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CHRONOLOGY (AND CHRONOLOGIES) OF THE KURA-ARAXES CULTURE IN THE SOUTHERN CAUCASUS: AN INTEGRATIVE APPROACH THROUGH BAYESIAN ANALYSIS

Annapaola Passerini*/**
Elena Rova*
Elisabetta Boaretto**

Abstract – *This study proposes a re-definition of the absolute chronology for the 4th and 3rd millennium in the Southern Caucasus, with particular regard to the Kura-Araxes culture. An overview of the history of research demonstrates how the fragmentation of archaeological practice has long challenged the completion of a comprehensive chronological study based on both absolute and relative archaeological data. In this work, the two datasets were combined following the principles of Bayesian modelling. Firstly, existing radiocarbon dates were collected and characterised in relation to chrono-cultural phases and associated material assemblages. Secondly, all dates were scrutinised based on archaeological and analytical reliability criteria. Thirdly, the remaining dates were compiled within Bayesian models representative of the chrono-cultural scenario. Results of the modelling process led to the distinction of differing chronological trends within geographically distinct sub-regions of the Southern-Caucasus, as represented by the Kura (North) and Araxes (South) river valleys, which are naturally demarcated by the Lesser Caucasus Range.*

Keywords – Chronology, Radiocarbon, Southern Caucasus, Early Bronze Age, Kura-Araxes culture.

Riassunto – Questo studio propone una ridefinizione della cronologia assoluta per il quarto e terzo millennio nel Caucaso Meridionale, con particolare riferimento alla cultura Kura-Araxes. Una panoramica della storia degli studi rivela come la frammentazione della ricerca archeologica abbia a lungo sfidato il completamento di uno studio cronologico basato su dati archeologici sia assoluti che relativi. In questo studio, i due gruppi di dati sono stati combinati seguendo i principi della statistica bayesiana. In primo luogo, le date radiocarboniche esistenti sono state raccolte e classificate in base alle fasi crono-culturali e ai materiali diagnostici ad esse associati. In secondo luogo, tutte le date sono state vagliate secondo criteri di attendibilità archeologica e analitica. In terzo luogo, le date selezionate sono state incluse in modelli bayesiani elaborati in coerenza con lo scenario crono-culturale ricostruito. I risultati del modello hanno portato alla distinzione di diverse tendenze cronologiche all'interno di regioni geograficamente distinte del Caucaso meridionale, le quali corrispondono alle valli dei fiumi Kura (Nord) e Araxex (Sud), che sono naturalmente delimitate dalla catena del Caucaso Minore.

Parole chiave – *Cronologia, ^{14}C, Bronzo Antico, Caucaso meridionale, cultura Kura-Araxes.*

INTRODUCTION

The past few decades have witnessed an intensification of archaeological research in the Southern Caucasus. Field investigations have been particularly stimulated by a growing interest towards the Kura-Araxes (KA) culture and its narrative in the context of the interregional communications that characterised the 4th and 3rd millennium BC in the Caucasian, Anatolian, and Upper Mesopotamian lands. However, several issues have and continue to challenge the understanding of the KA cultural complex: among these, the debate on the origins of the

KA culture and its relation to pre-KA Late Chalcolithic horizons during its formative stages; the question of its "migration" towards South-eastern Anatolia, Western Syria, the Southern Levant, and North-western Iran; the complexity of its fading and transformation during the final stages of its existence; and, last but not least, the problem of the KA pragmatic identity in the context of broader cultural and economic confrontations.

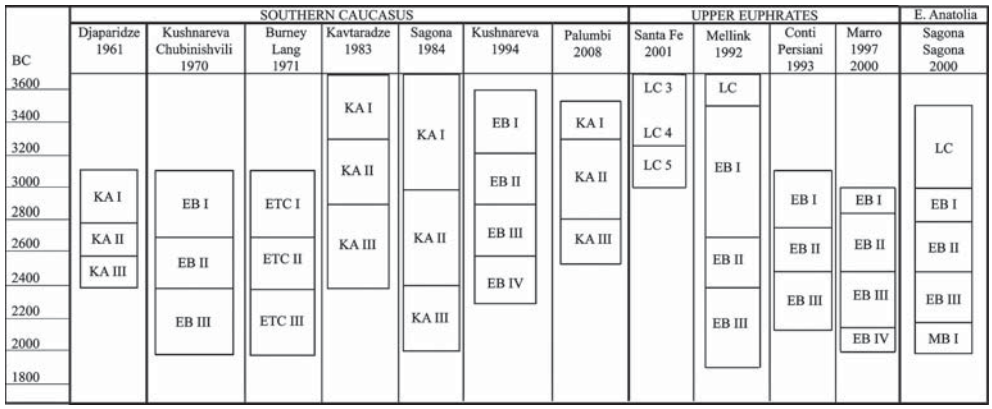
A major source of misunderstanding is represented by the general lack of information on the KA absolute chronology in relation to relevant material paradigms and the particular paucity of ^{14}C dates from Caucasian sites, as opposed to the relative abundance of contemporary dates from the neighbouring regions. Recent improvements in this area of research have been enabled by the acquisition of more consistent and reliable data thanks to the undertaking of systematic archaeological investigations, which led to the obtainment of new and more numerous radiocarbon dates tied to secure stratigraphies. However, the latter remain clustered within specific geographic outlines corresponding to the modern territories of Georgia, Armenia, and Azerbaijan. With the exception of the most recent attempt by Chataigner and Palumbi (2014) to promote a dialogue between all the researchers active in the Southern Caucasus, an all-round perspective on the KA chronology is still missing.

This study, which was undertaken in the frame of a Master's thesis under the auspices of a collaboration between the *Georgian-Italian Shida Kartli Archaeological Project* of the Ca' Foscari University of Venice with the Georgian National Museum of Tbilisi, and the Weizmann Institute of Science (Passerini 2015), aims at the re-assessment of the absolute chronology for the 4th and 3rd millennium BC in the Southern Caucasus in the light of the most recent ^{14}C dates and of a re-evaluation of the already published data. A thorough and integrative revision was undertaken by considering both relative and absolute chronological information in full accordance with the principles of regional Bayesian analysis. All available ^{14}C dates were collected and classified into archaeologically defined chrono-cultural phases and consequently modelled following the "order" provided by relative chronology. Issues in classification emerged during the process and observations on results and outliers allowed to bring forward several points of discussion concerning the broader KA periodisation.

More specifically, this chronological re-assessment has been framed following the different stages, as archaeologically recognised, of the KA culture, and outlined between the Late Chalcolithic (LC)/pre-KA and Early Kurgan (EK)/post-KA horizons that respectively interacted with the KA initial and final stages. Since the purpose of this work is to assess the status of the KA chronology in the proper Caucasian developmental area, issues and data concerning the problem of the Kura-Araxes "migration" were excluded prior to the undertaking of the analysis, which was therefore geographically limited to the territories of Georgia, Armenia, Azerbaijan, and part of Turkey (Erzurum region).

Chronology and periodisation of pre-KA, KA, and post-KA cultures: an overview

The chronological definition of the KA culture is characterised by the proliferation

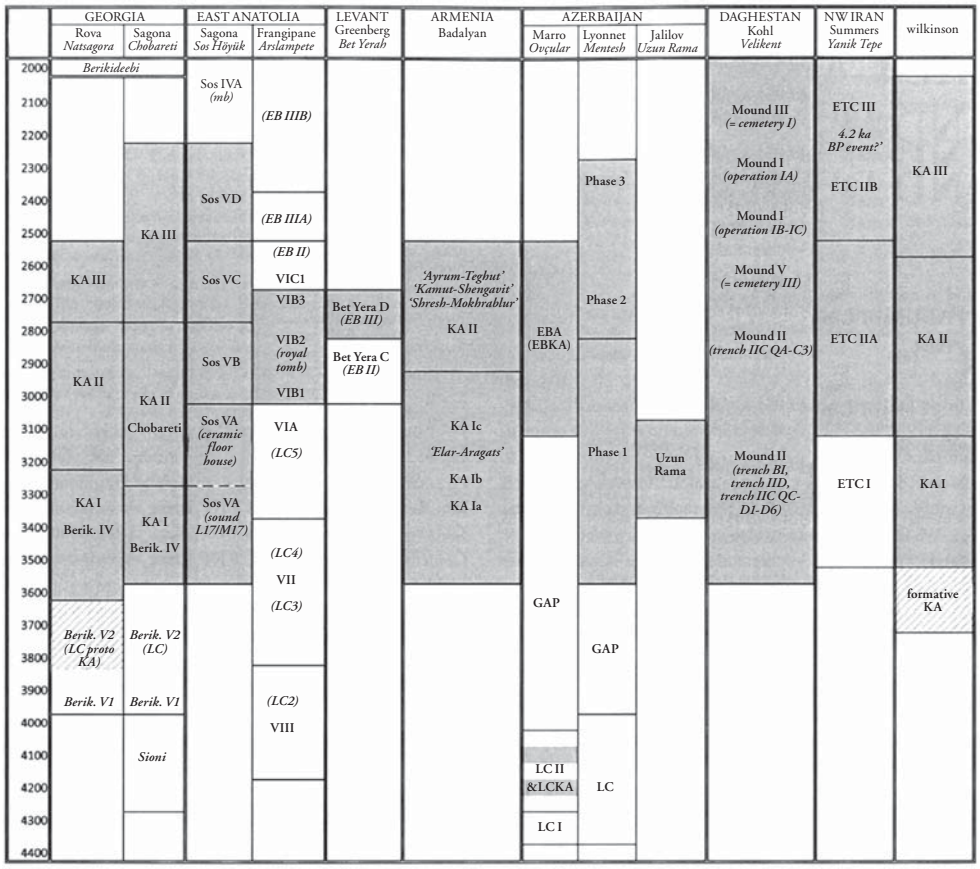


Tab. 1 – Synoptic table of the proposed chronologies and periodisations for the 4th and 3rd millennium BC in the Southern Caucasus (adapted from Palumbi 2008a: 19).

of differing regional chronologies, in their turn derived from the abundance of terminologies and approaches applied to the description of the KA phases (Tab. 1 and Tab. 2). Ultimately, this relates to the nature of KA material assemblages, which present a large regional and diachronic typological variation and are hardly enclosed in coherent (conventional) sequences of material cultural stages. Inconsistencies in the description of ceramic typologies are often cited as the main source of discrepancy (Esin 2000) and challenge the comparison of relative chronological systems that often respond to local perceptions. As a consequence, ^{14}C dates associated to different relative systems tend to fluctuate and thus to obscure the limits of the KA chronology.

A further reason of confusion is due to the incoherence in the use of the same terms in different regions, most notably regarding the use of "Late Chalcolithic" and "Early Bronze Age" (EBA) between the Southern Caucasus and the Near East. In the Near East the term LC is linked to the Uruk phenomenon and tied to fixed absolute dates most recently readjusted by the Santa Fe Workshop (Rothman 2001), thus bearing a prevalent chronological value. However, Soviet and post-Soviet tradition in the Southern Caucasus has often used these terms in reference to their original technological affiliation, regarding the presence of metal as the discriminating criterion of chronological distinction. This also explains why in these regions the Kura-Araxes culture has been mostly used as a synonym for EBA[1]. As a consequence, attempts towards integrating the two systems result in the apparent overlap of the Near Eastern LC with the South-

[1] In actuality, the attribution of the KA culture to a specific archaeological period has been debated since Soviet Times based on essential differences in the chrono-technological perception of this phenomenon. Kuftin (1940 in Kohl 2007: 87) and Piotrovskii (1949) suggested an attribution to the Eneolithic, or Chalcolithic, period as being more appropriately descriptive of the contemporaneity of the KA with the earliest metallurgical developments in the Southern Caucasus. However, the characteristics of the significantly arsenic-based metallurgy of the KA led Selimkhanov (1960 in Kohl 2007: 87) towards an Early Bronze Age affiliation, as also later shared by Chernykh (1992), Kavtaradze 1999 and more recently restated by Kohl (2009).



Tab. 2 – Synoptic table of the proposed chronologies on the Kura-Araxes culture according to the most recent data from the Northern and Southern Caucasus, Northwest Iran, Eastern Anatolia and the Southern Levant (Chataigner and Palumbi 2014: 248).

Caucasian EBA and the annihilation of archaeological identities under the same label (Rova in press a; Sagona 2014).

The pre-KA period in the Southern Caucasus is characterised by the presence of two main archaeological horizons, also known as Sioni and Chaff-Faced Ware (CFW). Sioni assemblages are known from Eastern Georgia, North-Eastern Turkey, Azerbaijan, and Armenia, and constitute the expression of a local South-Caucasian Chalcolithic (Marro 2008: 10-11; Sagona 2014: 25, 28). An internal chronological subdivision has been tentatively proposed for this period, with the distinction of an Early (ca. 5000-4000 BC) and a Late Phase (ca. 4000-3500 BC, Kiguradze 2000; Kiguaradze and Sagona 2003; Lyonnet *et al*. 2012), also referred to as Early and Late Sioni (Japaridze 1989 in Sagona 2014: 25). However, since Sioni evidence is still insufficient, a clear understanding of its chrono-cultural phases is yet to be reached. Plus, the majority of radiocarbon dates related to Sioni materials were retrieved from sites with mixed LC assemblages, thus hindering the isolation of pure Sioni

occupations and their correlation with the Santa Fe periodisation system.

On the other hand, CFW productions identify sites with strong North Mesopotamian-North-Syrian-related features ascribed to the so-called Leilatepe culture (Lyonnet 2007). Parallels with materials typical of the Amuq F phase (Marro 2007: 78-90, 2010: 39; Sagona 2014: 28) and of sites like Tell Brak (Oates *et al.* 2002) and Hacinebi (Pearce 2000; Stein *et al.* 1996) date the Leilatepe assemblages to the LC3 (3800/3700-3500 BC) and LC4 (3500-3300) phases of the Santa Fe system. However, older typological groups datable to the LC1 (4300/4200-4000 BC) and LC2 (4000-3800/3700 BC) are also known from the oldest occupations at Ovçular Tepesi (Marro 2010: 46), tentatively ascribed to a pre-Leilatepe phase.

The subdivision into internal phases of the KA culture is more evidently affected by the inaccurate use of culturally and technologically based terminologies, which contribute to the confusion and misplacement of available ^{14}C dates. With regards to the relative periodisation, Sagona's work of 1984, most recently updated by Palumbi (2008a), is still the most complete account of typological groups related to chrono-cultural phases. Broader changes in ceramic production support the most popular tripartite model, with an early (KA I), an intermediate (KA II), and a late (KA III) stage. While accounting for the entirety of the KA assemblage, Palumbi's proposal (2008a) regards pottery production as the main diagnostic marker: thereby, KA I is marked by the prevalent presence of Monochrome Ware (MW), KA II by the diffusion of Red-Black Burnished Ware (RBBW), and KA III by the increase of Black Burnished Ware (BBW) with incised decoration. Other categories, such as architecture and metallurgy, contribute to the definition of this sequence, but their extreme regional and diachronic variation challenges their use as a clear chronological reference, thus leaving pottery as the most overreaching element of chronological distinction. The absolute ranges proposed by Palumbi (2008a: 319) are 3500-3300 BC for KA I, 3300-2800 BC for KA II, 2800-2500 BC for KA III, partially referenced by scattered ^{14}C dates.

The threefold pattern appears repeatedly in the work of several scholars, though with different absolute dates and, furthermore, with slightly different definitions. Japaridze (1961 cited in Palumbi 2008a: 13) first attempted a definition of an early phase between the end of the 4th millennium and 2800 BC, an intermediate phase between 2800 and 2600 BC, and a final phase between 2600 and 2400 BC. Kushnareva and Chubinishvili (1970 in Kushnareva 1997: 44) treated the KA period as a synonym of EBA and distinguished between an EB I (3000 – 2700/2600 BC), an EB II (2700/2600 – 2400/2300 BC), and an EB III (2400/2300-2000 BC) phase. This proposal was shortly after shared by Burney and Lang (1971: 55-85), who, relying on the term Early Transcaucasian Culture (ETC) distinguished between an ETC I (3000-2700 BC), an ETC II (2700-2300 BC), and an ETC III (2300-2000 BC) phase. Most of these proposals were not supported by ^{14}C dates or relied on non-calibrated measurements (see for instance Kushnareva 1997).

A periodisation based on calibrated ^{14}C dates was suggested for the first time by Kavtaradze (1983), who later confirmed his position according to a more recent and

larger set of data (1999: 73-81), arguing for a high chronology for the KA culture, whose beginning and end he identified between 3700 and 2800 BC. In 1984, Sagona's proposal mediated this position by suggesting the subdivision between a KA I (3600-3000 BC), a KA II (3000-2400 BC), and a KA III (2400-2000 BC) phase, thus extending the duration of the KA culture. In 1992 Glumac and Anthony, referring to a series of ^{14}C dates, suggested a KA I (3600-3300 BC), KA II (3300-2500 BC), and KA III (2500-2000 BC) phase. Following the outcomes of this high chronology, Kushnareva (1997: 53-54), based on non-calibrated ^{14}C dates, also readjusted her initial proposal and distinguished the EBA period in EB I (3500-3200 BC), EB II (3200-2900 BC), EB III (2900-2600 BC), and EB IV (2600-2300 BC), the latter identified with the rising of the post-KA horizons.

As yet, the site of Sos Höyük (Erzurum region, Eastern Turkey) is the only case of a continuous occupation between the LC and the Middle Bronze Age (MBA) that has been tied to a series of radiocarbon dates, thus apparently offering a type-sequence for a reliable absolute chronology (Sagona 2000; Sagona and Sagona 2000). However, its occupation appears anomalous as compared to elsewhere in the Southern Caucasus: firstly, evidence for RBBW appears precociously at the site, probably in response to interactions with Central and Eastern Anatolia (Kiguradze and Sagona 2003; Palumbi 2003, 2008b); secondly, a longer endurance of some features of the KA culture (until 1500 BC ca) seems to be attested here, especially supported by the presence of a "Late Gritty" production as defined by Sagona (2000: 337), who attributed it to later expressions of the KA culture – although no other evidence for "Late Gritty" wares is hitherto known elsewhere. As a consequence, while the sequence of Sos Höyük might serve as a reference periodisation for the Erzurum region, more complications are to be met when trying to apply it to the broader South-Caucasian region.

An updated synthesis on the question of Kura-Araxes periodisations can be found in Chataigner and Palumbi 2014 (cf. Table 3). It should be especially emphasised that, although the three-fold chronological division (accounting for different terminological and chronological definitions) is still shared by most scholars, researchers from Armenia (Badalyan 2014) favour a two-fold division as better fitting the data from that region.

The end of the KA culture in the Southern Caucasus coincides with the emergence of the Early Kurgan (EK) cultures, which are typically marked by the adoption of the tumulus or barrow burial typology, known in the literature as *kurgan* (Gimbutas 1956). This funerary tradition distinguishes the EK from the KA communities on a socio-cultural level[2], with the increasing importance of distinction based on wealth, as opposed to the former KA horizons, where signs for social hierarchy are rare or atypical. The

[2] Recent discoveries, for instance at Mentesh Tepe in Azerbaijan (Lyonnet 2014), attest the use of *kurgans* during the KA period. To that regard, cultural changes between the KA and the EK periods are better defined by the accumulation of wealth with the profusion of precious metal typical of the EK burial assemblages, as opposed to a disinterest towards signs of social distinctions typical of KA burials.

immediate post-KA phase, in particular, has been subdivided into two main chrono-cultural aspects, also known as Martqopi and Bedeni, generally dated to the mid-late 3rd millennium BC and considered to be at the very transition with the MBA[3]. Common features with late KA ceramic productions have led to consider the Martqopi horizon (EK I) earlier than the Bedeni (EK II) expressions, which show more sophisticated technological innovations. However, the limited number of ^{14}C dates and the controversial recovery of mixed contexts of Martqopi and/or Bedeni materials with KA finds have so far hindered the distinction between the two "phases" on a clear absolute chronological level[4].

