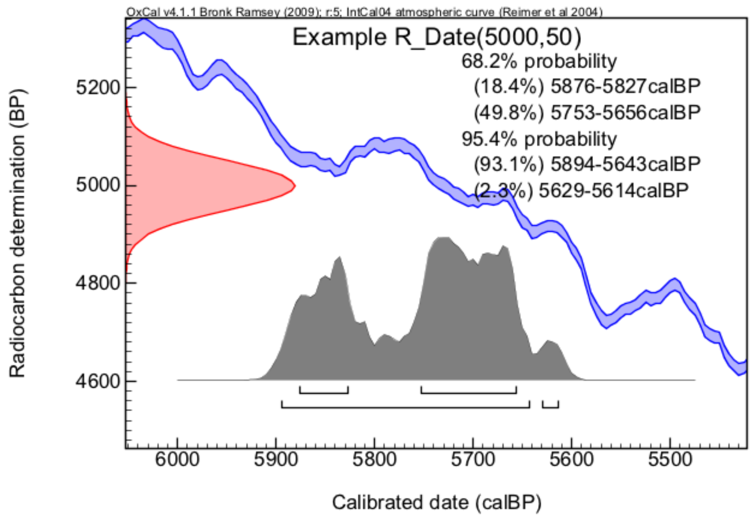

Figure 2: Probability distribution for the age of a object after calibration with the calibration curve (blue). The red line is the ^{14}C age with uncertainty, the gray line is the probability distribution for the object's real age. For the red and gray lines, the height of the line is the probability of that age. A hypothetical dating with a ^{14}C age of 5000 years and an uncertainty of 50 years was used. This image was created using OxCal 4.1 [10].

Material	%C	δ^{13}C (‰)
Charcoal	62-74	-28 to -22 [17]
Bone	45-50	-22 to -18

Table 1: Examples of the criteria used to determine how suited a sample is for carbon dating. All data are from [14] unless otherwise noted.

$$\delta^{13}\mathrm{C} = \left(\frac{\left(\frac{[^{13}\mathrm{C}]}{[^{12}\mathrm{C}]}\right)_{sample}}{\left(\frac{[^{13}\mathrm{C}]}{[^{12}\mathrm{C}]}\right)_{standard}} - 1 \right) \cdot 1000‰ \tag{1}$$

It compares the ^{13}C content of the sample to that of a predetermined standard. This ^{13}C content itself is defined by the ratio of ^{13}C to ^{12}C (square brackets indicate concentrations) [14]. The international standard used for this purpose is called PDB, and comes from carbonate from a belemnite from the North American PeeDee formation [14]. This carbonate has an *absolute* isotope ratio of [8]

$$\left(\frac{[^{13}\mathrm{C}]}{[^{12}\mathrm{C}]}\right)_{PDB} = 0.012372 \tag{2}$$

2 Tell Sabi Abyad and the 8.2 ka climate event

2.1 The 8.2 ka climate event

Around 8500 years ago, large ice sheets were still present on the Earth as remnants of the last ice age. However, the increased temperatures was causing much of this ice to melt. Held back by the large amounts of ice still present, some of the meltwater was contained in enormous superlakes, cut off from the ocean, an effect that may have been intensified by the effect of the ice age and ice sheets on the land beneath the ice. One such superlake is called Lake Agassiz, stuck behind the Laurentide Ice Sheet in what is now central Canada. This lake, when it was at its largest, is estimated to have held a staggering 163000 km^3 of fresh water [3].

As the Laurentide Ice Sheet melted, the water contained in Lake Agassiz trickled into the ocean, but the vast majority of the water in the lake was released in a small amount (possibly only one or two) of massive outburst floods. Because the amount of water released at once is so large, this event had a large impact on the thermohaline circulation (THC). The THC is the part of ocean circulation driven by differences in salt content and temperature of oceans. Salt content and temperature influence the density of the water, leading to a sinking of heavier water, which is colder and and contains more salt. The water that was introduced to the oceans from Lake Agassiz was fresh, causing the surface water of the oceans to freshen, making it lighter and thus weakening the THC. The THC is responsible for a lot of energy transport across the globe, so the weakening of this circulation has a significant effect on the global climate. This effect is the greatest in north west Europe because of its close proximity to the THC.

Evidence gathered from ice cores in Greenland, as well as many oceanic and terrestrial sources, indicate a sharp drop in temperature in large parts of the Northern Hemisphere for a period of around 160 years. This abrupt climate change is believed to have been caused by the change in the THC as a result of the draining of Lake Agassiz, and is called the 8.2 ka climate event. There is little evidence for the influence of the event in the Southern Hemisphere [19]. The event is dated to have started in the year 8247 calBP and ended in the year 8086 [5], with an error margin of about 50 years [9], [6]. Another source of information with regard to the timing and duration of the climate event is the reduced deposition of subfossil oak trunks near the River Main from 8220 to 7950 calBP [13], which is thought to have been caused by climate changes. The original publication about the existence of the 8.2 ka climate event, based on the dating of sediments near where the event took place, places it in the period 8400 to 8000 calBP [4]. Taking these various sources and their uncertainties into consideration, the 8.2 ka climate event cannot be reliably dated more precisely than 8400 to 8000 calBP.

2.2 Tell Sabi Abyad

In the northern part of Syria, near a tributary of the Euphrates called the Balikh, a location now called Tell Sabi Abyad I has been inhabited from roughly 7000 BCE[1], a period called the Late Neolithic Era. The continued inhabitance of the location for thousands of years has caused a mound to form, made of ruins and debris from the various stages of the settlement. Such a mound is called a Tell (or Tel), and contains a wealth of archaeological information [2], [17]. For a general introduction into the archaeology of Syria, see [1].

Tell Sabi Abyad I is special in that it is one of the oldest such Tells currently being excavated. The early inhabitance of the Tell can be divided into three parts. On the western part of the hill, a settlement dating between 7000 and 6300 BCE can be found. This part of the Tell is called Tell A. Then around 6300 BCE this part of Tell Sabi Abyad I was abandoned, and around that same time a new settlement was founded on the eastern part of the hill, now called Tell B. The difference between these two parts of the inhabitance is remarkable, as it is very sharp and many cultural changes took place among the people. New types of houses were built, new architecture, different types of pottery and other objects have been found. This settlement continues until around 5800 BCE [2]. The much smaller Tells C and D continue until around 5500 BCE [16], after which the Tell remains unused for millenia, until the Assyrians settle there around 1225 BCE [2].

[1]Before Common Era, equivalent to BC.

Figure 3 shows schematically the structure of Tell Sabi Abyad I [16]. In archaeology. occupation phases are characterised traditionally by pottery, especially in the Near East. Pottery phases in northern Syria are established according to Tell Halaf [1]. Figure 4 shows the location of Tell Sabi Abyad I in Syria.

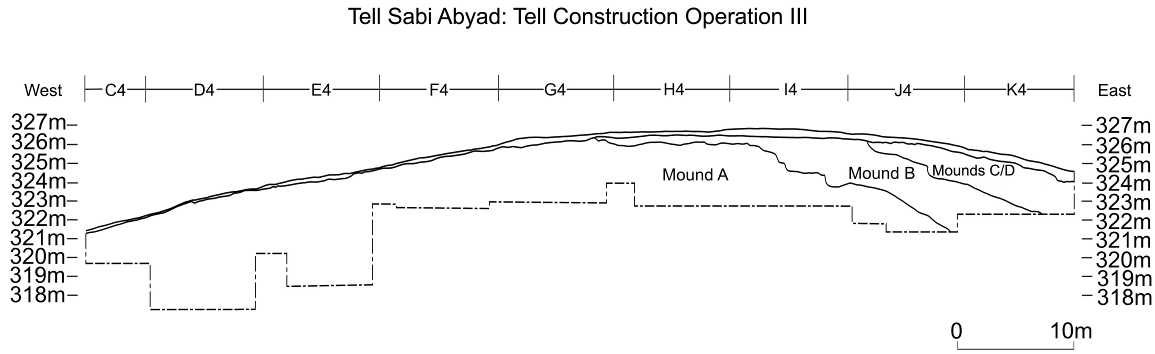

Figure 3: A schematic view of the structure of Tell Sabi Abyad I [16]. Of interest for this study is the transition between Tell A and Tell B.

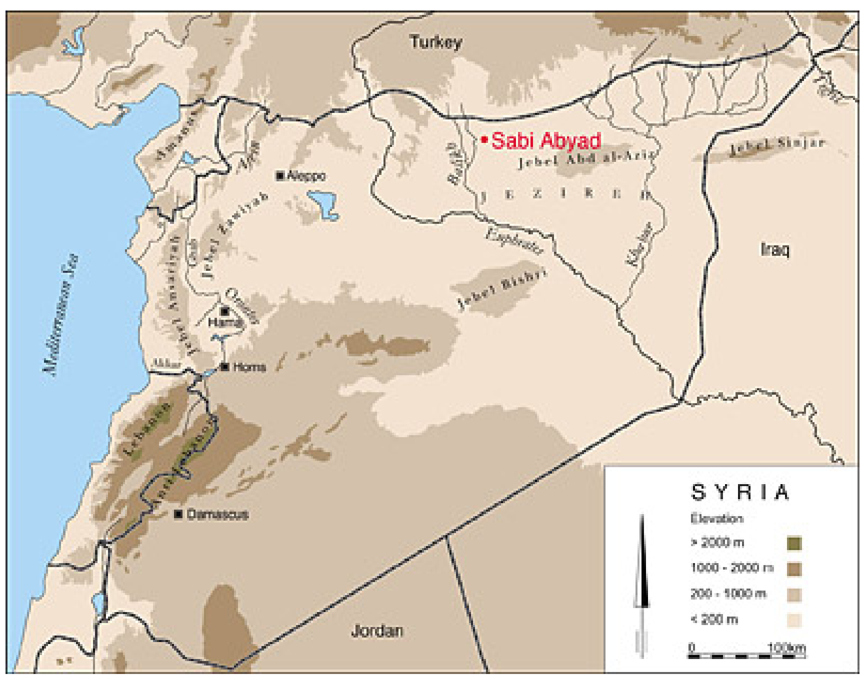

Figure 4: A map of Syria with the location of Tell Sabi Abyad I.

It is not clear what caused the drastic changes that took place at Tell Sabi Abyad I around 6300 BCE, but it has been suggested that it was effected by a sudden climate change. The purpose of this study is to determine whether the cultural changes that took place at Tell Sabi Abyad I around 6300 BCE coincide with the 8.2 ka climate event known from ice core temperature reconstructions. This would be a clear cut sign that the influence of this event extended at least as far as the Middle East, a region where more direct climatological archives such as ice cores do not exist.

3 OxCal

3.1 Bayesian statistics

A way of improving the accuracy of carbon dates is combining them with extra information, coming from an outside source (i.e. not from carbon dating). In practice this means additional information coming from the archaeological context of the dated samples, most often in the form of known sequences of samples, samples that are definitely (or definitely not) contemporary or other relationships between the dates.

A mathematically sound way of doing this is by applying so-called Bayesian statistics. Bayesian statistics is the statistics based on Bayes' theorem, a theorem which describes mathematically how to incorporate the information described above into an existing model. The underlying mathematics [11] are complicated and will not be treated here.

3.2 The operation of OxCal 4.1

The programme OxCal works by applying Bayesian statistics to the information entered by the user. This information generally consists of two things: the radiocarbon dates; and additional information about the chronology of these dates. This additional information is generally obtained from the archaeological dig site, for example by supplying the depth at which various samples (that were subsequently dated) were found. This depth is then a measure for the sequence of the samples, and is used by OxCal to refine the age probability distributions of the samples.

Many types of information can be processed by OxCal. The aforementioned depth will result in a stratigraphical analysis, but the sequence itself can be entered as well. OxCal will then assume that the age of the samples *has* to be the same as that sequence, and will proceed accordingly. Other possibilities include grouping samples in phases for which the internal sequence is not known and combining several dates into one (for example if one sample is dates more than once). Gaps which have a certain length and uncertainty can be added to signal a period of time in between two dates or phases. Another often used option is that of adding boundaries to the model. Boundaries are used to indicate that a certain set of dates or phases are representative of the *entire* phase or sequence, from beginning to end, which will give further restrictions to the possible sample ages and thus improve the results. Different kinds of boundaries can be used to account for different deposition probabilities of an object. Possibilities include uniform, linear, normal and exponential distributions. The locations of the boundaries are calculated by OxCal.

3.3 An example of using OxCal 4.1

As an example we will consider two hypothetical radiocarbon dates, 5000 BP with uncertainty 50 (which we will call A) and 5050 BP with uncertainty 50 (which we will call B). We will look how the various settings affect the probability distribution of A. It can easily be seen that each set of settings has different results. For each example the input as well as the output is shown.

