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TESTING TIMES: AN EVALUATION OF THE RADIOCARBON CHRONOLOGY FOR EARLY CERAMIC VESSEL PRODUCTION AT UST'-KARENGA

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This paper presents the initial results of a new phase of absolute dating at Ust'-Karenga. Three Optically-Stimulated Luminescence (OSL) dates were obtained on quartz grains extracted from Ust'-Karenga type ceramic sherds from Layers 4, 6 and 7 at Ust'-Karenga XII. These dates are used to test the reliability of the existing radiocarbon sequence and evaluate counter claims that sought to reject early dates for ceramics in the Transbaikal on the basis of a putative carbon cycle anomaly in the Transbaikal region. Our results strongly uphold the excavator's original interpretation of the site and independently confirm both the Late Pleistocene age and the long duration of the Ust'-Karenga pottery phase. The paper demonstrates the value of using independent absolute dating methods to test contested radiocarbon chronologies.

Keywords: Late Pleistocene pottery, Hunter-gatherers, OSL, Luminescence dating, Chronological resolution

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ТЕСТИРУЕМЫЕ ВРЕМЕНА: ОЦЕНКА РАДИОУГЛЕРОДНОЙ ХРОНОЛОГИИ РАННЕГО КЕРАМИЧЕСКОГО ПРОИЗВОДСТВА НА УСТЬ-КАРЕНГЕ

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Эта статья представляет результаты новой фазы абсолютного датирования Усть-Каренги. Три оптико-стимулированных люминесцентных (ОСЛ) даты были получены из кварцевых зерен, извлеченных из фрагментов керамики усть-каренгского типа из культурных горизон-

тов 4, 6 и 7 стоянки Усть-Каренга XII. Три даты были использованы для проверки валидности существующей радиоуглеродной серии дат и оценки встречных возражений, стремящихся отклонить ранние даты на основе предполагаемой аномалии углеродного цикла в Забайкалье. Наши результаты однозначно поддерживают оригинальную исследовательскую интерпретацию памятника и независимо подтверждают как позднеплейстоценовый возраст, так и длительность существования фазы усть-каренгской керамики. Статья демонстрирует ценность использования методов независимого абсолютного датирования для верификации радиоуглеродных хронологий.

Ключевые слова: позднеплейстоценовая керамика, охотники-собиратели, ОСЛ, люминесцентное датирование, хронологическое решение.

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The Lure of Origins

Today, it seems clear that across much of Eurasia, North Africa, and parts of the New World, the initial development and spread of ceramic vessel technology occurred almost entirely within societies of hunter-gatherers (van Berg and Cauwe 2000; Jordan and Zvebil 2009; Jordan *et al.* 2016). Yet, while *this* fact is now widely accepted, there has been a general reluctance to abandon the long standing significance of ceramic as a marker of particular social, political, and behavioural transformations in prehistoric societies (Hommel 2014; in press). By maintaining the traditional interpretive value of pottery, the emergence of this versatile craft has remained central to many developmental schemes and its chronology highly contentious.

In many cases, early dates for ceramics, once published, are accepted or rejected by scholars with no clear rationale on either side. As a result, across Eurasia, key assemblages from this early phase of hunter-gather pottery production hang suspended in space without a generally accepted chronological context. The confusion that results from this continuous wrangling over dates makes it difficult to consider any broader patterns and, at a local level, effectively stifles discussions about the character of early pottery and its place in the lives of the people who made and used it. For a scientific discipline like archaeology, this is not a position that can endure.

Opposition to existing chronologies usually crystallises around the security of association between radiocarbon dates and the ceramic material they purport to date, and in many cases, this is a justifiable concern. Researchers have attempted to bypass the problem by directly radiocarbon dating surface residues or organic ‘temper’ from within the ceramics themselves, these approaches come with their own challenges. More importantly – at least for the purposes of this article – the testing of existing radiocarbon data with new radiocarbon dates fails to escape another common criticism from researchers who attribute archaeologically unacceptable dates at a regional scale to ‘anomalies’ in local carbon cycles and systematic errors in our estimates of age. Clearly, alternative approaches are required.

In cases where the difference between radiocarbon dates and the ‘acceptable’ age of the material is small the problem can be difficult to resolve without further excavation, well contextualized dating evidence, and a clear understanding of local carbon circulation patterns, reservoir effects and so forth. Fortunately, the impact of such cases is relatively minor, especially in earlier periods where chronological boundaries are imprecise. The impact of these problems is far more keenly felt where the discrepancy in date is in the order of millennia. In these cases, while the implications for archaeological interpretation are immense, the solution is potentially more

straightforward. When chronological interpretations are sufficiently divergent it becomes possible to verify existing chronologies with non-radiometric dating techniques, such as Thermo-Luminescence (TL) and Optically Stimulated Luminescence (OSL). Although they are often significantly less precise, these techniques can provide us with reliable chronological data that are entirely independent of the carbon cycle, enabling us to test both the position of existing sequences and the general coherence of the stratigraphic context.