Considering that the chronological limits of the pre-KA, KA, and post-KA phases are still fluctuating due to the on-going debates on the subject, in re-assessing the absolute chronology of the Southern Caucasus we adopted an approach devoid of preconceived absolute time references. For these reasons, the terms pre-KA, KA I, KA II, KA III, EK I, EK II are here used in their pure archaeological meaning, standing for a specific material assemblage to which ^{14}C dates are associated. The term pre-KA in reference to dated CFW and Sioni horizons was preferred to LC since the latter, bearing an absolute chronological meaning (Santa Fe 2001), would indiscriminately apply to LC non-KA and early KA occupations that happen to be contemporaneous, due to the aforementioned offsets between the Near Eastern and Caucasian systems. As for the KA culture, the relative tripartite system was adopted according to Palumbi's definition (2008a: 201-210, 312), which distinguishes KA I, KA II, KA III on the basis of pottery, hearths, and architectural typologies. Specifically, KA I is identified by the presence of MW, sometimes rare RBBW, and domestic hearths of circular shape with a central hole; KA II is marked by the spreading of RBBW and new typologies of hearth (three-leaf-shaped and horseshoe-shaped with anthropomorphic or zoomorphic plastic decorations); KA III is typically marked by BBW with pre-fired incised and relief decorations. Finally, radiocarbon dates belonging to the post-KA period were tentatively distinguished between an EK I, or Martqopi, and an EK II, or Bedeni, phase according to their cultural affiliation to the homonym cultural group.

THE RADIOCARBON RECORD

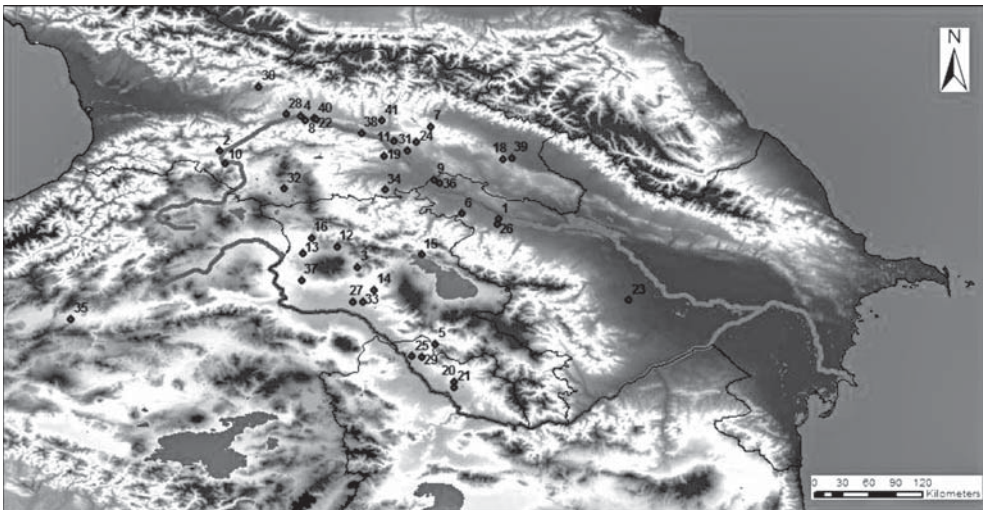
Data collection: issues concerning the nature of published ^{14}C dates

The first step of this work consisted in the collection of available ^{14}C dates for the 4th and 3rd millennium in the Southern Caucasus[5]. The majority of

[3] The chrono-cultural attribution of the Martqopi and Bedeni horizons is still a matter of debate. Scholars are divided between those supporting a characterisation within the Late Early Bronze Age, Middle Bronze Age, or Early Bronze-Middle Bronze Age transitional phase.

[4] In addition, while these assemblages are usually attributed to a Martqopi/Bedeni horizon in Georgia, similar ceramic productions in the neighbouring regions are often referred to as "Late Kura-Araxes".

[5] Data collection was completed in early 2015. Therefore, ^{14}C dates released during or after the finalisation of this study were not taken into account.



1. *Agilidere*	11. *Didube*	21. *Kültepe 2*	31. *Samgori*	41. *Zhinvali*
2. *Amiranis Gora*	12. *Gegharot*	22. *Kvatskhelebi*	32. *Satkhs*	missing. *Zeynani*
3. *Aparan III*	13. *Horom*	23. *Leilatepe*	33. *Shengavit*	
4. *Aradetis Orgora*	14. *Jrvezh/Avan*	24. *Martqopi*	34. *Sioni*	
5. *Areni – 1*	15. *Kalavan 1*	25. *Maxta 1*	35. *Sos Höyük*	
6. *Baba-Dervish 2*	16. *Karnut*	26. *Mentesh Tepe*	36. *Soyuq Bulaq*	
7. *Bedeni*	17. *Khizanaant Gora*	27. *Mokhra-Blur*	37. *T'alin*	
8. *Berikldeebi*	18. *Khramebi*	28. *Natsargora*	38. *Tsikhiagora*	
9. *Boyuk Kesik*	19. *Kiketi*	29. *Ovçular Tepesi*	39. *Tsnori*	
10. *Chobareti*	20. *Kültepe 1*	30. *Sachkhere*	40. *Tvlepias Tsqharo*	

Fig. 1 – Map of all ^{14}C dated sites mentioned in this work.

^{14}C dates was retrieved trough literature sources, alongside details about their sampling circumstances and context of provenance that were essential to their classification in chrono-cultural phases and reliability assessment. In some cases, this operation was limited by the partial nature of published information. Whenever possible, these *lacunae* were filled by contacting radiocarbon laboratories or field directors that produced those reports. The geographic distribution of ^{14}C dated sites is given in figure 1, while a graphic representation of ^{14}C dated chrono-cultural phases is given in figure 2. All the dates that could be attributed to a defined chrono-cultural phase were assembled in an un-modelled plot (fig. 3), while a full list of ^{14}C dates is reported in the *Appendix* with lab code, BP value, archaeological contexts, and literature references.

Standardisation is particularly lacking in reporting conventions, with the

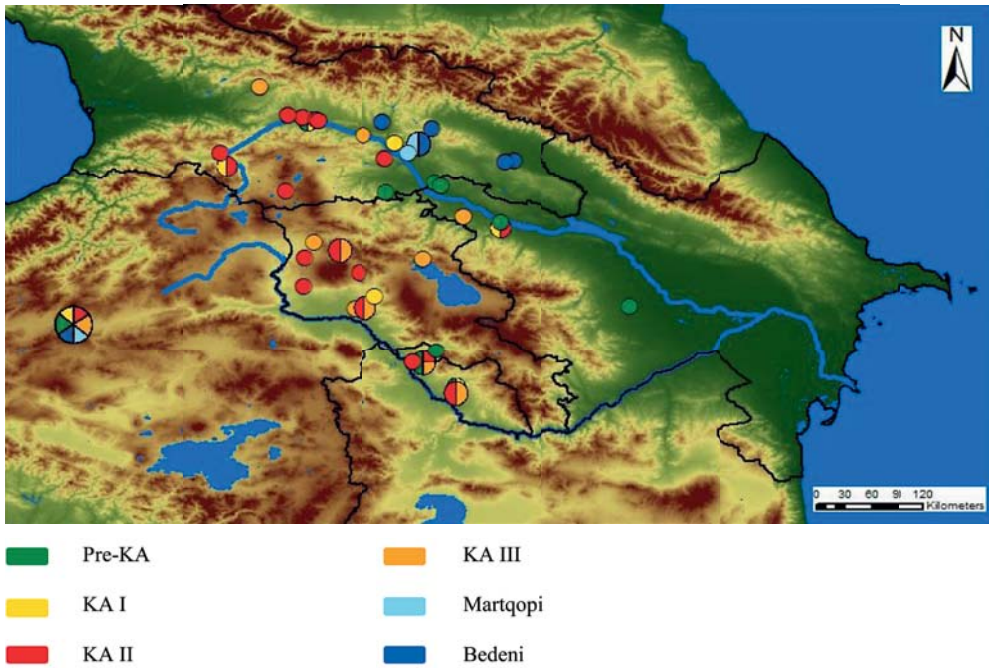


Fig. 2 – Map of all sites by ^{14}C dated phase.

frequent omission of essential details – such as lab code, BP term, dated material, sample pretreatment, measurement type – or the incongruity in the annotation of ^{14}C dates – *i.e.* either reported as uncal BP (whether or not according to Libby's half-life), uncal BC, or cal BC, etc. The use of different calibration curves should also be taken into account in addressing former chronological interpretations based on calibrated ages (Aitchison *et al.* 1989; Weninger *et al.* 2005). Misunderstandings have also derived from the use of different reporting conventions between the former Soviet and Western laboratories (Chataigner 1995).

In addition, some analytical issues affect the accuracy of older measurements. For instance, ^{14}C dates measured on charcoal with decay-counting method – requiring much larger samples and often forcing the integration of charcoals of different provenance to make for the required amount – tend to be less reliable as they may include charcoals of very different age. Conversely, ^{14}C dates measured with Accelerator Mass Spectrometry (AMS) can be obtained on much smaller samples. Moreover, a general lack of interest in taphonomy and sample contextualisation emerges in most older contributions (see Burchuladze 1968; Burchuladze and Togonidze 1987; Dolukhanov *et al.* 1970; Kavtaradze 1983; Kushnareva 1997).

In the present work, the issues regarding calibration and/or reporting conventions were avoided by considering ^{14}C dates only in their BP terms, as originally provided by laboratories, and by operating an analytical standardisation. Radiocarbon

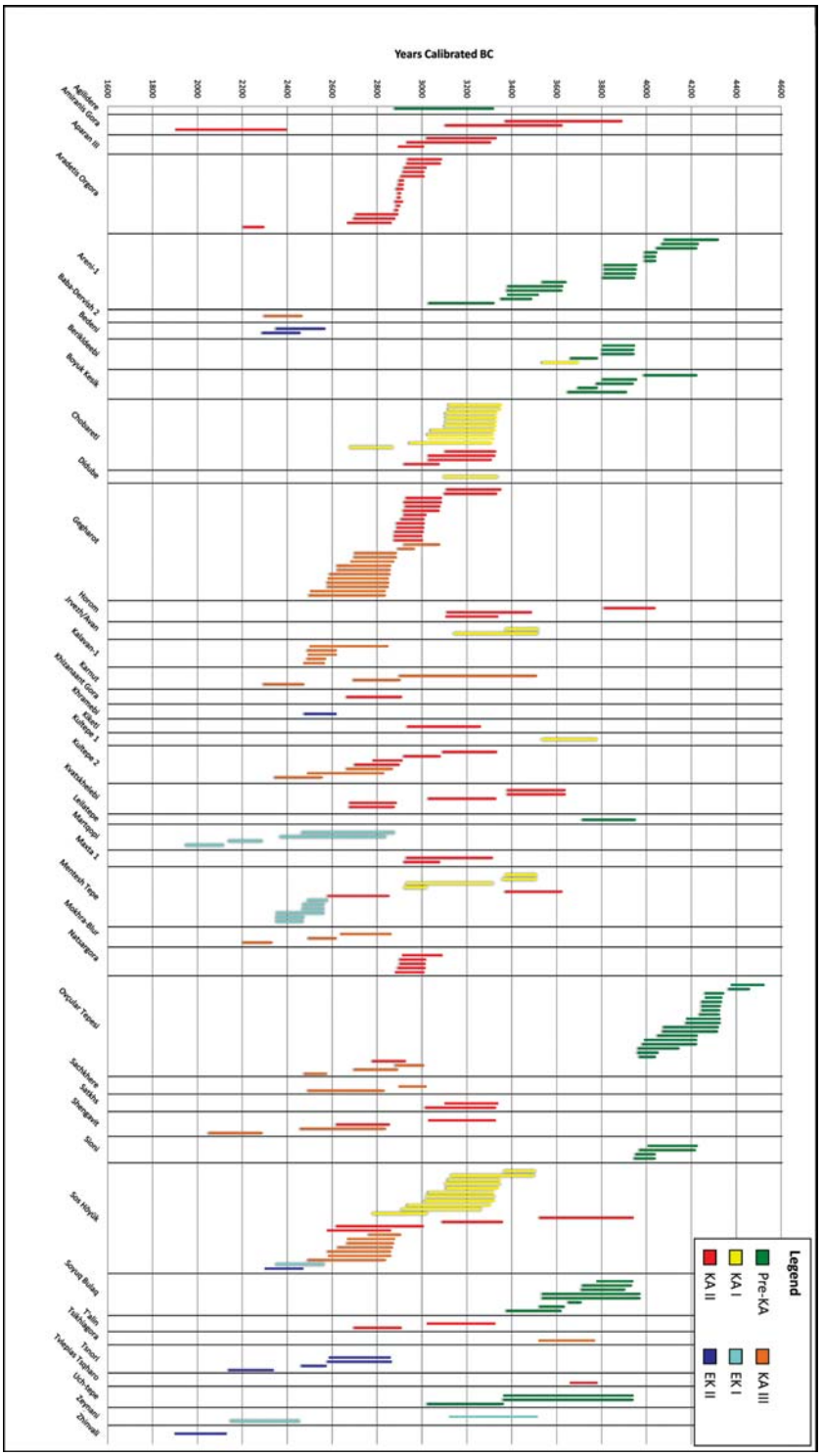


Fig. 3 – Calibrated ^{14}C dates from the 4th and 3rd millennium in the Southern Caucasus mentioned in this study that could be attributed to a chrono-cultural phase between pre-KA and EK II. Each date is shown at 1 sigma and coloured according to the associated phase. Dates UCIAMS-4018 (Areni-1), Beta-22638, Beta-220999 (Soyuq Bulaq), TB-809, TB-813 (Martqopi), and RUL-278 (Samgori) are not displayed as exceeding the limits of our chronological timescale, set between 4500 and 2000 BCE.

measurements are thus here reported in radiocarbon BP years (before present=1950) in accordance with the established international convention (Stuiver and Polach 1977). All dates were plotted and studied by using the OxCal v4.2.4 version (Bronk Ramsey and Lee 2013) and calibrated to the IntCal13 atmospheric curve (Reimer *et al*. 2013). In some cases, ^{14}C dates could only be gathered as lab codes reported in association to their calibrated ranges and it was not possible to recover their conventional lab value due to the unavailability of original literature sources and/or the inaccessibility of databases administered by laboratories that are no longer active. Nonetheless, these dates were recorded under their lab codes and reported in our final list for the sake of providing a statistical awareness of the actual number of measurements obtained from South-Caucasian sites[6].

Archaeological contexts: sampling, assemblages, and chrono-cultural phases

The second step of this work consisted in characterising each ^{14}C date as associated to a specific archaeological context, intended as a depositional event linked to diagnostic cultural material. The first element we retrieved is the sampled material, which has a two-fold definition. Firstly, different materials provide different resolutions – for instance, bones and seeds provide more accurate measurements than charcoal from long-lived species; secondly, depositional circumstances allow to assess whether a sample may be intrusive in a layer – for instance, a cluster of seeds, less susceptible to intra-strata movements, is more reliable than an individual seed and more securely associated to an archaeological unit (Boaretto 2007, 2009). The second element is related to the archaeological nature of the context and its affiliation to descriptive cultural phases. Some dates are only listed according to their general provenance from a site, whose affinity with a specific phase may be generally defined by the description of its material assemblage. In the absence of details regarding the stratigraphic origin of the sample and/or the archaeological features of the site, the associated date – even in the case of proper sampling, pre-treatment, and analysis – can hardly be linked to a specific chronological event.

In collecting ^{14}C dates from the Southern Caucasus, the classification in chrono-cultural phases was operated based on the material assemblage associated to the context. Considering that most ^{14}C dates were retrieved from literature sources, the accuracy of this classification often depended on the quantity and quality of details reported in archaeological publications. As stated above, incoherence of terminologies and

[6] In particular, twelve dates from Mokhra-Blur (Badalyan 2014), three dates from Norabats (Badalyan 2014), one date from Satkhe (Kavtaradze 1999), and one date from Uzun Rama (Poulmarc'h *et al.* 2014) were not included in this study as missing BP value. In addition, some dates were not included due to chrono-cultural pertinence, although they are reported with full analytical details. Specifically, dates from the mine of Sakdrisi (Stöllner *et al.* 2010) were not included as related to mining activity and not correlated with stratified KA archaeological material. Dates from Sotk 2 (Kunze *et al.* 2013) were excluded due to their unclear correlation with specific contexts and assemblages. Finally, the new dates from Godedzor (Palumbi and Chataigner 2014) were excluded due to the uncertainty in defining the cultural affiliation of the site and its materials.

periodisations affect the consistency of archaeological phases among scholars, consequently reflecting on the descriptive nature of excavation reports. Therefore, a process of homogenisation was here necessary to identify cultural (material) affiliation across sites and regions, in order to define comparative categories of dates that could be placed in a socio-cultural sequence (the archaeological order of phases) for the purpose of Bayesian modelling (*prior information)*.

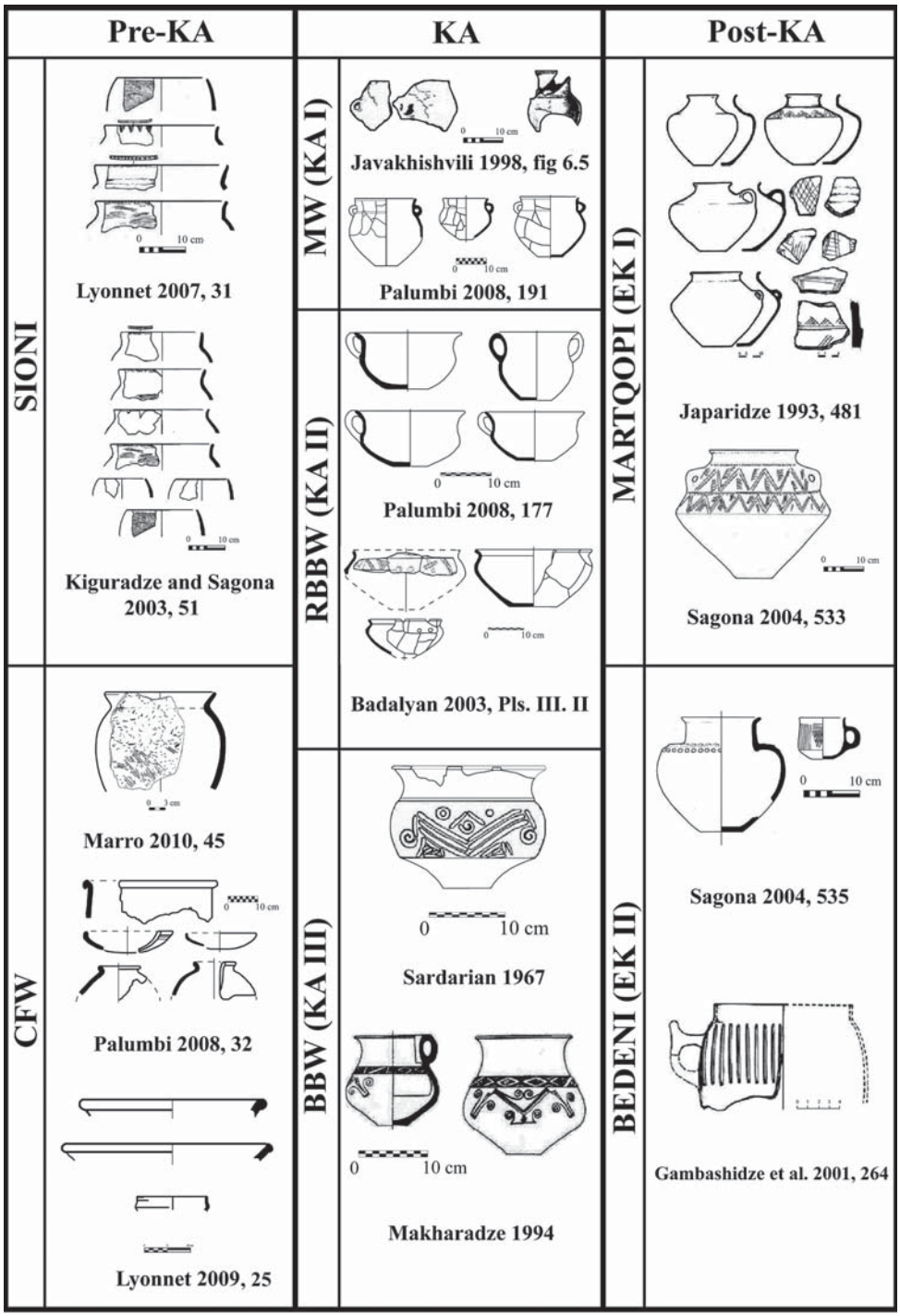
Material markers diagnostic of chrono-cultural phases were tracked across sites and stratigraphies. Particularly complex is the case of the KA culture, referring to a material "package" comprising several markers (Palumbi 2008a) that may have appeared and gone out of use at very different times. Due to the regional and diachronic variability of architectural and burial features, pottery typology is the most effective criterion of distinction between phases and, more often than not, the best described category within archaeological publications. Whenever possible, multiple categories were taken into account in order to provide the most accurate association of ^{14}C dates. However, in several cases the attribution of phases had to be operated on a pure ceramic basis due to limited information concerning other markers, forcefully following a reasoning based on presence/absence of specific typologies. For instance, in situations where the KA I and the KA II phases – which present major differences in architectural and domestic features – could only be distinguished based on pottery, the presence – even if minor – of RBBW of developed fixed colour scheme in association to these features has been preferentially associated with KA II. As for the distinction between KA II and KA III – which share several aspects of architectural, domestic, and metallurgical elements – the presence of incised BBW was treated as the most diagnostic criterion discerning the two. In the absence of more refined data, this constitutes the most reasonable operative proposal for the purposes of this study. In the following section we will provide an overview of each chrono-cultural phase in the light of their material characteristics (Table 3), with insights into those cases that were particularly problematic in terms of attribution.

