THE DOLMEN KOLIKHO, WESTERN CAUCASUS: ISOTOPIC INVESTIGATION OF FUNERAL PRACTICE AND HUMAN MOBILITY

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ABSTRACT. We investigated the dolmen known as Kolikho (Black Sea coast, Russia), discovered accidentally in 2008. It is a unique, undisturbed megalithic structure. The burial chamber contains disarticulated human remains from about 70 individuals. Radiocarbon dating shows that the dolmen was in use between roughly the 19th to 13th centuries BC. Strontium isotopes are used to investigate the origin and last residence location of the people buried in the structure.

INTRODUCTION

From the late 4th/early 3rd to the end of the 2nd millennium BC, the western slopes of the Caucasus Mountains were inhabited by cultures characterized by dolmens. These are massive megalithic mortuary constructions. These structures are found distributed on both slopes of the Great Caucasus range and along the Black Sea coastline, from the Taman Peninsula in the northwest to the Kolkhida Depression in the southeast (see Figure 1). At present, about 3000 dolmens are documented and are usually clustered in groups. The largest cluster consists of about 500 dolmens (Markovin 1978; Trifonov 2001). The Caucasian dolmens belong to a general class of megalithic tombs, widespread in Asia and western and northern Europe (Childe 1947–1948).

For the Caucasus, the dolmens represent a unique type of tomb architecture. They show a variety of chambered cairns and are built using giant stone blocks, which fit the cover of the chamber precisely. An additional feature of the western Caucasus dolmens is an early example of regular ashlar masonry. The most striking common feature to these dolmens is a relatively small (25–45 cm in diameter) entrance aperture. This entrance enabled access to the burial chamber for periodic interments, and can be closed by a stone plug.

Despite extensive studies in the past, the origins of the Caucasian dolmens remain unknown. Since the early 19th century, numerous hypotheses have been proposed to explain these origins in terms of migrations (de Montpereux 1843; Uvarov 1876, 1878; Tallgren 1933; Childe 1947–1948). However, the social context remains a mystery to the present day.

Studies of the burial remains have been seriously hampered because of destruction that has taken place on a large scale. Many conclusions of past studies are therefore based on incomplete or unreliable data. New and unique data became available recently due to the accidental discovery of an undisturbed dolmen in 2008. After seasonal flooding during that year, a previously unknown dolmen was discovered in the Tuapse region of the Black Sea coast in the Kolikho Valley, at 44°10.506′N and 34°04.632′E (see Figure 2). It had been buried under a 3-m-thick alluvial deposit. This dolmen, known as Kolikho, remained untouched since the Late Bronze Age. It is the first dolmen in the Caucasus that enables the study of human remains from an undisturbed sealed burial chamber.

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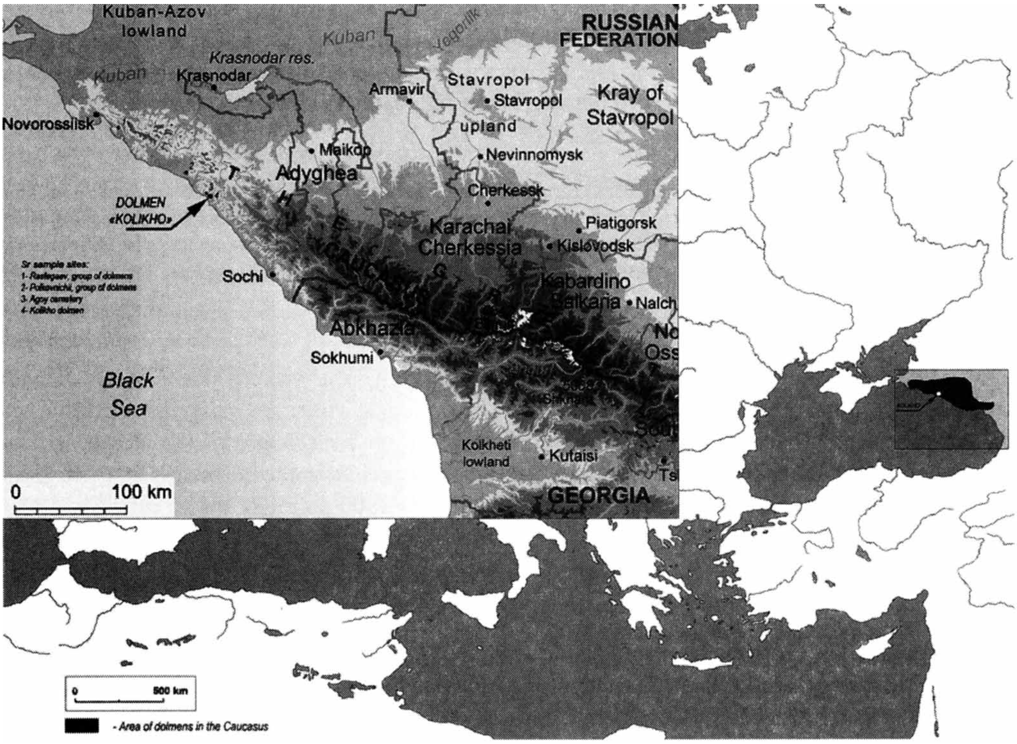