A Contested Chronology: The *Ust'-Karenga* Complex

This paper applies this alternative approach to one of the most hotly disputed early ceramic finds in East Asia, the site complex of *Ust'-Karenga*, where pottery fragments have been ^{14}C dated, on the basis of both associated charcoal and organic 'temper' within the ceramics, to c. 12,200–10,500 calBC (Kuzmin 2006; Kuzmin and Vetrov 2007).

At the time of writing, the site of *Ust'-Karenga* in the Upper Vitim Basin (Fig. 1) is the most thoroughly dated early pottery site in Eastern Siberia, and even the briefest survey of the literature would be sufficient to see that chronology has been the focus of almost every paper published about the site in the last twenty years. With new radiocarbon data, ac-

cessible information about earlier pottery finds in China and Japan (e.g. Keally *et al.* 2004; Kuzmin 2006; Wu *et al.* 2012; Zhao and Wu 2000) and a widening range of comparably dated sites in surrounding regions (e.g. Derevianko *et al.* 2004; Shewkomud and Yanshina 2012; Zhushchikovskaya 2005), it would be reasonable to assume that the chronology of *Ust'-Karenga* and other putative Late Pleistocene ceramic assemblages in the Transbaikal would have become increasingly secure. However, this has not been the case, and the dating of these sites and their ceramics continues to be regularly challenged.

Currently, the most complete discussion of the chronology of the *Ust'-Karenga* complex can be found in the proceedings of a regional conference held at Ulan-Ude (Vetrov, 2010). This paper was written as an indirect reply to two publications by a well-respected Palaeolithic archaeologist M.V. Konstantinov (2009a; 2009b) in which it was suggested that the proposed phenomenon of early pottery in the Transbaikal was 'unsupportable'. These papers, which represent the tip of an iceberg of contention, very rarely expressed in publication, target their criticism at what their author deems the naïve and uncritical reliance on radiocarbon data among archaeologists (Konstantinov 2009b). He goes on to argue, quite rightly, that radiocarbon dates must be under-

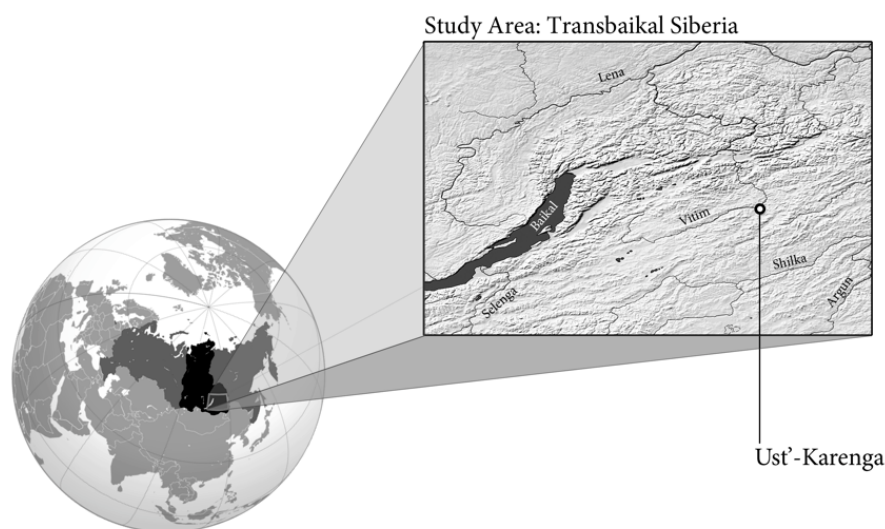


Fig. 1. Location of *Ust'-Karenga* in global and regional context

Рис. 1. Локализация Усть-Каренги в глобальном и региональном контексте

stood with reference to the typological and stratigraphic context of the finds they purport to date.

With specific reference to the position of the early ceramic finds within the sequence at Ust'-Karenga, Konstantinov (2009b: 190) suggests that the sediments described in Vetrov's papers are more in keeping with deposits from the latter half of the Holocene Climatic Optimum, while the ceramics themselves are typologically consistent with Middle Neolithic Bel'kachinsk culture finds in Yakutia (c. 4000–2600 calBC¹). Unfortunately, attempts to assess the validity of these claims are thwarted by the fact that no new results or specific evidence have been presented to explicitly support or refute these counter claims.

Stratigraphic situation

Usually taken as the 'type' profile for the Ust'-Karenga complex as a whole (Fig. 2a and b), the stratigraphic sequence at the adjacent sites of Ust'-Karenga XII, XIV and XVI is located in the sediments of a 20–25m terrace at the mouth of the Karenga. The sequence can be split into two distinct geomorphological phases: subaqueous and subaerial. This stratigraphic sequence outlined below was remarkably consistent across the body of the terrace body, although the preservation of the lower cultural layers in different locations was affected by the topography of the underlying bedrock and proximity to the ancient river channels.