Pre-Kura-Araxes (pre-KA)

The label pre-KA has been conventionally applied to ^{14}C dates associated to both Sioni and CFW contexts, for a total of 61 dates. This generalisation was motivated by difficulties in isolating pure Sioni horizons from CFW, as well as in distinguishing sub-phases within the CFW, due to the widespread mixture of archaeological materials at pre-KA sites. Considering that the emphasis of this study is on the chronological definition of internal KA phases, ^{14}C dates associated to pre-KA occupations were altogether treated as a *terminus post-quem* for the definition of the beginning of the KA I phase.

Sioni Ware production (Marro 2008: 10-11; Sagona 2014: 25, 28) is marked by mineral temper[7], with surfaces burnished and fired to a range of colours spanning from blackish-grey to grey and brown, and, sometimes, to buff and bright orange shades. Decorations may include rows of

[7] However, it can be occasionally vegetal-tempered.



Tab. 3 – Scheme of the chrono-cultural phases mentioned in this study, with relevant ceramic markers.

impressions or combed ornamentation. So far, ^{14}C dates associated to pure Sioni contexts are only known from the eponym site (Sagona 2014), while more often Sioni Ware appears mixed with other LC non-KA or KA I assemblages.

On the other hand, CFW represents a widespread production accounting for a long-lived duration and several regional variants (Marro 2010: 37-39). In the Southern Caucasus it is found in association with Leilatepe sites (Lyonnet 2007), which show strong parallels with the assemblage of the Amuq F phase (Marro 2007: 78-90, 2010: 39; Sagona 2014: 28). Specific parallels (for instance concerning hammer-head bowls, casseroles and jars with everted rims, Akhundov 2007; Museyibli 2007) also regard sites like Tell Brak (Oates *et al*. 2002) and Tell Hamoukar (Ur 2002; Wilkinson 2002), as well as Hacinebi (Pearce 200; Stein *et al*. 1996), thus designating an affiliation with the LC3 and early LC4 of Mesopotamia (Rothman 2001). The Leilatepe production is typically hand-made and marked by surface chaff-imprints. The surface is generally devoid of decorations, with rare traces of burnishing, while colours tend to vary from brown to orange-buff and fabrics are often not fully oxidised. The morphological repertoire includes wide necked-jars with short everted collars, holemouth jars, hemispherical bowls with in-turned lips, and larger bowls with out-rolled rims. Examples from the Southern Caucasus tend to fit this description, with a prevalence of chaff-tempered and chaff-faced bowls and jars, pinkish or buff in colour, and occasionally present variation in details from site to site (Marro 2010: 40).

Possible prototypes of the Leilatepe production have been found at Ovçular Tepesi, which present a long-lasting LC/pre-KA occupation and has been tentatively assigned to a pre-Leilatepe affiliation. More specifically, these assemblages show analogies (e.g. scraped surfaces and wide-necked jars with beaded rims, Marro 2010: 48) with the LC1 and LC2 ceramics of Upper Mesopotamia including productions such as the Coba Bowls and the repertoire typical of the LC2 Gawra horizon (e.g. mass-produced simple bowls, carinated bowls, coarse blob-painted bowls, Marro *et al*. 2009: 54, note 31).

Assemblages of the Leilatepe tradition usually occur in association with other materials showing analogies with the Syro-Mesopotamian world, such as building (especially mud-brick) techniques and architectural plans (*i.e*. rectilinear walls and rectangular organisation of spaces), which distinguish the Leilatepe culture from other South-Caucasian pre-KA traditions. This is the case of the earliest occupation at Berikldeebi (Javakhishvili 1998) and at Leilatepe itself (Akhundov 2007; Aliev and Narimanov 2001; Narimanov *et al*. 2007). However, other sites, such as Boyuk Kesik (Museyibli 2008; Museyibli and Huseynov 2008) and Soyuq Bulaq (Lyonnet *et al*. 2008; Museybli 2008) and Kavtiskhevi (Makharadze 2007), while yielding typical Leilatepe ceramics, are marked by the use of *kurgan* burials, which is unknown in the Mesopotamian tradition and can be more closely ascribed to Caucasian and Steppe funerary customs (as attested e.g. in the roughly contemporary Maikop culture). The cave site of Areni-1 has also yielded CFW assemblages with parallels at Leilatepe (Narimanov *et al*. 2007 in Areshian *et al*. 2012: 127), in admixture with Sioni types (Kiguradze and Sagona 2003: 40-44).

A brief digression should be devoted to those sites that yielded the few known specimens of "Proto-KA" production, a term that has been coined to define archaic-looking KA assemblages that appear within LC horizons (Kiguradze and Sagona 2003; Makharadze 2007; Marro 2008; Palumbi 2003, 2008a). The first case regards the site of Berikldeebi, a multiperiod settlement spanning from the pre-KA/LC to the Late Bronze Age, exemplified by five distinguished horizons. Level V can be ascribed to the Leilatepe culture, with a mud-brick structural horizon associated with sub-level V1 and a mud-brick rectangular structure, the so-called "temple", associated with the sub-level V2 (Javakhishvili 1998), and generally prevailing CFW assemblages. However, level V2 also yielded evidences of a minority group, characterised by grit-temper, thin walls, and burnished dark, irregular surfaces that are reminiscent of later KA I productions. Although strong affinities between Proto-KA and KA I assemblages would lead to consider the date related to level V2 (A-6408) as the very early start boundary for the KA culture, the sporadic occurrence of these ceramics (Palumbi and Chataigner 2014: 247) and the lack of refinement for the Proto-KA category (Marro 2008) suggest more caution in treating this evidence. Considering that at Berikldeebi Proto-KA pottery occurs within an occupation that is by all other rights definitely non-KA, the date obtained from level V2 is best characterised within our pre-KA phase[8].

Another case at issue is that of Sos Höyük, where Proto-KA pottery has also been identified in association with the earliest level VA. Here, this pottery shares characteristics noticed on the Proto-KA group of Berikldeebi V2 – mineral-tempered paste and irregular burnished surfaces of blackish and grey colours – but also shows a contrasting red-black colour scheme typical of later RBBW production (Marro 2008; Palumbi 2003; Kiguradze and Sagona 2003; Sagona and Sagona 2000), thus being more accurately defined as a "Proto-RBBW" – as opposed to Berikldeebi, where we might better talk of a "Proto-MW". However, considering that at Sos Höyük Proto-KA ware has been tentatively defined as a sub-group of MW (Palumbi 2008b), due to stratigraphic and typological reasons, in this work ^{14}C dates from level VA have been classified within the KA I phase, which is to be discussed in more detail.

Lastly, supposedly KA ceramics were recently identified at the pre-KA sites of Ovçular Tepesi (Marro *et al*. 2009; Marro *et al*. 2011; Marro *et al*. 2014) and Areni-1 (Areshian *et al*. 2012; Wilkinson *et al*. 2012), respectively in Nakhichevan and Armenia. However, since at Ovçular Tepesi no context yielding "Proto-KA" has been directly radiocarbon dated and the assemblage at Areni-1 is highly mixed, an isolation of ^{14}C dates directly associated to "Proto-KA" material was not applicable. In the absence of more refined stratigraphic data, all ^{14}C dates from both sites were assigned to the pre-KA phase.

Kura-Araxes I (KA I)

The KA I phase is the earliest stage of the KA culture and is generally marked

[8] To that regard, a controversy has recently arisen between Marro and Chataigner and Palumbi (Paléorient, 2015) concerning the interpretation of the "LCKA" evidence from Ovçular Tepesi.

by a break with preceding pre-KA local traditions with the emergence of MW production. The latter is generally made of gritty paste and marked by monochrome shades obtained in a prevalently reduced atmosphere, sometimes resulting in a rather dark range of colours. Outer surfaces are burnished, a treatment that is regarded as a distinctive element of the KA tradition and that is also present in the later RBBW and BBW groups, while decorations are rarely attested (Palumbi 2008a: 43). The morphological repertoire occasionally reproduces Sioni shapes (Kiguradze and Sagona 2003), but also includes new characteristics, such as pronounced shoulders, ovoid bodies, cylindrical or conical necks and lids, together with a profusion of handles, lugs, and perforated lugs typical of the KA tradition. Aside from pottery, architecture and domestic hearths also contribute to define the KA I phase, which is typically associated with monocellular buildings of circular plan made according to different techniques – mud bricks, pisé and wattle-and-daub – and fixed hearths of circular shapes with a central hole (Palumbi 2008a: 44, 203).

A total of 31 ^{14}C dates was collected for the KA I phase. Chrono-cultural attribution is particularly problematic in cases where information on stratigraphy and archaeological assemblage lacks accuracy of details. For instance, details about the context of the single ^{14}C date (OZF-720) from Didube, in Georgia, are vague. A horizon of pits – potentially belonging to distinguished occupations – is mentioned in the literature (Kuftin 1941 in Palumbi 2008a: 38), while it is still not clear whether the settlement had more levels of occupations. Kiguradze and Sagona (2003: note 1) mention this date in relation to the transition between the LC and the earliest KA in Georgia, thus relating it to the KA I phase. However, Sagona (2014: 27) recently listed this date as KA II. The presence of both MW and RBBW at the site (Palumbi 2008a: 38) has raised some doubts about the KA I attribution, although the occurrence of both phases can't be excluded *a priori*. Since the majority of pottery attested is MW and no specific information about the stratigraphic distribution of RBBW is available, the date from Didube was here listed as KA I.

Kura-Araxes II (KA II)

The KA II phase is the stage of full development of the KA culture and is marked by the spread of RBBW. This production is characterised by a red and black colour scheme, by which the exterior surface is darkened through a reduced atmosphere firing process, while the interior surface and, often, the outer side of the rim are oxidised to red (Palumbi 2008a; Sagona 1984). This fixed pattern distinguishes KA RBBW production from red and black repertoires of Eastern and Central Anatolia, which is the probable area of origin of this firing technology, later adopted by KA communities, who reproduced it in a morphological range compatible with local South-Caucasian traditions (Kiguradze and Sagona 2003: 93; Palumbi 2003: 104, 2008a: 40). Like MW, RBBW is made using coiling or slab building techniques, with mixed and mineral-tempered paste, and profusions of lugs and handles typical of the KA culture. Phase KA II can also be generally distinguished from phase KA I by the popularity of new hearth and architectural patterns: especially typical of this phase are three- or four-leaf-shaped and horseshoe-shaped hearths with anthropomorphic

or zoomorphic plastic decorations, which however continue into the following phase as well; complex architectural plans start to appear; metal artefacts, which are usually found in funerary contexts, which, for the majority, are known from the KA II phase, increase in frequency (Palumbi 2008a: 203-204). Nonetheless, circular hearths and simple circular dwellings – see respectively Amiranis Gora (Kushnareva 1997: 55) and Kvatskhelebi (Javakhishvili and Glonti 1962: 62-63) – may still be found in association with KA II sites, thus eluding their value as specific diachronic markers.

A total of 77 ^{14}C dates was collected from KA II occupations, thus marking KA II as the most dated KA chrono-cultural phase. However, due to the wide geographic distribution of RBBW both outside – most notably on the Turkish Upper Euphrates, *e.g.* at Arslantepe VIA/VIB (Frangipane 2000, 2004; Frangipane and Palumbi 2007; Palumbi 2008a) and in Syro-Palestine, where it's known as Khirbet Kerak Ware (Amiran 1965; de Miroschedji 2000; Philip 1999; Philip and Millard 2000) – and within the Southern Caucasus, several variants occur and local typologies often serve as a criterion of chronological distinction, thus creating discrepancies that challenge the chrono-cultural homogenisation of the archaeological record across regions. Two main variants were distinguished in Georgia: the Shida Kartli tradition (Sagona 1984: 99, see now also Rova 2014), which prefers more rounded shapes and less sharp carinations alongside a profusion of single and multiple handles; and the Tsalka tradition (Sagona 1984: 99-100), characterised by jugs and mugs with biconical body, cylindrical neck and rail rim and the presence of double-spiral plastic decorations. In Armenia, a variant is known marked by triple-curve profile and the practice of shaving the underside of a double-spiral design of Georgian derivation (Sagona 1984: 2011). Furthermore, in the latter case the typical red and black bichromy can be replaced by a black and yellowish scheme, known from the sites of Gegharot in Armenia (Badalyan *et al.* 2008, fig. 11; Hayrapetyan 2008: 73) but also from Mentesh Tepe (Period IV) in Azerbaijan (Lyonnet *et al.* 2012: 103).

It should be noted in this respect that ^{14}C dates from Armenian sites, especially the most recent series from Gegharot (Badalyan 2014; Badalyan *et al.* 2008), pose some issues due to the existence of an alternative chrono-cultural periodisation system based on local ceramic groups (Badalyan 2014; Smith *et al.* 2009). The material assemblages associated with these occupations have been distinguished between an early ("Elar-Aragats") and a late group (which includes the "Shresh-Mokhrablur" and "Karnut-Shengavit" local assemblages), corresponding to phases KA I and respectively KA II as defined in Armenia. The Elar-Aragats group comprises both monochrome and burnished wares with black burnished exterior and red interior and may be generally related to both (late) KA I and KA II as defined elsewhere in the Southern Caucasus (see Palumbi 2008a). The Shresh-Mokhrablur and Karnut-Shengavit groups include vessels often showing burnished black exterior and red interiors, elongated shapes, and decorative elements – including incised pre-firing geometric designs on the lower shoulder –, thus closer relating to the KA III productions – marked by a wide diffusion of incised decorations – but likely comprising both (late) KA II and KA III horizons as defined elsewhere in the Southern Caucasus (see Palumbi 2008a).

As no real direct conversion between the Armenian typological system (Badalyan 2014; Smith *et al*. 2009) and the one adopted here (following Sagona 1984 and Palumbi 2008a) is applicable, for the sake of convenience and consistency ^{14}C dates from Gegharot associated with the Elar-Aragats and Shresh-Mokhrablur/Karnut-Shengavit groups were here reported respectively as KA II and KA III.

Issues in attribution were also encountered for other KA II sites. The material affiliation of Aparan III is based on the limited results of a small-scale sounding (Badalyan and Avetisyan 2007: 58). The three ^{14}C dates from the site (AA-40153, LY-10623, Bln-5528) were obtained from charred grains found within storage vessels. MW and RBBW are both present in the material assemblage, but the computation of sherds is based on the results of limited investigations (Palumbi 2003: 98). Based on the presence of already fixed red and black pattern, an attribution of Aparan III to the KA II has been suggested (Palumbi 2008a: 188-189; Sagona 2014: 27). The two ^{14}C dates from T'alin (R-2627 from tomb 10, R-2628 from tomb 11, Badalyan 2003, 2014) are also associated to both (prevalent) MW and RBBW, the latter marked by burnished black outer surfaces and inner surfaces spanning from light brown to pink nuances (Palumbi 2003: 99). Considering that the bichromy of T'alin occurs elsewhere in Armenian assemblages and that the grave inventory has parallels with tombs at Gegharot (Badalyan *et al*. 2008: 55, 57) and Horom (Badalyan *et al*. 1994), fully ascribed to the KA II phase – as also recently confirmed by Sagona (2014: 27) – we opted for a KA II attribution for T'alin as well. As for what concerns Period IV at Mentesh Tepe, although the presence of RBBW cannot be clearly stated (Lyonnet *et al*. 2012: 103), the black and yellowish bichromy and the occurrence of metal items sharing trend with the mature KA metallurgical production (Lyonnet *et al*. 2012: 109-119) supports a correlation with the KA II phase – also following the most recent grouping of sites proposed by Sagona (2014: 27).

Kura-Araxes III (KA III)

The KA III phase is the later stage of the KA culture and is generally marked by the widespread use of incised BBW. This pottery is characterised by highly burnished black surfaces (Palumbi 2008a: 205) and a morphological continuity with previous KA productions. A sub-morphological variant is attested in Shida Kartli, where slightly raised bases and more elongated and sinuous figures are preferred (Rova 2014: 51). Specific of this category is the use of incised and grooved decoration, known in a variety of regional traditions (Sagona 1984: 102-106). Domestic hearths, architecture, and metallurgical production tend to share similarities with the previous KA II phase, thus defining BBW as the best discriminant criterion between the two phases.

A total of 43 ^{14}C dates was collected from KA III occupations. Once again, regionalism influences the ceramic assemblages, with a number of variants defined by different morphological or decorative preferences. Among these, the Kvemo Kartlian tradition of Georgia, which includes incised horizontal bands filled with chevrons, tendril designs and stylized animals, and sharp carinations (Sagona 1984: 103); the Shida Kartli variant, marked by accentuated girth, sharp carination, and a limited range of incised motifs placed around the girth; the Armenian tradition, with a wider

range of motifs among which rows of triangles on the shoulders, incised bands around the neck, grooved and tendril designs, and a more pronounced girth (Sagona 1984: 104). The Karnut-Shengavit incised tradition attested at Gegharot, although mainly on RBBW supports, has also been considered as a marker for KA III as defined elsewhere in the Southern Caucasus according to the reasons stated above (see KA II section). Finally, the tradition of incised decorations continues outside the Southern Caucasus, in Anatolia and the Levant, as part of KA-derived distinguished regional developments, while in Georgia and elsewhere KA III productions sometimes anticipate features of the following Martqopi/Early Trialeti expressions (Palumbi 2008a: 196; Rova 2014: 53; Sagona 1984: 105, 2000: 334).

Post-Kura-Araxes: Early Kurgan I (Martqopi) and II (Bedeni)

The end of the KA culture coincides with radical changes in the funerary landscape of the Southern Caucasus, particularly with the re-emergence of the *kurgan* burial type (Sagona 2004). Two main chrono-cultural horizons have been distinguished within the post-KA/EK period, namely the Martqopi (EK I) and the Bedeni (EK II) phase (Japaridze 1993; Kavtaradze 1999, 2004) as defined by material assemblages. The earlier date for the Martqopi horizon has been traditionally suggested based on affinities with the later KA ceramic productions, as, for instance, detected at Shengavit (Palumbi 2008a: 198) and Sos Höyük (Sagona 2000: 334). Conversely, Bedeni assemblages are considered to be later due to visible technological innovations as compared to former productions. Recent archaeological discoveries have suggested a (partial) contemporaneity of late KA and Martqopi and, respectively, Martqopi and Bedeni occupations, although evidence is still scanty and poorly understood[9]. In the absence of more refined data, in this work we maintained the distinction between EK I and EK II horizon and ^{14}C dates from EK sites have been classified according to their traditional affiliation to either the Martqopi or Bedeni group.

