ARCHAEOLOGICAL CULTURES ARE ALWAYS STUDIED IN TERMS OF THEIR NATURAL SETTING, ON THE ONE HAND, AND THE SURROUNDING POPULATIONS WITH WHOM THEY INTERACTED, ON THE OTHER. PROBLEMS WITH THE former INCLUDE THE UTILISATION OF NATURAL RESOURCES, PARTICULARLY RAW MATERIALS, WHILE STUDY OF THE latter REQUIRES CONSIDERATION OF ALL DIFFERENT FORMS OF CONTACT, INCLUDING STIPULATED DEMANDS IN RAW MATERIALS. Thus, both types of archaeological investigation concern themselves with the study of natural resources and their distribution.

Since the beginning of the 1960s, Near Eastern and Mediterranean archaeologists have particularly concerned themselves with the determination of the natural sources of obsidian and the routes by which this material was distributed. These investigations revealed the essential significance of obsidian for establishing ancient contacts among peoples of the central Mediterranean, the Aegean, and the Middle East. Obsidian sources from the northeastern regions of the Armenian plateau and the Caucasus essentially were...
not considered in these studies (map 1).  

The question of the analytical determination of obsidian was not emphasized in Caucasian archaeology during the Soviet period. On the one hand,

...for a very long time it was postulated that only a single obsidian source was utilised in antiquity for the entire Caucasus and much of the Middle East, a source near Mt. Aragats.

On the other hand, it was thought that

...deposits of obsidian were characteristic for almost all mountainous regions in the Caucasus, and almost everywhere in the Caucasus peoples utilised the local source of obsidian.

Both these erroneous perspectives essentially eliminated the question of the sources of Caucasian obsidian. To the degree to which there existed an interest in solving archaeological problems through the determination of geological information, investigations remained limited due to technical and methodological considerations.

One can mention only two works especially concerned with the determination of the sources of obsidian on archaeological sites in the Caucasus. In order to make their identifications of obsidian sources both studies used indices of refraction; however, a type with the same chemical composition could have different indices of refraction. Consequently, these studies sometimes showed that samples taken from a single source gave significantly different results, and, at other times, the indices of refraction were identical for samples taken from different obsidian sources.

The solution of this problem for the archaeology of Trans-Caucasia became possible only with the introduction of more precise methods of analysis. Nearly 700 samples of obsidian, including 576 artifact and 120 geological source samples, were analyzed by Dr. James Blackman of the National Institute of Standards and Technology in Maryland, USA, using the technique of instrumental neutron activation analysis (INAA). A. Palmieri and his colleagues at the University of Pavia, Italy, conducted analyses on 113 geological and 30 artefact samples; utilising the technique of X-ray florescence. J. Keller (Mineralogisch-Petrographisches Institut der Universität Freiburg, BRD) analysed 42 geological samples and 18 archaeological artifacts with E. Pernicka (Max-Planck Institut  

1. Nevertheless, some of these studies included a few analyses of geological samples of obsidian from Transcaucasia, which were not always precisely located, and, more rarely, samples of artifacts. Thus, a sample in the collection of the British Museum that was found ‘north of Yerevan’, was analyzed by optical emission spectroscopy; Cann and Renfrew 1964, p. 127. Ten samples found along the road between Yerevan and Tsakhkadzor, about 40 km. from the latter, were submitted to X-ray florescence; Fornaseri et al. 1975-1977. Six samples from ‘a source between the city of Razdan and the northwestern end of Lake Sevan’ were analyzed by instrumental neutron activation analysis ; Blackman 1984, pp. 23-26. Finally, another 18 samples from Dzhraber were analyzed by X-ray florescence; Keller and Seifried 1990; and Keller et al. 1996.  
2. Iessen 1965, p. 117.  
6. For more detail, see Chataigner 1995, p. 142.
für Kernphysik, Heidelberg, BRD) utilising X-ray florescence and neutron activation analysis. Finally, 44 geological samples and 109 artifacts have been dated by G. Bigazzi (Istituto di Geochronologija e Geochimica Isotopica, CNR, Pisa, Italy) using the technique of fission-track dating.

The resultant dates show the significance of this method for differentiating sources of obsidian and for complementing the results obtained by geochemical determinations.

In general, 23 sources of obsidian from the El’brus, Djavakheti, and Tsakhkunyats ranges, and the Aragats, Gegam, Vardeni, and Syunik plateaus, and from Mt. Ararat (map 1), as well as artifacts from 53 archaeological sites, dating to different periods (Neolithic to the Iron Age), from the northern Caucasus, Daghestan, Georgia, Armenia, and Azerbaijan, have been studied. The neutron activation analyses have identified nineteen sources or groups based on their trace-element chemical composition and found some artifacts that came from the so-called Group 3a, initially defined by C. Renfrew and his colleagues. Additionally, archaeological artifacts, which clustered into six different chemical groups, came from geological sources that have not yet been determined (Trans-Caucasian Unknown Groups 1-6 or TCUNK 1-6).

In order to understand better the factors that have influenced the exploitation and diffusion of Trans-Caucasian obsidian, we will present the characteristics of each deposit and consider certain features of the material itself and its environmental context. Each source will be characterized in terms of the following elements:

1) the quality of the obsidian — its utility for fashioning artifacts and the size of its blocs
2) the quantity of the obsidian — the extent of the deposit and the abundance of the material in its flows
3) its spatial accessibility — the altitude of the deposit and its geo-morphological context
4) its temporal accessibility — the medium thickness of durable snow cover and the number of months during which this snow cover persists and the presence of permanent habitations in the vicinity and/or transhumants during the summer
5) the existence of secondary deposits (blocks carried by rivers or deposited on terraces)

the location of the primary or secondary deposits in relation to the routes of communication (table 1).

<table>
<thead>
<tr>
<th>Source</th>
<th>Altitude of Summit (meters above sea level)</th>
<th>Altitude of Obsidian Source</th>
<th>Average Duration of Snow Cover</th>
<th>Average Depth of Snow above Deposit (cm)</th>
<th>Permanent Population near Obsidian Source</th>
<th>Seasonal Occupation (Transhumants)</th>
<th>Obsidian Blocks Carried by River</th>
<th>Quality of the Obsidian</th>
<th>Quantity of the Obsidian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chikiani</td>
<td>2417</td>
<td>2200-2400</td>
<td>X</td>
<td>X</td>
<td>tributary of Khrami</td>
<td>excellent</td>
<td>abundant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eni-El</td>
<td>1950</td>
<td>1700-1800</td>
<td>1/12-20/04</td>
<td>75</td>
<td>X</td>
<td>medium, small blocks</td>
<td>little</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cobbles near Shirakavan</td>
<td></td>
<td>1400-1500</td>
<td>20/12-10/03</td>
<td>25</td>
<td>X</td>
<td>cobbles carried by the Kars river and its tributaries</td>
<td>medium, cobbles of small size</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>Arteni</td>
<td>Mets : 2047 Pokr : 1753</td>
<td>1400-1600</td>
<td>20/12-10/03</td>
<td>25</td>
<td>X</td>
<td>excellent</td>
<td>abundant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gutansar</td>
<td>Gutansar : 2229 Alapars : 1809 Fontan : 1791</td>
<td>1500-1800</td>
<td>20/12-1/04</td>
<td>25-50</td>
<td>X</td>
<td>Hrazdan</td>
<td>good</td>
<td>abundant</td>
<td></td>
</tr>
<tr>
<td>Hatis</td>
<td>2529</td>
<td>1600-2000</td>
<td>10/12-10/4</td>
<td>50</td>
<td>X</td>
<td>X</td>
<td>Marmarik to the North, Kasakh to the South</td>
<td>good</td>
<td>abundant</td>
</tr>
<tr>
<td>Tsakhkunjats</td>
<td>Damlik : 2781 Tivakar : 2696</td>
<td>2000-2400</td>
<td>Hankavan : 2000</td>
<td>20/11-1/05</td>
<td>75</td>
<td>X</td>
<td>X</td>
<td>Marmarik to the North, Kasakh to the South</td>
<td>good</td>
</tr>
<tr>
<td>Geghasar Spitakasar</td>
<td>Geghasar : 3446 Spitakasar : 3560</td>
<td>3000-3200</td>
<td>10/10-1/06</td>
<td>200</td>
<td>X</td>
<td>X</td>
<td>tributary of Azat, source at foot of Geghasar</td>
<td>excellent</td>
<td>abundant</td>
</tr>
<tr>
<td>Khorapor</td>
<td>2906</td>
<td>2600-2900</td>
<td>10/11-20/05</td>
<td>100-125</td>
<td>X</td>
<td>X</td>
<td>poor</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>Sevkar Bazenk Satanakar</td>
<td>Bazenk : 3228 Satanakar : 3174</td>
<td>2700-3000</td>
<td>11/1-1/06</td>
<td>125-150</td>
<td>X</td>
<td>X</td>
<td>Vorotan</td>
<td>good</td>
<td>abundant</td>
</tr>
<tr>
<td>Ke'badzhar</td>
<td>3000-3200</td>
<td>11/1-10/06</td>
<td>150</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Geographical context of primary and secondary obsidian deposits in Trans-Caucasus.
Map 1. Location of obsidian sources in Trans-Caucasus.
Other factors, such as the political control of an obsidian deposit, are difficult to establish on the basis of archaeological or environmental data. Some deposits are dominated by the remains of fortifications, which could possibly provide an indication of such control, but such fortifications are either of indeterminate age or are attributed to later periods (the Iron Age or the Urartian Kingdom) or to a time when obsidian was largely supplanted by metals.

