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## Directly dated broomcorn millet from the northwestern Caucasus: Tracing the Late Bronze Age route into the Russian steppe



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### ABSTRACT

This paper provides new radiocarbon dates for preserved remains of broomcorn millet discovered in Bronze Age occupation layers at the Guamsky Grot rock shelter in the northwestern Caucasus. The millet grains directly date between the 12th–10th centuries BC, which complements dates obtained on wood and bone samples from the same layer. The pottery assemblage retrieved from layer 4/5 in Guamsky Grot where the millet was found has stylistic similarities with the Kobyakovo and proto-Maeotian cultures. Concentration of carbonized unhusked millet seeds in a fireplace together with fragments of flat calcined stones implies the seeds drying in the course of which the grains accidentally burned down. All Late Bronze Age sites in the West Caucasus where millet has been discovered represent kindred cultural traditions originating from the proto-Colchis, the Ochamchiri and the Dolmen cultures. Taking into account the finds of broomcorn millet in the Kobyakovo layer at the Safyanovo site (the Lower Don area), it may be suggested that the millet growing tradition north of the West Caucasus, probably, spread together with the West-Caucasian ‘Kobyakovo’ population, which were sedentary and established settlements in the Steppe: first in the Kuban River Region and then further northward – in the Lower Don River Region. It is precisely the region where the harvesting bronze sickles of the Kuban group came in to use in the second half of the second mill. BC.

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### 1. Background

The term millet refers to cultivated small-seeded grasses, which belong to the Panicoid subfamily and the Paniceae tribe. There were at least 18 millet species cultivated at various times in prehistory, many of which are still cultivated (Fuller, 2013) in different continents. Along with wheat, barley and rice, broomcorn millet (*Panicum miliaceum* L.) is one of the earliest domesticated plants, and has been an important source of vegetable carbohydrates and proteins for millennia. Depending on the localization of the wild ancestry, climatic conditions and cultural traditions, each of these grain species has its own history of domestication and spread. The history of broomcorn millet appears to be the most intricate and complicated.

Most scholars tend to agree that broomcorn millet was first domesticated in the northern parts of present-day China roughly 6000–5500 cal. BC, which is confirmed by finds of millet grains at several Early Neolithic sites (Weber and Fuller, 2008; Hunt et al., 2008; Bettinger et al., 2010; Zhao, 2011; Miller et al., 2016). Additional

supporting evidence comes from stable isotope studies of human and animal bones, which demonstrate a regular consumption of plants with a C<sub>4</sub> type of photosynthesis starting from the Early Neolithic exactly in the aforementioned region (Liu et al., 2012). A few scholars have suggested earlier dates for domestication, based on phytolith analyses (Lu et al., 2009); although, these claims require reliable morphological evidence for domestication using plant remains (Zhao, 2011; Zohary et al., 2012; Miller et al., 2016).

This research is complicated by the fact that the wild ancestor of broomcorn millet is still unknown (Zohary et al., 2012; Hunt et al., 2011, 2014); furthermore, the earliest finds of millet grains have been recorded, not only in Northern China, but also in Eastern Europe, specifically from the Caucasus (more than 30 sites: Hunt et al., 2008). However, recently conducted direct <sup>14</sup>C AMS-dating of ten millet samples from Neolithic layers (thought to pre-date 5000 BCE) at seven settlements in Central and southeastern Europe has revealed that all these finds are intrusive species. All of these grains turned out to be more recent than the mid-second millennium BC, and, in most cases, were more recent than 1000 BCE, some even dated to early medieval times (Motuzaitė-Matuzevičiūtė et al., 2013). Hence, the ancient designation of all of the earliest millet remains in Europe has been called into question.

