# New insights into the Mesolithic and Neolithic layers of the Darkveti rock shelter in the Imereti Region, Western Georgia

**Guram Chkhatarashvili[1], Nikoloz Tskvitinidze[2], Nikoloz Tsikaridze[3], James A. Davenport[4], and Michael D. Glascock[4]**

*1 Batumi Shota Rustaveli State University, Batumi, GA;* guramchkhatarashvili@bsu.edu.ge
*2 European University, Tbilisi, GA;* n.tskvitinidze@gmail.com
*3 Ilia State University, Tbilisi, GA;* nikoloztsikaridze@gmail.com
*4 Research Reactor Center, University of Missouri, Columbia, USA;* davenportja@missouri.edu; glascockm@missouri.edu

ABSTRACT – *The Darkveti multi-layered site in the Imereti region of Georgia offers valuable insights into prehistoric human activity. Despite extensive research conducted in the 1960s and 1970s by Lamara Nebieridze, certain aspects of the site's chronology and inhabitants' mobility remained unclear. This study aims to address these gaps through collaborative, interdisciplinary research involving Georgian and foreign scientists. The primary objective is to precisely date the cultural layers belonging to the Mesolithic and Neolithic epochs using absolute dating methods. By combining archaeological evidence with palaeontological, geoarchaeological, and palaeobotanical data, this study aims to reconstruct the palaeoenvironment and subsistence strategies of the Darkveti inhabitants. Additionally, the analysis of stone tools and lithic raw materials will shed light on technological developments and possible connections with neighbouring regions. The findings will contribute to a better understanding of the cultural dynamics, mobility patterns, and adaptations of prehistoric communities in the Imereti region and the wider Caucasus.*

KEY WORDS – *Georgia; Darkveti; Mesolithic; Neolithic*

## *Nov vpogled v mezolitske in neolitske plasti spodmola Darkveti v regiji Imereti, zahodna Gruzija*

IZVLEČEK – *Večslojno najdišče Darkveti v regiji Imereti v Gruziji ponuja dragocen vpogled v človekove dejavnosti v prazgodovini. Kljub obsežnim raziskavam, ki jih je v šestdesetih in sedemdesetih letih 20. stoletja opravila Lamara Nebieridze, sta kronologija naselbine in poselitvena mobilnost ostali nejasni. Namen naše študije je odpraviti te vrzeli z interdisciplinarnimi raziskavami, v katere so vključeni znanstveniki iz Gruzije in tujine. Osnovni cilj je natančno datiranje mezolitskih in neolitskih kulturnih plasti s pomočjo absolutnih metod. S povezanimi arheološkimi, paleontološkimi, geoarheološkimi in paleobotaničnimi podatki želimo rekonstruirati paleookolje in strategije preživetja prebivalcev Darkvetija. Poleg tega analiza kamnitih orodij in litičnih surovin osvetljuje tehnološki razvoj in povezave s sosednjimi regijami. Ugotovitve prispevajo k boljšemu razumevanju kulturne dinamike, vzorcev mobilnosti in prilagoditev prazgodovinskih skupnosti v regiji Imereti in na širšem Kavkazu.*

KLJUČNE BESEDE – *Gruzija; Darkveti; mezolitik; neolitik*

 DOI: 10.4312/dp.52.2

## Introduction

Western Georgia, located in the South Caucasus region of Eurasia, is notably distinguished by the Kvirila River valley, situated in the Colchian lowland and bordered to the west by the Black Sea. This area boasts a remarkable concentration of archaeological sites, with representations from every period ranging from the Palaeolithic to the Neolithic. It is characterized by a rich array of natural caves, grottos, and open-air sites, all of which provide evidence of extensive and prolonged human habitation.

Archaeological investigations have established that the Kvirila River valley was first inhabited by early humans during the Palaeolithic, and specifically since the Acheulean period. Successive discoveries of significant archaeological sites in this region have been well-documented by numerous researchers (*Bernatsky 1884; Krukovsky 1916; Nioradze 1933; 1953; Kiladze 1944; 1948; Tushabramishvili 1960; 1969; Javakhishvili 1971; Dochanashvili 1973; Nebieridze 1973; Nioradze 1975; Tushabramishvili, Tsereteli 1975*). A major advance in the study of these sites occurred in the 1990s, with the launch of joint international archaeological expeditions that included both Georgian and foreign scientists (*Meshveliani* et al. *1999; 2004; 2007; Tushabramishvili* et al. *1999; Adler* et al. *2006; Baz-Oz* et al. *2008; Bar-Yosef* et al. *2011*).

One of the most prominent sites within the valley is the multi-layered Darkveti rock shelter, notable for its extensive stone tool collection and a diverse array of archaeozoological findings. This site was extensively documented in a seminal work by the archaeologist Lamara Nebieridze (*1978*). However, in 2023 and 2024 the recent interdisciplinary research on the stone inventory and bone material yielded valuable new information regarding the mobility of early humans at the Darkveti site and the chronological framework of its habitation.

This paper presents the latest data obtained from these laboratory analyses, along with the corresponding archaeological context and overarching conclusions.

## Archaeological background

The Darkveti rock shelter was extensively studied from 1968 to 1972 by the Kvirila Valley Archaeological Expedition of the Institute of History, Archaeology, and Ethnography, led by Nebieridze (*1978*). The site is situated in the northwestern part of Upper Imereti (Figs. 1 and 2), within the Chiatura municipality, on the left bank of the Kvirila River, embedded in the limestone massif of the canyon-like valley. The Darkveti rock shelter was located approximately 5m above the current river level, with its entrance facing northeast.

Unfortunately, the archaeological site has since been completely destroyed. During the Soviet era, the construction of a narrow-gauge railway along the river's scarp led to the cutting and toppling of the main and side sections of the rock shelter. This destruction exposed material in the collapsed layers and on the surface. Fortunately, timely intervention by the archaeological expedition allowed for the study of untouched areas (*Nebieridze 1978.10*).

An area of approximately 75m$^2$ was excavated, revealing the following stratigraphy (Figs. 3–5):

- Layer I: Ash mixed with fine gravel, lying on an 8cm thick compacted clay floor. This layer contained materials from the Chalcolithic-Early Bronze Age.

- Layer II: Brown loose loam with ash admixture, approximately 30–35cm thick, resting on a 5cm thick compacted clay floor. A coal layer (5cm) was found

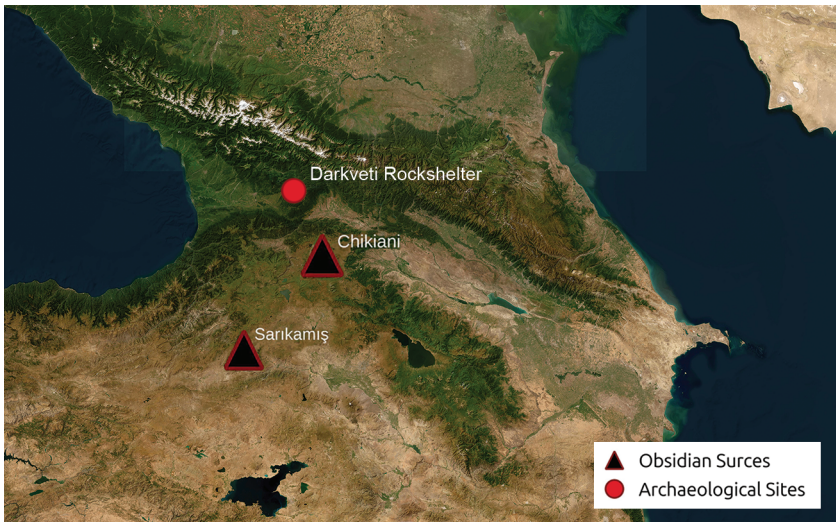



***Fig. 1. Map showing the location of the Darkveti rock shelter and the sources of obsidian.***

directly on the floor, topped by fine gravel (3cm). This layer contained numerous ceramics, stone, and bone tools.

- Layer III: Ash, approximately 30–32cm thick, was the richest in archaeological remains.

- Layer IV: Peaty ash, with hearth remains (burnt earth, ash) in the lower part. Only stone and bone materials were found in this layer.

