# Radiocarbon analysis of sites on the BTC, SCP and SCPX projects

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**SCPX Pipeline Azerbaijan**

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## Contents



Frontispiece: Sample 55, charred peach stone from Kərpiclitəpə, SCPX KP247.

Document history and status

| Revision | Date | Description | Author | Checked | Reviewed | Approved |
|---|---|---|---|---|---|---|
| P01 | 29/6/2022 | Draft for peer technical review | DJM | SB | | |
| P02 | 30/8/2022 | Grave numbers revised in figure 3 | DJM | SB | | |
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**Radiocarbon analysis of sites on the BTC, SCP and SCPX projects**

## 1. Introduction

Samples of suitable material such as bone or charcoal were sent for radiocarbon analysis from a number of sites on both the BTC/SCP and SCPX projects. The material from the BTC/SCP project is contained within the site reports for each excavation. The list of results is presented in Maynard (2011, Special Analyses). The SCPX results are included in each specific site report, but are grouped together in their respective periods in this document for the better understanding of the range of periods under consideration.

Taken together, the results cover all the major periods of the history of Azerbaijan and provide a framework to understand the results of work on each site. Although the BTC/SCP results covered a wider range of dates (in particular, the Chalcolithic period), the SCPX group gives more detail for the Bronze Age and medieval episodes.

These groups are discussed below with charts generated in Oxcal (https://c14.arch.ox.ac.uk) showing the spread of dates in a graphical form. The analysis of dating also includes the large number of results from the BTC project which together, provide a substantial group of data for the sites studied.

## 2. Radiocarbon Dates from the SCPX Project

The SCPX project submitted 39 samples for analysis from the archaeological excavations on the pipeline route. Six failed for various reasons, so 33 valid results have been obtained.

All age determinations were carried out by Beta Analytic in Florida. The results are presented in Table 1 giving the laboratory reference and conventional age BP and deviation (Before Present, 1950 AD by scientific convention). The Oxcal programme calibrates the result into a range of year BC or AD using the latest calibration formula curves IntCal13.

**Table 1 SCPX Radiocarbon Dates**

| Site | Feature | Number | BETA | Conventional Age |
|---|---|---|---|---|
| Bəyimsarov 206 | Grave 10 cow bone | SCPX206 1 | 483542 | 2100 +/- 30 BP |
| Borsunlu Camp | Kurgan 4 burial | SCPXCAMPK4 | 464799 | 2760 +/- 30 BP |
| Keçili 311 | Burial | SCPX311 10 | 464795 | 3440 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 56 | 489694 | 1010 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 60 | 489698 | 1020 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 54 | 489692 | 1030 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 58 | 489696 | 1040 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 50 | 489688 | 1140 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 53 | 489691 | 820 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 55 | 489693 | 830 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 59 | 489697 | 860 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 66 | 489704 | 860 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 57 | 489695 | 870 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 61 | 489699 | 880 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 62 | 489700 | 890 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 64 | 489702 | 890 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 52 | 489690 | 920 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 63 | 489701 | 920 +/- 30 BP |

| | | | | |
|---|---|---|---|---|
| Kərpiclitəpə 247 | | SCPX247 65 | 489703 | 920 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 67 | 489705 | 920 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 23 | 489687 | 930 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 51 | 489689 | 950 +/- 30 BP |
| Kərpiclitəpə 247 | | SCPX247 46 | 498814 | 960 +/- 30 BP |
| Ləki I 277 | Unit 5 furnace fill | SCPX277 29 | 498811 | 90 +/- 30 BP |
| Poylu 389 | Unit 24 large jar | SCPX389 19 | 483543 | 2930 +/- 30 BP |
| Poylu 389 | Unit 24 furnace fill | SCPX389 20 | 483544 | 3010 +/- 30 BP |
| Səmədabad 211 | Burial | SCPX211 48 | 498816 | 2100 +/- 30 BP |
| Səmədabad 211 | Burial | SCPX211 47 | 498815 | 2140 +/- 30 BP |
| Soyuqbulaq II 409 | Burial | SCPX409 35 | 483546 | 4380 +/- 30 BP |
| Tovuzçay 358 | Burial 107 | SCPX358 40 | 483549 | 2670 +/- 30 BP |
| Tovuzçay 358 | Burial 106 | SCPX358 37 | 483547 | 2760 +/- 30 BP |
| Tovuzçay III | Burial | SCPX358 45 | 498813 | 3910 +/- 30 BP |
| Zəyəmçay Kurgan II | Burial | SCPX336 9 | 498810 | 3420 +/- 30 BP |

## 3. Chalcolithic

This period was well represented in the BTC work with dates from settlements at Böyük Kəsik, Poylu II and burials at Soyuqbulaq. Only one site on SCPX gave a radiocarbon date of the period (Figure 1). This came from the kurgan burial of Soyuqbulaq II (Müseyibli, 2018). The

