Radiocarbon chronology of the Neolithic-Eneolithic period in the Karelian Republic (Russia)

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ABSTRACT – *This article discusses a radiocarbon-based chronology for the Neolithic–Eneolithic period in the present-day Republic of Karelia (Russian Federation). The main goal is to present all currently available radiocarbon datings, including the previously published dates, as well as the ones recently obtained by the authors. In total, there are 194 dates from 77 sites covering the period from the 6th to the 2nd millennium cal BC. Besides providing an up-to-date list of datings, the article also evaluates their reliability and utility in building a local chronology. Despite several shortcomings, the new AMS-supported chronology enables the study of past cultural dynamics in much greater detail than previously and allows its better integration into the wider north-east European chronological framework.*

KEY WORDS – *Neolithic; Eneolithic; radiocarbon chronology; pottery; Karelian Republic*

Radiokarbonska kronologija neolitika – eneolitika v Republiki Kareliji (Rusija)

IZVLEČEK – *V članku razpravljamo o radiokarbonski kronologiji obdobij neolitika-eneolitika v današnji Republiki Kareliji (Ruska federacija). Predstaviti želimo vse razpoložljive datume, tako tiste že objavljene kot tudi najnovejše datume, ki smo jih pridobili avtorji. Skupno je sedaj na voljo 194 datumov iz 77 najdišč, ki pokrivajo čas od 6. do 2. tisočletja pr. n. št. Poleg novega seznama vseh radiokarbonskih datumov ocenjujemo v članku tudi zanesljivost in koristnost le-teh za oblikovanje lokalne kronologije. Kljub številnim pomanjkljivostim omogoča nova kronologija, ki temelji na AMS radiokarbonskih datumih, veliko bolj natančne študije preteklih kulturnih dinamik, kot je bilo to možno v preteklosti, ter omogoča boljšo integracijo v kronološke okvirje na širšem območju severovzhodne Evrope.*

KLJUČNE BESEDE – *neolitik; eneolitik; radiokarbonska kronologija; lončenina; Republika Karelija*

Introduction

Aims

This paper presents all radiocarbon dates obtained from the Neolithic and Eneolithic sites (see below) in the present-day Karelian Republic, Russian Federation, and outlines the chronological position of the main groups of archaeological material (*i.e.* pottery types) known in this territory between the 6th and 2nd millennia cal BC. The current paper is a combination of two articles recently published in Russian: the first one providing a discussion of datings available prior to 2016 (*Tarasov, Khoroshun 2016*) and the second one presenting an AMS-based chronology

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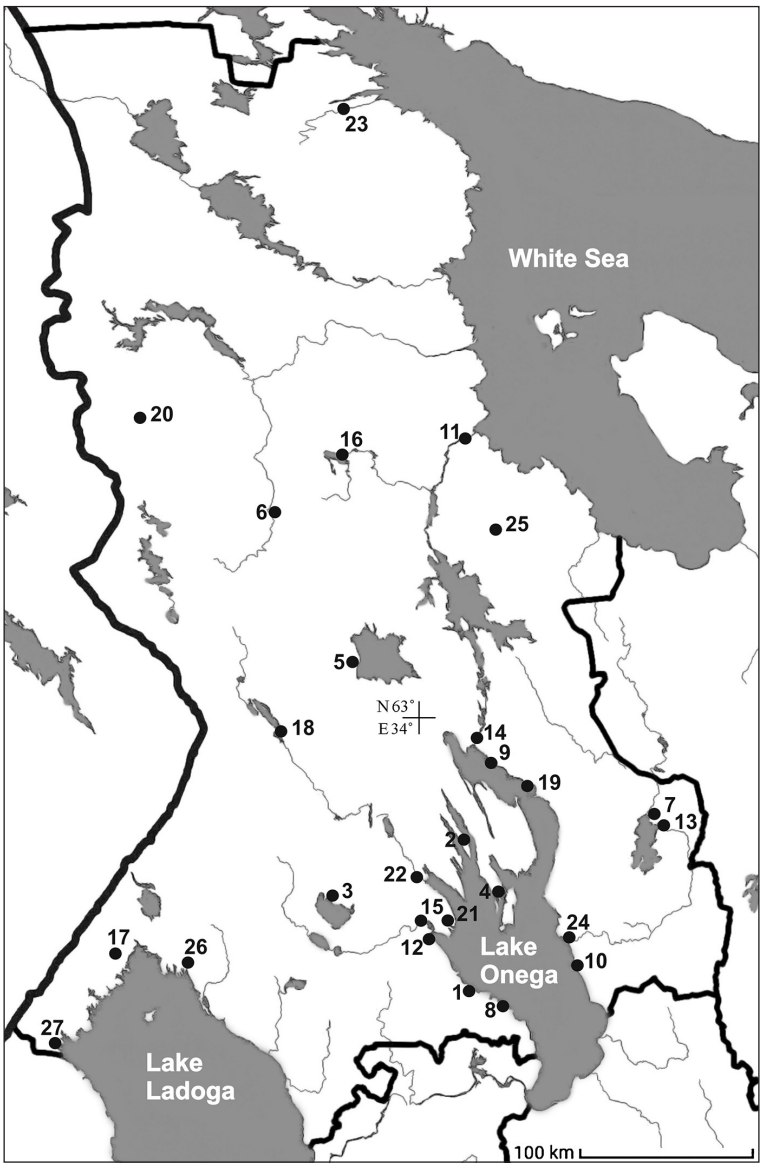
for the Karelian Neolithic through introduction of 41 new dates (*Nordqvist, Mökkönen 2017a*; see also *Nordqvist, Mökkönen 2016a; 2016b*).

Most of the previous discussions of radiocarbon dates from Karelia have been in Russian (*Kochkurkina 1991; German 2002; 2012; Kosmenko 2003; Lobanova 2004; Vitenkova 2009; Piezonka 2011; Mel'nikov, German 2013; Khoroshun 2015*; but see *Kosmenko 2004; Piezonka 2008; 2015; Zhulnikov* et al. *2012*). An overview of the chronology and periodisation of Karelia published in 1991 comprised a total of 112 conventional radiocarbon determinations from the Mesolithic Stone Age to the Early Middle Ages (*Kochkurkina 1991*), and a special publication devoted to the Neolithic chronology of eastern Europe discussed Karelia some 10 years later and contained 72 dates listed as Neolithic (*Timofeev* et al. *2004*; see also *Kosmenko 2004*). These publications are now out of date, since quite a few AMS dates have been produced in recent years (*e.g., Lobanova 2004; Piezonka 2008; Nordqvist, Mökkönen 2017a*). At the moment, 170 radiocarbon datings with a more or less clear connection to the Neolithic and Eneolithic periods have been obtained from Karelia; in addition, 24 datings have been presented in this context, even if their connection to the periods in question remains equivocal (see below).

Recently-obtained AMS dates have considerably refined the Neolithic chronology in Karelia. This paper is an attempt to compile all the available data and discuss the present state of affairs. The purpose is not to present the final word on the topic, as the number and quality of dates in many cases is still low and there are many ambiguities and problems, as will be shown below. Even if the main focus is on presenting the Karelian material, the chronology is also compared with corresponding chronologies in neighbouring regions, particularly Finland.

The dates that form the basis of this paper are listed in the tables. Table 1 presents the dates which ge-



Map 1. Location of sites with radiocarbon dates in the territory of Karelian Republic (Russian Federation: 1 Uya III; 2 Pegrema I–III, IX, Palayguba II, X; 3 Sulgu II, Lakshozero II, Kudoma X; 4 Vozhmarikha 1, 4, 19, 21, 26, Bukol'nikov 1, Vorob'i 4; 5 Panozero I; 6 Kalmozero II; 7 Shettima I; 8 Sheltozero V, X–XII; 9 Orovnavolok V, VII, XI, XVI, Chernaya Guba III–IV, IX, Myan'gora I; 10 Chernaya Rechka I, II, IIa, XII, Kladovets IV, Va, IX, Kladovets (cemetery); 11 Yerpin Pudas I, Zalavruga I, IV, Zolotets VI, X, XI, XX, Besovy Sledki, Besovy Sledki II; 12 Vigaynavolok I–II; 13 Sukhaya Vodla I; 14 Voynavolok XXIV, XXVII, XXIX, Kochnavolok II, Povenchanka XV; 15 Fofanovo XIII; 16 Berezovo XVIII, Tunguda III, XIV, XV, XVII; 17 Meyeri II; 18 Kudomguba VII; 19 Chelmuzhskaya Kosa XXI; 20 Kostomuksha II; 21 Pinguba II; 22 Suna XII; 23 Keret' XXII; 24 Pervomayskaya I; 25 Sumozero XV; 26 Koyrinoya 2, 3; 27 Kurkieki 52 (Kuuppala Kalmistomäki), Kurkieki 33 (Kylliäisenlahti W-2) (map created by A. Tarasov).

nerally correspond with archaeological materials present at the sites. In cases where a sample's connection with particular archaeological materials is unequivocal (*e.g.*, crusts on pottery shards), only this pottery type is mentioned (column 'Typological connection') even if the site contained material from other phases, too. However, if such a clear connection cannot be established, all assemblages present at the site are listed. Table 2 presents dates that do not correspond with any archaeological materials found at these sites. It includes Neolithic/Enolithic dates from sites with no finds from this period or datings from sites with Neolithic/Eneolithic material, but with significantly deviatory (younger) ages. The dates given in Table 2 are not included in the discussion below. The geographical locations of the sites are marked on Map 1. All dates have been calibrated with OxCal v. 4.2 (*Bronk Ramsey 2009*) and the calibration curve IntCal13 (*Reimer* et al. *2013*); in the text, they are given either as median values or with 2σ standard deviation.