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This study, along with other recent studies conducted to date grain remains (Borojevic, 2011; Stevens and Fuller, 2012; Pelling et al., 2015), has clearly demonstrated that the archaeological context of an archaeobotanical find (especially of small seed remains) does not always provide reliable information about its age. Hence, the issue of intrusive species poses a more significant research challenge now than it did a couple of decades ago. No matter how reliable the archaeological context would appear to be, the need to conduct direct radiocarbon dating, especially, for the earliest grains and seeds, as well as for plant species newly discovered in a specific region, is becoming more pressing.

Studying the history of the spread of domesticated grains, including millet, is an important component of the endeavor, aimed at reconstructing the way large population groups organized their subsistence systems. The top priority for our team is to determine where, when and in what natural and historical conditions millet was first cultivated once it reached the vast expanses between East Asia and Western Europe, reliably mapping the spread of this major food and forage crop. In many ways this goal coincides with the wider objectives declared in the ORIMIL Project, a French initiative headed by Estelle Herrscher (see <http://www.agence-nationale-recherche.fr/?Project=ANR-12-JSH3-0003>).

Our study aims to analyze the archaeological and cultural contexts of the first and so far, the only <sup>14</sup>C dated millet sample from in a multi-layer site known as Guamsky Grot. These dated grains represent the only early direct dates for millet grains in the Western Caucasus.

**2. Guamsky Grot: archaeological and cultural context**

Guamsky Grot is a rockshelter located in the Northwest Caucasus approximately two kilometers from the Guamka railway station (Apsheon district of the Krasnodar Region) on the northern slope of the

Guamsky range (44° 13.453' N, 39° 54.893' E, 400 m A.S.L. on the right bank of the Kurdzhips River) (Fig. 1).

The site was discovered by V.E. Schelinsky in 1975 and excavated in 1985–1989 by the Kuban expedition of the Leningrad branch of the Institute of Archaeology, Academy of Sciences, USSR, now the Institute for the History of Material Culture, St. Petersburg (Trifonov, 1990).

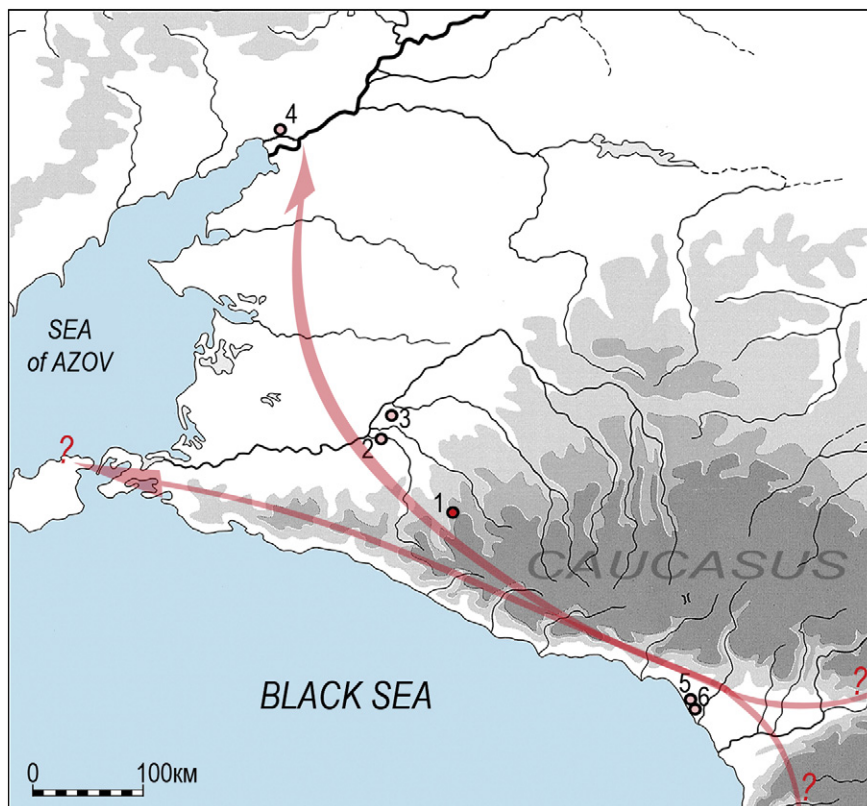
The rockshelter is a natural formation in heterogeneous limestone and is a shell-like alcove of around 700 m<sup>2</sup>, out of which around 200 m<sup>2</sup> have been excavated. The total thickness of the deposits inside the rockshelter varies from five to seven meters. Fourteen main lithological layers have been singled out by color and structure; stratigraphically, they are associated with archaeological materials dating to the Eneolithic Age, the Bronze Age, the Early Iron Age and the medieval period.

