Obsidian at Kobuleti (Western Georgia): Evidence for early human contact in Western Transcaucasia during the Mesolithic period

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A B S T R A C T. We describe a study of obsidian artefacts from a Mesolithic period site located at Kobuleti, Georgia, in the southeastern Black Sea region. A collection of obsidian artefacts discovered there were studied by X-ray flourescence analysis to determine their provenance. Two of the three types correspond to obsidian from the Chikiani and Sarikamis sources indicatEe early human mobility and cultural contact within Caucasia. One artifact did not match any of the currently known sources.

Keywords: Kobuleti, Artifact, Chikiani, Obsidian, X-ray fluorescence (XRF).

1. Introduction

Obsidian (volcanic glass) was one of the most popular varieties of stone used to make sharp-edged tools in ancient times. The sources of obsidian exploited by prehistoric humans are restricted to geologically-recent volcanic regions, such as east Africa, western North America, the trans-Mexican volcanic belt, western South America, Russian Far East, Japan, the islands of the South Pacific, the Mediterranean, and the Caucasus region. In recent times, archaeologists have made extensive use of geochemical analysis to investigate questions about obsidian artefact provenance.

Although the first report of obsidian use in the Caucasus was made by Chirvinskiy (1934), the first geochemical study of Caucasus obsidian appeared in a publication by Cann and Renfrew (1964). Obsidian sources are abundant in both the northern (Doronicheva et. al., 2016) and southern regions (Adler, 2002; Badalyan et. al., 2004; Biagi, et. al., 2017; Biagi and Nisbet, 2018;

Chataigner and Gratuze, 2014a, b; Frahm et. al., 2016; Glauberman, et. al., 2016; Pleurdeau, et. al., 2007).

Archaeological excavations in the territory of Georgia have revealed several hundred sites (caves, grottos, rock shelters, open-air stites, etc.) from the Stone Age (Paleolithic, Mesolithic, Neolithic) both near the Black Sea coastline (Gogitidze, 1978; Kalandadze, 1978; Nebieridze, 1972) and in the mountainous area (Adler et. al., 2006, 2008; Bar-Yosef, et. al., 2011; Gabunia, 1976; Grigolia, 1977; Meshveliani, et. al., 1999; Nioradze, 1933, 1953; Pinhasi, et. al., 2014; Tsereteli, 1973; Tushabramishvili, 1960; Tushabramishvili, et.al., 1999). Many of the sites show evidence of both temporary and long-term habitation. Some of the sites were used as lithics workshops.

Excavations carried out at various times have uncovered extensive archaeological materials, including obsidian. Unfortunately, obsidian artefacts from only a small number of Stone Age sites in central Georgia have been studied to determine their provenance (Badalyan, et. al., 2004; Le Bourdonnec, et. al., 2012). According to the research, the main source of the obsidian is the Chikiani Mountain in the Javakheti region of southern Georgia. It is likely that due to the convenient geographical location of the Chikiani source in central Georgia, obsidian from this source spread to other Stone Age sites in western and eastern Georgia.

The available evidence for the study of early Holocene occupation of the western Georgia will be presented here based on the archaeological data obtained from the site of Kobuleti. The main objective of this work is to reconstruct human habitation of the site about 10,000 years ago. This will be accomplished through a study of obsidian artefacts recovered from Kobuleti.

2. Geographic and archaeological context

Kobuleti is an open-air site situated on the Colchian Plain, which occupies almost the whole of western Georgia and lies to the east of the Black Sea. The Colchian Plain is characterized by a humid subtropical climate. The site of Kobuleti is located on a hill overlooking the north bank of the river Kintrishi in Ajara (western Georgia) (GPS: 41.8030˚ N, 41.8844˚ E). The hill is formed from basalt rock, where is upper part is associated with archaeological site. The height of the hill reaches 50 m a.s.l.

The first archaeological investigations at the site were performed by Berdzenishvili and Nebieridze (1964). The first scientific research at the site was conducted by archaeologist

Gogitidze (1978, 2008), who organized many field seasons in the village of Kobuleti from 1971-1986. Gogitidze (2008) dated the site to the Late Mesolithic - Early Neolithic period, determined only by analogues. More than one hundred pits used for different purposes were found during archaeological excavations. A total of about 30,000 artefacts made of flint and obsidian were recovered. About 2,000 of the artefacts were tools and the remainder were debitage (flakes, chips, chunks, etc.). Because of the moist soil, wood and bone materials were not found during the archaeological excavations at Kobuleti. Unfortunately, no radiocarbon and palynological studies were conducted.