Periodisation

The Neolithic finds of Karelia have been traditionally divided into temporal units – archaeological cultures – primarily on the basis of pottery (see *Kochkurkina 1991; Kochkurkina, Kosmenko 1996*). These types coincide with ceramic types recognised in neighbouring territories, especially Finland, although the periodisation schemes used in these areas are quite different, mainly due to differing research traditions (also *Nordqvist 2013; Nordqvist, Mökkönen 2017c*). According to the periodisation applied to Karelia, the Early Neolithic is represented by Sperrings and Säräisniemi 1 Wares, the mid-part of the period by Pit-Comb Ware, and the Late Neolithic by Comb-Pit Ware. The subsequent phases with Rhomb-Pit Ware and ceramics with asbestos and organic tempers are traditionally considered to belong already to another period, the Eneolithic, which has been separated because of small-scale exploitation of native copper originating on the western shores of Lake Onega.

The separation of the Eneolithic introduces some inconsistencies into the periodisation. As will be shown later, sites with Comb-Pit and Rhomb-Pit Wares were, in fact, largely coeval and share fairly similar material cultures and cultural images. Nevertheless, only sites with Rhomb-Pit Ware are traditionally regarded as Eneolithic, whereas sites with Comb-Pit Ware are still Neolithic, as no copper items have been found at 'pure' Comb-Pit Ware sites in Karelia. However, individual copper objects (predominantly amorphous pieces) have been discovered in Comb-Pit Ware (*i.e.* Typical Comb Ware) contexts in Finland and northern Sweden (see *Nordqvist, Herva 2013*). To solve the problem, A. M. Zhul'nikov (*1999*) has suggested that only sites with asbestos- and organic-tempered pottery should be regarded as Eneolithic, as during this time the thermal treatment of copper (including melting and casting) became known; at sites with Rhomb-Pit Ware (and Typical Comb Ware) only evidence of cold hammering and annealing exists (*Zhul'nikov 1999.66*; see *Ikäheimo, Pääkkönen 2009; Ikäheimo, Nordqvist 2017* for Finland). Still, the total amount of copper items remained small and the metal did not change the general cultural image in any significant way. Therefore, the initial adoption of copper should be seen just as another example of a growing interest in the mineral world in general during the Neolithic, not a sign of a separate period (*Nordqvist, Herva 2013.424; Herva* et al. *2014; 2017*).

Because of the controversies associated with the Eneolithic period in Karelia, the dates connected with Rhomb-Pit Ware and asbestos- and organic-tempered pottery are included in this paper as well. In other words, the period covered, from the (later) 6th to the (earlier) 2nd millennia cal BC, is equivalent to the Neolithic and the Eneolithic (or the Neolithic and the earlier part of Early Metal Period) according to traditional Karelian periodisation (Fig. 1).

Overview of Karelian radiocarbon data

Context datings

Most Karelian radiocarbon dates (114) are context dates, mostly processed on charcoal and originating in cultural layers and different features (pits, fireplaces, dwelling constructions) of settlement sites. The reliability of these dates is seriously questioned by the fact that the majority of settlement sites in Karelia are multi-component, non-stratified locations, which contain material from several habitation episodes whose typological dating may span several millennia. This situation is explained by the geological and hydrological settings and the Stone Age and Early Metal Period economy: the groups of fisher-hunter-gatherers preferred to settle near water, which in the Karelian situation meant living mainly on lake shore terraces. As the shorelines of the majority of Karelian lakes remained fairly stable during the Holocene, areas suitable for settling remained almost the same up to the present time. This is characteristic even of such a large lake as Lake Onega, where numerous regressions and transgres-

sions took place, but affected parts of its coasts in different ways (*e.g., Devyatova 1986; Saarnisto, Vuorela 2007*).

Due to mixed multi-component assemblages, as well as the rough excavation and documentation methods employed, especially earlier, in most cases it is not possible to establish an unequivocal connection between a charcoal sample and particular archaeological materials identified at a site. This is evident in the case of charcoals collected from the cultural layer, but even in the case of samples originating in fireplace-like or other features it is not possible to fully exclude the possibility of forest fires or other post-depositional contamination.

The old-wood effect might also affect dates processed on charcoal from clear structures, such as dwelling remains. Because tree species and the origins (branch, trunk) of dated charcoals have not been determined, further estimating its presence and magnitude is not possible. As the log-based houses were made with stone tools, the timbers used to build them are unlikely to have been dry deadwood or thick live trunks with significant age. However, repairing and reuse may have introduced material of different ages into the houses and, again, later (natural) mixing cannot be ruled out. Thus, even if the dates from burnt constructions (walls) of dwellings are likely linked to human activities and even if they may be considered as the most reliable charcoal context dates, especially at single-component sites, they may yield widely varying ages. This is well illustrated by dwelling 1 at the Sumozero XV site (*Zhul'nikov 2005.85–88*): seven samples of charcoal and birch bark were taken from a burnt house construction (Tab. 1), but the determinations spread over half a millennium, at the minimum. All in all, the number of dates from dwellings is not very big: 35 dates in total (21 from burnt walls), most deriving from Late Neolithic/Eneolithic contexts.

Datings of charred residues and burnt bones

The introduction of the AMS technique has revolutionised dating and local chronologies in many fields. However, in Karelia the number of AMS dates has risen only in recent years (see *Nordqvist, Mökkönen 2017a*). At the moment, there are 60 AMS determinations related to pottery (44 charred residue/food crust, 14 birchbark tar, one paint-like substance, one unknown) and seven dates of bone (six of them burnt). In addition, 13 dates of charred crusts established by conventional method exist.

The dated samples are clearly of anthropogenic origin, and their archaeological context is usually unquestionable, although in the case of bones, the connection with specific archaeological phenomena may remain uncertain at multi-component sites. Also, sampling and laboratory-related issues, contamination by (younger) organics (which may affect all other types of samples as well), and the influence of the (freshwater) reservoir effect may reduce the accuracy of the dates.

The reservoir effect has been intensively studied recently on the basis of archaeological and experimental materials (*e.g., Fischer, Heinemeier 2003; Olsen* et al. *2010; Philippsen, Heinemeier 2013; Kulkova* et al. *2015; Philippsen 2015*). In Karelia, the existence of the freshwater reservoir effect was hypothesised in connection with Late Neolithic/Eneolithic asbestos- and organic-tempered wares, and it was proposed that the crust dates are mainly affected by the freshwater reservoir effect, as they tend to date somewhat older than charcoal dates (*Zhulnikov* et al. *2012*). However, this tendency remains speculative, as the study contained almost no comparable AMS or conventional datings from the same sites, not to mention the same contexts (see also *Nordqvist, Mökkönen 2017a*).

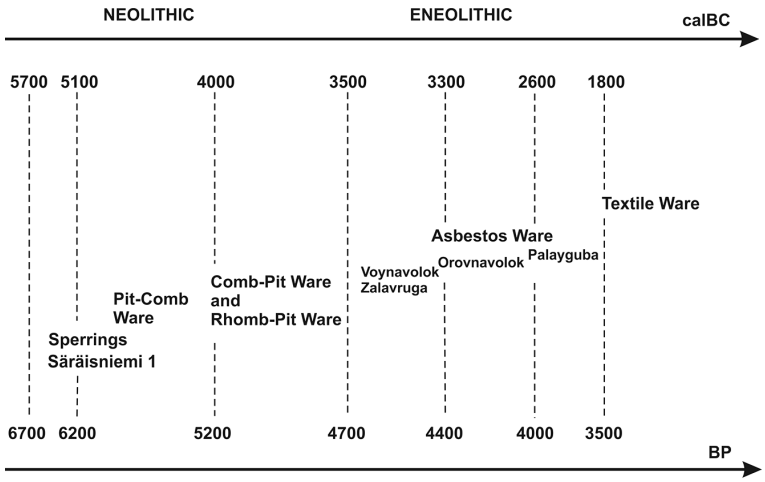


Fig. 1. Simplified chronology of the leading Neolithic and Eneolithic ceramic types in Karelia (designed by A. Tarasov).

The differences between AMS dates and conventional dates connected with the same cultural phases vary from zero up to 500–600 ^{14}C-years or even more. It is not possible to say that AMS dates would always be

older than context dates – it may also be the other way round – and the results also highlight the inconsistency of context dates at several locations. At many sites, AMS dates are spread over 50–200 ^{14}C-years: currently, it is not possible to decide whether this is due to prolonged or recurrent use of the locations, or to limitations in measurement accuracy, the properties of calibration curves, or reservoir effects.

One way to control for the presence of the (freshwater) reservoir effect has been the study of bulk stable isotopes. Even if this provides a rather crude tool compared to the more sophisticated analyses of compound-specific values, they are nevertheless thought to allow some level of estimate of the components included in the dated samples. Unfortunately, isotopic data are scarce, and only δ^{13}C values have been published for the recently-obtained AMS dates: they range between –24‰ and –30‰, the average being –27.5‰ (see *Nordqvist, Mökkönen 2017a*). In previous studies the boundary between residues of marine and terrestrial/freshwater origin is often set at –26‰ (*Fischer, Heinemeier 2003. 460*). As most Karelian dates have values below this, they could be expected to include terrestrial and/or freshwater components, also hinted at by the sites' location beside lakes and rivers. Still, the values are on average fairly moderate. The only dates with a marine component have been obtained from sites located in the White Sea area, but none of these give obviously divergent results.