All layers are rich in charcoal, ash and bones of wild and domesticated animals.

A concentration of charred millet grains in the form of a caked mass that also contains fragments of burned limestone was identified in fireplace 2, located at the bottom of layer 4/5 near the western wall of the rockshelter in the course of excavations in 1986 (Trifonov, 1987). The fireplace, which is almost two meters in diameter, was made of stones placed along the perimeter of an oval spot of calcined loam. The thickness of the calcined loam was approximately 20 cm.

The thickness of layer 4/5 does not exceed 30 cm. In some sections, the layer is divided into two streaks of loam of different color; where the layer is less than 10 cm thick; there is no distinction in color. The layer is abundant with chipped stone and detritus. Regarding its structure and color, it is substantially different from overlying layer 3B and underlying layer 6A (Fig. 2).

The most typical archaeological material is represented by handmade pottery, including pots with a smooth collar under the rim, burnished bowls, ladles and burnished dishes, ornamented with incised



**Fig. 1.** Map of Western Caucasus and Lower Don area showing locations for sites dated to II-nd mill. BC, where millet (*Panicum miliaceum* L.) was found: 1 – Guamsky Grot, 2 – Chishkho, 3 – Lesnoe, 4 – Safianovo, 5 – Dikha Gudzuba, 6 – Pichori. The red arrows show possible directions of the Millet spread through the Western Caucasus into the Lower Don area and Crimea.