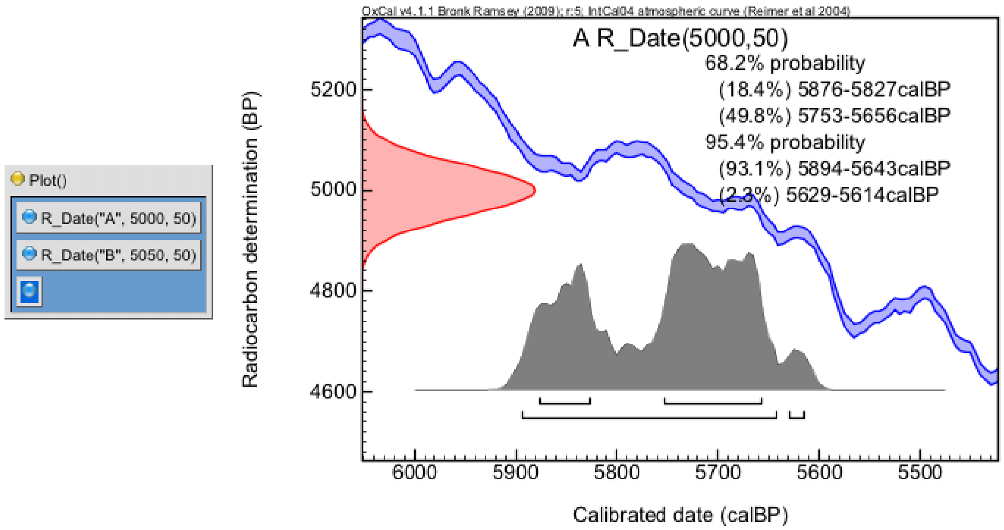

Figure 5: If we give OxCal no information on the relationship between dates A and B, it will simply perform independent calibrations for both dates. After all, the samples could be from two distinct digs, or even from different continents.

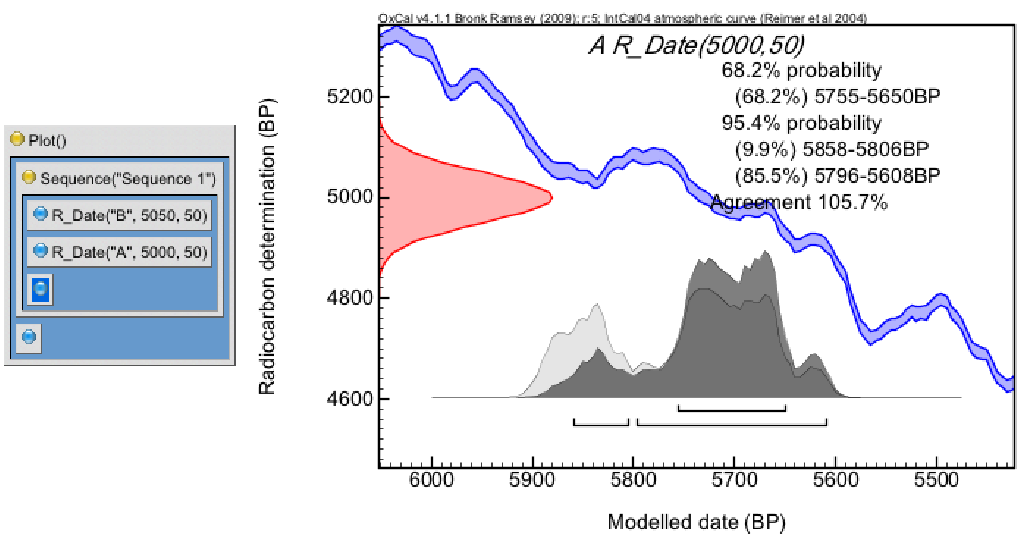

Figure 6: Now we tell OxCal that the two dates are indeed related, and that B has to be older than A (a sequence of two). The programme will give a slightly adjusted probability distribution, and will warn you that no boundaries were used, as boundaries are highly recommended to improve your results.

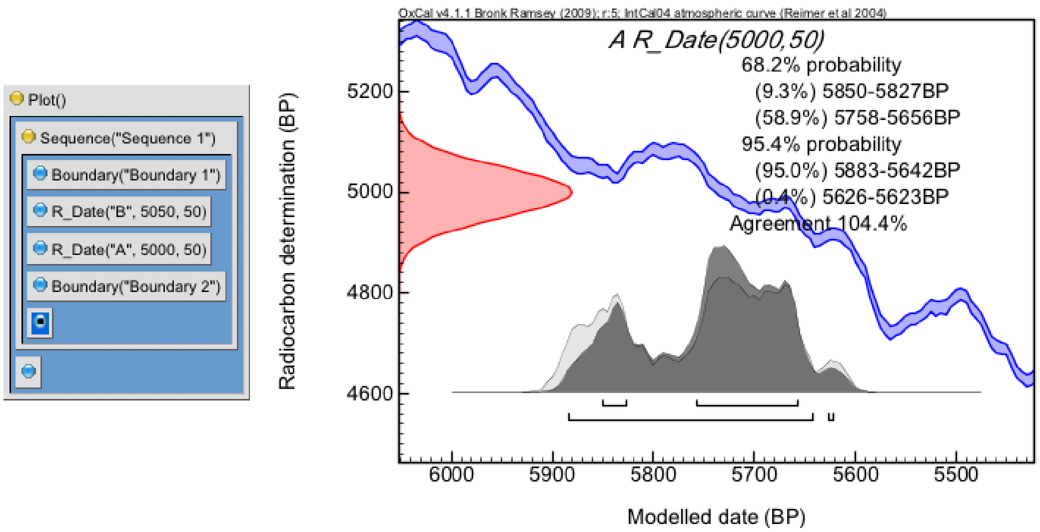

Figure 7: The next step is then, obviously, to add boundaries. This will tell OxCal that A and B are representative of a period, which is apparently short in this example. Boundaries can only be used in combination with a sequence or phase because those imply a relationship between the dates. There can be no boundaries without such a relationship.

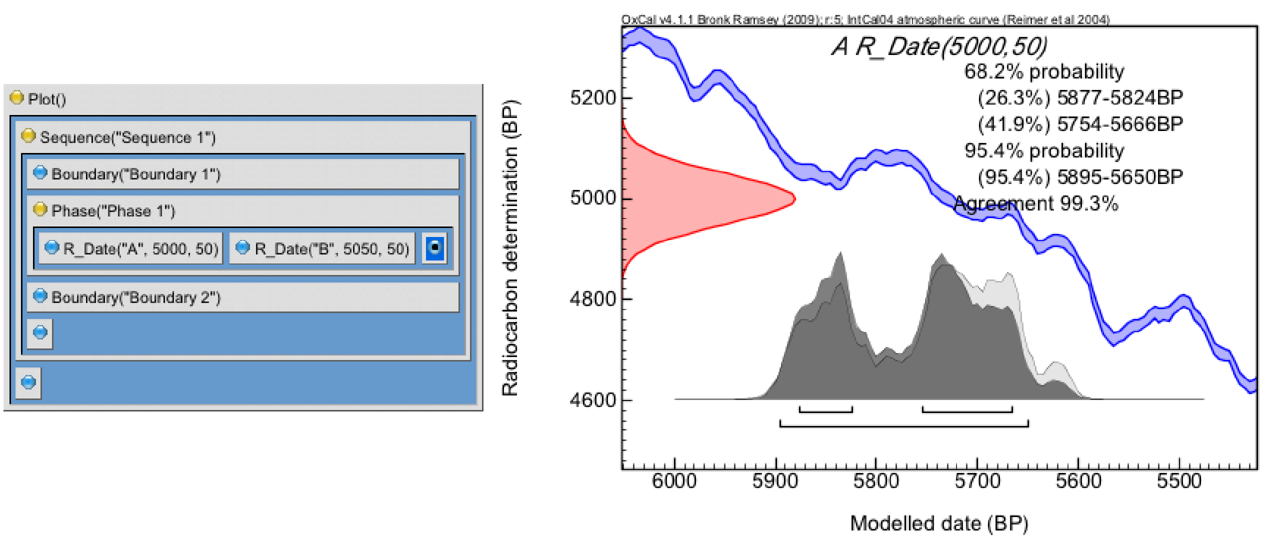

Figure 8: Another possibility, if we don't know that B has to be older than A, is using a phase. This means that A and B belong to the same period, or phase, but we don't know in which order. Doing this will require putting the boundaries outside of the phase, because there is no known order within the phase. Additionally, a sequence has to be defined to fix the location of the boundaries with respect to the phase.

4 Application to Tell Sabi Abyad

The details of the input and output of the OxCal model that was used are shown in appendix A. This section will focus on the transition between Tell A and Tell B, as this is the relevant part for the purpose of this study. The position of the end of Tell A and beginning of Tell B with respect to the 8.2 ka climate event will be discussed, along with possible explanations and interpretations.

4.1 The model

The archaeological samples were categorised by level, based on the depth and location where the object was found. These levels are named by depth, ie. the level with the highest number is the deepest, and thus the oldest. Tell A has 12 levels (A1 to A12), Tell B has levels B3 to B8. This means that the levels closest to the 8.2 ka climate event are A1 and B8.

The model consists of two independent parts; Tell A and Tell B. For each Tell, the levels were represented by phases which contained the appropriate datings. The start and end of each was represented by a boundary. There were no boundaries in between the phases in order to allow for possible overlap. There are a few instances where the same sample has been dated twice. In these cases OxCal was used to combine the two into a single object in the model.

In the penultimate version of the model there were 13 levels to Tell A (A1 to A13), but new archaeological insights have lead to the incorporation of level A1 into B8. A1 was removed, and A2 renamed A1 and so on. The results of both models will be discussed and compared, with the emphasis on the updated version.

4.2 The results

As mentioned above, the start and end of each Tell has been represented by a boundary. This means that looking at the probability distributions for these boundaries will give information about the transition from Tell A to Tell B. The boundary marking the end of the inhabitance of Tell A is shown in figure 9. The results of both the penultimate and final models are shown.

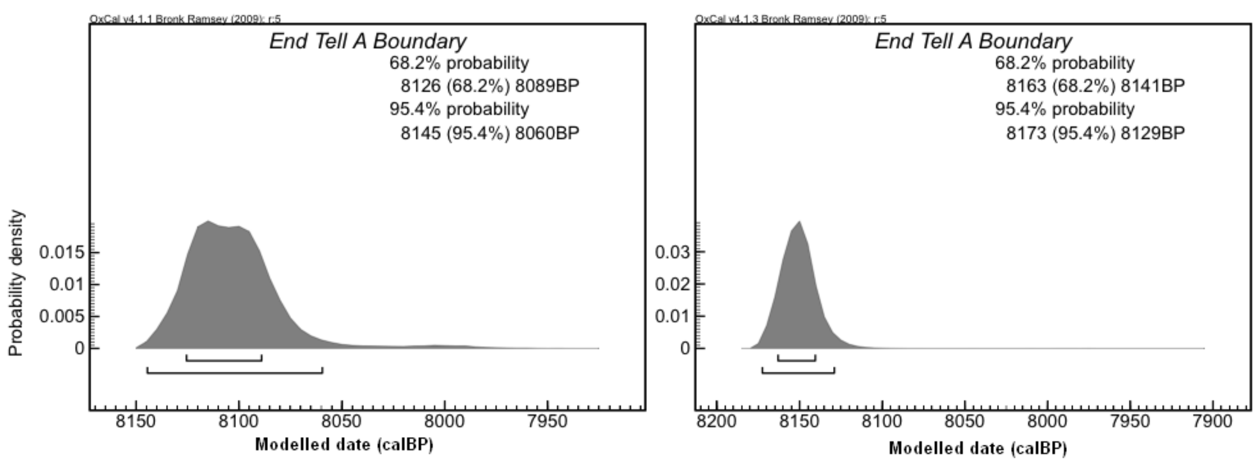

Figure 9: Probability distribution for the boundary representing the end of Tell A. On the left the penultimate results are shown, on the right the final results.

The final probability distribution shows that there is a 95.4% chance that the end of the inhabitance of Tell A lies in the the interval 8173-8129 calBP. Given that the 8.2 ka climate event is dated to have occured in the period 8400-8000 calBP, and is said to have lasted for approximately 160 years [5], this is completely consistent with a transition caused by the event. Looking at the 68.2% chance interval will lead to the same conclusions, as will the penultimate results.

There are two notable differences between the results acquired from the different models. The final version of the model gives results that are a little older, which is assumed to be caused by the fact that the samples from the youngest level in the penultimate model have been removed and placed in Tell B. Removing the youngest samples will obviously lead to older dates. Another difference is that the final results are far more accurate; the 95.4% chance interval is only 44 years long, as opposed to 85 in the older model. This may be because the datings in the youngest level of the final model are less spread out than the datings in the youngest level of the old model. In the old model, 75% of the used datings were in the same century (6 out of 8), whereas this is over 86% in the final model (23 out of 28). In the final model, the average uncertainty is also a bit lower (42.68 as opposed to 44.38).