Figure 1 Map of the western Caucasus region. The Kolikho dolmen and Sr sample sites (1–4) are indicated

Figure 2 The Kolikho dolmen during the rescue excavation in August 2008

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The burial chamber was quite small: 1.3 × 1.4 × 1.5 m. It was packed with partly disarticulated skeletons of about 70 individuals (Figure 3). All remains were placed in the chamber through the entrance hole at the front. There are indications that the bodies were placed in the chamber after they were dried or defleshed. To obtain space on the stone floor in the chamber for each successive interment, the human remains of previous inhumations were moved to the side. Over time, this resulted in a stratified accumulation of human bones along the walls of the burial chamber.

Figure 3 The Kolikho dolmen, showing the burial chamber and the human remains (detailed in top left inset)

The discovery of the Kolikho dolmen provides an unique opportunity to investigate the most important questions about the megalithic tomb burial practices in the Caucasus: when were the remains buried; for how long has the dolmen been in use; where did the people buried in the tomb originate; and where did they live? Here, we report on the first investigations concerning this unique find.

METHODS

For radiocarbon dating, the datable material for bone is collagen. The extraction of this collagen takes place following a standard procedure developed by Longin (1970). For conventional dating, the ^{14}C activity of the bone collagen is measured by liquid scintillation counting (LSC) at the Saint Petersburg laboratory (lab code Le). For accelerator mass spectrometry (AMS) analyses performed in Groningen (lab code GrA), the collagen is combusted, purified, and transferred into graphite. The graphite is pressed into target holders for the ion source of the AMS. The AMS then measures the $^{14}C/^{12}C$ and $^{13}C/^{12}C$ ratios of the graphite, from which the ^{14}C age is determined (van der Plicht et al. 2000).

For Sr analysis, bone samples (femurs) of 200 mg were powdered in a mortar. They were treated using standard protocols: cleaned in a HCl solution to remove organic material, carbonate, and surface contamination, followed by centrifuging and dissolving in HF/HNO_3. The Rb/Sr fraction is extracted by chromotography, using an AG50W-X8 resin. The isotope ratios are measured by the multicollector mass spectrometer TRITON at the Institute of Geology and Geochronology in Saint Petersburg. The measured isotope ratios are normalized to the international standard NIST-987. The protocol is standard and described in detail by Derry et al. (1994).

Radiocarbon Dating: Age and Duration of the Kolikho Dolmen

Prehistorians assumed for a long time that the Caucasian dolmens were permanent structures for collective burials. The common explanation for burial practice was that the bodies were successively deposited on the chamber floor by funeral attendants, entering the dolmen through the roof after removing a capstone. The size of the entrance hole, with a diameter ranging from 25 to 45 cm, was thought to be too small to serve as an entrance. It was therefore generally accepted that the entrance hole had a symbolic function, such as usage for ritual feeding of ancestors, or an opening through which the soul of the deceased could come and go (Markovin 1978). There is an obvious problem with this theory: it would have been very unlikely that the massive capstones were removed for burials.