This paper discusses, first, the nature of each separate obsidian deposit and then considers their utilisation as based principally on the clustering of archaeological artifacts with geological source samples that were determined by the neutron activation analyses and complemented by the X-ray florescence work.

**SOURCES OF THE DJAVAKHETI RANGE**

*Chikiani*

The Chikiani volcano (in Georgian, ‘the glass that glistens’) rises above the northeastern shore of Lake Paravani in southern Georgia. It is located in a region of high plateaus — Djavakheti — with a medium elevation of 1800-2100 m that was formed by the accumulation of lava flows in which the original folded structure is discernible only in places. The summit of the volcano, which reaches 2417 m, rises only ca. 300 m above the shores of the nearby lake. Its Turkish name, Kojun Dagh or ‘Cow Mountain’ adequately suggests the gentleness of the relief.

These high steppic plateaus experience a very rigorous climate and are known locally as the ‘Georgian Siberia’ with very mild summers and very cold winters and a snow cover that lasts more than six months. Nevertheless, this region in which stock raising forms the primary activity is inhabited permanently. Currently, some villages are located along the shores of Lake Paravani, and archaeological sites in the area have been documented for all periods from Mesolithic times onwards.

This area is accessible from the high steppic plateaus to the south that extend into northern Armenia, but these plateaus are nearly empty due to the rigorous climate. On the other hand, Lake Paravani, which is situated on the eastern edge of the Djavakheti range, dominates the Khrami river valley to the east, the Khrami river being a tributary of the Kura. The pass found at the foot of Chikiani slopes gently towards the plains of Kvemo Kartli and the river basin.

The Khrami river, moreover, carries numerous obsidian pebbles as far as its lower course where sites of the Neolithic-Chalcolithic Shulaveri-Shomu culture, dated to the 6th to 4th millennia BC, are located. The Chikiani obsidian is spread everywhere over the dome of the volcano and extends in a large flow to the east. The quality of the obsidian is excellent — very homogeneous and without inclusions; it is abundant and easy to access, the only limitation for its utilisation being the climate; more specifically, the snow cover during the winter. Finally, the Chikiani source is the only available source
of obsidian in Georgia and is the most accessible for the peoples living in the Kura basin.

The chemical and chronological studies have shown that there were several temporally successive flows between 2.6 and 2.3 million years ago (that is during 300,000 years), and several chemical trace elements (specifically, Barium, Strontium, Zirconium, and Yttrium) vary in their percentages corresponding to the progressive evolution of the magma.\(^{10}\)

Eleven obsidian source samples were taken from the Chikiani dome (at the foot of the western slope of the Djavakheti plateau near the northeastern shore of Lake Paravani). The analyses showed that they had an identical trace element chemical composition and formed a single homogeneous group.\(^{11}\) One hundred and twenty one archaeological artifacts clustered together with the Chikiani geological source samples (map 2). These artifacts came from 21 archaeological sites dating to the Early and Late Neolithic, Chalcolithic, Early and Middle Bronze, and Early Iron periods. These sites include: Berikldeebi, Naomari-gora (14 samples), Dmanisi, Uchoglan (8 samples), Akhali Zhinvali, Djavakhi (7 samples), Anaseuli I, Samele klde, Zhinvali, Arukhlo I, Jogaz (6 samples), Anaseuli II, Abanoskhevi (5 samples), Kobuleti, Khramis Didi Gora, Lori Berd, Padar (4 samples), Verin Naver (3 samples), Karmrakar (2 samples), Alikemek tepesi, and Velikent (1 sample).

Thus, the area over which the obsidian from the Chikiani source was distributed extends between the shores of the Black and Caspian Seas. The significance of this Chikiani source of obsidian varied a great deal across this broad territory. Many of the above-mentioned sites obtained 50-100% of their obsidian from the Chikiani source. The entire territory encompassed by the sites that principally obtained their obsidian from the Chikiani source forms what can be called the ‘Chikiani zone.’ This zone lies to the north of the line drawn between Kobuleti (120 km northwest of Chikiani) and Uchoglan (290 km southeast of Chikiani).

**Eni-El (or Kechut or Amasia or Ashotsk)**

There are other flows of obsidian in north-western Armenia, which are well known in the geological literature and have received different names related to their geography, geology or the administrative unit to which they belong. Specifically, they are known as the Eni-El hills, the volcanic massif of Kechut, the district of Amasia, and the region of Ashotsk. The obsidian deposits are located south of Chikiani in the south-western foothills of the Djavakheti range near the villages of Agvorik and Sizavet, and on the heights of Eni-El where they are spread across in blocks of black and even red and black color. The obsidian deposits are not numerous and restricted on their surface since the eruptions, which are dated from 1.1 million years ago,\(^{12}\) are entirely covered by a layer of humus on which vegetation has developed.

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The area in which they are situated consists of high steppic plateaus c. 1800 m above sea level and traverses the large earthen-covered Akhurian valley that runs initially west to east from the Akababa Dagh range in Turkey and then turns abruptly to the south at the heights of Eni-El. It is a region with mild relief, opening to the north onto the high plateaus of Djavakheti through the Bavra pass and to the south into the Shirak plain through the Akhurian valley. This area experiences a rigorous climate: mild summers (17 degrees centigrade on average) and dry and very cold winters with a snow cover present from November to April, attaining an average of 75 cm. Nevertheless, there are permanent habitations in the area.

The hills of Eni-El contain on their southern flanks, which dominate the Akhurian valley, an important deposit of very high quality dacite that has been exploited from very early times, since Lower Palaeolithic. Large Acheulean dacite artifacts have been collected on these slopes and their periphery. The obsidian itself was at least locally exploited during the Bronze Age since a fortress and a few structures were built on these summits, and obsidian artifacts have been recovered there. This obsidian has a sufficiently high quality for working, but occurs primarily in small sizes (10 cm in
diameter on average) that limited its utilisation. Nevertheless, the flows are easily accessible, and some ancient and contemporary habitations are found directly alongside them, though they are not numerous.