- Layer V: Gravel and large boulders, approximately 1m thick, contained no material (*Nebieridze 1978.11–12*).

Beneath the coarse layer on the main excavation area, an 8–30cm thick ash layer was found, representing the sixth cultural layer. The archaeologist Nebieridze observed that, despite differences in structure and colour, all cultural layers of the rock shelter shared a common feature: an abundance of ash and charcoal, indicating intensive use of fire by the ancient inhabitants. The large boulders deposited on top of the Mesolithic and Neolithic layers indicate a natural disaster that likely led to significant changes in the area and a temporary abandonment of the site. During the excavations, the large fallen boulders were still visible atop the Neolithic layer, supporting the assumption that habitation ceased before the Chalcolithic era (*Nebieridze 1978.17*).

Natural disasters likely forced the inhabitants to leave the rock shelter temporarily. However, the ceiling collapse might have continued during human occupation, as manifested by fine cracks on the walls of the shelter. The study of the layers in Darkveti rock shelter revealed that the site was selected as a place of residence starting from the Mesolithic, and continued to be used until the Early Bronze Age. Favourable ecological conditions, such as dryness, clear walls, proximity to water, and possibly rich flora and fauna, contributed to its intensive use.

## Chipped stone assemblage of the Darkveti rock shelter

As previously mentioned, our study presents significant results from the interdisciplinary analysis of the stone and bone collection from the Mesolithic and Neolithic layers of the Darkveti rock shelter. We thus provide a brief description of the layers and the recovered inventory.



***Fig. 2. Darkveti rock shelter. General view from the northwest.***

The work on the stone collection used the methods of Jacques Tixier and Khizri Amirkhanovich Amirkhanov. In particular, specimens with a width of less than 12mm are categorized as bladelets, and those with a width of more than 12mm as blades (*Tixier 1974.10–11*). As for microblades, their size is 7mm and less (*Amirkhanov 1987.10*).

Layer V was found at a depth of 2.10m from the surface, beneath a sterile gravel layer approximately 1m thick. This layer contained a significant number of flint and obsidian tools, production debris, and animal bones (Tabs. 1–2; Fig. 6). The tools were primarily manufactured using pressure flaking techniques, as evidenced by the presence of pencil-like cores (4 items), three of which are obsidian and one flint. These cores show traces of regular microblade detachments on their sides (Fig. 6.1).

Among the tools there are an interesting group of burins (Fig. 6.2–4), with a total of 17 pieces. Most are made on blades. Burins are selected in various forms: simple, unifacial, bifacial, oblique, and others. Within the collection, the second position after the scrapers is occupied by points (Fig. 6.7,28). Most are made on blades and flakes, they are chiefly represented by side-scrapers. Among the tools, numerous blades and microblades show signs of retouching, and several of these have undergone indirect retouching (Fig. 6.24–27).

The collection includes a few combined burins (scraper-burins) (Fig. 6.6,15), and there are also a few perforators, denticulated tools, and a chisel (Fig. 6.5,8–9).

Of particular interest are the microliths (rectangular), which are made on blades and microblades (Fig. 6.10–14,16–23), some with two retouched edges (*Nebieridze 1978.20–21*). These artefacts likely served as inserts for hunting tools. Among the pebble tools, a single stone net sinker was found (Fig. 6.34), featuring slight notches on both sides.

It is noteworthy that bone material is also present in the assemblage (Fig. 6.29–33). The bones belong to various species of animals and birds, with some being used as tools (*e.g.,* perforators). Additionally, a pendant made from bird bone was discovered (*Nebieridze 1978.21*).

The lithic assemblage includes a large quantity of production debris, primarily consisting of blades, indicating that the inhabitants were proficient in blade production techniques, allowing them to produce blades and microblades of various sizes for toolmaking on the spot.

Layer IV is characterized by a diverse array of materials (Tabs. 1–2; Figs. 7–8). There are a total of 25 cores, including prismatic, conical, and pencil-like examples (Fig. 7.8–14). Both pressure flaking and direct percussion techniques appear to have been used in core processing. Some cores have two platforms, showing clear detachments from blade production. The pencil-like cores exhibit negatives from the removal of microblades.

Scrapers are less numerous in this layer (Fig. 8.1–4), but several forms can be identified: end-scrapers, round scrapers, and high-edged scrapers. There are also fewer burins, though they come in various shapes (Fig. 8.8–16).

Compared to the Mesolithic layer, there are more perforators in this one, made on blades and flakes with retouched working tips on both sides (Fig. 8.5–7).

The trapezoids are made from the medial sections of the blades, which have been retouched on the edges (Fig. 7.16–19) (*Nebieridze 1978. 22*).

In addition to the aforementioned tools, the collection includes a few unique items such as points, adzes, chisels, and others (Fig. 8.17–22). The pebble tool collection features a polished axe and a fragment of an oval-shaped hand grinder (Fig. 7.1).

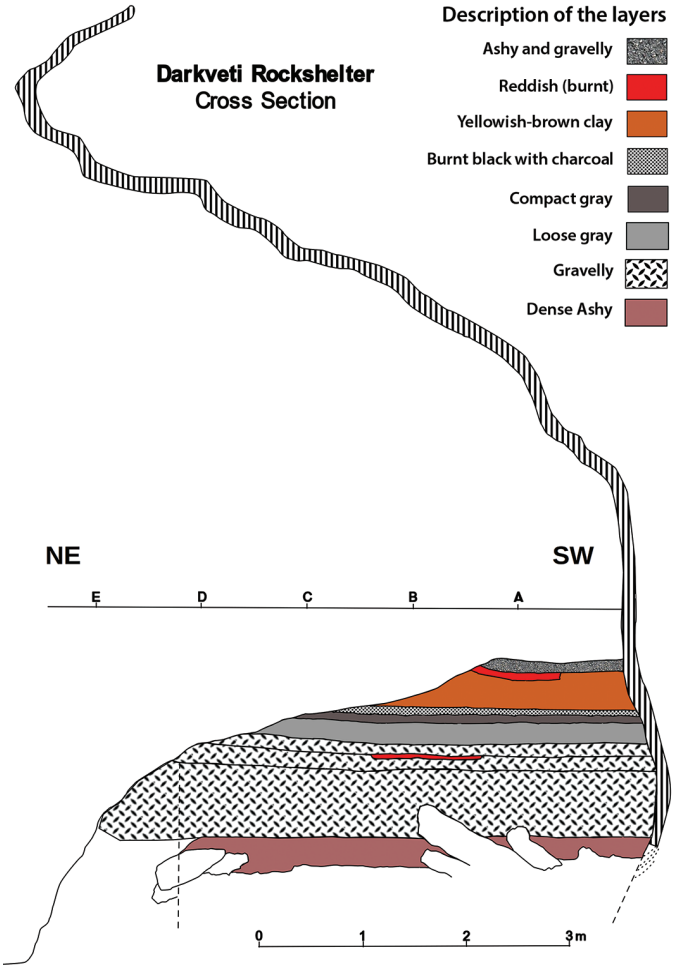
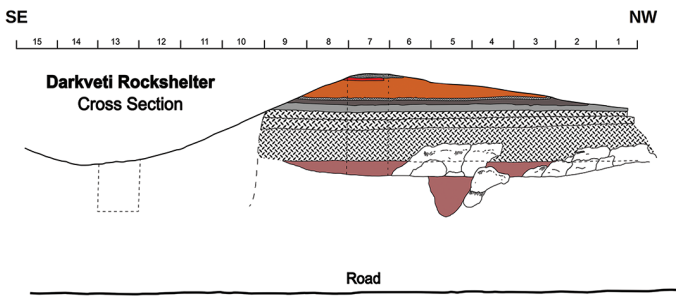



Fig. 3



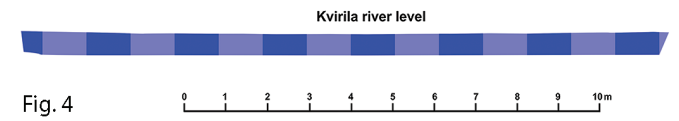




Fig. 4

***Figs. 3 and 4. Darkveti rock shelter. Cross sections.***

In Layer IV, isolated items include a bird bone awl and a perforator (Fig. 7.2–7), as well as a large, polished fragment of a deer antler (Fig. 7.15). Smaller antler fragments, likely used as tools, were also found (*Nebieridze 1978.24*).