A total of 16 ^{14}C dates were collected[10] for the EK I/Martqopi phase. The homonym ceramic production (Japaridze 1995: 73) maintains a morphological repertoire related to that of the previous KA tradition, with more accentuated girths and doubly concave biconical profiles (Bertram 2010: 256). Surfaces are generally black, burnished and decorated with incised ornamentation sometimes recalling KA III motifs (Edens 1995: 55; Sagona 2004: 491-492). Particularly diagnostic are bands of geometric designs running around the neck or on the shoulder of the vessels. It

[9] In the case of Khashuri Natsargora in the Shida Kartli region of Georgia, for instance, the contemporaneity of Kura-Araxes and Bedeni material originally suggested by the excavators has been more probably explained by KA II settlement layers having been disturbed by a later Bedeni occupation, mainly consisting of pits (Rova 2014; Rova *et al.* 2010).

[10] The recent unpublished PhD dissertation by Eleonora Carminati (Melbourne 2016), *The Emergence of Inequality in the Southern Caucasus: The Early Kurgan Period (2800-2100 BC)*, suggests a new attribution to the EK horizon of already existing ^{14}C data, along with unreleased dates. Since our data collection was concluded before the completion of this doctoral work, new unreleased data could not be taken into consideration.

should be noticed that materials formerly classified as "Early Trialeti" have also been included in this category due to close similarities both in shapes and decorative patterns (Edens 1995: 54; Kavtaradze 2004: 548; Sagona 2004: 492).

Only 12 ^{14}C dates could be collected for the EK II/Bedeni phase[11]. The associated pottery tends to be technologically more refined than Martqopi assemblages, with a clear distinction between a coarse and a fine ware, the latter more often found in association with *kurgan* burials (Puturidze and Rova 2012: 56-57; Rova 2014: 63; Rova *et al*. 2010: 15-16) and the former more common in the (rare) settlement contexts (*e.g.* at Berikldeebi, see Jalabadze 2014, now also at Aradetis Orgora, 2016 excavation by the *Georgian-Italian Shida Kartli Archaeological Project*, still unpublished). While fine ware surfaces continue to appear black and highly burnished, new morphological and decorative elements appear within this assemblage: new shapes include straight-sided cups and spurred handles, while decorations account for graphite or mica burnishing, pattern burnishing, multiple knobs, and both vertical and horizontal grooves (Sagona 2004: 492-493).

The majority of EK ^{14}C dates are associated to single *kurgans* and often lack specifics on the dated material and context within the burial feature. Potential issues in context characterisation also arise from the problem of funerary re-use and the often elusive association of burial depositions (human remains) with material assemblages and, therefore, chrono-cultural phases. Except for the most recent EK measurements (see for instance Mentesh Tepe, Lyonnet 2014: 125-127), due to the unavailability of more accurate information we relied on the traditional affiliation of *kurgan* sites with a specific phase, rarely supported by descriptions of the burial assemblage. At Sos Höyük both Martqopi and Bedeni assemblages are present, associated to local period VD, and ^{14}C dates associated to these burials were here distinguished based on pottery descriptions. Recent re-examination of the site stratigraphy identified Bedeni variants within period IVA, but the on-going status of this revision does not allow further distinctions with regards to ^{14}C date-context-assemblage correlation (Sagona 2004: 492-493). Therefore, with regards to Sos Höyük we will only consider the sequence between periods VA and VD.

BAYESIAN MODELLING

Radiocarbon dating is the most applied scientific dating method in archaeological research. Over the past 60 years, improvements have been made towards both its application – with the advent of AMS dating, the extension of the list of datable materials, and a general improvement of the pre-treatment procedures – and resolution in terms of measurements and calibration (Boaretto 2007, 2009). The latter constitutes a matter of particular relevance for archaeological and chronological interpretations, interested by the necessity of converting isotopic ratios into calendar determinations. However, even when calibrated, ^{14}C dates are presented as probability distributions whose

[11] See supra, fn. 9.

span may be problematic in trying to assess a specific event.

The use of Bayesian statistics (Bayes 1973) applied to radiocarbon dating and archaeological settings has allowed the integration of data and information of different nature in order to build models and quantify their probability of accuracy. Several software solutions – *i.e.* OxCal, CALIB, BCal etc. – are available: in this study we used OxCal 4.2.2 (Bronk Ramsey and Lee 2013).

The operation known as *Bayesian modelling* allows for a refinement of ^{14}C calibrated distributions related to a specific research question by integrating the radiocarbon and archaeological information (Sahu 2004: 111, Steier and Rom 2000: 183). The former provides details about the absolute value of dates, whereas the latter provides information about the chronological order of the samples. This order, or *prior information*, is usually retrieved from stratigraphic relationships in the case of a single site, where the depositional order defines relative chronological relationships among contexts (=single depositional events). As a consequence, ^{14}C dates can be grouped into defined occupations, which can be modelled according to their stratigraphic sequence (Litton and Buck 1995).

Conversely, ^{14}C dates related to an archaeological phase spread over a region cannot rely on stratigraphic links and the phase/activity that they represent needs to be determined in association to a specific artefacts assemblage (Bronk Ramsey 2009; Griffiths 2014). This phase/activity may coincide with the use of a particular type of ceramic or metal item that is assumed to have come into use and gone out of use at particular times (Bronk Ramsey 2008: 265; Griffiths 2014: 872). In other cases, multiple material markers forming a "cultural package" may contribute to define a phase/activity and a more complex perspective needs to be adopted (Griffiths 2011, 2014). The Southern Caucasus falls precisely within this circumstance and, due to the nature of the KA package, clarification is mandatory in the way chrono-cultural groups are categorised.

Issues and limitations of a regional model

The radiocarbon record for the 4th and 3rd millennium of the Southern Caucasus consists of 240 ^{14}C dates from 42 different sites spread all over the region, each one related to one or more material phases. As stratigraphic links between these sites cannot be drawn, the ^{14}C dates were grouped according to their association to a particular cultural horizon, which is here described as an occurrence of cultural items forming a chrono-cultural "package". Notably, as explained above, the pre-KA/LC group includes ^{14}C dates associated with CFW (Lyonnet 2007; Marro 2010) and Sioni (Sagona 2014) materials; the KA group includes all ^{14}C dates related to the homonym "package", distinguished in three sub-phases (KA I, KA II, KA III) based on characteristics in pottery, metals, and architectural features (Palumbi 2008a). The post-KA/EK group was distinguished in an earlier Martqopi (EK I) and a later Bedeni (EK II) phase based on the association with the respective ceramic repertoire (Japaridze 1995; Rova 2014; Sagona 2000, 2004, 2014). The order (pre-KA, KA I, KA II, KA III, EK I, EK II) follows the traditional cultural periodisation.

Unlike stratigraphy, the *prior information* based on cultural affiliation

is a less accurate categorisation due to difficulties in defining the outlines of each phase based on a "package" composed of different materials that may have different chronological spans (Griffiths 2014). The relative chronology for the KA sub-phases is generally defined by a prevalent ceramic typology alongside characteristics of the architectural and domestic occupation. However, although an approach not only based on ceramic typology was here adopted, pottery is often the only or most described element in archaeological reports, while information concerning other markers is hard to assess due to their extreme diachronic and geographic variability. As a consequence, pottery constitutes the most evident marker of cultural change recognisable across the region. Also, considering that the nature of the radiocarbon record did not allow for a sorting of "pure" and mixed ceramic depositions – which would have further reduced the usable data per chrono-cultural phase – a distinction based on presence/absence was here generally applied.

Reliability assessment: removal of ^{14}C dates with unclear sampling or archaeological contexts

Following the collection and chrono-cultural characterisation of the radiocarbon record, all known ^{14}C dates were selected for Bayesian modelling according to both analytical and archaeological reliability criteria. The first includes information about sampling, lab treatment, and impact of standard deviation; the second is based on stratigraphic trustworthiness and chrono-cultural affiliation. However, the majority of ^{14}C dates was collected from secondary and literature sources and most often their assessment needed to rely on information derived from archaeological reports, with little to none detail about their measurement procedure. Only the exclusion of six ^{14}C dates (RTD-7749, RTD-7752, RTD-7753, RTD-7755, RTD-7756, RTD-7764) from Aradetis Orgora was based on a first-hand analysis conducted by the authors (Passerini *et al.* 2016).

The first assessment regards the quality of the sampled material, which is often omitted or scarcely characterised within publications. For instance, ^{14}C dates measured on wood charcoal could not be distinguished between long-lived and short-lived samples as such detail is frequently absent. Dates reported with no specification of the material source, but having secure archaeological contextualisation, were not excluded from the analysis in order to avoid a reduction of the already poor radiocarbon record for the region. These were then considered altogether with charcoal-derived samples and accordingly treated as possibly bearing old-wood effect. Issues regarding the sampled material led to the exclusion of three dates from Mokhra-Blur (GrN-8176, GrN-8177, Gr-8178) measured on different charcoals collected as single samples and thus compromising the accuracy of the date. A single date from Sos Höyük VA (Beta-135363), measured on phytoliths, was also excluded due to the problematic resolution of this material. The extraction and the isolation of the organic ^{14}C signal from the mineral silica component of phytoliths is still in the process of being optimised and the accuracy of the obtained measurement in relating to the depositional event is still under debate (Boaretto 2009; Hatté *et al.* 2008; Mulholland and Prior 1993).

Secondly, dates with a standard deviation equal to or exceeding ± 100 were excluded from the analysis. At the scale of our chronological re-assessment,

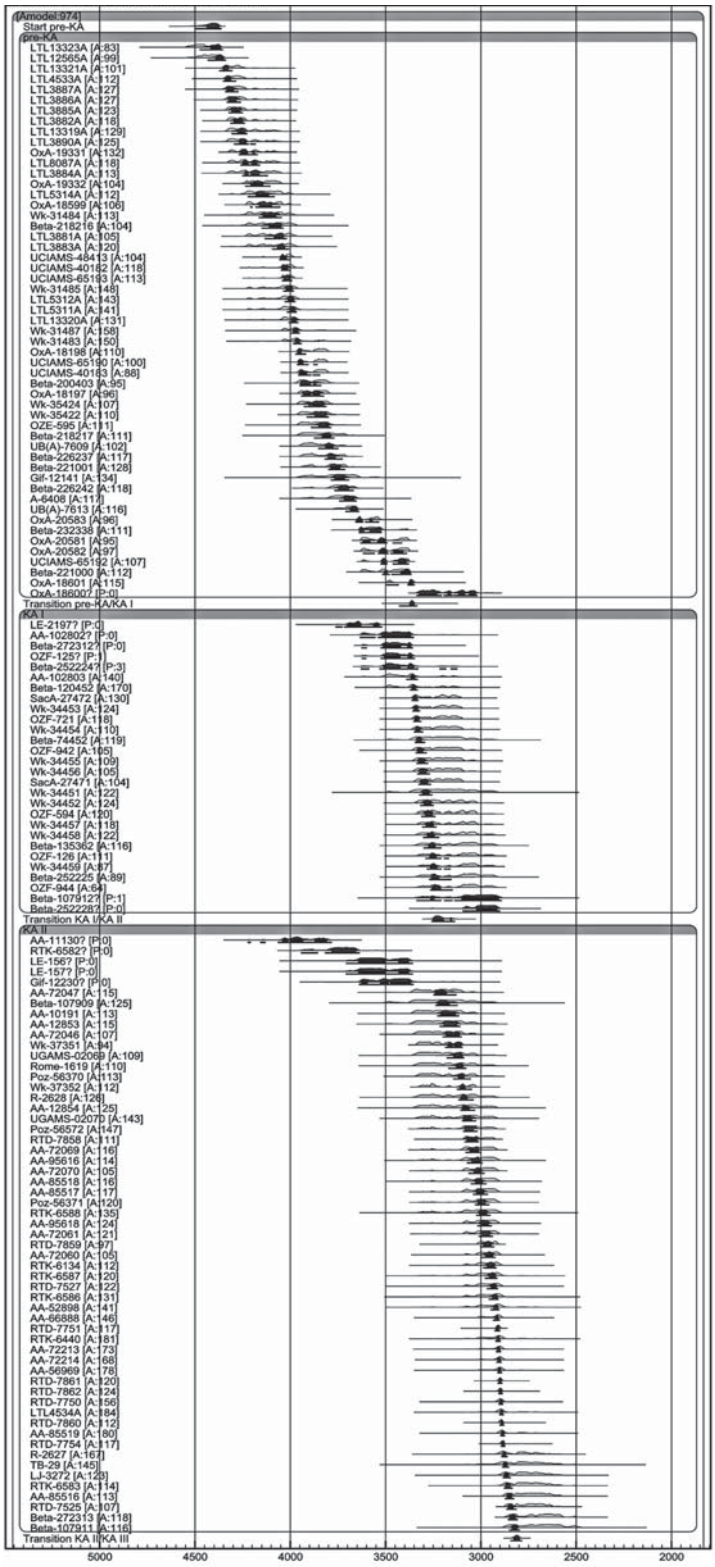
the far too wide calibrated range of these dates would potentially agree with any proposed interpretative reading, thus defying the purpose of identifying more refined chronological spans. Based on this criterion, dates were excluded from Agilidere (Ki-14592), Amiranis Gora (TB-3, TB-4, TB-9), Karnut (LE-4488), Leilatepe (Ki-14950), Martqopi (GX-9252), Sos Höyük (Beta-107908, Beta-107910), Soyuq Bulaq (Ki-14591, Ki-4970), Tsikhiagora (TB-831), and Uch-tepe (LE-300, LE-305, LE-330). The earliest date from Areni-1 (UCIAMS-40181), two dates from Martqopi (TB-809, TB-813), and the single date from Samgori (RUL-278) were also excluded as widely exceeding the chronological limits of this work, set on a timescale between 4500 and 2000 BC.

Thirdly, dates from unknown or unclear contexts were excluded from the analysis. In some cases, this was due to the lack or unavailability of information about the provenance of the sample, thus affecting its associative reliability. Dates from unknown contexts were excluded from Didube (OZF-720), Gegharot (AA-66894, AA-66895), Khramebi (TB-242), and Shengavit (Bln-5526, Bln-5527). A date from Bedeni (TB-30) was removed due to its unsecure attribution to Kurgan 5. The single date from Baba-Dervish 2 (LE-780), although provided with a depth in stratigraphy, could not be related to a specific context. The same was applied to a date from Kültepe 1 (LE-163).

In other cases, exclusion was driven by the unclear nature of the archaeological context and/or the absence of specific information about the associated archaeological assemblage. Among these are two dates from Shengavit (LE-458, LE-672), whose attribution to level IV is questionable since the chrono-cultural distinction of levels at the site was arbitrarily operated after the original excavations, potentially confusing the association with the samples (Sagona 1984: 54). One date from Horom (AA-7767) sampled from an exploratory trench of dubious interpretation was also excluded. The three dates from Aparan III measured from charred grains contained in storage vessels (AA-40153, LY-10623, Bln-5528), although derived from short-lived samples that fully respond to radiocarbon reliability criteria, were excluded due to the limited extent of the excavation trench (1.5. x 1.5 m), which challenges the understanding of their stratigraphic relationships with regards to the occupation(s) at the site. The two dates from Sachkhere (TB-416, TB-417) were excluded because related to generic contexts (a floor and pit) of non-specific location within the site, composed by different burial mounds associated with different assemblages (see Rova in press b). Three dates from Mentesh Tepe (Beta-272308, Beta-272311, Gif-12531) were excluded due to the absence of information regarding their associated archaeological assemblage, which is, however, explained in the light of the preliminary status of the study on the site. Two other dates from Sos Höyük VD (OZH-822, Beta-84372) were excluded due to the impossibility of establishing their material affiliation to either the Martqopi or the Bedeni culture, both present within the VD horizon. Finally, a date from Aradetis Orgora (RTD-7524) was not considered due to the disturbed nature of its associated context (see Passerini *et al*. 2016).

Defining modelling parameters

Out of 240 ^{14}C dates, 52 were discarded due to archaeological and analytical considerations as described in the previous



OxCal v4.2.4 Bronk Ramsev (2013); r:5 IntCal13 atmospheric curve (Reimer et al. 2013).

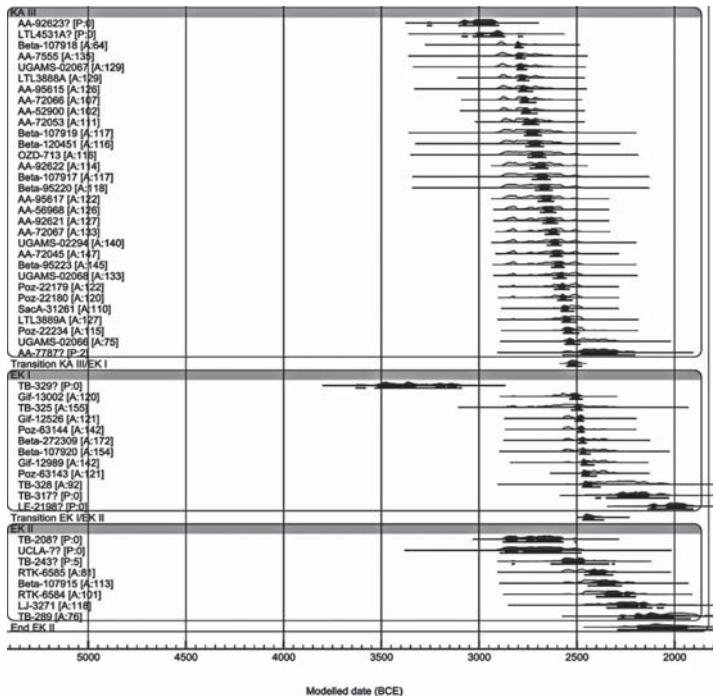


Fig. 4 – Contiguous model of ^{14}C dates from the Southern Caucasus ("Overall" model).

paragraph and the remaining 188 were analysed through Bayesian modelling. These were grouped in chrono-cultural phases ordered according to the traditional cultural sequence, from pre-KA to EK II, which constitutes our *prior information*. Following this, a modelling strategy was defined and specific parameters were evaluated as best suited to our chronological study.

In Bayesian modelling[12], a *Phase* is a grouping of ^{14}C dates that are not constrained to a specific chronological order and are considered as equally weighing for the analysis. A *Phase* can be used for dates belonging to the same occupation event, such as within a level or stratum. A *Sequence* is a grouping of ^{14}C dates that are constrained in chronological order. It can be used for a single site, where the order is necessarily provided by the stratigraphic sequence to which ^{14}C dates are associated. More broadly, a *Sequence* can be applied to a regional chrono-cultural situation whose different groups of events, or culturally defined phases, follow a predisposed order – in this study, the sequence from pre-KA to EK II. A *Sequence* can be used to build either a sequence of *Phases* or a sequence of *Sequences*.

A *Boundary* is used to calculate the start and end of each group of events. Different types of boundary may be applied according to the relation between

[12] For the definition of the command tools see OxCal v4.2.4 (Bronk Ramsey 2009; Bronk Ramsey and Lee 2013).

these groups: a *sequential* boundary implies that sequences/phases follow one another in chronological order, but allows for intervals between them; a *contiguous* boundary implies that one sequence/phase starts *as* the previous one finishes; an *overlapping* boundary implies that the sequences/phases may overlap one another. Each element within a *sequential* or a *contiguous* sequence is modelled according to the previous element, thus providing a *posterior* distribution that strictly depends on the way events are grouped and on the type of boundary imposed.