12 samples, taken from 2 sources from this area that were located 6-7 km. from each another formed a single, chemically homogeneous group that supposedly came from a single source\textsuperscript{13}. The center of the volcanic eruption that produced this obsidian, however, was not determined. Only two archaeological artifacts clustered together with this latter group of geological samples: both came from the settlement of Sgnakhner near the village of Keti on the southern slope of the Shirak range, c. 25 km. south of the source area. These two samples constituted 11\% of the artifacts analyzed from Keti, but only 1.85\% of all the artifacts analyzed from the Shirak plain (2 samples of 108). The dating of these samples suggests that this source was only occasionally exploited during the Early Bronze Age and during the 2nd half of the 2nd millennium and the beginning of the 1st millennium BC.

SECONDARY SOURCES NEAR SHIRAKAVAN

An alluvial level, containing numerous obsidian pebbles, is visible in the section of the ancient terraces of the Akhurian river which today are located by the lake formed by the large dam near Shirakavan to the southwest of Gumri along the middle stretch of the Akhurian valley. According to the geologists, this spread of obsidian, which is situated near the confluence of the Akhurian and Kars rivers, has been carried by the latter river, since an obsidian deposit is located upstream in the Turkish province of Kars. This deposit, which forms this level of obsidian pebbles, was most likely greatly utilised during proto-historic times, as is suggested by the large number of Bronze and Iron Age sites found in the area.

This secondary spread of obsidian is easily accessible, and the Shirak plain, on which it is found, constitutes a major passage or route connecting the Ararat plain to the south, the province of Kars to the west, and Georgia to the north. Habitation is permanent in the area of Shirakavan, and the snow cover is limited, since it lasts less than three months (from mid-December to mid-March) and is only 25 cm. thick on average\textsuperscript{14}. This secondary spread of obsidian is abundant, but the pebbles are small and seem to have been primarily utilised to produce slingshots or small projectiles.

The chemical analyses have confirmed the originality of this obsidian, since these samples do not cluster together with any of the identified geological sources from Armenia and Georgia. That is, this obsidian must originally come from a deposit in northeastern Turkey, the precise origin of which remains to be determined.

\textsuperscript{14} Bagdassarian 1975.
SOURCES ON THE ARAGATS PLATEAU

The Arteni rhyolite complex, which is situated on the south-western edge of the Aragats massif, was formed as the result of numerous extrusions and igneous volcanic eruptions\textsuperscript{15}, and this complexity is evident in the different chemical compositions of the Arteni obsidians. There are several deposits of obsidian: Pokr (or ‘little’) Arteni; Satani Dar; Mets (‘big’) Arteni; and the Aragats flow. The dates show that the different sources were formed successively between 1.38 and 1.17 million years ago\textsuperscript{16}, and the chemical analyses show that they have a common ‘signature,’ but also exhibit some variations which allows us to distinguish partially among them.

The Arteni complex is situated at a most important crossroads that had always traversed Armenia: from west to east, from Turkey to Nakhicevan, via the Araxes basin and the Ararat plain and from south to north connecting the Araxes basin with Georgia and Kars, via the Akhurian valley and the Shirak plain. The Pokr Arteni volcano rises to a height of 1753 m. and Mets Arteni to 2047 m, though their obsidian flows are situated on the slopes and at their bases until they touch the Ararat plain, which here is situated roughly 1500 meters above sea level. The snow cover is one of the slightest in Armenia, lasting less than 3 months and on average not exceeding 25 cm. in depth. Permanent villages are located near this complex.

The obsidian, thus, is very accessible during most of the year. The obsidians from the Pokr Arteni deposit and from the Aragats flow, in particular, are very abundant and of exceptionally high quality. This obsidian has been exploited at least since the Middle Palaeolithic (or Mousterian) since bifaces have been recovered at several places on the slopes of Satani Dar and Pokr Arteni. These deposits are still exploited today. Dynamite, unfortunately, is used to extract blocks to prepare different objects, such as jewelry, figurines, and ashtrays.

The Laboratory of the National Institute of Standards and Technology in Maryland, USA was not able to analyze obsidian from the Aragats flow and attributed nearly all the artifacts assigned to the Arteni complex as coming from the Pokr Arteni deposit. However, the Freiberg and Pisa laboratories, which have respectively analysed and dated the samples from Pokr Arteni and the Aragats flow, ascribe most of the artifacts that they have analyzed to the Aragats flow. More analytical work is needed to distinguish between the Pokr Arteni and Aragats flow obsidians; until that work is accomplished, it is probably best to lump together the obsidians from the Pokr Arteni and Aragats flow. In our discussion of the analytical results (below), reference to artifact samples attributed to the Pokr Arteni deposit (the Pokr Arteni I group) should be read as coming either from the Pokr Arteni deposit or from the Aragats flow.

All five geological source samples from Mets Arteni had a similar, relatively homogeneous chemical composition. Obsidian source samples from Pokr Arteni exhibited a much broader range of variation. Three of five formed a separate group (Pokr

\textsuperscript{15} Pozdneorogennyi 1971, p. 81.  
\textsuperscript{16} Badalian et al. 2001, p. 377.
Arteni I), while the other two significantly differed from this group and from each other.

The geological samples from the Arteni complex (map 3) clustered together with 159 archaeological artifacts, though they were distributed unevenly within the above-mentioned groups. Thus, only five archaeological artifacts (or 3.1% of the total number of artifacts that were identified as coming from the Arteni complex) clustered together with the geological samples from Mets Arteni. 154 artifact samples (96.9%) clustered with the first Pokr Arteni I group (i.e., Pokr Arteni or Aragats flow). No archaeological artifacts clustered with the second and third Pokr Arteni geological groups, nor with the neighboring geological source of Satani Dar.

Map 3. Distribution of archaeological artefacts manufactured from the Arteni obsidian source.

The 154 artifacts that belonged to the Pokr Arteni I group came from 22 archaeological sites dated from the Neolithic, Chalcolithic, Early, Middle, and Late Bronze, and Iron Age periods. These included: 21 samples from Masisi-blur; 17 from Aratashen; 16 from Mashtotsi-blur; 15 from Ada-blur; 14 from Karnut; 10 from Horom; 6 each from Armavir and Keti; 6 each from Shirakavan, Arich, Metsamor, and Mokhara-blur; 5 from Anushavan; 4 from Lori Berd; 3 each from Khatumakh and Karmrakar; 2 each from Jrahovit and Verin Naver; and single examples from Lchashen, Nakhichevan Kül-tepe, Tli, and Velikent. Settlements on which more than 50% of the obsidian (up to
80%) belonged to this Pokr Arteni I group were tightly distributed up to 60 km. to the southeast of the source on the Ararat plain and c. 30-35 km. to the north of the source on the Shirak basin.

3 of the 5 artifacts from the Mets Arteni cluster were found on settlements in Shirak (Karnut, Horom, and Shirakavan) and 2 on the Ararat plain (Armavir and Verin Naver). In other words, they were found within the same zone of utilisation as the obsidian from Pokr Arteni or immediately near its border.

SOURCES OF THE TSAKHKUNYATS RANGE

The Tsakhkunyats chain stretches 35 km east to west to the northeast of the Aragats massif. Its crest line, which reaches an elevation of nearly 3000 m, separates the Kasakh valley to the south from the Marmarik valley to the north, the rivers of which flow nearly 1000 m lower down. The Tsakhkunyats chain is covered with forests and alpine pastures; the precipitation, which comes from the north, is very abundant, the mountains receiving 700-800 mm of rain per year. The summers are fresh, and the winters are cold; the snow cover is stable, attaining an average thickness of 75 cm that lasts more than five months from mid-November to the beginning of May17.

This chain contains several volcanoes with obsidian flows, and these are the oldest such in Armenia, dating back c. 4.5 million years ago18. From west to east, one encounters the obsidian deposits of Damlık, Ttvakar, Kamakar, Arkajasar, Aiğasar, and Dalar19. These obsidian flows are situated on the mountain slopes between 2000 and 2400 m elevation and are relatively easily accessible since the slopes are not steep. However, an additional constraint affects those deposits that are situated in the interior of the chain and, consequently, are less accessible than those located on the northern and southern slopes.