## Archaeozoological remains

As previously noted, a substantial quantity of faunal remains was discovered in the Mesolithic and Neolithic layers (Tab. 2). The palaeontologists Nikolai Iosifovich Burchak-Abramovich and Oleg Bendukidze identified the following species: red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), bear (*Ursus spelaeus*), wild boar (*Sus scrofa*), wild goat (*Capra sp.*), and beaver (*Castor fiber*), among others (*Nebieridze 1978. 35*).

In the Early Neolithic (IV) layer, osteological remains of domesticated animals appear, including cattle (*Bos taurus*), pig (*Sus domesticus*), small ruminants (*Ovis aut Capra*), and dog (*Canis familiaris*) (*Nebieridze 1978.91*).

It is noteworthy that the faunal material is typical of the Early Holocene (Preboreal and Boreal) faunal assemblages in western Georgia. The abundance of red deer, roe deer, wild boar, and wild goat bones suggests that these species were particularly significant to the ancient hunters. The Mesolithic layer at the nearby Kotias-Klde site provides valuable information for reconstructing the hunting practices and broader faunal landscape (*Meshveliani* et al. *2007*).

## Materials and methods

Obsidian is present in smaller quantities compared to flint in the lithic assemblage from the Darkveti rock shelter. However, it is noteworthy for its high quality. The collection is dominated by artefacts made of black and translucent obsidian, which likely originate from various sources. To investigate this, obsidian artefacts from layers III-V of the Darkveti rock shelter were selected for analysis.

The goal of the geochemical analysis was to determine the chemical composition of the obsidian to ascertain its provenance. This research was conducted at the Archaeometry Laboratory of the University of Missouri Research Reactor Center.

The study was conducted by submitting 47 artefacts from the Darkveti rock shelter samples to the Archaeometry Laboratory at the University of Missouri Reactor Research (MURR). 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 35kV 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 Michael D. Glascock (*2020*).

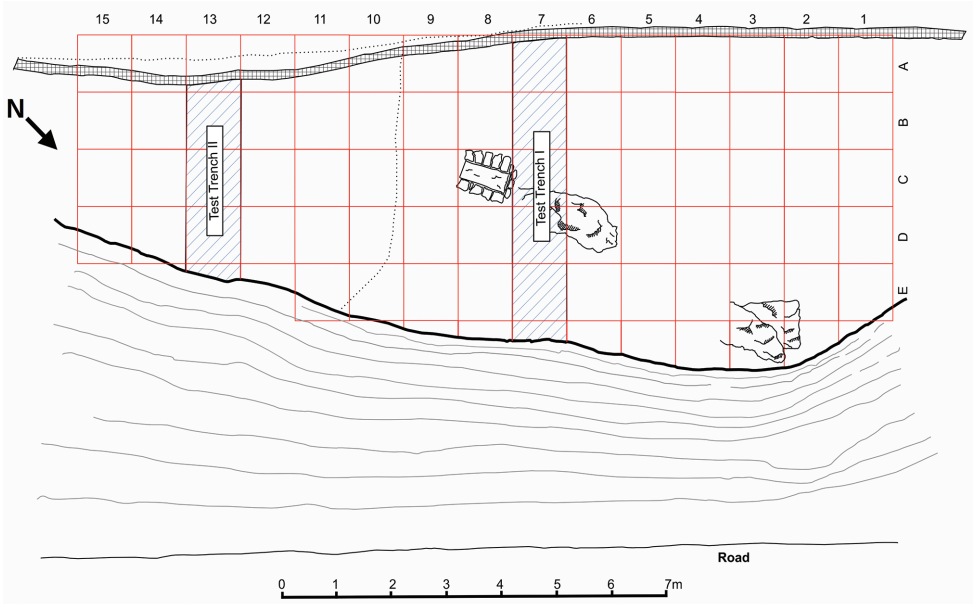



***Fig. 5. Darkveti rock shelter. Plan of the excavations.***

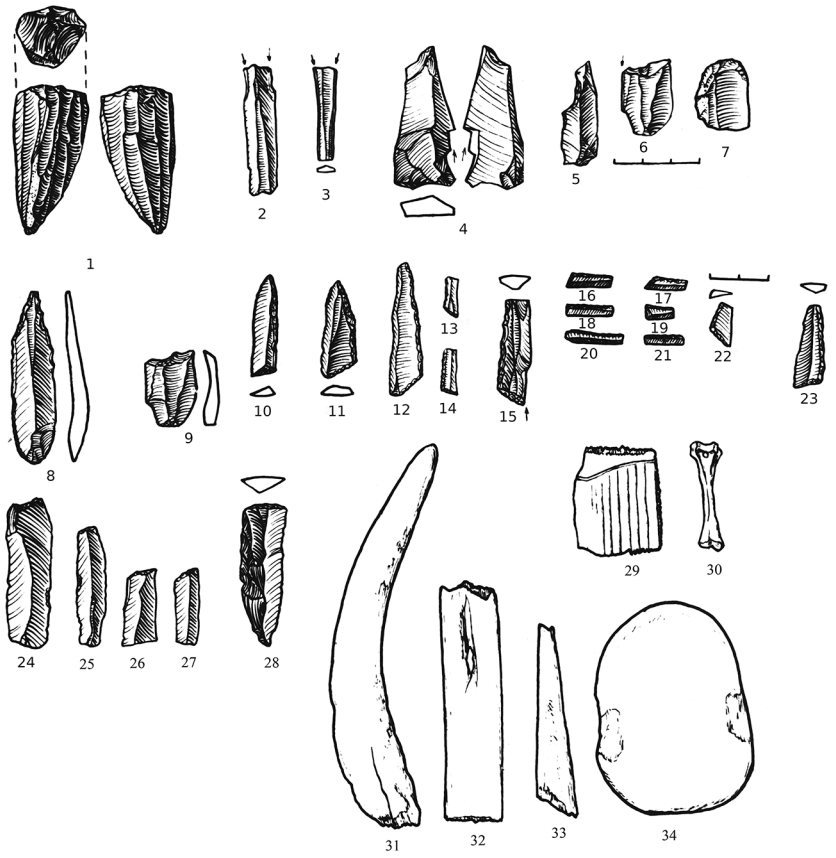


***Fig. 6. Darkveti rock shelter. Lithic and bone artefacts.* 1 *core;* 2–4 *burins;* 5, 8, 9 *perforator, denticulate tool, chisel;* 6, 15 *scraper-burin;* 7, 28 *scrapers;* 10–14, 16–23 *blades and microblades (microliths) with abrupt retouch;* 24–27 *retouched blades and microblades;* 29–33 *bone tools;* 34 *net sinker.***

The artefacts were non-destructively analysed 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 artefacts, the most reliable data is usually only possible for Rb, Sr, Y, Zr, and Nb. Sample size and thickness can be problematic for small artefacts, an issue that was solved by examining element ratios (Sr/Rb, Rb/Zr, *etc.*) as recommended by Richard E. Hughes (*2010*). Multiple elements were used to determine differences between sources where ratio values would otherwise overlap.

To determine the absolute dates of the Mesolithic and Neolithic layers at the Darkveti rock shelter, bone material was selected for radiocarbon analysis. This research was conducted using the AMS (Accelerator Mass Spectrometry) method at the Vilnius Radiocarbon Laboratory.

Radiocarbon dates were calibrated using the online calibration program OxCal 4.4.4 (*Bronk Ramsey, Lee 2013*) using atmospheric data from Paula J. Reimer *et al.* (*2020*). Samples comprise two fragments of bone *Cervus elaphus*. The selected samples come from the layers V and IV of the Darkveti rock shelter.

## Results

The results of the XRF analysis were compared to a database of obsidian source samples which were also analysed at MURR using the same Thermo Quantx ARL lab-based XRF spectrometer. An overview of the data reveals two sources for the obsidian in this study. These are Chikiani in Georgia and Sarıkamış 2 (Hamamli) in Türkiye. All samples from layers III and V originated from Chikiani. For the samples from layer IV, two were from Türkiye (Figs. 9–11), and 20 samples from Chikiani. The data can be found in supplemental Table 3 (https://doi.org/10.4312/dp.52.2).

