NEW DATA OF OBSIDIAN PROCUREMENT AND MOBILITY OF ANCIENT HUMANS

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Abstract: The issue of the origin and supply of obsidian in prehistoric archaeological sites of the southeastern Black Sea region has been the focus of active study by Georgian and foreign researchers in recent times. The inventory of obsidian discovered in Mesolithic and Neolithic settlements along the Black Sea coast of Adjara has been the subject of scientific study and has been published, and its origin and distribution area have been determined. Conclusions that are pertinent to the subject have been deduced, providing unique information about the movement and mobility of ancient humans. Interesting data was published in 2022 about the obsidian of the village of Kobuleti (G. M. Chkhatarashvili G.). However, for some reason, it impossible to identify a third source of obsidian. The presented work incorporates the most recent data, which was conducted Archaeometry Laboratory at the University of Missouri Reactor Research (MURR) using the XRF method.

A geochemical analysis of obsidian has yielded insights into the mobility and movement patterns of ancient humans inhabiting the village of Kobuleti. This analysis, supported by newly determined absolute dates, has constrained the temporal framework of these activities to the 10th-9th millennia BC.

Key words: Kobuleti, Caucasus, obsidian, XRF, mobolity.

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Introduction. In prehistoric period, various types of stone were utilized for the fabrication of tools. In the selection of raw materials, priority was given to their high quality and ease of processing. In this regard, obsidian stands as a preeminent example of a raw material, exhibiting a profound historical demand that dates back to antiquity. The earliest known use of obsidian dates back to the Olduwian period (Piperno). However, over time, there was a gradual increase in demand for these raw materials (Ono) (Y. Kuzmin).

The Caucasus is regarded as one of the most active regions in terms of obsidian utilization, particularly in light of the numerous identified sources of obsidian within its northern (E. S. Doronicheva) (E. K. Doronicheva) and southern territories (Badalyan) (Frahm) (Adler) (P. N. Biagi) (P. N. Biagi) (C. G. Chataigner) (Fig. 1). The active use of obsidian in the Adjara region commenced in the early Holocene, marking a period of intensive exploitation of the Black Sea coast by ancient humans (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (S., The archaeological sites of the stone age in the Kintrishi valley (in Georgian)).

Since 2019, a significant project has been underway with the funding of Batumi Shota Rustaveli State University and the Shota Rustaveli National Science Foundation of Georgia. The objective of this project is to ascertain the provenance of obsidian found on prehistoric monuments in Adjara and to determine the mobility patterns of the populace during that historical period. With the support of the aforementioned institutions and the fruitful cooperation of Georgian and foreign scientists, significant research was conducted on the study of obsidian from Khutsubani (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (C. M. Chkhatarashvili G.), Makhvilauri (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (D. A. Chkhatarashvili G.), Kvirike, Choloki, Jikhanjuri (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (C. G. Manko V.) (D. A. Chkhatarashvili G.) and the Kobuleti (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (S., The archaeological sites of the stone age in the Kintrishi valley (in Georgian)) (G. M. Chkhatarashvili G.). However, in the context of the latter, the re-implementation of laboratory work became imperative, owing to the identification of an unknown source (GUG024) detected during the preceding study.

The work thoroughly delineates the sources of obsidian supply in the Kobuleti and provides new absolute dates, which accurately determine the time of ancient human mobility.

Geographical position. The Kobuleti site, a stone age site, is situated 6 kilometers southeast of Kobuleti, on the right bank of the Kintrishi River (Fig. 2). The site is an open-type settlement located on a high hill near the river. The hill's height is estimated to be approximately 50 meters. Archaeological research has revealed that the upper part of the hill was a habitation area for ancient humans, as evidenced by the presence of cultural layers throughout almost the entire territory.

The Kobuleti is geographically situated in the Colchis Plain, which occupies the extreme eastern part of the Black Sea. The region's climate is classified as subtropical, fostering the growth of flora typical of this geographical zone. Pollenological studies conducted in the Kobuleti and Khutsubani also revealed that during the early Holocene period (10th-7th millennia BC), the climate in the Kintrishi river was moderate and warm. This finding is supported by the presence of a substantial number of pollen grains of thermophilic plants in palynological samples (Chkhatarashvili) (C. M. Chkhatarashvili G.).

It is noteworthy that the Ajara region, particularly its Black Sea coast, is distinguished by its abundant precipitation and high relative humidity, which ranges from 70% to 83% annually. The absence of faunal and/or anthropological material in excavations of open-air sites may be attributed to the constant dampness of the soil. Therefore, the only material evidence that provides insight into the nature of human life during that period is derived from stone tools, cores and produce waste.

Consequently, the thorough examination of stone artifacts yielded intriguing findings, which will be addressed in greater depth in the subsequent discussion.

History of archaeological investigation. The first scientific excavations of the Kobuleti aligned with the 1960s, a period during which N. Berdzenishvili and L. Nebieridze initiated rigorous research endeavors along the Black Sea coastal expanse of Ajara (N. Berdzenishvili). The site was subjected to a comprehensive archaeological investigation from 1973 to 1986 by the esteemed archaeologist S. Gogitidze (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)).

In 2019, following a protracted hiatus, the study of the Kobuleti resumed with the financial support of Batumi Shota Rustaveli State University (G). The expedition (head of excavations: G. Chkhatarashvili) was carried out within the framework of Georgian-Ukrainian cooperation, where an interdisciplinary group (trasologist, geologist, palynologist, geochemist, geophysicist, etc.) was involved along with archaeologists. As a result of the archaeological campaigns, a substantial stone collection was obtained, consisting of approximately 35,000 pieces of flint and obsidian. 3 000 of them were tools.