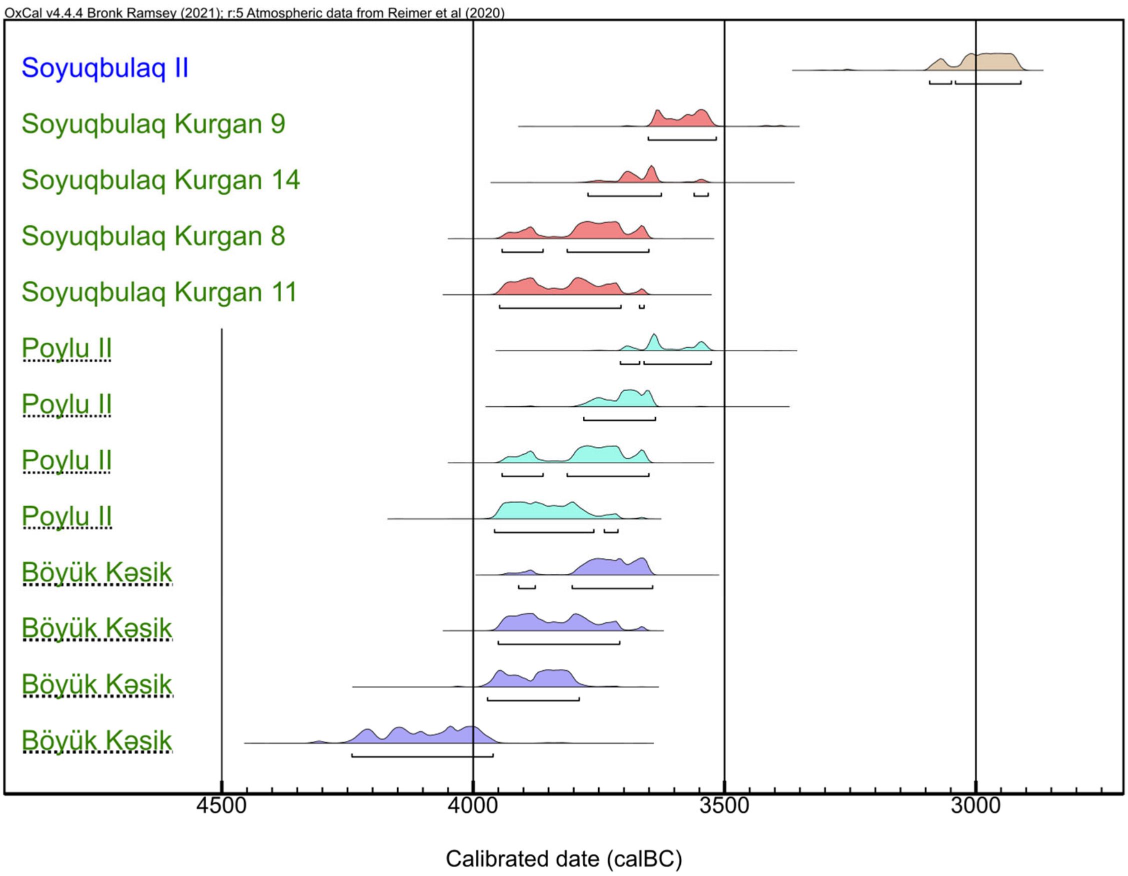


*Figure 1: Chalcolithic calibrated radiocarbon dates. BTC names shaded green, SCPX shaded blue. Settlement sites underlined.*

calibrated date is something like 500 to 600 years later than the results from the BTC work. The nature of the site is very different in character from other burial sites of the period.

## 4. Kura Araxes to Middle Bronze Age

All material from this period comes from funerary locations. The BTC work revealed early material from Şamkirçay kurgan III and the Həsənsu kurgan (Figure 2). The view of the excavator was that the material from Həsənsu kurgan was earlier than the results of the radiocarbon (Müseyibli, 2007). Indeed, the radiocarbon dates do seem inconsistent. The only SCPX result from the Kura Araxes period is Grave 120 from Tovuzçay II. This was isolated from the main cemetery by about 100m, and is about 1500 years earlier than the rest of the material found in the area.

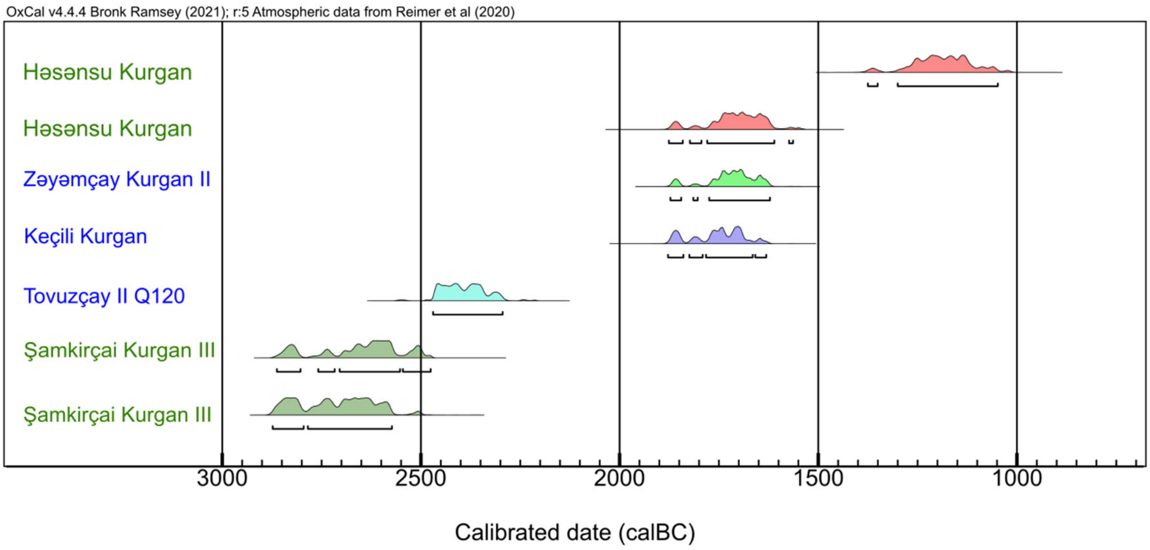


*Figure 2: Kura Araxes period to Middle Bronze Age calibrated radiocarbon dates. BTC site names shaded green, SCPX sites shaded blue. All are burial sites.*

The SCPX dates indicate two Middle Bronze Age Kurgan burials. Zəyəmçay Kurgan II is important as it contained a bronze rapier, while Keçili kurgan also had similar dates. The other kurgans west of the Zəyəmçay river are also likely to be of this period, although they contained few finds and no radiocarbon results were obtained.

## 5. Late Bronze Age Early Iron Age

SCPX produced a number of dates that fleshed out the information for this period (Figure 3). Settlement sites were identified at Xunan, Poylu II on BTC, and again at Poylu II in the SCPX work. The majority of the information for this period comes from burial locations. Zəyəmçay Necropol, Tovuzçay I, Borsunlu kurgan (dendrochronological date from the roof timbers) and the intrusive late burials at Soyuqbulaq were found in the BTC. The SCPX evidence came from Tovuzçay II and Borsunlu Camp.

The Xunan settlement dates indicates it is contemporary with the early phase of Tovuzçay I, while the SCPX data show more of a focus on the Early Iron Age. Indeed, the radiocarbon determinations from Grave 106, Tovuzçay II and Borsunlu Camp are identical, although the forms of burial were different at both locations. The Tovuzçay cemetery contained bodies laid in single graves covered by a stone capping, while the Borsunlu Camp was formed of circular kurgans, in which graves were inserted. The lack of additional radiocarbon dating at Borsunlu Camp cannot disprove the idea that these are earlier kurgans into which graves were inserted.