The Chikiani source has several subsources (*Biagi, Gratuze 2016*), which are primarily distinguished by variable percentages of barium and zirconium. Barium was not detected in this analysis, and as a result subsource assignments within the Chikiani source could not be reliably determined.

Radiocarbon analysis yielded a very interesting series of absolute dates, which significantly determined the age of the Mesolithic and Neolithic layers of the Darkveti site (see Tab. 4). It is noteworthy that Nebieridze, using the data and methods available in the 1970s, accurately determined the ages of layers IV and V at this site (6216–5929 cal BC and 7308–6826 cal BC, respectively).

## Discussion

At the end of the Pleistocene, the southern Caucasus went through considerable floral turnovers, between 14 and 11 ka BP eastern and southern Georgia was dominated by glacial desert-steppe and the moist refugium of western Georgia by mixed forests (*Connor,*

| Types of artefacts | Total Number | | |
|---|---|---|---|
| **Cores and products of knapping** | **V layer** | **IV layer** | **Total** |
| Pencil-like core | 4 | 7 | 11 |
| Prismatic core | - | 2 | 2 |
| Conic-like core | - | 10 | 10 |
| Flakes (primary, seconday) | 616 | 749 | 1365 |
| Blade, Bladelet | 219 | 214 | 433 |
| Microblade | 14 | - | 14 |
| **Tools** | **70** | **41** | **111** |
| Scrapers | 29 | 6 | 35 |
| Burins | 17 | 5 | 22 |
| Asimetrical triangles | 8 | - | 8 |
| Trapeze | 2 | 16 | 18 |
| Segments | - | 2 | 2 |
| Microblades with abrupt retouched | 4 | - | 4 |
| Borers | 3 | 6 | 9 |
| Denticulate tools | 4 | 2 | 6 |
| Combined tools | 1 | - | 1 |
| Axe | - | 1 | 1 |
| Millstone | - | 1 | 1 |
| Net sinker | 1 | - | 1 |
| Points | - | 2 | 2 |
| Slingstone | 1 | - | 1 |
| **Total** | **923** | **1023** | **1946** |

***Tab. 1. Darkveti rock shelter. Stone tool complexes.***

*Kvavadze 2009*). The Pleistocene–Holocene transition was characterized by a shift from desert-steppes to oak-xerophyte communities and mixed forests (*O.c.*). This situation remained relatively stable until the early Holocene and became apparent by 9 ka BP, which changed during the mid-late Holocene when coniferous forests and mountain grasslands advanced (*O.c.*). After the Last Glacial Maximum (LGM), the early Holocene witnessed repeated sea-level fluctuations in response to different climatic-environmental influences, altering coastal geomorphology (*Bruckner* et al. *2010*), later, around the beginning of the mid-Holocene, the Black Sea reached its present level with insignificant alterations since (*Tskvitinidze* et al. *2020*). These events were accompanied by increased aridity at the end of the Pleistocene, followed by a gradual increase in precipitation, culminating around the mid-Holocene and retreating since then (*Connor, Kvavadze 2009*). All these events appear to have been more oscillatory in character, but may have had significant impacts on humans (*Bruckner* et al. *2010*). Increasing temperatures led to the formation of modern vegetation belts, creating fertile ground for new migrations (*Gavashelishvili* et al. *2021*).

Recent research demonstrates that the physical environment has strongly shaped the cultural and genetic landscapes of the Caucasus since the Upper Palaeolithic, implying genetic continuity in the region and that Y-DNA haplogroups of the past populations were associated with particular biomes (*Tarkhnishvili* et al. *2012*). According to this research, Caucasian hunter-gatherers (CHG) are the descendants of early anatomically modern humans, dispersed from Africa into Eurasia. They separated from western hunter-gatherers around 45ka BP, shortly after their expansion into Europe, and from the ancestors of Neolithic populations at 25kya, around the LGM (*Jones* et al. *2015*). It seems that CHG associated with the forested environment

| № | Species | Layer IV | Layer V |
|---|---|---|---|
| 1 | *Bos taurus* | 5/2 | - |
| 2 | *Sus domesticus* | 47/5 | - |
| 3 | *Ovis aut capra* | 17/3 | - |
| 4 | *Canis familiaris* | 1/1 | - |
| 5 | *Capreolu capreolus* | 179/8 | 4/1 |
| 6 | *Cervus elaphus* | 66/2 | 7/1 |
| 7 | *Sus scrofa* | 53/1 | 1/1 |
| 8 | *Rupicarpa rupicapra* | 3/1 | - |
| 9 | *Capre sp.* | 1/1 | 1/1 |
| 10 | *Ursus arctos* | 8/2 | 1/1 |
| 11 | *Felis silvestris* | 2/1 | - |
| 12 | *Males meles* | 2/1 | - |
| 13 | *Microtus sp.* | 1/1 | - |
| 14 | *Lutra lutra* | 4/1 | - |
| 15 | *Martes sp.* | 14/3 | - |
| 16 | *Erinaceus Europaeus* | 3/2 | 1/1 |
| 17 | *Castor fiber* | 1/1 | 1/1 |
| 18 | *Glis glis* | 3/1 | - |
| 19 | *Duromus nitedula* | 2/1 | - |
| 20 | *Querquedula querquldula* | 1/1 | - |
| 21 | *Authia ferina* | 1/1 | - |
| 22 | *Alectorisg raeca* | 1/1 | - |
| 23 | *Grus grus* | 1/1 | - |
| 24 | *Pica pica* | 2/1 | - |
| 25 | *Corvus corone* | 1/1 | - |

***Tab. 2. Osteological remains of the Darkveti rock shelter. The numerator of the fraction represents the number of bones, and the denominator represents the number of individuals.***

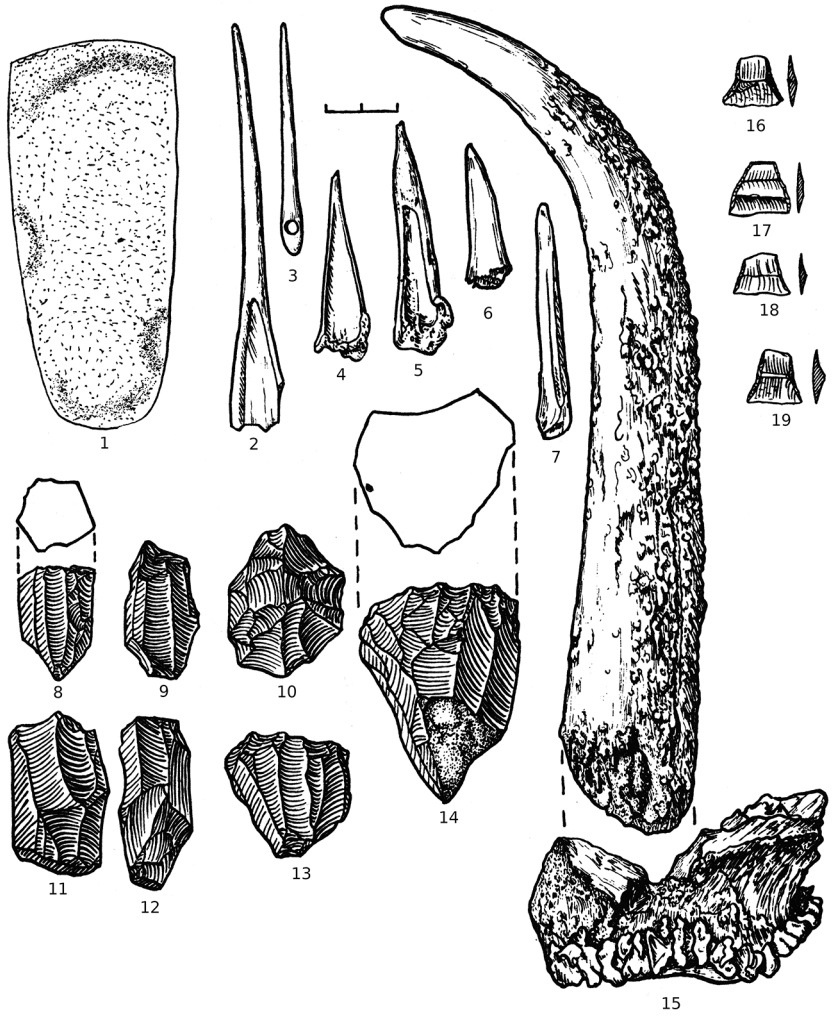



***Fig. 7. Darkveti rock shelter. Lithic and bone artefacts.* 1 *polished axe;* 2–7 *bone tools;* 8–14 *cores;* 15 *polished fragment of a deer antler;* 16–19 *geometric microliths (trapezoids).***