The subaqueous phase, which accounts for the larger part of the sequence extending from the bedrock to around 50cm (or less) below the modern surface, is composed primarily of finely laminated alluvial sands with lenses of silt and bluish grey clay (Ineshin 1979; Vetrov 1992). This phase contains four cultural layers which have revealed the earliest evidence of human occupation at Ust'-Karenga (cultural

Layers 8a, 8 and 7a) and the earliest ceramic vessels in the region (Layer 7) – encountered at Ust'-Karenga XII, XIV and XVI (Fig. 3). These cultural layers are clearly visible as darker strata, thicker than the laminated sediments and sterile sands that surround them

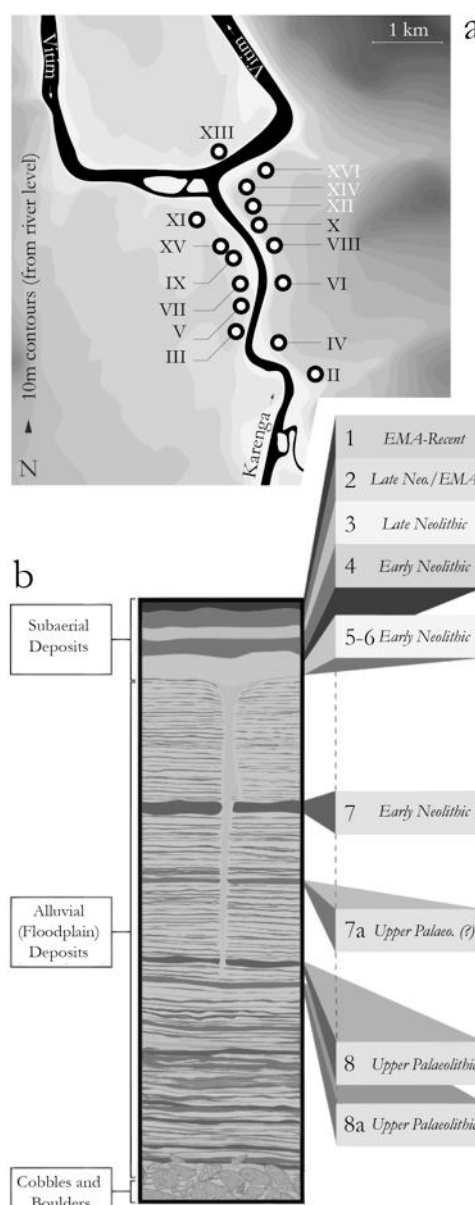


Fig. 2: a – Map showing the location of the main sub-sites of the Ust'-Karenga complex; b – Generalised stratigraphic section derived from Ust'-Karenga XII (after Vetrov 2005)
Рис. 2: а – карта, показывающая основные пункты усть-каренгского комплекса; б – сводная стратиграфическая колонка с местонахождения Усть-Каренга XII (по: Ветров, 2005)

¹ In the local literature, this comparative date is often given as an uncalibrated date range of '5–4 ky bp' (Vetrov 2011).

В местной литературе этот относительный возраст часто подается как некалиброванный интервал в пределах 5–4 тыс. л. н. (Ветров, 2011).

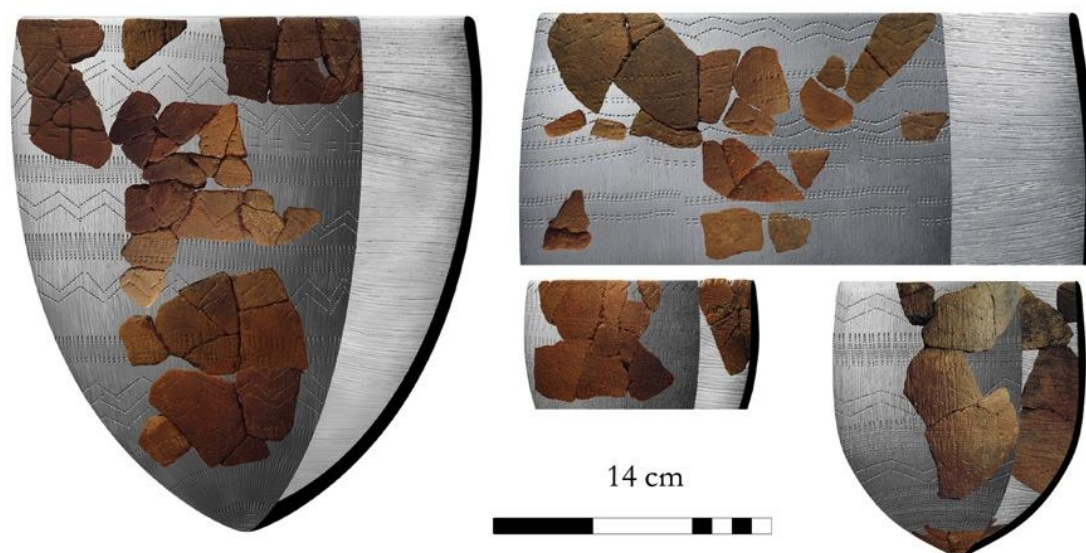


Fig. 3. Selection of Early Ust'-Karenga culture vessels from Layer 7, Ust'-Karenga XII–XVI
Рис. 3. Реконструкция сосудов усть-каренгской культуры из культурного горизонта 7, Усть-Каренга XII–XVI