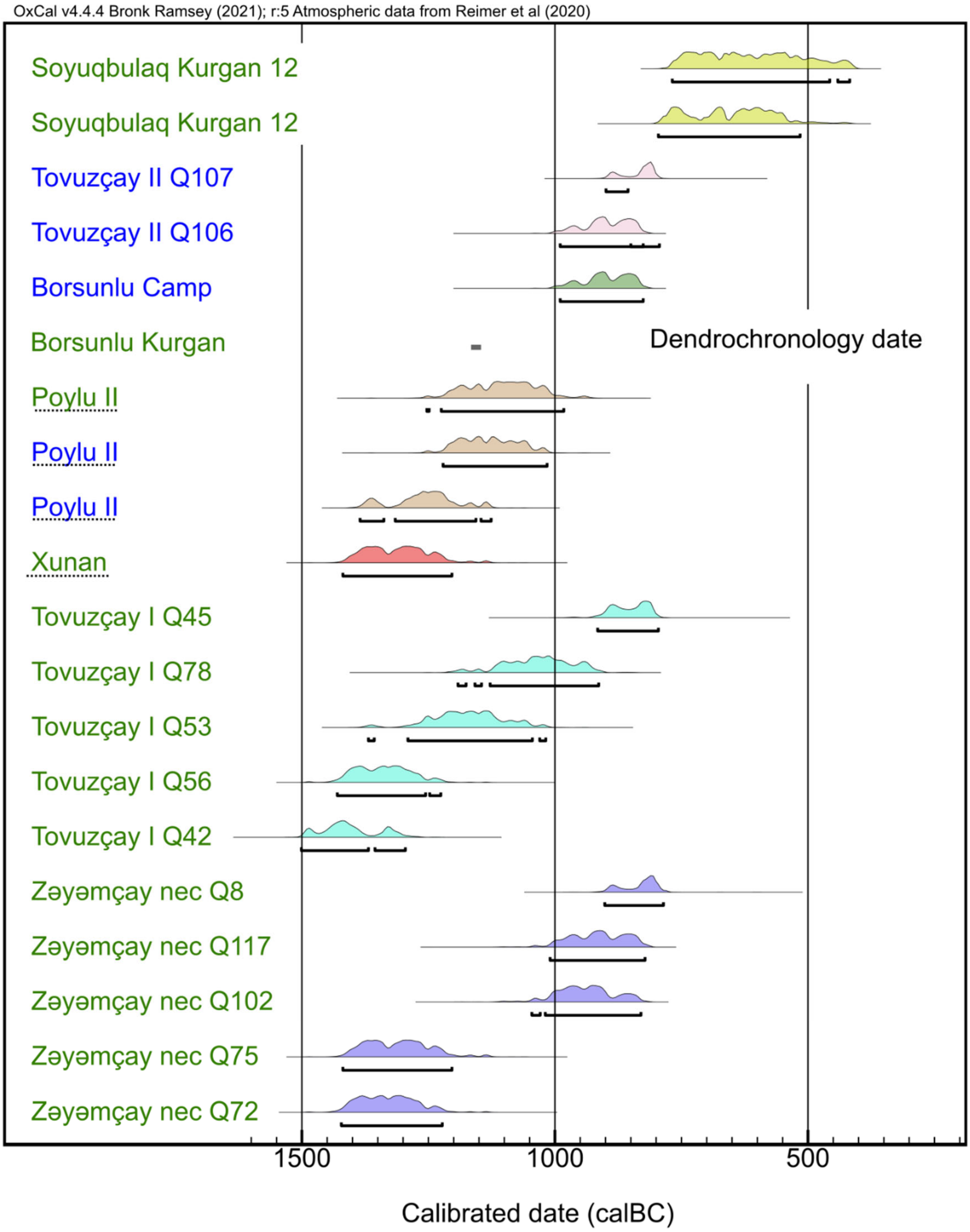


*Figure 3: Late Bronze Age, Early Iron Age calibrated radiocarbon dates. BTC names shaded green, SCPX shaded blue. Settlement sites underlined.*

## 6. Antique period

The BTC work produced a number of dates of the Antique period. These included settlement deposits at Qıraq Kəsəmən I and II, Chaparli and Poylu II and a date from a grave at Səmədabad. SCPX added to this with dates from graves at Bəyimsarov and further ones at Səmədabad. Figure 4 shows a tight grouping from about 400 BC to 200 AD. The conventional view is that the Antique continued to about 400 AD. before transitioning to the Albanian period. No evidence directly attributable to that particular period can be seen in the radiocarbon data. As one of the Səmədabad graves contained a rare example of a figurine (Kiriçenko and Agalarzadə, 2019), two radiocarbon samples were processed from this grave to improve the precision of the dating (see below).

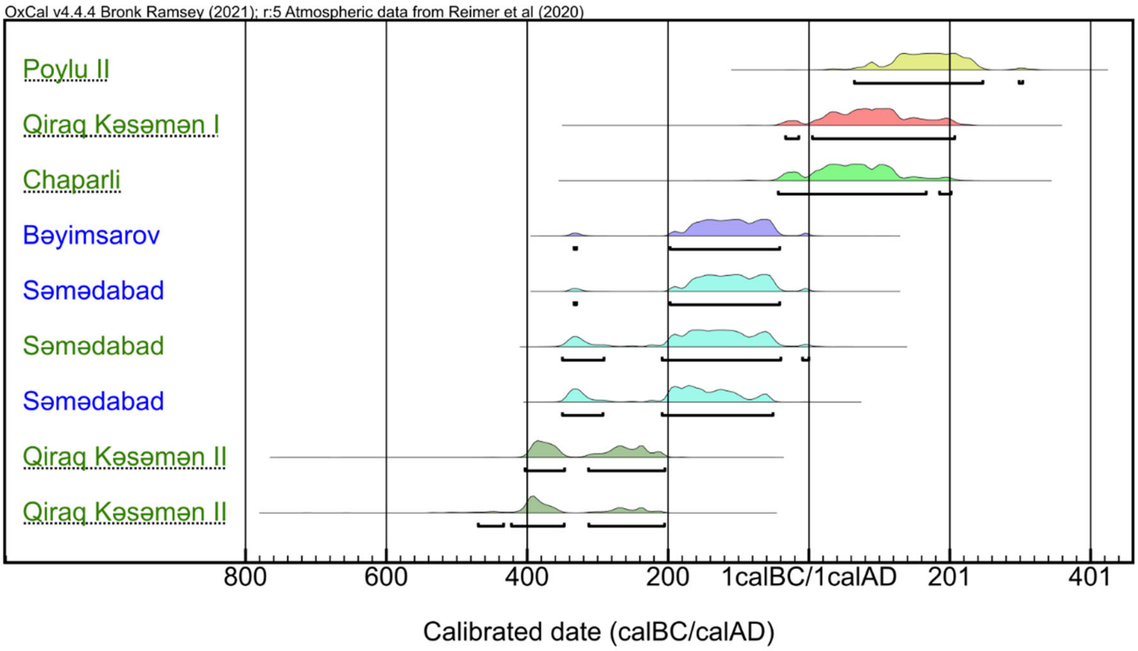


*Figure 4: Antique period calibrated radiocarbon dates. BTC names shaded green, SCPX shaded blue. Settlement sites underlined.*

## 7. Medieval

BTC results contain range of dates from settlements including Qıraq Kəsəmən I and II and the dates from the cemetery at Chaparli. Results for SCPX were focused on the important site of Kərpiclitəpə in an attempt to precisely date different phases of the use of the castle site using Bayesian analysis (see below). The combined grouping of medieval dates is shown in figure 5. This indicates that the Chaparli cemetery was in use at the time of the early phases of use of Kərpiclitəpə. Other dates from the settlements of Qıraq Kəsəmən I and II suggest continued occupation through that period, and earlier, confirming result information found on other settlement sites that shows their use that can be both long-term and possibly non-continuous.