A technological analysis of the stone inventory indicates that the cores were processed using a manual pressing technique. This assertion is substantiated by the presence of conical and pencil-like cores within the collection, as illustrated in Fig. 3: 1. Additionally, several core tablets were identified (Fig. 3: 2). As a result of the processing of the cores, thin blade, bladelets and microblades were obtained. These were subsequently processed to create tools with various functions.

The most prevalent tools are burins (Fig. 3: 6, 7, 11-24). These include simple, single-sided, double-sided, etc. Burins were made on blades.

The second place in the category of tools is occupied by retouched blades and flakes (see Fig. 3: 4, 5, 9-10, 25-35). The retouch is characterized by its subtlety, with the application of double retouching being a rarity. It has been observed that some of these specimens exhibit signs of retouching along the entire length of the side. Furthermore, the combination of notched blades within the same group is also permissible. The notch is not extensive; it is primarily concentrated on the ventral side. The tools exhibit indications of usage.

There are some interesting scrapers (see Fig. 3: 6-7). Most of them are made on the flakes, but there are also many end scrapers made on the blades. There are different types of tools, oval, round, straight etc.

A notable category of tools is represented the microblades with abrupt retouch (Fig. 3: 36-58). Analogous instruments were utilized in the pursuit of game for the purpose of inserting the tips of throwing tools.

A modest space within the apparatus is occupied by chisels (Fig. 3: 8) and perforators, on which traces of utilization are distinctly discernible.

The techno-typological analysis of the stone inventory indicates that the primary activity of ancient humans in the Kobuleti must have been hunting, as evidenced by typologically confirmed tools. Furthermore, the use-wear-analysis of the stone inventory yielded noteworthy conclusions, predominantly confirming the presence of tools utilized for the processing of game meat (Esakiya). The artifacts exhibited minimal evidence of long-term usage, suggesting that the site was utilized for a limited period, potentially on a seasonal basis, perhaps during hunting activities. It is reasonable to assume that subsequent studies will provide further insights into this matter.

Consequently, in addition to the stone inventory, archaeological excavations revealed pits of various sizes and shapes. Of particular interest are the pits that support the pillars of a residential house. However, due to the extensive damage inflicted by anthropogenic activities, discussing these forms poses a significant challenge, as the cultural layers that once defined them have been largely eradicated. However, in one of the trenches, which was excavated in 2019, the contours of a rectangular house were revealed. Following the conclusion of the research, the precise answers will be revealed. Furthermore, during the excavations, numerous hearths were discovered, and in these hearths, charcoal and burnt wood were found.

Materials and methods.

a) Geochemistry. Within the stone collection of the Kobuleti, obsidian is particularly notable for its abundance and diversity. The specimen is primarily distinguished by the presence of black, transparent, and black-brown veins. We think their diversity should be associated with different origins. To this end, a geochemical analysis was conducted. A total of 32 obsidian flakes were selected for the study.

Analysis was performed using a Thermo Quantx ARL lab-based XRF spectrometer. The instrument has a rhodium-based X-ray tube which was operated at 35 kV with a current to measure the emitted X-rays with a silicon diode detector. The instrument was specifically calibrated for obsidian by measuring a set of 40 very well-characterized obsidian source samples using data acquired by neutron activation analysis (NAA), inductively coupled plasma-mass spectrometry (ICP-MS), and XRF. For more information about this calibration see a publication by prof. M. Glascock (Glascock).

The artifacts were non-destructively analyzed by XRF. Samples were counted for one minute each. The elements measured include K, Ca, Ti, Mn, Fe, Zn, As, Rb, Sr, Y, Zr, Nb and Th. However, due to the variation in sizes, shapes and thicknesses of the artifacts, the most reliable data is usually only possible for Rb, Sr, Y, Zr, and Nb.

b) Radiocarbon. To obtain absolute dates, a radiocarbon method was used. Charcoal was collected for analysis. The Analysis (C14 AMS method) were conducted in VILNIUS RADIOCARBON. Radiocarbon dates were calibrated using the online calibration program OxCal 4.4.4 (Bronk Ramsey C.) *using atmospheric data from Paula J. Reimer et al.* (Reimer P. J.).

Results.

a) A geochemical analysis of obsidian, similar to the study conducted in 2022, confirmed three sources of obsidian supply (see Fig. 4; Tab. 1). Two of these regions were identified as Chikiani (southern

Georgia) and Sarikamish, Hamamli (eastern Turkey). The third source, according to specialists, should be the „Akhshtu-type" obsidian deposit from the North Caucasus.

b) Radiocarbon analysis yielded a series of absolute dates (see Table 2) that elucidated the age of the cultural layer from which the obsidian samples were obtained.

Discussion. In Kobuleti, the raw materials utilized for the making of tools included flint and obsidian. The flint is of a notably high quality, with reddish-pink and bluish hues being the most prevalent. Preliminary findings suggest that ancient humans possessed knowledge relevant to the selection of raw materials necessary for the fabrication of tools. Western Georgia is characterized by a prevalence of flint, a type of rock that is frequently utilized as a raw material. However, the issue of their origin and distribution at archaeological sites remains to be the subject of further study. Regrettably, the Kintrishi gorge has not yet undergone rigorous geological scrutiny, which would have facilitated a more comprehensive response to the origin of the flint discovered at the site. It is hypothesized that in the future, a planned, complex expedition will be necessary to record and study flint deposits in the Kintrishi gorge.

As previously mentioned, the Caucasus region is abundant in sources of obsidian. An intriguing study on the origin of the Kobuleti was conducted by foreign colleagues (Badalyan). However, the small collection that was studied was not enough to draw definitive conclusions. In 2022, a study was conducted on 50 obsidian fragments (G. M. Chkhatarashvili G.). Three sources of obsidian were identified; however, the third source could not be identified.