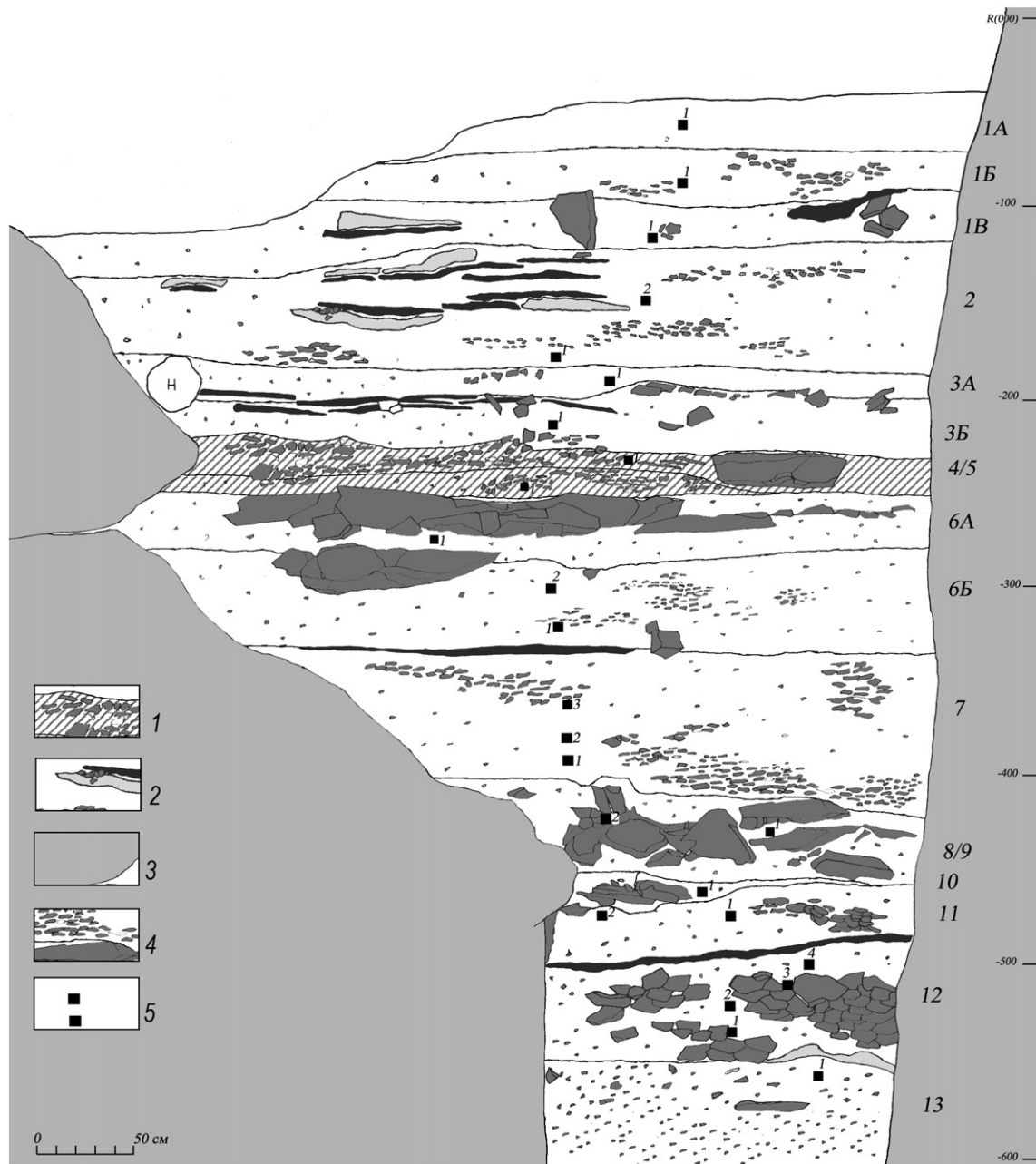


Fig. 2. Guamsky Grot, stratigraphic profile, section S-E, 1986: Legend: 1 – layer 4/5, 2 – charcoal and ash, 3 – rock, 4 – broken rock, 5 – soil samples.

zigzags, triangles, and rhombs filled up with vertical, inclined or net-like hatching.

In the North Caucasus and the Trans-Kuban Region this pottery, on the one hand, has some stylistic similarities with proto-Maeotian ceramics and, on the other hand, it shares common traits with pottery of the Kobayakovo culture (Anfimov and Sharafutdinova, 1982; Sharafutdinova, 1989).

The pottery assemblage from layer 4/5 in Guamsky Grot demonstrates a clear continuity in its development compared with an earlier tradition represented by ceramics from underlying layer 6A with clear traits of a classical Kobayakovo ornamental tradition of zigzag-like and triangular patterns made by cord impressions (Sharafutdinova, 1980).