(Fig. 2b). At the upper interface with the subaerial sediments, the subaqueous sequence appears to be truncated and is certainly scarred by extensive polygonal frost-wedge formations, which locally deform the well-defined stratigraphy below. Another significant phase of cryogenic activity is also apparent in the alluvial phase below the cultural layers (Ineshin 1979; Vetrov 1992). There is some disagreement in the literature about which of these cultural layers constitute true *paleosols* and which do not. However, nomenclature aside, it seems to be generally accepted that the darker layers (which are presumed to be more humic in composition) are correlated with for periods of stability when the climate was comparatively warmer. There is also general agreement that the cryogenic features provide natural chronological brackets which can be used to constrain the dating of the cultural layers (Ineshin 1979; Konstantinov 2009a; Vetrov 1992). Dispute arises because, in the absence of other chronological evidence (or distrust in its validity), a number of equally plausible interpretations of this sequence can be made. This position is hardly unique in the archaeology of Eastern Siberia, but unlike many other early pottery sites where the association of absolute dates, material culture, and stratigraphy has been legitimately questioned

on the basis of various forms of post-depositional disturbance (see McKenzie 2009), the cultural layers of the subaqueous sequence at Ust'-Karenga, including the earliest 'ceramic-bearing' layer (Layer 7) are conveniently delimited from the upper layers by substantial accumulations (0.4–1.0 m) of archaeologically sterile sediments (Kuzmin and Vetrov 2007; Vetrov 1992). Though the impact of more recent cryogenic disturbances is significant, it remains spatially discrete, leaving large areas of the lower levels of the site effectively *in situ*. In short, it is extremely unlikely that significant mixing of the upper (1–6) and lower cultural layers (7–8a) could have occurred, and the stratigraphy at Ust'-Karenga XII, as a whole, appears to be a promising context in which to explore the absolute dating of this period of Siberian prehistory.

The sediments of the subaerial phase appear more homogeneous and are likely to have been formed by the drifting of unconsolidated sediments as much as by the action of periodic flooding. Within these deposits, clearly defined soil horizons (ancient and modern) are discernible and six cultural layers (Layers 6–1) have been distinguished on the basis of colour, texture, and associated material culture (Kuzmin and Vetrov 2007; Vetrov 2010). Ust'-Karenga pottery is also found in these subae-

rial sediments – predominantly in Layers 6–4 (with occasional sherds in layers the upper layers), but whereas in Layer 7 it occurs in isolation, in these subaerial layers it is found alongside other ceramic types. In part, this blurring of cultural layers is a result contamination between these upper layers. This makes it even more important obtain direct dates for ancient events.

An Alternative Approach

Recent developments in OSL measurement technologies have widened the scope of this technique (Huntley et al. 1985) allowing it to be applied to smaller sample sizes and a wider range of materials, including pottery (Hood and Schwenninger 2015). This, therefore, provides the possibility of obtaining an absolute date on the production of the vessel. This technique is not usually sufficiently precise for this purpose, but as the aim of this study was to independently test the validity of a radiocarbon sequence, this was not a significant concern.

Ideally, for OSL analysis to have the greatest possible precision, we would rely on freshly excavated material, with directly associated sediments (which could also be dated), *in situ* dose rate measurements, and precise information about depth below surface, water content of the associated sediment, and post-excavation storage conditions. In spite of this, it was decided that this study would focus on existing collections of material.

There were several reasons behind this decision, including the practical difficulties of conducting expeditionary research in this remote region. However, the main reason was to allow us to evaluate a *realistic* research model that could be applied to similar chronological disputes in other regions. Many of these potential study locations are also remote from major cities, and though some are still a focus of research activity, many have already been excavated or otherwise destroyed. For this technique to be a viable way of testing existing dating sequences it must be able to incorporate curated material. Equally importantly, given the comparative rarity of this early ceramic

material, the technique would need to be minimally destructive.