The geochemical study of obsidian conducted in Kobuleti in 2023 yielded the following picture:

Chikiani is a mountain of volcanic origin. It is situated in the Javakheti region of southern Georgia, in proximity to Lake Paravani. Chikiani is the sole obsidian source in Georgia, distinguished by its high-quality obsidian. As demonstrated by research findings, Chikiani obsidian was utilized in the construction of not only prehistoric monuments but also those from subsequent historical periods (Badalyan) (P. N. Biagi) (P. N. Biagi) (Gratuze B.).

The Chikiani obsidian source is located at a distance of 170 to 180 kilometers from the village of Kobuleti. Chikiani is arguably among the youngest volcanic mountains in the Caucasus, with an estimated age ranging from 2.6 to 2.3 million years (Badalyan).

The source of the Sarikamish obsidian is located in the eastern Turkish province of Kars. Preliminary studies have indicated that the Sarikamish Obsidian were used since stone ages. This can be attributed to the superior quality of the stone. Sarıkamıs obsidian is classified by specialists into two distinct groups: „northern" and „southern." The southern group is situated in proximity to the contemporary cities of Mescitli and Sehitemin. Its distinguished by a high concentration of barium and a relatively low concentration for zirconium (C. I. Chataigner). *The estimated age of the source is between 4.9 and 4.4 million years* (Bigazzi). The „Northern group," situated in proximity to contemporary cities such as Kizil Kilisa, Handere, and Hamamli, is comparatively younger, with an estimated age range of 3.8–3.5 million years (Bigazzi). This group is characterized by a high concentration of zirconium and a low concentration for barium. In Kobuleti, the Hamamli obsidian has been discovered, situated at a distance of 200-220 km from a direct line.

The source of obsidian of the **„Akhshtu type"** was initially identified at the settlement of Akhshtu in proximity to the contemporary city of Sochi (Russian Federation). According to the research of I. Kuzmin, this particular type of obsidian should be located in the North Caucasus region (Y. K. Kuzmin). It is important to note that, according to its composition, it is entirely dissimilar to the obsidian sources in the North Caucasus (including Zayukovo). The obsidian deposit is located approximately 300 kilometers from the Kobuleti when measured in a straight line.

The age of the Kobuleti has been determined by researchers to be between 10th and 9th millennia BC, according to both relative-typological and absolute dating methods. However, several new dates are noteworthy (see Table 2: 5-6), which extend the chronological framework of the site back to the 7th millennium BC. Evidence suggests that the Kobuleti has been inhabited for several millennia.

The stone industry of Kobuleti finds its closest analogues in the Khutsubani (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (C. M. Chkhatarashvili G.), Kvirike (S., Samkhret-aghmosavlet shavizghvisp'iretis neolituri k'ult'ura (in Georgian)) (C. G. Manko V.), Anaseuli I (L), Darkveti rockshelter (V layer) (L.) (Chkhatarashvili G), Bavra, Bavra I-II (M.), Bavra-ablari (Varoutsikos) and other collections. Furthermore, the Kobuleti exhibits a striking similarity to contemporary sites in the Middle East (Dittermore) (Howe) (Hole). The opinion is expressed that the large migration processes that occurred on the border of the Late Pleistocene-Early Holocene period are the basis for a number of innovations that appear in the site of the prehistoric period of Ajara (C. G. Manko V.).

Conclusion. An important discovery was made based on an interdisciplinary study conducted on the Kobuleti stone collection in 2023. A third source of obsidian supply was identified, which further expanded the area of activity and contact zone of ancient humans. It appears that the inhabitants of Kobuleti are actively becoming acquainted with regions abundant in obsidian, suggesting the possibility of an exchange of raw materials, or „trade," between these regions. The presence of obsidian from North Caucasus offering a unique source of information. It has been demonstrated that humans during that period traversed vast distances, often hundreds of kilometers, to acquire obsidian supplies. A comparable instance was substantiated in the Mezmainskaya Cave (Adygea, Russian Federation), where investigations corroborated the existence of Chikiani obsidian (V.). The Caucasus has been an active zone of migrations and contacts since ancient times.

The new absolute dates further clarified the age of the Kobuleti and determined its place in the general system of periodization of the prehistoric period of the Caucasus. It is hypothesized that future research on the territory of the Kobuleti will yield further new information and further enrich our understanding of the ancient inhabitants of the Kintrishi gorge.

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Describe of figures:

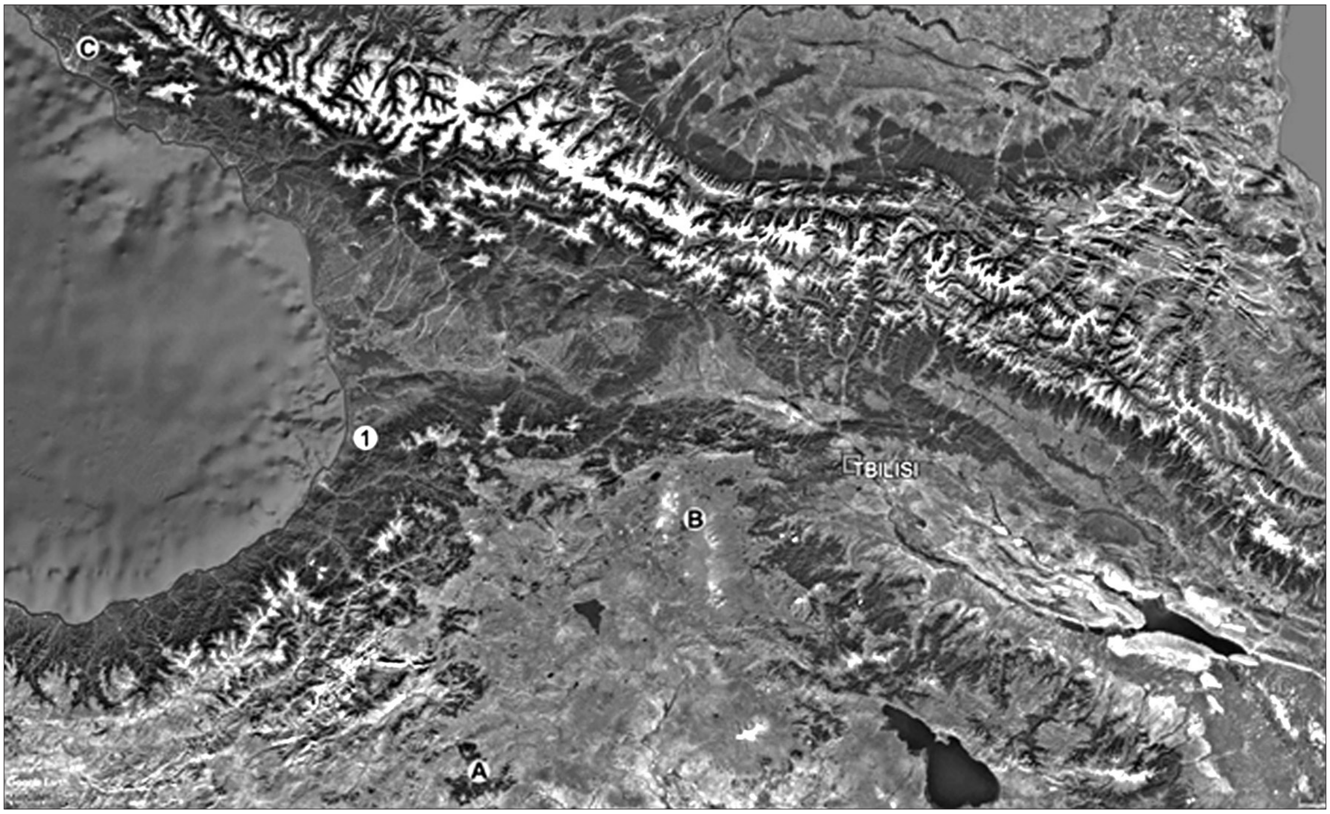

Fig. 1.Kobuleti site and obsidian sources in Caucasus.
1 – Kobuleti; A – Sarikamish (hamamli); B – Chikiani; C – „Akshtu type“

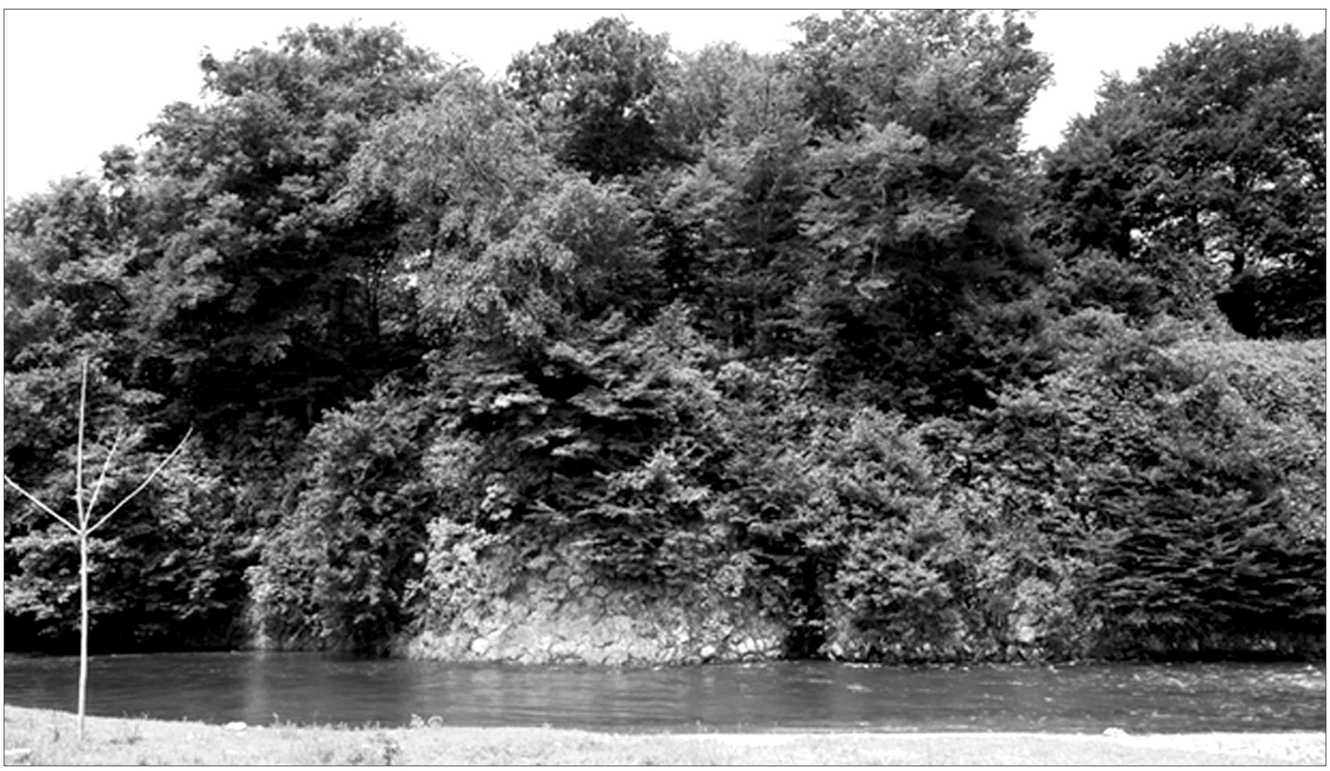

Fig. 2. Kobuleti site (view from South).