The magnitude of the (freshwater) reservoir effect in north-eastern Europe, low on natural limestone, has been considered fairly small (*Pesonen* et al. *2012. 665*), but the topic has not been specifically studied. It was proposed recently that low alkalinity of water does not automatically mean that the freshwater reservoir offset would not be present, as other factors such as the depth of basins, prolonged ice coverage and glacial meltwaters may have contributed to the phenomenon (*Philippsen 2015.160*). In northern central Europe, southern Scandinavia and south-eastern Baltic, the estimates and measured results of the (freshwater) reservoir offset range from some centuries to thousands of years (*e.g., Fischer, Heinemeier 2003.461; Olsen* et al. *2010.640; Hartz* et al. *2012. 1041; Philippsen, Heinemeier 2013.1098; Piličiauskas, Heron 2015.539*). Nevertheless, these results cannot be directly applied to Karelian material, as the magnitude is strongly dependent on the geographical location and geological and natural environment, as well as on the period in question (*e.g., Keaveney, Reimer 2012.1314; Philippsen 2015.160–162*). A possible range of error in Karelia is illustrated by an Early Neolithic (Säräisniemi 1) vessel from the Kalmozero II site (Tab. 1): two dates from samples taken from the outer and inner surfaces of the same shard produced an offset of two to three centuries (*Piezonka 2008.69, Abb. 2*; also *Hartz* et al. *2012.1043*)

Evaluation

The material available is biased: datings concentrate in certain areas and pottery types. Another major problem is the large share of conventional charcoal dates with poor link with actual archaeological materials. The standard errors of these conventional ^{14}C-ages are generally large and vary from 20 to 150 (even 600) years, with the average between 80–90 years. This causes wide distributions in calibrated ages, at times providing accuracy of a millennium only. Laboratory-related issues are more difficult to assess, but as almost all conventional datings (over 98% of the dates listed in *Kochkurkina 1991* and *Kosmenko 2003*) originate from the same laboratory, *i.e.* Radiocarbon Laboratory of the Institute of Geology at the University of Tartu (see *Liiva* et al. *1975*), they should be consistent. Nevertheless, the general quality of these datings can be expected to be fairly low by default, although no systematic evaluation of their reliability has been done (see *e.g., Kuzmin, Tankerslay 1996; Pettitt* et al. *2003; Seitsonen* et al. *2012*). Similar uncertainties apply to crust dates obtained through the conventional method – re-dating of some shards with AMS showed that the unduly small samples used in the original dates made them unreliable and resulted in too young ages (*Nordqvist, German 2017*).

AMS-dated samples from clear archaeological contexts and with generally smaller standard errors (30–70 years BP, average 40 years BP) are also not free of problems. The potential reservoir effect is an important topic and no modern or ancient materials are currently available that could be used to reliably verify the offset in different reservoirs in the territory of Karelia. As AMS dates cluster quite nicely in many cases, it may be proposed that they still point towards the most likely use periods of different pottery types, whereas conventional dates have the tendency to disperse over a much wider period. Nevertheless, the current low number of AMS dates alone cannot be expected to provide precise dating for every cultural type and period.

With all this in mind, it can be stated that the chronology presented below operates within a margin

of error of 100–200 years, and in some cases the offset may be even greater. Even if the initial and terminal dates of some pottery types must be considered tentative, the general tendencies are correct and the proposed timeframes are also generally accord with chronologies obtained in neighbouring areas.

Radiocarbon chronology of the Karelian Republic

Sperrings and Säräisniemi 1 Wares

The oldest pottery in the Karelian Republic is Sperrings Ware, known also in Finland (where it is called older Early Comb Ware, style I:1, also Sperrings 1) (*e.g., German 2011; Pesonen, Leskinen 2011*). The earliest dates – charcoal from Uya III (6770±80 BP, TA-2352) and a burnt bone from Sulgu II (6670± 35 BP, KIA-35900) – may be related to Mesolithic occupation at the sites and therefore reasonably questioned (*Kosmenko 2003.32; German 2011.273–274; Piezonka 2015.54*). The charcoal date from Pegrema IX (6510±150 BP, TA-1161) is usually referred to as the oldest certain date for Sperrings (*Vitenkova 1996.78; German 2002.265, Tab. 1; Kosmenko 2003.32; Vereshchagina 2003.149*), but it suffers from a large standard error. The earliest AMS dating also derives from Uya III (6225±40 BP, GrA-63566) (Fig. 2), and is compatible with datings from Finland and Karelian Isthmus, which place the beginning of Sperrings Ware there to around 5300–5200 cal BC (*Pesonen* et al. *2012.664, Tab. 2; Piezonka 2015. 198–199, Abb. 170; Nordqvist, Mökkönen 2016a. 204*).

All the remaining conventional dates for Sperrings Ware originate in mixed contexts containing also partly temporally overlapping Pit-Comb Ware (see below) and date between 5500–4400 cal BC (medians 5400–4600 cal BC). The majority of crust/tar dates group around 5200–4500 cal BC (medians 5200–4600 cal BC). The youngest date (5507±50 BP, KIA-35901) derives from a vessel slightly differing from the remaining Sperrings material at Vozhmarikha 26 (see *Mel'nikov, German 2013.109*). It is somewhat younger than the dates obtained in the surrounding areas, placing the end of Sperrings Ware at around 4400 cal BC (*Pesonen* et al. *2012. 664, Tab. 2; Seitsonen* et al. *2012.110; Piezonka 2015.199, Abb. 170*).

Almost coeval with Sperrings is Säräisniemi 1 Ware, which is characteristic of the northern Karelian Republic, Finland and Norway (*e.g., Torvinen 2000; German 2011; Skandfer 2011*). At the moment only three AMS dates exist for this type in Karelia – two dates of one shard from Kalmozero II (6340±70 BP; KIA-35899A and 6080±45 BP; KIA-35899B; the former date may include the reservoir effect, see above) and one date from Besovy Sledki (5775±40 BP; GrA-63547) (Fig. 3). All context dates previously connected with Säräisniemi 1 Ware derive from Yerpin Pudas I. They date between *c.* 5600–4000 cal BC (medians 5500–4100 cal BC) and may also be connected with other components present at the site, especially Pit-Comb Ware.

Dates from Karelia do not differ significantly from the range given for Säräisniemi 1 Ware in other re-

Fig. 2. Sperrings Ware (designed by T. Mökkönen).

gions, *i.e.* 5300–4500 cal BC (*Pesonen* et al. *2012.664, Tab. 2; Piezonka 2015.208–209, Abb. 174; Nordqvist, Mökkönen 2016a.204*).[1] In the light of current dates, it seems plausible that there is no significant temporal difference between Sperrings (Early Comb) and Säräisniemi 1 Wares in the north; in fact, in some areas, Säräisniemi 1 Ware precedes Sperrings Ware (also *Pesonen* et al. *2012.670*). This further corroborates the recently-presented idea that Säräisniemi 1 Ware is not just a late northern variant of Sperrings Ware (see *Pesonen 1991.84; Vitenkova 1996.81; Torvinen 2000.16; German 2006.234–236; Pesonen, Leskinen 2011.300*), but that these pottery types have different origins and development histories (*Piezonka 2015.208–209*). Furthermore, a few Finnish dates indicate that in some areas the use of Säräisniemi 1 Ware may have continued as late as the early 4th millennium cal BC (*Torvinen 1999.238; Carpelan 2004.29; Piezonka 2015.244; Nordqvist, Mökkönen 2016a.204*).

Besides Sperrings and Säräisniemi 1 Wares, a few other pottery types dating to the 5th millennium cal BC have been reported from Karelia: younger Early Comb Ware style I:2 (also Sperrings 2; see *German 1998*, who calls this pottery 'Early Comb Ware') and Kaunissaari Ware (also discussed under the umbrella term of Early Asbestos Ware; see *Pesonen 1996.24*). Both types have their predominant distribution areas in Finland, where they are considered to be mostly younger than Sperrings Ware and dated between 4500 and 3800 cal BC (*Pesonen* et al. *2012.664, Tab. 2; Oinonen* et al. *2014.4, Tab. 1; Nordqvist, Mökkönen 2016a.204–205*). No dates exist for these types in Karelia and, in general, they occur there very rarely.

Pit-Comb Ware

The emergence of Pit-Comb Ware in Karelia is traditionally connected with the Lyalovo culture, widespread in central and north-western Russia in the 5th millennium cal BC, and probably especially with its later stage (*Smirnov 1991; 1996; Gurina, Kraynov 1996; Vitenkova 2016.128; Smol'yaninov 2013.238*). At the moment, the chronology of Pit-Comb Ware is based mainly on context dates, as only four AMS dates exist from Besovy Sledki and Besovy Sledki II in the White Sea region (Fig. 3). Three of these date to the second half of the 5th millennium cal BC, which has often been considered the main use period of this pottery type (*Kosmenko 2003.32; Lobanova 2004.254, 259*), but the fourth one is younger (see below).

According to Nadežda V. Lobanova (*2004.256; 2009.58–59*), who sees the first stage of Pit-Comb Ware as synchronous with Sperrings Ware, the oldest date that can be associated with Pit-Comb Ware comes from Chernaya Rechka I (6200±100 BP, TA-1634). In addition, there are also some other early context dates, but the connection between all these dates and Pit-Comb Ware contexts has been challenged (*German 2002.264; Filatova 2012*; see also *Sidorov 1997.103–105*). Accepting the early dates would also

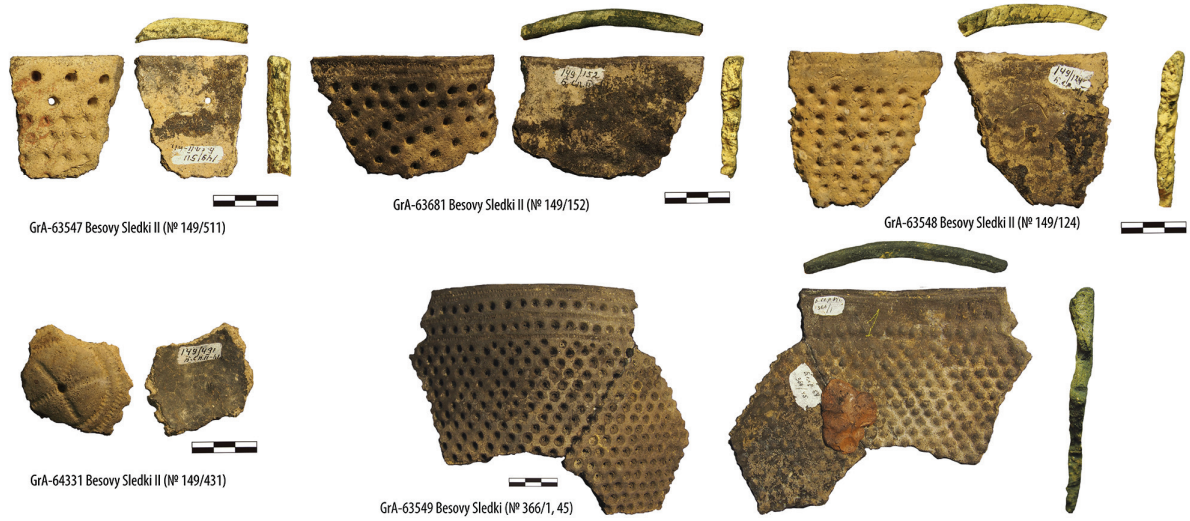


Fig. 3. Säräisniemi 1 Ware (upper left) and Pit-Comb Ware (designed by T. Mökkönen).