Sampling strategy and OSL Analysis

For this study five ceramic samples (Fig. 4) were selected from defined archaeological contexts. The samples were all typologically attributable to the Ust'-Karenga culture and chosen from petrographically defined groups with coarse inclusions dominated by quartz and quartz-rich rock fragments (primarily granitic in origin) (see Hommel *et al.* in press). Two samples were taken from the earliest ceramic-bearing layer (Layer 7) and two further samples were taken from the boundary of the overlying sterile alluvium and the low-

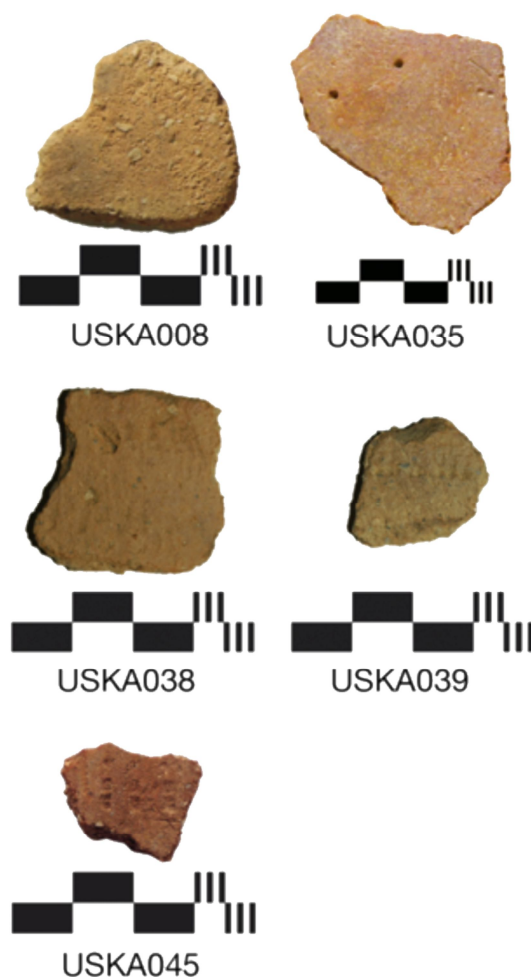


Fig. 4. Photographs of the selected ceramic samples for the OSL study

Рис. 4. Фотографии отобранных керамических образцов для OSL исследования

est subaerial layer (Layer 6). A final sample was taken from Layer 4 which represents the uppermost stratigraphic layer in which material attributable to the Ust'-Karenga culture is routinely recovered in secure context.

On the basis of optically stimulated luminescence measurements (OSL) of sand-sized quartz (125–180µm) extracted from the sherds, a series of three age estimates was obtained. The extraction of quartz grains was carried out using standard preparation techniques including dry sieving, HCl (10 %) treatment to remove carbonates, HF treatment (48 %) to dissolve feldspathic minerals, heavy mineral separation with sodium polytungstate and final re-sieving of the treated mineral fraction. Measurements were performed in an automated Risø luminescence reader (Bøtter-Jensen, 1988; 1997; 2000) using a SAR post-IR blue OSL measurement protocol (Murray and Wintle 2000; Banerjee et al. 2001; Wintle and Murray 2006). Dose rate determinations are based on the concentration of radioactive elements (potassium, thorium and uranium) within the sherds (internal beta dose rate) as well as a representative sediment sample from Layer 7 at Ust'-Karenga XII in order to assess the external gamma dose rate. It was not practical as part of this study to undertake infield measurements at the site, so a large systematic error of 10 % was attached to the latter in order to account for any uncertainty. The dosimetric analyses were derived from elemental analysis of the samples (ceramic and sediments) by ICP-MS/AES using a fusion sample preparation technique. The final OSL age estimates include an additional 4 % systematic error to account for uncertainties in source calibration and measurement reproducibility. Dose rate calculations are based on Aitken (1985). These incorporated beta attenuation factors (Mejdahl 1979), dose rate conversion factors (Adamiec and Aitken 1998) and an absorption coefficient for the water content (Zimmerman 1971) based on a mean moisture content of 5 to 13 %. The contribution of cosmic radiation to the total dose rate was calculated as a function of latitude, altitude, burial depth and average over-burden density based

on data by Prescott and Hutton (1994). The high palaeodose values for the samples reflect the antiquity of the prehistoric sherds but are mainly due to the high environmental dose rates, ranging from 3.7 to 8.5 Gy/ka. Whereas the sediment contains concentrations of radionuclides (K=3.4 %; Th=4.5 ppm and U=1.3 ppm) which may be regarded as normal, the same is not true for the clay fabrics which were all found to contain elevated concentrations of potassium (2.6–4.0 %), thorium (8.9 to 192.0 ppm) as well as uranium (3.2 to 32.0 ppm). *A priori*, there is no reason to question these values, nor the veracity of the calculated age estimates, but it is worth noting that these are unusually high levels of activity.