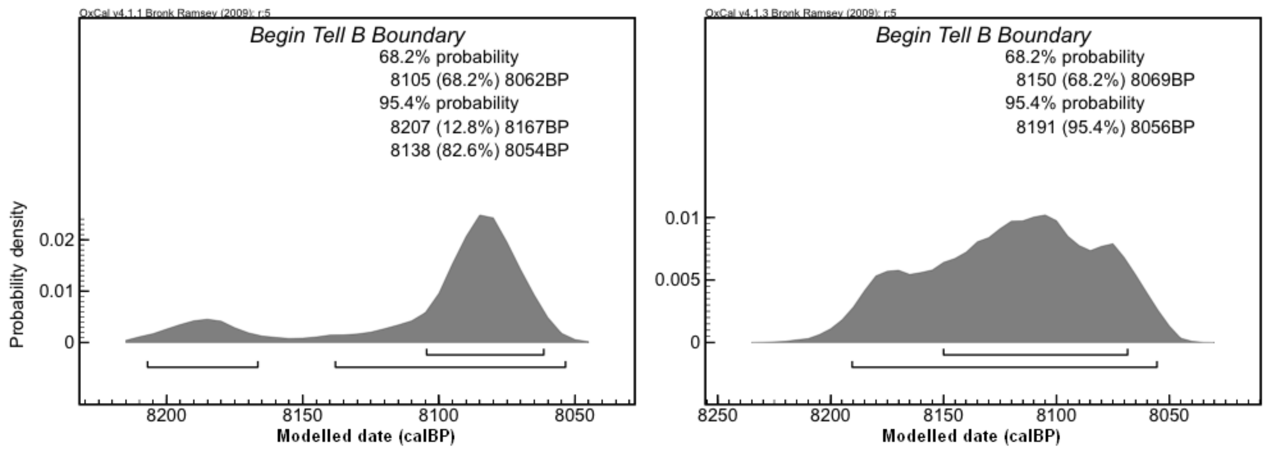

Figure 10: Probability distribution for the boundary representing the beginning of Tell B. On the left the penultimate results are shown, on the right the final results.

Figure 10 shows the probability distributions for the boundary representing the start of the inhabitance of Tell B. Both models give results in the same interval, roughly 8200-8050 calBP, but the results are more concentrated and thus more accurate in the older model. This is probably because the datings that were originally in the oldest level of Tell B were mostly in the 7400-7300 calBP interval, whereas the ones that were added in the final model are mostly in the interval 7300-7200 calBP. The datings become more spread out, and this leads to a larger uncertainty in the boundary. The level closest to the boundary logically has the most effect on the boundary, and the difference between the two models is exclusively in those levels.

Looking more closely at the final data for the boundary representing the beginning of the inhabitance of Tell B, the intervals 8150-8069 calBP (68.2% probability) and 8191-8056 calBP (95.4% probability) are given. There is a large amount of overlap between the end of Tell A and the beginning of Tell B, ie. neither is significantly earlier or later than the other. This is consistent with a transition between the two locations that happened over the course of a few decades, or one lifetime. The dates given for the beginning of Tell B are also well within the 8400-8000 calBP interval given for the 8.2 ka climate event.

The data acquired through the use of OxCal shows that the transition between the inhabitance of Tell A and Tell B falls well within the interval given for the climate event. However, as the climate event has not been dated very accurately so far, it is not possible to say much about it. Until more accurate data becomes available, all that can be said is that the changes at Tell Sabi Abyad I *might* be caused by the climate event. We cannot prove that it was so, nor is there conclusive evidence that it was something else.

4.3 Discussion

While the large number of carbon datings used for this study has produced accurate results, there are ways that could potentially improve them. From a technical perspective, the construction of the model can be improved upon, using some of the options that OxCal 4.1 provides but have not been used in this study.

Examples of these options are the use of different types of boundaries, changing where to allow overlap or not allow it, to better approximate the true situation. How this should be done exactly should be decided through archaeological reasoning, as should be whether or not the two parts of the model (Tell A and Tell B) can be combined into a whole, possibly divided by some kind of boundary or gap.

As we have seen in the difference between the two versions of the model, changing entire levels can have a significant effect, at least when the levels are close to the time period under investigation. The change that was made did not have significant effects on the other boundaries (the beginning of A and the end of B), they only changed by a few years. This is shown in figures 11 and 12. Because the number of datings is so large, it is unlikely that revising the levels of the individual samples will have a significant impact on the results. Nonetheless, it might still improve the results by a small amount.

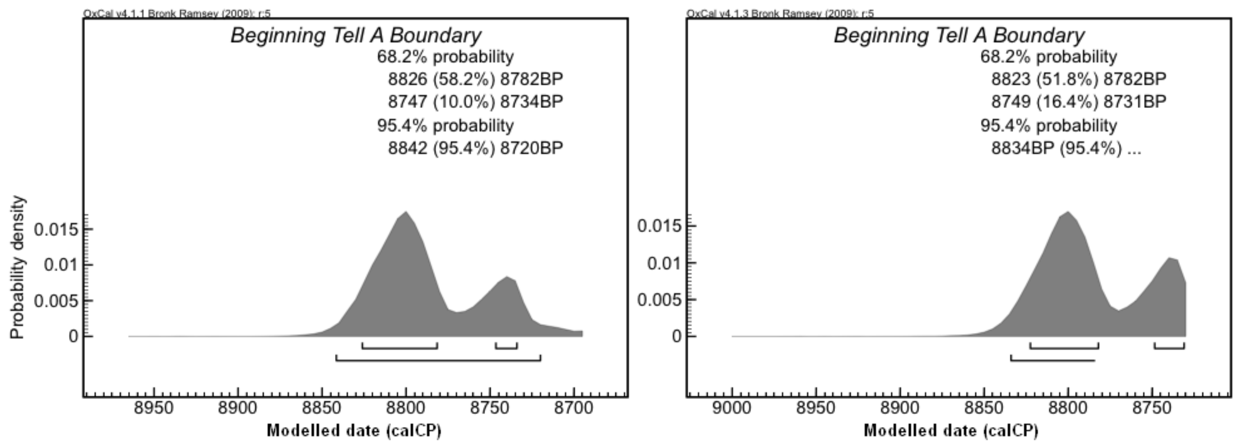

Figure 11: Probability distribution for the boundary representing the beginning of Tell A. On the left the penultimate results are shown, on the right the final results.

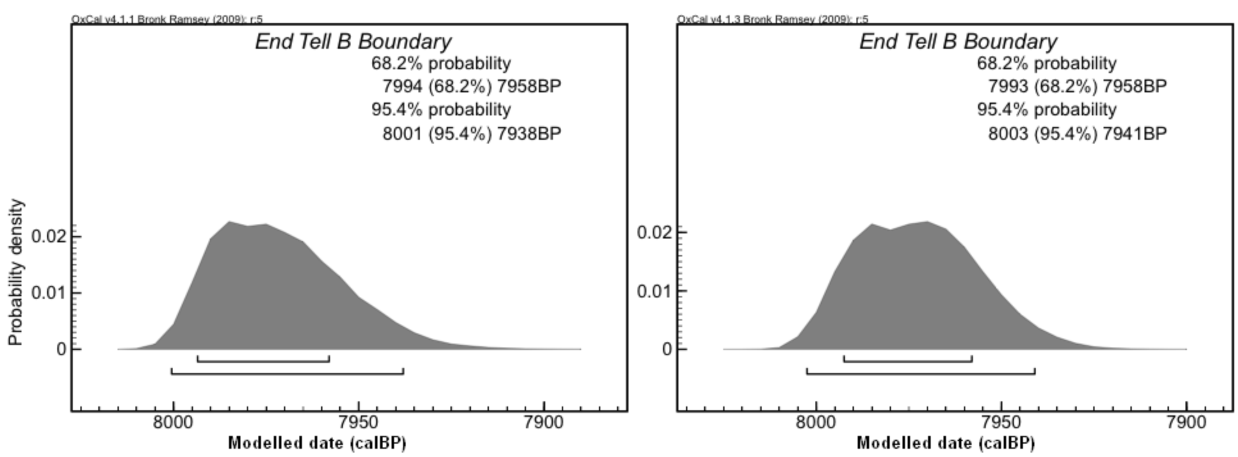

Figure 12: Probability distribution for the boundary representing the end of Tell B. On the left the penultimate results are shown, on the right the final results.

The same is true for reviewing the physical criteria. One may choose to be more lenient in this, or more strict. Because of the age of the samples, many of them are on the verge of being unacceptable, and thus being stricter can significantly reduce the number of usable samples. This could have a noticeable effect on the results, depending on how many samples are rejected.

As the excavation of the site continues, more samples suitable for dating may be found, which would not only increase the total number of samples, but also the amount of samples that are considered to be good based on physical criteria. More good samples can be used as a justification for being more strict in judging the quality of the samples, thus improving the overall quality of the datings. More samples and better samples can both lead to better results. Continued excavation will also lead to a better understanding of Tell Sabi Abyad. This would provide the archaeologists with the ability to describe a better, more detailed model of the site.

More detailed information about the 8.2 ka climate event can be included by looking at the precise structure of the temperature during this time, rather than considering it to be a more or less uniform period of 160 years. This may help to clarify the course of events in an archaeological way, and maybe the results of this study can be matched to the climate event in a better way after all. But probably the greatest influence will be given by more accurate data on the climate event, thus reducing the time period to look at. This may show that the climate event does not coincide with the transition from Tell A to Tell B anymore, or that it still does.

A Appendices

A.1 Raw data

These are the raw carbon dates. The levels have been slightly adjusted by A. van Acht-Kaneda after preliminary processing with OxCal, and not all samples below were used in the final results because of physical reasons (see section 1.3) and archaeological reasons (for example contamination with other layers, uncertainty about which layer the sample belongs to).

A.1.1 The levels of Tell A

Level	Sample name	Dating (BP)	Uncertainty	Comments
Level A1 (formerly A2)	GrA-42461	6930	45	Contaminated; not used
	GrA-37848	7125	40	
	GrA-42472	7165	45	Contaminated; not used
	GrN-28855	7360	25	
	GrA-42455	7370	45	
	GrA-42338	7380	45	
	GrN-28851	7400	25	
	GrA-42340	7400	45	
	GrA-42477	7415	45	
	GrA-42334	7420	45	
	GrA-33003	7425	35	
	GrA-32997	7440	35	
	GrA-42453	7440	45	
	GrA-42337	7445	45	
	GrA-42456	7445	45	
	GrA-42499	7445	45	
	GrA-42500	7450	45	
	GrA-42866	7450	45	
	GrA-42479	7455	45	
	GrA-42462	7460	45	
	GrA-42470	7460	45	
	GrA-42459	7465	45	
	GrA-42495	7465	45	
	GrA-42496	7470	45	
	GrA-42342	7475	45	
	GrA-42467	7475	45	
	GrA-42473	7475	45	
	GrA-42457	7480	45	
	GrA-42476	7490	45	
	GrA-42468	7520	45	
	GrA-42452	7600	50	Contaminated; not used
Level A2 (formerly A3)	GrA-42492	7380	45	Contaminated; not used
	GrA-42490	7395	45	Contaminated; not used
	GrA-42491	7400	45	
	GrA-42480	7425	45	
	GrA-42494	7425	45	
	GrA-32046	7440	45	
	GrA-42489	7475	45	Insufficient ^{13}C; not used
	GrA-42900	7475	50	From the same sample as GrA-42720

	GrA-42465	7510	45	
	GrA-42463	7535	45	
	GrA-42720	7560	50	From the same sample as GrA-42900
	GrA-42722	7605	40	
	GrA-42466	7675	45	Contaminated; not used
Level A3 (formerly A4)	GrA-42724	7435	40	
	GrN-29720	7450	15	
	GrA-42723	7450	40	
	GrA-42727	7455	40	
	GrN-29719	7485	15	
	GrA-42481	7500	45	
Level A4 (formerly A5)	GrA-37653	7380	35	Insufficient carbon; not used
	GrA-37206	7385	45	
	GrA-37205	7405	45	
	GrA-42901	7425	50	From the same sample as GrA-42767
	GrA-42733	7445	40	
	GrA-42730	7460	40	
	GrA-42768	7465	40	
	GrA-42732	7475	40	
	GrA-42778	7475	40	
	GrA-26927	7475	45	
	GrA-32058	7495	45	
	GrA-37680	7505	35	
	GrA-42764	7505	40	
	GrA-26928	7525	45	
	GrA-42767	7530	70	From the same sample as GrA-42901
	GrA-42728	7540	40	
	GrA-42729	7540	40	
	GrA-24219	7570	50	
	GrN-29714	7680	30	
	GrA-24248	7720	50	
	GrA-32063	12230	60	Obviously incorrect; not used
	GrA-42766	18850	80	Obviously incorrect; not used
	GrA-26877	27790	370	Obviously incorrect; not used
Level A5 (formerly A6)	GrA-32053	7545	45	Contaminated; not used
	GrA-42889	7555	45	From the same sample as GrA-42777
	GrA-42776	7595	45	
	GrA-37664	7610	35	
	GrA-32051	7625	45	
	GrA-42780	7655	45	
	GrA-37655	7695	35	
	GrA-42775	7725	45	
	GrA-32062	7740	45	
	GrA-32056	7760	50	
	GrA-42777	7790	60	From the same sample as GrA-42889
Level A6 (formerly A7)	GrA-42782	7535	45	
	GrN-29706	7570	60	
	GrA-32052	8170	80	Contaminated; not used
Level A7 (formerly A8)	GrA-42796	7635	45	
	GrA-32047	7640	45	

	GrA-42791	7665	45	
	GrA-42781	7680	45	
	GrA-31875	7690	45	
	GrA-31877	7695	45	
	GrA-42798	7700	45	
	GrA-31876	7700	50	
	GrA-32048	7705	45	
	GrA-42788	7710	40	
	GrA-42790	7710	45	
	GrA-42786	7715	45	
	GrA-42785	7725	45	
	GrA-42795	7725	45	
	GrA-32049	7735	45	
	GrN-29713	7765	30	
	GrA-42787	7835	45	
Level A8 (formerly A9)	GrA-42850	7715	45	
	GrA-42792	7760	45	
	GrA-42797	7775	45	
	GrA-42800	7780	45	
Level A9 (formerly A10)	GrA-42801	7705	45	
	GrA-42807	7740	45	
	GrA-42804	7795	45	
	GrA-42806	7820	45	
	GrA-32059	7930	45	Contaminated; not used
	GrA-42802	8270	45	Contaminated; not used
Level A10 (formerly A11)	GrA-42813	7910	45	
	GrA-42811	7925	45	
	GrA-42815	7940	45	
	GrA-42810	7970	45	
	GrA-42812	7985	45	
Level A11 (formerly A12)	GrA-42817	7890	50	
	GrA-33006	7930	35	
	GrA-33009	7990	35	
	GrA-42818	7995	45	
	GrA-42820	8615	50	Contaminated; not used
Level A12 (formerly A13)	GrA-33001	7955	35	
	GrA-33002	8005	35	
	GrA-42821	8010	45	
	GrA-33007	8040	35	

Table 2: The radiocarbon datings from Tell A.