An alternative explanation is that the corpses were prepared before burial, until they were totally defleshed, or held together partially by residual undecayed body tissue. This allowed final deposition of the remains in the burial chamber through the entrance hole. The size of the hole is large enough to push a body or set of bones including the skull through (Kuftin 1949; Soloviev 1960).

Until recently, the precise circumstances of either direct or later burial remained unknown because of past intrusions in the free-standing dolmens, and due to poor excavation practices in the past (Rezepkin 2010). Also, older and more naive views—like corpses in a sitting posture (Felitsyn 1904)—are still referenced in recent publications (Markovin 1997). It seems hard to believe, but a sepulchral function for the dolmens was considered very unlikely until recently (Smirnov 2009).

The precise circumstances of the burials of human remains are obviously crucial for a proper understanding of the purpose of the dolmens. The distinction between direct or later interment identifies significant cultural features, distinguishing groups of dolmens from each other, just as architecture, building techniques, or pottery designs are distinctive. The Kolikho dolmen provides now for the first time an opportunity to apply ^{14}C dating for this burial practice (Zaitseva et al. 2010). A large amount of human bones (~70 individuals) were accompanied by only a very small number of grave goods: 2 badly damaged pots, 1 small bronze javelin head, 1 bone belt buckle, and 1 stone disk with signs inscribed.

A cross-section of the dolmen and location of the samples is shown in Figure 4. A series of 9 samples (1 charcoal, 8 human bones) was collected from the accumulation of the human bones along the burial chamber walls, and from the bottom of the cultural deposits overlaying the burial chamber and cairn. In spite of the disturbance, the succession of interments is generally conserved in the deposit. Because the size of the burial chamber is so small, the deposit can be viewed as a stratified accumulation of bones. The aggregated thickness of the deposit ranges from 60 to 80 cm. Samples for dating were taken from the top to the bottom. The difference in depth between the sampled horizons is about 10 cm.

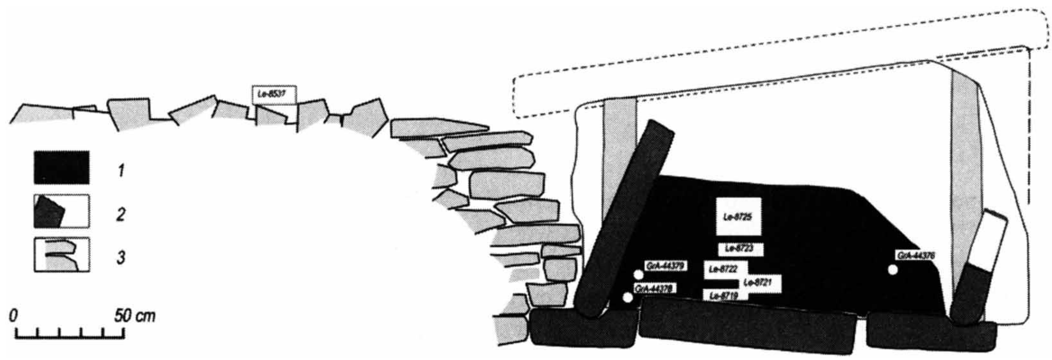

Figure 4 Cross-section through the burial chamber and the cairn of the Kolikho dolmen. The location of the ^{14}C samples are indicated by their laboratory codes (Le and GrA): 1) accumulation of human bones; 2) sandstone slabs; 3) stones of the cairn.

The samples were dated in Saint Petersburg (Le, conventional) and in Groningen (GrA, AMS). Three bone samples from particular individuals were dated by AMS. Five conventional samples consist of a set of bones from particular spots in the stratified accumulation. The latter do not necessarily correspond to individual skeletons. The results are shown in Table 1.

Table 1 ^{14}C dates of the samples from the Kolikho dolmen. Dates and calibrated age ranges are given at 1σ confidence level.