Moreover, one must add two secondary sources to these primary obsidian deposits. The Kasakh and Marmarik rivers carry numerous obsidian boulders and pebbles that wash down from the mountain slopes after heavy rains. Thus, Hankavan, which is sometimes described as an obsidian deposit, is in fact the name of a village situated at the northern foot of the chain where numerous currents join together to form the Marmarik river. These torrential streams come from different directions and drain the flows from the Damlık and Ttvakar volcanoes. Hankavan, thus, is a secondary, heterogeneous deposit that gathers its obsidian from the Damlık and Ttvakar sources.

Consequently, the accessibility of the obsidian from the Tsakhkunyats range ought to be divided into two types:

1) the primary sources, which are situated in the interior of the chain, are accessible only during the warm summer season when, still today, pastoral transhumants

make their pastures and herd their animals;

2) the secondary sources, which are deposited by the various streams and the Marmarik and Kasakh rivers, are relatively easy to access (the obsidian being very abundant) throughout the year.

The only constraints for the latter are the size of the boulders and pebbles which are imposing enough at the very foot of the mountains but which diminish in size as they are carried downstream. The Marmarik river runs to the east and to lake Sevan, while the Kasakh heads south towards the Ararat plain and the Araxes river.

The quality of the Tsakhkunyats obsidian is very high. The chemical analyses show that the different volcanoes belong to the same ‘family,’ characterized, in particular, by high values of Barium, which are comparable to those present in the Chikiani volcano of southern Georgia, but which are also distinguished by elevated values of Lanthanum, Cerium, Thorium, and Uranium\(^{20}\). The analyses likewise show that there are nuances among the different Tsakhkunyats volcanoes, but these are not pronounced. For this reason, we are not totally confident in our ability to distinguish among the different obsidian sources in this chain, and, consequently, it may be more prudent to lump together the different sources into a single ‘Tsakhkunyats’ group so that the determination of provenances remains coherent.

Attempts at more precise identifications have yielded the following picture. The neutron activation analyses of samples from the Tsakhkunyats range have chemically identified two separate groups, originating respectively from the Damlik and Ttvakar volcanoes (including the Hankavan secondary source), on the one hand, and the Kamakar source, on the other.\(^{21}\)

According to the neutron activation analyses, 13 artifacts from 9 sites cluster together with the Damlik source. These are: Karnut (4 samples); Tseteli Gorebi (2 samples); and Anushavan, Arich, Horom, Karmrakar, Artashat, Verin Naver, and Lori Berd (1 sample each). X-ray florescence determined that 10 additional artifact samples came from the Damlik source: Gekharot (3 samples); Tsakhkkaovit (6 of 7 samples); and Mokhra-blur (one sample). Two artifacts from the site of Fioletovo and one from Tsakhkhaovit may have come from the Ttvakar source or, less precisely, from this Damlik group; the sites are located respectively 28 km north-east and 20 km from the Ttvakar source.

The X-ray florescence analyses show that the zone of principal utilisation of the Damlik obsidian lay immediately west of the source. The sites of Gekharot, which is situated 18 km from the source, and Tsakhkhaovit, 15 km from the source, receive respectively 100 to 85% of their obsidian from the Damlik volcano. Nearly 83% (24 of 29 samples) of the tested Tsakhkunyats obsidians came from the Damlik source or, better, group of sources.

Only 2 artifacts clustered together with the geological samples defining the Kamakar source. They came from two sites in the Shirak basin: Horom and Shirakavan. Thus, the zone of the utilisation of the Kamakar obsidian lies within the Shirak area where the obsidian from Damlik (Ttvakar, Hankavan) was also found.

**SOURCES OF THE GEGHAM PLATEAU**

Sources of obsidian on the Gegam plateau are associated with the Gutansar, Fontan, Alapars, and Hatis volcanoes that form the Hrazdan-Abovyan group in the western piedmont, and the Spitaksar and Gekhasar of the Martuni group that is found near the watershed of the southern part of the massif.

*Gutansar*

The Gutansar complex is found to the north of Yerevan and covers a large area between the volcano itself and the left bank of the Hrazdan river, which flows from lake Sevan towards the Araxes. This complex contains several volcanic domes (Gutansar, Fontan, Alapars, Lusavan, Gyumush-GES) that erupted during a relatively short period between 310,000 to 240,000 years ago. The flows are very abundant and contain enormous blocks of obsidian of very high quality. The Gutansar volcano reaches 2229 m, but the deposits are easily accessible since they flow into the lower part of the dome, and on the surface the flows extend over 40 km at an altitude ranging between 1500 and 1800 m. This region has a snow cover c. 25-50 cm. thick, which lasts from December to the beginning of April. Some permanent villages lie near the obsidian flows, and animal herds graze on the high grasses that cover them.

Numerous Middle Palaeolithic artifacts have been collected near the village of Jraber. Moreover, the Razdan valley that cuts through the basaltic plateau over which the obsidian flows are spread conceals numerous caves. These caves served as shelters for the Mousterian populations (Lusakert, Yerevan); in order to fashion their tools, these peoples utilised the abundant blocks of obsidian which are found on the left bank of the river.

The obsidian from the Gutansar complex is thus very easily accessible, very abundant, and of very high quality. Of course, there are some differences among the deposits. Near Gyumush-GES, the obsidian is of average quality, while 2-3 km distant near Numrus, it is excellent. This complex is located on a secondary route of communication between the Ararat plain and Lake Sevan, which is located at an elevation of c. 2000 m and which itself serves as a route of communication farther north via the Debed valley ultimately to the Kura basin.

The chemical analyses reveal an exceptional homogeneity for the different sources, making it practically impossible to distinguish among them given the margin of

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error that accompanies the analytical results. The samples from Gutansar, Lusavan, Gyumush-GES, and ‘Fontan’ appeared chemically identical and grouped together to form a single large cluster, belonging to a homogeneous source — ‘the Gutansar complex.’ Six samples from Alapars were distinguished analytically from the Gutansar obsidian, but the compositions of these two volcanoes were so similar that several artifacts could not be attributed with certainty to one or the other source. Consequently, they are referred to as just coming from the ‘Gutansar complex’ until more thorough analyses are conducted.

55 artifacts from 18 different Trans-Caucasian sites from the Neolithic-Chalcolithic through Early, Middle, and Late Bronze periods were clustered together within ‘the Gutansar complex.’ These include: Jrahovit (12 samples); Artashat (7 samples); Lchashen (5 samples); Aratashen and Aigenvan (4 samples each); Khatchurch, Masisi-blur, Berin Naver (3 each); Ada-blur, Mokhra-blur, Mashtotsi-blur, Shengavit (2 each); and Armavir, Metsamor, Dvin, Jogaz, Nerkin Getashen, Nakhichevan, and Kül-tepe (1 sample each). The settlements which received more than 50% of their obsidian from ‘the Gutansar complex’ include: Jrahovit; Artashat; Lchashen and - provisionally on the basis of a very limited number of samples — Shengavit. Thus, the zone dominated by obsidian from ‘the Gutansar complex’ consists of sites found on the eastern part of the Ararat plain and northwest to Lake Sevan, extending in a radius c. 55 km from the source itself.

This picture of the distribution of Gutansar obsidian assumes a totally different dimension once we direct attention beyond Trans-Caucasia to the ancient Near East in general. Earlier J. Blackman had analyzed the obsidian found at the site of Tal-i Malyan in Fars province of southwestern Iran. As part of this work he examined six geological samples from a source between Hrazdan and the northwestern end of Lake Sevan. Five of these formed a homogenous group, which he termed ‘Sevan 1’, and two obsidian artifacts (labelled group F) from Malyan, which came from levels of the Kafteri period (2100-1800 BC), clustered together with this group. Comparison of the chemical composition of the obsidian from the ‘Sevan 1’ group and obsidian from ‘the Gutansar complex’ showed them to be completely identical. Thus, the origin of the above-mentioned archaeological artifacts seems to be well established. At least at the end of the 3rd and beginning of the 2nd millennia BC obsidian from Gutansar reached settlements along the southwestern Zagros as far as c.1500 km from the source itself.