In our models, chrono-cultural archaeologically defined phases have been ordered as a *sequence*, following the interpretation that bespeaks a progression from pre-KA, to KA I, KA II, KA III, EK I, and EK II phase. A *contiguous* boundary was applied since the occurrence of mixed archaeological assemblages supports the idea of continuity between phases. Finally, within each group (=chrono-cultural phase) ^{14}C dates have been internally modelled as a *sequence* according to their radiocarbon age, although the actual order is unknown. However, such order does not affect the *posterior* distribution since each group was defined based on the associated archaeological assemblage – and not based on preconceived absolute terms – and is ordered according to the chrono-cultural sequence. This choice of *sequences* was considered the most reasonable since the constraint of a *phase* would necessarily imply a chronological homogeneity of each chrono-cultural stage over a very extended region. Considering that the available ^{14}C dates come from very different sites, sometimes as few or single dates, and that each site may have experienced the same phase at slightly different times, these were reasonably assumed as single chronological events throughout the Southern Caucasus.

The Overall model

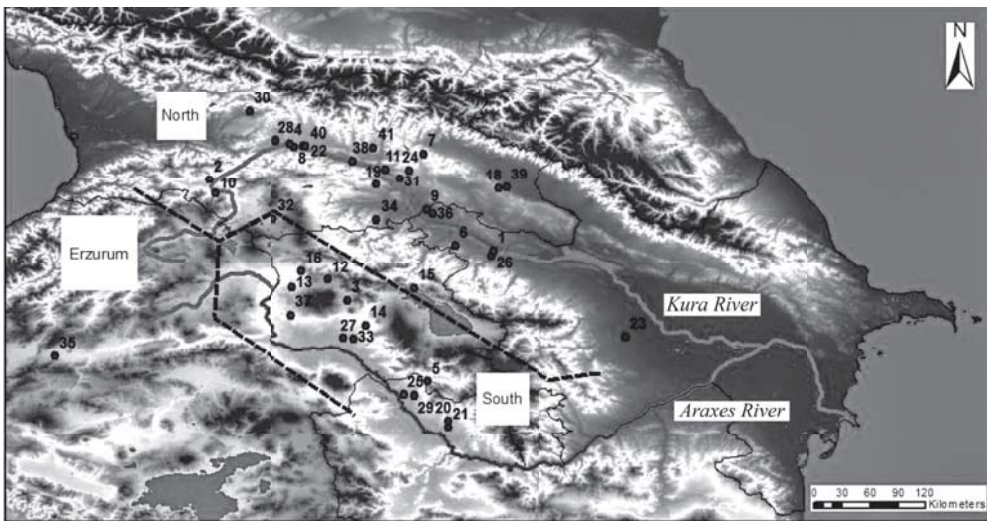
The selected ^{14}C dates were modelled by using OxCal v.4.2.4. Results are represented as a multiplot (fig. 4). Each date is represented by its associated lab code and followed by an individual agreement index, provided as [A:xxx], that quantifies the statistical agreement of each data point to the model (the "fit" of each date). The model agreement index is given on the top left of the multiplot and provided as [Amodel:xxx]. Analytical outliers were identified after the first run according to the agreement value – below 60%, which is the conventional threshold for a positive agreement – and isolated using the *Outlier* tool of OxCal, but are still represented in the plots. Outliers are indicated with a [P] followed by a question mark and distinguished by a dark grey distribution. For the remaining dates, the light grey area represents their associated calibrated possible distribution, the dark grey area the modelled distribution fitting the parameters of the model.

Results of the first simulation show a high agreement index of 974 for the model and of values >60 for the majority of individual dates, with the identification of 22 outliers out of 188 dates. Therefore, in analytical terms a contiguous model for the whole region is possible and works at a positive agreement, with the identification of major outliers and an approximate understanding of the duration of each chrono-cultural phase. However, the presence of outliers should not be neglected and reduced to an unaware exclusion of unfitting ^{14}C dates. In the Overall model, outliers were specifically identified at the

end and at the beginning of each chrono-cultural phase – for instance at the pre-KA/KA I and the KA I/KA II transition. Considering that all selected ^{14}C dates were assumed to be correct both in terms of ^{14}C measurement and archaeological affiliation, and that their accuracy can't be excluded a *priori*, an *overlap* between these phases is the most reasonable conclusion. Higher resolutions models are, therefore, necessary in order to obtain more accurate boundaries for each phase and new modelling strategies can be defined based on the evaluation of outliers. However, these would, in their turn, require the availability of higher definition dates.

The Sub-regional models

Observations on the outliers identified in the Overall model suggested that they might be related to chronological overlaps of geographic nature within the Southern Caucasus. Considering that



1. *Agilidere*
2. *Amiranis Gora*
3. *Aparan III*
4. *Aradetis Orgora*
5. *Areni – 1*
6. *Baba-Dervish 2*
7. *Bedeni*
8. *Berikldeebi*
9. *Boyuk Kesik*
10. *Chobareti*
11. *Dicaube*
12. *Gegharot*
13. *Horom*
14. *Jrvezh/Avan*
15. *Kalavan 1*
16. *Karnut*
17. *Kuizanaant Gora*
18. *Khramebi*
19. *Kketi*
20. *Kültepe 1*
21. *Kültepe 2*
22. *Kvatskhelebi*
23. *Leilatepe*
24. *Martqopi*
25. *Maxta 1*
26. *Mentesh Tepe*
27. *Mokhra-Blur*
28. *Natsargora*
29. *Ovçular Tepesi*
30. *Sachkhere*
31. *Samgori*
32. *Satkhs*
33. *Shengavit*
34. *Sioni*
35. *Sos Höyük*
36. *Soyuq Bulaq*
37. *T'alin*
38. *Tsikhiagora*
39. *Tsnori*
40. *Tvlepias Tsqharo*
41. *Zhinvali*

missing. *Zeynani*

Fig. 5 – Map delimiting modelled sub-regions.

the Kura-Araxes culture spread over a very large area and that chrono-cultural phases are defined by typological material categories, traits typical of each phase are very likely to have been transmitted at different times throughout the region. In particular, overlapping dynamics were noticed between two groups of ^{14}C dates: the first group includes sites located north of the Lesser Caucasus –following the flow of the Kura river –, the second group those located south of it – following the flow of the Araxes river. Since the purpose of this work is to refine the boundaries of each phase and the combination of these two clusters affects the *posterior* distribution of individual dates in the regional model, we decided to focus on geographic sub-regions in order to minimise possible instances of overlap and obtain more refined chrono-cultural sequences (fig. 5). The identified sub-regional groups were, therefore, analysed as two distinguished "North" and "South" models. The site of Sos Höyük, as the only dated representative of the East Anatolian region, was also analysed separately due to the peculiarities of its stratigraphy and its spatial isolation from the remaining South-Caucasian sites.

The "North" and the "South" clusters were also modelled as a *sequence of sequences* with *contiguous boundary* (figs. 6-7). This separation reduced the number of ^{14}C dates per cluster (87 for the North and 81 for the South), sometimes with an under-representation (only 2 dates for the KA I in the South), or the total absence of some chrono-cultural phases (dated EK I and EK II sites are not known from the Southern cluster), see Table 4 and Table 5. On the other hand, in this way instances of overlap were reduced alongside the number of outliers, with the North model yielding a total agreement of 265 and 11 outliers, and the South an agreement of 389 and 4 outliers. Finally, the site of Sos Höyük was modelled as a *sequence* of *phases* linked by a *contiguous* boundary (fig. 8), which yielded an agreement of 77 and 2 outliers. ^{14}C dates were grouped according to their association to a cultural occupation level and ordered according to the stratigraphic *sequence* (from VA to VD), each level representing a homogenous occupation (*phase*), related to the successive level by terms of continuity (*contiguous boundary*) with no known gaps.

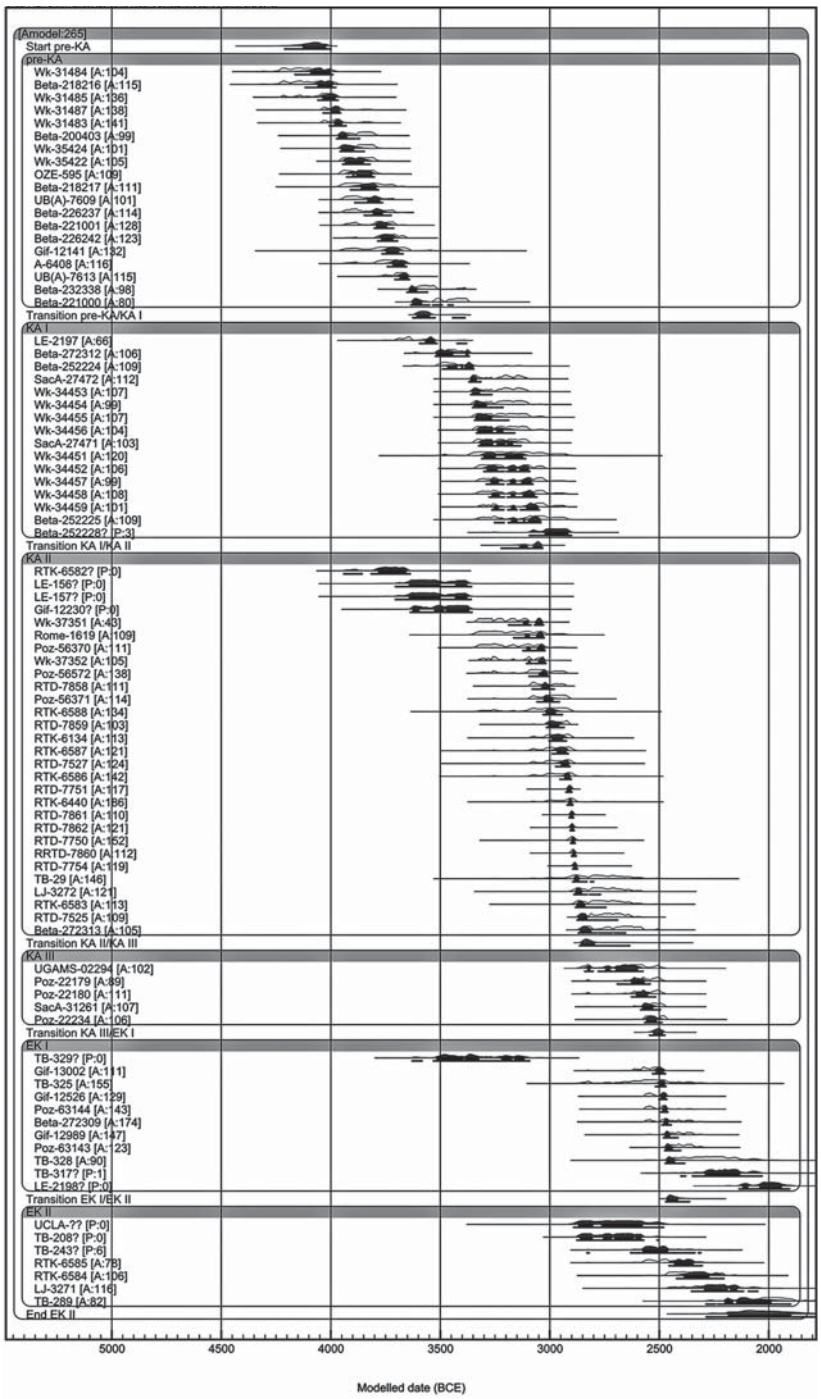
RESULTS

Overview and comparison of modelled results

In total, four different models were proposed for the Southern Caucasus. The results of three of them – one referring to the entire region, and two referring to specific geographic clusters – are summarised in a synoptic table (Table 6). A stratigraphic model, whose results are displayed separately (Table 7), was proposed for the site of Sos Höyük. Each model yielded different ranges for the start and end of each chrono-cultural phase, alongside different outliers according to the geographic scale adopted (Table 8).

The *Overall* model has an agreement of 974 and a total of 22 outliers out of 188 ^{14}C dates. The beginning of the pre-KA phase is set between 4400-4370 Cal BC at 1 σ[13]. Date OxA-18600 from Areni-1 Cave

[13] This result shouldn't be treated as an absolute statement since it's defined by the earliest known date from pre-KA horizons and not as a *posterior distribution*.



OxCal v4.2.4 Bronk Ramsev (2013); r:5 IntCal13 atmospheric curve (Reimer et al. 2013).

Fig. 6 – Contiguous model of ^{14}C dates from the North cluster.

Site name	Pre-KA	KA I	KA II	KA III	EK I	EK II
Agilidere	✗					
Amiranis Gora			✗			
Aradetis Orgora			✔			
Baba-Dervish 2				✗		
Bedeni						✔
Berikldeebi	✔	✔				
Boyuk Kesik	✔					
Chobareti			✔			
Didube		✗				
Kalavan-1				✔		
Khizanaant Gora			✔			
Khramebi						✗
Kiketi			✔			
Kvtaskhelebi			✔			
Leilatepe	✗					
Martqopi					✔	✗
Mentesh Tepe		✔	✔		✔	
Natsargora			✔			
Sachkhere				✗		
Samgori					✗	
Sioni	✔					
Soyuq Bulaq	✔					
Tsikhiagora				✗		
Tsnori						✔
Tvlepias Tsqharo			✔			
Zeynani					✔	
Zhinvali						✗

Dated phases: ✔ represented in the model; ✗ not represented in the model

Tab. 4 – List of ^{14}C dated sites of the North group with indication of represented ^{14}C dated archaeological phases per site.

Site name	Pre-KA	KA I	KA II	KA III	EK I	EK II
Aparan III			✗			
Areni-1	✔					
Gegharot			✔	✔		
Horom			✔			
Jrvezh/Avan		✔				
Karnut				✔		
Kültepe 1		✗				
Kültepe 2			✔	✔		
Maxta 1			✔			
Mokhra-Blur				✗		
Ovçular Tepesi	✔		✔	✔		
Satkhs			✔			
Shengavit			✔			
T'alin			✔			

Dated phases: ✔ represented in the model; ✗ not represented in the model

Tab. 5 – List of ^{14}C dated sites of the South group with indication of represented ^{14}C dated archaeological phases per site.

Model	Start Pre-KA		Transition Pre-KA/KA I		Transition KA I/KA II		Transition KA II/KA III		Transition KA III/EK I		Transition EK I/EK II	
	1 σ	2 σ	1 σ	2 σ	1 σ	2 σ	1 σ	2 σ	1 σ	2 σ	1 σ	2 σ
Overall	4440-4370	4510-4360	3380-3350	3420-3330	3260-3200	3260-3140	2830-2790	2850-2780	2540-2490	2560-2470	2470-2410	2470-2360
North	4130-4020	4220-3990	3610-3550	3630-3380	3140-3030	3230-3030	2860-2790	2870-2630	2530-2480	2550-2470	2470-2410	2480-2360
South	4480-4380	4540-4360	3490-3440	3500-3400	3230-3120	3350-3110	2870-2810	2880-2790	N/A	N/A	N/A	N/A

Tab. 6 – Modelled transitional dates for the Overall, North, and South models. Calibrated ranges are provided as Cal BC and rounded at the nearest 10 yr.

	Start VA	Transition VA/VB	Transition VB/VC	Transition VC/VD
Cal BCE 1 σ	3370-3160	3250-3010	2830-2670	2670-2530
Cal BCE 2 σ	3400-3100	3300-2960	2870-2630	2750-2440
Outliers	OZF-125 (VA) Beta-107918 (VC)			

Tab. 7 – Modelled transitional dates for Sos Höyük. Calibrated ranges are provided as Cal BC and rounded at the nearest 10 yr.

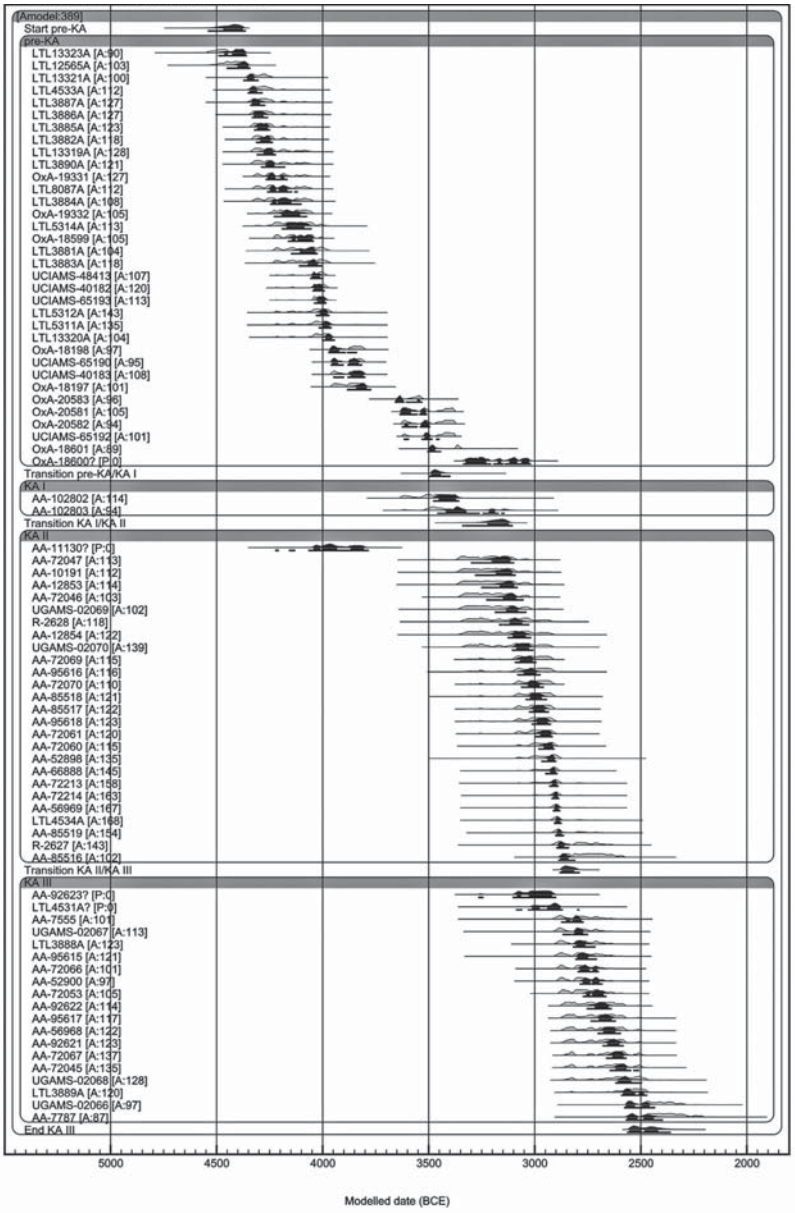


Fig. 7 – Contiguous model of ^{14}C dates from the South cluster.

was rejected as an outlier at the end of the pre-KA sequence, since it has a late span probably resulting from a continuation in the use of the Chalcolithic area at the site (Areshian *et al*. 2012: 123). The pre-KA/KA I transition is set between 3380 and 3350 Cal BC, with five outliers (LE-2197, AA-102802, Beta-272312, OZF-125, Beta-252224) rejected from the beginning of the KA I sequence. The KA I/KA II

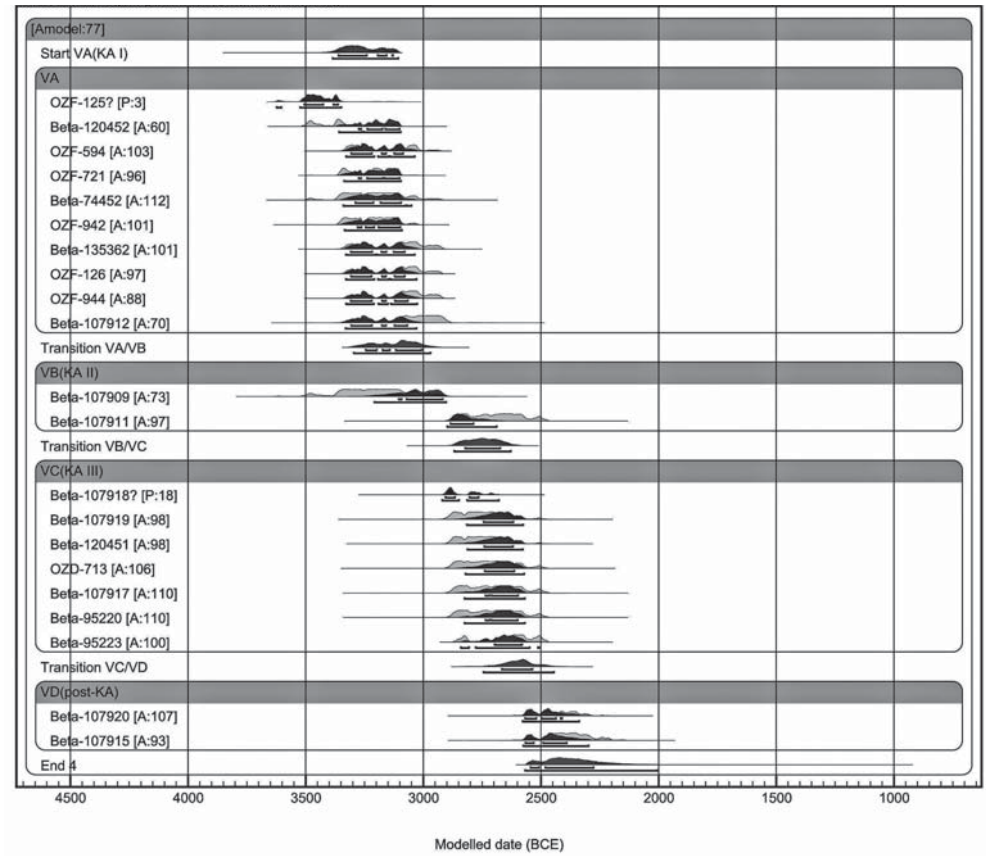


Fig. 8 – Contiguous model of ^{14}C dates from Sos Höyük.

transition is set between 3260-3200 Cal BC, with two outliers (Beta-107912, Beta-25228) rejected from the end of the KA I sequence and five outliers at the beginning of the KA II sequence (AA-11130, RTK-6582, LE-156, LE-157, Gif-12230). The KA II/KA III transition is set between 2830 and 2790 Cal BC with the rejection of two outliers (AA-92623, LTL-4531A) at the beginning of the KA III sequence and one (AA-7787) at the end of the same sequence. The KA III/EK I sequence is set between 2540-2490 Cal BC with the rejection of three outliers from the EK I sequence (TB-329, TB-317, LE-2198), while the EK I/EK II transition is set between the 2470-2410 Cal BC with the rejection of three outliers from the EK II sequence (UCLA-?, TB-208, TB-243).