survived in the Colchic refugium of western Georgia during the LGM (*Tarkhnishvili* et al. *2012*), but in the early post-glacial period the migration of hunter-gatherers from elsewhere into the Caucasus intensified (*Gavashelishvili* et al. *2021*). Around 9 ka BP Neolithic societies initiated expansion at a greater rate, and gradually displaced hunter-gatherer communities in regions with lower forest density, and drove hunter-gatherers towards more densely forested areas (*Tarkhnishvili* et al. *2014; Gavashelishvili* et al. *2023*). Research confirms that during this period hunter-gatherers dominated in western Georgia, while farming societies developed in eastern Georgia, taking more time to colonize the dense forests of the west (*O.c.*). The archaeological sites of western Georgia echo these climatic/environmental events and cultural turnovers, especially the cavernous sites of the Upper Imereti, which are on the frontline of some important changes (*Tskvitinidze* et al. *2020*).

The inhabitants of the Darkveti rock shelter mostly preferred flint for making stone tools. Geological surveys indicate numerous sources of flint in the Imereti region, which is especially rich in Turonian-Cenomanian type flint, distinguished by its high quality. It appears that the ancient inhabitants of the rock shelter were well acquainted with different types of flint and preferred using it. The geochemical analysis has also given us a very interesting picture in this context (Tab. 5). It is quite reasonable that people preferred using flint, a readily available raw material in the region, over obsidian, the sources of which were far away.

Chikiani Mountain, located in the Javakheti region of southern Georgia near Paravani Lake, is the only source of high-quality obsidian in Georgia, and it is found in the stone collections of archaeological sites from many eras (*Badalyan* et al. *2004; Biagi* et al. *2017; Biagi, Nisbet 2018; Gratuze, Rova 2022*). The Darkveti rock shelter is 102km away from Chikiani in a direct line. For ancient humans, covering such a distance to obtain obsidian was not a significant challenge, and numerous examples of this practice are well-documented (*Doronicheva 2015.221,227; Blegen 2017; Chkhatarashvili, Glascock 2022; Chkhatarashvili* et al. *2024a; 2024b*).

The Sarıkamış source of obsidian is located in eastern Türkiye, in the modern province of Kars. This region is characterized by a highly mountainous terrain, includ-

| № | Layer | Dates (BP) | Dates 95.4% (BC) | Dates 68.3% (BC) | Lab. Index | Sample | Reference |
|---|---|---|---|---|---|---|---|
| 1 | V | 8085±47 | 7308-6826 | 7174-6863 | FTMC-JU83-8 | Bone | First published |
| 2 | IV | 7190±42 | 6216-5929 | 6076-6012 | FTMC-JU83-9 | Bone | First published |

***Tab. 4. Radiocarbon dates of layers of the Darkveti rock shelter.***

ing volcanic mountains. The obsidian from this area is of high quality, predominantly black and brownish in colour. The Sarıkamış obsidian deposit is approximately 227km away from the Darkveti rock shelter in a straight line.

It is noteworthy that geochemists distinguish between the so-called 'northern' and 'southern' groups in Sarıkamış obsidian (*Bigazzi* et al. *1998; Chataigner* et al. *2014*). Within the northern group there are three subgroups – Kızıl Kilisa, Handere, and Hamamlı – and obsidian from the Hamamlı subgroup has been identified in the Darkveti obsidian collection.

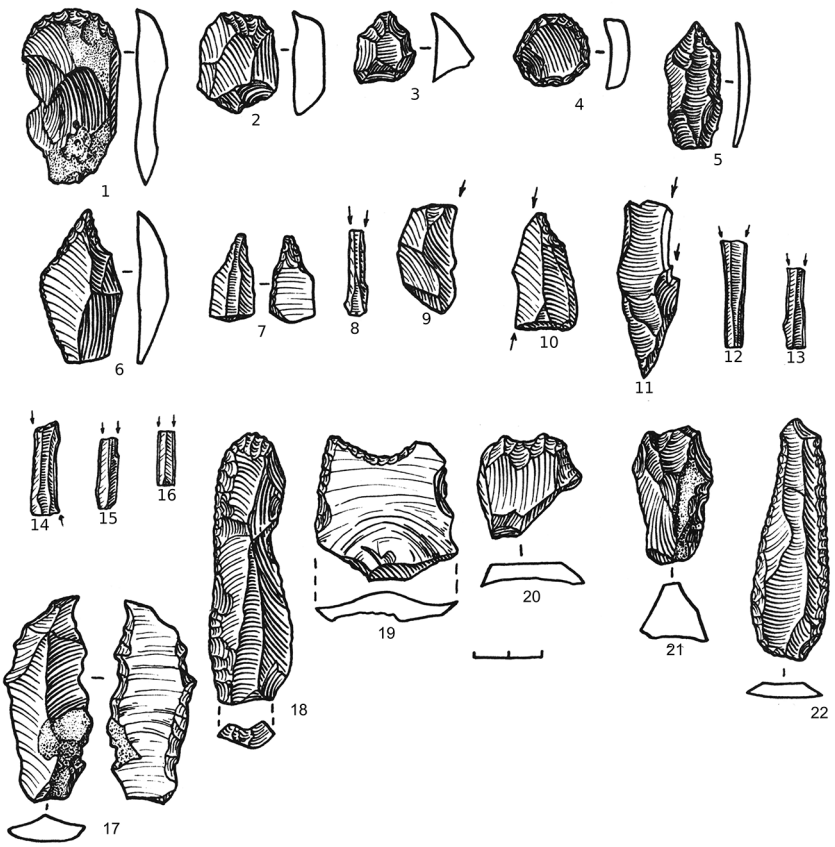



***Fig. 8. Darkveti rock shelter. Lithic artefacts.* 1–4 *scrapers;* 5–7 *perforators;* 8–16 *burins;* 17–22 *retouched blades, flakes and chisels.***

It is notable that Sarıkamış obsidian has been repeatedly discovered in Stone Age archaeological sites in western Georgia (*Le Bourdonnec* et al. *2012; Chkhatarashvili, Glascock 2022; Chkhatarashvili* et al. *2024a*). This indicates that ancient humans were well acquainted with these sources of obsidian and exhibited a discernible preference for them. This serves as further evidence of the mobility and extensive contacts among ancient human populations.

A significant amount of information has been provided in connection with the chronology of the Mesolithic and Neolithic layers of the Darkveti rock shelter discussed in Nebieridze's work. Thus, with the use of new dates, we further refine the ages of the cultural layers.