There is also a strong hint that the effects of the Mongol invasion of 1235AD can be seen in the data.

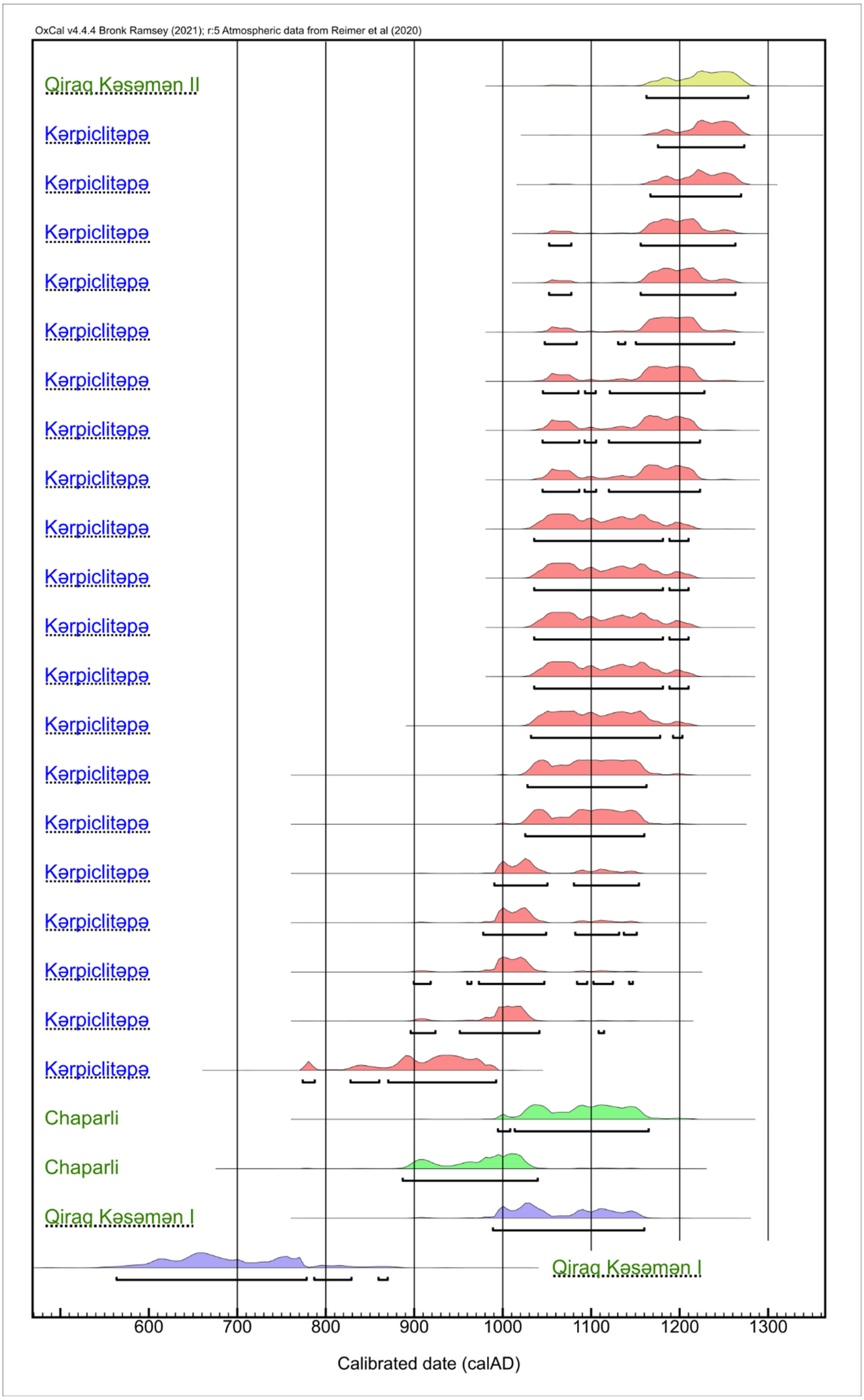


*Figure 5: Figure 5: Medieval calibrated radiocarbon dates. BTC names shaded green, SCPX shaded blue. Settlement sites underlined.*

## 8. Kərpiclitəpə Bayesian Modelling

A series of 19 radiocarbon samples were taken across the site during the 2017 excavation and a further one from the 2018 work. These were selected to make the best use of stratigraphic relationships resulting from the various phases of use of the site. Unfortunately, no-one stratigraphic series covers the full extent of the site, so a degree of inference is required to interpret the full sequence. The samples were processed by the Beta Analytic laboratory in Florida. Samples selected for dating were carbonised grains and seeds and small twigs to avoid the issue of old material being used such as long lived tree branches. Bone was avoided as much as possible because of the risk of material being incorporated from later deposits leading to an inaccurate, later estimate of date.

The basic radiocarbon results are presented in table below. The sample locations across the site are shown on Figure 6.