**Hatis**

The Hatis volcano consists of a c. 25 km sq massif that rises southeast of the Gutansar dome. Flows from the latter, however, show up at the base of the northern flank.

23. Samples collected from the source near the Fontan village and attributed to the Fontan volcano seem to belong to the Gutansar volcano on the basis of the analytical data. For this reason, the ‘Fontan’ cluster is placed in inverted commas.
of the Hatis volcano. The snow cover is only slightly more marked than on ‘the Gutansar complex,’ since the Hatis volcano rises to 2529 m; the snow reaches an average depth of 50 cm and lasts from mid-December to mid-April. The obsidian flows are spread in the middle regions and the lower flanks but do not extend onto the plain.

Several deposits of obsidian have been noted across the entire surface of the volcano (Akunk, Zerborian, Xian-Xian, and Kaputan), but their total area is considerably less than that on the neighboring Gutansar volcano. One of the deposits contains some mineral inclusions (feldspars) that are visible to the naked eye and that limit its utility. However, artifacts of different periods from Middle Palaeolithic times onwards have been recovered on the flanks of the Hatis volcano and witness the exploitation of this resource by populations throughout the Ararat plain from very early times.

This source, thus, is less well studied than the great neighboring complex of Gutansar, and it is set a little to the side of the route that leads to Lake Sevan. However, its obsidian is of good quality and easily accessible during most of the year. Chemical analyses show that the Hatis volcano contained not one deposit but three separate flows of different ages and compositions.

The Hatis analytical cluster contained 29 artifacts from 7 Chalcolithic and Early Bronze Age settlements. These include: Dvin (9 samples); Jrahovit (6 samples); Artashat (5 samples); Mokhra-blur (3 samples); and Masisi-blur, Aygevan, and Metsamor (2 samples each). As we see, only settlements located on the Ararat plain utilised the Hatis obsidian. The site of Dvin is roughly in the center of the area, 37 km from the source, that marks the point dominated by Hatis obsidian (75% or 9 of 12 artifacts). Thus, the predominance of Hatis obsidian can be traced in the center of the zone where Gutansar obsidian was also utilised. In general, the zone dominated by the sources of the Hrazdan-Abovyan group is found on the Ararat plain: Shengavit; Jrahaovit; Dvin; Artashat; and Aygevan.

**Geghasar and Spitaksar**

The Gegham range flanks Lake Sevan to the west and extends north to south for c. 50 km, attaining a maximum elevation of 3609 m. The Spitaksar (3560 m) and Geghasar (3446 m) volcanoes, which are situated in the southern part of the range only 6 km from each other, are the only two peaks to have obsidian flows. These flows are the most recent ones in Armenia and are dated from 40,000 to 80,000 years ago for Geghasar and 120,000 years for Spitaksar (or Upper Pleistocene).

The flows are spread along the flanks of the domes and at their feet on the high plateaus that are located at c. 3000-3200 m and covered with steppic vegetation. These plateaus are densely populated during the summer by transhumants who come there to

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pasture their herds of sheep, goats, cattle, and horses and to cut hay for winter fodder. In fact, this mountain chain, which is the second highest in Armenia after Aragats, experiences a stable snow cover c. 2 m thick on average that lasts for c. 8 months from mid-October to the end of May. These climatic conditions are very severe and limited the accessibility of these obsidian deposits, effectively making it possible only to obtain obsidian during the summer. However, the deposits are very abundant. The numerous transhumants who summer there could exploit them and prepare preforms or nuclei (such as those that we have found on the lower slopes of Geghasar), later taking the worked forms with them down into the lowlands when they descend at the beginning of the autumn. Moreover, a torrent takes its source at the very foot of Geghasar on its northwest flank and carries numerous blocks of obsidian towards the Azat river in which it deposits them and which are then taken farther to the south and the Ararat plain. 15 km from the deposit, at the level of the village of Garni, the Azat river always carries obsidian pebbles, which even at this distance from the source still measure 6 to 8 cm along their long dimension.

Macroscopically, the obsidians from Geghasar and Spitaksar are very different. At Geghasar the obsidians are differently colored (transparent, grey, red, brown and black). At Spitaksar the obsidian contains numerous crystalline inclusions which make it more difficult to work because the small crystals are opposed to the waves of force transmitted by percussion and make more problematic the form of the flakes detached. However, chemically, these two sources show a remarkably similar composition, attesting to the fact that they originated from the same magmatic chamber and that they evolved very little during the 40,000 years or so that separated the two volcanic eruptions.

Four obsidian samples from Geghasar, which were analysed by INAA, formed a single homogeneous group; samples from Spitaksar were not analyzed in this work. However another INAA study conducted on four samples from Spitaksar and Geghasar showed that the chemical compositions of the obsidians from both volcanoes were identical.

68 artifacts from 19 settlements dated from the Neolithic-Chalcolithic and Early, Middle, and Late Bronze Age periods grouped together with the Geghasar cluster. These include: Noratus (10 samples); Nerkin Getashen (9 samples); Nakhichevan Kül-tepe and Leila-tepesi (7 samples each); Chalagan-tepe, an unnamed settlement in the Karabagh plain, Lchasen, Jraovit, and Aigevand (4 samples each); Tsiteli Gorebi (3 samples): Ada-blur, Aratashen, and Mashtotsi-blur (2 samples each); and Masisi-blur; Dvin, Khatunarkh, Joraz, Khramis Didi Gora, and Velikent (1 sample each). The areas in which obsidian from this source dominates the chipped stone assemblages (50 to 100% of total samples tested) are situated as follows: 1) on the edge of the southern Ararat plain (Kül-tepe — 110 km from source, and 7 of 14 tested samples)

2) on the western and southern shores of Lake Sevan (Noratus and Nerkin Getashen — 25-30 km from source, and, respectively, 10 and 9 of 10 samples from each site)
3) in the Karabagh plain (Chalagan-tepe, and the unnamed settlement — 185 km from the source, and 4 samples from, respectively, 6 and 7 samples tested).

Khorapor

The Vardenis range, which contains a single volcano with an obsidian deposit, rises to the southeast of Lake Sevan. This volcano, which reaches an elevation of 2906 m, rises some 20 km. from the shore of the lake in a region of high plateaus that it dominates only by a few hundred meters. This highland region is covered with snow from mid-November to the end of May and reaches an average thickness of 100 to 125 cm. The volcano, thus, is accessible only during the summer.

The obsidian is found both at the summit of the dome and on the flanks of the volcano. However, it is of poor quality to work since it contains many crystalline inclusions and generally consists of small nodules within a rhyolitic matrix. Moreover, no artifacts have been found on this deposit.

SOURCES ON THE SYUNIK PLATEAU

Obsidian deposits from volcanoes of the Vorotan/Sisian group are located on the Syunik (Karabagh) plateau in the basin of the upper Vorotan river.

Syunik

Several volcanoes in this range, which is situated in southeastern Armenia and forms part of the frontier with Azerbaijan, have large flows of obsidian: Bazenk; the foothills of Pokr Sevkar; Mets Sevkar; Mets Satanakar; Michnek Satanakar, and Pokr Satanakar. The longest and thickest flows are those from Mets Sevkar and from ‘the foothills of Pokr Sevkar.’ This latter term is used because the obsidian deposit is near the dome of Pokr Sevkar, but more recent deposits of basalt cover most of the surrounding landscape and the relation of the obsidian to Pokr Sevkar is uncertain. One hypothesis is that this deposit was part of the great flow emitted by Mets Sevkar in this direction.