The distinguishing feature of the Mesolithic layer at the Darkveti rock shelter is the use of the pressure technique to produce straight, knife-like blades and microblades from pencil-shaped and conical cores. Additionally, this layer contains a significant quantity of lateral microblades, asymmetric triangles, burins of various shapes, end-scrapers, and other tools. As a direct parallel to this layer, notable

| Layer | Chikiani | Sarıkamış 2 (Hamamlı) |
|---|---|---|
| Layer III | 18 | — |
| Layer IV | 20 | 2 |
| Layer V | 7 | — |

***Tab. 5. Summary of the sources of obsidian for the samples found in the Darkveti rock shelter.***

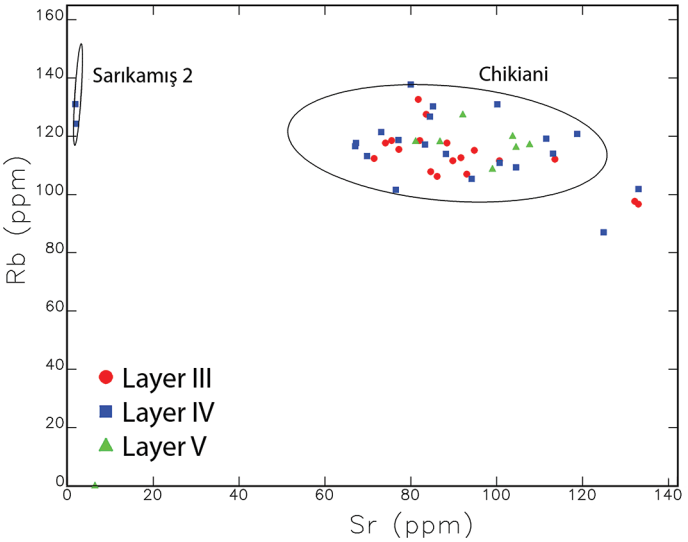



***Fig. 9. Scatterplot of strontium (Sr) versus rubidium (Rb) showing obsidian samples from layers III, IV, and V of the Darkveti rock shelter, with ellipses drawn at 90% confidence intervals representing probable sources.***

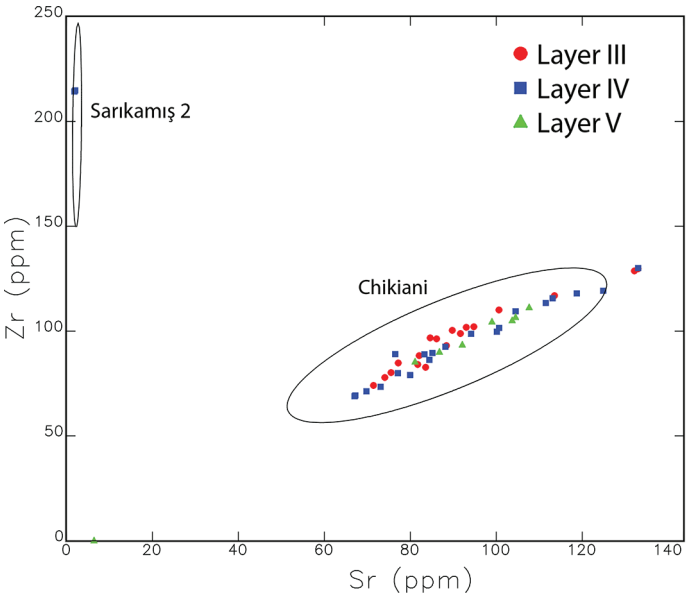



***Fig. 10. Scatterplot of strontium (Sr) versus zirconium (Zr) showing obsidian samples from layers III, IV, and V of the Darkveti rock shelter, with ellipses drawn at 90% confidence intervals representing probable sources.***

examples include Kobuleti (*Gogitidze 1978; 2008; Chkhatarashvili, Manko 2020; Chkhatarashvili* et al. *2020*), Khutsubani (*Gogitidze 1978; Chkhatarashvili* et al. *2024b*), Bavra, Bavra I, Bavra II (*Gabunia 2001; Gabunia, Tsereteli 2003*), Bavra-Ablari (*Varoutsikos* et al. *2017*), Kvirike (*Gogitidze 1978; Manko, Chkhatarashvili 2022*), and Sosruko (M1-M2) (*Zamiyatnin, Akritas 1957; Leonova 2021; Manko, Chkhatarashvili 2021*), among others.

To determine the age of the Mesolithic layer, the stratigraphic data from the Darkveti rock shelter are crucial. Layer V (7308–6826 BC) was deposited directly on sterile, alluvial yellowish loam, and is separated from the Neolithic layer above it by another sterile layer.

The Neolithic layer of the Darkveti rock shelter represents the non-ceramic Neolithic period. The primary characteristic of this layer is the use of the hand pressure technique, along with the direct percussion method, demonstrated by the presence of prismatic, conical, and pencil-shaped cores. Numerous microliths, including trapezoidal chips from two phases, are abundant in this stratum. Unlike the Mesolithic period, asymmetric triangles are absent in this layer, as anticipated.

Comparable to Layer IV of the Darkveti rock shelter, we should highlight the complexes of the 'Cold Cave' ('Tsivi Mgvime'), Apiancha, and Melouri (*Kalandadze 1986*), as well as Anaseuli I (*Nebieridze 1972*) and Jvartskvma (*Manko, Chkhatarashvili 2020*). These complexes are characterized by a notable presence of polished stone axes, with ceramics absent in these contexts.

One of the key defining factors of Layer IV is its stratigraphic context with a newly acquired absolute date (6216–5929 BC). This layer directly overlays the Mesolithic layer, with a sterile gravel layer measuring 1m thick separating the two.

## Conclusion

Recent collaborative laboratory work by Georgian and international scientists has provided crucial insights into the mobility and interactions of the inhabitants of the Darkveti rock shelter. The Darkveti rock shelter had a very good strategic location, which attracted the attention of the ancient humans of the region. Of course, the intensive use of the site is indicated not only by its good location, but also, apparently, by the favourable palaeo-climatic environment and the corresponding abundance of flora/fauna. The study of the cultural layers of the rock

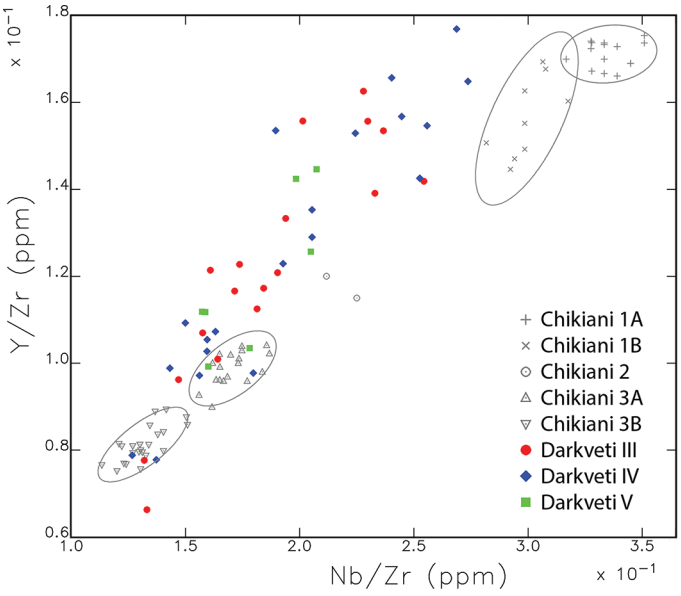



***Fig. 11. Scatterplot of the ratios of niobium and zirconium (Nb/Zr) versus yttrium and zirconium (Y/Zr) showing obsidian samples from layers III, IV, and V of the Darkveti rock shelter determined via XRF, with data and ellipses drawn at 90% confidence intervals from Chikiani subsources determined via LA-ICP-MS, as calculated by Paolo Biagi and Bernard Gratuze (2016).***

shelter showed that the site was intensively although intermittently used for a number of reasons, from the Mesolithic to the Early Bronze Age.

It appears that the selection of raw materials for tool manufacture was of paramount importance to the dwellers of Darkveti, who employed specific strategies for this purpose. They were likely well versed in the available resources and made informed decisions on which materials to prioritize. The fact that these prehistoric societies did not rely solely on the abundant flint deposits in the Imereti region but travelled several hundred kilometres to obtain obsidian is particularly noteworthy. This highlights the need for further study of flint deposits, which could offer a unique perspective on the movement and behaviour of prehistoric societies.

As part of the interdisciplinary research, determining the precise age of the Mesolithic and Neolithic layers at the Darkveti rock shelter using the radiocarbon method was of utmost importance. We must, however, acknowledge the contributions of the site's first researcher, the archaeologist Nebieridze, who approximately 50 years ago, based on the available information at the time, provided us with an estimated age of the layers. Recent research has validated her earlier hypothesis, indicating that life in the Darkveti rock shelter began around the 8th millennium BC and resumed again towards the end of the 7th millennium cal BC.