The *North* model has an agreement of 265 and a total of 11 outliers out of 86 ^{14}C dates. The beginning of the pre-KA is set between 4130-4020 Cal BC. The pre-KA/KA I transition is set between 3610-3350 Cal BC. The KA I/KA II transition is set between 3140-3030 Cal BC, with the rejection of one outlier (Beta-252228) at the end of the KA I sequence and four outliers (RTK-6583, LE-156, LE-157, Gif-12230) at the beginning of the KA

Model	Agreement	Outliers					
		Pre-KA	KA I	KA II	KA III	EK I	EK II
Overall	974	OxA-18600	LE-2197 AA-102802 Beta-272312 OZF-125 Beta-25224 Beta-107912 Beta-252228	AA-11130 RTK-6582 LE-156 LE-157 Gif-12230	AA-92623 LTL4531A AA-7787	TB-329 TB-317 LE-2198	UCLA-? TB-208 TB-243
North	265		Beta-252228	RTK-6582 LE-156 LE-157 Gif-12230		TB-329 TB-317 LE-2198	UCLA-? TB-208 TB-243
South	389	OxA-18600		AA-11130	AA-92623 LTL4531A		

Tab. 8 – Summary of agreement indexes and analytical outliers identified in the Overall, North and South models after Bayesian analysis.

II sequence. Date Wk-37351, despite an individual agreement of 45, has not been flagged as an outlier since it's probably due to the "wiggly" calibrated span of its measurement (see Figure). The KA II/KA III transition is set between 2860-2790 Cal BC. The KA III/EK I transition is set between 2530-2480 Cal BC with the rejection of three outliers from the EK I group (TB-329, TB-317, LE-2198), while the EK I/EK II transition is set between 2470-2430 Cal BC with the rejection of three outliers from the EK II group (UCLA-?, TB-208, TB-243).

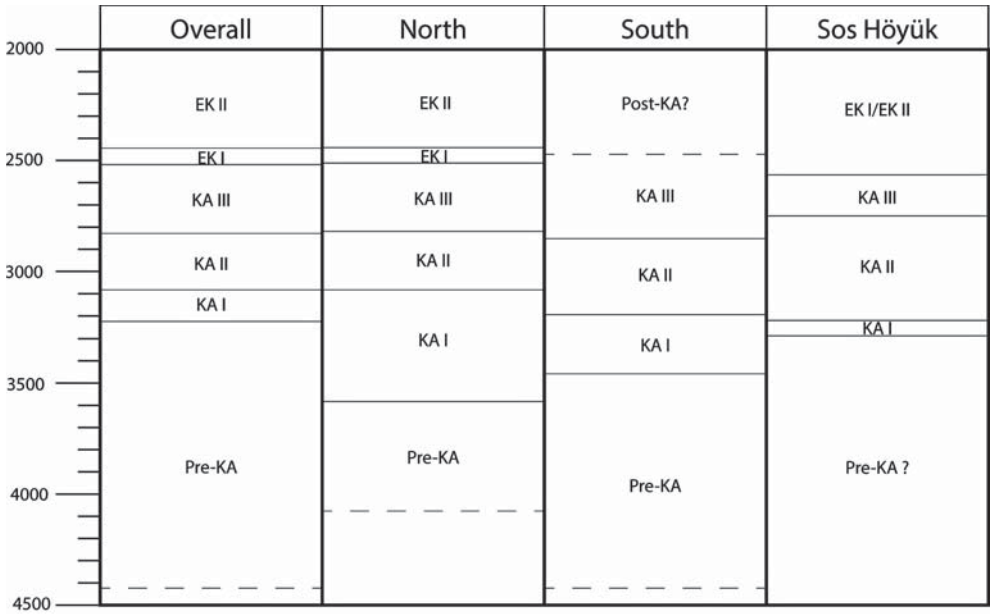
The *South* model has an agreement of 389 with a total of 4 outliers out of 81 ^{14}C dates. The beginning of the pre-KA is set between the 4480-4380 Cal BC. The pre-KA/KA I transition is set between 3490-3440 Cal BC, with the rejection of an outlier (OxA-18600) at the end of the pre-KA sequence. The KA I/KA II transition is set between 3230-3120 Cal BC, with the rejection of a single outlier from the beginning of the KA II sequence (AA-11130). The KA II/KA III transition is set between 2870-2810 Cal BC, with the rejection of two outliers from the beginning of the KA III sequence (AA-92623, LTL-4531A). No dates for the EK I and EK II phase are available for the *South* cluster.

The stratigraphic model of Sos Höyük has an agreement of 77 with a total of 2 outliers out of 21 ^{14}C dates. The occupation of level VA begins between 3370-3160 Cal BC, with the rejection of one date (OZF-125) from the beginning of the VA group, too old to fit the parameter of a *Phase*. The VA/VB (KA I/KA II) is set between 3250-3000 Cal BC. However, level VB is underrepresented: out of four available dates, two were excluded prior to Bayesian modelling due to their standard deviation (Beta-107908, Beta-107910), leaving with two dates

(Beta-107909, Beta-107911) of quite differing spans that end up expanding the range of the transition. The limits for phase VB are, therefore, better defined as enclosed between levels VA and VC. Having such issue in mind, the VB/VC (KA II/KA III) transition is set between 2830-2670 Cal BC, also very extended. The VC/VD transition (KA III/post-KA) is set between 2670-2540 Cal BC. VD is also underrepresented, with only two chrono-culturally defined ^{14}C dates.

A comparison between the results obtained from the three regional models shows a decrease in number of outliers in the sub-regional groups and the reduction of instances of overlap affecting the *Overall* model (Table 8). Some ^{14}C dates remain constantly flagged as outliers in all the models, thus probably constituting "true" outliers, while other better fit the sub-regional scale. However, the duration of each transition is modelled at very different ranges according to the geographic filter applied. The *Overall* model yielded more restricted transitional ranges of 30 (pre-KA I/KA I), 60 (KA I/KA II), and 50 (KA III/EK I) years. These transitional spans are dramatically extended in the sub-regional models: the *North* yielded spans of 110 years for the pre-KA/KA I and the KA I/KA II transitions, and of 70 years for the KA II/KA III transition; the *South*, while maintaining restricted spans of 50 years for the pre-KA/KA I and 60 years for the KA II/KA III, yielded a span of 110 years for the KA I/KA II transition. This analytical behaviour may be explained as a result of the number of ^{14}C dates used per model, being the *Overall* the richest cluster capable of providing more restricted ranges based on more numerous elements, although observations on its results and outliers suggested an overlapping boundary to be more appropriate. The value of transitional ranges within sub-regional models is affected by a reduced number of ^{14}C dates per chrono-cultural phase in each model, with the majority of KA I dates falling in the *North* cluster and the majority of pre-KA and KA III dates belonging to the *South* cluster.

Closer comparisons between the sub-regional results signal substantial differences in the absolute range modelled for some of the transitions (Table 9). The pre-KA/KA I transition shows a difference of 110 years between the two groups, with the beginning of the transition being a century earlier in the *North*, where the early KA I evidence is known at Berikldeebi; conversely, the end of the pre-KA/KA I transition is set much later in the *South*, where later pre-KA occupations are attested. The KA I/KA II transition also shows a difference of 110 years, with an earlier beginning in the *South*, followed by the *North*. The KA II/KA III transition shows a difference of 10-20 years, which might suggest a slightly earlier beginning of the KA III in the South, although the difference is negligible in the light of the analysed timescale. Little can be commented on the KA III/EK I and EK I/EK II transitions, which concern only the *North* and are affected by the poor knowledge on these horizons and the controversies on the measurement and chrono-cultural attribution of the few available ^{14}C dates. Several outliers have been rejected but, in the absence of new and more abundant information on the EK phenomenon, it is hard to assess whether these may have been a problem of misinterpretation or measurement.



Tab. 9 – Synoptic chronological table showing the modelled results obtained from the Overall, North, South and Sos Höyük models. The chronological outlines of each phase are here represented by using the median value of each modelled transition (see Tabs 6 and 7). Dashed lines have been applied to the boundaries that couldn't be modelled based on preceding or following data, but are only defined by the earliest/latest known ^{14}C date.

Assessment and consideration of modelled outliers

The presence of outliers in the *Overall* model suggested the adoption of a sub-regional strategy in analysing ^{14}C dates from the Southern Caucasus. Instances of overlap were partially circumvented in the sub-regional clusters, with a general decrease in the number of outliers, although some of these were flagged in the North, South, and Sos Höyük models as well. Once again, considering the two assumptions by which selected ^{14}C dates are correct both in terms of chrono-cultural affiliation and radiocarbon measurement, the persistence of outliers in the sub-regional models needs to be addressed in evaluating the plausibility of the same models.

The *North* model yielded 11 outliers. Beta-252228 from Mentesh Tepe was rejected at the end of the KA I sequence. The sample was obtained from a charcoal collected from a KA pot (Bertille Lyonnet, personal communication) found within a collective burial under the kurgan recovered at the site (Lyonnet 2010, 2014; Lyonnet *et al*. 2012) and therefore meets the reliability criteria. The re-use of the funerary chamber may be taken into account in evaluating this result, although the occurrence of a longer KA I phase at the site can't be excluded. Four dates (RTK-6582, LE-156, LE-157, Gif-12230) were rejected from the KA II sequence. Date RTK-6582 was recently obtained from a tooth collected from grave 3 at Tvlepias Tsqharo. The sample was collected *a posteriori* from the

Georgian National Museum of Tbilisi and, since issues with its measurement can be securely excluded (Elisabetta Boaretto, personal communication), there remains the possibility of a misattribution of the sample to the archaeological context. Date LE-156 was obtained from unknown material associated to level C-1 at Kvatskhelebi (Kavtaradze 1983; Kushnareva 1997) and issues with its range may be either related to sampling circumstances or misattribution to the archaeological context, both of which could not be verified since the date is an old measurement from a lab that is no longer active. Date LE-157, obtained from seeds, is also assigned to level C-1 in association with building 1, but details about its treatment history can't be retrieved. Date Gif-12230, obtained from human bone associated to burial 28 at Mentesh Tepe, is also an outlier, whose discrepancy with the material characterisation of the burial has already been underlined by Poulmarc'h (2014: 152). The excavations at the site are still an on-going process and further evaluation should be avoided in the absence of more refined results. The last six outliers were rejected from the EK I (TB-329, TB-317, LE-2198) and the EK II (UCLA-?, TB-208, TB-243) sequence. Most of these dates are old measurements, while published details concerning sampled material and specific contextualisation within the kurgans or settlement are vague or nonexistent, thus hindering further re-evaluations in terms of radiocarbon resolutions. Sometimes, ^{14}C dates from the same kurgan (see for instance kurgan 1 at Tsnori) provided very different ranges, which might be explained as a consequence of the re-use of funerary structures in this period.

The *South* model yielded 4 outliers. Date OxA-18600 from Areni-1 was rejected at the end of the pre-KA sequence and it has been explained as the result of a later use of the Chalcolithic area at the cave (Areshian *et al*. 2012: 123). No dates were rejected from the KA I sequence, while date AA-11130 from Horom was rejected from the KA II sequence. The measurement was obtained from charcoal collected from a KA tomb and its inaccuracy had already been underlined in the literature (Badalyan *et al*. 1994: 14) in comparison with another date measured on a human bone from the same tomb (AA-10191). Considering the resolution of bone as opposed to charcoal, the second measurement can be better trusted as being related to the actual timing of the KA deposition. Two dates (AA-92623, LTL4531A) were rejected from the KA III sequence. Date AA-92623 was obtained from undetermined charcoal generally associated to the later KA occupation at Gegharot (Badalyan 2014: 83), but, in the absence of details about its exact context of provenance and sampling circumstances, issues with calibration and sampling or with the duration of the occupation at the site can be equally suggested. Date LTL4531A was obtained from undetermined charcoal collected from a KA hearth at Ovçular Tepesi and no particular issues with its sampling have been underlined.

The model of Sos Höyük yielded 2 outliers (OZF-125 from VA, Beta-107918 from VC). Date OZF-125, also flagged as an outlier in the Overall model, was obtained from undetermined charcoal associated to level VA. Whether issues with accuracy of the material, treatment, and measurement occurred is not assessable. The fact that it's maintained as an outlier in the stratigraphic model could also be related to Bayesian limitations and the

imposition of a *Phase* parameter that forces a contemporaneity of dates related to an occupation level. Date Beta-107918 is only flagged as an outlier in the stratigraphic model, but not in the Overall simulation. This is a result of the application of a more detailed modelling strategy relying on specific stratigraphic information, whose issues may be "masked" in the general model. The outlying distribution of this date can be either a problem of lab measurement and accuracy or, more probably, of the problematic dating of level VB that influences its *posterior distribution* in the model.

DISCUSSION AND CONCLUSIONS

The re-evaluation of the absolute chronology of the 4th and 3rd millennium BC in the Southern Caucasus followed a strict methodology – from collection, to characterisation, selection, and modelling of ^{14}C dates – that contributed to highlight some issues in terms of both chrono-cultural periodisation and radiocarbon measurements. The identification of outliers and instances of overlap in the *Overall* model suggested the adoption of a more tailored strategy, with the fragmentation of the ^{14}C record in smaller geographic clusters allowing for the occurrence of fewer outliers and the identification of regional chronological differences. Before entering into detailed interpretations of the results, it should however be reminded that the present study has referred to Palumbi's (2008a) relative proposal with regards to the distinction of KA materials in relation to KA chrono-cultural phases. This system, although in co-presence with other material types, prevalently relies on pottery as the main diagnostic marker. The latter is also the most – sometimes the only – reported and consistent relative information on KA occupations, thus constituting the most immediate element for the detection of broader regional changes. As a consequence, current conclusions should also be considered in light of the nature of the relative system, which relates to the diffusion of specific pottery typologies. The extent to which the latter should be used as representative of a chrono-cultural phase is, however, questionable and open to further revision.

Differences between the sub-regional models most likely reflect the regional origins of KA diagnostic markers, with special regards to the definition of the KA I and the KA II phases, showing the most noticeable offset between the *North* and the *South* clusters. The earlier range for the pre-KA/KA I transition (3610-3550 Cal BC) in the *North* is compatible with the evidence from Berikldeebi, Georgia. Thus far this is the only known site where evidence for "Proto-KA" foreshadowing characteristics of MW (Kiguradze and Sagona 2003: 91-92; Makharadze 2007: 128-131; Marro 2008: 14-15; Palumbi 2003: 84, 2008a: 34) has been found in levels preceding an occupation characterised by typical MW, attesting for the material experimentation that led to the pottery that traditionally defines the KA I phase.

The prolongation of the pre-KA phase in the *South*, as attested by dates from Areni-1 Cave, may be related to its proximity to Northern Mesopotamia and the traditional *focus* of the CFW horizon. However, how this relates to the KA I phase in the sub-region is up for discussion. In the present study, only two ^{14}C dates from Jrvezh/Avan (AA-102802, AA-102803) were equalled to

KA I as defined by Palumbi (2008a) based on the description of the pottery assemblage (Badalyan 2014), which we considered as best affiliated with MW. The complexity of integrating the Armenian system within Palumbi's periodisation has already been addressed. A conventional choice was here adopted for the sake of simplification and the purposes of Bayesian modelling, which had to be based on consistent material criteria. More refined chrono-typological accounts need to be achieved on this specific question, and further revisions may be undertaken in the presence of more numerous and consistent ^{14}C dates.

An earlier range (3230-3120 Cal BC) for the transition to KA II was obtained for the *South* cluster, followed by the *North* (3140-3030 Cal BC). This is compatible with the current paradigm about the Central-Eastern Anatolian origin of RBBW (Frangipane and Palumbi 2007; Palumbi 2003, 2008a) and a later diffusion in the Erzurum region and, maybe from there, into the Southern Caucasus. Indeed, the earliest evidence of RBBW[14] is known from the site of Sos Höyük, where specimens of so-called "Proto-KA" (intended as Proto-RBBW, see Marro 2008) have been found in association with level VA (Palumbi 2003; Sagona 2000, 2014). Considering the ambiguity in the description and understanding of this category, also in relation to its associated contexts, we could not distinguish a proto-KA phase and level VA has been fully assigned to phase KA I. The range obtained for the transition to VB/KA II at Sos Höyük (3250-3010 Cal BC) may be regarded as an argument for the earliest emergence of RBBW at the site, but its far too wide span and inaccuracy of ^{14}C dates from the occupation challenge its role in drawing chrono-cultural conclusions. Nonetheless, the chronological data generally confirms the earlier appearance of RBBW in the Erzurum regions and in the Armenian uplands, which were naturally connected through the Araxes River (Palumbi 2003).

The ranges obtained for the KA II/KA III transition show a difference of 10-20 years, with the earliest transition in the *South* cluster (2870-2810 Cal BC), followed by the *North* (2860-2790) Considering the regional scale to which ^{14}C dates were analysed, this offset may be considered negligible. Despite this, an inverted flow of influence may have occurred between the Armenian uplands, where incised decoration typical of BBW – traditionally associated with KA III – appears and diffuses quite precociously on RBBW assemblages (Badalyan 2014; Badalyan and Avetysian 2009; Badalyan *et al*. 2009; Sagona 1984). The transition modelled for Sos Höyük (2830-2670 Cal BC) is also quite wide and, as previously discussed, affected by the number and quality of ^{14}C dates for level VB.