**Table 2 Kərpiclitəpə Radiocarbon Dates**

| Beta | Sample No. | Context | Material | Conventional Age | Calibrated calAD IntCal 20 |
|---|---|---|---|---|---|
| 489687 | 23 | Unit 30. Same stratigraphy as Sample 58 | Seeds | 930 +/- 30 BP | 1032-1178 (93.2%); 1192-1203 (2.3%) |
| 498814 | 46 | South of site, 2018. Unknown stratigraphic context | Wood | 960 +/- 30 BP | 1025-1160 (95.4%) |
| 489688 | 50 | Unit 30 under 134 in U30. Under gypsum plaster spread, outside northwest wall | Charred | 1140 +/- 30 BP | 870-992 (82.0%); 828-860 (8.5%); 774-787 (4.9%) |
| 489689 | 51 | Unit 25, north section (12/13) junction. Above brick fill of ditch, earlier than Sample 52 | Charred | 950 +/- 30 BP | 1028-1162 (95.4%) |
| 489690 | 52 | Unit 25, north section (11), fill of ditch. Slightly later than Sample 51 | Charred twigs | 920 +/- 30 BP | 1035-1181 (88.8%); 1188-1210 (6.6%) |
| 489691 | 53 | Unit 25 north section fill of ditch (5). Third charcoal layer from the top, earlier than Sample 54 | Charred | 820 +/- 30 BP | 1175-1273 (95.4%) |
| 489692 | 54 | Unit 25 north section fill of ditch (3). Second charcoal layer from the top, later than Sample 53 | Charred | 1030 +/- 30 BP | 973-1047 (87.4%); 899-918 (2.9%) |
| 489693 | 55 | Unit 2a Pit (170). Charred peach stone from pit (170) | Charred | 830 +/- 30 BP | 1167-1269 (95.4%) |
| 489694 | 56 | Unit 20 Tandir 126, u20. Contents of tandir 126, just inside wall (118), later than Sample 23 and Sample 58 | Charred | 1010 +/- 30 BP | 990-1050 (70.5%); 1080-1154 (25.4%) |
| 489695 | 57 | Unit 15 Hearth (69), u15. Material in base of open fronted hearth, above wall (118) Later than Sample 23 and Sample 58, possibly later than Sample 56 | Charred | 870 +/- 30 BP | 1150-1261 (83.5%); 1047-1083 (11.1%) |
| 489696 | 58 | Unit 24 Base of wall (118), u24. Grain seeds collected along east side of wall 118, incorporated with soil over the lower parts of the stones, same stratigraphy as Sample 23 | Charred grain | 1040 +/- 30 BP | 951-1041 (88.5%); 896-924 (6.4%) |
| 489697 | 59 | Unit 4 Base of pit in north section (133). Material from pit (133) (the big one) in N section. Pit also contained coin hoard and wooden peg | Charred twig | 860 +/- 30 BP | 1156-1263 (89.6%); 1052-1077 (5.8%) |
| 489698 | 60 | Important context as it seals the big plaster layer 113 part of working area. Late | Charred crop residue | 1020 +/- 30 BP | 978-1049 (82.0%); 1082-1131 (11.2%) |
| 489699 | 61 | Unit 16 North section. Over brick kiln structure Late | Charred crop residue | 880 +/- 30 BP | 1121-1228 (77.0%); 1045-1085 (16.9%) |
| 489700 | 62 | Unit 10 charcoal layer north section. Later than Sample 61 | Charred | 890 +/- 30 BP | 1120-1223 (69.6%); 1045-1086 (23.1%) |
| 489701 | 63 | Unit 3a South section sealed by plaster layer, cut by wall. Related to robbing of fort? | Charred | 920 +/- 30 BP | 1035-1181 (88.8%); 1188-1210 (6.6%) |

| | | | | | |
|---|---|---|---|---|---|
| 489702 | 64 | Unit 3a South section sealed by plaster layer, same stratigraphy as Sample 63. Robbing periods | Charred | 890 +/- 30 BP | 1120-1223 (69.6%); 1045-1086 (23.1%) |
| 489703 | 65 | Unit 3a South section sealed beneath Sample 64. Earlier than Sample 64 | Charred | 920 +/- 30 BP | 1035-1181 (88.8%); 1188-1210 (6.6%) |
| 489704 | 66 | Unit 3 South section. Black robber disturbance, earlier than Sample 67 | Charred | 860 +/- 30 BP | 1156-1263 (89.6%); 1052-1077 (5.8%) |
| 489705 | 67 | Unit 6 in area towards south section. Underneath brick robbing debris (143) | Bone | 920 +/- 30 BP | 1035-1181 (88.8%); 1188-1210 (6.6%) |


*Figure 6: 247 Kərpiclitəpə 2017. Locations of radiocarbon samples*

## Site Phases

Phase 1 Site construction. Fort built of a mud wall rampart faced with brickwork. There is evidence that two episodes of brick facing was applied to the external wall. Whether there was a long period of time between these is not known. Associated features are the gypsum surfaces formed from mixing mortar for wall building outside the northeast rampart and in the area between the north rampart and the brick kiln. The brick kiln must have been associated with this phase and was backfilled to create a level area once the need for brick production had ceased.

Phase 2 Initial use of the site. This is the working areas over the gypsum layer close to the kiln. It also includes the tandir ovens around the internal stone edging of the mud rampart of the fort. The carbonised seeds from the tandir interiors must represent a late stage in this activity.

Phase 3 is later use of the site including layers filling part of the fort area.

Phase 4 External activity beyond the confines of the fort. These are tandir ovens and large storage pits containing a wide range of material.

Phase 5 Late buildings. No dating evidence is available for these.

Phase 6 Removal of the fort structure and robbing of bricks and tiles. This had the potential to create a lot of disturbed deposits with material mixed together. No dating evidence is available for this.

## Radiocarbon Bayesian Modelling

The methods employed here have been described by Bronk Ramsey (2009a), Bronk Ramsey and Lee (2013) and Bayliss et al (2011). The results from the site are analysed within a Bayesian framework (Buck et al., 1996). The principle behind the Bayesian approach to the interpretation of data is encapsulated by Bayes' theorem (Bayes, 1763). Basically, new data collected about a problem ('the standardised likelihoods' – in this case calibrated radiocarbon dates) are analysed in the context of existing experience and knowledge of that problem ('prior beliefs' – in this case, the archaeology) by expressing both as probability density functions. The combination of the two permits a new understanding of the problem ('posterior beliefs'). Such estimates will vary with the model(s) employed and several different models may be constructed based on varying interpretations of the same data. The purpose of modelling is to progress beyond the dates at which the individual samples left the carbon cycle to the dates of the archaeological events associated with those samples.

A working example of this approach is used in Healy *et al* (2019).

### Objectives of the process

The age of the site is fairly tightly identified by conventional archaeological observation as being in the two centuries prior to the Mongol invasion (Nəcəfov, 2018). There appears to be no earlier use of the site. Later activity can be seen in Phase 5 structures and Phase 6 robbing of fired brick from the walls. Phase 5 could be an element of the continued occupation of the site, while Phase 6 robbing could have occurred at any time afterwards, and may indeed, have taken place intermittently over a very long period of time. No radiocarbon material is available for Phases 5 and 6. If any were available, interpretation would be difficult, due to the high degree of mixing of disturbed deposits in the upper layers of the site.

A primary objective was to identify the date of the construction of the site. Unfortunately, only one sample comes from this stratigraphic location (Sample 50) and it is not clear that this is so. The modelled date of this sample is *834-995 cal AD* (modelled results are shown in italics for clarity).

Sample modelled dates as shown in Figure 7. Samples 46, 53, 54, 57 and 60 were removed from the modelling process.