Discussion

Although it was necessary to introduce substantial systematic errors into our calculations – due to small sample size and the impracticality of conducting in-field measurements of environmental dose rate and sediment moisture content – the OSL analysis provided broad probability distributions for the production date of three ceramic fragments (Table 2). These results are consistent with the stratigraphic position of the ceramic samples analysed and span the expected range of the Ust'-Karenga culture (as estimated from calibrated ranges of existing radiocarbon analysis) (Table 1; Fig. 5). Of course, the correlation is far from perfect, but it was never expected that the results of these analyses would allow us to refine the existing chronology. Instead, the aim was to consider the general trend of dates obtained directly on ceramic material from across the stratigraphic section and to test the general position of the radiocarbon series using a fully independent dating technique. Critically, the aim was to use these results to evaluate two discordant interpretations outlined in the literature (Vetrov 2011). If we plot the OSL dates together with the ranges expected for both of these interpretations then it becomes immediately clear which is the more probable (Fig. 6). Future work on the dating of the site will allow us to further to confirm these results, ideally based on both new OSL dates on ceramics as

Table 1
Таблица 1

Summary of published radiocarbon dates from the Ust'-Karenga complex. Calibration of the radiocarbon dates was performed using OxCal 4.2 and the IntCal13 curve (Bronk-Ramsey 2009; Riemer et al. 2013)

Сводка опубликованных радиоуглеродных дат комплекса стоянок Усть-Каренга. Калибровка дат проведена с использованием программ OxCal 4.2 и IntCal13 кривой (Bronk-Ramsey 2009; Riemer et al. 2013)

Cultural layer (Subsite) Культурный горизонт (пункт)	Lab. number Лабораторный номер	Date (bp) Дата (л.н.)	Error Ошибка	Calibrated range (95.4%) Калиброванный диапазон (95.4%)	Material Материал	References Источник
2/1 (USKA XII) 2/1 (Усть-Каренга XII)	LE-2653	1890	40	AD 28–230 28–230 гг. н.э.	Charcoal Уголь	Vetrov 1986; 1992 Ветров 1986; 1992
	LE-2651	3250	40	1617–1440 BC 1617–1440 до н.э.	Charcoal Уголь	
	LE-2652	3340	40	1739–1521 BC 1739–1521 до н.э.	Charcoal Уголь	
	LE-2650	3670	40	2195–1939 BC 2195–1939 до н.э.	Charcoal Уголь	
3 & 2	No dates available Данных нет					–
4/3 (USKA III) 4/3 (Усть-Каренга III)	IMSOAN-922	6100	400	5844–4081 BC 5844–4081 до н.э.	Wood/Bark Уголь / Кора	Vetrov 1982; 1986 Ветров 1982; 1986
	LE-1961	6890	80	5976–5641 BC 5976–5641 до н.э.	Wood/Bark Уголь / Кора	
4 (USKA III) 4 (Усть-Каренга III)	LE-1960	7230	80	6326–5923 BC 6326–5923 до н.э.	Charcoal Уголь	Timofeev et al. 2004 Тимофеев и др. 2004
5 & 6	No dates available Данных нет					–
7 (USKA XII) 7 (Усть-Каренга XII)	AA-21378	10600	110	10,739–10,206 BC 10,739–10,206 до н.э.	Pottery organic temper Керамика, органический компонент	Vetrov 1995; Kuzmin et al. 2004 Ветров 1995; Kuzmin et al. 2004
	GIN-8067	10750	60	10,794–10,633 BC 10,794–10,633 до н.э.	Charcoal from hearth Уголь из очага	

	AA-60667	10870	70	11,126–10,816 BC 11,126–10,816 до н.э.	Pottery organic temper Керамика, органиче- ский ком- понент		
	AA-38101	11065	70	11,336–10,982 BC 11,336–10,982 до н.э.	Pottery organic temper Керамика, органиче- ский ком- понент		
	GIN-8066	11240	80	10,982–10,726 BC 10,982–10,726 до н.э.	Charcoal from hearth Уголь из очага		
	AA-60202	12170	70	12,302–11,845 BC 12,302–11,845 до н.э.	Charcoal from layer Уголь из слоя		
	AA-60201	12180	60	12,296–11,886 BC 12,296–11,886 до н.э.	Charcoal from layer Уголь из слоя		
7a	No dates available Данных нет						–
8 (USKA III) 8 (Усть- Каренга III)	GIN-8069	12710	380	14,236–11,891 BC 14,236–11,891 до н.э.	Charcoal Уголь	Vetrov 1995 Ветров 1995	
	GIN-6469	12880	130	13,886–13,056 BC 13,886–13,056 до н.э.	Charcoal Уголь		
	GIN-8070	13560	195	15,024–13,866 BC 15,024–13,866 до н.э.	Charcoal Уголь		
	GIN-8668	16430	240	18,496–17,287 BC 18,496–17,287 до н.э.	Charcoal Уголь		
8a	No dates available Данных нет						–

well as sediments, and new radiocarbon series (in clear stratigraphic relationship). Alongside the dating itself, it is vital to consider the environmental, climatic and cultural context in more detail.