This region of high plateaus, situated between 2700 and 3000 m (the peak of Bazenk reaches 3239 m), endures a rigorous climate. It is covered by snow for more than 7 months (from the beginning of November to June), and the level of snow reaches 125 to 150 cm on average. This highland area is only accessible during the summer when numerous transhumants come to pasture their herds and cut hay for fodder to sustain their animals during the long months of winter. Heaps of artifacts have been found on most of these flows (Bazenk, Mets Satanakar, Mets Sevkar, and Pokr Sevkar), and real obsidian workshops with concentrations of tools (blades, scrapers) mixed with debitage and percussion stones in rhyolite have been found on Pokr Sevkar. The torrents that descend from these high plateaus and join the Vorotan river carry blocks of obsidian, but in the
valley where there are permanent villages, the obsidian pebbles, which one can collect from the river, are reduced in size and scarcely usable for making tools.

*Kel'baJar*

The volcano complex of Kel'baJar is located on the Azerbaijan slope of the high plateaus which in Armenia comprise the region of Syunik. The climatic conditions are even slightly more rigorous than Syunik since the median elevation ranges between 3000 and 3200 m, and the snow cover, which reaches 150 cm in thickness, lasts until the middle of June. It has not been possible to describe more fully this deposit due to the ongoing territorial conflict between Armenia and Azerbaijan.

The neutron activation analyses of samples from sources on the Syunik plateau defined three different chemical groups. The first or Satanakar-Sevkar group, which forms a single homogeneous cluster, contains samples from Mets Satanakar and Pokr Sevkar and also includes 18 artifacts from Chalcolithic sites in Trans-Caucasia. The second group is formed from 4 of 5 samples taken from somewhere near Kel'baJar and is termed Kel'baJar I, the samples presumably coming from the Bazenk and Kecheldag volcanoes. The final chemical group is formed from a single sample (1 of 5) from the KelíbaJar area. This distinct group is called Kel'baJar II and possibly represents a second source of Kecheldag obsidian.

18 artifacts cluster with the Satanakar-Sevkar group and come from the following six sites: Alikemek-tepesi (6 samples); Nakhicevan Kült-tepe (4 samples); Leila-tepesi (3 samples); Chalagan-tepe and Uchoglan (2 samples each); and Chinar (1 sample). Thus, the area over which obsidian from this source is distributed consists of sites on the southern edge of the Ararat plain, the Karabagh plain, and the Mungan steppe. The settlement of Alikemek-tepesi, which is located 250 km to the east, marks the edge of the area within Trans-Caucasia where obsidian from Satanakar-Sevkar is dominant. More than 85% of the analyzed obsidian from Alikemek-tepesi (6 of 7 samples) came from the Satanakar-Sevkar source.

However, Satanakar-Sevkar may have been distributed far beyond Trans-Caucasia. The Satanakar-Sevkar obsidian presents a similar chemical composition to the so-called 3c group initially defined by C. Renfrew and his colleagues. This group was defined by samples from Neolithic, Chalcolithic, and Early Bronze Age sites found near Lake Urmiah (Hajji Firuz, Yanik Tepe, and Kushali Tepe) in today's northwestern Iran. Some artifacts from 4th millennium sites in southern Iraq (Oueili, Uruk) may also be attached to this group, as well as 5 artifacts of the so-called group B, or more than 20% of the obsidian from Kafteri levels (end of 3rd/beginning of 2nd millennia) at the previously mentioned site of Tal-i Malyan in southwestern Iran.

According to the X-ray florescence studies conducted by J. Keller, all the

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samples from the Middle Bronze cemeteries of Sisian I and Sisian II clustered together with the obsidians from the source on the Sevkar volcano. 24 artifacts from 5 sites clustered together with the Bazen/Kechaldag/Kel'baJar I group: Zar cave (18 samples); Leila-tepesi and Chinar (2 samples each); and Uchoglan and the unnamed settlement (1 sample each). As we see, only sites from Kel'baJar and the Karabagh plain are listed here; that is, the area of the distribution of the obsidian from this group stretches to the east of the source for 80-100 km. Within these limits, the obsidians from this deposit include 100% of the samples from the Zar cave and 2 of 3 from the Chinar site on the eastern edge of the area.

The Kel'baJar II cluster also contained 6 artifacts: 4 from Leila-tepesi; and one each from the unnamed settlement and from Masisi-blur. If one excludes the Chinar samples from this tiny group, the zone dominated by the Kechaldag obsidian is limited to the Zar cave.

CONCLUDING OBSERVATIONS

Thus, in very general terms, we have sketched the picture of the distribution of Trans-Caucasian obsidian. The limits of these analyses and of this current article do not allow us to describe in greater detail the means by which the peoples of Trans-Caucasia obtained their obsidian at different times in the ancient history of this area. Correspondingly, we are forced to restrict ourselves to some general observations. In consideration of all the possible strategies that peoples employed to obtain their obsidian, two principal models are evident: single-source and multiple source procurement strategies.

THE SINGLE SOURCE MODEL

The significant exploitation of a single source by an industry is termed a single-source model. This situation can be observed on a series of sites of different periods in many regions of Trans-Caucasia. These include; the Early Neolithic and Chalcolithic settlements of western Georgia — Kobuleti, Anaseuli I and Samele-kide; the Late Neolithic and Chalcolithic settlements of Kvemo Kartli — Dmanisi, Javakhi, and Arukhlo; and the Late Chalcolithic, Early Bronze, and Bedeni settlements of Shida Kartli — Berikldeebi, Akhali, Zhinvali, and Abanoskhevi37.

The first type: those sites utilising only a single source of obsidian

Moreover, the single source model is also evident for the settlement of Noratus in the Sevan basin, the cemeteries of Sisian I and Sisian II on the Syunik plateau, and possibly for the settlement of Gekharot, although the small series of analysed samples from this settlement precludes any definite conclusions. Finally, the Zar cave in the

KelibaJar region also appears, in our opinion, to conform to this model since all 18 samples from this site came from a single source.

As we have seen, the sites for whom the single source model applies obtained their obsidian from Chikiani, Gekhasar, Satanakar-Sevkar, Kechaldag-KelibaJar, and, possibly, Damlik. In general, the single source model of procurement applies to those sites on volcanic plateaus that are located in areas near a single source of obsidian, such as, above all, the source of Chikiani. In this instance the distances over which obsidian from the source was distributed extended 100-200 km (although, from time to time the Chikiani obsidian was found 360 km from the source at Velikent in the northeastern Caucasus and over 450 km to the east at the site of Alikemek-tepesi in eastern Trans-Caucasia.)

The Chikiani source, in fact, represents an exceptional case in the group of Trans-Caucasian obsidian sources since it is the only source situated on the northern flanks of the Small Caucasus ranges on the high plateau that dominates the Kura river basin. All the other sources are found in the middle of these ranges of mountains or on their southern flanks and are separated from the Kura basin by numerous ridges. This exclusive situation certainly was a major factor influencing the choice of Chikiani obsidian for the populations of the Kura basin.

Other factors also played a role in the widespread distribution of Chikiani obsidian: the abundance and excellent quality of the obsidian; easy access on a gentle slope from the Khrami valley; and the presence of numerous blocks of obsidian that descend from the mountain in torrential streams to this lower-lying region. The high Djavakheti plateaus are scarcely accessible for six months due to the thick layer of snow that covers them; but during the summer the alpine pastures are occupied by transhumants who have come from the Kura basin and who are able to procure obsidian from the Chikiani source. In the autumn, these transhumants descend to their home regions, and this movement also facilitates the diffusion of Chikiani obsidian over long distances. It is probably in this fashion that Chikiani obsidian was distributed from neighboring site to neighboring site, from the Kura basin to the Mughan steppe (Alikemek-tepesi) bordering the Caspian Sea, located c. 450 km from the Chikiani source itself.