A.1.2 The levels of Tell B

Level	Sample name	Dating (BP)	Uncertainty	Comments
Level B3	GrA-42824	6530	40	Contaminated; not used
	GrA-42825	7130	45	
	GrA-37674	7175	35	
	GrA-42822	7200	45	

Level B4	GrA-42836	6045	40	Contaminated; not used
	GrA-42838	7020	45	
	GrA-42834	7135	40	
	GrA-42835	7160	40	
	GrA-42833	7315	40	
Level B5	GrA-42380	6925	100	Insufficient carbon; not used
	GrA-42844	7090	45	
	GrA-42839	7140	45	
	GrA-42840	7180	50	
	GrA-42843	7195	45	
	GrA-37679	7205	35	
	GrA-37199	7230	45	Insufficient carbon; not used
	GrA-42887	7235	40	
	GrA-42845	7240	45	
	GrA-37677	7255	35	
	GrA-37671	7280	35	
	GrA-41789	7295	40	
Level B6	GrA-42854	7200	45	
	GrA-42853	7240	50	
	GrA-42849	7250	45	
	GrA-42848	7285	45	
	GrA-42846	7360	45	
Level B7	GrA-42860	7215	45	
	GrA-42869	7225	45	
	GrA-42855	7245	45	
	GrA-42858	7290	45	
	GrA-42859	7325	45	
	GrA-42856	7375	45	
Level B8	GrA-42891	7280	45	
	GrA-42890	7305	40	
	GrA-42865	7315	45	Insufficient ^{13}C; not used
	GrA-42868	7320	45	
	GrA-42894	7350	45	
	GrA-42893	7355	45	
	GrA-42862	7360	45	
	GrA-42864	7365	45	
	GrA-42336	6880	40	Contaminated; not used, formerly level A1
	GrA-34942	7175	45	Formerly level A1
	GrA-42333	7230	45	Formerly level A1
	GrA-42343	7230	45	Formerly level A1
	GrA-42344	7230	45	Formerly level A1
	GrA-42346	7250	45	Formerly level A1
	GrA-42486	7250	45	Formerly level A1
	GrA-37693	7255	40	Formerly level A1
	GrA-42347	7360	45	Formerly level A1

Table 3: All radiocarbon datings from Tell B.

A.2 OxCal input

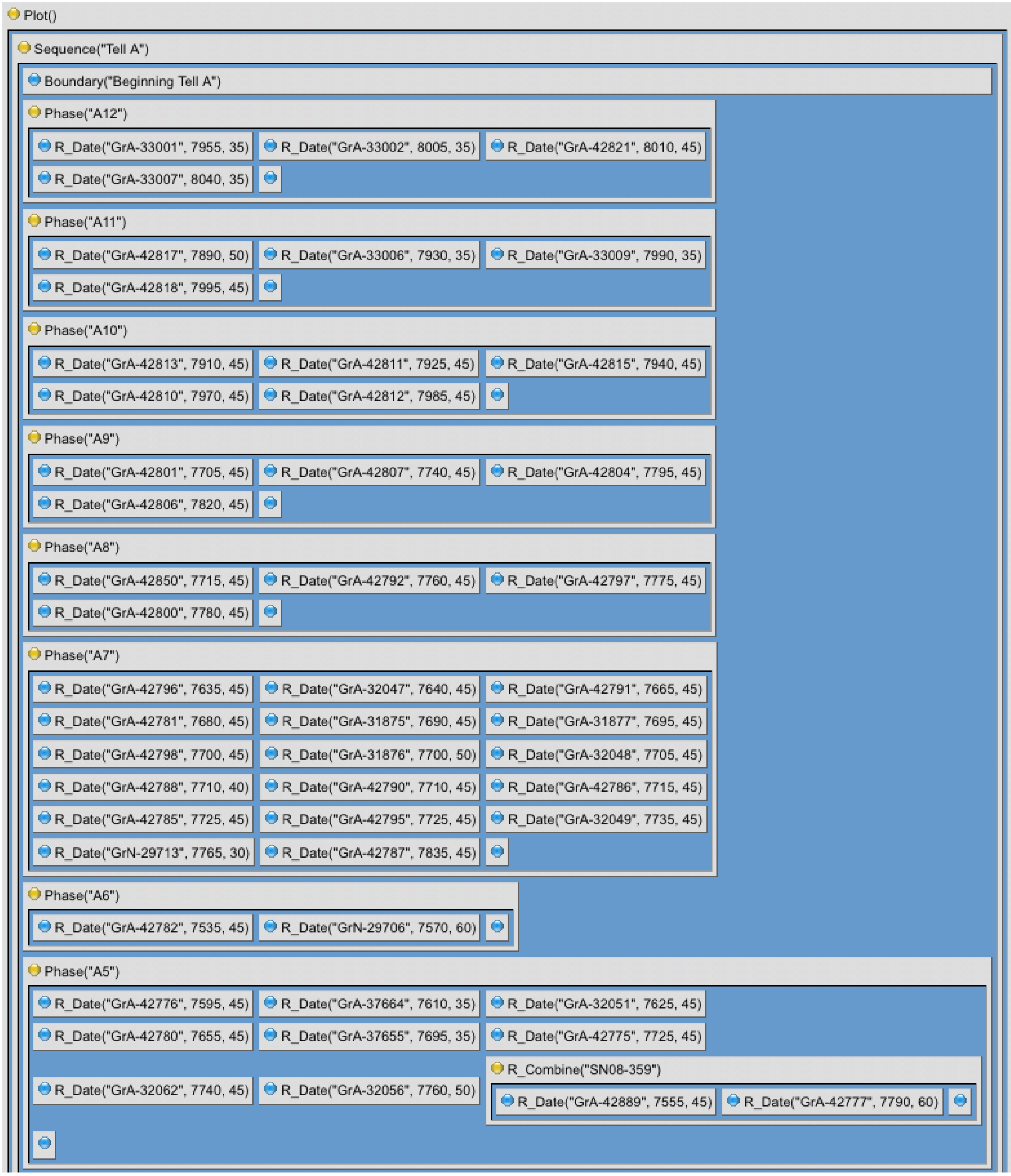

Figure 13: Final OxCal input for Tell A, levels A5-A12.

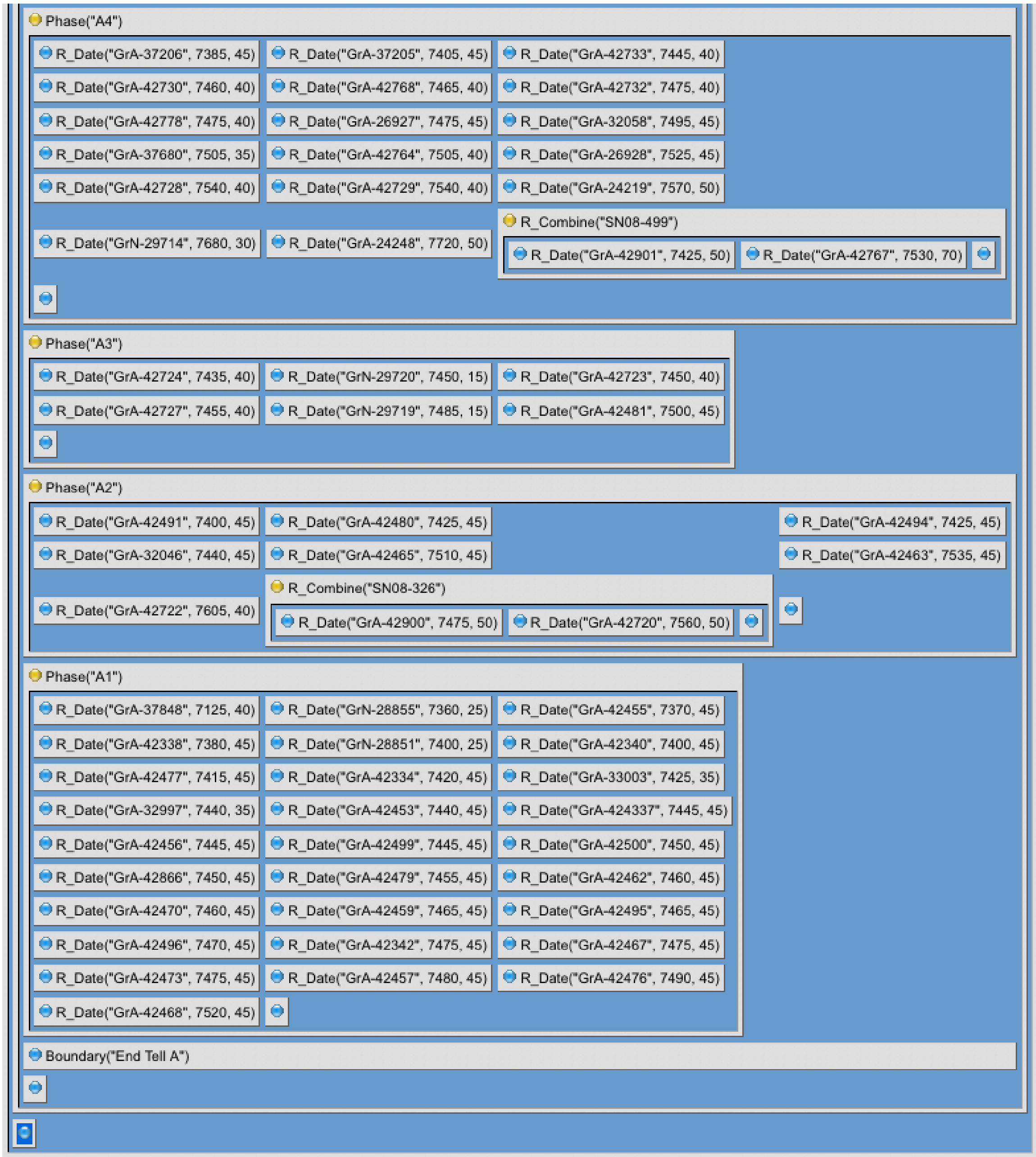

Figure 14: Final OxCal input for Tell A, levels A1-A4.

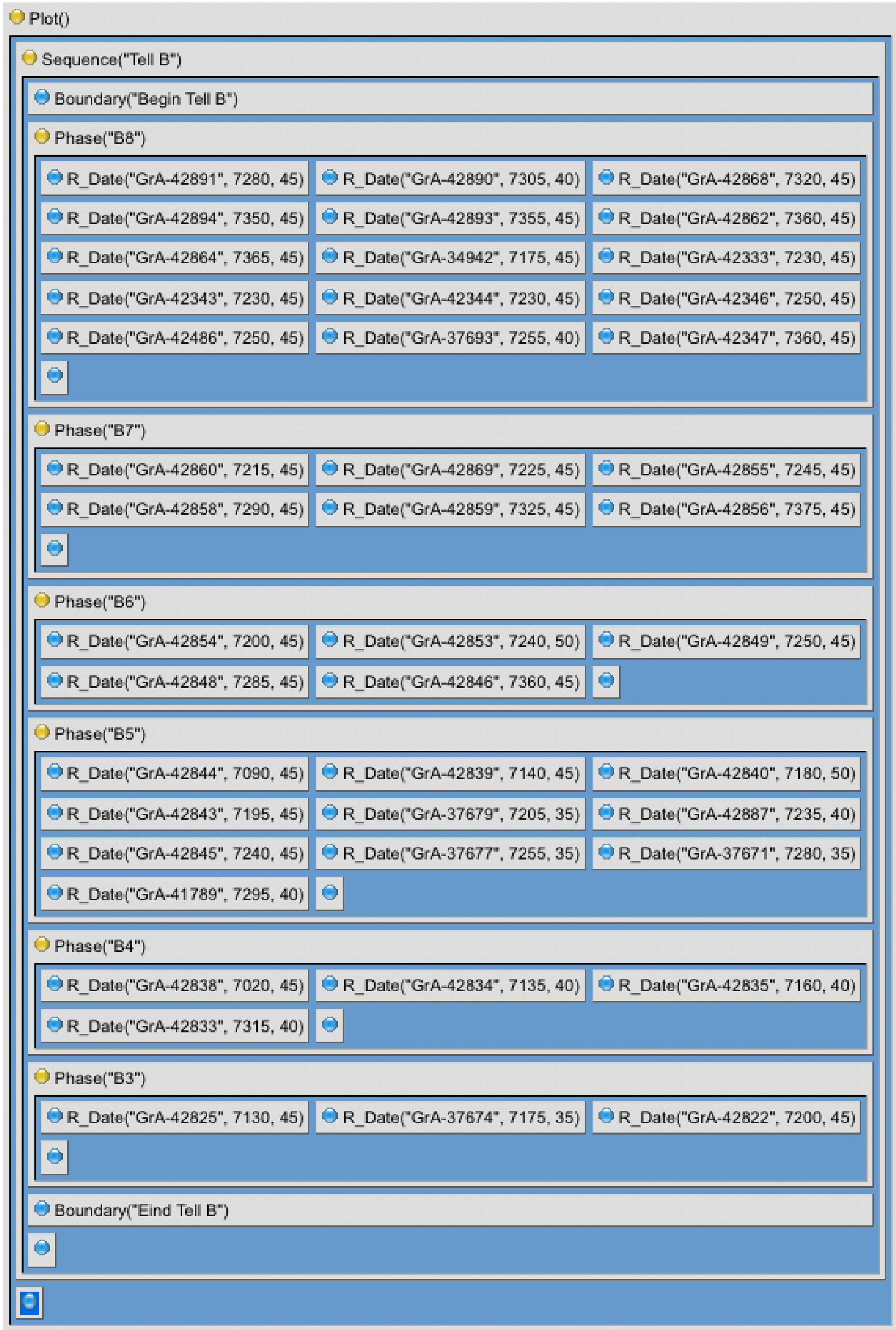

Figure 15: Final OxCal input for Tell.