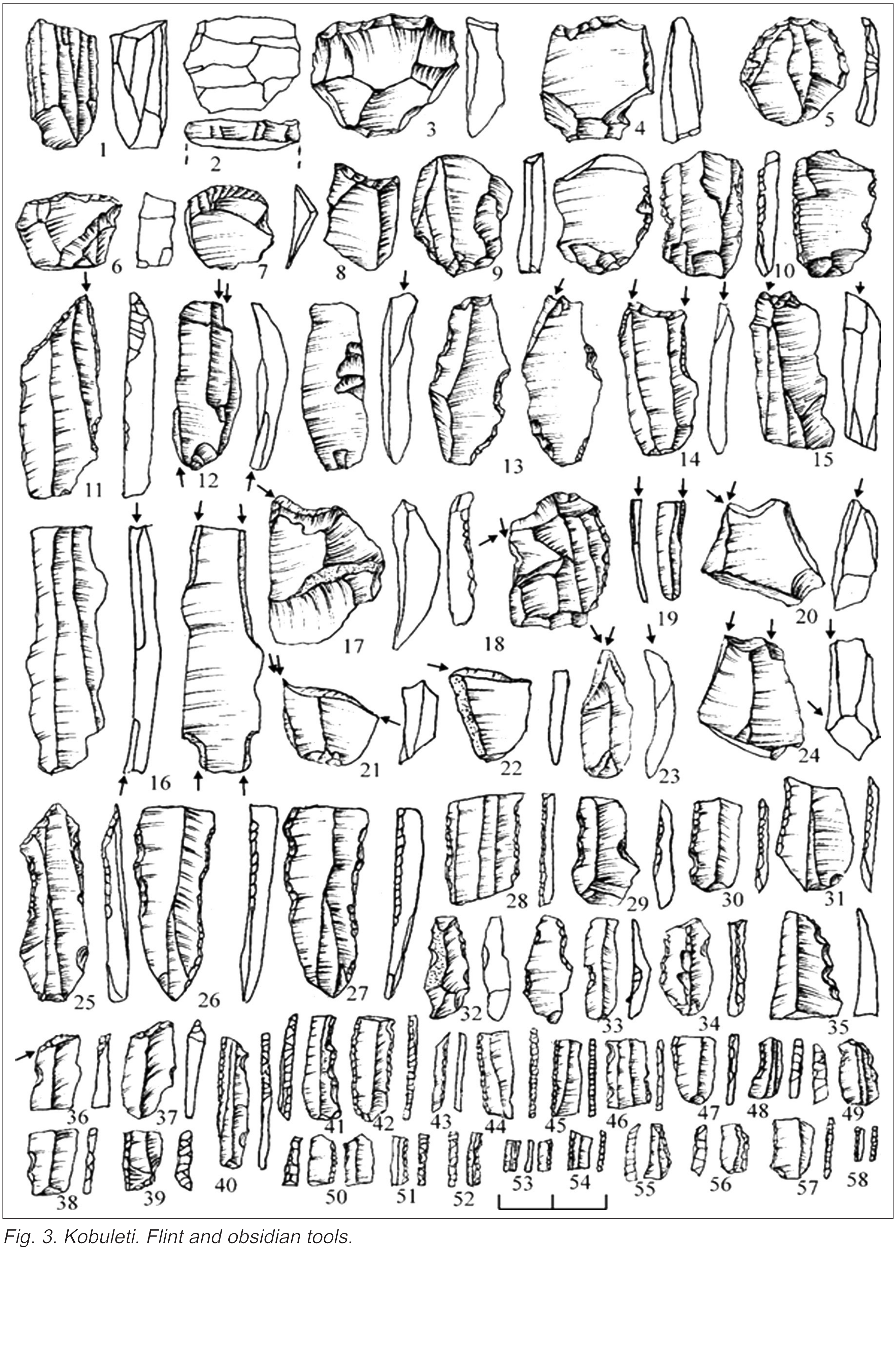

Fig. 3. Kobuleti. Flint and obsidian tools.