*Acknowledgements*
*The presented work was carried out within the framework of the joint scientific project of Batumi Shota Rustaveli State University and LEPL Ajara Museum. The Archeometry Laboratory at the University of Missouri Research Reactor is supported by a grant from the National Science Foundation (No. 2208558). The authors of the work are very grateful to the laboratory of VILNIUS RADIOCARBON for the laboratory analyses. This work was supported by the Shota Rustaveli National Science Foundation of Georgia (SRNSFG), grant – FR-21-17740.*

∴

## References

Adler D. S., Bar-Oz G., Belfer-Cohen A., and Bar-Yosef O. 2006. Ahead of the Game, Middle and Upper Paleolithic Hunting Behaviors in the Southern Caucasus. *Current Anthropology 47(1): 89–118.* https://doi.org/10.1086/432455

Amirkhanov Kh. A. 1987. *Čohskoe poselenie. Čelovek i ego kul'tura v mezolite i neolite gornogo Dagestana*. Nauka. Moskva. (in Russian)

Badalyan R., Chataigner C., and Kohl Ph. 2004. Trans-Caucasian obsidian: The exploitation of the sources and their distribution. In A. Sagona (ed.), *A view from the highlands. Archaeological studies in honour of Charles Burney.* Ancient Near Eastern Studies. Supplement 12. Peeters. Leuven: 437–465.

Bar-Oz G., Belfer-Cohen A., Meshveliani T., Jakeli N., and Bar-Yosef O. 2008. Taphonomy and zooarchaeology of the Upper Palaeolithic cave of Dzudzuana, Republic of Georgia. *International Journal of Osteoarchaeology 18: 131–151*. https://doi.org/10.1016/j.aeae.2015.04.002

Bar-Yosef O., Belfer-Cohen A., Mesheviliani T., +5 authors, and Matskevich Z. 2011. Dzudzuana: an Upper Palaeolithic cave site in the Caucasus foothills (Georgia). *Antiquity 85 (328): 331–349.* https://doi.org/10.1017/S0003598X0006779X

Bernatsky A. 1884. Iskopaemis ostatki peschernogo cheloveka I peschernix jivotnix na Kavkaze. *Kavkaz 17(XI): 255.* (in Russian)

Biagi P., Gratuze B. 2016. New data on source characterization and exploitation of obsidian from the Chikiani Area (Georgia). In A. Ferrari, E. Ianiro (eds.), *Armenia, Caucaso e Asia Centrale. Ricerche 2016*. Eurasiatica 6. Edizioni Ca Foscari. Venezia: 9–36. http://doi.org/10.14277/6969-093-8/EUR-6-1

Biagi P., Nisbet R., and Gratuze B. 2017. Discovery of obsidian mines on mount Chikiani in the lesser Caucasus of Georgia. *Antiquity 91(357): 1–8*. https://doi.org/10.15184/aqy.2017.39

Biagi P., Nisbet R. 2018. The Georgian Caucasus and its resources: the exploitation of the mount Chikiani uplands during the metal ages. *Antiquity 92(362): 1–9*. https://doi.org/10.15184/aqy.2018.53

Bigazzi G., Poupeau G., Bellot-Gurlet L., and Yegingil Z. 1998. Provenance studies of obsidian artefacts in Anatolia using the fission-track dating method: An overview. In M.-C. Cauvin, A. Gourgaud, B. Gratuze, N. Arnaud, G. Poupeau, J.-L. Poidevin, and C. Chataigner (eds.), *L'obsidienne au Proche et Moyen Orient: du volcan à l'outil.* BAR International Series 738. Archaeopress. Oxford: 69–89.

Blegen N. 2017. The earliest long-distance obsidian trans port: Evidence from the ~200 ka middle stone age Sibilo School Road Site, Baringo. Kenya. *Journal of Human Evolution 103: 1–19.* https://doi.org/10.1016/j.jhevol.2016.11.002

Bronk Ramsey C., Lee S. 2013. Recent and Planned Development of the Program OxCal. *Radiocarbon 55(2–3): 720–730.* https://doi.org/10.1017/S0033822200057878

Brückner H., Kelterbaum D., Marunchak O., Porotov A., and Vött A. 2010. The Holocene sea level story since 7500 BP – Lessons from the Eastern Mediterranean, the Black and the Azov Seas. *Quaternary International 225(2): 160–179.* https://doi.org/10.1016/j.quaint.2008.11.016

Chataigner C., Isikli M., Gratuze B., and Çil V. 2014. Obsidian sources in the regions of Erzurum and Kars (north-East Turkey): new data. *Archaeometry 56(3): 1–24.* https://doi.org/10.1111/arcm.12002

Chkhatarashvili G., Manko V. 2020. Kobuleti Site: The Evidence of Early Holocene Occupation in Western Georgia. *Documenta Praehistorica 47: 28–35.* https://doi.org/10.4312/dp.47.2

Chkhatarashvili G., Manko V., Kakhidze A., Esakiya K., Chichinadze M., Kulkova M. and Streltcov M. 2020. South-East Black Sea Coast in Early Holocene Period (According to Interdisciplinary Archaeological Investigations in Kobuleti Site). *Sprawozdania Archeologiczne 72(2): 213–230.* https://doi.org/10.23858/SA/72.2020.2.2261

Chkhatarashvili G., Glascock M. 2022. Obsidian at Kobuleti (Western Georgia): Evidence for early human contact in Western Transcaucasia during the early Holocene. *Archaeological Research in Asia 29: 1–8.* https://doi.org/10.1016/j.ara.2021.100348

Chkhatarashvili G., Davenport A. J., Glascock M. D., Khalvashi M., and Zoidze T. 2024a. Reconstructing Neolithic obsidian procurement in Western Georgia through a obsidian characterization study. *Journal of Archaeological Science: Reports 57: 104663.* https://doi.org/10.1016/j.jasrep.2024.104663

Chkhatarashvili G., Chichinadze M., Glascock M. D., Davenport A. J., Khalvashi M., Aslanishvili L., and Rodinadze Sh. 2024b. Interdisciplinary investigation of the Khutsubani site (Western Georgia). *Revista Arheologică XX(1): 171–183.* http://doi.org/10.52603/RA.XX.1.2024_09

Connor S. E., Kvavadze E. V. 2009. Modelling late Quaternary changes in plant distribution, vegetation and climate using pollen data from Georgia, Caucasus. *Journal of Biogeography 36: 529–545.* https://doi.org/10.1111/j.1365-2699.2008.02019.x

Dochanashvili G. 1973. 1967–1968 wlebsi Khergulis kldeshi chatarebuli samushaoebis shedegebi. *Masalebi Sakartvelosa da Kavkasiis Arkheologiisatvis. 6: 38–50.* (in Georgian).

Doronicheva E. V. 2015. The spread of Homo sapiens and regional mobility in the Early Upper Paleolithic in the Caucasus and the Levant. In M. V. Bankovich (ed.), *Obrazy i znaki v traditsiyakh Yuzhnoy i Yugo-Zapadnoy Azii*. Sbornik muzeya antropologii i etnografii LXI. Muzey antropologii i etnografii im. Petra Velikogo (Kunstkamera). Rossiyskaya Akademiya Nauk. Sankt-Peterburg: 212–226, 543.

Gabunia M. 2001. Javakhetis mezolituri kul'tura. *Istoria da arkheologia I: 136–165.* (in Georgian)

Gabunia M., Tsereteli L. 2003. Kavkasiis mezolituri kul'tura. *Arkheologiuri kvlevis centris jurnali 12: 5–12*. (in Georgian)

Gavashelishvili A., Yanchukov A., Tarkhnishvili D., Murtskhvaladze M., Akhvlediani I., and Kazancı C. 2021. Landscape genetics and the genetic legacy of Upper Paleolithic and Mesolithic unter-gatherers in the modern Caucasus. *Scientific Reports 11(1): 17985*. https://doi.org/10.1038/s41598-021-97519-6

Gavashelishvili A, Chukhua M, Sakhltkhutsishvili K, Koptekin D., and Somel M. 2023. The time and place of origin of South Caucasian languages: insights into past human societies, ecosystems and human population genetics. *Scientific Reports 13(1): 21133*. https://doi.org/10.1038/s41598-023-45500-w

Glascock M. D. 2020. A systematic approach to geochemical sourcing of obsidian artifacts. *Scientific Culture 6(2): 35–46*. https://zenodo.org/records/3724847

Gogitidze S. 1978. *Samkhret-Agmosavlet Shavizgvispiretis neolituri kul'tura*. Metsniereba. Tbilisi. (in Georgian)

2008. *Kintrishi kheobis kvis khanis arkheologiuri dzeglebi*. Batumi University. Batumi.