The second type: environmental conditions conducive to isolation

On the other hand, the distribution of sites obtaining their obsidian from a single source shows that it is not just the sites' proximity to the source (at least 30-35 km distant) that has influenced their exclusive choice for procurement from this source. Some sites, located 30-35 km from a source obtained their obsidian from several sources. For example, Keti, which is located 23 km from Ashots, received its obsidian equally from Arteni, Tsakhkunyats, and the Kars region, and the site of Lchasen, which is located only 27 km from Gutansar, also exploited the obsidian from Geghasar and Arteni. Several sites that obtained their obsidian from a single source are located more than 40 km from that source. Thus, the site of Chkalovka is situated 42 km as the bird flies from the source.
at Geghasar and the site of Karchakhghbyur is situated 48 km from the Sevkar source. In both these cases, the distance is really greater since the elevations separating the sources from the sites exceed 3000 m.

The decision to receive obsidian from a single source seems more due to the factor of geographical 'isolation'. In fact, most of the Early and Late Bronze settlements established around Lake Sevan (such as Chkalovka, Mtnadzor, and Noratus) exclusively obtained their obsidian from Geghasar. Quite possibly, these peoples spent their summers in the highlands dominated by the Geghasar volcano (as some peoples continue to do so today), and it was during that time that they procured their obsidian. Similarly, the villages in the Vorotan valley (such as Sisian and Zorakar) and those located on the south shore of Lake Sevan (Karchaghbyur) also moved themselves during the summer onto the high plateaus of Syunik where they collected the obsidian from Sevkar and Satanakar.

The mountain chains of Gegham, Vardenis, Syunik, encircle the Vorotan valley and the greater part of the Lake Sevan basin. Transhumance or the moving of herds during the summer onto the highlands where the obsidian deposits are located allows us to explain the exclusive concentration on specific deposits in the settlements where these transhumant herders lived during the winter. One must assume that the quantity of obsidian that they brought down with them from the highlands in the form of pre-shaped or semi-finished blocks and artifacts was sufficient to satisfy their needs during the long months when the snows prohibited their movements.

It is especially noteworthy that the single-source model of obsidian procurement occurred in different areas and in different periods from the Neolithic through Bronze Age times. Moreover, this model seems to apply during the course of the entire time period considered within one area; namely, at Chikiani.

MULTIPLE SOURCE MODEL

The multiple source (or polysource) model concerns strategies used for the exploitation of several sources. As a rule, these strategies utilise 3-5 sources with a single source predominating (50-80%). This model applies to Neolithic and Chalcolithic settlements (Ada-blur, Aratashen, Khatunarkh, Masisi-blur, Mashtotsi-blur); and Early (Mokhra-blur, Metsamor, Shengavit, Dvin, Jrahovit, Aygevan) and Middle (Verin Naver) Bronze Age sites of the Ararat valley. It also applies to Late Neolithic sites of western Georgia (Anaseuli II) and Chalcolithic sites of eastern Georgia (Khramis Didi Gora, Tsiteli Gorebi), the Karabagh plain (Chalagan tepe, Leila tepes), Uchoglan, and the unnamed settlement), the Mughan steppe (Alikemek tepesi), and Nakhicevan (Kül-tepe).

Likewise one discerns the same pattern in Bronze and Iron Age sites of the Shirak plain (Anushavan, Arich, Ketri, Karmrakar, Karnut, Horom), on the northern slope of Aragats (Tsakhkaovit), on the shore of Lake Sevan (Lchashen), in the Lori region (Lori Berd), in the Agtsev valley (Fioletovo), in the Debed valley (Jogaz), and along the Caspian coastal plain of Dagestan (Velikent). Among the mentioned sites there are also those belonging to the zones of Arteni, the Hrazdan-Abovyan group (Gutansar and Hatis), Geghasar, Tsakhkunyats (Damlik, Kamakar) and Chikiani. The model also applies to a certain degree to the Ashots sources, Ke'l'baJar I, and Bayezid (at the foot of the
Ararat volcano).

The first type: sites utilising several sources within a 30-70 km radius

It is obvious that the multiple source model applies first of all to settlements located within or on the immediate periphery of volcanic plateaus; that is, in intermontane valleys bordering volcanic areas. Here in conditions that were saturated with different obsidian sources, it was always possible to obtain obsidian from alternative deposits. The case of the Arteni source illustrates this point. This source benefited from several natural features. The obsidian is abundant and of excellent quality. The flows descend to the level of the plain and are accessible almost throughout the entire year (the snow cover being relatively negligible during the winter). Moreover, the Arteni deposit is situated in the western part of the Ararat plain near the junction of two major exchange routes: one that ran west to east in the Araxes basin and one that ran north to south along the Akhurjan valley. Despite these advantages, the geographic spread of Arteni obsidian is relatively restricted and cannot in any way be compared to the spread of obsidian from the Chikiani source. The reason for this difference is probably the existence of several alternative sources of obsidian within a 100 km. radius (Gutansar, Hatis, and Tsakhkunyats in Armenia and the Kars and Digor regions in Turkey) that allowed people to utilise these alternative sources.

The mixed pattern of utilisation of the basic obsidian deposits typically extended for 30-70 km (within this radius are included 90% of the settlements conforming to the multiple source model), and sometimes even up to 200 km. While the inhabitants of a settlement had their choice among several different sources within this 30-70 km radius, the nearest source typically was most extensively utilised. Nevertheless, the criterion of distance was not necessarily the most pertinent factor; rather, the quality of the obsidian and its accessibility were, it would seem, often more important. Thus, the site of Karnut on the Shirak plain is situated only 37 km from the Ashots obsidian deposit, the inhabitants of Karnut did not utilise Ashots obsidian probably due to the very nature of this deposit; obsidian is not abundant and occurs only in small blocks. These people preferred to obtain their obsidian from Arteni and Tsakhkunyats that are located respectively more than 50 km to the south or east. Similarly, the people at Khatunarkh on the Ararat plain obtained their obsidian from 5 sources all within a radius of 70 km from the site. The nearest potential source Hatis, which was located 38 km from the site, was not utilised, while the sources of Gutansar and Arteni (located respectively 41 and 47 km from the source) furnished most of the samples analyzed from this site, Tshakhkunyats, 50 km distant, also was ignored, while the deposit at Geghasar, located more than 60 km away, furnished 10% of the studied materials. Some inhabitants of the Ararat plain still lead their flocks and herds today pass the summer on the high plateau at the foot of the Geghasar volcano; it is probable that some of the inhabitants of Khatunarkh did the same in their day.

The second type: the dominant utilised source is located more than 100 km from the site
This type is found in regions far removed from the obsidian deposits, such as the Karabagh, Mil, and Mughan steppes. The procurement is always diversified. To the Chikiani obsidian, which comes in small quantities into the Kura basin, one must add the sources on the high plateaus, such as Kel’baJar, Sevkar-Satanakar, and Geghasar on which the steppe peoples led their flocks and herds during the favorable summer season. Free access to these alpine pastures appears to have been the rule during Chalcolithic and Bronze Age times, as it was again most recently when the steppe populations from Karabagh established their encampments on the Syunik plateau, at the foot of the Sevkar source.

More distant sources could be preferred as well as those that were closer. Thus, in northern Armenia the site of Lori Berd received 40% of its obsidian from the Arteni source, which is located more than 100 km away; the rest came from Chikiani (also 40%) and from Tsakhkunyats, both sources being 70 km distant from the site. The Jogaz settlement preferentially procured Chikiani obsidian, which was located 120 km away, and secondarily utilised obsidian from Gutansar and Geghasar, which are situated as the bird flies respectively 86 and 103 km from the site. These selections suggest some privileged relations between certain regions. Lori Berd was more in relation with the Shirak plain where the dominant exploited source was Arteni, while Jogaz in the Debed valley looked more to the Kura basin that exploited the Chikiani obsidian source. These two cases seem to suggest the existence of exchange networks and the redistribution of primary raw materials, such as obsidian.