In 2019, for the first time in 33 years, with the funding from Batumi Shota Rustaveli State University we had opportunity to re-visit Kobuleti using interdisciplinary research (palynology, use-wear analyses, geophysics, and geochemistry). The techno-typological and use-wear analysis of the stone artefacts show that the tools were not made locally, but instead were brought to the site as ready-made products. Microscopic analysis of the artefacts reveals that the main activities on the site were the processing of game meat and leather working (Esakiya, Chkhatarashvili, 2020). No evidence for long-term usage was determined on any of the tools. According to the palynological analysis, the climate was warm at the time when the site was functioning. This was confirmed by examining the spores of thermophilic plants in the samples (Chkhatarashvili, et. al., 2020).

The excavations were carried out in the central part of the hill to the north of a previously studied trench. We made several survey trenches, in order to locate an undisturbed cultural layer. The most interesting among them appeared to be the trench number 3, where we investigated 32 m^2 and found the stratigraphic picture listed in Table 1.

All cultural evidence was fixed in the three soil layers. Despite different colors, all three layers belong to the same period – the Mesolithic – both typologically and structurally. In addition, we have discovered 12 pits where we found numerous flint and obsidian artefacts. Pit 5 was found in layer 1, pit 6 in layer 2 and pits 1-4, 7-12 were associated with layer 3.

During the course of the archaeological work, we discovered a total of 1533 artefacts (see Tables 2-3). Of these, a total of 262 are formal tools (i.e., burins, chisels, endscrapers, etc.), 179 are bladelets, 165 are microblades, and the remaining debitage consists of chips, flakes, and chunks. Three spent cores and four tablets (i.e., rejuvenated platforms) were also recovered.

Typological analysis of the flint and obsidian indicates they were not knapped on the spot. By comparing the quantities of blades versus flakes/chunks, it appears the artefacts were most likely brought to Kobuleti in the form of ready-made products and mainly used for hunting.

A majority of the bladelets and microblades have semi-flat shapes. Apparently, they used a pressure technique to produce bladelets and microblades from cores (Hildebrand, 1996). Many of these show evidence of retouching on their edges (**Fig. 1: 1-3**). Some of the bladelets are notched (**Fig. 1: 4-6)**.

The second most numerous group among the tools are burins. They are rather diverse with side and angle burins, double-faceted and dihedral burins, etc. (**Fig. 1: 7-9)**. The majority of the burins were produced from blades, but some of them were made from flakes. There is a one combined tool - burin-endscraper (**Fig. 1: 10)**.

Also, among the finds were 15 endscrapers (**Fig. 1: 11)** and several chisels (**Fig. 1: 12)**. It appears the endscrapers and chisels were produced by retouching some of the flakes. There were also several truncated blades (**Fig. 1: 14)** -- some of them were truncated facetted blades still showing the negative of a microburins spall.

An important group of tools are microblades with abrupt retouching on their edges. These were used specifically for hunting. There are both thick (up to 3 mm) and thin (about 1 mm) microblades (**Fig. 1: 14-18)**.

At present, we only have one absolute date for the site of Kobuleti (Table 4). According to other archaeological sites of the Stone Age in Georgia, the date fits exactly in the chronological framework of the Mesolithic period (Gabunia, Tsereteli, 1991: 196). It is still debatable whether the Mesolithic Period should be the distinguished separately and independently from the Upper Paleolithic Period (Rogachev, 1966). Other archaeologists see it as a separate epoch (Formozov, 1970). Some researchers consider the main criteria for isolating the Mesolithic Period to be only the typological features of the tools and the nature of economy; others consider only the ecological-climatic, paleontological and social elements (Kozlowski, 1973). With all this in mind, we believe that the Kobuleti is a Mesolithic site, which the early human (hunter) visited seasonally.

3. Materials and Methods

Following the 2019 field work, it was decided to submit obsidian artefacts for geochemical analysis to precisely determine the chemical composition and provenance of the obsidian. It should

be noted that the research on four samples of Kobuleti obsidian had already been conducted (Badalyan, et. al., 2004). The earlier study established the only source of Kobuleti's obsidian was Chikiani Mountain in southern Georgia. However, our goal was to study a much larger number of samples, which would naturally allow us to draw more accurate conclusions. The study was conducted by submitting the artefacts to the Archaeometry Laboratory at the University of Missouri Reactor Research (MURR).