The modelled results demonstrate a general breakdown in the KA chrono-cultural pattern based on material typologies and bespeak for the probable occurrence of more complex dynamics of transmission of cultural traits and ideas within the KA communities in the Southern Caucasus. As previously discussed, this also stands as a necessary

[14] Excluding recent claims for the discovery of RBBW dated to the 5th millennium BC at Ovçular Tepesi (Marro *et al*. 2011; Marro *et al*. 2014) and at Areni-1 Cave (Wilkinson *et al*. 2012).

consequence of the use of chrono-typological schemes based on specific pottery classes, whose production, adoption, and diffusion are by their own nature fluid and variable, especially when dealing with handmade and decentralised manufacture. While being the most integrative and general proposal for the whole region, Palumbi's outline (2008a) of the KA chrono-cultural narrative is not devoid of such issues: within a diachronic and interregional varied cultural "package", MW, RBBW and BBW can surely be regarded as a discerning device for the detection of broader changes that are related to different chrono-cultural phases; however, geographic variables seem to have a significant role in the construction of the KA identity throughout time and regions.

In the present study, chrono-cultural attributions, whenever possible, were defined based on more than one material/typological category – for instance by taking into consideration architecture and additional material parallels with assemblages from sites of secure attribution in those cases where this information was available. In most occasions, however, the choice needed to rely on pottery alone, with particular difficulties in discerning mixed assemblages. The separation of mixed from pure pottery assemblages would have reduced the already thin number of ^{14}C dates per chrono-cultural phase and was therefore discarded. Presence/absence was then the prevailing criterion, and this should be kept in mind while evaluating the results.

Regardless of these issues, modelled results revealed a partial co-existence and geographic overlaps between the ceramic classes that have been traditionally associated with the different phases of the KA culture. All in all, if pottery really constitutes the marker for cultural change within the KA horizon, areas of overlap might be regarded as "grey" chronological spans during which new elements are introduced and gradually assimilated in varying proportions. As a consequence, potential transitional phases may be identified in the future in the spans that separate the beginning of phases KA I, II, and III in the sub-regional clusters with the final goal of transcending sub-regional specifics towards obtaining a South-Caucasian homogeneous chronological picture.

In general, the ranges obtained from the sub-regional models tend to agree with the absolute limits proposed by Palumbi (2008: 319) for the end and start of the KA culture (between 3500 and 2500 BC ca), with the earliest begin of KA I between 3610-3550 Cal BC (*North* model) and the latest end of KA III between 2530-2480 Cal BC (*North* model). This picture also accords with Kavtaradze's (1983, 1999) proposal for a high chronology placing the beginning of the KA culture around the mid-4th millennium BC, which was later shared (1984) and most recently reconfirmed by Sagona (2014).

As for what concerns the end of the KA culture, the chrono-cultural re-assessment concerning the post-KA/EK horizons is challenged by the impossibility of a more scrutinised evaluation of the associated ^{14}C data. The modelled results point towards ~2500 Cal BC for the end of the KA, with the rejection of several outliers (see previous section). Considering the distribution of known ^{14}C dates for the KA III phase and the overall absence of outliers at the end of the KA III sequence, this range seems a plausible chronological

limit for the end of the KA phenomenon. Unfortunately, the same confidence cannot be applied to the assessment of the beginning of the EK horizon. The characterisation of the EK ^{14}C data used in the models is vague both in analytical and archaeological terms, thus also hindering a consideration of modelled outliers – whose rejection cannot be weighed in the light of further details. In other words, especially considering recent evidence for the coexistence of KA with Martqopi and/or Bedeni materials (Rova *et al*. 2010: 14-15; Puturidze 2012; Puturidze and Rova 2012: 56-57), an earlier date for the appearance of the EK phenomenon can't be excluded *a priori* based on the results of our models. For similar reasons, the internal chronological distinction between Martqopi and Bedeni should also be carefully considered.

To conclude, this work represents a first attempt at an integrative approach towards assessing the cultural chronology of the 4th and 3rd millennium BC in the Southern Caucasus. Founded on the combination of both archaeological and radiocarbon sciences, the results and preliminary observations shed light on the intricacies of the subject. The latter concern methodological matters pertaining to both archaeological assemblages and absolute chronologies, thus suggesting a critical and constructive perspective on future directions. Firstly, new and more numerous ^{14}C dates tied to secure archaeological and radiocarbon contexts need to be obtained within a strict and aware collaboration between archaeologists and ^{14}C specialists (see Passerini *et al*. 2016). Secondly, archaeological phases based on material assemblages should be revised, with more nuanced and accurate definitions of the associated archaeological markers alongside the refinement of regional stratigraphies based on recent tools and data. Thirdly, once more refined and numerous data for the Southern Caucasus are made available, more comparisons with secure ceramic and absolute chronological sequences from areas (e.g. the Turkish Upper Euphrates) that show close connections with the Kura-Araxes phenomenon should be addressed. In the long-term, as more nuanced information emerges from the recent excavations, it is hoped that more tailored and refined research strategies will be applied, calling into questions dogmas and conventions so far applied to the Kura-Araxes phenomenon, or phenomena.

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Appendix

List of all ^{14}C dates from the Southern Caucasus cited in text (see also fig. 3). The samples are ordered according to sites and appear in alphabetical order. Within each site, radiocarbon dates are ordered according to the corresponding chrono-cultural phase and in each phase according to the radiocarbon age. Lab codes of unknown BP age are also reported for the sake of statistical representation of the existing data.

Site	Lab Code	Age	±	Sample type	Archaeological Context	Phase	References
Agilidere	Ki-14592	4350	110	Unknown	Unknown	Pre-KA	Korenevskij 2011: 33
Amiranis Gora	TB-4	4835	180	Charcoal	Locality III; charcoal of the metallurgical workshop of the earliest building horizon	KA II	Burchuladze 1968: 466
	TB-9	4625	170	Charcoal	Locality XXIX	KA II	Burchuladze 1968: 466
	TB-3	3720	165	Charcoal	Locality XIX	KA II	Burchuladze 1968: 466
Aparan III	AA-40153	4455	75	Cereals	Pit (vessel)	KA II	Badalyan 2003: 21
	Bln-5528	4428	39	Cereals	Pit (vessel)	KA II	Badalyan and Avetisyan 2007: 58
	LY-10623	4321	33	Cereals	Pit (vessel)	KA II	Badalyan and Avetisyan 2007: 58
Aradetis Orgora	RTD-7858	4405	21	Charcoal	Locus 2308	KA II	Passerini *et al*. 2016
	RTD-7749	4397	21	Seeds	Locus 2315	KA II	Passerini *et al*. 2016
	RTD-7764	4374	35	Charcoal	Locus 2308	KA II	Passerini *et al*. 2016
	RTD-7859	4357	21	Charcoal	Locus 2296 (wall post)	KA II	Passerini *et al*. 2016
	RTK-6134	4345	45	Charcoal	KA level (section W)	KA II	Passerini *et al*. 2016
	RTD-7751	4312	21	Charcoal	Locus 2294 (burnt layer)	KA II	Passerini *et al*. 2016
	RTD-7755	4306	25	Charcoal	Locus 2404 (burnt layer)	KA II	Passerini *et al*. 2016
	RTD-7756	4288	35	Charcoal	Locus 2299 (floor, charcoal under *in situ* KA vessel)	KA II	Passerini *et al*. 2016
	RTD-7861	4284	18	Charcoal	Locus 4406 (wooden post)	KA II	Passerini *et al*. 2016
	RTD-7862	4281	21	Charcoal	Locus 2404 (burnt layer)	KA II	Passerini *et al*. 2016
	RTD-7750	4278	37	Charcoal	Locus 2294 (burnt layer)	KA II	Passerini *et al*. 2016
	RTD-7860	4267	23	Charcoal	Locus 2296 (wall post)	KA II	Passerini *et al*. 2016
	RTD-7754	4242	20	Charcoal	Locus 2299 (floor, charcoal under in situ KA vessel)	KA II	Passerini *et al*. 2016
	RTD-7752	4215	39	Charcoal	Locus 2296 (wall post)	KA II	Passerini *et al*. 2016
	RTD-7753	4183	35	Charcoal	Locus 2406 (wooden post)	KA II	Passerini *et al*. 2016
	RTD-7525	4146	28	Charcoal	KA level 2222	KA II	Passerini *et al*. 2016
	RTD-7524	3823	28	Charcoal	KA level 2217	KA II	Passerini *et al*. 2016
Areni-1	UCIAMS-40181	7440	25	Charcoal	Unit 1006, unidentified, from the bottom of the deep test pit inside T1	Pre-KA	Wilkinson *et al*. 2012: 23
	OxA-19331	5366	31	Teeth	Unit 1003, square R23, Burial 1, tooth from the skull of the plastered head 2, second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23

Site	Lab Code	Age	±	Sample type	Archaeological Context	Phase	References
Areni-1	OxA-19332	5323	30	Teeth	Unit 1003, square R23, Burial 1, tooth from the skull of the plastered head 1, second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23
	OxA-18599	5285	28	Teeth	Unit 1004, square P23, Burial 3, tooth from the skull of plastered head 3, second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23
	UCIAMS-48413	5240	20	Other	Unit 1002, desiccated grape vine from the first or second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23
	UCIAMS-40182	5230	25	Charcoal	Unit 1004, collected from the bottom of the second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23
	UCIAMS-65193	5230	20	Organic tissue	Unit 1003, square R23, Burial 1, brain tissue from the skull of plastered head 1, second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121 Published as UCIAMS-65187; John Southon (UC Irvine Keck-CCAMS facility), personal communication
	OxA-18198	5098	29	Grass	Unit 2002, desiccated grasses wrapping a jar from the second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121
	UCIAMS-65190	5095	20	Organic residue	Unit 1001, collected from a jar from the first (upper) Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121 Published as UCIAMS-65186; John Southon (UC Irvine Keck-CCAMS facility), personal communication
	UCIAMS-40183	5090	25	Charcoal	Unit 1003, Square R23, Burial 1, found near plastered head 1, second Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23
	OxA-18197	5077	29	Seeds	Unit 1002, Prunus seed from the first Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 121; Wilkinson *et al*. 2012: 23
	OxA-20583	4810	31	Grass	Square S32, pit 3, locus 7 (spit7), taken from the shoe found inside a storage bin of the first (upper) Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 120
	OxA-20581	4725	32	Leather	Square S32, pit 3, locus 7, collected from the shoe found inside a storage bin of the first (upper) Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 120
	OxA-20582	4708	32	Leather	Square S32, pit 3, locus 7, collected from the shoe found inside a storage bin of the first (upper) Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 120
	UCIAMS-65192	4700	20	Leather	Square S32, pit 3, locus 7, collected from the shoe found inside a storage bin of the first (upper) Chalcolithic level	Pre-KA	Areshian *et al*. 2012: 120 Published as UCIAMS-65186; John Southon (UC Irvine Keck-CCAMS facility), personal communication
	OxA-18601	4601	28	Charcoal	Squares N30/O30, spit 5/6, locus 2, charcoal of Tamarix sp. From the first upper Chalcolitic level	Pre-KA	Areshian *et al*. 2012: 120

Site	Lab Code	Age	±	Sample type	Archaeological Context	Phase	References
Areni-1	OxA-18600	4460	29	Charcoal	Square L29, spit 2, charcoal of Acer sp. From the burnt layer underneath the structure 2 of the second medieval level	Pre-KA	Areshian *et al*. 2012: 120
Baba-Dervish 2	LE-780	3900	60	Unknown	From a depth of 1m	KA III	Kushnareva 1997: 52
Bedeni	RTK-6585	3960	55	Seeds	Kurgan 5, hazel nuts from the basket	EK II	D-REAMS, Georgian-Italian Shida Kartli archaeological project
	RTK-6584	3870	55	Textile	Kurgan 5 (excavated in 1967)	EK II	D-REAMS, Georgian-Italian Shida Kartli archaeological project
	TB-30	3330	60	Wood	Large kurgan (kurgan 5?)	EK II	Burchuladze *et al*. 1976: 356
Berikldeebi	Wk-35424	5075	38	Charcoal	Pit 172, level V1	Pre-KA	Sagona 2014: 32
	Wk-35422	5070	37	Charcoal	Pit 174, level V1	Pre-KA	Sagona 2014: 32
	OZE-595	5070	40	Bone	Pit, level V1	Pre-KA	Kiguradze and Sagona 2003: 93
	A-6408	4955	55	Unknown	Level V2	Pre-KA	Badalyan *et al*. 1992: 48
	LE-2197	4850	50	Unknown	Settlement, level IV1	KA I	Kavtaradze 1983: 31
Boyuk Kesik	Beta-218216	5260	60	Charcoal	Kv8d	Pre-KA	Museyibli and Huseynov 2008: 42
	Beta-200403	5090	40	Charcoal	Kv6, outside roundhouse	Pre-KA	Museyibli and Huseynov 2008: 42
	Beta-218217	5040	60	Charcoal	Kv8c, 1.4 m	Pre-KA	Museyibli and Huseynov 2008: 42
	Beta-226242	4960	40	Charcoal	Kv7d, 1.6 m	Pre-KA	Museyibli and Huseynov 2008: 42
	Gif-12141	4960	90	Charcoal		Pre-KA	Museyibli and Huseynov 2008: 42
Chobareti	SacA-27472	4535	30	Cereals	Pit 17	KA I	Kakhiani *et al*. 2013: 26
	Wk-34453	4528	34	Charcoal	Base of Pit 12, 90 cm below the surface in Trench 6	KA I	Kakhiani *et al*. 2013: 22
	Wk-34454	4517	35	Charcoal	Base of Pit 14, 1.8 cm below the surface in Trench 12	KA I	Kakhiani *et al*. 2013: 22
	Wk-34455	4501	39	Charcoal	base of Pit 7, 1.0 cm below the surface in Trench 11	KA I	Kakhiani *et al*. 2013: 23
	Wk-34456	4501	33	Charcoal	Pit 15, 25-30 cm above the base, and 1.0 cm below the surface in Trench 6	KA I	Kakhiani *et al*. 2013: 23
	SacA-27471	4500	30	Cereals	Pit 16	KA I	Kakhiani *et al*. 2013: 25
	Wk-34451	4490	90	Charcoal	Building 3, floor level; earliest level	KA I	Kakhiani *et al*. 2013: 21
	Wk-34452	4470	36	Charcoal	1 m below the surface in Pit 7, Trench 11	KA I	Kakhiani *et al*. 2013: 21
	Wk-34457	4451	34	Cereals	Square F42.1, Locus 103, Basket 28, S. 29, upper level, layer above eastern floor of Structure 4	KA I	Kakhiani *et al*. 2013: 24

Site	Lab Code	Age	±	Sample type	Archaeological Context	Phase	References
Chobareti	Wk-34458	4449	41	Cereals	Square F42.1/F42.4, Locus 103, Basket 29, S. 50, upper level, layer above eastern floor of Structure 4	KA I	Kakhiani *et al*. 2013: 24
	Wk-34459	4434	35	Cereals	Square F42.4, Locus 103, Basket 29, S. 45, upper level, layer above eastern floor of Structure 4	KA I	Kakhiani *et al*. 2013: 25
	Wk-37351	4490	21	Cereals	F42, locus 122; later floor of Structure 4	KA II	Sagona 2014: 35
	Poz-56370	4460	40	Bone	Burial 5	KA II	Sagona 2014: 35
	Wk-37352	4454	20	Cereals	F42, locus 122; later floor of Structure 4	KA II	Sagona 2014: 35
	Poz-56371	4380	40	Bone	Burial 9	KA II	Sagona 2014: 35
Didube	OZF-720	4486	60	Charcoal	Unknown	KA I	Kiguradze and Sagona 2003: 93
Gegharot	AA-72047	4523	49	Charcoal	Lower portion of the early EB deposit between the pedestalled E616 wall and the early EB E661 wall, roughly west of the EB tomb	KA II	Badalyan *et al*. 2008: 51
	AA-72046	4492	41	Charcoal	Lowest fill deposit abutting the locus E665 EB wall to the west	KA II	Badalyan *et al*. 2008: 51
	AA-72069	4402	38	Seeds	Sample taken from within the EB jar near the hearth locus 30	KA II	Badalyan *et al*. 2008: 51
	AA-95616	4391	49	Charcoal	EBA settlement	KA II	Badalyan 2014: 78
	AA-72070	4389	37	Charcoal	Sample found in the EB pit in locus 13 - EB room.	KA II	Badalyan *et al*. 2008: 51
	AA-95618	4374	42	Charcoal	EBA settlement	KA II	Badalyan 2014: 78
	AA-72061	4371	38	Seeds	Sample found at elevation 2290.680 m on the floor of EB room near the vessels 2,3.	KA II	Badalyan *et al*. 2008: 51
	AA-72060	4346	38	Charcoal	Sample found at elevation 2290.650 m on the floor of EB room.	KA II	Badalyan *et al*. 2008: 51
	AA-52898	4314	60	Bone	Op. T10a locus 3	KA II	Smith *et al*. 2004: 20
	AA-66888	4313	39	Charcoal	T15	KA II	Badalyan *et al*. 2010: 266
	AA-72213	4293	44	Bone	Human bone, collective burial	KA II	Badalyan *et al*. 2008: 51
	AA-72214	4286	42	Bone	Human bone, collective burial	KA II	Badalyan *et al*. 2008: 51
	AA-56969	4285	43	Charcoal	EBA round construction floor	KA II	Badalyan *et al*. 2008: 51
	AA-92623	4383	40	Charcoal	Upper EBA layer	KA III	Badalyan 2014: 83
	AA-95615	4204	52	Charcoal	Upper EBA layer	KA III	Badalyan 2014: 83
	AA-72066	4201	37	Charcoal	Found under the south wall of EB room.	KA III	Badalyan *et al*. 2008: 51
	AA-52900	4197	40	Charcoal	Fortress, Op. T02 locus C10	KA III	Smith *et al*. 2004: 20

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Gegharot	AA-72053	4171	37	Charcoal	Area of dark mottled matrix, devoid of most material except some large sherds that might be the same vessel. 80 cm from N baulk, 138 cm from W edge of trench.	KA III	Badalyan *et al*. 2008: 51
	AA-66894	4130	45	Charcoal	Unknown	KA III	Badalyan *et al*. 2008: 51
	AA-92622	4128	41	Charcoal	Upper EBA layer	KA III	Badalyan 2014: 83
	AA-95617	4119	42	Charcoal	Upper EBA layer	KA III	Badalyan 2014: 83
	AA-56968	4105	41	Charcoal	From the floor in the southern part of the EBA building.	KA III	Badalyan *et al*. 2008: 51
	AA-66895	4104	47	Charcoal	Unknown	KA III	Badalyan *et al*. 2008: 51
	AA-92621	4104	40	Charcoal	Upper EBA layer	KA III	Badalyan 2014: 83
	AA-72067	4080	38	Charcoal	Eeastern part of pit 1.	KA III	Badalyan *et al*. 2008: 51
	AA-72045	4077	41	Charcoal	EB living surface (floor) above locus E661 (wall) throughout T2E south and central	KA III	Badalyan *et al*. 2008: 51
Horom	AA-11130	5150	60	Charcoal	Burnt surface of the tomb	KA II	Badalyan *et al*. 1994: 14
	AA-7767	4565	60	Unknown	KA wall, exploratory trench	KA II	Badalyan *et al*. 1993: 3
	AA-10191	4505	50	Bone	KA tomb, human bone	KA II	Badalyan *et al*. 1994: 14
Jrvezh/Avan	AA-102802	4674	59	Teeth	Human tooth, burial 1	KA I	Badalyan 2014: 78
	AA-102803	4613	59	Teeth	Human tooth, burial 1	KA I	Badalyan 2014: 78
Kalavan-1	UGAMS-02294	4080	50	Bone	Tomb UF 5	KA III	Poulmarc'h et al. 2016: 965, see also Poulmarc'h 2014 (PhD thesis)
	Poz-22179	4045	35	Bone	Tomb UF 5	KA III	Poulmarc'h et al. 2016: 965, see also Poulmarc'h 2014 (PhD thesis)
	Poz-22180	4045	35	Bone	Tomb UF 5	KA III	Poulmarc'h et al. 2016: 965, see also Poulmarc'h 2014 (PhD thesis)
	SacA-31261	4020	30	Bone	Tomb UF 8	KA III	Poulmarc'h et al. 2016: 965, see also Poulmarc'h 2014 (PhD thesis)
	Poz-22234	3990	35	Bone	Tomb UF 9	KA III	Poulmarc'h *et al*. 2014: 236, see also Poulmarc'h 2014 (PhD thesis)
Karnut	LE-4488	4490	230	Bone	Habitation no 3	KA III	Badalyan and Avetisyan 2007: 138
	AA-7555	4220	60	Bone	Habitation no 4	KA III	Badalyan and Avetisyan 2007: 138
	AA-7787	3915	65	Bone	Habitation no 4	KA III	Badalyan and Avetisyan 2007: 138
Khizanaant Gora	TB-29	4220	90	Cereals	Level C1	KA II	Burchuladze *et al*. 1976: 356
Khramebi	TB-242	4030	50	Unknown	Unknown	EK II	Kavtaradze 1983: 29, 107
Kiketi	Poz-56572	4420	35	Bone	Tomb 5, human cranium	KA II	Poulmarc'h 2014 (PhD thesis): 211