Gratuze B., Rova E. 2022. New data on different patterns of obsidian procurement in Georgia (Southern Caucasus) during the Chalcolithic, Bronze and Iron Age Periods. *Archaeological Research in Asia 32: 1—17*. https://doi.org/10.1016/j.ara.2022.100397

Hughes R. E. 2010. Determining the Geologic Provenance of Tiny Obsidian Flakes in Archaeology Using Nondestructive EDXRF. *American Laboratory 42(7): 27–31.*

Javakhishvili G. 1971. *Dasavlet amierkavkasiis adresamitsatmokmedo kulturis istoriisatvis.* Unpublished PhD thesis. Tbilisi University. Tbilisi. (in Georgian)

Jones E. R., Gonzalez-Fortes G., Connell S., +19 authorts, and Bradley D. G. 2015. Upper Palaeolithic genomes reveal deep roots of modern Eurasians. *Nature Communications 6(1): 8912.* https://doi.org/10.1038/ncomms9912

Kalandadze K. 1986. *Dasavlet sakartvelos neolituri kul'tura akhali agmochenebis shukze.* Metsniereba. Tbilisi. (in Georgian)

Kiladze N. 1944. Mgvimevis paleolituri nashtebi. *Sakartvelos Sakelmtsifo Muzeumis Moambe XII-B: 279–290*. (in Georgian)

1948. Mravalfeniani arkeologiuri dzegli – Sagvarjile. *Sakartvelos Metsnierebata Akademiis Moambe XIV 9: 561–567.* (in Georgian)

Krukovsky S. 1916. *Peshera Gvardzilas-klde v Rgani*. Izvestie Kavkaskogo Muzeia X(3). Tiflis. (in Russian)

Le Bourdonnec F.-X., Nomade S., Poupeau G., +7 authors, and Lordkipanidze D. 2012. Multiple origins of Bondi Cave and Ortvale Klde (NW Georgia) obsidians and human mobility in Transcaucasia during the Middle and Upper Palaeolithic. *Journal of Archaeological Science 39: 1317–1330*. https://doi.org/10.1016/j.jas.2011.12.008

Leonova E. V. 2021. Grot Sosruko: revizija materialov iz raskopok S. N. Zamjatnina i radiouglerodnaja hronologija verhnih sloev kamennogo veka. *Camera Praehistorica 1: 101–119.* (in Russian) https://camera-praehistorica.kunstkamera.ru/files/camera_praehistorica/2021_01/05_leonova.pdf

Manko V., Chkhatarashvili G. 2020. Rannegolocenovaja stojanka Džvarchma v Zapadnoj Gruzii. *Revista Arheologică XVI(1): 63–77.* (in Russian)
http://doi.org/10.5281/zenodo.4058041

2021. Stojanka Sosruko: problemy interpretacii kamennyh kompleksov. *Camera Praehistorica 2(7): 36–57.* (in Russian). https://camera-praehistorica.kunstkamera.ru/files/camera_praehistorica/2021_02/02_man_ko.pdf

2022. Kvirike: The Early Holocene site in Western Georgia. *Revista Arheologica XVIII(2): 5–16.*
http://doi.org/10.5281/zenodo.7540859

Meshveliani T., Bar-Yosef O., Belfer-Cohen A., +4 authors, and Vekua A. 1999. Excavations at Dzudzuana cave, Western Georgia (1996–1998): Preliminary Results. *Préhistoire Européenne 15: 76–86.*

Meshveliani T., Bar-Yosef O., and Belfer-Cohen A. 2004. Paleolithic in western Georgia. In P. J. Brantinham, S. L. Kuhn, and K. W. Kerry (eds.), *The Early Upper Paleolithic beyond Western Europe*. University of California Press. Barkeley, Los Angeles, London: 129–143.

Meshveliani T., Bar-Oz G., Bar-Yosef O., +4 authors, and Matskevich Z. 2007. Mesolithic hunters at Kotias Klde, Western Georgia: preliminary results. *Paleoorient 33(2): 47–58.* https://www.persee.fr/doc/paleo_0153-9345_2007_num_33_2_5220

Nebieridze L. 1972. *Dasavlet Amirekavkasiis Neoliti*. Metsniereba Tbilisi. (in Georgian)

1973. *Darkvetis mravalfenian ekshi chatarebuli mushaobsi dziritadi shedegebi. Mokle Angarisgebi.* Savele Arkheologiuri kvleva-dzieba 1972 tsels. Tbilisi: 20–29. (in Georgian)

1978. *Darkvetis mravalfeniani ekhi.* Metsniereba Tbilisi. (in Georgian)

Nioradze G. 1933. *Paleoliteli adamiani Deviskhvrelshi.* Sakartvelos Muzeumis shromebi. Tbilisi. (in Georgian)

1953. *Kvis khanis adamiani Sakadzias gamokvabulshi*. Sakartvelos Muzeumis shromebi. Tbilisi. (in Georgian)

Nioradze M. 1975. *Samertskhle-kldis mgvime*. Tbilisi. (in Georgian)

Reimer P. J., Austin W. E. N., Bard E., +38 authors, and Talamo S. 2020. The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP). *Radiocarbon 62(4): 725–757*. https://doi.org/10.1017/RDC.2020.41

Tarkhnishvili D., Gavashelishvili A., and Mumladze L. 2012. Palaeoclimatic models help to understand current distribution of Caucasian forest species. *Biological Journal of the Linnean* Society *105(1): 231–248.*
https://doi.org/10.1111/j.1095-8312.2011.01788.x

Tarkhnishvili D., Gavashelishvili A., Murtskhvaladze M., Gabelaia M., and Tevzadze G. 2014. Human Paternal Lineages, Languages, and Environment in the Caucasus. *Human Biology 86(2): 113–130*. https://doi.org/10.3378/027.086.0205

Tixier J. 1974. *Glossary for the description of stone tools. With special reference to the Epipaleolithic of the Maghreb*. Newsletter of Lithic Technology. Washington State University. Washington.

Tskvitinidze N., Tsikaridze N., Kvavadze E., and Lordkipanidze D. 2020. Chalcolithic settlement at Bronze Cave, Tsutskhvati Cave Complexs (Republic of Georgia, Imereti). *Bulletin of the Georgian National Academy of Sciences 14(2): 127–131.*

Tushabramishvili D. 1960. *Gvarjilas-kldis paleolituri nashtebi*. Tbilisi. (in Georgian)

1969. *1966 tsels chatarebuli arkheologiuri samushaoebis shedegebi Kvirilas kheobashi. Sakartvelos sakhelmtsifo muzeumis ekspediciebis angarishebi I: 3–11.* (in Georgian)

Tushabramishvili D., Tsereteli L. 1975. *Sarekis ekhis zeda-paleolituri nashtebi.* Dzeglis megobari 37. (in Georgian)

Tushabramishvili N., Lordkipanidze D., Vekua A., Tvalchrelidze M., Muskhrlishvili A., and Adler D. 1999. The Paleolithic rock shelter of Ortvala klde, Imereti region, the Georgian Republic. *Préhistoire Européenne 15: 65–77.*

Varoutsikos B., Mgeladze A., Chahoud J., Gabunia M., Agapishvili T., Martin L., and Chataigner C. 2017. From the Mesolithic to the Chalcolithic in the South Caucasus: New Data from the Bavra Ablari Rock Shelter. In A. Batmaz, G. Bedianashvili, A. Michalewicz, and A. Robinson (eds.), *Context and Connection: Essays on the Archaeology of the Ancient Near East in Honour of Antonio Sagona*. Peeters. Leuven: 233–255.

Zamyatnin S. N., Akritas P. G. 1957. *Arheologičeskie issledovanija 1957 goda v Baksanskom ušel'e.* Kabardino-Balkarskij naučno-issledovatel'skij institut. Nal'čik: Kabardino-Balkarskoe knižnoe izdatel'stvo. Nalchik: 471–473. (in Russian)