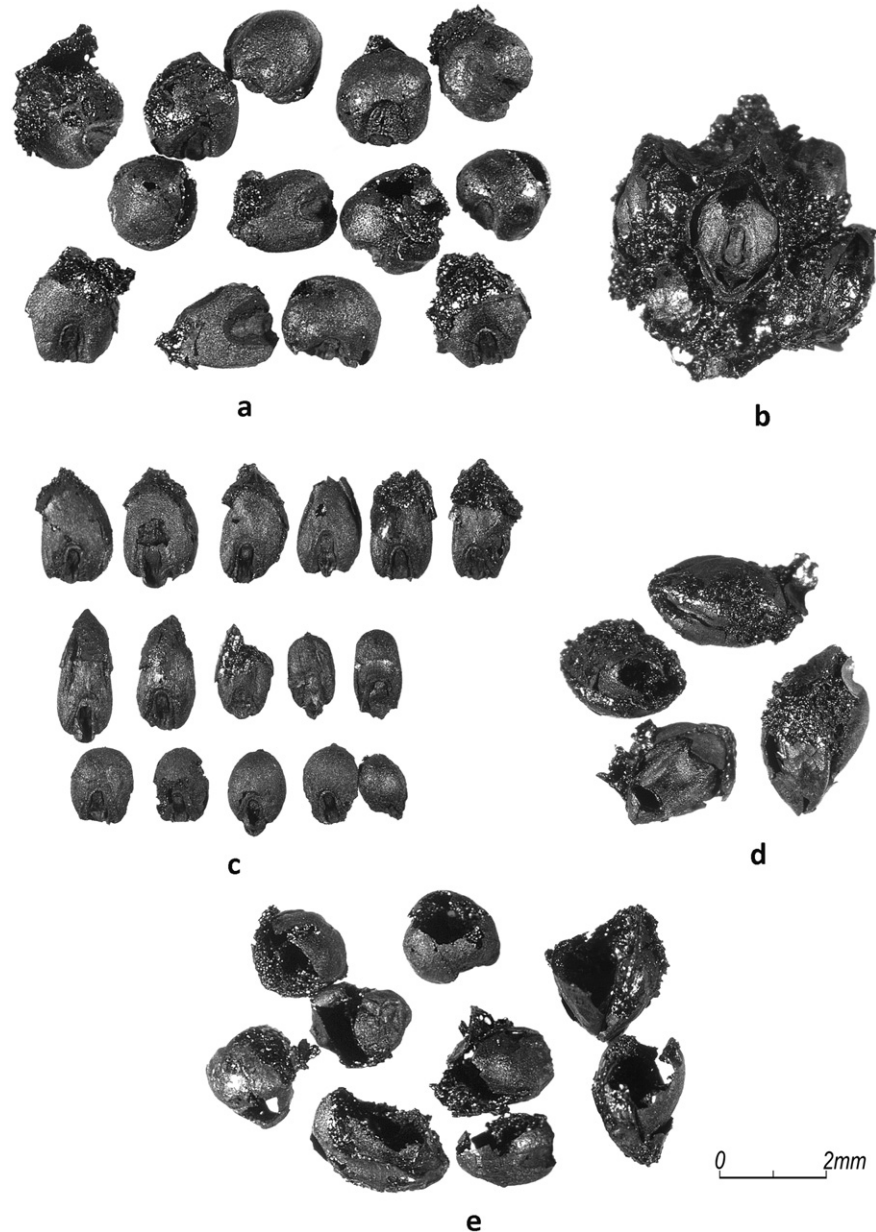
Given the aforementioned cultural remains, the artifacts retrieved from layer 4/5 (where the millet grains were recovered) may represent the late development stage of the same Kobayakovo cultural tradition, to which artifacts of the preceding period found in layer 6A are attributed. The latter artifacts are inseparably linked to the dolmen ceramic

tradition represented in underlying layers 6B–9. This development trajectory describes the development of the proto-Maeotian cultural tradition of the Late Bronze Age–Early Iron Age in the North Caucasus (Kohl and Trifonov, 2014).

### 3. Archaeobotanical study

Numerous millet grains, all from the same hearth feature, were used together in order to obtain a radiocarbon date from the laboratory of the Institute for the History of Material Culture (IHMC RAS), St.-Petersburg (1988). The preserved grains were sent to the Laboratory of Scientific Methods at the Institute of Archaeology, RAS, in 2015.

The dated sample consists of several small lumps of grains (from 1 to 3 cm in diameter) and shattered grains (Fig. 3, a–e). The total sample size did not exceed 40 ml, including 15 ml of shattered grains. No extraneous impurities such as soil, small pebbles, burned clay and even charcoal were identified in the sample.



**Fig. 3.** Millet (*Panicum miliaceum* L.) seeds from layer 4/5, Guamsky Grot, N-W Caucasus: a – ripe seeds, b – seeds enclosed in lemma and palea, c – seeds at different stages of maturity, d – lump of seeds, e – hollow (burnt out) seeds. Scale bar 2 mm.