The geological and artefact samples were analyzed for composition using a ThermoQuantx ARL spectrometer operating at 35kilovolts. The spectrometer was calibrated for obsidian studies by analyzing a suite of 40 geological obsidians previously analyzed by NAA, XRF and inductively coupled plasma mass spectrometry (Glascock, 2020). The elements measured were K, Ca, Ti, Mn, Fe, Zn, Rb, Sr, Y, Zr, Nb, and Th using a 60-second measurement time on each sample.

4. Results

The results for the ten geological samples from Chikiani are listed in Table 4. The results for the 50 artefacts from Kobuleti are listed in Table 5. The Kobuleti artefacts were compared to the geological samples from Chikiani which determined that 48 of the artefacts did indeed come from the Chikiani source (see **Fig. 2**). The one other artefact GUG001 came from the Sarikamis source (Northern group). The remaining artefact GUG024 was compared to all known sources in Armenia, Azerbaijan, North Caucasus and Turkey with the conclusion that the source is unknown.

5. Discussion

As shown in **Fig. 3,** there are many sources of obsidian have been identified in the South Caucasus: Georgia, Azerbaijan, Armenia and Eastern Turkey (Liubin, Belyaeva, 2009; Chataigner, Gratuze, 2014). As for the North Caucasus, the only known source is Kabardino-Balkaria, near Zayukovo (Doronicheva, et. al., 2019). Chikiani and Sarikamis are two of the nearest sources to the site of Kobuleti with distances of 168 km and 180 km, respectively.

The Chikiani mountain source is located in south Georgia (Javakheti region). It was the only accessible obsidian source for primeval man living in the western and eastern territory of the modern Georgia. Obsidian cobbles are present over a large area of the volcanic dome which flows to the east. The obsidian is high quality - very homogeneous and absent of inclusions (Badalyan, et. al., 2004).

The Sarıkamış obsidian source is named after a small town in the Kars province in eastern Turkey. The area if very mountainous. According to chemical analyses of obsidians have been discovered in several deposits that divide into two groups: Sarikamis “South” and “North”. The Sarıkamıs South source area is located near the towns of Mescitli and Sehitemin. It is characterized by high concentrations for barium and relatively low amounts of the heavy rare earths (yttrium, erbium and ytterbium). This group is the oldest (4.9–4.4 Ma, Bigazzi, et. al., 1998) and comes from an undifferentiated magma (Gallet, 2001). The Sarıkamıs North source area is located near the towns of Kizil Kilisa, Handere and Hamamlı. It is characterized by low barium concentrations and higher concentrations for yttrium and especially zirconium. This group is the more recent (3.8–3.5 Ma; Bigazzi, et. al., 1998) and comes from a more evolved magma in which zircon is present as micro-crystals (Chataigner, et. al., 2014; Gallet, 2001).

According to geochemical analyses of obsidian artefacts discovered in Aratashen, Karkrakar, Keti (western Armenia) (Chataigner, et. al., 2014, 20-22) and Ortvala-klde (western Georgia) (Le Bourdonnec, et. al., 2012) archaeological sites were come from the Sarikamis North source. The sample of Sarikamis obsidian in this study came from the Sarikamis North source.

6. Conclusion

According to our research, the early humans at Kobuleti were supplied with obsidian from multiple sources. By far, the most important source was the Chikiani Mountain which lies southeast of Kobuleti. The Sarikamis source located south of Kobuleti served as a minor secondary source of obsidian for the inhabitants of Kobuleti. Our analysis also revealed the existence of one unknown source. Unfortunately, it could not be identified. It is possible that we will have even more extensive contacts. Research shows that the first borns were constantly moving and had active contacts with other regions. In summary, it can be said that obsidian found in the Ajara region along the southeastern Black Sea coast is the earliest evidence of the use of obsidians from Chikiani and Sarikamis dating to the VIII millennium BC.

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Table 1. Stratigraphy of trench number 3 at the site of Kobuleti.

Depth (m)	**Description of layers**
0 to 0.2	Humus layer
0.2 to 0.3	Layer 1. Blackish-brown soil
0.3 to 0.45	Layer 2. Brown soil
0.45 to 0.65	Layer 3. Light brown soil with small pebbles
0.65 and below	Yellow (sterile) layer

Table 2. List of flint and obsidian artifacts in soil layers 1-2 at Kobuleti.