1 Also, older AMS dates have been presented for Säräisniemi 1 Ware from northern Norway (*e.g.*, 6570±60 BP, TUa-3018 and 6330±50 BP, TUa-3021; *Skandfer 2011.356, Tab. 12.1*), but these are affected by the marine reservoir effect (see *Pesonen* et al. *2012.667–668; Piezonka 2015.208*).

mean that Pit-Comb Ware in Karelia would be contemporaneous with the appearance of Lyalovo culture in the Upper-Volga region, currently dated to the very late 6th millennium or to the turn of the 5th millennium cal BC (*Zaretskaya, Kostyleva 2011. 180–182; Hartz* et al. *2012.1045*).

Context dates connected with Pit-Comb Ware cover almost the whole of the 5th millennium cal BC, but due to the above-mentioned uncertainties, the initial date must be placed only roughly in the first half of the 5th millennium cal BC. Typologically, the final stage of Pit-Comb Ware has been seen to overlap with Comb-Pit and Rhomb-Pit Wares (*Lobanova 2004.261; Khoroshun 2013.126–127*), and a series of dates obtained from Vorob'i 4 showed that at least in some areas the use of Pit-Comb Ware continued during the first two or three centuries of the 4th millennium cal BC.

In addition, there are dates which seem 'too young'. These include a crust date from Besovy Sledki II (4785±45 BP, GrA-64331). Typologically, this shard fits the characteristics of Pit-Comb Ware, but such a long continuation of use of this type seems very improbable (see also *Nordqvist, Mökkönen 2017a* for discussion). A coeval context date of charcoal exists from Chernaya Rechka I (4700±80 BP, TA-1633), but as there are two even much younger dates from the same site (with no corresponding archaeological material) it cannot be given much value. Finally, several crust dates produced by conventional methods from Vorob'i 4 are too young due to insufficient sample sizes (see *Nordqvist, German 2017* for discussion).

Comb-Pit and Rhomb-Pit Wares

Comb-Pit Ware, corresponding to Typical Comb Ware of the eastern Baltic and Finland (*Yanits 1959; Nordqvist, Mökkönen 2015*), and Rhomb-Pit Ware, which finds analogies elsewhere in north-western and central Russia (*Smirnov 1991; Smol'yaninov 2009; Vitenkova 2016*), followed Pit-Comb Ware in Karelia. Traditionally, they were seen as subsequent types also among themselves, but the introduction of more accurate dating has shown them to be more or less contemporary (*Zhul'nikov 2005.25; Khoroshun 2013.117; Vitenkova 2016.118*). Currently, their chronology is based on many AMS and context dates, although the latter often originate from sites with mixed complexes of Comb-Pit and Rhomb-Pit Wares and cannot be attributed to only one of them. Based on some dates and stratigraphical observations (site Chernaya Guba III) it has been proposed that the appearance of Comb-Pit Ware would be slightly older, but the available data are too vague to draw such conclusions. In fact, it is not even known if the two assemblages at the same sites indicate the repeated use of these locations by two different groups or if both types were used by the same population (*Vitenkova 2016.121*).

Based on AMS dating, Comb-Pit Ware in Karelia dates to 4000–3600 cal BC (medians 4000–3700 cal BC) and Rhomb-Pit Ware 3900–3400 cal BC (medians 3800–3500 cal BC) (Figs. 4, 5). Most of the context dates fall between 4000–3100 cal BC (medians 3900–3300 cal BC), within which the main use period of these types belongs. Such dating also fits the results from Finland, where an extensive dating programme has defined the use period of Typical Comb Ware from 3900 up to 3400 cal BC (*Pesonen 2004. 90; Oinonen* et al. *2014*; authors' unpublished data). Chronology of Rhomb-Pit-related pottery is poorly known outside Karelia, and the only available direct dating (made of ceramic matrix) suggests that it existed between 3600–3100 cal BC (*Skorobogatov* et al. *2016.247*).

However, there are context dates which date slightly older (Pegrema I, 5145±110 BP, TA-541 and Pegrema II, 5070±120 BP, TA-811) or even considerably younger (*e.g.*, Pegrema I, 4200±50 BP, TA-493; Pegrema III, 4240±90 BP, TA-813).[2] Even if they are at least partly related to other activities at these sites (*e.g., Kosmenko 2003.25; Nordqvist, Mökkönen 2016b.232*), it seems probable that, just as in some parts of Finland (*Mökkönen 2008.123–124*; also *Seitsonen* et al. *2012.111*), Comb Ware tradition continued in Karelia in some form and in some areas until the early 3rd millennium cal BC. Still, for example, the date from Lakshezero II (3920±60 BP, TA-1520), presented also as the final date for Comb-Pit Ware, probably belongs to the later asbestos pottery-related use of this site (*Vitenkova 2002.142*).

In addition to uncertain context dates, one AMS dating from Chernaya Guba III (6060±40 BP, GrA-

2 The young dates from Pegrema I and Pegrema III are problematic because they have been presented quite differently in different publications. The date of 4240±90 BP has also been given as 4200±90 BP, with index ID TA-813 or with no index ID; the date 4250±50 BP (TA-493) has also been published as 4200±50 BP. Moreover, the date TA-813 has been said to originate from both of these sites (see *Zhuravlev 1977; 1979; 1984; 1991; Zhuravlev, Liiva 1980; Kochkurkina 1991; Vitenkova 2002; Timofeev* et al. *2004*).

63539) is problematic, as it is almost a millennium older than expected. The reservoir effect cannot be ruled out (the $\delta^{13}C$ value is –27.84‰), and there is always the possibility of typological misinterpretation, even if in this case the dated shard fully fits the characteristics of Comb-Pit Ware. If the date is even tentatively connected with the Pit-Comb Ware, recovered in small amounts at this site (*Vitenkova 2002.29*), it would also be by far the oldest direct date of Pit-Comb Ware in Karelia. Furthermore, two conventional dates of pottery crust from Vozhmarikha 21 may date to the end phase of Comb-Pit Ware use, but may also suffer from the same problems discussed in connection with the Pit-Comb Ware dates from Vorob'i 4.

Finally, a date measured on birch bark found in a grave at Bukol'nikov 1 (4740±60 BP, LE-9391) has been connected with Comb-Pit Ware (*Mel'nikov, German 2013.120*), even if no Comb-Pit Ware was found at the site. The grave goods, *e.g.,* amber jewellery and a bifacial flint point, may be seen to support this connection. However, the assemblage from the site includes mostly Pit-Comb Ware and some asbestos-tempered pottery of possibly Voynavolok type – within the temporal limits provided by the date, the burial could also be connected with the latter phase.

Zalavruga, Voynavolok, Orovnavolok and Palayguba Wares

Previously, all asbestos- and organic-tempered pottery in Karelia was discussed under the one heading of Asbestos or Classic Ware (*Gurina 1961.161; Kosmenko 1992.131*). Such a view does not permit the tracing of cultural dynamics during the 4th–2nd millennia cal BC, and since then four types of pottery have been separated from the material: Zalavruga, Voynavolok, Orovnavolok and Palayguba Wares (*Zhul'nikov 1991; 1999; 2005*). These types have varying distributions mainly in Karelia and find some parallels in the Finnish types of Kierikki and Pöljä. They have also contemporary analogues in the east, and generally the emergence of asbestos- and organic-tempered pottery in Karelia has been connected with the development of the Volosovo cultural entity in the Volga-Oka region (*Zhul'nikov 1999.6–7* and references cited). The starting point of Volosovo in the Upper Volga region is dated to around 3600 cal BC (*Kostyleva, Utkin 2010.248–250*).

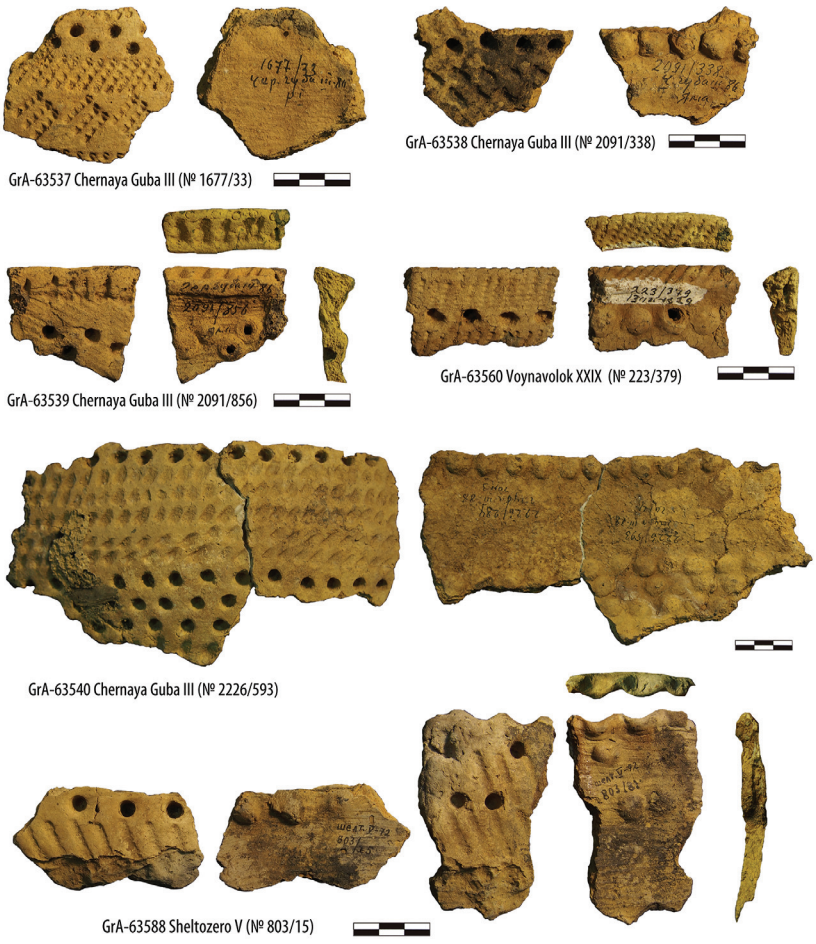


Fig. 4. Comb-Pit Ware (designed by T. Mökkönen).