A.3 OxCal output

A.3.1 Tell A

Name	Unmodelled (BP)						Modelled (BP)					
Show all Show structure	from	to	%	from	to	%	from	to	%	from	to	%
							Warning! Poor agreement - A= 4.0%(A'c= 60.0%) Warning! Poor agreement - A= 4.2%(A'c= 60.0%)					
Sequence Tell A												
Boundary Beginning Tell A							8823	8731	68.2	8834	...	95.4
Phase A12												
R_Date GrA-33001	8977	8722	68.2	8987	8648	95.4	8805	8721	68.2	8820	8706	95.4
R_Date GrA-33002	8998	8780	68.2	9009	8726	95.4	8809	8722	68.2	8822	8713	95.4
R_Date GrA-42821	9000	8779	68.2	9015	8660	95.3	8808	8722	68.2	8821	8711	95.4
R_Date GrA-33007	9015	8789	68.2	9025	8775	95.4	8809	8722	68.2	8824	8716	95.4
							Warning! Poor agreement - A= 40.4%(A'c= 60.0%)					
Phase A11												
R_Date GrA-42817	8846	8597	68.2	8978	8589	95.5	8764	8697	68.2	8781	8671	95.4
R_Date GrA-33006	8950	8643	68.3	8980	8632	95.4	8765	8700	68.2	8783	8671	95.4
R_Date GrA-33009	8991	8779	68.2	9003	8719	95.4	8778	8703	68.2	8793	8670	95.4
							Warning! Poor agreement - A= 43.3%(A'c= 60.0%)					
R_Date GrA-42818	8995	8777	68.2	9009	8656	95.4	8772	8701	68.2	8792	8672	95.4
							Warning! Poor agreement - A= 53.1%(A'c= 60.0%)					
Phase A10												
R_Date GrA-42813	8932	8609	68.2	8978	8599	95.3	8700	8632	68.2	8730	8605	95.4
R_Date GrA-42811	8968	8639	68.3	8980	8608	95.4	8702	8636	68.2	8735	8608	95.4
R_Date GrA-42815	8973	8649	68.3	8985	8637	95.4	8701	8638	68.2	8738	8611	95.4
R_Date GrA-42810	8982	8770	68.2	8996	8648	95.4	8706	8641	68.2	8746	8626	95.4
							Warning! Poor agreement - A= 54.5%(A'c= 60.0%)					
R_Date GrA-42812	8990	8776	68.2	9005	8652	95.4	8707	8642	68.2	8745	8630	95.4
							Warning! Poor agreement - A= 38.2%(A'c= 60.0%)					
Phase A9												
R_Date GrA-42801	8540	8434	68.2	8582	8412	95.4	8593	8571	68.2	8609	8551	95.4
							Warning! Poor agreement - A= 27.8%(A'c= 60.0%)					
R_Date GrA-42807	8556	8455	68.2	8594	8425	95.4	8595	8570	68.2	8626	8555	95.4
R_Date GrA-42804	8628	8540	68.2	8696	8447	95.4	8610	8570	68.2	8637	8560	95.4
R_Date GrA-42806	8638	8547	68.2	8761	8457	95.4	8623	8579	68.2	8643	8561	95.4
Phase A8												
R_Date GrA-42850	8543	8446	68.2	8585	8418	95.4	8575	8543	68.2	8585	8530	95.4
R_Date GrA-42792	8592	8479	68.2	8607	8426	95.4	8575	8545	68.2	8586	8534	95.4
R_Date GrA-42797	8599	8479	68.2	8634	8434	95.4	8575	8546	68.2	8587	8535	95.4
R_Date GrA-42800	8602	8480	68.2	8638	8434	95.4	8575	8546	68.2	8587	8536	95.4

Figure 16: OxCal numerical output for Tell A, levels A8-A12.

Phase A7												
R_Date GrA-42796	8506	8385	68.2	8540	8376	95.4	8518	8448	68.2	8539	8443	95.4
							Warning! Poor agreement - A= 50.9%(A'c= 60.0%)					
R_Date GrA-32047	8508	8387	68.2	8540	8379	95.4	8519	8448	68.2	8540	8443	95.4
							Warning! Poor agreement - A= 58.0%(A'c= 60.0%)					
R_Date GrA-42791	8515	8408	68.2	8544	8389	95.4	8520	8450	68.2	8541	8445	95.4
R_Date GrA-42781	8517	8417	68.2	8553	8393	95.4	8521	8455	68.2	8543	8445	95.4
R_Date GrA-31875	8537	8423	68.2	8580	8402	95.4	8522	8460	68.2	8545	8445	95.4
R_Date GrA-31877	8537	8427	68.2	8581	8406	95.4	8523	8461	68.2	8545	8445	95.4
R_Date GrA-42798	8537	8430	68.2	8581	8409	95.4	8533	8462	68.2	8546	8446	95.4
R_Date GrA-31876	8538	8429	68.2	8584	8408	95.4	8532	8463	68.2	8547	8446	95.4
R_Date GrA-32048	8540	8434	68.2	8582	8412	95.4	8532	8464	68.2	8547	8446	95.4
R_Date GrA-42788	8540	8450	68.2	8582	8416	95.4	8532	8465	68.2	8546	8447	95.4
R_Date GrA-42790	8541	8446	68.2	8583	8415	95.4	8532	8466	68.2	8548	8446	95.4
R_Date GrA-42786	8543	8446	68.2	8585	8418	95.4	8533	8467	68.2	8549	8447	95.4
R_Date GrA-42785	8548	8448	68.2	8589	8421	95.4	8535	8470	68.2	8550	8448	95.4
R_Date GrA-42795	8548	8448	68.2	8589	8421	95.4	8536	8470	68.2	8550	8448	95.4
R_Date GrA-32049	8556	8451	68.2	8592	8426	95.4	8537	8472	68.2	8551	8449	95.4
R_Date GrN-29713	8592	8484	68.2	8597	8455	95.4	8554	8477	68.2	8559	8455	95.4
R_Date GrA-42787	8684	8549	68.2	8851	8479	95.4	8560	8479	68.2	8565	8457	95.4
							Warning! Poor agreement - A= 28.9%(A'c= 60.0%)					
Phase A6												
R_Date GrA-42782	8397	8330	68.2	8416	8208	95.4	8455	8436	68.2	8475	8430	95.4
							Warning! Poor agreement - A= 1.2%(A'c= 60.0%)					
R_Date GrN-29706	8425	8334	68.2	8517	8205	95.4	8455	8436	68.2	8475	8430	95.4
							Warning! Poor agreement - A= 29.0%(A'c= 60.0%)					
Phase A5												
R_Date GrA-42776	8425	8370	68.2	8515	8334	95.4	8434	8407	68.2	8448	8400	95.4
R_Date GrA-37664	8422	8384	68.2	8509	8361	95.5	8432	8407	68.2	8447	8400	95.4
R_Date GrA-32051	8451	8382	68.2	8539	8367	95.4	8438	8410	68.2	8450	8401	95.4
R_Date GrA-42780	8515	8401	68.2	8541	8388	95.4	8439	8415	68.2	8451	8404	95.4
R_Date GrA-37655	8536	8428	68.2	8549	8411	95.4	8442	8420	68.2	8455	8409	95.4
R_Date GrA-42775	8548	8448	68.2	8589	8421	95.4	8443	8421	68.2	8456	8410	95.4
R_Date GrA-32062	8556	8455	68.2	8594	8425	95.4	8444	8421	68.2	8459	8411	95.4
							Warning! Poor agreement - A= 52.6%(A'c= 60.0%)					
R_Date GrA-32056	8593	8460	68.2	8628	8425	95.4	8444	8421	68.2	8460	8411	95.4
							Warning! Poor agreement - A= 39.6%(A'c= 60.0%)					
R_Combine SN08-359	8455	8390	68.2	8537	8383	95.4	8438	8412	68.2	8450	8403	95.4
	Warning! X-Test fails at 5% - SN08-359 X2-Test: df=1 T=9.895(5% 3.8)											

Figure 17: OxCal numerical output for Tell A, levels A5-A7.

Phase A4												
R_Date GrA-37206	8310	8168	68.2	8340	8048	95.3	8350	8325	68.2	8370	8319	95.4
							Warning! Poor agreement - A= 19.5%(A'c= 60.0%)					
R_Date GrA-37205	8310	8180	68.2	8350	8060	95.4	8355	8326	68.2	8373	8320	95.4
							Warning! Poor agreement - A= 29.8%(A'c= 60.0%)					
R_Date GrA-42733	8327	8204	68.2	8355	8183	95.4	8358	8328	68.2	8377	8321	95.4
							Warning! Poor agreement - A= 59.6%(A'c= 60.0%)					
R_Date GrA-42730	8343	8207	68.2	8365	8190	95.4	8361	8330	68.2	8380	8321	95.4
R_Date GrA-42768	8346	8209	68.2	8370	8194	95.4	8362	8330	68.2	8381	8321	95.4
R_Date GrA-42732	8361	8212	68.2	8375	8198	95.4	8366	8331	68.2	8383	8322	95.4
R_Date GrA-42778	8361	8212	68.2	8375	8198	95.4	8366	8331	68.2	8383	8322	95.4
R_Date GrA-26927	8362	8211	68.2	8378	8194	95.4	8368	8331	68.2	8386	8322	95.4
R_Date GrA-32058	8379	8216	68.2	8389	8199	95.4	8372	8335	68.2	8392	8324	95.4
R_Date GrA-37680	8383	8224	68.2	8392	8205	95.4	8373	8338	68.2	8389	8325	95.4
R_Date GrA-42764	8384	8220	68.2	8394	8202	95.4	8375	8337	68.2	8392	8325	95.4
R_Date GrA-26928	8397	8320	68.2	8411	8205	95.4	8385	8340	68.2	8402	8328	95.4
R_Date GrA-42728	8398	8341	68.2	8416	8214	95.4	8390	8346	68.2	8406	8332	95.4
R_Date GrA-42729	8398	8341	68.2	8416	8214	95.4	8390	8346	68.2	8406	8332	95.4
R_Date GrA-24219	8413	8350	68.2	8506	8211	95.4	8406	8362	68.2	8415	8335	95.4
R_Date GrN-29714	8515	8418	68.2	8540	8412	95.4	8418	8397	68.2	8425	8386	95.4
							Warning! Poor agreement - A= 32.6%(A'c= 60.0%)					
R_Date GrA-24248	8546	8445	68.2	8590	8416	95.4	8416	8395	68.2	8425	8380	95.4
							Warning! Poor agreement - A= 17.5%(A'c= 60.0%)					
R_Combine SN08-499	8344	8206	68.2	8368	8190	95.4	8362	8330	68.2	8381	8321	95.4
Phase A3												
R_Date GrA-42724	8319	8201	68.2	8348	8180	95.4	8331	8315	68.2	8340	8304	95.4
R_Date GrN-29720	8325	8213	68.2	8340	8198	95.4	8330	8314	68.2	8339	8305	95.4
R_Date GrA-42723	8332	8205	68.2	8361	8186	95.4	8331	8315	68.2	8340	8305	95.4
R_Date GrA-42727	8340	8206	68.2	8363	8188	95.4	8332	8315	68.2	8340	8305	95.4
R_Date GrN-29719	8363	8316	68.2	8373	8211	95.4	8335	8316	68.2	8341	8306	95.4
R_Date GrA-42481	8381	8217	68.2	8393	8198	95.4	8333	8315	68.2	8341	8305	95.4
Phase A2												
R_Date GrA-42491	8310	8177	68.2	8349	8055	95.4	8315	8290	68.2	8325	8274	95.4
R_Date GrA-42480	8314	8194	68.2	8356	8172	95.4	8316	8291	68.2	8326	8275	95.4
R_Date GrA-42494	8314	8194	68.2	8356	8172	95.4	8316	8291	68.2	8326	8275	95.4
R_Date GrA-32046	8325	8201	68.2	8361	8180	95.4	8317	8292	68.2	8326	8276	95.4
R_Date GrA-42465	8388	8220	68.2	8402	8202	95.4	8319	8294	68.2	8329	8278	95.4
							Warning! Poor agreement - A= 57.6%(A'c= 60.0%)					
R_Date GrA-42463	8397	8330	68.2	8416	8208	95.4	8320	8295	68.2	8329	8279	95.4
							Warning! Poor agreement - A= 25.7%(A'c= 60.0%)					
R_Date GrA-42722	8424	8379	68.2	8513	8346	95.4	8320	8300	68.2	8330	8285	95.4
							Warning! Poor agreement - A= 0.2%(A'c= 60.0%)					
R_Combine SN08-326	8386	8326	68.2	8403	8210	95.4	8320	8295	68.2	8330	8280	95.4
							Warning! Poor agreement - A= 27.3%(A'c= 60.0%)					

Figure 18: OxCal numerical output for Tell A, levels A2-A4.