Type	**Layer 1**		**Layer 1, Pit 5**		**Layer 2**		**Layer 2, Pit 6**		**Total**		
Cores and debitage	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	
Core	1					1			1	1	2
Tablettes					2	1	1		3	1	4
Blades	3				7	2	18	9	28	11	39
Bladelets	8	13	3	8	45	27	7	14	63	62	125
Microblades	2	10	1	6	16	23	34	24	53	63	116
Flakes	8	9	19	16	54	23	99	31	180	79	259
Chips	12	18			16	6	65	21	92	45	138
Chunks	5	12			35	63	13	20	53	95	148
Burin spalls		1			3	2			3	3	6
Tools	**15**	**25**	**6**	**8**	**26**	**44**	**15**	**48**	**62**	**122**	**184**
Burins	5	5	5		12	5	3	9	25	19	44
Endscrapers		3		1	2	2		2	2	8	10
Chisels					5	4	1	2	6	6	12
Retouched Flakes					1			2	1	2	3
Retouched blades, bladelets, microblades	7	13		2	4	15	2	13	13	43	59
Notched blades, bladelets	1			5	1	8	2		4	13	17
Truncated Blades, bladelets, microblades	2	3			1	3	4	5	7	11	18
Microblades with abrupt retouch		1				7	3	12	3	20	23
Endscraper-Burin			1						1		1
Total											

Table 3. List of flint and obsidian artifacts in soil layer 3 at Kobuleti.

Type	**Layer 3**		**Pit 1**		**Pit 2**		**Pit 3**		**Pit 4**		**Pit 7**		**Pit 8**		**Pit 9**		**Pit 10**		**Pit 11**		**Total**		
Cores and debitages	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Flint**	**Obsidian**			**Flint**	**Obsidian**	**Flint**	**Obsidian**	**Total**
Cores					1																1		1
Blades		3	2	3									1	2							3	8	11
Bladelets	14	3			8	1					2	2	3	3	3	2			12	1	42	12	54
Microblades	12	5	1	4	7	3					1	3			2				8	3	31	18	49
Flakes	22	11	2	1	17	5				1	2		7	3	26	9			14	6	90	36	126
Chips	23	2			10	2					3	3	12	3					11	2	59	12	71
Chunks	47	12			41	4					1								15	3	##	19	123
Tools	**19**	**7**	**0**	**0**	**4**	**1**	**1**	**0**	**0**	**0**	**4**	**7**	**9**	**4**	**6**	**2**			**2**	**9**	**43**	**35**	**78**
Burins	3	2			2	1					1	1	1	3						4	7	11	18
Endscrapers		1									1		1		2						4	1	5
Chisels	2																		1		3		3
Retouched Flakes	2												1		2	1					5	1	6
Retouched Blades, bladelets, microblades	12	3			2		1				2	6	4	1	1	1				10	22	21	40
Truncated Blades, bladelets		1																				1	1
Microblades with abrupt retouch															1				1		2		2
Total																							

Table 4. Radiocarbon date of Kobuleti site.

Location	Sample	Lab. Cod	Dates ^{14}C BP	Dates cal. BC (68.2 %)	Dates cal. BC (95.4 %)	Reference
Pit 7, Level 2	Charcoal	Spb-3084	8670±100	7831-7584	7995-7534	This work

Table 5. Concentrations of elements in parts per million for obsidian from the Chikiani source.

ANID	K	Ca	Ti	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Th
CHIK01	31822	4172	797	536	5520	44.0	122.5	81.2	14.2	83.4	20.9	14.0
CHIK02	25947	3064	588	368	4824	40.4	118.0	74.9	13.4	78.4	20.6	14.9
CHIK03	41274	5645	909	576	6143	44.8	129.2	87.8	14.9	93.3	20.2	14.8
CHIK04	40402	4929	816	473	5684	43.5	126.6	82.4	14.2	86.6	19.4	16.7
CHIK05	43258	6251	963	580	6327	49.4	129.8	93.3	14.5	98.0	21.6	15.7
CHIK06	41727	5431	924	519	5866	43.0	125.5	87.5	15.2	92.6	19.9	15.3
CHIK07	41199	4968	829	508	5635	45.8	122.6	81.5	14.5	84.9	20.8	13.2
CHIK08	35756	4500	749	428	5681	43.6	119.5	86.5	14.5	95.2	19.9	13.7
CHIK09	41265	5623	853	466	5822	45.0	124.8	83.5	14.3	91.2	20.3	15.3
CHIK10	38654	4989	778	474	5864	48.8	124.5	87.4	13.8	93.3	19.5	16.4

Table 6. Concentrations of elements in parts per million for obsidian artifacts from Kobuleti.