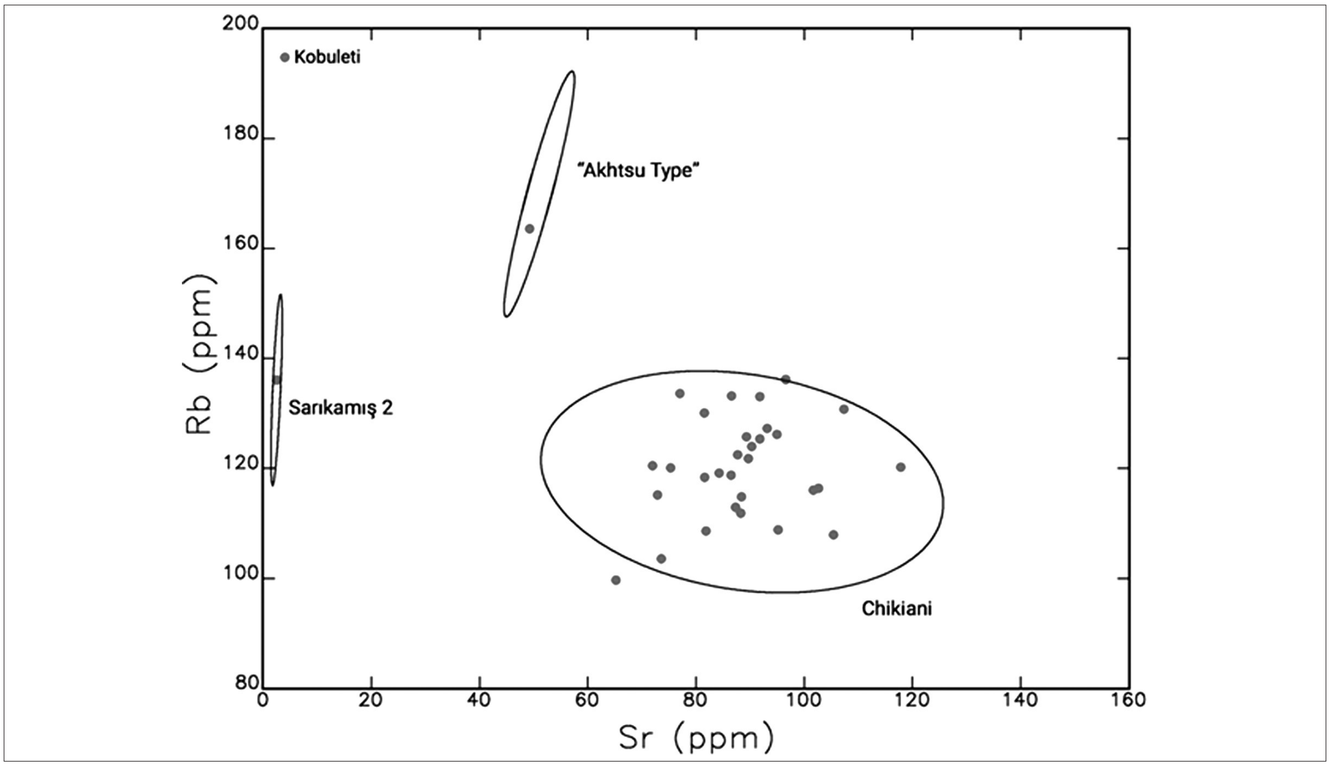

Fig. 4. Scatterplot of strontium versus rubidium showing samples from Kobuleti with ellipses representing compositional groups. Ellipses are drawn at 90% confidence.

Describe of tables

Tab. 1. Results of geochemical analysis of obsidian.

	Site	Layer	Sample	Source	K	Ca	Ti	Mn	Fe	Zn	As
GUG254	Kobuleti	Early Holocene	1	Chikiani	36962,02	5041,52	864,27	491,96	6804,41	51,35	3,53
GUG255	Kobuleti	Early Holocene	2	Chikiani	36204,70	3400,40	761,47	396,75	5389,66	41,32	0,00
GUG256	Kobuleti	Early Holocene	3	Chikiani	26942,95	3620,40	561,65	697,90	5540,11	40,79	0,00
GUG257	Kobuleti	Early Holocene	4	Chikiani	32324,21	4656,06	1171,22	483,80	8221,39	54,56	0,00
GUG258	Kobuleti	Early Holocene	5	Chikiani	32310,41	4078,25	628,69	482,88	5778,36	45,75	0,49
GUG259	Kobuleti	Early Holocene	6	Sarikamis	37826,68	1302,08	334,73	461,69	6346,93	58,01	1,89
GUG260	Kobuleti	Early Holocene	7	Chikiani	24063,92	3120,65	629,50	362,16	4505,60	37,36	0,00
GUG261	Kobuleti	Early Holocene	8	Chikiani	29436,71	3839,91	655,17	388,67	5393,82	42,54	0,00
GUG262	Kobuleti	Early Holocene	9	Chikiani	32917,89	4447,17	758,18	451,00	6342,87	46,49	0,00
GUG263	Kobuleti	Early Holocene	10	Chikiani	31272,63	4387,06	787,68	428,41	5634,30	43,45	0,00
GUG264	Kobuleti	Early Holocene	11	Chikiani	36578,00	4681,40	734,77	550,09	6283,67	50,87	1,87
GUG265	Kobuleti	Early Holocene	12	Chikiani	38016,50	5692,07	820,65	569,80	7296,30	56,96	1,42
GUG266	Kobuleti	Early Holocene	13	Chikiani	28456,56	3569,11	621,11	413,61	4924,38	45,03	0,00
GUG267	Kobuleti	Early Holocene	14	Chikiani	38063,47	5598,18	914,94	519,77	7382,39	54,33	0,00
GUG268	Kobuleti	Early Holocene	15	Chikiani	32317,55	4280,66	778,66	438,34	6007,70	48,81	1,18
GUG269	Kobuleti	Early Holocene	16	Chikiani	31138,94	4247,46	674,38	398,38	5596,17	46,47	0,00
GUG270	Kobuleti	Early Holocene	17	Chikiani	35131,71	5084,83	1084,51	465,53	7766,19	49,75	0,00
GUG271	Kobuleti	Early Holocene	18	Chikiani	32317,37	4106,66	882,28	447,53	6392,91	48,76	1,56
GUG272	Kobuleti	Early Holocene	19	Chikiani	35980,32	4152,96	902,91	394,72	6882,66	45,10	0,00
GUG273	Kobuleti	Early Holocene	20	Chikiani	33149,58	4184,37	778,80	414,60	5976,40	47,15	0,00
GUG274	Kobuleti	Early Holocene	21	Akshtu type	27253,64	3953,47	410,70	358,99	4204,72	35,73	8,69
GUG275	Kobuleti	Early Holocene	22	Chikiani	30591,29	4658,83	926,05	418,78	6442,21	43,18	0,00
GUG276	Kobuleti	Early Holocene	23	Chikiani	34070,99	4897,46	816,99	470,84	6486,36	51,88	0,00
GUG277	Kobuleti	Early Holocene	24	Chikiani	28646,17	4301,47	825,73	360,63	6038,48	42,03	0,00
GUG278	Kobuleti	Early Holocene	25	Chikiani	29017,07	4053,84	736,86	402,58	6103,60	42,41	0,00
GUG279	Kobuleti	Early Holocene	26	Chikiani	27247,68	3701,10	719,45	362,67	5656,59	43,11	0,00
GUG280	Kobuleti	Early Holocene	27	Chikiani	38565,03	6493,56	894,69	517,28	7602,25	61,17	0,00
GUG281	Kobuleti	Early Holocene	28	Chikiani	29962,56	3533,01	605,50	390,20	5168,85	44,99	0,00
GUG282	Kobuleti	Early Holocene	29	Chikiani	32355,41	4226,76	673,52	420,00	5745,25	46,21	0,00
GUG283	Kobuleti	Early Holocene	30	Chikiani	37269,76	4924,07	931,83	529,35	6859,60	52,77	0,89
GUG284	Kobuleti	Early Holocene	31	Chikiani	36104,88	5081,20	1024,62	549,09	7682,55	54,47	0,00
GUG285	Kobuleti	Early Holocene	32	Chikiani	37252,07	5167,04	1111,08	457,53	7555,72	55,93	0,00