**Table 3 Kərpiclitəpə Results of Bayesian Modelling of Radiocarbon Dates**

| Sample | Unmodelled (BC/AD) | | | Modelled (BC/AD) | | | Indices Amodel 122.5 Aoverall 120.7 |
|---|---|---|---|---|---|---|---|
| Name | from | to | % | from | to | % | A |
| 55 | 1167 | 1269 | 95.4 | 1209 | 1270 | 95.4 | 112.3 |
| 66 | 1052 | 1263 | 95.4 | 1187 | 1249 | 95.4 | 112.1 |
| 59 | 1052 | 1263 | 95.4 | 1166 | 1225 | 95.4 | 113.4 |
| 52 | 1035 | 1210 | 95.4 | 1043 | 1169 | 95.4 | 129.5 |
| 51 | 1028 | 1162 | 95.4 | 1041 | 1166 | 95.4 | 99.8 |
| 67 | 1035 | 1210 | 95.4 | 1042 | 1170 | 95.4 | 129.5 |
| 63 | 1035 | 1210 | 95.4 | 1043 | 1170 | 95.4 | 129.5 |
| 64 | 1045 | 1223 | 95.4 | 1044 | 1176 | 95.4 | 89.6 |
| 65 | 1035 | 1210 | 95.4 | 1043 | 1170 | 95.4 | 129.5 |
| 62 | 1045 | 1223 | 95.4 | 1044 | 1176 | 95.4 | 89.6 |
| 61 | 1045 | 1228 | 95.4 | 1045 | 1178 | 95.4 | 61.7 |
| 23 | 1032 | 1203 | 95.4 | 1021 | 1104 | 95.4 | 91.3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 56 | 990 | 1154 | 95.4 | 990 | 1052 | 95.4 | 123.9 |
| 58 | 896 | 1114 | 95.4 | 985 | 1040 | 95.4 | 109.8 |
| 50 | 774 | 992 | 95.4 | 834 | 995 | 95.4 | 102.8 |
| 46 | 1025 | 1160 | 95.4 | | | | |
| 53 | 1175 | 1273 | 95.4 | | | | |
| 54 | 899 | 1147 | 95.4 | | | | |
| 57 | 1047 | 1261 | 95.4 | | | | |
| 60 | 978 | 1151 | 95.4 | | | | |

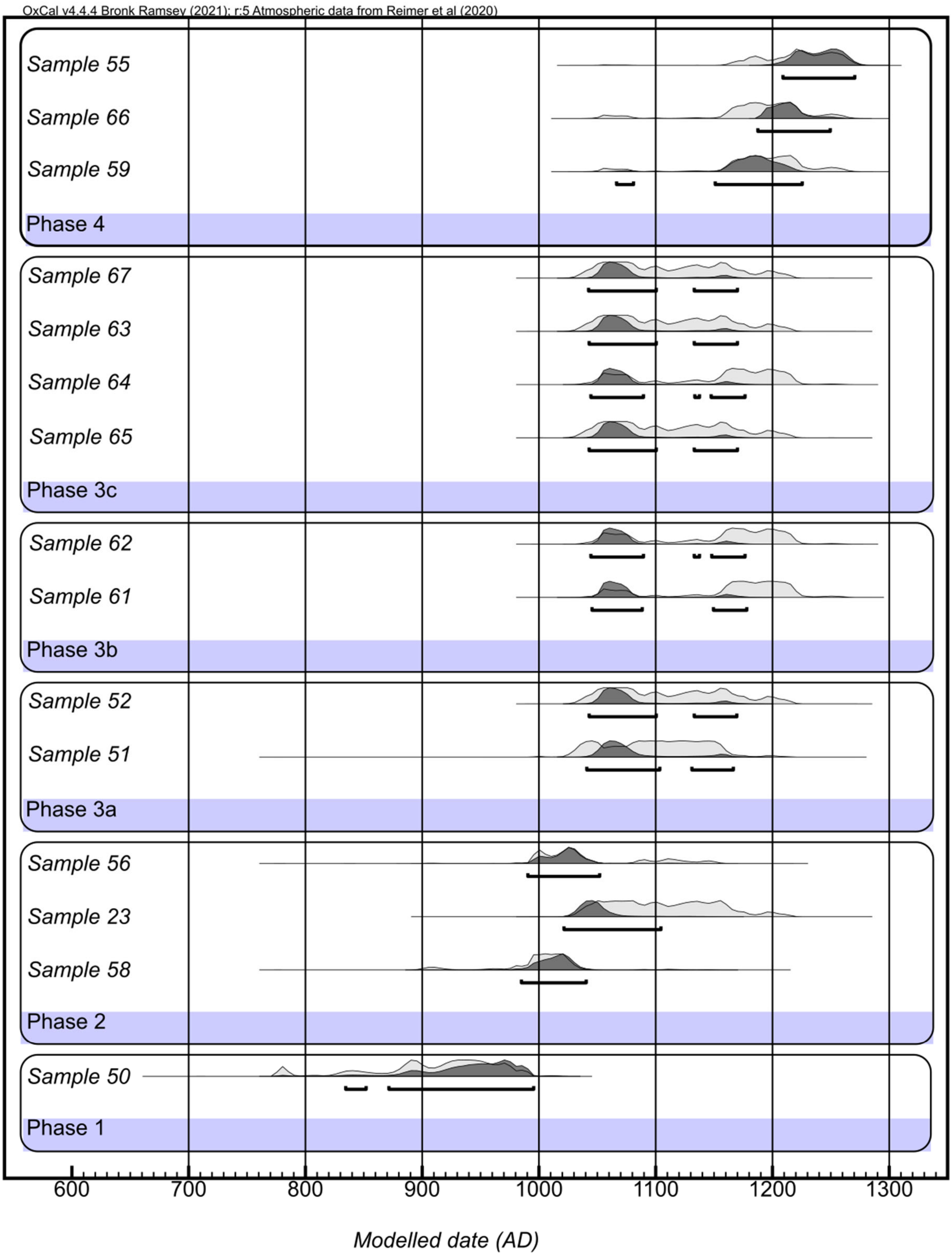


*Figure 7: Kərpiclitəpə chronological model for radiocarbon dates. For each date, the total distribution represents the simple radiocarbon date and the solid distribution is derived from and constrained by the model.*

The OxCal modelling was run several times using boundaries created by the interpreted phases of the site. The final version shown in Figure 7 has a high level of agreement (Amodel of 122.5%) only one of the results has a low value of 61.7%, where 60% is the lowest acceptable value (Table 3). Overall, the high level of agreement suggests that the model is inherently correct.