ANID	Chemgrp	K	Ca	Ti	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Th
GUG001	SARIKAMIS	37093	2234	538	623	7899	69.2	136.2	3.3	42.7	222.9	27.1	17.3
GUG002	CHIKIANI	35480	4309	746	431	5613	45.1	117.6	85.4	13.4	97.1	18.6	14.7
GUG003	CHIKIANI	26886	3302	653	274	5606	38.0	97.2	105.3	10.4	117.7	16.9	12.7
GUG004	CHIKIANI	37396	4904	871	441	6224	42.4	118.6	98.6	14.5	109.5	18.6	15.0
GUG005	CHIKIANI	42435	6770	1152	478	7000	45.0	122.7	115.3	14.3	121.2	18.5	16.6
GUG006	CHIKIANI	35441	4200	720	423	5360	41.7	118.0	80.9	13.6	90.0	21.2	14.5
GUG007	CHIKIANI	31828	3547	563	369	4902	45.0	112.9	69.0	13.2	75.7	19.8	12.2
GUG008	CHIKIANI	43092	6236	879	608	6002	47.4	128.7	77.1	16.0	79.0	21.0	15.2
GUG009	CHIKIANI	37242	4406	741	433	5875	42.9	118.7	83.2	13.8	91.4	20.4	12.1
GUG010	CHIKIANI	38044	4767	815	471	5521	42.4	119.4	83.4	14.8	90.1	20.0	14.3
GUG011	CHIKIANI	36764	4322	839	410	5898	42.9	116.6	91.5	13.6	100.8	19.5	15.6
GUG012	CHIKIANI	38249	4785	834	485	6325	46.0	122.9	87.7	13.5	97.3	20.7	14.0
GUG013	CHIKIANI	38363	4107	882	510	6019	47.2	124.5	76.2	14.7	78.8	21.1	14.9
GUG014	CHIKIANI	38430	4705	791	483	5831	42.4	116.5	88.0	14.6	94.2	19.4	13.6
GUG015	CHIKIANI	33274	4631	882	374	6370	38.6	103.8	112.5	12.3	121.5	17.7	14.1
GUG016	CHIKIANI	35608	4227	778	396	5451	36.6	113.6	86.1	13.7	95.4	17.9	13.9
GUG017	CHIKIANI	41694	5359	843	581	5789	45.3	129.5	76.3	16.0	80.3	21.3	15.2
GUG018	CHIKIANI	38094	4818	781	499	5920	45.0	122.9	83.4	14.9	92.8	22.0	14.8
GUG019	CHIKIANI	37510	4326	715	411	5517	43.5	119.8	82.6	14.1	89.4	19.3	15.5
GUG020	CHIKIANI	42580	6348	1036	527	6804	44.0	124.4	99.4	15.0	108.0	17.2	15.0
GUG021	CHIKIANI	40122	4657	767	510	5636	45.2	128.4	76.8	15.7	81.4	21.0	13.1
GUG022	CHIKIANI	37057	5286	1154	450	7258	41.3	112.5	110.1	13.1	117.3	17.8	15.4
GUG023	CHIKIANI	37685	5037	837	445	5833	43.5	121.1	86.3	15.0	94.2	19.4	15.6
GUG024	unknown	39940	6075	647	437	5221	39.9	177.1	51.9	16.1	69.4	27.2	14.2
GUG025	CHIKIANI	33744	3916	823	375	5734	43.4	113.8	87.9	13.2	91.5	19.8	14.8
GUG026	CHIKIANI	35858	4606	992	435	6759	48.6	114.3	89.6	14.2	98.9	17.3	14.5
GUG027	CHIKIANI	39018	5341	847	476	6271	44.9	121.2	95.7	14.1	102.6	17.8	15.8