Moreover, while the single source model of procurement from Chikiani characterizes central Georgia during Chalcolithic times, two Late Chalcolithic sites from this area form exceptions. The site of Khramis Didi Gora obtained only 50% of its obsidian from the Chikiani source; and, particularly, Tsiteli Gorebi did not obtain obsidian from Chikiani but utilised 3 other sources: Geghasar (more than 200 km distant); Tsakhkunyats (approximately 160 km distant); and an undetermined source. The exploitation of these obsidian deposits which are located in today's Armenia near Lake Sevan may be explained by the period in which Tsiteli Gorebi was established; namely, the final Chalcolithic phase of transition between the Shulaveri-Shomu Tepe culture and that of the Kura-Araxes Early Bronze culture. This transitional period was marked by population movements and the abandonment of low terraces near the Kura basin combined with the peopling of the higher plateaus. During this period contacts were established between different regions of Trans-Caucasia.

A third type: sites whose chipped stone industry primarily consisted of flint

Finally, the multiple source model characterizes sites that primarily contain flint as their basic chipped stone resource, such as, for example, the site of Velikent in southeastern Daghestan. The 3 analysed obsidian samples from Velikent came from 3 different Trans-Caucasian obsidian sources: Chikiani, Arteni, and Geghasar. In this case, the distance from which obsidian was obtained ranged from 350-400 km. In terms of current understanding, Velikent constitutes a special case. Throughout the Kura and Araxes basins and on the Mil and Karabagh steppes obsidian dominates flint in the
chipped stone tool assemblages. It is only in the Mughan steppe at Alikemek tepesi where obsidian is not dominant but nevertheless represents 21% of the lithic assemblage. At Velikent, obsidian is extremely rare, only 6 pieces having been recovered in the current excavations at the site\(^{38}\). One must qualify this site as conforming to the multiple source model; obsidian at Velikent appears as an exotic material and not exploited in the same sense as flint.

**VARIATIONS IN SPACE AND TIME IN THE CHOICE OF SOURCES**

One must especially emphasize that the multiple source model pertains in one region over a remarkably extended period of time; namely, in the Ararat plain in the Neolithic, Chalcolithic, and Early and Middle Bronze periods. The concrete manifestations of this model, however, do vary in different parts of the plain. Settlements of the northern part of the Ararat plain entered primarily into the zone of distribution dominated by obsidian from Arteni and secondarily by obsidian from the Gutansar complex. Farther to the south on settlements located in the eastern part of the plain, the obsidian came principally from the Hrazdan-Abovyan group of sources and secondarily from the Geghasar source. Finally on the southern edge of the plain at the site of Nakhichevan Kül-tepe Geghasar obsidian was most dominantly utilised, though obsidian from the Mets Satanakar-Sevkar source was documented here for the first time on the Ararat plain. Obsidian from Mets Satanakar-Sevkar dominated assemblages even farther east, such as at Alikemek-tepesi. Thus, the basic principle for the procurement of obsidian by sites on the Ararat plain relates to their location within the plain from the northwest (Arteni source) to the east (Gutansar, Hatis) and to the southeast (Geghasar).

In our opinion, the stability of both models of procurement that is observed over such an extended period of time is basically explained by geographical factors. It is obvious that the formulated models depend on the location of each site relative to the system of obsidian sources; that is, by their specific geographical situation. However, the specific manifestations of the multiple source model are subject to changes of a different order: from partial to cardinal changes in resource strategy. Most informative in this respect is the picture that can be sketched on the basis of the data available from the Ararat plain. Here the materials exhibit certain dynamic features.

Firstly, the area over which the Geghasar obsidian is distributed in Chalcolithic times shifts southeastwards during the Early Bronze period to encompass sites on the eastern part of the plain. Secondly, the significance of the Hatis source changes over time. It essentially played no role in the distribution of obsidian on the Ararat plain during Chalcolithic times, but became an important source during the subsequent Early Bronze period. Finally, obsidian from one of the most important Trans-Caucasian sites, Chikiani, apparently did not reach the Ararat plain during the Chalcolithic and Early Bronze periods but is only documented there during the Middle Bronze Age at the site of Verin Naver

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\(^{38}\) Gadzhiev et al. 2000, p. 62, n. 5.
The principal changes that affected the multiple source model are apparent by comparing Early Bronze with Late Bronze/Iron Age materials from the site of Keti. During Early Bronze times the inhabitants of this site procured obsidian from three sources, including the Trans-Caucasian Unknown Group 1 (or TCUNK-1) — 66.7% of the obsidian and the Arteni source — 22.2%. Later during the Late Bronze and Iron Age, obsidian was obtained from four sources, but now the TCUNK-1 source only played a minimal role (11.1%), while the Arteni source now dominated, rising to 55.5%. 22.2% of the obsidian came from a new unknown source — TCUNK-2, while obsidian from the Agvorik-Sizavet source continued to play a minimal role in both instances (one sample from the Early Bronze and one sample from the Late Bronze/Iron Age series).

Finally, it should be noted that only 7 analyzed artifacts (or only c. 1% of the total) probably came from sources located south of the Araxes basin or outside Trans-Caucasia proper. In other words, the prehistoric inhabitants of Trans-Caucasia only rarely utilised obsidian from eastern Anatolia. We know that Trans-Caucasian obsidian diffused much farther to the south, even reaching the site of Tal-i Malyan in southwestern Iran, but scarcely any obsidian moved in the opposite direction south to north or into Trans-Caucasia. Obviously there was no reason for such movement given the number of high quality and accessible obsidian deposits within Trans-Caucasia.

It is obvious that there are limitations to our analysis. Some of these relate to simple sampling problems associated with the number and representative character of the analyzed samples. Nevertheless some of the observed changes in the procurement and exchange of obsidian must reflect actual variations in the economic activities of the prehistoric inhabitants of Trans-Caucasia. Probably, the reasons for the changes in their resource strategies were related to concrete cultural, political, and economic developments and should be explained in the context of these specific historical situations. Unfortunately, these developments and situations are only dimly reflected in the analytical data. In other words, our models for interpreting the data are partial but must relate to a dynamic historical and cultural reality.

BIBLIOGRAPHY

ARAZOVA R.B. and MAMEDOV A.I.
1979 “Sravnitel'noe izuchenie obsidiana iz eneoliticheskikh poselenii Azerbaidzhana i mestorozhdenii Zakavkaza'ya”. Izvestiya AN Az.SSR. Seriya istorii, filosofii i prava 3, pp. 50-57.

BADALYAN R.

BADALIAN R., BIGAZZI G., CAUVIN M-C., CHATAIGNER C., JRBASHYAN R., KARAPETYAN S.G., ODDONE M. and POIDEVIN J-L.

BAGDASARIAN A.B. (ed.)

BLACKMAN J.M.

BLACKMAN J., BADALIAN R., KIKODZE Z. and KOHL Ph.

CANN J. and RENFREW C.

CHATAIGNER C.

FORNASERI M., MALPIERI L., PALMIERI A.M. and TADDEUCCI A.
1975-1977 “Analyses of Obsidians from the Late Chalcolithic Levels of Arslantepe (Malatya)”. Paleorient 3, pp. 231-246.

FRANCAVIGLIA V.
1994 “L’Origine des Outils en Obsidienne de Tell Magzalia, Tell Sotto, Yarim Tepe et Kül Tepe, Iraq”. Paleorient 2, pp. 18-34.

GADZHIYEV M.G., KOHL PH., MAGOMEDOV R.G., STRONACH D. and GADZHIYEV S.M.

IESSEN A.A.

KARAPETIAN S.G.

KELLER J., DJERBASHIAN R., KARAPETIAN S.G., PERNICKA E. and NASEDKIN V.

KELLER J. and SEIFRIED C.

KRPNOV E.I.

MALEEV E.F.

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