One of the principal criticisms levelled by Konstantinov (2009a) at the current stratigraphic interpretation, is that if the sequence were indeed attributable to the late glacial period, it would show a series of four discrete

phases of warming/stability (Layers 8a, 8, 7a, and 7). He considers this to be difficult to explain. Yet many interpretations of the pattern of late glacial climatic change suggest that this kind of multi-phase process should be expected in well resolved alluvial sequences such as this (see Ellis *et al.* 2004; Yu and Eicher 2001). If the sediments at Ust'-Karenga represent such a sequence, then the Upper Vitim presents an ideal opportunity to study human

Table 2
Таблица 2

Summary of the results of the OSL dating programme
Результаты программы ОСЛ датирования

Field code Полевой шифр	Laboratory code Лабораторный шифр	Palaeodose (Gy) Палеодоза (Gy)	External gamma dose rate (Gy/ka) Показатель дозы внешнего гамма-излучения (Gy/ka)	Cosmic dose rate (Gy/ka) Показатель космической дозы (Gy/ka)	Total dose rate (Gy/ka) Показатель общей дозы (Gy/ka)	OSL age estimate (calendar years before 2013) Исчисленный ОСЛ возраст (календарный возраст до 2013 г.)
Layer 4 (USKA045) Культ. горизонт 4 (USKA045)	X6345	44.26 ± 8.95	0.97 ± 0.10	0.23 ± 0.20	4.19 ± 0.30	10560 ± 2260
Layer 6 (USKA038) Культ. горизонт 6 (USKA038)	X6343	51.50 ± 3.76	0.97 ± 0.10	0.23 ± 0.09	3.73 ± 0.23	13820 ± 1320
Layer 7 (USKA035) Культ. горизонт 7 (USKA035)	X6347	131.77 ± 19.41	0.97 ± 0.10	0.21 ± 0.03	8.26 ± 0.50	15960 ± 2540

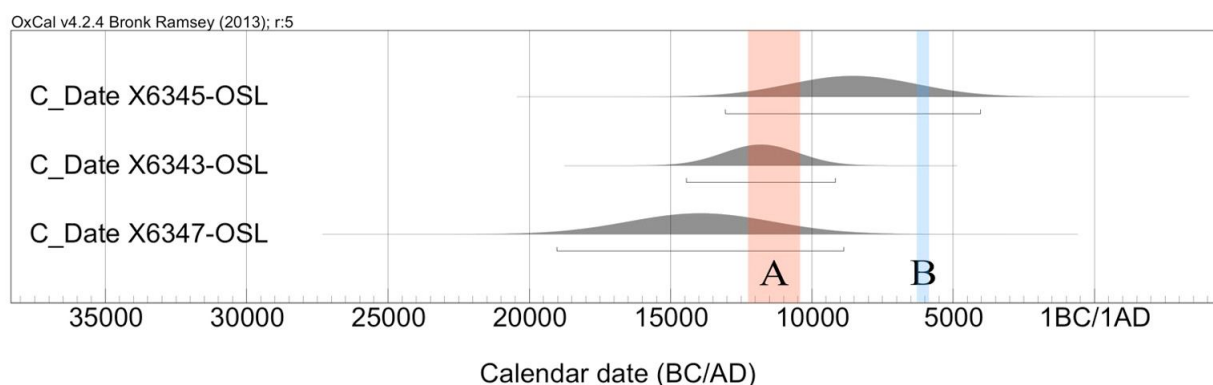


Fig. 5. Showing the OSL results for Ust'-Karenga ceramic fragments from Layers 7, 6 and 4 plotted against (A) date range (calBC) of radiocarbon results from Ust'-Karenga Layer 7 at USKA XII and (B) date range (calBC) of radiocarbon results from Ust'-Karenga Layer 4 at USKA III.

Рис. 5. Демонстрация ОСЛ результатов анализа керамических фрагментов из культурных горизонтов 7, 6 и 4, наложенных на (А) диапазон радиоуглеродных дат (калиброванный возраст, лет назад), полученных по 7 культурному горизонту Усть-Каренги в диапазонах дат USKA XII и (В) диапазон радиоуглеродных дат (калиброванный возраст, лет назад), полученных по 4 культурному горизонту Усть-Каренги в диапазонах дат USKA III