Nr	Sampling location	Material and sample code	Lab code	^{14}C date (BP)	Calibrated age (BC)
1	Burial chamber, floor level	Human bone 08-918	GrA-44378	3505 ± 30	1850–1770
2	Burial chamber, floor level	Human bone	Le-8719	3350 ± 80	1740–1520
3	Burial chamber, level 800	Human bone	Le-8722	3210 ± 120	1640–1370
4	Burial chamber, level 900	Human bone	Le-8721	3140 ± 100	1520–1290
5	Burial chamber	Human bone 08-922	GrA-44379	3195 ± 30	1495–1435
6	Burial chamber, level 700	Human bones	Le-8723	3050 ± 120	1440–1120
7	Burial chamber, top of accumulation	Human bone 08-138	GrA-44376	3015 ± 30	1320–1250
8	Burial chamber, level 600–100	Human bones	Le-8725	2930 ± 170	1320–930
9	Bottom of the cultural deposits overlaying the burial chamber and cairn	Charcoal	Le-8537	2720 ± 30	900–830

The ^{14}C dates show good agreement with the stratigraphic depth. They are consistent with a continuous chronology. The results show that the dolmen was in use for about a millennium. The conventional dates have poor precision; however, when we consider only the AMS dates, which have the best measurement precision, the time period is about the 19th–13th century BC.

The later cultural deposit with charcoal dates to the beginning of the 1st millennium BC, after which the alluvial deposits buried the dolmen. The possibility of a reservoir effect present in the human bone dates needs to be considered. Such effects have been observed for this region (e.g. Shishlina et al. 2007). Reservoir effect studies require paired dates of bones with associated samples like plant remains or herbivore animal bones. Unfortunately, such sample materials are not available. Stable isotope ($\delta^{15}N$) analysis of the human bones is planned, and may shed light on the possible existence of reservoir effects.

Strontium Isotope Analysis: Origin of the People Buried in the Dolmen

Identification of local and non-local individuals buried in the Kolikho dolmen is possible by means of strontium (Sr) isotope analysis of human skeletal remains. This method has provided important results in archaeology for the last 20 yr, in particular by characterizing past human migration and mobility (e.g. Price et al. 1994).

Sr isotope analysis can be used to determine the region where people spent their childhood (based on $^{87}Sr/^{86}Sr$ ratios in tooth enamel samples) as well as the last decade of their lives (based on $^{87}Sr/^{86}Sr$ ratios in bone samples). Unfortunately, for Kolikho there are obvious problems with unambiguously identifying the complete set of bones of every single skeleton. To make room for successive burials, earlier human remains were disturbed, and skulls (being the most bulky components) were detached and moved to the sides of the chamber. Therefore, we were unable to reconstruct the individual identity of skulls and sets of long bones. This seriously hampers direct comparative analysis of Sr isotopes in tooth and bone samples for one and the same individual.

We therefore used the following strategy. The tooth enamel samples and bone samples were assumed to represent different individuals. In the course of the analysis, we took into account that bones, in contrast to tooth enamel, exchange strontium with the environment during the life of an individual, so that the $^{87}Sr/^{86}Sr$ ratio changes according to the local geology of a new residence. Postmortem Sr contamination of local origin can also change the antemortem $^{87}Sr/^{86}Sr$ ratio in bones (Bentley 2006). The turnover of Sr in bones during a human lifetime is quite slow and can take 7 yr or more, while the period of complete substitution of the lifetime Sr in bones for Sr from the burial environment varies (Sjögren et al. 2009). In practice, this means that the $^{87}Sr/^{86}Sr$ ratio in bones differing more than ~0.001‰ from the local isotope ratio may indicate individuals who spent at least the last 7–10 yr of their lives outside the region where they were buried.

To reveal the region where people from the Kolikho dolmen spent the last decade of their lives, 47 bone samples were taken from 47 individual cortical femurs, which were attributed to 25 male individuals and 10 female individuals; 12 femurs have not been identified in terms of gender.