Asbestos- and organic-tempered wares are relatively well dated by AMS and context dates (including numerous dates from burnt dwelling constructions), although the dates are unevenly distributed among the pottery types. There are also notably many 'non- fitting' dates connected to sites with these pottery types or their use periods (see Table 2).

The oldest date connected with asbestos- and organic-tempered pottery in Karelia is a tar date related to Voynavolok Ware (Pervomayskaya I, 4710±35 BP, GrA-63682) (Fig. 6). Generally, AMS dates for this type fall between 3600–2900 cal BC (medians 3500–3000 cal BC) and cluster into two groups between 3600–3400 cal BC and 3400–2900 cal BC. The first cluster corresponds neatly with older ideas of a short use period of

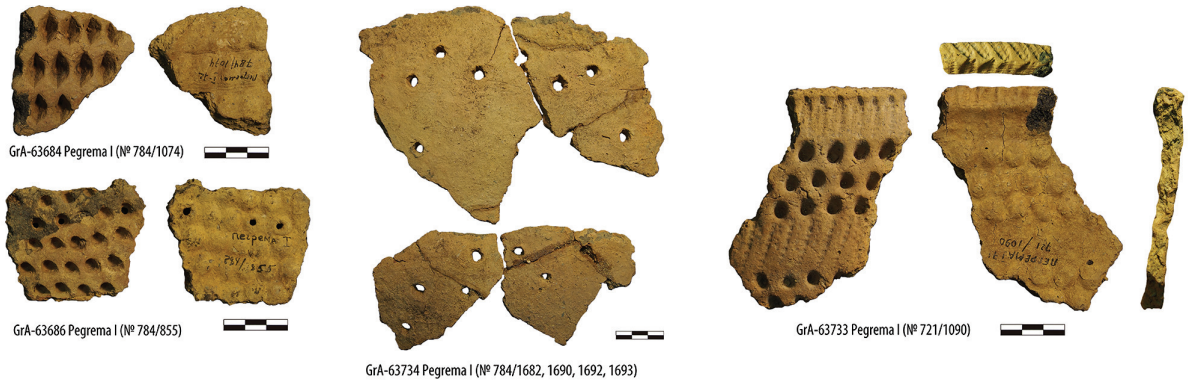


Fig. 5. Rhomb-Pit Ware (designed by T. Mökkönen).

this pottery type, just a few centuries in the mid-4th millennium cal BC (*Zhul'nikov 1999.47, 76–78*; also *Zhul'nikov, Tarasov 2014.262*). The second cluster is contemporary with the few available context dates from burnt dwelling constructions (3300–2600 cal BC, medians 3100–2900 cal BC).

In other words, the beginning of Voynavolok Ware may be dated to the mid-4th millennium cal BC. Such dating is also supported by Finnish material, where Kierikki Ware is dated between 3600 and 2900 cal BC (*Pesonen 2004.90, 92; Nordqvist, Mökkönen 2017b; Mökkönen, Nordqvist in prep.*). Like Voynavolok Ware, Kierikki Ware is seen as a descendant of the Comb Ware tradition, and some of the heterogeneous material classified as Kierikki bears considerable resemblance to Voynavolok Ware (*Nordqvist, Mökkönen 2017b; Mökkönen, Nordqvist in prep.*). Furthermore, some pottery labelled (erroneously) as Kierikki is actually pure Voynavolok type (pottery from Vuopaja; *Zhulnikov* et al. *2012.127*; this is the oldest AMS-dated Voynavolok shard, 4805±85 BP, Ua-4364; *Carpelan 2004*).

The end date of Voynavolok Ware should be placed in the first centuries of the 3rd millennium cal BC, at the latest. However, the youngest dates (Voynavolok XXVII, 4280±80 BP, GrA-63562 and Fofanovo XIII, 4470±60 BP, GrA-62484) derive from shards that also allow typological attribution to Orovnavolok Ware or represent a so-called 'transitional type' between these two (see *Zhul'nikov, Tarasov 2014.261; Tarasov 2015.250*; also *Nordqvist, Mökkönen 2017a* for discussion). Respectively, the same reason, in addition to a possible freshwater reservoir effect, explains the overlap of Voynavolok type and the oldest dates connected with Orovnavolok Ware (Orovnavolok XVI, 4770±40 BP, Beta-117966; Fofa-

Fig. 6. Voynavolok Ware (designed by T. Mökkönen).

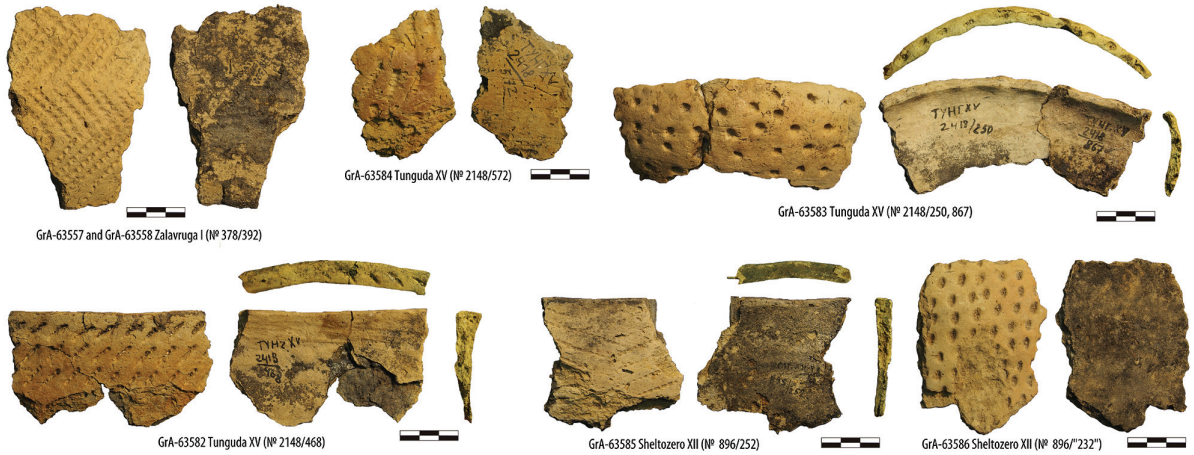


Fig. 7. Orovnavolok Ware and Palayguba Ware (bottom row) (designed by T. Mökkönen).

novo XIII, 4585±35 BP, GrA-62059; Tunguda XV, 4570±35 BP, GrA-63583) (Fig. 7). This typological overlap is well-evidenced by material and dates from Fofanovo XIII, where, however, Voynavolok pottery has generally been recovered in lower stratigraphic layers than the Orovnavolok type (*Zhul'nikov, Tarasov 2014; Tarasov 2015*).

The remaining AMS dates of Orovnavolok Ware fall between 3300–2700 cal BC (medians 3200–2900 cal BC) and are roughly congruent with the majority of context dates from dwelling constructions, 3100–2600 cal BC (medians 2800 cal BC). Still, there are a few dates some centuries younger, although it is highly implausible that at least the youngest date (Voynavolok XXIV, 3560±80 BP, TA-819) would anymore represent the use period of Orovnavolok Ware.

In sum, the start of this type should be a bit later than Voynavolok Ware and probably dates to around 3400 cal BC, although the nature of the 'transitional type' remains ambivalent. The end date can probably be placed in the first half of the 3rd millennium cal BC, and no later than 2500 cal BC. Thus, in addition to Kierikki and Voynavolok Wares, it belongs to the same chronological horizon as Pöljä Ware of Finland, with which it also shares some typological and stylistic similarities (pure Orovnavolok Ware has been recognised in Finland on some occasions; *Nordqvist, Mökkönen 2017b; Mökkönen, Nordqvist in prep.*; see also *Zhul'nikov 2005.29*). Pöljä Ware is dated by AMS dates to 3500–2500 cal BC, but including context datings, its end has been extended to *c.* 1900 cal BC (*Pesonen 2004.90, 92*; authors' unpublished data).

Zalavruga Ware of the White Sea area has been considered a northern parallel to Voynavolok pottery (*Zhul'nikov 2005.27*). Its dating is based on a few crust/tar dates only, as all context dates derive from mixed sites and have no definite connection with this pottery (Fig. 8). AMS dates fall between 3500 and 2900 cal BC (medians 3400–2900 cal BC), whereas conventional dates date to 3700–1800 cal BC. In other words, the main use period of Zalavruga Ware is the second half of the 4th millennium cal BC.

Fig. 8. Zalavruga Ware (designed by T. Mökkönen).

It is largely contemporary with Voynavolok Ware, but also overlaps with Orovnavolok Ware, as also evidenced by coeval datings from the Zalavruga I site. Zalavruga Ware shares some features with Kierikki Ware and the organic-tempered Comb Ware of northern Finland, but their relationships remain unresolved (*Zhul'nikov 2007.123; Nordqvist, Mökkönen 2017b; Mökkönen, Nordqvist in prep.*).

The youngest type of Neolithic/Eneolithic asbestos- and organic-tempered potteries is Palayguba Ware. Currently, only two AMS datings exist for it (Sheltozero XII, 3815±35 BP, GrA-63585 and 3725±35 BP, GrA-63586) (Fig. 7). In this case, context dates from dwellings suggest a somewhat earlier dating. The oldest derives from Kudomguba VII (4010±80 BP, TA-1893), but the most dates from clear Palayguba contexts date younger than 2600 cal BC and up to the first centuries of the 2nd millennium cal BC (2900–1700 cal BC, medians 2500–1900 cal BC). Thus, it seems to overlap little with Orovnavolok Ware, to which it has been also genetically connected, as well as with Corded Ware/Fat'yanovo cultures, which have been seen to influence it too (*Zhul'nikov 1999*). Temporally, Palayguba Ware is largely coeval also with Pöljä Ware, and the end date proposed for the latter, 1900/1800 cal BC, may well apply to most Palayguba pottery.