We did not attempt a total abundance count of the grains present in the sample, due to the high level fragmentation, most likely, caused by a high burning temperature and subsequent taphonomic processes. A substantial number of the caryopses preserved only outer frame, while the main part of endosperm almost completely burned away (Fig. 3, e), making the grains very brittle and crumbly. The millet grains were still enclosed in their chaff when carbonized (Fig. 3, b, d); although, with some minor exceptions, the grains shattered from the lumps separated from the lemma and palea (Fig. 3, a, c). The grains are small, with the largest specimens not exceeding 2 mm in length. Unfortunately, the poor state of preservation prevents accurate measurements and precise average calculation of the grain sizes.

Despite the preservation conditions of the sample, the identification of the grains as broomcorn millet (*Panicum miliaceum* L.) is clear. The morphology of the caryopses is characteristic of the domesticated grain, notably in their overall form, size and the position of the embryo. The specimens that are still articulated in their hull also help with identification. Variations in the grain shape – from rounded (almost

spherical) to elongated with pointed apex (Fig. 3, a, c) – are quite common in archaeological millet concentrations as millet seeds ripen unevenly. When mature seeds in the upper part of the panicle start shattering, the seeds in lower spikelets are still unripe and characterized by narrow and elongate shape (Yakushkin, 1953). Studying the morphology of such small seeds is extremely important for developing criteria for recognition of millet versus small-grained weedy taxa (Motuzaitė-Matuzevičiūtė et al., 2012; Song et al., 2013). Undeveloped or immature grains from Guamsky Grot are depicted in seed cluster d in Fig. 3.

The grain assemblage from the Guamsky Grot contained only four seeds of weed plants, i.e. barnyard grass (*Echinochloa crus-gali*, 1 seed), and goosefoots (*Chenopodium album*, 1 seed and Chenopodiaceae, 2 seeds).

Under certain conditions, incompletely developed (or immature) grains are interpreted as by-products after threshing and winnowing (Song et al., 2013). However, in our case, given the circumstances of the find (the caked homogenous mass, a lack of external impurities),

**Table 1**  
Guamsky Grot:  $^{14}\text{C}$ -LSC dating of the millet and charcoal samples from layer 4/5.

Item	Lab index	Layer	Square	Sample	$^{14}\text{C}$ age, years ago	BC calibrated. OxCal 3.10 1 $\sigma$
1	Le-4235	4–5	69/70–86/87, Fireplace 2	Charred millet grains <i>Panicum miliaceum</i>	2670 $\pm$ 120	1010 BCE (60.7%) 750 BCE
2	Le-4231	4–5	69/70–86/87 Fireplace 2	Charcoal	2900 $\pm$ 80	1220 BCE (65.3%) 970 BCE
3	Le-4236	4–5	69/70–86/87 Fireplace 2	Charcoal	2850 $\pm$ 75	1130 BCE (68.2%) 910 BCE

the find is unlikely to have been waste thrown into the fireplace. Most likely, the grains were deliberately placed on flat stones where they were dried in small portions. Heating of hulled cereals (wheat, barley and millet) is a common ethnographically documented practice that makes dehusking easier (Hillman, 1984; Moreno-Larrazabal et al., 2015). Hence, the grains burned in fireplace 2 are, probably, the result of an unsuccessful attempt to process millet before it could be consumed.

#### 4. Radiocarbon dating

To determine the age of the burned millet and describe the archaeological context in which it was found, grain samples, charcoal from the fireplace where the millet grains were found and a wild boar bone from the grid square next to the fireplace were dated. One grain sample and two charcoal samples were dated by the Institute for the History of Material Culture, RAS, using a traditional liquid scintillation counting (LSC) method (Table 1), whereas a second millet sample and the animal bone (wild boar) were dated with the use of the Accelerator Mass Spectrometry (AMS) method in the Groningen Laboratory (Netherlands) (Table 2).