GUG028	CHIKIANI	34082	3746	684	406	5775	42.7	119.3	73.0	13.1	76.0	20.2	14.8
GUG029	CHIKIANI	42618	6154	1003	567	6400	47.6	127.5	87.4	15.3	91.0	20.1	13.7
GUG030	CHIKIANI	35675	4009	674	430	5086	42.7	120.1	75.6	14.6	78.1	21.0	14.6
GUG031	CHIKIANI	30135	4182	709	342	5300	40.1	110.3	86.9	11.9	93.6	18.0	14.2
GUG032	CHIKIANI	37628	5083	1030	479	6844	45.7	120.1	84.6	13.5	92.4	18.3	14.9
GUG033	CHIKIANI	41173	5061	871	511	5945	44.6	124.0	83.8	15.2	88.5	19.3	15.3
GUG034	CHIKIANI	39145	4985	976	493	6577	47.0	121.5	96.4	13.5	104.3	19.1	16.5
GUG035	CHIKIANI	39369	5432	1098	421	6957	45.3	116.1	108.4	13.9	114.6	19.4	13.7
GUG036	CHIKIANI	37005	4131	696	432	5604	40.4	122.1	80.4	13.0	85.6	21.6	14.7
GUG037	CHIKIANI	42609	5539	879	554	6019	50.9	130.2	83.2	15.2	89.0	20.5	14.8
GUG038	CHIKIANI	35549	3750	717	386	5817	45.9	113.7	85.7	12.5	95.1	18.7	14.4
GUG039	CHIKIANI	28742	3215	701	334	4651	42.4	107.4	73.5	12.6	77.7	19.1	13.0
GUG040	CHIKIANI	38281	5146	807	469	5942	48.6	123.5	79.5	14.7	85.5	20.2	13.4
GUG041	CHIKIANI	37166	4772	814	452	5710	42.3	120.6	79.0	13.6	83.8	19.2	14.8
GUG042	CHIKIANI	38041	4537	792	434	5700	44.3	118.3	92.2	13.9	99.1	18.4	14.3
GUG043	CHIKIANI	43325	6708	1046	539	6882	47.3	126.3	105.7	14.7	112.2	19.4	15.5
GUG044	CHIKIANI	30789	3510	756	381	5275	40.1	118.2	79.5	13.7	87.5	18.8	13.9
GUG045	CHIKIANI	40397	5392	985	469	6179	53.8	121.7	97.9	13.6	109.0	18.3	15.3
GUG046	CHIKIANI	43177	6055	984	515	6552	48.2	125.6	98.1	14.7	106.1	18.6	15.3
GUG047	CHIKIANI	32940	4172	827	415	6014	46.5	111.9	92.3	13.4	99.0	19.3	14.6
GUG048	CHIKIANI	35501	4073	651	398	5655	41.3	114.5	82.3	13.8	90.3	17.1	13.3
GUG049	CHIKIANI	36795	4291	689	423	5676	43.4	117.0	84.9	13.2	88.4	20.2	14.9
GUG050	CHIKIANI	41545	5197	845	557	5748	50.0	132.5	77.3	16.4	76.1	21.2	15.1