However, there are even younger dates connected with Palayguba Ware (the youngest date is from Palayguba II, 3150±100 BP, TA-1007), although some of these may already belong to the context of subsequent Textile Ware present at some sites. No genetic relationship has been proposed between these two pottery types, and their overlap remains an open question. In Karelia, the oldest context dates connected with Textile Ware date to the turn of the 3rd and 2nd millennia cal BC or the first half of the 2nd millennium cal BC (Kelka III, 3520±80 BP, TA-2269 and 3100±70 BP, TA-2268; *Zhul'nikov 1999.77*). They are fairly consistent with the earliest AMS dates of Textile Ware from Finland, starting from the early 2nd millennium cal BC onwards (*Lavento 2001.102, Fig. 6.11, 106*). AMS dates for Textile Ware in Karelia fall between *c*. 1500–1300 cal BC (*Kosmenko 2003*).

Final remarks

The data presented in this paper are still limited in temporal and spatial coverage, and do not allow the study of regional and temporal differences in the distribution of various phenomena in detail. In an area as large as the Karelian Republic, it is not reasonable to assume that development (*e.g.*, appearance or disappearance of a pottery type) would have been simultaneous or similar everywhere. Instead, there might have been large differences (for example, some pottery types may have existed for longer periods in certain areas), which can cause inconsistency in the data and 'deviatory' initial and terminal dates.

Similarly, the data are too thin to provide reliable evidence of the temporal differences of some pottery types proposed on typological grounds, or to be used in statistical analyses defining certain event sequences. Also, potential sources of error – like the old wood and the (freshwater) reservoir effect – must be studied in the future, as this might also clarify the reason behind the differences between residue-based AMS and conventional charcoal dates.

Despite the numerous problems and unanswered questions, the currently available radiocarbon dates enable the study of chronological sequences in Karelia in much greater detail than was possible even two or three years ago. Nowadays, it is also possible to correlate the Karelian chronology more or less precisely with the general north-east European chronological framework. All this creates a better foundation for understanding the cultural dynamics between the later 6th and the early 2nd millennia cal BC of north-western Russia.

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Tab. 1. Neolithic–Eneolithic radiocarbon dates, which generally correspond with archaeological materials and contexts present at these sites.

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC; 2σ)	Typological connection	References
1	Uya III	6770±80	TA-2352	Charcoal from fireplace, depth :1m	5837–5538	Mesolithic (?), Sperrings	*Kosmenko 2003*
		6225±40	GrA-63566	Crust on pottery	5304–5059		*Nordqvist, Mökkönen 2016a*
		6160±40	GrA-63581	Black paint on pottery	5217–5000		*Nordqvist, Mökkönen 2016a*
		5970±40	GrA-63546	Birch bark tar on pottery	4956–4729		*Nordqvist, Mökkönen 2016a*
3	Sulgu II	6670±35	KIA-35900	Calcinated bone, elk or reindeer	5646–5527	Sperrings	*Piezonka 2008*
		6085±30	KIA-36724	Birch bark tar of food crust on pottery	5202–4857		*Piezonka 2008*
		6015±30	KIA-33925	Birch bark tar on pottery	4995–4810		*Piezonka 2008*
2	Pegrema IX	6510±150	TA-1161	Charcoal from fireplace, depth 0,6m	5730–5081	Sperrings	*Zhuravlev 1984*
11	Yerpin Pudas I	6510±120	TA-344	Unknown	5660–5227	Säräisniemi 1, Pit-Comb, Comb-Pit, asbestos-tempered	*Devyatova 1976*
		5990±100	TA-799	Charcoal from fireplace	5210–4624		*Devyatova 1976*
		5860±100	TA-472	Unknown	4981–4493		*Devyatova 1976*
		5825±80	TA-413	Unknown	4896–4490		*Devyatova 1976*
		5460±80	TA-800	Charcoal from fireplace	4459–4057		*Devyatova 1976*
		5240±50	TA-795	Charcoal from fireplace at the bottom of cultural layer	4231–3965		*Devyatova 1976*
8	Sheltozero XI	6480±70	TA-1312	Charcoal from cultural layer, depth 0,75–0,93m	5605–5316	Sperrings, Pit-Comb, Voynavolok	*Pesonen 1988*
		5960±70	TA-1313	Charcoal from cultural layer, depth 0,75–0,8m	5024–4691		*Pesonen 1988*
8	Sheltozero X	6400±80	TA-1308	Charcoal from pit	5509–5218	Sperrings, Pit-Comb	*Kochkurkina 1991*
27	Kurkieki 33 (Kylliäisen-lahti W-2)	6400±600	LE-6928	Charcoal from pit	6591–4045	Mesolithic, Sperrings, asbestos-tempered	*Seitsonen, Gerasimov 2008*
7	Shettima I	6400±150	TA-1552	Charcoal from fireplace, depth 0,3–0,4m	5628–5024	Sperrings, Pit-Comb, small amount of Voynavolok and Orovnavolok	*Pesonen 1988*
6	Kalmozero II	6340±70	KIA-35899A	Crust on pottery	5478–5081	Säräisniemi 1	*Piezonka 2008*
		6080±45	KIA-35899B	Crust on pottery	5207–4846	Säräisniemi 1	*Piezonka 2008*
26	Koyrinoya 3	6262±40	Hela-2827	Calcinated bone, mammal	5320–5076	Mesolithic, Sperrings	*Takala* et al. *2016*
		6209±43	Hela-2829	Calcinated bone, beaver	5300–5051		*Takala* et al. *2016*
10	Chernaya Rechka I	6200±100	TA-1634	Charcoal from fireplace	5373–4851	Pit-Comb, small amount of Palayguba	*Lobanova 1988*
		5950±100	TA-1648	Charcoal from fireplace	5201–4555		*Lobanova 1988*
		5800±100	TA-1550	Charcoal from fireplace, depth 0,6–0,85m	4929–4408		*Lobanova 1988*
		5500±100	TA-1651	Charcoal from fireplace, depth 0,5–0,8m	4544–4055		*Lobanova 1988*
		4700±80	TA-1633	Charcoal from fireplace, depth 0,3–0,5m	3652–3196		*Kochkurkina 1991*
		3240±100	TA-1649	Charcoal from fireplace, depth 0,6–1,15m	1751–1266		*Kochkurkina 1991*
9	Orovnavolok V	5945±40	GrA-63735	Birch bark tar on pottery	4932–4725	Sperrings	*Nordqvist, Mökkönen 2016a*
		5850±80	TA-2265	Charcoal from fireplace, depth 0,4–0,55m	4931–4519	Sperrings, Pit-Comb	*Kosmenko 2003*
		5720±60	TA-2266	Charcoal from fireplace, depth 0,5–0,6m	4716–4449		*Kosmenko 2003*

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC; 2σ)	Typological connection	References
10	Chernaya Rechka IIa	5930±80 5420±100	TA-2353 TA-2203	Charcoal from cultural layer, depth 0,3–0,4m Charcoal from pit, depth 0,6–0,9m	5016–4604 4454–4001	Pit-Comb	*Kochkurkina 1991* *Kochkurkina 1991*
8	Sheltozero V	5870±40 5045±35	GrA-63587 GrA-63588	Crust on pottery Crust on pottery	4839–4617 3956–3715	Sperrings Comb-Pit	*Nordqvist, Mökkönen 2016a* *Nordqvist, Mökkönen 2017a*
10	Kladovets Va	5850±80	TA-1450	Charcoal from 'ritual' pit in a burial, depth 0,25–0,35m	4931–4519	Pit-Comb	*Lobanova 1988*
5	Panozero I	5795±35	KIA-33924	Birch bark tar on pottery	4722–4548	Sperrings	*Piezonka 2008*
11	Besovy Sledki II	5775±70 5635±40 5410±40 4785±45	GrA-63547 GrA-63681 GrA-63548 GrA-64331	Crust on pottery Crust on pottery Crust on pottery Crust on pottery	4783–4465 4542–4367 4348–4076 3653–3381	Säräisniemi 1 Pit-Comb 	*Nordqvist, Mökkönen 2016a* *Nordqvist, Mökkönen 2016a* *Nordqvist, Mökkönen 2016a* *Nordqvist, Mökkönen 2016a*
4	Bukol'nikov 1	5600±25 4740±60	LE-8908 LE-9391	Charcoal from fireplace Birch bark from burial	4487–4361 3641–3372	Pit-Comb, asbestos-tempered	*Mel'nikov, German 2013* *Mel'nikov, German 2013*
4	Vozhmarikha 4	5560±45	LE-6604	Charcoal from fireplace	4487–4336	Pit-Comb, Comb-Pit	*Mel'nikov, German 2013*
11	Besovy Sledki	5550±40	GrA-63549	Crust on pottery	4458–4338	Pit-Comb	*Nordqvist, Mökkönen 2016a*
4	Vozhmarikha 26	5507±50	KIA-35901	Crust on pottery	4456–4261	Sperrings	*Piezonka 2008*
4	Vorob'i 4	5360±70 5136±120 5135±45 5115±120 5100±120 5030±60 5000±40 4948±110 4790±120 4779±110 4641±120 4632±150 4626±120 4427±150	GrA-68145 SPb-1786 GrA-67742 SPb-1822 SPb-1785 GrA-68144 GrA-67744 SPb-1775 SPb-1783 SPb-1777 SPb-1781 SPb-1778 SPb-1782 SPb-1779	Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery Crust on pottery	4341–4005 4238–3666 4040–3799 4231–3660 4229–3653 3961–3700 3945–3665 3976–3520 3938–3138 3904–3142 3652–3025 3691–2927 3647–3021 3621–2678	Pit-Comb	*Nordqvist, German 2017* *Nordqvist, German 2017* *Nordqvist, German 2017* *Nordqvist, German 2017* *German 2016* *German 2016* *German 2016* *German 2016* *German 2016* *German 2016* *German 2016* *German 2016* *German 2016* *German 2016*
10	Kladovets IX	5310±80	TA-2288	Charcoal beneath a dweliing	4327–3981	Pit-Comb, small amount of Orovnavolok	*Lobanova 2004*
9	Orovnavolok VII	5260±70	TA-2267	Charcoal from cultural layer	4314–3958	Pit-Comb	*Lobanova 2004*
15	Fofanovo XIII	5220±80 5150±80 4685±35	SPb-784 SPb-783 GrA-62060	Charcoal from fireplace, depth 0,8m Charcoal from fireplace, depth 0,7m Crust on pottery	4259–3804 4229–3766 3627–3369	Pit-Comb (singular fragments), Voynavolok, Orovnavolok Voynavolok	*Tarasov 2015* *Tarasov 2015* *Nordqvist, Mökkönen 2017a*