On the whole, taking into account differences in the dating methodology and the nature of the samples (bone, grains, and charcoal), all measurement results are quite consistent with each other (Fig. 4, 1). A considerable statistical error ( $\pm 120$  years) in the traditional measurement of the grain sample is explained by the sensitivity of the method to the small size of the sample.

Ultimately, the period between the 12th and the 10th centuries BC applies both to the millet grains from Guamsky Grot and the layer 4/5 where they were found (Fig. 4, 2).

#### 5. Discussion and conclusions

The millet remains from Guamsky Grot are the first and so far the only directly dated grain in the West Caucasus, though it is not the only millet find at the archaeological sites of the region. In the North-west Caucasus piedmont area, broomcorn millet grains were found in the occupation layers at Lesnoye and at Chishkho (Lebedeva, 2011a) attributed to the Kuban River sites of the Kobyakovo type (Chernykh, 2009) as is the case with artifacts from layers 4/5–6A in Guamsky Grot. The occupation layers at these settlements are dated to the second half of the second millennium BC, which is confirmed by  $^{14}\text{C}$ -date of animal bones from layer 6A in Guamsky Grot (Trifonov et al., 2012). It is also implied by  $^{14}\text{C}$ -dates of the artifacts from recent excavations of

Kobyakovo settlements in the Don River delta (Dally et al., 2012; van Hoof et al., 2012).

Excavations at Dikha-Gudzuba and Pichori, which are proto-Colchis settlements located on the Black Sea coast in Colchis lowland have yielded seeds of broomcorn millet and possibly foxtail millet (*Setaria italica*), known in the Caucasus as mohar (*Setaria italica* (L.), or liberty millet (*Setaria italica* Beauv.), which have been found in the layers dated to the third through the second millennium BC (Lisitsyna and Prischepenko, 1977; Rusishvili, 1990).

It should be emphasized that all Late Bronze Age sites in the West Caucasus where millet has been discovered (Rusishvili, 1990) represent kindred cultural traditions originating from the proto-Colchis, the Ochamchiri and the Dolmen cultures (Dzhibladze, 2007; Apakidze, 2009; Trifonov, 2011).

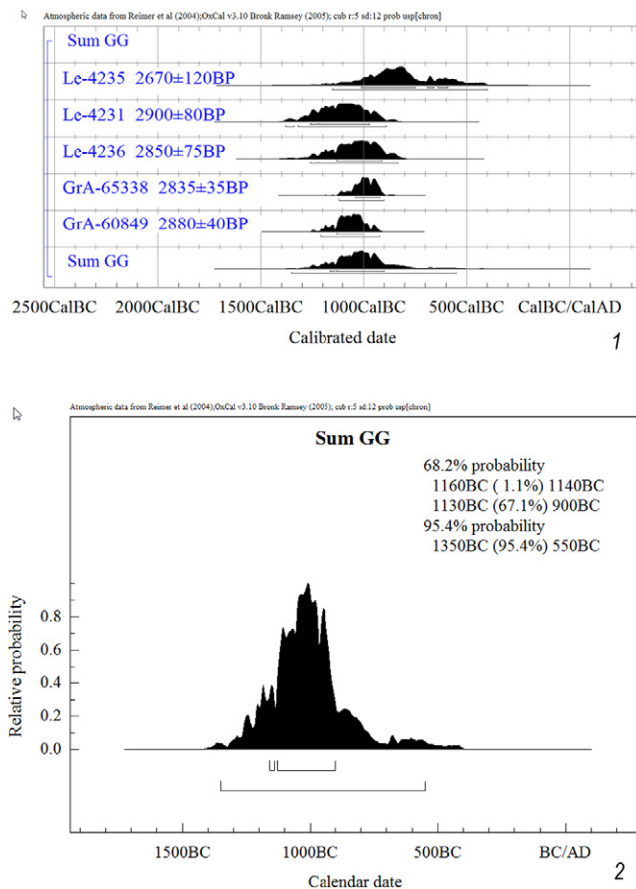
The issue of where millet came from to the West Caucasus should be reviewed within the overall context of its spread across all of Eurasia; however, the Eurasia archaeobotanical map is still too patchy. The South Caucasus where millet has been found in the Eneolithic–Early Bronze layers (in the modern chronology, roughly sixth to fourth millennium BC) at several settlements (Lisitsyna and Prischepenko, 1977; Rusishvili, 1990) may turn out to be the nearest region with millet presence; however, presently, this suggestion cannot be reinforced with hard evidence. The weakest point of the hypothesis concerning the early spread of millet in the South and West Caucasus is, first of all, its indirect (based on the archaeological context) dating at multi-layer sites of the South Caucasus and Colchis, where a possible intrusion of the grains from the upper layers to the lower layers cannot be excluded.