▼ Phase A1												
R_Date GrA-37848	7997	7883	68.2	8017	7862	95.4	8166	8147	68.2	8176	8140	95.4
							Warning! Poor agreement - A= 0.2%(A'c= 60.0%)					
R_Date GrN-28855	8276	8064	68.2	8303	8042	95.5	8196	8165	68.2	8293	8154	95.4
R_Date GrA-42455	8305	8060	68.2	8323	8044	95.4	8285	8163	68.2	8293	8157	95.4
R_Date GrA-42338	8310	8165	68.2	8332	8046	95.4	8285	8168	68.1	8294	8161	95.4
R_Date GrN-28851	8300	8180	68.2	8316	8176	95.4	8286	8179	68.2	8294	8175	95.4
R_Date GrA-42340	8310	8177	68.2	8349	8055	95.4	8283	8178	68.2	8295	8169	95.4
R_Date GrA-42477	8311	8185	68.2	8360	8165	95.4	8280	8186	68.2	8295	8175	95.4
R_Date GrA-42334	8311	8189	68.2	8355	8169	95.4	8278	8189	68.2	8296	8176	95.4
R_Date GrA-33003	8310	8195	68.2	8338	8180	95.4	8277	8194	68.2	8296	8181	95.4
R_Date GrA-32997	8321	8204	68.2	8345	8184	95.4	8268	8200	68.2	8295	8185	95.4
R_Date GrA-42453	8325	8201	68.2	8361	8180	95.4	8270	8198	68.2	8296	8181	95.4
R_Date GrA-42337	8327	8203	68.2	8363	8182	95.4	8269	8199	68.2	8296	8182	95.4
R_Date GrA-42456	8327	8203	68.2	8363	8182	95.4	8269	8199	68.2	8296	8182	95.4
R_Date GrA-42499	8327	8203	68.2	8363	8182	95.4	8269	8199	68.2	8296	8182	95.4
R_Date GrA-42500	8334	8204	68.2	8364	8184	95.4	8268	8200	68.2	8296	8183	95.4
R_Date GrA-42866	8334	8204	68.2	8364	8184	95.4	8268	8200	68.2	8296	8183	95.4
R_Date GrA-42479	8341	8205	68.2	8368	8185	95.4	8268	8200	68.2	8295	8185	95.4
R_Date GrA-42462	8344	8205	68.2	8370	8189	95.4	8267	8201	68.2	8296	8185	95.4
R_Date GrA-42470	8344	8205	68.2	8370	8189	95.4	8267	8201	68.2	8296	8185	95.4
R_Date GrA-42459	8348	8206	68.2	8374	8190	95.4	8266	8202	68.2	8296	8186	95.4
R_Date GrA-42495	8348	8206	68.2	8374	8190	95.4	8266	8202	68.2	8296	8186	95.4
R_Date GrA-42496	8352	8209	68.2	8376	8193	95.4	8265	8203	68.2	8296	8187	95.4
R_Date GrA-42342	8362	8211	68.2	8378	8194	95.4	8265	8203	68.2	8296	8188	95.4
R_Date GrA-42467	8362	8211	68.2	8378	8194	95.4	8265	8203	68.2	8296	8188	95.4
R_Date GrA-42473	8362	8211	68.2	8378	8194	95.4	8265	8204	68.2	8296	8188	95.4
R_Date GrA-42457	8366	8212	68.2	8380	8195	95.4	8264	8204	68.2	8295	8190	95.4
R_Date GrA-42476	8376	8215	68.2	8386	8199	95.4	8263	8206	68.2	8296	8191	95.4
R_Date GrA-42468	8394	8224	68.2	8409	8203	95.4	8260	8210	68.2	8296	8195	95.4
							Warning! Poor agreement - A= 37.2%(A'c= 60.0%)					
Boundary End Tell A							8163	8141	68.2	8173	8129	95.4

Figure 19: OxCal numerical output for Tell A, level A1.

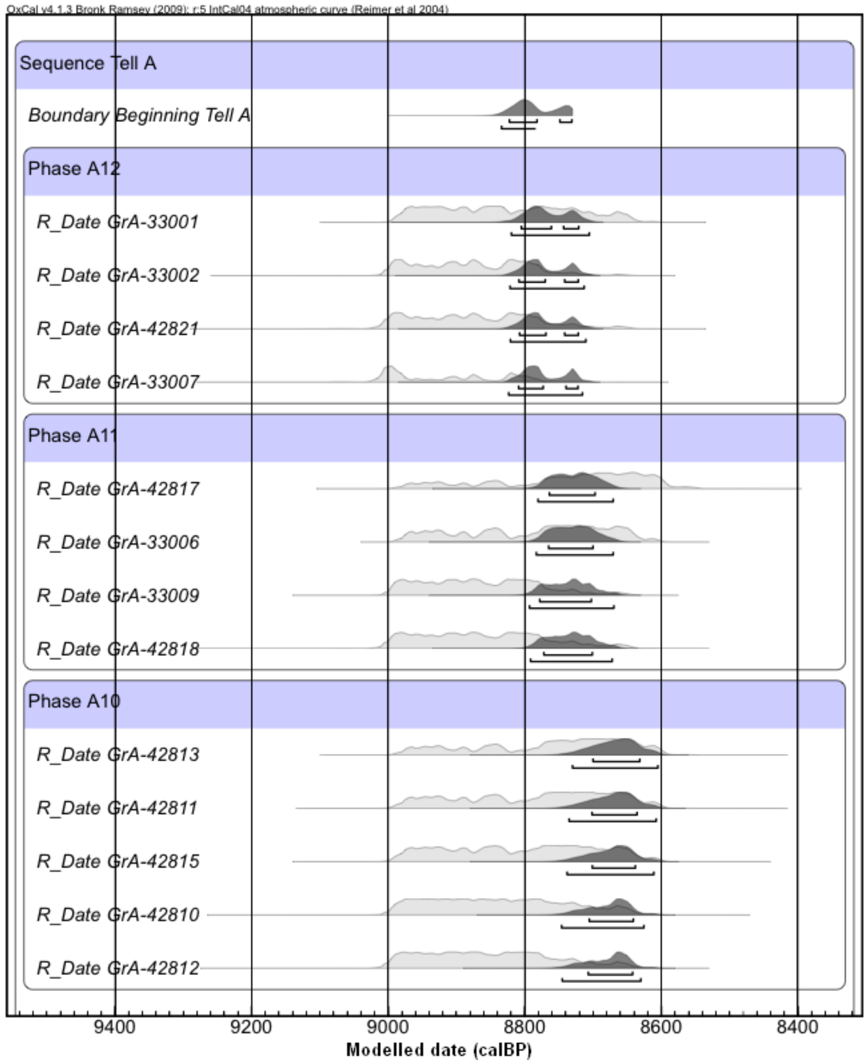

Figure 20: OxCal graphical output for Tell A, levels A10-A12.

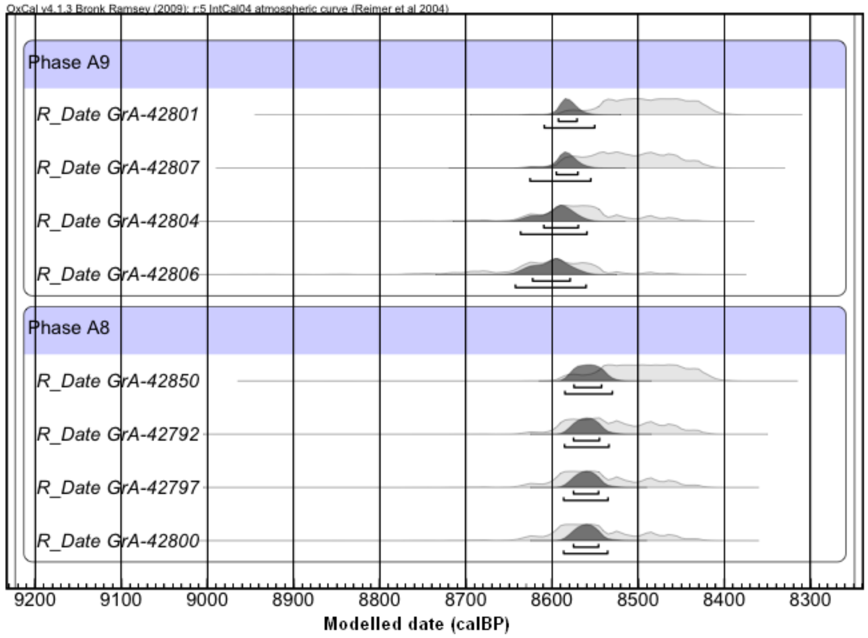

Figure 21: OxCal graphical output for Tell A, levels A8 and A9.

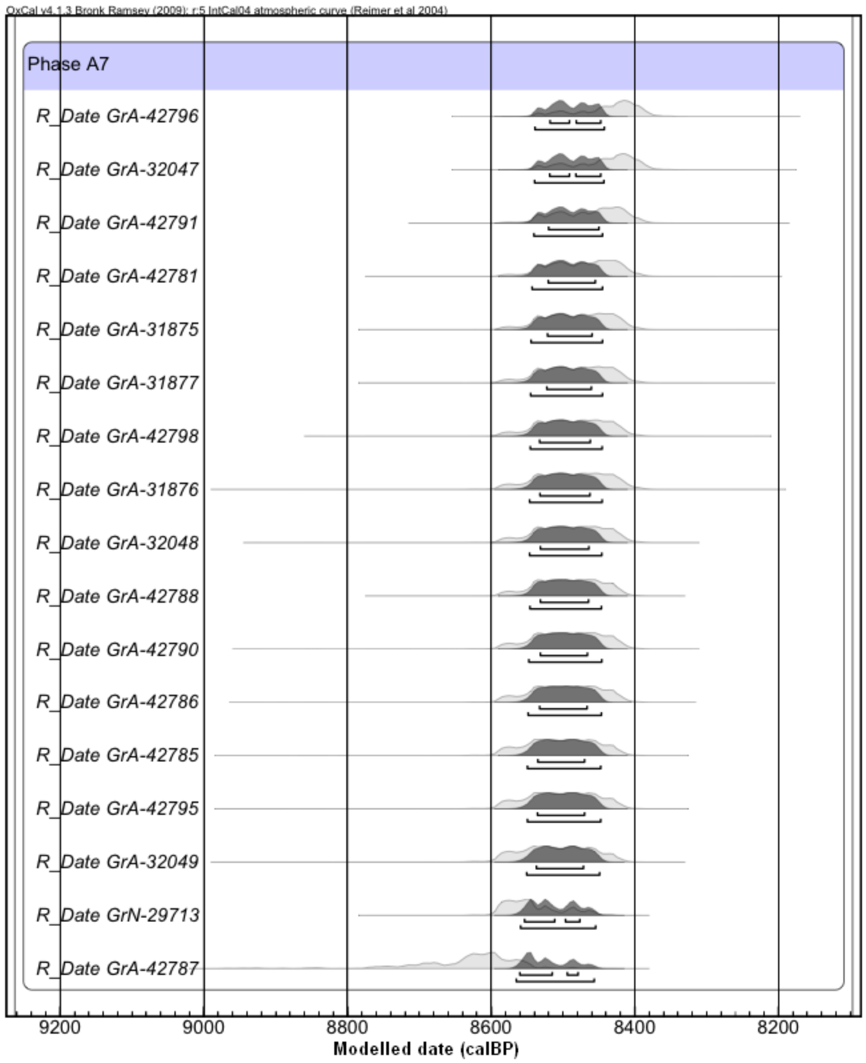

Figure 22: OxCal graphical output for Tell A, level A7.