To obtain the Sr background signal of the region, reference faunal samples (snail shells, *Helix pomatia*) have been collected both in the vicinity of the dolmens as well as from locations about 100 km northwest of the Kolikho dolmen (Figure 1 and Table 2). The measured $^{87}Sr/^{86}Sr$ isotope ratios in the burial environment of the Kolikho dolmen and in the reference faunal samples is shown in Table 2. The Sr isotope ratios in bone and tooth enamel samples are summarized in Tables 3 and 4, respectively.

Table 2 $^{87}Sr/^{86}Sr$ ratios from faunal samples (snail shells *Helix pomatia*) from the Kolikho environment and from the environment of other dolmen sites.

Nr	Sample description	$^{87}Sr/^{86}Sr$ (‰)
1	Kolikho dolmen environment, 1	0.707703 ± 18
2	Kolikho dolmen environment, 2	0.707964 ± 10
3	Kolikho dolmen environment, 3	0.708740 ± 14
4	Rastegaev, group of dolmens, Achibs Valley	0.708459 ± 14
5	Agoy cemetery, Agoy Valley	0.707599 ± 13
6	Polkovnichii (Dzhubga 2) group of dolmens, Dzhubga Valley	0.708567 ± 42

Table 3 $^{87}Sr/^{86}Sr$ ratios from human bone samples from the Kolikho dolmen.

Nr	Sample code	$^{87}Sr/^{86}Sr$ (‰)	Nr	Sample code	$^{87}Sr/^{86}Sr$ (‰)
1	92-KLH-08	0.707893 ± 15	25	651-KLH-08	0.709207 ± 88
2	102-KLH-08	0.707936 ± 35	26	6-KLH-08	0.709061 ± 14
3	113-KLH-08	0.708078 ± 112	27	674-KLH-08	0.709601 ± 8
4	138-KLH-08	0.707845 ± 24	28	729-KLH-08	0.709420 ± 12
5	379-KLH-08	0.707893 ± 16	29	775-KLH-08	0.709195 ± 8
6	396-KLH-08	0.708065 ± 38	30	777-KLH-08	0.709103 ± 10
7	922-KHL-08	0.707901 ± 10	31	802-KLH-08	0.709702 ± 8
8	672-KLH-08	0.708321 ± 8	32	807-KLH-08	0.709049 ± 9
9	97-KLH-08	0.708421 ± 18	33	817-KLH-08	0.709754 ± 6
10	99-KLH-08	0.708501 ± 10	34	877-KLH-08	0.709581 ± 9
11	324-KLH-08	0.708232 ± 59	35	822-KLH-08	0.709497 ± 8
12	363-KHL-08	0.708529 ± 16	36	907-KLH-08	0.709173 ± 11
13	387-KLH-08	0.708399 ± 31	37	913-KLH-08	0.708507 ± 10
14	757-KLH-08	0.708407 ± 9	38	913N-KLH-08	0.708899 ± 20
15	782-KLH-08	0.708251 ± 6	39	917-KLH-08	0.708868 ± 10
16	871-KLH-08	0.708622 ± 10	40	616-KLH-08	0.710340 ± 37
17	872-KHL-08	0.708280 ± 12	41	642-5-KLH-08	0.710125 ± 28
18	904-KLH-08	0.708690 ± 11	42	653-KLH-08	0.711245 ± 58
19	918-KHL-08	0.708545 ± 15	43	484-KLH-08	0.710906 ± 38
20	136-KLH-08	0.709165 ± 31	44	855-KLH-08	0.710737 ± 9
21	291-KLH-08	0.709412 ± 52	45	752-KLH-08	0.714195 ± 7
22	470-KLH-08	0.709394 ± 16	46	834-KLH-08	0.712968 ± 14
23	479-KHL-08	0.708776 ± 28	47	569-KLH-08	0.714575 ± 36
24	623-KLH-08	0.709564 ± 31	48	584-KLH-08	0.713917 ± 38

Table 4 $^{87}Sr/^{86}Sr$ ratios from human tooth enamel samples from the Kolikho dolmen.