The fact that millet is absent in the recently collected archaeobotanical assemblage from Arukhlo I, which is a Neolithic site, where millet was recorded earlier among the excavation materials discovered by T.N. Chubinishvili in the 1970s (Lisitsyna and Prischepenko, 1977; Hansen et al., 2013) should not be disregarded either. More importantly, the finds of millet or millet pollen, if the latter are really can be distinguished from wild panicoid pollens, in the graves (Kvavadze, 2016) and layers dated to the period before 2000 BCE at sites in the Caucasus are very rare and not numerous (Rusishvili, 1990).

We conclude, therefore, that currently it is not possible to evaluate with confidence the role of the Caucasus in the routes of spread of millet. Archaeobotanists will continue searching for new finds of this grain in the Caucasus and the abutting areas, and running direct dates on the material. In this sense, the directly dated millet remains from Guamsky Grot are vital to our understanding of the spread of one of the world's most important grain crops, providing one of the only early data points from the Caucasus. While we cautiously present this hypothesis, the

**Table 2**  
Guamsky Grot:  $^{14}\text{C}$ -AMS dating of the millet and charcoal samples from layer 4/5.

Item	Lab index	Layer	Square	Sample	$^{14}\text{C}$ age, years ago	BC calibrated. OxCal 3.10 1 $\sigma$
1	GrA-65,338	4–5	69/70–86/87, Fireplace 2	Charred millet grains <i>Panicum miliaceum</i>	2835 $\pm$ 35	1040 BCE (68.2%) 920 BCE
2	GrA-60,849	4–5	101	Wild boar <i>Sus scrofa</i>	2880 $\pm$ 40	1130 BCE (68.2%) 1000 BCE



**Fig. 4.** <sup>14</sup>C-dates for Guamsky Grot, layer 4/5. Comparison (1) and summed probability distribution (2) of direct millet dates (Le-4235, GrA-65338) and dates of samples from the layer 4/5.

finds of broomcorn millet in the Kobayakovo layer at the Safyanovo site (van Hoof et al., 2012), may suggest that millet was grown north of the West Caucasus in the late second millennium B.C. Furthermore, we pose the possibility that the grain spread together with the 'Kobayakovo' population, which was a sedentary population with permanent domestic structures. The Kobayakovo material culture is first present in the Kuban River Region and then further northward - in the Lower Don River Region. It is noteworthy that it is precisely the region where the harvesting bronze sickles of the Kuban group came in to use in the second half of the II mill. BC (Dergachev and Bochkarev, 2002).

After millet appeared in the West Caucasus at least by the second half of the second millennium BC, it continued to be used as a staple crop throughout the following three millennia (Lebedeva, 2009, 2011b), until it was replaced by maize (*Zea mays* ssp. *mays*), which was introduced from Turkey not earlier than the 18th century (Kantaria, 1989). Cuisine and preferences in food are some of the most characteristic cultural traditions of a people, and, from this point of view, millet consumption is an independent indicator of cultural continuity between different historical periods in the West Caucasus.

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