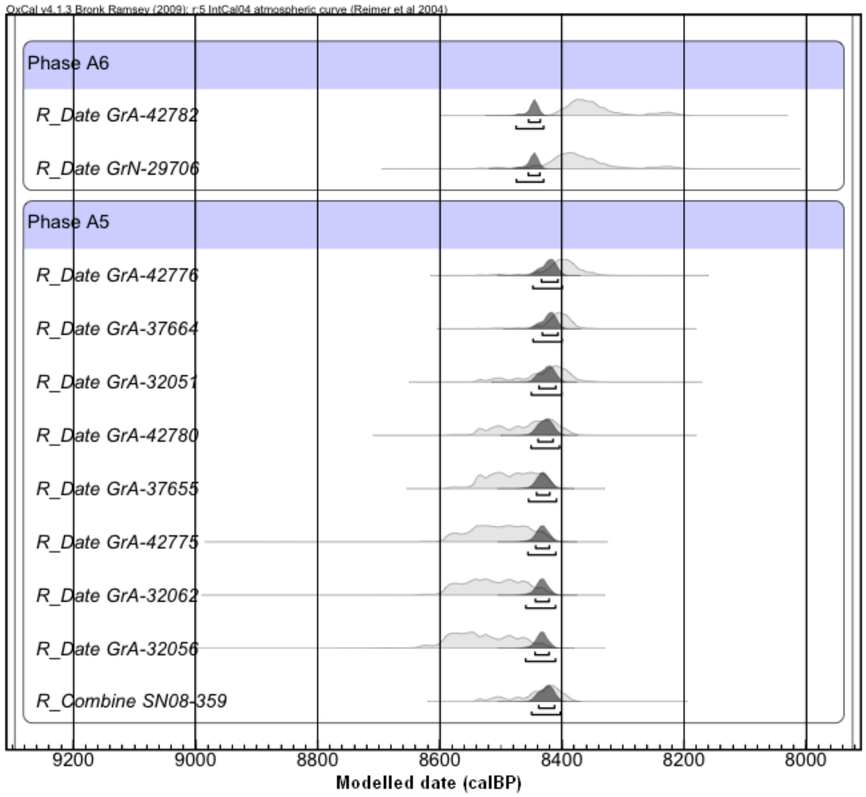

Figure 23: OxCal graphical output for Tell A, levels A5 and A6.

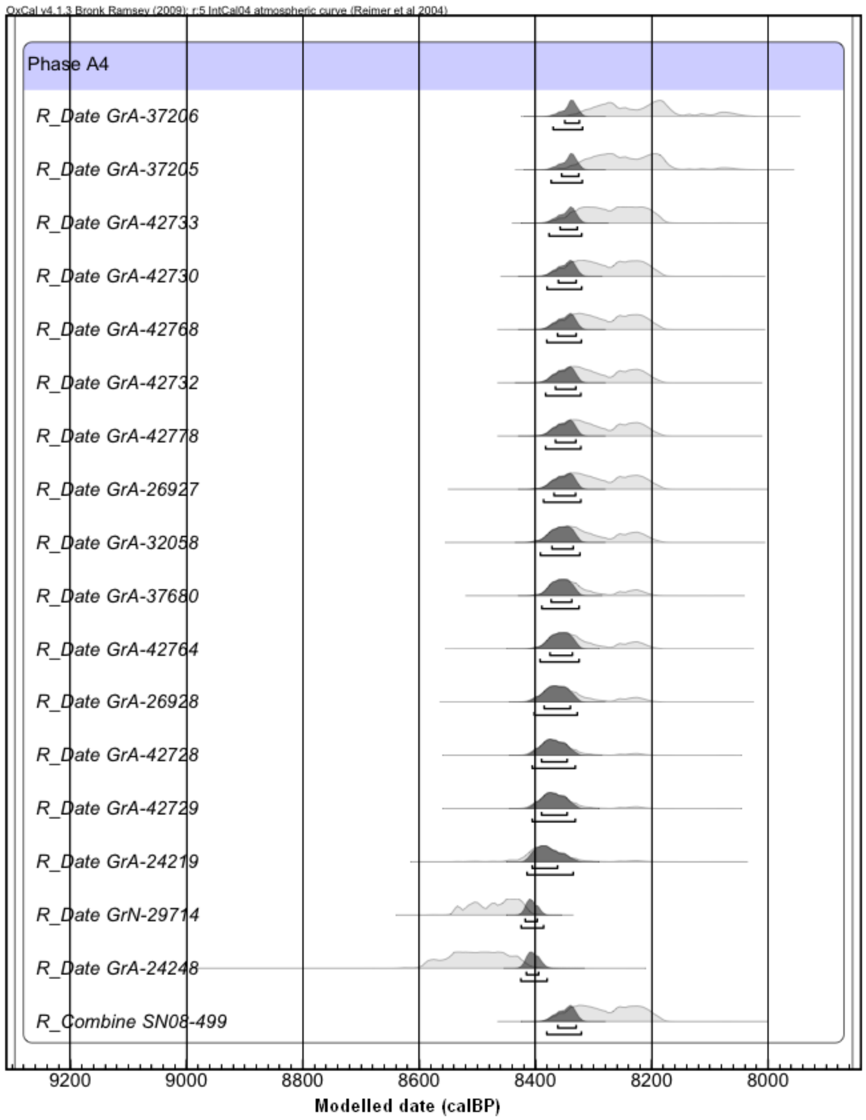

Figure 24: OxCal graphical output for Tell A, level A4.

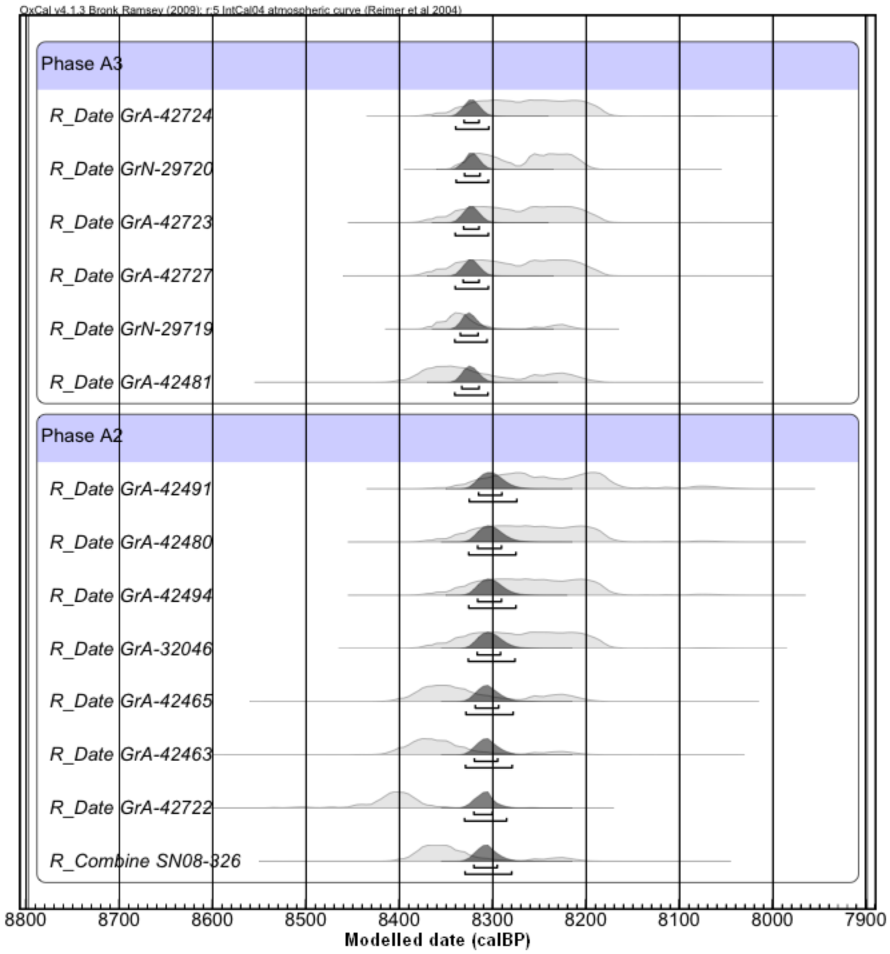

Figure 25: OxCal graphical output for Tell A, levels A2 and A3.

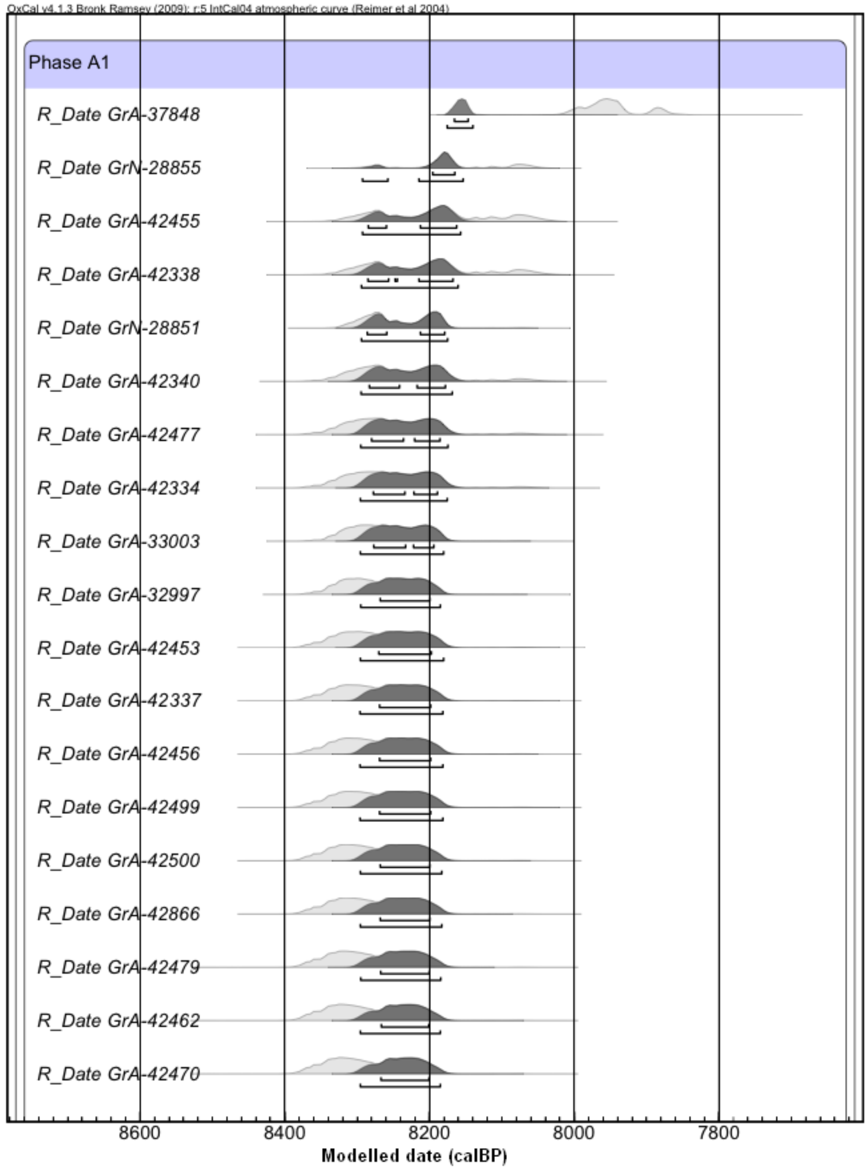

Figure 26: OxCal graphical output for Tell A, level A1.

A.3.2 Tell B

Name Show all Show structure	Unmodelled (BP)						Modelled (BP)					
	from	to	%	from	to	%	from	to	%	from	to	%
							Warning! Poor agreement - A= 10.2%(A'c= 60.0%) Warning! Poor agreement - A= 9.1%(A'c= 60.0%)					
▼ Sequence Tell B												
Boundary Begin Tell B							8150	8069	68.2	8191	8056	95.4
▼ Phase B8												
R_Date GrA-42891	8161	8032	68.2	8180	8005	95.4	8116	8050	68.2	8156	8040	95.4
R_Date GrA-42890	8170	8051	68.2	8183	8019	95.4	8116	8052	68.2	8161	8041	95.4
R_Date GrA-42868	8179	8049	68.2	8283	8013	95.4	8116	8052	68.2	8164	8041	95.4
R_Date GrA-42894	8279	8048	68.1	8310	8028	95.4	8116	8053	68.2	8173	8041	95.4
R_Date GrA-42893	8288	8050	68.2	8313	8033	95.4	8117	8052	68.2	8175	8041	95.4
R_Date GrA-42862	8297	8051	68.1	8314	8040	95.4	8117	8052	68.2	8175	8041	95.4
R_Date GrA-42864	8303	8055	68.3	8318	8043	95.4	8117	8052	68.2	8178	8041	95.4
R_Date GrA-34942	8019	7954	68.2	8155	7877	95.5	8127	8046	68.3	8151	8040	95.4
							Warning! Poor agreement - A= 11.5%(A'c= 60.0%)					
R_Date GrA-42333	8154	7978	68.2	8163	7968	95.4	8114	8049	68.2	8154	8040	95.4
R_Date GrA-42343	8154	7978	68.2	8163	7968	95.4	8114	8049	68.2	8153	8040	95.4
R_Date GrA-42344	8154	7978	68.2	8163	7968	95.4	8113	8049	68.2	8153	8040	95.4
R_Date GrA-42346	8157	8010	68.2	8169	7979	95.4	8114	8049	68.2	8155	8040	95.4
R_Date GrA-42486	8157	8010	68.2	8169	7979	95.4	8114	8049	68.2	8155	8040	95.4
R_Date GrA-37693	8156	8015	68.2	8171	7983	95.4	8114	8049	68.2	8155	8040	95.4
R_Date GrA-42347	8297	8051	68.1	8314	8040	95.4	8117	8052	68.2	8176	8041	95.4
▼ Phase B7												
R_Date GrA-42860	8151	7966	68.2	8161	7957	95.4	8067	8034	68.2	8099	8027	95.4
R_Date GrA-42869	8153	7974	68.2	8161	7965	95.4	8067	8034	68.2	8098	8027	95.4
R_Date GrA-42855	8157	8006	68.2	8167	7977	95.4	8068	8035	68.2	8098	8027	95.4
R_Date GrA-42858	8163	8046	68.2	8182	8010	95.4	8070	8035	68.2	8096	8027	95.4
R_Date GrA-42859	8181	8049	68.2	8290	8015	95.4	8071	8036	68.2	8095	8027	95.4
R_Date GrA-42856	8310	8070	68.2	8328	8045	95.4	8072	8037	68.2	8093	8028	95.4
							Warning! Poor agreement - A= 43.8%(A'c= 60.0%)					

Figure 27: OxCal numerical output for Tell B, levels B7 and B8.