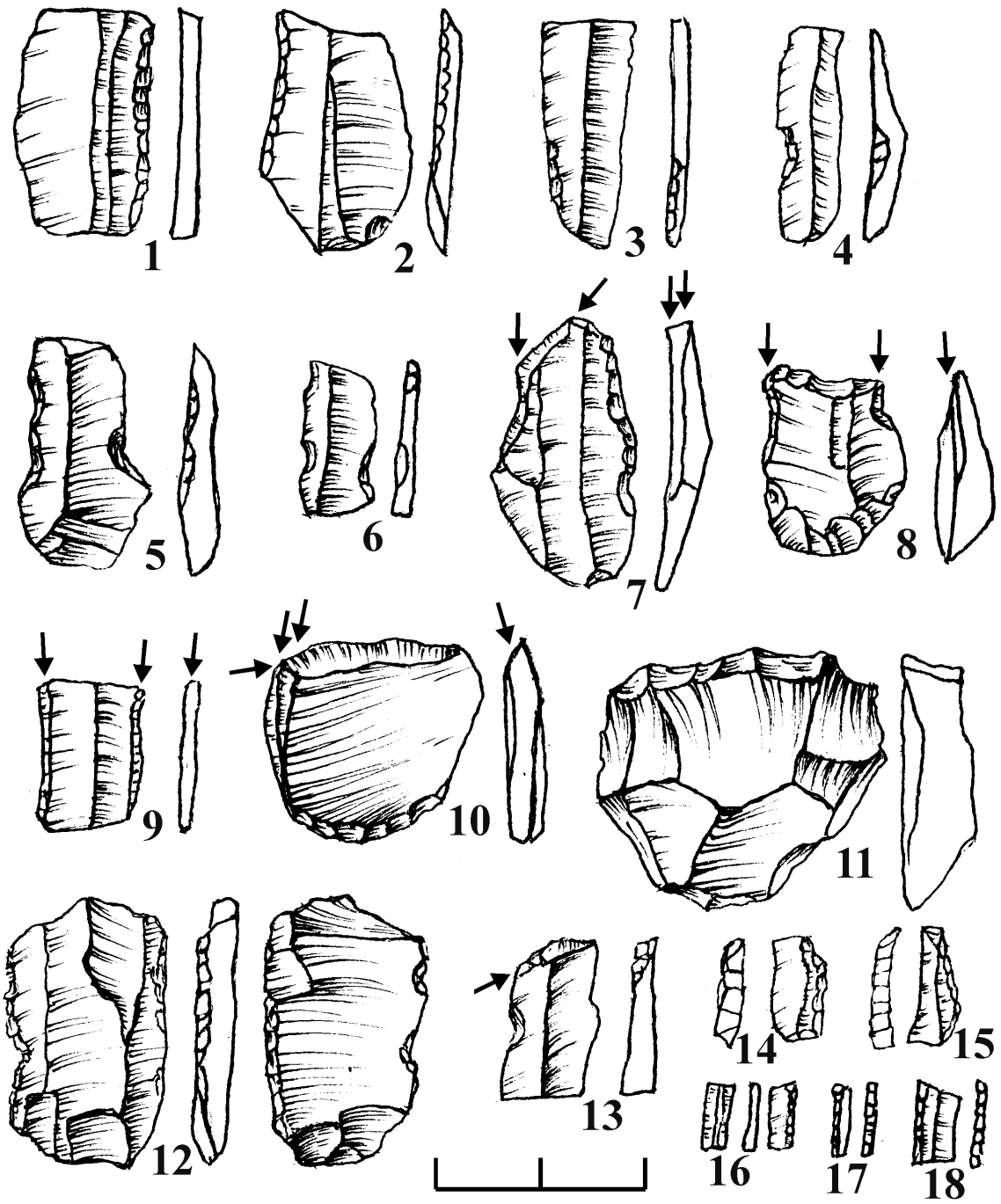

Figure 1. Obsidian tools at Kobuleti.

1-3 retouch blades; 4-6 notch blades and bladelets; 7-9 burins; 10 combined tool: endscraper-burin; 11 endscraper; 12 chisel; 13 truncated blade; 14-18 microblades with abrupt retouch

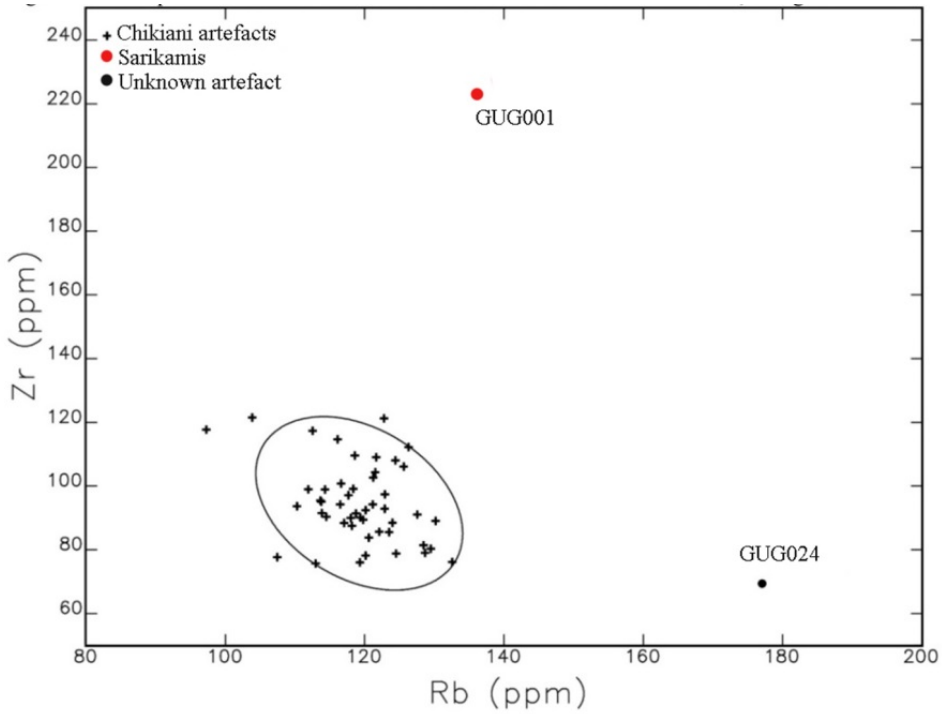

Figure 2. Scatterplot of Rb versus Zr for obsidian artifacts from the site of Kobuleti.