A single sample (59) comes from a pit that contained a hoard of 38 coins. These coins are identified as being of the Eldiguzid dynasty. One coin was identified as Qizil Arslan, 1186-1191.

These are the Eldiguzid dynasty kings and their dates:

| | | |
|---|---|---|
| Shamsaddin Eldaniz | 1136-1175 | |
| Muhammad Jahan Pahlavan | 1175-1186 | |
| Qizil Arslan | 1186-1191 | Coin hoard |
| Nusrataldin abu Bakr | 1191-1210 | |
| Muzaffar al-Din Uzbek | 1210-1225 | |

The OxCal programme can combine results of identified dated coins with the radiocarbon date to give a greater precision in the modelled date (C_date). Sample 59 came from the same deposit with a conventional radiocarbon date of 860+/–30BP which calibrates to 1156–1263 AD (89.6%) or 1052–1077 AD (5.8%). If the assumption is made that the coin hoard was deposited at 1191 AD and used in the programme with the C_date function for Sample 59 then a modelled date of 1187-1260 cal AD with a 95.4% probability with Amodel of 104.0%.

The group of three radiocarbon dates from Phase 3 all end in a period where historical events may be expected to influence archaeological observations on site. Historical sources state that the Mongols occupied most of Azerbaijan in AD1231. In AD1235, the Mongols destroyed the cities of Ganja, Shamkir, Tovuz and Shabran on their way to conquer Kievan, Russia.

It has been suggested by the excavators that the site, that Kərpiclitəpə was affected by these events (Nəcəfov, 2018). This seems to be supported by the radiocarbon dates from Phase 3 which do not extend beyond this time.

An overview of phases of the site informed by the Bayesian modelling suggests the following:

Phase 1 site construction *834 to 995 cal AD*

Phase 2 earliest use the site may be in the period *985 to 1052 cal AD*

Phase 3 later use of the site may be in the period *1041 to 1178 cal AD*

Phase 4 late use of large pits outside Fort may be in the period *1066 to 1270 cal AD* with a possible historical end date of 1235 AD

Phase 5 later structures after 1235, possibly 1300 to 1400 AD

Phase 6 robbing of fired bricks possibly in the period 1500 to 1700 AD

The IoAE report (Nəcəfov, 2018) describes a layer of charcoal found throughout the west of the site in both 2017 and 2018 excavations. It is suggested that this represents a major destructive episode across the site and that this could be associated with 1235. There are two radiocarbon samples from this deposit and a further three samples that are found in related locations. Sample 46 comes from an unknown location in the 2018 excavation that is supposed to be from deep in the site, so showing the start of use of the site. Samples 51 and 52 are part of this dark continuous layer across the west of the site. Samples 53 and 54 are about 1.5m above this, separated by deposits of clean material. The five samples are presented in figure 5 as simple calibration results ordered in the stratigraphic sequence. This sequence is shown in Figures 8 and 9.

Sample 54 appears to be too late in the sequence. Either there is a problem with the sample, or more likely, the deposit from which it was taken has been mixed in some way with earlier material incorporated into it. Sample 46 does not appear to represent the earliest activity on the site. The dark layer across the west of the site contains radiocarbon results in the range of 1028 to 1210 cal AD. This sequence cannot be directly modelled under OxCal due to the lack of associated interpretation. However, it is clear that the dark layer cannot be the result of events in 1235 as none of the sample date ranges extend that far. Sample 53 with a calibrated range of 1175-1273 cal AD, does however, possibly extend to the 1235 period of Mongol intervention. The layers from which Samples 53 and 54 were taken appear to be too high in the site profile to allow them to be seen as this large dark layer


*Figure 8: Radiocarbon Samples 51, 52, 53 and 54. Stratigraphic sequence of locations in dark horizon on the west portion of the north section.*

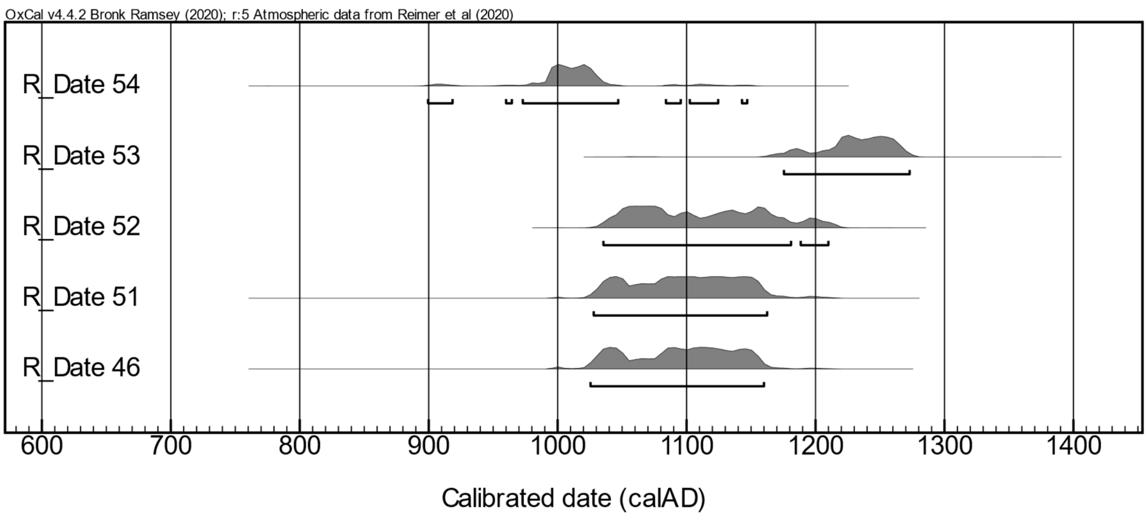


*Figure 9: Radiocarbon Samples 46, 51, 52, 53 and 54. Calibrated date range. Shown in stratigraphic sequence.*

A further consideration of the stratigraphic sequence is that Samples 60, 61 and 62 lie over the backfilled brick kiln. They do not directly date this activity of backfilling as they are separated by a series of layers that cover the backfilling. It can however be seen that the calibrated date for Sample 60 of 896-1041 cal AD, and the modelled dates of *1045-1178 cal AD* (61) and *1044-1176 cal AD* (62) form a close group of dates later than the filling of the brick kiln suggest that the abandonment of the kiln may have occurred before 1000 AD, which is in agreement with Sample 50 modelled date of *872 to 995 cal AD*, that underlies a gypsum layer laid down during the Phase 1 construction.

**Possible further action**

Further radiocarbon determinations could be taken from selected samples to provide additional precision on dates. Using the OxCal programme, it is possible to combine or amalgamate radiocarbon dates taken from the same piece of material. This can give a higher resolution of the final modelled date.