▼ Phase B6												
R_Date GrA-42854	8043	7958	68.2	8159	7943	95.4	8045	8025	68.2	8064	8017	95.4
R_Date GrA-42853	8157	8000	68.2	8168	7970	95.4	8047	8025	68.2	8065	8017	95.4
R_Date GrA-42849	8157	8010	68.2	8169	7979	95.4	8047	8025	68.2	8065	8017	95.4
R_Date GrA-42848	8162	8040	68.2	8180	8009	95.4	8049	8025	68.2	8066	8018	95.4
R_Date GrA-42846	8297	8051	68.1	8314	8040	95.4	8051	8026	68.2	8068	8020	95.4
							Warning! Poor agreement - A= 44.3%(A'c= 60.0%)					
▼ Phase B5												
R_Date GrA-42844	7965	7865	68.2	8005	7835	95.4	8016	7996	68.2	8026	7984	95.4
							Warning! Poor agreement - A= 15.5%(A'c= 60.0%)					
R_Date GrA-42839	8003	7937	68.2	8033	7860	95.4	8020	7996	68.2	8030	7984	95.4
R_Date GrA-42840	8027	7949	68.2	8159	7878	95.5	8024	7999	68.2	8036	7985	95.4
R_Date GrA-42843	8037	7957	68.2	8158	7939	95.4	8025	8000	68.2	8036	7986	95.4
R_Date GrA-37679	8032	7967	68.2	8156	7953	95.4	8025	8000	68.2	8036	7987	95.4
R_Date GrA-42887	8155	7984	68.3	8161	7974	95.4	8029	8005	68.2	8041	7990	95.4
R_Date GrA-42845	8156	8001	68.2	8165	7973	95.4	8029	8005	68.2	8041	7990	95.4
R_Date GrA-37677	8156	8015	68.2	8168	8000	95.4	8030	8009	68.2	8044	7995	95.4
R_Date GrA-37671	8161	8035	68.2	8172	8017	95.4	8033	8011	68.2	8045	8000	95.4
R_Date GrA-41789	8164	8053	68.2	8179	8017	95.4	8033	8011	68.2	8045	8000	95.4
							Warning! Poor agreement - A= 51.7%(A'c= 60.0%)					
▼ Phase B4												
R_Date GrA-42838	7932	7796	68.2	7950	7745	95.4	8006	7981	68.2	8011	7962	95.4
							Warning! Poor agreement - A= 1.1%(A'c= 60.0%)					
R_Date GrA-42834	7999	7936	68.2	8021	7868	95.4	8006	7981	68.2	8011	7966	95.4
R_Date GrA-42835	8008	7953	68.2	8040	7875	95.4	8006	7981	68.2	8012	7967	95.4
R_Date GrA-42833	8176	8050	68.3	8190	8019	95.4	8006	7981	68.2	8013	7972	95.4
							Warning! Poor agreement - A= 2.0%(A'c= 60.0%)					
▼ Phase B3												
R_Date GrA-42825	8001	7933	68.2	8025	7853	95.4	7997	7967	68.2	8006	7950	95.4
R_Date GrA-37674	8011	7963	68.2	8046	7935	95.4	7997	7968	68.2	8005	7952	95.4
R_Date GrA-42822	8043	7958	68.2	8159	7943	95.4	7997	7968	68.2	8005	7953	95.4
Boundary Eind Tell B							7993	7958	68.2	8003	7941	95.4

Figure 28: OxCal numerical output for Tell B, levels B3-B6.

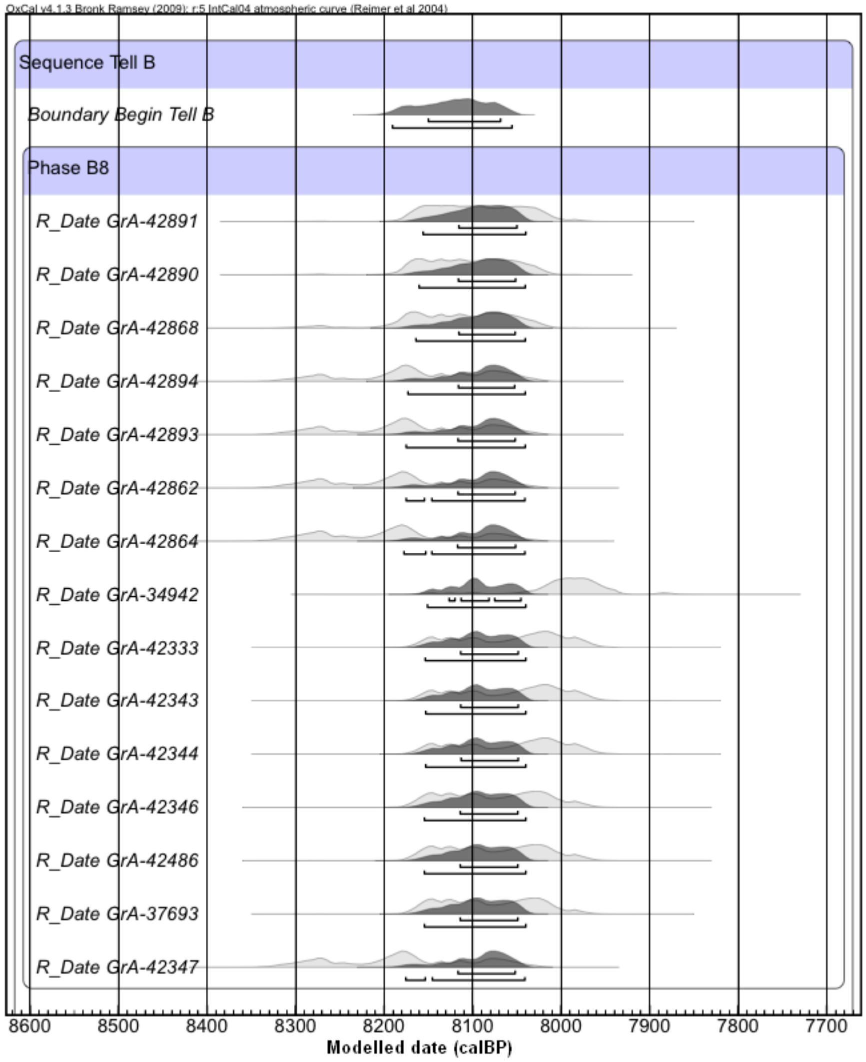

Figure 29: OxCal graphical output for Tell B, level B8.

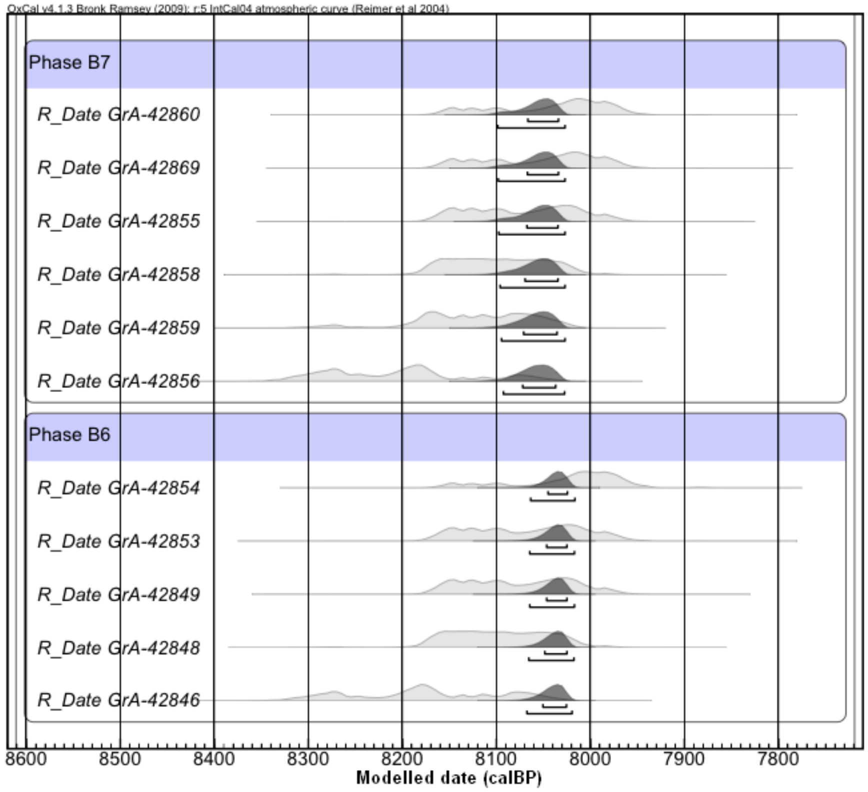

Figure 30: OxCal graphical output for Tell B, levels B6 and B7.

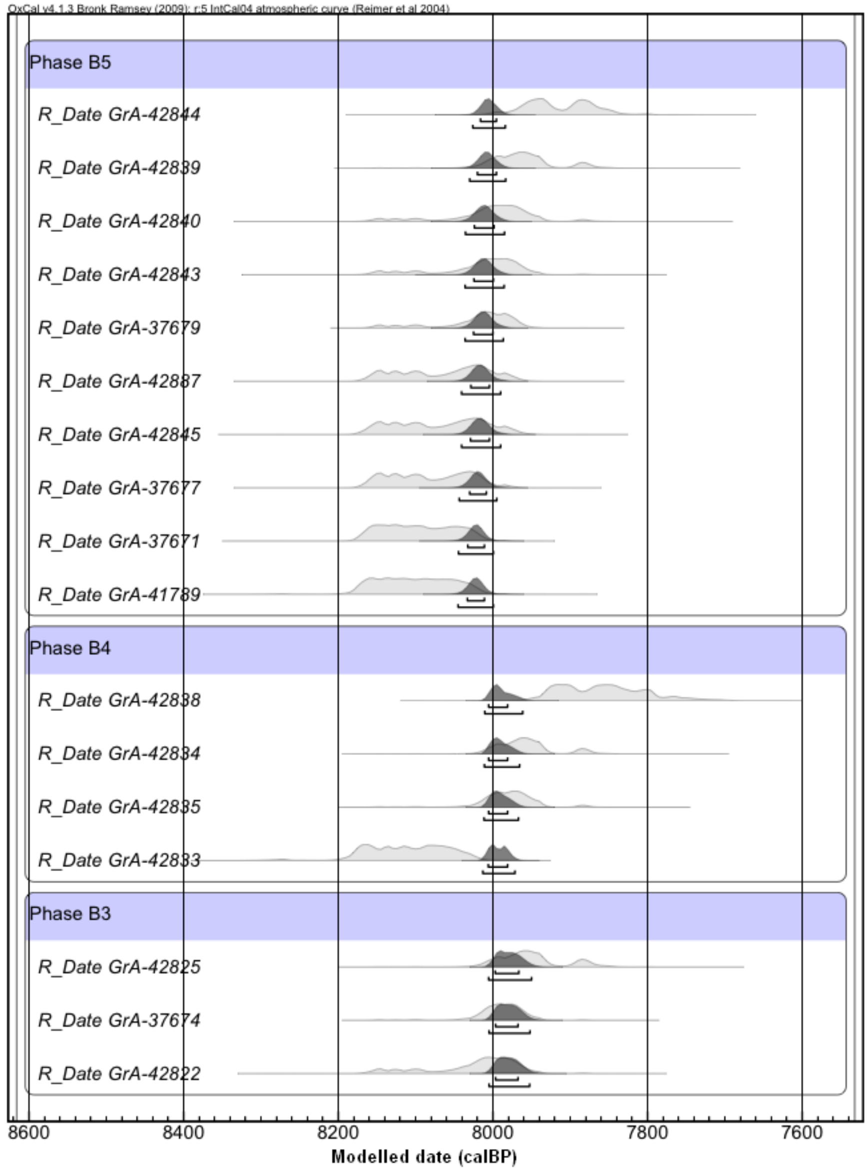

Figure 31: OxCal graphical output for Tell B, levels B3-B5.

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