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC; 2σ)	Typological connection	References
15	Fofanovo XIII	4585±35	GrA-62059	Crust on pottery	3501–3112	Orovnavolok	*Nordqvist, Mökkönen 2017a*
		4535±35	Poz-85971	Calcinated bone, indet fr, mammalia	3364–3102	Pit-Comb (singular fragments), Voynavolok, Orovnavolok	This publication
		4470±60	GrA-62484	Crust on pottery	3355–2934	Voynavolok	*Nordqvist, Mökkönen 2017a*
		4454±42	Hela-2812	Crust on pottery	3341–2937	Orovnavolok	*Zhulnikov* et al. *2012*
		4025±35	GrA-63891	Bone, humerus sin diaphysis fr, beaver	2831–2468	Pit-Comb (singular fragments), Voynavolok, Orovnavolok	This publication
11	Zolotets VI	5160±150	TA-421	Unknown	4325–3662	Comb-Pit, Rhomb-Pit, Zalavruga	*Savvateev* et al. *1974*
		4620±60	TA-391	Charcoal from cultural layer	3629–3106		*Savvateev* et al. *1974*
		4150±80	TA-793	Charcoal from cultural layer, depth 0,2–0,45m	2901–2496		*Devyatova 1976*
		3780±150	TA-801	Charcoal from cultural layer, depth 0,1–0,3m	2624–1771		*Devyatova 1976*
9	Chernaya Guba III	6060±40	GrA-63539	Birch bark tar on pottery	5195–4842	Comb-Pit	*Nordqvist, Mökkönen 2017a*
		5155±35	GrA-63538	Crust on pottery	4042–3811		*Nordqvist, Mökkönen 2017a*
		4950±100	TA-1890	Charcoal from fireplace in a dwelling	3968–3527	Pit-Comb, Comb-Pit, Rhomb-Pit	*Kochkurkina 1991*
		4925±35	GrA-63540	Birch bark tar on pottery	3775–3646	Comb-Pit	*Nordqvist, Mökkönen 2017a*
		4895±35	GrA-63537	Birch bark tar on pottery	3762–3637		*Nordqvist, Mökkönen 2017a*
2	Pegrema I	5145±110	TA-541	Charcoal from pit	4236–3705	Rhomb-Pit	*Zhuravlev 1984*
		4980±60	LE-1029	Charcoal from pit	3943–3653		*Zhuravlev 1984*
		4825±35	GrA-63684	Birch bark tar on pottery	3694–3523		*Nordqvist, Mökkönen 2016b*
		4780±50	TA-492	Charcoal from pit	3655–3378		*Zhuravlev 1984*
		4730±35	GrA-63686	Birch bark tar on pottery	3635–3377		*Nordqvist, Mökkönen 2016b*
		4720±35	GrA-63733	Birch bark tar on pottery	3634–3375		*Nordqvist, Mökkönen 2016b*
		4695±35	GrA-63734	Crust on pottery	3630–3370		*Nordqvist, Mökkönen 2016b*
2	Pegrema II	5070±120	TA-811	Charcoal from cultural layer	4227–3640	Sperrings, Pit-Comb, Rhomb-Pit	*Zhuravlev 1984*
		4750±120	TA-810	Charcoal from cultural layer	3794–3110		*Zhuravlev 1984*
		4550±90	TA-808	Charcoal from cultural layer	3618–2937		*Zhuravlev 1984*
2	Pegrema I / III	4240±90	TA-813	Charcoal from dwelling	3091–2575	Rhomb-Pit	*Zhuravlev 1976*
		4200±50	TA-493	Charcoal from dwelling	2904–2631		*Zhuravlev 1976*
14	Voynavolok XXIX	5030±35	GrA-63560	Birch bark tar on pottery	3946–3713	Comb-Pit	*Nordqvist, Mökkönen 2017a*
9	Orovnavolok XVI	5080±70	Beta-117965	Charcoal from a lens close to entrance of a dwelling	4036–3707	Comb-Pit, Rhomb-Pit	*Lobanova 2004*
		4970±50	Beta-117964	Crust on pottery	3939–3650		*Lobanova 2004*
		4870±50	Beta-117962	Crust on pottery	3771–3530	Rhomb-Pit	*Lobanova 2004*
		4840±50	Beta-117963	Crust on pottery	3748–3518		*Lobanova 2004*
		4770±40	Beta-117966	Crust on pottery	3644–3381	Orovnavolok (?)	*Khoroshun 2013*
		4390±50	Beta-117961	Crust on pottery	3325–2901		*Khoroshun 2013*
		4200±20	TA-828	Charcoal from the burnt wall of a dwelling	2891–2698	Orovnavolok	*Kochkurkina 1991*

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC; 2σ)	Typological connection	References
12	Vigaynavolok I	4940±30	KIA-33930	Crust on pottery	3777–3654	Rhomb-Pit	*Khoroshun 2013*
		4725±30	KIA-33931	Birch bark tar on pottery	3634–3377		*Khoroshun 2013*
4	Vozhmarikha 1	4900±130	LE-848	Charcoal from fireplace in a dwelling	3965–3376	Comb-Pit	*Mel'nikov, German 2013*
		4420±60	LE-9393	Unknown	3336–2911		*Mel'nikov, German 2013*
9	Chernaya Guba IX	4840±80	TA-2023	Charcoal from fireplace in a dwelling	3793–3377	Pit-Comb, Comb-Pit, Rhomb-Pit	*Kochkurkina 1991*
		4340±80	TA-2140	Charcoal from the wall of a dwelling	3336–2708	Voynavolok	*Kochkurkina 1991*
13	Sukhaya Vodla I	4810±60	TA-1553	Charcoal from fireplace, depth 0,35–0,4m	3706–3379	Pit-Comb, Rhomb-Pit, small amount of Orovnavolok and Palayguba	*Pesonen 1988*
11	Zalavruga I	4775±70	TA-393	Charcoal from a washed fireplace	3694–3372	Rhomb-Pit, Zalavruga, Orovnavolok, Palayguba	*Savvateev* et al. *1974*
		4580±35	GrA-63559	Crust on pottery	3499–3111	Zalavruga	*Nordqvist, Mökkönen 2017a*
		4570±35	GrA-63551	Crust on pottery	3496–3104		*Nordqvist, Mökkönen 2017a*
		4495±35	GrA-63555	Crust on pottery	3352–3037		*Nordqvist, Mökkönen 2017a*
		4295±35	GrA-63552	Crust on pottery	3012–2878		*Nordqvist, Mökkönen 2017a*
		4285±35	GrA-63557	Crust on pottery	3013–2873	Orovnavolok	*Nordqvist, Mökkönen 2017a*
		4255±40	GrA-63558	Crust on pottery	3007–2694		*Nordqvist, Mökkönen 2017a*
		4010±70	GIN-130	Charcoal from fireplace	2861–2304	Rhomb-Pit, Zalavruga, Orovnavolok, Palayguba	*Devyatova 1976*
24	Pervomayskaya I	4710±35	GrA-63682	Birch bark tar on pottery	3632–3373	Voynavolok	*Nordqvist, Mökkönen 2017a*
		4685±35	GrA-63592	Crust on pottery	3627–3369		*Nordqvist, Mökkönen 2017a*
		4615±35	GrA-63683	Crust on pottery	3517–3144		*Nordqvist, Mökkönen 2017a*
		4610±35	GrA-63590	Crust on pottery	3516–3136		*Nordqvist, Mökkönen 2017a*
4	Vozhmarikha 21	4700±120	SPb-1784	Crust on pottery	3709–3096	Comb-Pit	*German 2016*
		4487±110	SPb-1776	Crust on pottery	3507–2901		*German 2016*
14	Voynavolok XXVII	4693±35	Hela-2428	Crust on pottery	3629–3370	Voynavolok	*Zhulnikov* et al. *2012*
		4605±35	GrA-63565	Crust on pottery	3515–3128		*Nordqvist, Mökkönen 2017a*
		4410±150	TA-1748	Charcoal from the burnt wall of a dwelling	3518–2666		*Pankrushev 1988*
		4365±35	GrA-63562	Crust on pottery	3090–2903		*Nordqvist, Mökkönen 2017a*
		4280±80	TA-1726	Charcoal from the burnt wall of a dwelling	3265–2620		*Pankrushev 1988*
27	Kurkieki 52 (Kuuppala Kalmistomäki)	4620±60	SU-2651	Charcoal from cultural layer	3629–3106	Sperrings, Pit-Comb, Comb-Pit, Late Comb, asbestos-tempered, Textile	*Saarnisto 2003*
11	Zolotets XX	4610±35	GrA-63550	Birch bark tar on pottery	3516–3136	Zalavruga	*Nordqvist, Mökkönen 2017a*
16	Berezovo XVII	4600±100	TA-2271	Charcoal from a layer buried under the embankment of a dwelling related to Orovnavolok	3634–3026	Comb-Pit, Rhomb-Pit, Zalavruga, Orovnavolok	*Zhul'nikov 1999*
9	Chernaya Guba IV	4580±60	TA-2024	Charcoal from fireplace in a dwelling	3517–3097	Pit-Comb, Comb-Pit, Rhomb-Pit	*Kochkurkina 1991*