Site	Lab Code	Age	±	Sample type	Archaeological Context	Phase	References
Kültepe 1	LE-163	4880	90	Charcoal	8.5 depth, Early Bronze age layer	KA I	Butomo 1965: 226-227 Quoted by Kavtaradze (1983) as 3714 ± 244
Kültepe 2	UGAMS-02069	4480	50	Seeds	Ash deposit in front of the lot 43 hearth	KA II	Ristvet *et al*. 2011: 52
	AA-85518	4383	45	Charcoal	Lot 47 hearth, floor 37	KA II	Ristvet *et al*. 2011: 52
	AA-85519	4254	41	Charcoal	Concentration near hearth 28	KA II	Ristvet *et al*. 2011: 52
	AA-85516	4151	48	Charcoal	Lot 21 hearth	KA II	Ristvet *et al*. 2011: 52
	UGAMS-02067	4220	50	Charcoal	Floor, lot 4, beside lot 3 firepit	KA III	Ristvet *et al*. 2011: 12
	UGAMS-02068	4050	50	Charcoal	Lot 7, firepit	KA III	Ristvet *et al*. 2011: 12
	UGAMS-02066	3940	50	Charcoal	Floor next to fire-pit (feature 1, lot 3)	KA III	Ristvet *et al*. 2011: 12
Kvatskhelebi	LE-156	4760	90	Unknown	Level C-1	KA II	Kushnareva 1997: 52 Quoted by Kavtaradze (1983) as 3582 ± 277
	LE-157	4760	90	Seeds	Level C1; building 1, grain	KA II	Butomo 1965: 226-227
	Rome-1619	4465	55	Unknown	Level C1, building 1	KA II	Glonti *et al*. 2008: 156
	LJ-3272	4190	60	Charcoal	Level C1, House 1	KA II	Kavtaradze 1983: 31
	RTK-6583	4175	55	Seeds	Level C1, house 1	KA II	D-REAMS, Georgian-Italian Shida Kartli archaeological project
Leilatepe	Ki-14950	5040	100	Unknown	Room 10	Pre-KA	Korenevskij 2011: 33
Martqopi	TB-813	2060	100	Unknown	Kurgan 5	EK I	Japaridze 1998: 200
	TB-809	2040	90	Unknown	Kurgan 5	EK I	Japaridze 1998: 200
	GX-9252	4065	155	Unknown	Kurgan 4	EK I	Kavtaradze 1983: 31, 107
	TB-325	4010	80	Unknown	Kurgan 4	EK I	Kavtaradze 1983: 31, 107
	TB-317	3775	50	Unknown	Kurgan 3	EK I	Kavtaradze 1983: 30
	LE-2198	3640	40	Unknown	Kurgan 4	EK I	Kavtaradze 1983: 31, 107
Maxta 1	UGAMS-02070	4430	50	Seeds	Lot 13 floor	KA II	Ristvet *et al*. 2011: 52
	AA-85517	4382	41	Charcoal	Lot 11 floor	KA II	Ristvet *et al*. 2011: 52
Mentesh Tepe	Beta-272312	4660	40	Charcoal	Kurgan 4, wall	KA I	Lyonnet *et al*. 2012: 92
	Beta-252224	4630	50	Charcoal	Kurgan 4	KA I	Lyonnet *et al*. 2012: 92
	Beta-252225	4430	50	Charcoal	Funeral chamber, kurgan 4, near pot 1	KA I	Lyonnet 2010: 36
	Beta-252228	4370	40	Charcoal	Funeral chamber, kurgan 4, in pot	KA I	Lyonnet 2010: 36
	Gif-12230	4690	70	Charcoal	Str. 28	KA II	Lyonnet *et al*. 2017: 138
	Gif-12531	4135	30	Charcoal	Locus 96, pot 2	KA II	Lyonnet *et al*. 2012: 92
	Beta-272313	4110	40	Bone	Z. 7 str. 28 , human bone	KA II	Lyonnet *et al*. 2012: 92
	Beta-272308	4040	40	Charcoal	Z. 10, Loc. 15, south part	KA II	Lyonnet *et al*. 2012: 92
	Beta-272311	4010	40	Charcoal	z. 10 in KA cup	KA II	Lyonnet *et al*. 2012: 92
	Gif-13002	4035	30	Charcoal	Str. 54, NW balk	EK I	Lyonnet 2014: 119
	Gif-12526	3975	30	Charcoal	Area K, St. 61; timber from chamber of kurgan	EK I	Lyonnet *et al*. 2012: 92
	Poz-63144	3970	30	Bone	Str.54, human bone of indiv. 2	EK I	Lyonnet *et al*. 2017: 138
	Beta-272309	3950	40	Charcoal	Timber from chamber of kurgan	EK I	Lyonnet *et al*. 2012: 92
	Gif-12989	3930	30	Charcoal	Str. 54, timber from chamber of kurgan	EK I	Lyonnet 2014: 119
	Poz-63143	3920	30	Bone	Str. 54 human bone of indiv. 1	EK I	Lyonnet *et al*. 2017: 138

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Mokhra-Blur	GrN-8177	4140	30	Charcoal	Upper layer; level IV	KA III	Kushnareva 1997: 52
	GrN-8176	4050	30	Charcoal	Level III	KA III	Badalyan 2014: 83
	GrN-8178	3825	30	Charcoal	Level IV	KA III	Kushnareva 1997: 52
	Bln-2762	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	Bln-2763	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	Bln-2780	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	Bln-2781	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	Bln-2799	?	?	Unknown	Level IX	?	Badalyan 2014: 78
	Bln-5607	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	Bln-5608	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	Bln-5609	?	?	Unknown	Level IX	?	Badalyan 2014: 78
	Bln-8179	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	GrN-18117	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	GrN-18118	?	?	Unknown	Unknown	?	Badalyan 2014: 83
	GrN-18119	?	?	Unknown	Level IX	?	Badalyan 2014: 78
Natsargora	RTK-6588	4380	65	Seeds	Filling of KA pit (ashes 0388)	KA II	Rova 2014: 64
	RTK-6587	4340	55	Seeds	Burnt soil, just below top soil	KA II	Rova 2014: 64
	RTD-7527	4338	53	Seeds	KA filling	KA II	D-REAMS, Georgian-Italian Shida Kartli archaeological project
	RTK-6586	4325	60	Seeds	Surface 0065	KA II	Rova 2014: 64
	RTK-6440	4300	55	Bone	KA pit	KA II	Rova 2014: 64
Norabats	Bln-2800	?	?	Unknown	Unknown	?	Badalyan 2014: 78
	GrN-18120	?	?	Unknown	Unknown	?	Badalyan 2014: 78
	GrN-18121	?	?	Unknown	Unknown	?	Badalyan 2014: 78
Ovçular Tepesi	LTL4534A	4273	45	Charcoal	Locus OT'09 12089, pit partly dug into the virgin soil and lined with stone	KA II	Marro *et al*. 2011: 62
	LTL4531A	4302	45	Unknown	Locus OT'09 6172, KA structure, hearth	KA III	Marro *et al*. 2011: 62
	LTL3888A	4207	45	Unknown	Locus OT'08 6120, ashy layer under stone hearths	KA III	Marro *et al*. 2009: 48
	LTL3889A	4020	45	Unknown	Locus OT'08 6099, stone hearth	KA III	Marro *et al*. 2009: 48
	LTL13323A	5635	45	Charcoal	Locus 11267; house 11.1	Pre-KA	Marro *et al*. 2014: 142
	LTL12565A	5600	45	Charcoal	Locus 5333; house 5.1	Pre-KA	Marro *et al*. 2014: 142
	LTL13321A	5450	45	Charcoal	Locus 5259; house 5.2	Pre-KA	Marro *et al*. 2014: 142
	LTL4533A	5431	45	Unknown	Locus OT'09 1287, pit	Pre-KA	Marro *et al*. 2011: 62
	LTL3887A	5423	50	Unknown	Locus OT'08 1229, hearth house 1	Pre-KA	Marro *et al*. 2011: 62
	LTL3886A	5414	45	Unknown	Locus OT'08 1205, house 1	Pre-KA	Marro *et al*. 2009: 48
	LTL3885A	5408	40	Unknown	Locus OT'06 2070-2	Pre-KA	Marro *et al*. 2009: 48
	LTL3882A	5393	35	Unknown	Locus OT'07 8052	Pre-KA	Marro *et al*. 2009: 48
	LTL13319A	5389	45	Charcoal	Locus 5137; house 5.5	Pre-KA	Marro *et al*. 2014: 142
	LTL3890A	5388	45	Unknown	Locus OT'08 5124	Pre-KA	Marro *et al*. 2009: 48
	LTL8087A	5364	40	Charcoal	Locus 5194; house 5.3	Pre-KA	Marro *et al*. 2014: 142
	LTL3884A	5356	45	Unknown	Locus OT'07 1070	Pre-KA	Marro *et al*. 2009: 48
	LTL5314A	5298	45	Unknown	Locus OT'09 11041	Pre-KA	Marro *et al*. 2011: 62
	LTL3881A	5257	45	Unknown	Locus OT'06 2070-1	Pre-KA	Marro *et al*. 2009: 48
	LTL3883A	5250	50	Unknown	Locus OT'07 1069	Pre-KA	Marro *et al*. 2009: 48

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Ovçular Tepesi	LTL5312A	5215	50	Charcoal	Locus OT'09 5161, work dial; house 5.5	Pre-KA	Marro *et al*. 2011: 62
	LTL5311A	5210	50	Seeds	Locus OT'08 5077, floor of house 5.6; *Pisum/Vicia*	Pre-KA	Marro *et al*. 2011: 62
	LTL13320A	5200	45	Charcoal	Locus 5212; house 5.5	Pre-KA	Marro *et al*. 2014: 142
	UB(A)-7609	5037	37	Charcoal	Kurgan 1, burial	Pre-KA	Lyonnet *et al*. 2008: 36; Museyibili 2008: 19
Sakdrisi	ETH-33225	4390	60	?	Mine 1-3	?	Stööllner *et al*. 2010: 128
	ETH-33226	4215	60	?	Mine 1-1	?	Stööllner *et al*. 2010: 128
	ETH-33223	44120	65	?	Mine 1-2	?	Stööllner *et al*. 2010: 128
	ETH-33224	44120	65	?	Mine 1-2	?	Stööllner *et al*. 2010: 128
	Hd-24207	4380	21	?	Mine 1/2	?	Stööllner *et al*. 2010: 128
Sachkhere	TB-416	4334	60	Charcoal	Floor upper building level	KA III	Burchuladze and Togonidze 1987: 253
	TB-417	4060	40	Charcoal	Pit	KA III	Burchuladze and Togonidze 1987: 253
Samgori	RUL-278	3080	85	Wood	Timber from hit covering interment of Kurgan	EK II	Butomo 1965: 226
Satkhe	AA-12853	4500	60	Unknown	B1, loc. 10	KA II	Badalyan *et al*. 1994: 29
	AA-12854	4445	60	Unknown	B1, loc. 2, pit. Sq. Room A	KA II	Badalyan *et al*. 1994: 29
	AA7768	?	?	Unknown	Unknown	KA II	Kavtaradze 1999
Shengavit	Bln-5526	4462	47	Unknown	Unknown	KA II	Badalyan *et al*. 2009: 51
	Bln-5527	4116	38	Unknown	Unknown	KA II	Badalyan *et al*. 2009: 51
	LE-458	4020	80	Unknown	Layer IV	KA III	Glumac and Anthony 1992: 167[1]
	LE-672	3770	60	Unknown	Level IV	KA III	Glumac and Anthony 1992: 167[1]
Sioni	Wk-31484	5281	52	Bone	XVI-32; structure 1	Pre-KA	Sagona 2014: 34
	Wk-31485	5227	48	Bone	XVI-34; structure 1	Pre-KA	Sagona 2014: 34
	Wk-31487	5172	48	Bone	XVIII-34; structure 1	Pre-KA	Sagona 2014: 34
	Wk-31483	5164	46	Bone	XVI-30; structure 1	Pre-KA	Sagona 2014: 34
Sos Höyük	OZF-125	4643	43	Charcoal	Level VA, M17, locus 3770	KA I	Sagona 2014: 37
	Beta-120452	4590	50	Charcoal	Level VA, L17d/M17c, locus 4223, basket 25, base of sondage	KA I	Sagona 2000: 351
	OZF-721	4524	34	Charcoal	Level VA, M17, locus 3779	KA I	Sagona 2014: 37
	Beta-74452	4510	70	Charcoal	Level VA, collected from exposed L17d scarp before commencement of project in 1994	KA I	Sagona 2000: 351
	OZF-942	4510	40	Charcoal	L16C, locus 4110	KA I	Sagona 2014: 37
	OZF-594	4457	34	Bone	L16C, locus 4110	KA I	Sagona 2014: 37
	Beta-135362	4440	50	Charcoal	Level VA, L17B, locus 4247	KA I	Sagona and Sagona 2000: 58
	OZF-126	4440	40	Bone	Level VA, M17, locus 3766	KA I	Sagona 2014: 37
	OZF-944	4430	40	Charcoal	Level VA, L17B, locus 4287	KA I	Sagona 2014: 37
	Beta-107912	4390	70	Charcoal	Level VA, L17d/M17c, locus 4201, basket 2, base of curved wall on exterior	KA I	Sagona 2000: 351
	Beta-135363	4290	70	Phytolith	Level VA, locus 4299 within area of curved wall	KA I	Sagona and Sagona 2000: 59

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Sos Höyük	Beta-107910	4910	170	Charcoal	Level VB, L17b, locus 1593, basket 307, 2nd plaster floor	KA II	Sagona 2000: 351
	Beta-107909	4510	90	Charcoal	Level VB, L17b, locus 1590, basket 301, between 1st and 2nd plaster floors	KA II	Sagona 2000: 351
	Beta-107908	4230	120	Charcoal	Level VB, L17b, locus 1586, basket 242, 1st plaster floor	KA II	Sagona 2000: 351
	Beta-107911	4110	70	Charcoal	Level VB, L17b, locus 1597, basket 322, 3rd plaster floor	KA II	Sagona 2000: 352
	Beta-107918	4240	40	Charcoal	Level VC, M15d, locus 1853, basket 153, beneath plaster floor	KA III	Sagona 2000: 352
	Beta-107919	4170	70	Charcoal	Level VC, M15d, locus 1854, basket 196, directly above plaster floor	KA III	Sagona 2000: 352
	Beta-120451	4160	60	Charcoal	Level VC, M16/N16, locus 3645, basket 11, house with high stone foundations	KA III	Sagona 2000: 353
	OZD-713	4140	70	Charcoal	Level VC, M16/N16, locus 3645, basket 11, house with high stone foundations	KA III	Sagona 2000: 353
	Beta-107917	4120	70	Charcoal	Level VC, M15d, locus 1847, basket 139, west of pit and south of basin	KA III	Sagona 2000: 352
	Beta-95220	4120	70	Charcoal	Level VC, M16, locus 3605, basket 201, below rectilinear house	KA III	Sagona 2000: 352
	Beta-95223	4070	50	Charcoal	Level VC, M16, locus 2610, basket 211, below rectilinear house	KA III	Sagona 2000: 352
	OZH-822	4430	50	Charcoal	Level VD, L16, locus 4161	EK (?)	Sagona 2014: 37
	Beta-84372	4140	60	Charcoal	Level VD, L17b, locus 1515, basket 78, around portable hearth	EK (?)	Sagona 2000: 353
	Beta-107920	3950	50	Bone	Level VD, M15d, locus 1855, basket 216, Burial 1	EK I	Sagona 2000: 353
	Beta-107915	3910	60	Bone	Level VD, Burial 3, M16	EK II	Sagona 2000: 353
Sotk 2	MAMS-14466	4737	32	Charcoal	Trench C	?	Kunze *et al*. 2013: 60
	MAMS-14468	6264	28	Charcoal	Trench C	?	Kunze *et al*. 2013: 60
	MAMS-14473	4134	24	Charcoal	Trench D	?	Kunze *et al*. 2013: 60
	MAMS-16893	4142	21	Bone	Trench F	?	Kunze *et al*. 2013: 60
Soyuq Bulaq	Beta-226237	5020	40	Charcoal	Kurgan 11, burial	Pre-KA	Museyibili 2008: 21
	Beta-221001	5000	40	Charcoal	Kurgan 8, burial	Pre-KA	Museyibili 2008: 21
	Ki-14591	4970	180	Unknown	Kurgan 1	Pre-KA	Korenevskij 2011: 33
	Ki-4970	4970	180	Unknown	Unknown	Pre-KA	Korenevskij 2011: 45
	UB(A)-7613	4918	35	Charcoal	Kurgan 4, burial	Pre-KA	Lyonnet *et al*. 2008: 36; Museyibili 2008: 19
	Beta-232338	4770	40	Bone	Kurgan 14, human bone from burial	Pre-KA	Museyibili 2008: 21
	Beta-221000	4700	40	Bone	Kurgan 9, human bone from burial	Pre-KA	Museyibili 2008: 21
T'alin	R-2628	4448	52	Bone	Tomb 11	KA II	Badalyan 2003: 22
	R-2627	4230	58	Bone	Tomb 10	KA II	Palumbi 2003: 98

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Tsikhiagora	TB-831	4850	110	Unknown	Level B2 of the final period of the KA culture of Shida Kartli	KA III	Kavtaradze 1999
Tsnori	TB-208	4120	50	Unknown	Kurgan 1	EK II	Dedabrishvili 1979: 25
	UCLA-?	4120	90	Unknown	Kurgan 1	EK II	Kavtaradze 1983: 31, 107
	TB-243	3985	50	Unknown	Kurgan 1	EK II	Kavtaradze 1983: 29
	LJ-3271	3800	60	Unknown	Kurgan 1	EK II	Kavtaradze 1983: 31
Tvlepias Tsqharo	RTK-6582	4950	60	Bone	Grave 3, tooth	KA II	D-REAMS, Georgian-Italian Shida Kartli archaeological project
Uch-tepe	LE-300	4830	230	Unknown	Unknown	Pre-KA	Kavtaradze 1999
	LE-330	4830	230	Wood	Kurgan 3	Pre-KA	Glumac and Anthony 1992: 167
	LE-305	4500	120	Wood	Kurgan 3, covering of basic internment	Pre-KA	Butomo 1965: 226
Uzum Rama	PLD-23944	?	?	Charcoal	?	?	Poulmarc'h *et al*. 2014: 242
Zeynani	TB-329	4600	75	Unknown	Kurgan 1	EK I	Kavtaradze 1983: 31
	TB-328	3825	80	Unknown	Kurgan 1	EK I	Kavtaradze 1983: 31
Zhinvali	TB-289	3630	70	Unknown	Lower level of the area in front of the altar	EK II	Kavtaradze 1983: 30

[1] These dates derive from an earlier publication (Dolukhanov and Trifonov 1972) that could not, unfortunately, be retrieved in original.

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