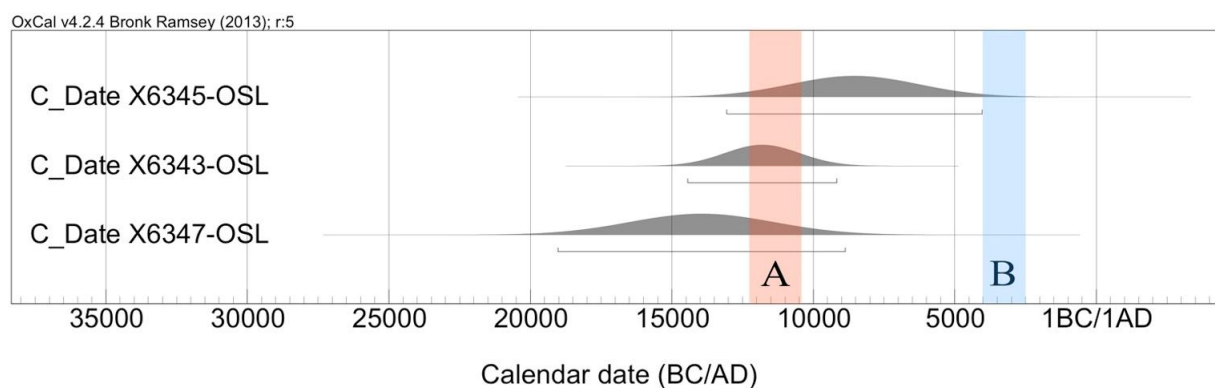


Fig. 6. Showing the OSL results for Ust'-Karenga ceramic fragments from Layers 7, 6 and 4 plotted against (A) date range (calBC) of radiocarbon results from Ust'-Karenga Layer 7 and (B) the 'accepted' age of the Ust'-Karenga ceramic phase in Konstantinov 2009a and 2009b.

Рис. 6. Демонстрация ОСЛ результатов анализа керамических фрагментов из культурных горизонтов 7, 6 и 4, наложенных на (А) диапазон радиоуглеродных дат (калиброванный возраст, лет назад), полученных по 7 культурному горизонту Усть-Каренги и (В) «допущенный» возраст усть-каренгской керамической фазы (Константинов, 2009а, 2009б)

adaptation to catastrophic environmental change. This would certainly require further fieldwork, perhaps at a significant scale.

If we are to take archaeological context into account, as Konstantinov (2009b: 190) rightly requires, we need look at the specifics of the assemblage as a whole within a wider regional context. With this in mind, it is worth noting that the lithic assemblage associated with the early ceramics at Ust'-Karenga – which is based around multi-purpose bifaces and microblade production – is entirely consistent with the lithic industries found at other late glacial/early post-glacial sites in Eastern Eurasia (Vetrov 1995b; Ineshin and Tetenkin 2017). Perhaps more obviously significant is the fact that several early ceramic traditions in the Amur Basin have also produced secure Final Pleistocene/Early Holocene dates (e.g. Derevianko and Dorj 1992; Derevianko *et al.* 2004; Kuzmin and Jull 1997; Kuzmin and Orlova 2000; Shewkomud 2005; Zhushchikovskaya 2005). Some of the material shows clear technological relationships with the early ceramics of the Transbaikal, in general, and Ust'-Karenga in particular (Hommel in press; Shewkomud 2005). This, too, offers considerable strength to the excavator's interpretation of the site. Further support for early

ceramic sites in the Transbaikal is found in the consistent results from a recent re-dating of a problematic sequence at Studenoye and new research at the site of Krasnaya Gorka (Razgildeeva *et al.* 2012; Tsydenova *et al.* 2017). Our research suggests that there is no systematic reason to expect these radiocarbon dates to be problematic, though it would be interesting to extend our evaluation to some of these contexts as well.

Conclusion

While it is important to maintain a critical stance in the face of scientific data, and while it is always essential to consider all available archaeological, environmental and stratigraphic contexts. It is vital that new data is presented to support or challenge existing interpretations.

In the case of Ust'-Karenga, errors vocally attributed to perceived problems with radiocarbon dates at a regional scale have been refuted in this paper by applying an absolute dating technique based on independent physical phenomena. While the broad probability ranges calculated for the dates leaves plenty of room for further research and discussion, the consistent correlation between luminescence dates and radiocarbon results strongly supports

the latter's validity. Although there is no doubt that the chronology of early Neolithic sites needs to be further refined. It is hoped that future discussions will rest on scientific data and that other forms of investigation into the character of life in the past will become an equally important focus.

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Attribution criteria

Vetrov V.M. during the excavations of the Ust-Karenga site obtained field archaeological materials, the analysis of which is given in the article. Hommel P.N., Schwenninger J.-L., Ineshin E.M. completed the research work, based on the obtained results, generalized and wrote the manuscript, and have copyright to the article and bears equal responsibility for plagiarism.

Conflict of interest

The authors state that there is no conflict of interest.

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Критерии авторства

В.М. Ветровым во время раскопок стоянки Усть-Каренга были получены полевые археологические материалы, анализ которых приводится в статье. П.Н. Хоммел, Ж.-Л. Швеннингер и Е.М. Инешин выполнили исследовательскую работу, на основании полученных результатов провели обобщение, подготовили рукопись и документы к печати, имеют на статью авторские права и несут полную ответственность за ее оригинальность.

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