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC; 2σ)	Typological connection	References
16	Tunguda XV	4570±35	GrA-63583	Crust on pottery	3496–3104	Orovnavolok	*Nordqvist, Mökkönen 2017a*
		4515±35	GrA-63582	Crust on pottery	3357–3097		*Nordqvist, Mökkönen 2017a*
		4435±35	GrA-63584	Crust on pottery	3330–2926		*Nordqvist, Mökkönen 2017a*
11	Zalavruga IV	4430±80	TA-392	Unknown	3343–2914	Rhomb-Pit, Zalavruga, Orovnavolok, Palayguba	*Savvateev* et al. *1974*
		3810±50	TA-794	Charcoal from cultural layer	2460–2064		*Devyatova 1976*
		3700±100	TA-797	Charcoal from cultural layer	2458–1784		*Devyatova 1976*
16	Tunguda XVII	4370±60	TA-2289	Charcoal from the burnt wall of a dwelling	3326–2888	Orovnavolok	*Zhul'nikov 1999*
		3920±60	TA-2290	Charcoal from the burnt wall of a dwelling	2571–2208		*Zhul'nikov 1999*
16	Tunguda III	4350±100	TA-2270	Charcoal from the burnt wall of a dwelling	3354–2697	Orovnavolok	*Zhul'nikov 1999*
		4220±60	TA-2200	Charcoal from the burnt wall of a dwelling	2924–2620		*Kochkurkina 1991*
16	Tunguda XIV	4340±80	TA-2019	Charcoal from the burnt wall of a dwelling	3336–2708	Orovnavolok	*Kochkurkina 1991*
		4210±60	TA-2018	Charcoal from the burnt wall of a dwelling	2917–2620		*Kochkurkina 1991*
4	Vozhmarikha 19	4330±120	SPb-1780	Crust on pottery	3354–2631	Orovnavolok	*German 2016*
17	Meyeri II	4300±100	TA-1518	Charcoal from fireplace	3332–2624	Comb-Pit	*Kochkurkina 1991*
14	Voynavolok XXIV	4250±70	TA-820	Charcoal from dwelling	3080–2622	Orovnavolok	*Zhuravlev 1977*
		4200±80	TA-846	Charcoal from dwelling	3009–2500		*Zhuravlev 1984*
		3560±80	TA-819	Charcoal from the burnt wall of a dwelling	2135–1692		*Zhuravlev 1977*
18	Kudomguba VII	4010±80	TA-1893	Charcoal from the wall of a dwelling	2865–2296	Palayguba	*Kochkurkina 1991*
11	Zolotets XI	3990±60	TA-798	Charcoal from cultural layer, depth 0,2–0,4m	2837–2299	Orovnavolok	*Devyatova 1976*
19	Chelmuzhskaya Kosa XXI	3980±90	TA-1783	Charcoal from the wall of a dwelling	2862–2207	Palayguba	*Kochkurkina 1991*
		3750±100	TA-1947	Charcoal from the wall of a dwelling	2466–1920		*Kochkurkina 1991*
		3540±80	TA-1948	Charcoal from the floor of a dwelling	2132–1667		*Kochkurkina 1991*
25	Sumozero XV	3950±60	Beta-?	Charcoal from the construction of a dwelling	2620–2213	Palayguba	*Zhul'nikov 2005*
		3935±105	TUa-?	Charcoal from the construction of a dwelling	2860–2136		*Zhul'nikov 2005*
		3875±55	TUa-?	Charcoal from the construction of a dwelling	2485–2151		*Zhul'nikov 2005*
		3750±60	Beta-?	Charcoal from the construction of a dwelling	2400–1972		*Zhul'nikov 2005*
		3690±60	Beta-?	Charcoal from the construction of a dwelling	2279–1916		*Zhul'nikov 2005*
		3670±65	TUa-?	Charcoal from the construction of a dwelling	2275–1886		*Zhul'nikov 2005*
		3540±70	Beta-?	Charcoal from the construction of a dwelling	2118–1690		*Zhul'nikov 2005*
10	Chernaya Rechka XII	3930±80	TA-1784	Charcoal from fireplace, depth 0,25–0,75m	2832–2147	Pit-Comb, small amount of Palayguba	*Kochkurkina 1991*
3	Lakshezero II	3920±60	TA-1520	Charcoal from fireplace	2571–2208	Small amount of Sperrings, Comb-Pit and asbestos-tempered	Vitenkova 1986
26	Koyrinoya 2	3870±33	Hela-2831	Calcinated bone, mammal	2466–2211	Orovnavolok	*Takala* et al. *2016*
8	Sheltozero XII	3815±35	GrA-63585	Crust on pottery	2452–2140	Palayguba	*Nordqvist, Mökkönen 2017a*
		3725±35	GrA-63586	Crust on pottery	2275–2024		*Nordqvist, Mökkönen 2017a*

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC; 2σ)	Typological connection	References
3	Kudoma X	3530±80	TA-1258	Charcoal from cultural layer, depth 0,3–0,6m	2126–1661	Sperrings, Pit-Comb, Comb-Pit, Rhomb-Pit, Orovnavolok, Textile	*Pankrushev 1988*
10	Kladovets IV	3400±60	TA-1410	Charcoal from fireplace, depth 1–1,1m	1881–1534	Mesolithic, Sperrings (singular fragments), Pit-Comb, Rhomb-Pit, asbestos-tempered (singular fragments)	*Pankrushev 1988*
12	Vigaynavolok II	3370±110	TA-?	Charcoal from dwelling	1940–1430	Pit-Comb (singular fragments), Comb-Pit and Rhomb-Pit (singular fragments), Palayguba	*Zhuravlev 1977*
11	Zolotets X	3300±60	TA-390	Unknown	1736–1447	Palayguba, Textile	*Savvateev* et al. *1974*
14	Kochnavolok II	3260±70	TA-831	Charcoal from dwelling	1731–1409	Palayguba	*Pankrushev 1988*
2	Palayguba II	3150±100	TA-1007	Charcoal from fireplace	1657–1128	Palayguba	*Zhuravlev 1984*

Tab. 2. Radiocarbon dates from Neolithic-Eneolithic contexts with deviatory age, and dates with Neolithic–Eneolithic age, but no correspondence with archaeological materials found at these sites. These dates have been included in many previous works on Karelian chronology, even if their suitability for building a chronology is virtually non-existent.

No. on map	Site	^{14}C date (BP)	Lab. Index	Context/dated item	Calibrated date (cal BC/AD; 2σ)	Typological connection	References
18	Kudomguba VII	6720±90	TA-1724	Charcoal from a pit, depth 0,45m	5775–5483	Palayguba	*Kochkurkina 1991*
		1000±40	TA-1725	Charcoal from cultural layer	AD 975–1155		*Kochkurkina 1991*
4	Vozhmarikha 1	6410±50	LE-7231	Charcoal from hearth in a dwelling	5476–5312	Mesolithic, Pit-Comb, Rhomb-Pit	*Mel'nikov, German 2013*
		6370±140	LE-849	Charcoal from fireplace	5613–5008		*Mel'nikov, German 2013*
23	Keret' XXII	6130±50	LE-8047	Charcoal from fireplace	5216–4941	Non-ceramic	*Tarasov 2008*
9	Myan'gora I	5880±80	TA-1079	Charcoal from cultural layer	4944–4545	Mesolithic	*Kochkurkina 1991*
22	Suna XII	5160±70	TA-1310	Charcoal from cultural layer and pit, depth 0,3–0,65m	4228–3785	Mesolithic	*Kochkurkina 1991*
26	Koyrinoya 3	4884±37	Hela-2828	Calcinated bone, ringed seal	3763–3543	Mesolithic, Sperrings	*Takala* et al. *2016*
10	Kladovets (cemetery)	4560±80	TA-1785	Charcoal from a burial, depth 0,3m	3619–3020	Pit-Comb	*Kochkurkina 1991*
21	Pinguba II	4400±60	TA-1409	Charcoal from fireplace	3332–2902	Medieval	*Pesonen 1988*
8	Sheltozero X	4300±80	TA-1311	Charcoal from cultural layer, depth 0,4–0,9m	3322–2635	Sperrings, Pir-Comb	*Kochkurkina 1991*
14	Povenchanka XV	4270±60	TA-1519	Charcoal from fireplace, depth 0,25–0,35m	3084–2669	Mesolithic	*Kochkurkina 1991*
9	Orovnavolok XI	4210±50	TA-929	Charcoal from cultural layer, depth 0,45m	2910–2632	Mesolithic	*Kochkurkina 1991*
11	Zolotets XX	3670±80	TA-792	Turf from the site	2293–1781	Pit-Comb, Comb-Pit, Rhomb-Pit, Zalavruga	*Kochkurkina 1991*
20	Kostomuksha II	3600±80	TA-963	Charcoal from cultural layer, depth 0,4–0,5m	2197–1745	Mesolithic	*Kochkurkina 1991*
10	Chernaya Rechka II	3430±80	TA-2202	Charcoal from fireplace, depth 0,8–1,15m	1938–1531	Sperrings (singular fragments), Pit-Comb	*Kochkurkina 1991*
15	Fofanovo XIII	3288±70	SPb-781	Charcoal from fireplace, depth 0,6m	1741–1426	Pit-Comb (singular fragments), Voynavolok, Orovnavolok	*Tarasov 2015*
		3158±80	SPb-782	Charcoal from fireplace, depth 0,6m	1616–1226		*Tarasov 2015*
9	Orovnavolok XVI	3060±70	TA-827	Charcoal from fireplace in a dwelling	1495–1116	Orovnavolok	*Pankrushev 1988*
		3050±60	TA-829	Charcoal from fireplace in a dwelling	1434–1126		*Pankrushev 1988*
2	Palayguba X	2670±120	TA-1444	Charcoal from fireplace	1124–430	Orovnavolok	*Zhuravlev 1984*
10	Chernaya Rechka I	2080±60	TA-1650	Charcoal from fireplace, depth 0,5–0,75m	352 BC–AD 55	Pit-Comb, small amount of Palayguba	*Kochkurkina 1991*
14	Kochnavolok II	1480±60	TA-831	Charcoal from cultural layer, depth 0,45–0,55m	AD 428–655	Palayguba	*Pankrushev 1988*
2	Pegrema III	1150±70	TA-1260	Charcoal from cultural layer, depth 0,45m	AD 695–1017	Rhomb-Pit	*Kochkurkina 1991*

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