Nr	Sample code	$^{87}Sr/^{86}Sr$ (‰)
1	KHL-08-791	0.708396 ± 17
2	KHL-08-814	0.708348 ± 27
3	KHL-08-841	0.708346 ± 15
4	KHL08-908	0.708685 ± 30
5	KHL08-931	0.708053 ± 29
6	KHL-08-939	0.708296 ± 19
7	KHL-08-368.2	0.708213 ± 27
8	KHL-08-614	0.708223 ± 19
9	KHL-08-840	0.708518 ± 22
10	KHL-08-900	0.708044 ± 30

All faunal values from the Kolikho dolmen environment are in the range 0.707–0.708‰. The sites within a range of 100 km of the Black Sea coastline northwest of the Kolikho dolmen show similar values. The values from the vicinity of Polkovnichii (Dzhubga 2), the Agoy cemetery, and the Rastegaev group of dolmens was as expected because of the very similar geology of the Kolikho-Agoy, Dzhubga, and Achibs valleys.

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$^{87}Sr/^{86}Sr$ analyses of the fauna provide a background for the study of the human remains. If we accept that a value of probable local variability of $^{87}Sr/^{86}Sr$ rarely exceeds 0.001‰ (Sjögren et al. 2009) and take 0.708‰ as the highest value for the Sr ratio in the Kolikho burial environment, then 25 of the 47 bone samples indicate non-local values. This means that about half of the individuals buried in the Kolikho dolmen spent at least the last decade of their lives somewhere beyond the region with average values of $^{87}Sr/^{86}Sr$ between 0.707 and 0.708‰. The non-local human values range between 0.709 and 0.714‰, but these values can be influenced by postdepositional strontium.

The results from human tooth samples (Table 4) are more homogeneous than those of the bone samples and show a good agreement with the average values of $^{87}Sr/^{86}Sr$ in the Kolikho dolmen and environment. This shows that no people were born in regions with Sr values within the range of 0.709–0.714‰. We cannot know whether some people changed their residence or not. It is impossible to establish whether enamel and bone belong to the same indivudual.

The geological provenance of the western Caucasus shows that $^{87}Sr/^{86}Sr$ ratios of 0.713–0.714‰ can be expected only in the region of the Paleogene bedrock, which are younger than the sedimentary Cretaceous and Jurassic bedrock formations of the Kolikho Valley. The group of 4 individuals with values of 0.713–0.714‰ are likely highlanders who spent the last decade of their lives in the mountainous region about 200 km southeast of the Kolikho Valley, while the rest of the non-locals are likely individuals who resided for the same period somewhere to the east of the Kolikho Valley at a distance of about 100 km. At this distance, the nearest area is located representing a geology with Sr values different from the Kolikho region.

Our research is still in progress. We need to explain the substantial number of non-locals and the significant distance between their burial place and last residence. Anthropological examination of human remains made in the Museum of Ethnography and Anthropology in Saint Petersburg indicates that all non-local bone samples belonged to adults younger than 45–50 yr old, most of them male. Based on all data, we can assume that samples with non-local Sr values represent both migrants and bodies of those who lived and died far away of the Kolikho Valley and whose remains were transported over a long distance to be buried in the Kolikho dolmen.

CONCLUSION

The Kolikho dolmen is the first megalithic archaeological site in the Caucasus for which the period of use can be established based on reliable samples. ^{14}C dating of burials clearly demonstrate that the serial sampling of an entire burial deposit is essential for a successful analysis of dolmen burial practice.

Strontium analysis of the bones show that about half of the 70 people who were buried in the Kolikho dolmen spent the last decade of their lives far outside of the Kolikho Valley. The investigation of the dolmen is still in progress. Further anthropological, isotopic, and DNA analyses will be undertaken in the near future.

Altogether, the data obtained from the dolmen Kolikho will contribute to a better understanding of funeral rituals, individual mobility, and community structure, and generate the possibility of making a more precise demographic description of the type and size of the communities that used the dolmens in the western Caucasus.