	Site	Layer	Sample	Source	Rb	Sr	Y	Zr	Nb	Th
GUG254	Kobuleti	Early Holocene	1	Chikiani	133,05	91,78	12,29	92,88	20,89	15,10
GUG255	Kobuleti	Early Holocene	2	Chikiani	112,90	87,32	11,00	94,47	18,84	13,49
GUG256	Kobuleti	Early Holocene	3	Chikiani	115,17	72,89	13,18	75,39	18,31	13,32
GUG257	Kobuleti	Early Holocene	4	Chikiani	122,48	87,69	12,17	91,46	17,75	14,83
GUG258	Kobuleti	Early Holocene	5	Chikiani	130,07	81,56	12,46	81,34	18,26	15,82
GUG259	Kobuleti	Early Holocene	6	Sarikamis	136,07	2,52	36,32	193,98	25,13	16,55
GUG260	Kobuleti	Early Holocene	7	Chikiani	103,54	73,57	9,52	76,88	18,39	12,19
GUG261	Kobuleti	Early Holocene	8	Chikiani	108,58	81,84	10,07	87,29	17,15	11,78
GUG262	Kobuleti	Early Holocene	9	Chikiani	126,17	94,94	11,64	98,43	18,53	17,05
GUG263	Kobuleti	Early Holocene	10	Chikiani	119,14	84,24	11,81	91,06	20,13	14,31
GUG264	Kobuleti	Early Holocene	11	Chikiani	133,59	77,01	12,98	73,38	20,67	15,43
GUG265	Kobuleti	Early Holocene	12	Chikiani	133,16	86,53	12,69	87,84	17,36	16,30
GUG266	Kobuleti	Early Holocene	13	Chikiani	120,46	71,96	12,76	71,09	17,67	15,36
GUG267	Kobuleti	Early Holocene	14	Chikiani	136,16	96,58	13,08	99,75	17,92	17,69
GUG268	Kobuleti	Early Holocene	15	Chikiani	123,97	90,30	14,00	93,47	19,16	14,63
GUG269	Kobuleti	Early Holocene	16	Chikiani	118,76	86,48	11,21	89,88	19,04	14,66
GUG270	Kobuleti	Early Holocene	17	Chikiani	120,20	117,85	11,57	118,36	17,68	15,70
GUG271	Kobuleti	Early Holocene	18	Chikiani	127,25	93,15	13,30	94,00	18,03	15,99
GUG272	Kobuleti	Early Holocene	19	Chikiani	116,03	101,67	10,04	109,32	15,45	13,38
GUG273	Kobuleti	Early Holocene	20	Chikiani	121,77	89,67	11,78	95,03	19,56	15,82
GUG274	Kobuleti	Early Holocene	21	Akshtu type	163,57	49,22	11,72	64,96	26,97	15,14
GUG275	Kobuleti	Early Holocene	22	Chikiani	116,38	102,62	11,34	105,38	17,79	14,39
GUG276	Kobuleti	Early Holocene	23	Chikiani	125,35	91,79	11,86	93,57	18,39	16,17
GUG277	Kobuleti	Early Holocene	24	Chikiani	107,90	105,40	10,28	107,03	16,47	14,13
GUG278	Kobuleti	Early Holocene	25	Chikiani	111,82	88,26	11,82	93,93	17,72	13,55
GUG279	Kobuleti	Early Holocene	26	Chikiani	114,83	88,38	11,69	91,37	17,52	16,01
GUG280	Kobuleti	Early Holocene	27	Chikiani	99,64	65,17	7,57	57,06	11,42	7,70
GUG281	Kobuleti	Early Holocene	28	Chikiani	120,08	75,29	11,70	79,47	17,16	14,27
GUG282	Kobuleti	Early Holocene	29	Chikiani	118,35	81,59	13,34	86,92	19,73	12,63
GUG283	Kobuleti	Early Holocene	30	Chikiani	125,75	89,31	11,29	93,52	17,78	15,96
GUG284	Kobuleti	Early Holocene	31	Chikiani	130,76	107,34	13,73	109,41	18,81	16,85
GUG285	Kobuleti	Early Holocene	32	Chikiani	108,83	95,15	8,01	90,92	15,91	13,81