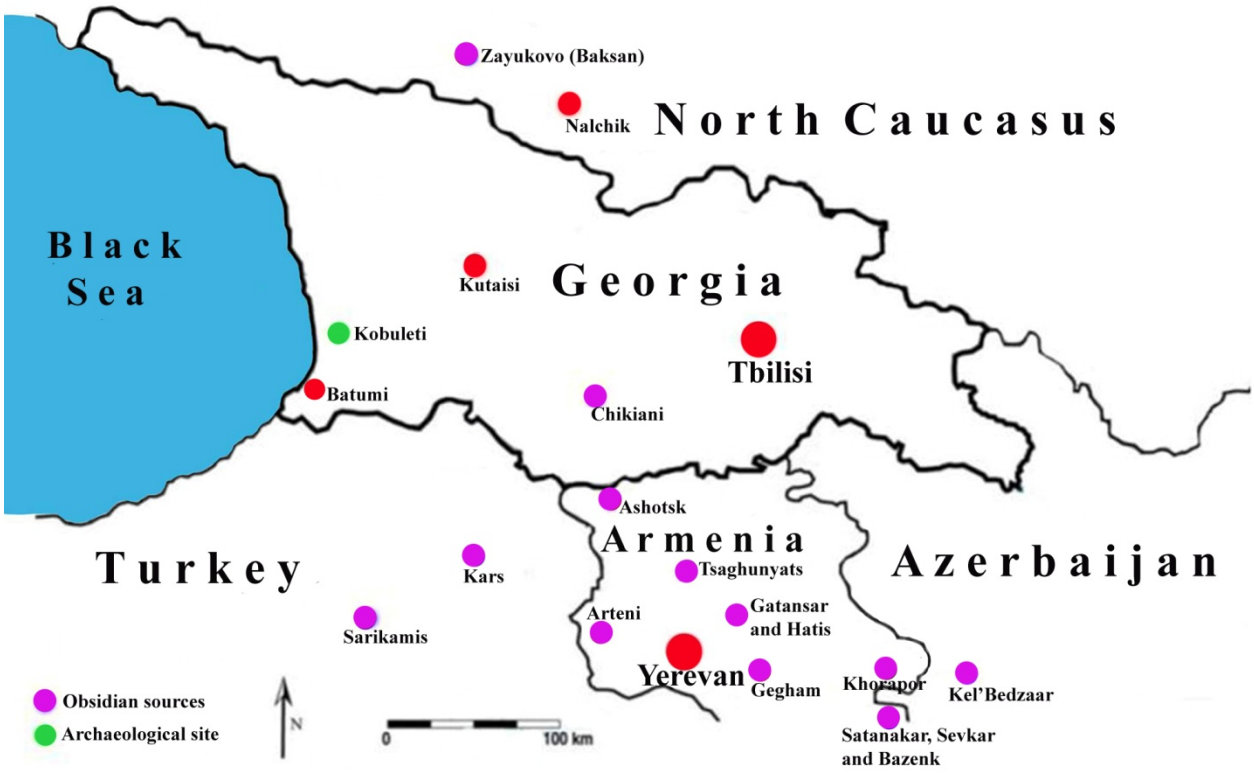

Figure 3. Map showing the location of the Kobuleti archaeological site and the main obsidian sources in Caucasus.

1. Kobuleti; 2. Chikiani (Georgia); 3. Kars; 4. Sarikamis „north group" (Turkey), 5. Arteni, 6. Ashotsk, 7. Tsaghkunyats, 8. Gatansar and Hatis, 9. Gegham, 10.Khorapor, 11. Satanaskar, Sevkar and Bazenk (Armenia); 11. Kel'Bedzaar (Azerbaijan); 12. Zayukovo (Northern Caucasus)