The following samples are those where a further series of radiocarbon date would be of benefit.

| Sample | Objective |
|---|---|
| 50 | Increase precision of the date for construction of the fort. |
| 60 or 61 | Increase precision of the dates covering the fill of the brick kiln |
| 59 or 55 | Increase precision of latest dates of a group that appear to precede the 1235 historical event |

**Summary**

The radiocarbon dating programme was successful in providing improved results with a greater precision as a result of the application of Bayesian modelling. The aim to provide a clear indication of the earliest date for the site was not achieved due to the absence of suitable material from the site. Four radiocarbon dates suggest that there may be a relationship with the possible historical date of 1235 for the end of organised activity on site.

## 9. Səmədabad Bayesian Modelling

In early 2018, Grave 11 was examined this jar grave contained a total of 25 pottery vessels of different types, along with an anthropomorphic clay figure of a woman, 2 elongated clay items, 3 bronze bracelets and green glass beads.

Two radiocarbon dates were obtained from bone in the grave. This gave results of:

| Grave | Beta | Conventional Age | Calendar calibration (95.4% probability) | Material |
|---|---|---|---|---|
| Grave 11 | 488815 | 2120+/-30 BP | (95.4%) 213-88 cal BC | Bone |
| Grave 11 | 488816 | 2100+/-30 BP | (95.4%) 198-47 cal BC | Bone |

The Oxcal programme allows radiocarbon results to be combined to overcome variations in the uncertainty of the results and provide a more accurate modelled date. The samples must be obtained from the same carbon reservoir. As both results (Beta 488815 and Beta 488816) from Grave 11 come from the same individual, this condition is met.

Both sample were processed in Oxcal using the Combine function. The results are shown in Figure 10. The modelled result of *176-50calBC* at 95.4% probability provides a good indicator of the true age of

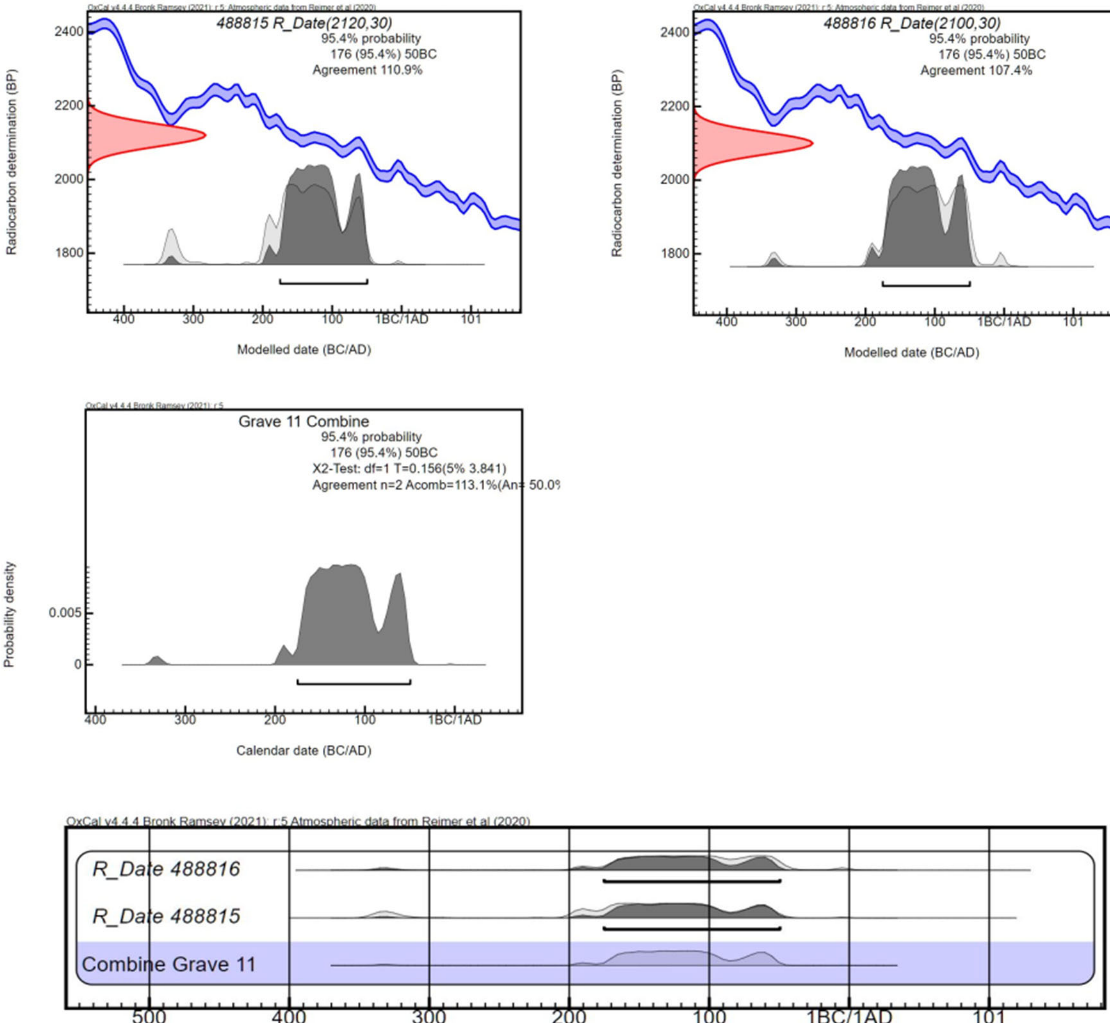


*Figure 10: Samedabad Grave 11 Oxcal modelled radiocarbon results using Combine function.*

the burial. This modelling also suggests that the single date from Grave 3, about 10m to the north, recorded during the BTC work (Beta 220993) is highly likely to also originate in this period. This sample is calibrated as follows

| Grave | Beta | Conventional Age | Calendar calibration (95.4% probability) | Material |
|---|---|---|---|---|
| Grave 3 | 220993 | 2120+/-40 BP | (95.4%) 351-1 cal BC<br>(11.6%) 351-292 cal BC<br>(83.1%) 209-41 cal BC<br>(0.8%) 10-1 cal BC | tooth |

## 10. Summary

The results from the two archaeological projects, separated by approximately 10 years, shows both an increase in the technical presentation of the data and the confirmation of previously suspected trends in the determination of dates for sites studied on the projects.

The combination of results for both projects gives a total of 76 usable samples that cover the period between approximately 4,500 BC to 1,300 AD. These provide a framework that can be used to assist the development of future studies of archaeological sites across Azerbaijan.

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