	Site	Layer	Sample	Source	Sr/Rb	Rb/Zr	Sr/Zr	Y/Zr	Nb/Zr	Fe/Mn
GUG254	Kobuleti	Early Holocene	1	Chikiani	0,69	1,43	0,99	0,13	0,22	13,83
GUG255	Kobuleti	Early Holocene	2	Chikiani	0,77	1,20	0,92	0,12	0,20	13,58
GUG256	Kobuleti	Early Holocene	3	Chikiani	0,63	1,53	0,97	0,17	0,24	7,94
GUG257	Kobuleti	Early Holocene	4	Chikiani	0,72	1,34	0,96	0,13	0,19	16,99
GUG258	Kobuleti	Early Holocene	5	Chikiani	0,63	1,60	1,00	0,15	0,22	11,97
GUG259	Kobuleti	Early Holocene	6	Sarikamis	0,02	0,70	0,01	0,19	0,13	13,75
GUG260	Kobuleti	Early Holocene	7	Chikiani	0,71	1,35	0,96	0,12	0,24	12,44
GUG261	Kobuleti	Early Holocene	8	Chikiani	0,75	1,24	0,94	0,12	0,20	13,88
GUG262	Kobuleti	Early Holocene	9	Chikiani	0,75	1,28	0,96	0,12	0,19	14,06
GUG263	Kobuleti	Early Holocene	10	Chikiani	0,71	1,31	0,93	0,13	0,22	13,15
GUG264	Kobuleti	Early Holocene	11	Chikiani	0,58	1,82	1,05	0,18	0,28	11,42
GUG265	Kobuleti	Early Holocene	12	Chikiani	0,65	1,52	0,99	0,14	0,20	12,81
GUG266	Kobuleti	Early Holocene	13	Chikiani	0,60	1,69	1,01	0,18	0,25	11,91
GUG267	Kobuleti	Early Holocene	14	Chikiani	0,71	1,36	0,97	0,13	0,18	14,20
GUG268	Kobuleti	Early Holocene	15	Chikiani	0,73	1,33	0,97	0,15	0,20	13,71
GUG269	Kobuleti	Early Holocene	16	Chikiani	0,73	1,32	0,96	0,12	0,21	14,05
GUG270	Kobuleti	Early Holocene	17	Chikiani	0,98	1,02	1,00	0,10	0,15	16,68
GUG271	Kobuleti	Early Holocene	18	Chikiani	0,73	1,35	0,99	0,14	0,19	14,28
GUG272	Kobuleti	Early Holocene	19	Chikiani	0,88	1,06	0,93	0,09	0,14	17,44
GUG273	Kobuleti	Early Holocene	20	Chikiani	0,74	1,28	0,94	0,12	0,21	14,42
GUG274	Kobuleti	Early Holocene	21	Akshtu type	0,30	2,52	0,76	0,18	0,42	11,71
GUG275	Kobuleti	Early Holocene	22	Chikiani	0,88	1,10	0,97	0,11	0,17	15,38
GUG276	Kobuleti	Early Holocene	23	Chikiani	0,73	1,34	0,98	0,13	0,20	13,78
GUG277	Kobuleti	Early Holocene	24	Chikiani	0,98	1,01	0,98	0,10	0,15	16,74
GUG278	Kobuleti	Early Holocene	25	Chikiani	0,79	1,19	0,94	0,13	0,19	15,16
GUG279	Kobuleti	Early Holocene	26	Chikiani	0,77	1,26	0,97	0,13	0,19	15,60
GUG280	Kobuleti	Early Holocene	27	Chikiani	0,65	1,75	1,14	0,13	0,20	14,70
GUG281	Kobuleti	Early Holocene	28	Chikiani	0,63	1,51	0,95	0,15	0,22	13,25
GUG282	Kobuleti	Early Holocene	29	Chikiani	0,69	1,36	0,94	0,15	0,23	13,68
GUG283	Kobuleti	Early Holocene	30	Chikiani	0,71	1,34	0,95	0,12	0,19	12,96
GUG284	Kobuleti	Early Holocene	31	Chikiani	0,82	1,20	0,98	0,13	0,17	13,99
GUG285	Kobuleti	Early Holocene	32	Chikiani	0,87	1,20	1,05	0,09	0,17	16,51

№	Dates (BP)	Dates 95.4 % (BC)	Lab. Index	Sample	Site	References
1	9600±70	9231-8776	SPb-3624	charcoal	Kobuleti	Chkhatarashvili, 2023
2	9587±70	9227-8765	SPb-3621	charcoal	Kobuleti	Chkhatarashvili, 2023
3	9510±32	9121-8657	FTMC-PE65-3	charcoal	Kobuleti	Chkhatarashvili, 2023
4	9465±32	9111-8632	FTMC-PE65-2	charcoal	Kobuleti	Chkhatarashvili, 2023
5	8670±100	8171-7534	SPb-3084	charcoal	Kobuleti	Chkhatarashvili et. al., 2020
6	7949±70	7047-6653	SPb-3623	charcoal	Kobuleti	Manko, Chkhatarashvili 2022b
7	9263±42	8621-8337	FTMC-KU57-1	charcoal	Kobuleti	First published
8	9250±45	8615-8309	FTMC-KU57-2	charcoal	Kobuleti	First published
9	9328±44	8736-8434	FTMC-KU57-3	charcoal	Kobuleti	First published

Tab. 2. Absolute dates of Kobuleti.

* Radiocarbon dates were calibrated using the online calibration program OxCal 4.4.4 (Bronk Ramsey, Lee 2013) 2013) using atmospheric data from Paula J. Reimer et al. (2020).

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