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REFERENCES

Bentley RA. 2006. Strontium isotopes from the Earth to the archaeological skeleton: a review. *Journal of Archaeological Method and Theory* 13(3):135–87.

Childe G. 1947–1948. Megaliths. *Ancient India* IV:4–13.

Derry LA, Brasier MD, Corfield RM, Rozanov AY, Zhuravlev AY. 1994. Sr and C isotopes in Lower Cambrian carbonates from the Siberian craton: a paleoenvironmental record during the 'Cambrian explosion.' *Earth and Planetary Science Letters* 128(3–4):671–81.

Felitsyn ED. 1904. *Zapadnokavkazskie dol'meny. Materialy po arkheologii.* Moscow. In Russian.

Kuftin BA. 1949. *Materiali k arkheologii Kolkhidy.* T. 1. Tbilisi. In Russian.

Longin R. 1971. New method of collagen extraction for radiocarbon dating. *Nature* 230(5291):241–2.

Markovin VI. 1978. *Dol'meny Zapadnogo Kavkaza.* Moscow. In Russian.

Markovin VI. 1997. *Dol'mennye pamyatniki Prikuban'ya I Prichernomor'ya.* Moscow. In Russian.

de Montpereux D. 1843. *Voyage autour de Caucase, chez les Tcherkesses et les Abkhases, en Colchide, en Géorgie, en Arménie et en Crimée.* Paris: Librairie de Gide.

Price TD, Johnson CM, Ezzo JA, Ericson JA, Burton JH. 1994. Residential mobility in the prehistoric Southwest United States: a preliminary study using strontium isotope analysis. *Journal of Archaeological Science* 21(3):315–30.

Rezepkin AD. 2010. K voprosu o klassifikatsii dol'menov i pogrebal'nom obryade "dol'mennoi kul'turi." In: Kamenetskii IS, Sorokin AN, editors. *Chelovek i drevnosti: pamyati Alexandra Alexandrovicha Formozova (1928–2009).* Moscow: Grif i K. p 412–22. In Russian.

Shishlina NI, van der Plicht J, Hedges REM, Zazovskaya EP, Sevastyanov VS, Chichagova OA. 2007. The Catacomb cultures of the North-West Caspian steppe: ^{14}C chronology, reservoir effect, and paleodiet. *Radiocarbon* 49(2):713–26.

Sjögren KG, Price TD, Ahlström T. 2009. Megaliths and mobility in south-western Sweden. Investigating relationships between a local society and its neighbours using strontium isotopes. *Journal of Anthropological Archaeology* 28(1):85–101.

Smirnov AM. 2009. Pustoi dol'men: utrata istochnika ili norma pogrebal'noi praktiki. *Stratum Plus* 2:169–84. In Russian.

Soloviev LN. 1960. Pogrebeniay dol'mennoi kul'turi I prilegayuschei chasti Adlerskogo raiona. *Trudi Abkhazskogo instituta yazyka, literaturi I istorii* XXXI: 70–96. In Russian.

Tallgren AM. 1933. Dolmens of North Caucasia. *Antiquity* 7(26):190–202.

Trifonov VA. 2001. Chto my znaem o dol'menakh Zapadnogo Kavkaza. In: Piotrovsky Yu, editor. *Dol'meny – svideteli drevnikh tsivilizatsii.* Krasnodar. p 20–54. In Russian.

Uvarov AS. 1876. Megaliticheskie pamyatniki v Rossii. *Drevnosti* VI:3.

Uvarov 1878. Megaliticheskie pamyatniki v Rossii. *Drevnosti* VII 3:245–74. In Russian.

van der Plicht J, Wijma S, Aerts AT, Pertuisot MH, Meijer HAJ. 2000. The Groningen AMS facility: status report. *Nuclear Instruments and Methods in Physics Research B* 172(1–4):58–65.

Zaitseva GI, Trifonov VA, Burova ND. 2010. ^{14}C dates from the dolmen "Kolikho" in the Western Caucasus. In: *Abstracts of the 10th International Conference "Methods of Absolute Chronology."* 22–25 April 2010, Gliwice, Poland. p 70.